VASCULAR PLANTS FLORA OF FISHPONDS COMPLEXES IN THE LIGHT OF NUMERICAL COEFFICIENTS

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Abstract

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The paper is an attempt to evaluate the degree of naturalness of the vascular plants flora of 24 fishponds complexes using numerical coefficients of: modernization, rarity, floristic individuality and naturalness. The vascular plants flora recorded in the areas under study consists of 584 species. The high degree of naturalness is shown by the numerical coefficients used for the analysis, which is confirmed by an important role of indicator species and species characteristic for natural and semi-natural vegetation connected with consecutive stages of succession on water bodies. It is also confirmed by high percentage of protected and endangered species.

Key words: vascular plants flora, numerical coefficients, fishponds

Introduction

Fishponds of the area of over 10 ha cover about 47.000 ha in Poland. They are especially frequently distributed in the Południowopodlaska lowland, where apart from fish breeding, they are of a great natural value, e.g. they play the key role in sustaining biodiversity and are a significant part of the landscape (Falkowski, Nowicka-Falkowska, 2001). Despite being created by man they make refuges for plant and animal species endangered by extinction due to their habitat loss. No attempt to evaluate the degree of naturalness of fishponds by means of numerical coefficients has been made so far.

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Object and methods

The object of the floristic study was 24 fishpond complexes of Żelechowska plateau (Southern Podlasie lowland). Documentation of floristic features was based on floristic records made from 1996–1999 by the field cartogram method of the net of irregular areas. Each complex was taken as a separate area of the cartogram. The records

were made during the optimal part of a vegetation season being completed during other phases of phenological development. The measure of the occurrence frequency of the species was the number of ponds complexes (areas of the cartogram) in which the species were recorded. A three-grade scale: rare (1–5 localities), frequent (6–19 localities) and common (20–24 localities) was applied. The degree of vegetation transformation by man, expressed with contribution of persistently established anthropophytes (archaeophytes and kenophytes) was worked out by means of the coefficient of modernization (W_M) (Jackowiak, 1990):

$$W_M = \frac{Ken}{Arch + Ken} \times 100\%$$

W_M – coefficient of modernization of flora, Ken – number of kenophytes, Arch – number of archaeophytes

Floristic value of each complex was measured with the coefficient of floristic value (O_f), which is a mean value of coefficients of floristic rarity of the species (Loster, 1985):

$$O_f = \frac{W_f}{1_k}$$

W_f – floristic value; l_k – number of species in a complex.

$$W_f = \sum W_r$$

W_r – coefficient of rarity

$$W_r = \frac{N - n}{N}$$

N – number of complexes, n – number of complexes in which a rare species occurs.

Floristic biodiversity was described by means of the coefficient of naturalness (K_f), which is based on the occurrence of indicator species of classes: *Lemnetea, Bidentetea tripartiti, Isoëto-Nanojuncetea, Potametea, Phragmitetea, Molinio-Arrhenatheretea, Scheuchzerio-Caricetafusci* and *Alnetea glutinosae*. This coefficient is expressed by the formula (Géhu, 1979):

$$K_f = \frac{W_f - W_{fa}}{1_k}$$

l_k – number of species in a complex, W_{fa} – floristic value of alien species occurring in the studied habitats, W_f – floristic value.

Results

584 species of vascular plants from 90 families and 314 genera were recorded in the fishponds complexes under study. A three-grade rising scale shows that 177 species (30% of the flora) are considered common, 307 species (53%) frequent, and the remaining 100 species (17%) belong to rare. 97 species (16.61%) belong to anthropophytes including 64 archaeophytes

and 31 kenophytes. 26 species comprised by legal protection including 16 totally protected and 54 species endangered in the country and region were recorded in the area (Głowacki et al., 2003; Kaźmierczakowa, Zarzycki, 2001; Zarzycki, Szeląg, 1992).

The influence of man on the flora of each complex is reflected by contribution of anthropophytes. Its growth is directly proportional to higher density of arable fields and buildings in the neighbourhood. The coefficient of anthropophytisation for the whole flora recorded in the complexes under study is 16.61%. After working out contribution of anthropophytes in the flora of each complex the values obtained range from 2% to 20.5%. The following complexes are characterised by the highest contributions: Adamów (19.3%), Korytnica (20.34%) and Mroków (20.82%). The lowest ones were observed in: Jagiełła (4.37%), Wola Rowska (7.19%) and Wólka Sobieszyńska (7.69%) (Fig. 1) whose surrounding forests and meadows prevail in. Contribution of anthropophytes also depends on the number of species, which does not mean however that growth of the number of species results in the number of anthropophytes. In some objects of considerable number of species observed the coefficient of anthropophytisation is low despite presence of arable fields and buildings in the neighbourhood (Wola Rowska, Jagiełła, Nowy Świat and Radoryż Kościelny) (Table 1).

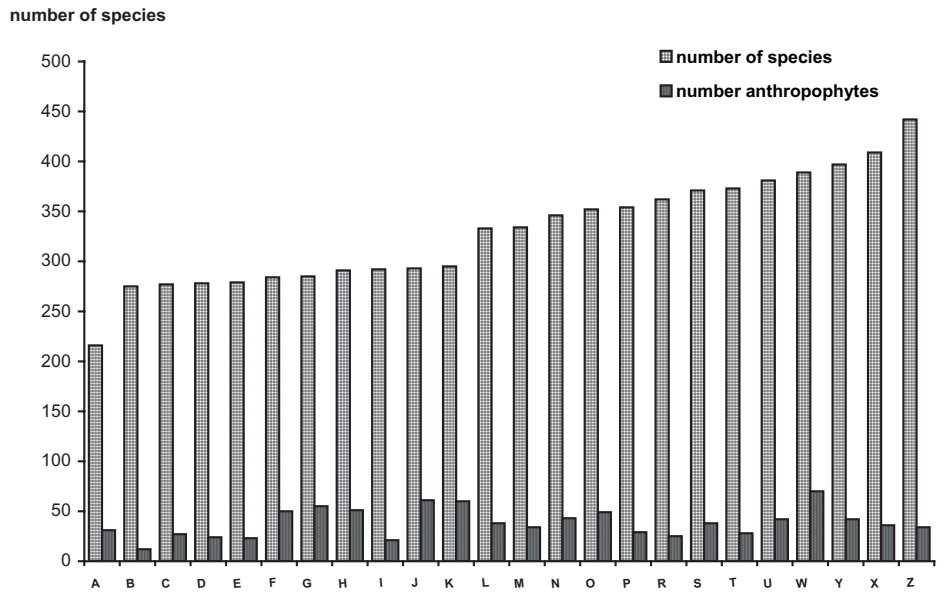

Fig. 1. Correlation between the number of species recorded and the number of anthropophytes. A – Krzywda; B – Jagiełła; C – Burzec; D – Wola Mysłowska; E – Czarna; F – Sulbiny; G – Adamów; H – Nowodwór; I – Wola Rowska; J – Mroków; K – Korytnica; L – Kobyla Wola; M – Wodynie; N – Budy Krępskie; O – Zastawie; P – Kołodziąż; R – Radoryż Kościelny; S – Maciejowice; T – Podzamcze; U – Ryki; W – Trojanów; Y – Nowy Świat; X – Jagodne; Z – Wólka Sobieszyńska.

T a b l e 1. Contribution of the species and indicators of anthropogenic changes of the flora in connection with the area and the surroundings of the complexes.

.	Fishpond complex	Area in ha	Landscape	Number of species	% contribution rare species	Number / % indicator species	% contribution anthropophytes	W_{fa}	W_f-W_{fa}	W_M	O_f	K_f
1.	Adamów	66.15	M, B	285	5.26	116/40.70	19.3	45.54	23.75	20.75	0.24	0.08
2.	Budy Krępskie	69.48	F, M	346	4.05	140/ 40.46	12.43	54.50	33.46	25	0.25	0.10
3.	Burzec	151.7	F, M	277	2.53	125/45.13	9.75	34.33	22.42	24	0.21	0.08
4.	Czarna	10.94	M, B, F	279	1.43	116/41.58	8.24	31.83	21.28	23.81	0.19	0.08
5.	Jagiełła	53.14	F, M	275	1.09	138/50.18	4.37	27.25	26.46	25	0.19	0.10
6.	Jagodne	305.55	F, M	409	5.13	172/42.05	8.8	73.41	54.33	34.28	0.20	0.13
7.	Kobyla Wola	23.76	M, A	333	5.12	162/48.50	11.38	30.58	47.50	27.78	0.23	0.14
8.	Kołodziąż	90.68	F, M	354	3.11	162/45.76	8.19	50.29	43.67	22.22	0.27	0.12
9.	Korytnica	41.68	M, A, F, B	295	3.39	111/37.63	20.34	47.04	19.69	28.07	0.23	0.07
10.	Krzywda	25.06	M, B	216	0.93	114/52.78	14.35	16.13	13.46	20	0.14	0.06
11.	Maciejowice	81.99	M	371	6.22	172/46.49	10.27	46.00	59.89	35.14	0.26	0.16
12.	Mroków	28.80	M, A	293	2.1	116/39.59	20.82	44.54	26.13	17.24	0.24	0.09
13.	Nowodwór	95.33	M, B, F	291	2.75	116/39.87	17.53	43.51	18.38	30.61	0.21	0.06
14.	Nowy Świat	108.7	M, B, F	397	4.03	170/42.82	10.58	55.58	61.08	27.5	0.29	0.15
15.	Podzamcze	64.99	M, A, F	373	8.31	160/42.90	7.51	67.66	46.08	51.85	0.31	0.12
16.	Radoryż Kościelny	201.72	M	362	6.35	180/49.72	6.91	35.67	65.79	47.83	0.28	0.18
17.	Ryki	325.06	M, B, F	381	6.56	157/41.21	11.02	60.41	55.12	30	0.30	0.15
18.	Sulbiny	37.08	M, A	284	1.76	127/44.72	17.61	34.25	25.79	25	0.21	0.09
19.	Trojanów	144.27	M, A, F	389	5.9	162/41.54	17.95	66.00	51.79	23.53	0.30	0.13
20.	Wodynie	41.85	F, M	334	3.89	153/45.81	14.07	39.97	46.50	20.45	0.26	0.14
21.	Wola Mysłowska	62.24	F, M	278	1.44	140/50.36	8.63	22.59	28.75	30.43	0.19	0.10
22.	Wola Rowska	29.06	F, M	292	7.19	128/43.84	7.19	48.54	42.63	25	0.21	0.12
23.	Wólka Sobieszyńska	311.55	M, B, F	442	9.75	186/42.08	7.69	80.58	70.71	31.25	0.34	0.16
24.	Zastawie	145.17	M, A, F	352	3.41	155/44.03	13.92	48.54	42.63	21.28	0.26	0.12
	Total	**2515.95**	**M, A, B, F**	**584**	**16.95**	**214/36.64**	**16.61**	**134.58**	**120.21**	**31.82**	**0.44**	**0.21**

M – meadows; A – arable fields; B – buildings; F – forest; Wf – floristic value; Wfa – floristic value of alien species occuring in the studied habitats; Kf – coefficient of naturalness; Of – coefficient of floristic value; WM – coefficient of modernization of flora

The coefficient of modernization for the whole flora is 31.82%. It ranges from 17.24% (Mroków) to 51.85% (Podzamcze) (Fig. 2). Its distribution shows differences in the group of anthropophytes.

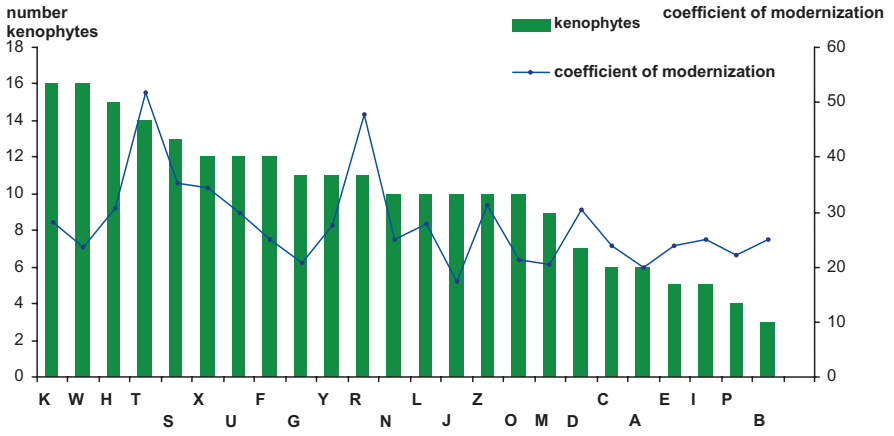

Fig. 2. Correlation between the number of kenophytes and the coefficient of modernization.

In contrary to floristic value floristic individuality does not depend on total number of species in each complex. High value of floristic individuality is typical for the complexes abundant in rare species: Wólka Sobieszyńska (0.34), Podzamcze (0.31), Ryki (0.30) and Radoryż Kościelny (0.28). Therefore, lower floristic individuality is observed in complexes of relatively smaller contribution of rare species: Krzywda (0.14), Jagiełła (0.19), Czarna (0.19) and Wola Mysłowska (0.19) (Fig. 3).

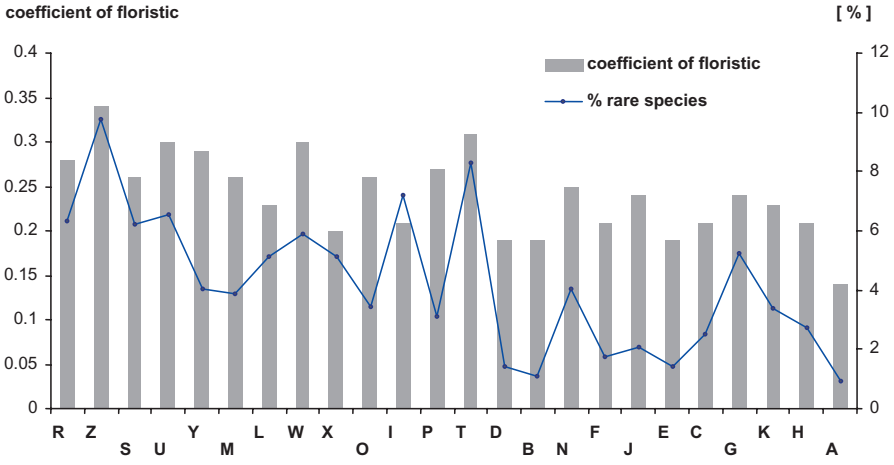

Fig. 3. Correlation between the contribution of rare species and floristic individuality.

The coefficient of naturalness is characterised by occurrence of 214 indicator species (36.64% of flora) connected with this type of water bodies. Contribution of indicator species and the influence on the coefficient of naturalness of particular ponds complexes which stems from this is presented in Table 1 and Fig. 4. Values of the coefficient of naturalness range from 0.06 to 0.18. 71% of all the complexes under study are characterised by coefficient from 0.08 to 0.15. High coefficient of naturalness (over 0.15) was recorded in fishponds in Radoryż Kościelny (0.18), Maciejowice (0.16), Nowy Świat (0.15), Wólka Sobieszyńska (0.16) and Ryki (0.15). Low coefficient (below 0.08) characterises fishponds in Krzywda (0.06), Korytnica (0.07) and Nowodwór (0.06), which are near arable fields and buildings.

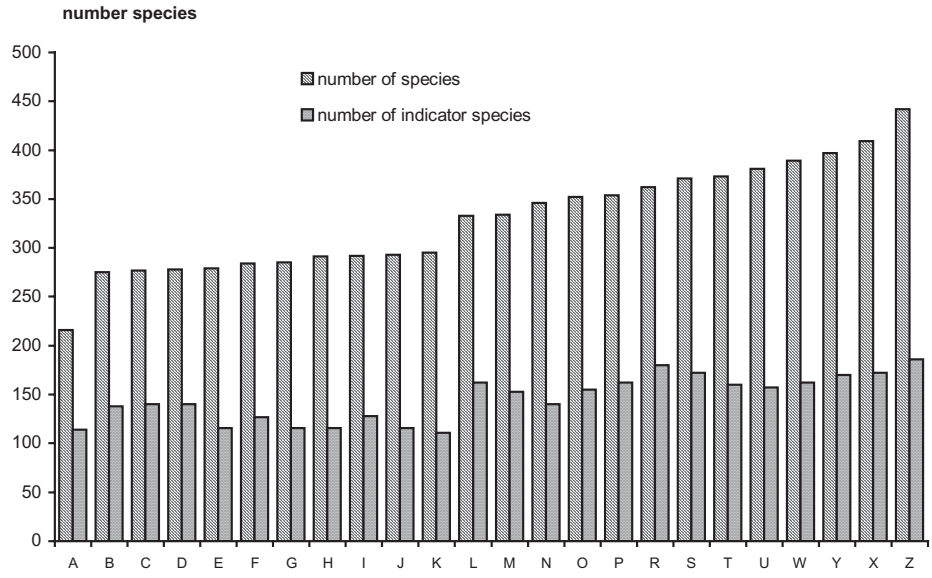

Fig. 4. Correlation between the total number of species and the number of indicator species.

Discussion

Floristic biodiversity of the ponds complexes is not alongside their floristic value. Whereas the presence of 'accidental' species in the flora of particular ponds complexes stems from the presence of arable fields and buildings in the neighbourhood. The number of archaeophytes and kenophytes does not clearly depend on the area of a complex. It remains under the influence of the presence of arable fields, abandoned arable fields and buildings in the neighbourhood of ponds complexes. We can therefore conclude that the number of

archaeophytes remains almost unchanged in relation to the total number of the species recorded in a complex while the number of kenophytes varies (Kornaś, 1977). Floristic value of each complex is best characterised by the coefficient of naturalness. In contrary to floristic value the coefficient does not take into account the presence of accidental species e.g. weeds of cultivation passing from the neighbouring crops or species occurring in open rubbish dumps.

Conclusion

Values of the coefficients point out a high grade of naturalness of the vascular plants flora of fishponds and depend on: total number of species, contribution of rare species, number of anthropophytes, adjoining neighbourhood and the areas of the complexes. It is confirmed by a great contribution of rare and endangered species. The largest influence of man on biodiversity of the flora expressed by coefficient of anthropophytisation applied to the complexes partially surrounded by arable fields, buildings and main and local roads. The number of anthropophytes does not depend on the area of a complex but on the kind of surroundings. The number of kenophytes changes above all, which is shown by the coefficient of modernization. For all the flora it is 31.82%. In order to find out more about the degree of the influence of man on biodiversity of the flora the coefficient of floristic individuality, which depends on the number of rare species occurring in each complex, was used. Floristic value of the complexes under study is best characterised by the coefficient of naturalness, which does not take accidental species into account: weeds of cultivation and ruderal plants. The coefficient of naturalness depends on the occurrence and number of the species typical for natural and semi-natural vegetation – indicator species connected with this type of water bodies.

Translated by the authors

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