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PIKEPERCH (*SANDER LUCIOPERCA* (L.)) EXPLOITATION IN REFERENCE TO STOCKING PROGRAMS AND THE SIZE STRUCTURE OF ITS HABITATS IN NORTHEASTERN POLAND IN 1951-1994

Andrzej Skrzypczak, Andrzej Mamcarz

Department of Lake and River Fisheries, University of Warmia and Mazury in Olsztyn, Poland

ABSTRACT. The analyses were based on commercial fisheries records of catches and stocking in lakes in northeastern Poland. The authors described the lake size structure in three categories of pikeperch, *Sander lucioperca* (L.), habitats determined by the frequency of occurrence of this species in commercial catches. In each of the five lake size classes, the moment pikeperch individuals appeared was pinpointed in light of stocking programs. Differences in the value of pikeperch exploitation parameters were determined in the three habitat types, and the level of variation was examined in stocked and unstocked lakes. Trend lines of pikeperch exploitation in the 1951-1994 period were plotted for these groups of lakes. The importance of pikeperch stocking for the occurrence of this species in new habitats declined as the size of the studied lakes increased.

Key words: PIKEPERCH (*SANDER LUCIOPERCA*), HABITAT, LAKES, STOCKING, RELATIVE CATCH

INTRODUCTION

Pikeperch, *Sander lucioperca* (L.), is a biologically and commercially valuable component of lake ichthyofauna (Nagięć 1961), and Poland lies near the western border of the natural distribution of this predator (Nagięć 1977). This fish species was the subject of many studies and publications in the late nineteenth and early twentieth centuries as well as in the interwar years (Staff 1950). In the early years of the development of commercial fisheries, larger numbers of pikeperch were reported in very few Mazurian lakes (Bernatowicz 1947). In the early 1950s, intensive pikeperch stocking programs were undertaken (Skrzypczak and Mamcarz 2001).

More has been learned about the distribution of pikeperch populations due to research on exploited populations (Bonar 1977, Nagięć 1977). This predatory fish is

CORRESPONDING AUTHOR: Dr Andrzej Skrzypczak, Uniwersytet Warmińsko-Mazurski, Katedra Rybactwa Jeziorowego i Rzecznego, ul. Oczapowskiego 5, 10-957 Olsztyn, Tel.: +48 89 5233388; e-mail: andrzej.skrzypczak@uwm.edu.pl

often used as an indicatory species for the early eutrophication of lakes (Bnińska and Wołos 1998). The presence and spreading of populations of this species in the complex of the Great Mazurian Lakes were reported by Skrzypczak and Mamcarz (1995). The occurrence of pikeperch in various habitat classes has been determined (Skrzypczak and Mamcarz 2005a) as has their distribution in river drainage basins in northeastern Poland (Skrzypczak i Mamcarz 2005b).

The objective of this paper was to characterize the size structure of pikeperch habitats in northeastern Poland, and to analyze the effects of commercial exploitation of this fish species with regard to pikeperch stocking conducted in the 1951-1994 period.

MATERIAL AND METHODS

Based on records in fisheries management logs for northeastern Poland from the 1951-1994 period, the authors selected a group of lakes in which pikeperch occurred in the fishing statistics or in which they were stocked. The lakes were assigned a pikeperch habitat category that corresponded with the frequency of occurrence of this fish species in commercial catches. This index was expressed as the ratio of the number of years pikeperch was present in the catches to the total number of years it was exploited. The index served to divide the lakes into three categories of pikeperch habitats: A (≥ 0.75) – permanent; B (0.74-0.25) – temporary; C (< 0.25) – incidental.

Lake logs provided information on pikeperch stocking and the annual catches of this species, as well as the number of months it was exploited each year. The annual catch of pikeperch (kg) was divided by the area of the lake (ha) and the appropriate number of months; thus, the exploitation parameter expressed as relative catch (kg ha^{-1} $month^{-1}$) was obtained (Skrzypczak and Mamcarz 2003). The areas of the lakes used in calculations were taken from the data provided by the Inland Fisheries Institute and cited in Choiński (1991).

The coefficient of variation, defined as the ratio of standard deviation (SD) to the mean (Łomnicki 2003), was used to analyze the variability of the statistical series of relative pikeperch catch.

Analysis of variance (ANOVA) was applied to examine the variation of the average relative pikeperch catch between years (intergroup variability), and in each year within the lakes analyzed (intragroup variability). The same tool was used to test the statistical significance of the differences in the average relative catch of pikeperch and the coefficient of variation for this parameter between lakes that were stocked and not stocked with pikeperch. The results of the tests were presented by giving the values of *F*-Fisher's test statistics (the level of statistical significance and number of degrees of freedom are in subscript) and critical *F*. All tests and analyses were valid at a level of significance of $\alpha = 0.05$.

Time-related changes in the occurrence of pikeperch in commercial catches were estimated with a cubic polynomial function. The values of the *R*-squared determination coefficient were treated as a trend line adjustment measure (StatSoft 1997).

RESULTS

Among the 619 lakes in northeastern Poland in which pikeperch was present for different lengths of time between 1951 and 1994, the most numerous group (254 lakes) was composed of water bodies in the size category < 50 ha. Most of these lakes (63%) were classified as habitat category C, *i.e.*, lakes in which pikeperch lived for the shortest time period (Fig. 1). The percentage of lakes classified as category A habitats increased in larger lake size categories. The least variation in lake size was observed for temporary pikeperch habitats (category B), whose contribution to all the lakes ranged from 30.7% among the lakes < 50 ha to 39.1% among the lakes > 500 ha.

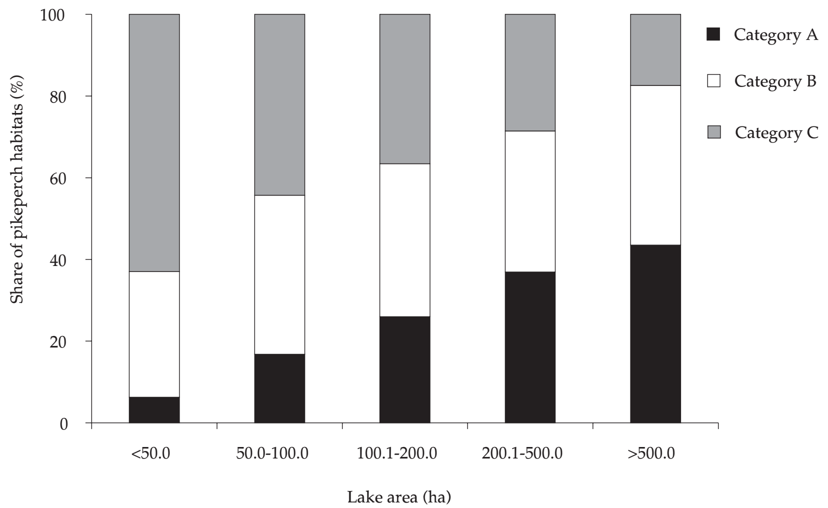

Fig. 1. Size structure of pikeperch habitats (categories A, B, and C – see Material and Methods) in northeastern Poland in 1951-1994.

Category A habitats. Half of the 116 lakes in this category measured between 100 and 500 ha. They covered a total area of 13597 ha, which was 29.4% of the total area of permanent pikeperch habitats (Table 1). Over 66% of the area was comprised of lakes >500 ha. In 1951 at the beginning of the study period, pikeperch was documented in 75 lakes, while it appeared later in other lakes and in more than half of these (22 lakes) it was introduced through stocking. Pikeperch spread by stocking mainly in smaller lakes (< 100 ha), but the role of stocking in establishing new pikeperch habitats became less important as the size of lakes increased. Over 72% of category A lakes were stocked with pikeperch. No documented pikeperch stocking was noted for 32 lakes in this category.

TABLE 1

Size structure and characteristics of permanent pikeperch habitats (category A – see Material and Methods) in northeastern Poland in 1951-1994 (BS – before stocking; AS – after stocking)

Size class of lakes (ha)	Category A of pikeperch habitats						
	No. of lakes	Total area (ha)	Pikeperch in catches from 1951	Pikeperch in catches after 1951		Stocked lakes	Non-stocked lakes
				BS	AS		
< 50.0	16	548	7	3	6	12	4
50.0 - 100.0	22	1 509	12	4	6	14	8
100.1 - 200.0	27	3 975	20	3	4	21	6
200.1 - 500.0	31	9 622	21	5	5	24	7
> 500.0	20	30 592	15	4	1	13	7
Total	116	46 246	75	19	22	84	32

The analysis of the trend lines of relative pikeperch catch, which are similar for both stocked and unstocked lakes, indicated that the mean values of this parameter were higher in lakes where stocking had been conducted (Fig. 2). However, statistically significant differences ($P < 0.05$) in the volume of catch by year between stocked and unstocked lakes was only detected in 1967.

In lakes stocked with pikeperch, the relative catch parameter for this predatory fish species was characterized by higher statistical variation between particular years than that from lakes by year ($F_{0.05;43;3381} = 1.51$ at $F_{crit.} = 1.38$). Such statistically significant differences were not observed for unstocked lakes ($F_{0.05;43;1154} = 1.33$ at $F_{crit.} = 1.39$). The mean value of the variation coefficient of the relative catch from unstocked lakes was 1.77 (± 0.56), which was statistically lower ($F_{0.05;1;86} = 11.03$ at $F_{crit.} = 3.95$) than that from stocked lakes (2.15 ± 0.49).

Category B habitats. In the group of habitats belonging to this category (215 lakes covering 40526 ha in total), 60% of the lakes (*i.e.*, 129 lakes with a total area of 5829 ha) were < 100 ha (Table 2).

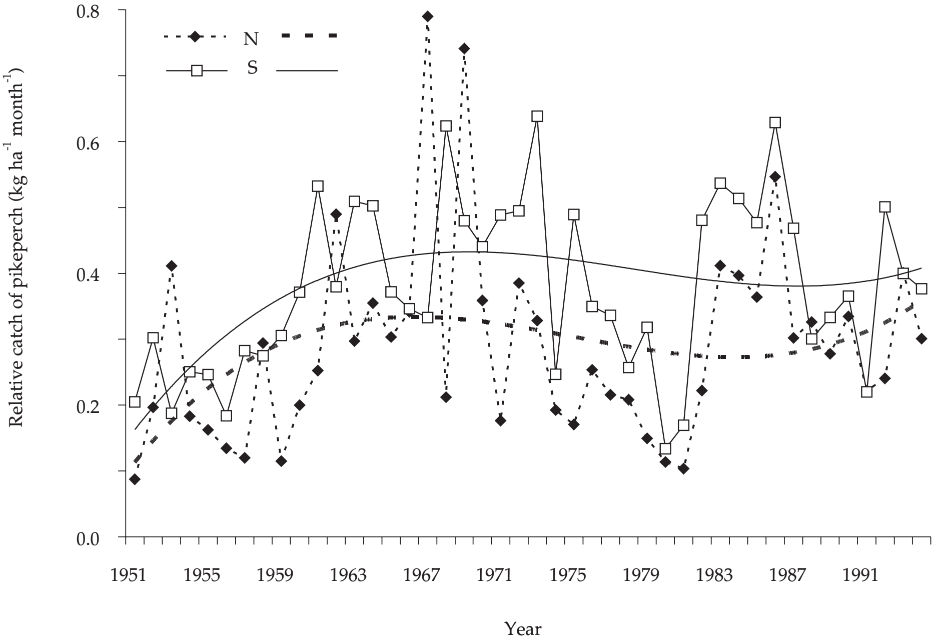

Fig. 2. Trend lines of the average relative catch of pikeperch in stocked (S) and unstocked (N) category A habitats (see Material and Methods) in northeastern Poland.

TABLE 2

Size structure and characteristics of temporary pikeperch habitats (category B – see Material and Methods) in northeastern Poland in 1951-1994 (BS – before stocking; AS – after stocking)

Size class of lakes (ha)	Category B of pikeperch habitats						
	No. of lakes	Total area (ha)	Pikeperch in catches from 1951	Pikeperch in catches after 1951		Stocked lakes	Non-stocked lakes
				BS	AS		
< 50.0	78	2156	17	34	27	56	22
50.0 - 100.0	51	3673	10	27	14	32	19
100.1 - 200.0	39	5519	6	21	12	26	13
200.1 - 500.0	29	8995	3	20	6	12	17
> 500.0	18	20183	6	12	-	7	11
Total	215	40526	42	114	59	133	82

In the early years of the time period investigated, pikeperch was present in 42 lakes. In all the size categories of lakes, most pikeperch catches were not preceded by stocking. Pikeperch stocking is documented in nearly 62% of these lakes. Most of the lakes smaller than 200 ha were stocked, but in the larger lakes it was more sporadic.

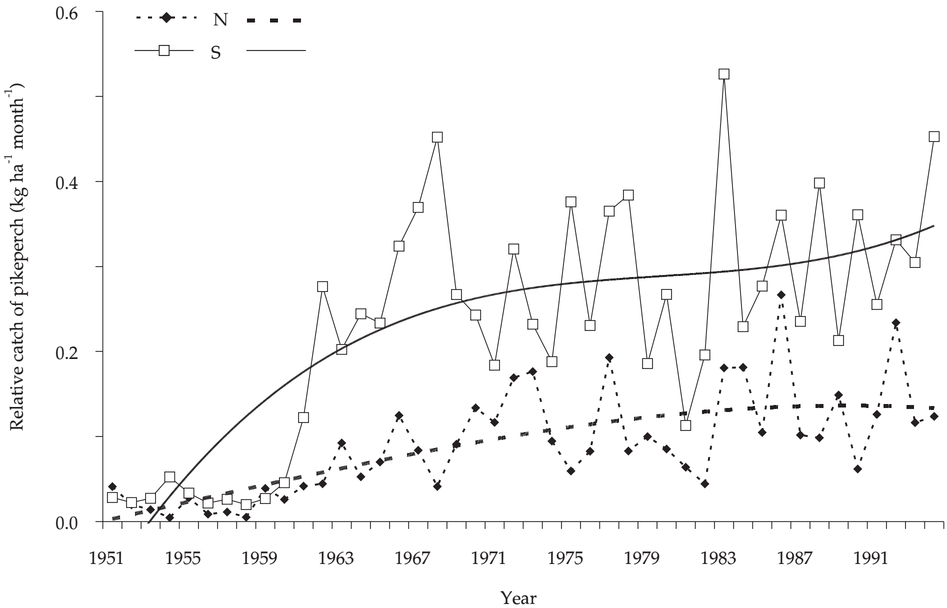

Fig. 3. Trend lines of the average relative catch of pikeperch in stocked (S) and unstocked (N) category B habitats (see Material and Methods) in northeastern Poland.

The trend lines of the relative pikeperch catch indicate increasing tendencies throughout the period with higher average values of this parameter for the stocked lakes (Fig. 3). In the unstocked lakes, the trend line did not exceed 0.15 kg ha^{-1} $month^{-1}$. Statistically significant differences ($P < 0.05$) in the volume of relative catch in each year between stocked and unstocked lakes were recorded in 1964, 1967, 1975, 1985, 1988, and 1990.

Variation in the relative catch parameter between years is statistically larger than that within years for both stocked ($F_{0.05;43;5033} = 3.16$ at $F_{crit.} = 1.38$) and unstocked ($F_{0.05;43;3102} = 1.73$ at $F_{crit.} = 1.38$) lakes.

No statistically significant differences were found in the variation coefficient of the relative catch parameter between the two groups of lakes ($F_{0.05;1;86} = 3.52$ at $F_{crit.} = 3.95$). In stocked lakes variation ranged from 1.85 to 5.21 at a mean of 3.23 (± 0.95), while in unstocked lakes the range was 1.99 to 6.24 at a mean of 3.61 (± 0.93).

Category C habitats. In the 1951-1994 period, pikeperch occurrence was recorded sporadically in 288 lakes in northeastern Poland which covered a combined area of 29454 ha. The size of over 55% of these lakes was < 50 ha (Table 3). Of the 160 lakes which belonged to this size category, the occurrence of pikeperch in fish catches was not associated with pikeperch stocking in 119 (74.4%) of them. Lakes < 50 ha comprised over half of all the stocked lakes in category C. No stocking was documented in nearly 80% of all the analyzed cases.

TABLE 3

Size structure and characteristics of incidental pikeperch habitats (category C – see Material and Methods) in northeastern Poland in 1951-1994 (BS – before stocking; AS – after stocking)

Size class of lakes (ha)	Category C of pikeperch habitats						
	No. of lakes	Total area (ha)	Pikeperch in catches from 1951	Pikeperch in catches after 1951		Stocked lakes	Non-stocked lakes
				BS	AS		
< 50.0	160	3553	15	119	26	34	126
50.0 - 100.0	58	4057	4	46	8	12	46
100.1 - 200.0	38	5676	2	32	4	8	30
200.1 - 500.0	24	7267	1	21	2	4	20
> 500.0	8	8901	3	5	-	2	6
Total	288	29454	25	223	40	60	228

The analysis of relative pikeperch catch over many years indicated that this species was poorly exploited. The trend lines plotted from the mid 1980s, both for stocked and unstocked lakes, did not usually exceed 0.05 kg ha^{-1} $month^{-1}$ (Fig. 4). A rapid increase in average catches, especially in the group of stocked lakes, was noted in the last decade of the analyzed period. Statistically significant differences ($P < 0.05$) in the relative catch volume in particular years between the stocked and unstocked lakes were determined in 1959 and 1993.

Variation in the relative catch of this predatory fish between the years is statistically higher than that from the analyzed lakes during each year in both stocked ($F_{0.05;43;1800}$ = 1.72 at $F_{crit.}$ = 1.38) and unstocked ($F_{0.05;43;7471}$ = 1.79 at $F_{crit.}$ = 1.38) lakes. The variation coefficient of the relative catch in the stocked lakes, which was determined to range from 3.11 to 6.62, with an average value of 4.69 (± 0.89), was characterized by a statistically lower value ($F_{0.05;1;86}$ = 64.12 at $F_{crit.}$ = 3.95) than that in the unstocked lakes, where it ranged from 3.24 to 12.55 at a mean value of 7.75 (± 2.31).

For each category of pikeperch habitat, the trend line plotted for the pikeperch relative catch was characterized by a higher determination coefficient (R^2) value. The values of this and the parameters of the equations of the third order polynominal curves are presented in Table 4. The lowest level of adjustment to the trend line of the average relative pikeperch catch in the 1951-1994 period was noted among the permanent pikeperch habitats (category A lakes).

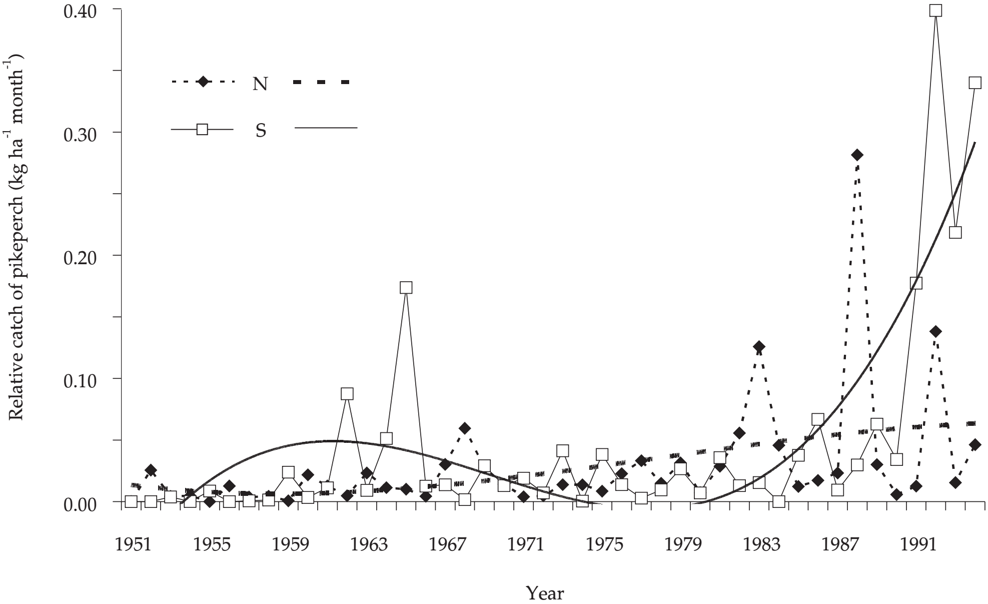

Fig. 4. Trend lines of the average relative catch of pikeperch in stocked (S) and unstocked (N) category C habitats (see Material and Methods) in northeastern Poland.

TABLE 4

Regression equation coefficients ($Y = ax^3+bx^2+cx+d$) and determination coefficients (R^2) in the 3-degree polynomial adjustment of trend lines approximating the relationship between mean annual values of the relative catch of pikeperch (Y) and time (x) in stocked and unstocked habitats (categories A, B, C – see Material and Methods) in northeastern Poland in 1951-1994

Category of pikeperch habitats		R^2	Equation coefficient			
			a	b	c	d
A	Stocked	0.235	0.0000	-0.0015	0.0385	0.1257
	Non-stocked	0.101	0.0000	-0.0021	0.0453	0.0517
B	Stocked	0.581	0.0000	-0.0012	0.0360	-0.0963
	Non-stocked	0.478	-0.0000	0.0000	0.0051	-0.0022
C	Stocked	0.677	0.0000	-0.0015	0.0246	-0.0705
	Non-stocked	0.175	-0.0000	0.0002	-0.0024	0.0158

DISCUSSION

The size structure of the pikeperch habitats in all the lake categories provides both a detailed picture and confirmation of the results obtained previously by Skrzypczak and Mamcarz (2005a), who discovered that the importance of pikeperch habitats tended to decline as their mean size decreased. Similar observations were reported by Toivonen (1966), although lake size was not always associated with the requirements of this fish species (Mikulski 1964).

According to data in Bonar (1978), pikeperch lakes comprised around 20% of open freshwaters in northern Poland. The present results indicate that, from 1951 to 1994, of the total of 240 lakes > 100 ha situated in northeastern Poland (Choiński 1991) 32.5% was comprised of permanent pikeperch habitats (category A) while temporary habitats (category B) constituted 35.8% of the total water potential.

The analysis of pikeperch stocking implies that its role is diverse in the expansion of the species and depends on the size of the lake. The ratios of pikeperch appearing in a catch prior to the first stocking to all documented cases of the first pikeperch catch following stocking were 0.9, 1.9, and 5.6 for category A, B, and C lakes, respectively. This means that stocking played the most important role in creating new pikeperch habitats in category A lakes. The analysis of this correlation in lake size categories seems to suggest that stocking becomes less important for the appearance of pikeperch in new habitats as lake size increases. The values of this correlation varied from 2.6 (lakes < 50 ha) to 21.0 (lakes > 500 ha). Similar conclusions can be drawn from a comparison of the number of lakes in which pikeperch was first fished after stocking relative to all the stocked lakes in each lake size class. Among the lakes smaller than 50 ha, such lakes accounted for 57.8%, whereas in the lakes > 500 ha, they made up only 4.5%.

The results of the analysis of the relative pikeperch catch indicated that there was high variation in mean annual values as well as between lakes within each size category. Among the genera Stizostedion (at present Sander) and Perca, the occurrence of generations with varied abundance is often noted (Nagięć 1978). Draganik and Nagięć (1995) reported on the relationship between pikeperch biomass and the volume of pikeperch catches in Jeziorak Lake. Over a time period of several decades, differences in the numbers of the strongest and the weakest generations can be 10-fold or higher (Svärdoson and Molin 1973).

Analysis of the morphological and morphometric characteristics of the permanent pikeperch habitats indicated that these lakes were the closest to pikeperch lakes in fisheries typology and were consequently the most favorable for sustaining this species (Skrzypczak and Mamcarz 2005a). In this category of habitats, the group of unstocked lakes (which was the only set analyzed) was characterized by the higher variation of relative catch between the lakes in particular years than that of the same parameter between years. At the same time, this was the smallest set (n = 32) in which lakes < 100 ha were nearly as numerous as those > 200 ha (12 and 14, respectively). Differences in the intensity and methods of fishing exploitation have been demonstrated between these classes of lakes (Skrzypczak and Mamcarz 2003). Simultaneously, the low value of the determination coefficient (R^2) for the trend line confirms the relatively high fluctuation of the average relative catch parameter for these lakes. On the other hand, with much better adjustment of the trend line in the lakes stocked with pikeperch, the variation coefficient of the exploitation parameter is larger than for the unstocked lakes. Assuming that the unstocked and stocked habitats (of category A) were affected by the same abiotic factors, it can be hypothesized that the significantly higher variation coefficient in the latter group resulted from the introduction of pikeperch stocking material. However, stocking was not conducted regularly, and, as Skrzypczak and Mamcarz (2005a) reported, on average 8.00 (± 4.58) lakes in this category of habitats were stocked annually during the 1952-1991 period. This means that statistically a single lake was stocked on average every 10-11 years. In Jeziorak Lake, in which pikeperch is an autochthonous species, the average annual catch of this fish from 1952 to 1991 ranged from 1.9 to 8.4 kg ha^{-1} (Draganik and Nagięć 1995).

There have been reports of pikeperch appearing in lakes that were quite different from the type of lakes favored by this species (Wołos and Bnińska 1998). Therefore, it should be assumed that temporary habitats (category B lakes) were chosen by pikeperch because of the physicochemical properties of their waters rather than their morphological and morphometric characteristics. At the same time, in this group of lakes the largest differences were recorded in the mean relative catch of pikeperch between stocked and unstocked lakes. This could have been caused by two factors; firstly, stocking was conducted in over 61% of the lakes, albeit not regularly. The investigations conducted by Skrzypczak and Mamcarz (2005a) showed that within this category of lakes an average of 8.75 (± 1.91) were stocked each year in the 1951-1994 period. This means that, statistically, stocking was conducted every 15 years in a single lake. Nonetheless, it needs to be stressed that the successful stocking of this fish species depends on the presence of suitable conditions rather than on the quantity of stocking material introduced (Zakęś and Szkudlarek 1996). Additionally, the larger relative pikeperch catch from stocked lakes might have resulted from that fact that the group of stocked lakes was composed predominantly of smaller water bodies in which the application of more efficient fishing technologies and higher relative catch are common, as was demonstrated by Skrzypczak and Mamcarz (2003). Reports on the effect of stocking on the abundance of fish generations proved that stocking is more effective in small water reservoirs (Nagięć 1978).

The abundance of pikeperch populations is affected by abiotic factors (temperature, water level, wind power) and innumerable biotic factors (Nagięć 1978). They were most likely responsible for the dramatic decline in the relative catch of this fish species in the late 1970s and early 1980s that was observed in category A and B lakes (both stocked and unstocked). The smallest pikeperch catches were documented in 331 lakes in northeastern Poland. Similar tendencies, including both the declining abundance of pikeperch populations and inferior results of commercial exploitation, were reported by Draganik and Nagięć (1995) in their studies of Jeziorak Lake.

Category C habitats, in which pikeperch appeared sporadically, are comprised mainly of the smallest lakes (< 50 ha) that are the most vulnerable to the influence of external abiotic factors. The relative catch from these lakes was the lowest, which proves that pikeperch is of rather low significance to the ichthyofauna of category C habitats. Nevertheless, the very distinct difference in the adjustment of the trend line as well as the values of the variation coefficient of the relative catch that were observed in the present study confirm that stocking with pikeperch, although performed rather haphazardly, had some effect on pikeperch catches in the group of the smallest lakes. The study conducted by Skrzypczak and Mamcarz (2005a) revealed that an average of 2.45 lakes (± 1.91) were stocked annually within this lake size group, which means that statistically a single lake was stocked once every 24 years.

The higher value of the determination coefficient for the trend lines in the relative catch from stocked lakes within each category of pikeperch habitats suggests that the mean values of this parameter are clustered more closely around the curve, and that stocking can, to a certain extent, attenuate natural fluctuations in the abundance of this fish. Researchers do emphasize, however, that even populations that live under optimum and constant environmental conditions are not free from fluctuations in their numbers (Nagięć 1978).

CONCLUSIONS

1. In the 1951-1994 period, permanent and temporary pikeperch habitats were noted in a total of 68.3% of the lakes > 100 ha located in northeastern Poland.
2. Fish stocking, as a contributing factor to pikeperch settling in new habitats, was of decreasing importance in larger lakes.
3. The pikeperch catches recorded in lakes stocked with this species were on a higher average level. Although the variation of this exploitation parameter was very high, in most cases the differences in this parameter were not confirmed to be statistically significant.
4. The variation coefficient of the relative pikeperch catch from stocked lakes compared with that from unstocked lakes declined as average lake size decreased within each of the pikeperch habitat categories.

REFERENCES

Bernatowicz S. 1947 – On the threshold of the commercial management of Mazurian Lakes – Prz. Ryb. 7/8: 259-263 (in Polish).

Bnińska M., Wołos A. 1998 – Effectiveness of coregonid management versus environment quality – Arch. Pol. Fish. 6(2): 295-314.

Bonar A. 1977 – Relations between exploitation, yield and community structure in Polish pikeperch (*Stizostedion lucioperca*) lakes – J. Fish. Res. Bd. Can. 34: 1576-1580.

Bonar A. 1978 – The influence of fishery exploitation and predation on fish numbers in pike-perch lakes – Rocz. Nauk Rol. H 98(3): 26-42 (in Polish).

Choiński A. 1991 – Catalogue of Polish lakes. Part II–Mazurian Lakeland – Wyd. Nauk. UAM, Poznań, 157 pp. (in Polish).

Draganik B., Nagięć M. 1995 – Exploitation factors of pikeperch (*Stizostedion lucioperca* L.) caught in Jeziorak Lake – Acta Acad. Agric. Tech. Olst. Prot. Aqua. Piscat. 20: 3-30 (in Polish).

Łomnicki A. 2003 – An introduction to statistics for biologists – Wyd. Nauk. PWN, Warszawa, 261 pp. (in Polish).

Mikulski Z. 1964 – Some biological features of pikeperch lakes – Verth. Int. Ver. Limnol. 15: 151-157.

Nagięć M. 1961 – Growth in the size of pikeperch (*Lucioperca lucioperca*) in the lakes of northeastern Poland – Rocz. Nauk Rol. 77-B-2: 549-578 (in Polish).

Nagięć M. 1977 – Pikeperch (*Stizostedion lucioperca*) in its natural habitats in Poland – J. Fish. Res. Bd. Can. 34: 1581-1585.

Nagięć M. 1978 – Dynamics of an intensively exploited pike-perch population (*Stizostedion lucioperca* (L.)) in Jeziorak Lake, Mazurian Lake District – Zesz. Nauk. ART Olsztyn 8: 119-176 (in Polish).

Skrzypczak A., Mamcarz A. 1995 – Occurrence of pikeperch (*Stizostedion lucioperca*) in the complex of Great Mazurian Lakes – Acta Acad. Agric. Tech. Olst., Prot. Aqua. Piscat. 20: 31-44 (in Polish).

Skrzypczak A., Mamcarz A. 2001 – Stocking and introductions of pikeperch, *Stizostedion lucioperca* (L.) in northeastern Poland – In: Some issues in fisheries in 2000 (Ed.) A. Wołos, IRS Olsztyn: 39-49 (in Polish).

Skrzypczak A., Mamcarz A. 2003 – Analysis of fishery exploitation parameters of lakes and assessment of their suitability for observation of trends in fish catches – EJPAU 6(2), (art-3.html).

Skrzypczak A., Mamcarz A. 2005a – Occurrence of pikeperch, *Sander lucioperca* (L.), and its habitats in northeastern Poland in 1951-1994 – Arch. Pol. Fish. 13(1): 99-110.

Skrzypczak A., Mamcarz A. 2005b – Distribution of pikeperch, S*ander lucioperca* (L.), habitats in river drainage basins in northeastern Poland in 1951-1994 – EJPAU 8(3), (art-21.html).

Staff F. 1950 – Freshwater fish in Poland and neighboring countries – Wyd. Trzaska, Evert i Michalski, Warszawa, 286 p. (in Polish).

StatSoft 1997 – STATISTICA for Windows. Volume I. General Conventions and Statistics I – StatSoft Polska, Kraków, 878 p. (in Polish).

Svärdson G., Molin G. 1973 – The impact of climate on Scandinavian populations of sander (*Stizostedion lucioperca* L.) – Inst. Freshwater Res. Drottningholm Rep. 53: 112-139.

Toivonen J. 1966 – Pikeperch and the eutrophication of the lakes in Finland – Limnologisymposion 1965: 62-67.

Wołos A., Bnińska M. 1998 – Effectiveness of coregonid management on the background of fish yield changes in 25 Polish lakes – Arch. Pol. Fish. 6(2): 315-328.

Zakęś Z., Szkudlarek M. 1996 – What to stock with? – In: Pikeperch-fishery management-eutrophication, IRS Olsztyn: 41-50 (in Polish).

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STRESZCZENIE

EKSPLOATACJA SANDACZA (*SANDER LUCIOPERCA* (L.)) NA TLE ZARYBIEŃ I STRUKTURY WIELKOŚCI JEGO SIEDLISK W PÓŁNOCNO-WSCHODNIEJ POLSCE W LATACH 1951-1994

Analizy oparto na zapisach gospodarczych o odłowach ryb i zarybieniach w jeziorach północno-wschodniej Polski. Dokonano charakterystyki struktury wielkości jezior w trzech kategoriach siedlisk sandacza, *Sander lucioperca* (L.), na podstawie częstotliwości pojawiania się tego gatunku w połowach komercyjnych (rys. 1). W pięciu klasach wielkości jezior scharakteryzowano moment pojawienia się sandacza na tle prowadzonych zarybień (tab. 1-3). W wyłonionych kategoriach siedlisk określono różnice w wielkości parametru eksploatacji gatunku oraz zbadano poziom jego zmienności w jeziorach zarybianych i niezarybianych. Dla tych grup jezior wykreślono linie trendu dla parametru eksploatacji sandacza w latach 1951-1994 (rys. 2-4). W analizowanym okresie na terenie Polski północno-wschodniej siedliska stałe i czasowe sandacza obejmowały łącznie 68,3% wszystkich jezior o powierzchni > 100 ha. Ranga zarybień, jako czynnika przyczyniającego się do zajmowania nowych siedlisk przez ten gatunek, malała wraz ze wzrostem wielkości jezior. Odłowy sandacza na przeciętnie wyższym poziomie stwierdzono w jeziorach zarybianych tym gatunkiem. Przy dużej zmienności parametru eksploatacji w większości przypadków nie udowodniono jednak statystycznych istotności tych różnic.