

Fish stock assessment in dam reservoirs located in the upper Vistula and Warta river catchment areas based on angling catch records

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Abstract. The regional departments of the Polish Anglers' Association (PAA) in the provinces of Bielsko-Biała, Częstochowa, and Katowice (with a combined membership of 62,163 in 2005) stipulated that anglers keep records of catches in registers. On average, 35,682 registers were analyzed annually from 2001 to 2005, which represents 57.4% of total PAA membership. The mean annual number of the anglers recording catches in dam reservoirs was 23,231, and the average catch in this category of waters was 185 tons of fish. Of the 22 fish species recorded in the catches, six comprised 91.6% of the total catch, as follows: common carp, *Cyprinus carpio* (L.); bream, *Abramis brama* (L.); roach, *Rutilus rutilus* (L.); pike, *Esox lucius* L.; pikeperch, *Sander lucioperca* (L.); perch, *Perca fluviatilis* (L.). The share of cyprinids decreased from 73.5% in 2001 to 64.8% in 2005, whereas the share of predators increased from 18.1 to 26%, in the same time period. Carp, pike, and pikeperch were the main species in the PAA stocking programs, hence the changes observed in the species composition of the catches resulted primarily from stocking. In 2005, the maximal shares of the fish species noted were as follows: carp – 64.7% (Czechło Dam Reservoir near Chrzanów), pike – 19.8% (Dzieckowice Dam Reservoir), pikeperch – 27.8% (Tresna Dam Reservoir), bream – 72.8%

(Rybnik Dam Reservoir). The results indicate that eutrophication and stocking are the main factors that determine the status of fish stocks in dam reservoirs located in the upper Vistula and Warta catchment areas.

Keywords: angler catches, fish stocks, dam reservoirs

Introduction

Rational fisheries management is possible under one fundamental condition, namely that the required population data is available. Many researchers agree that the analyses of angling catches can be a source of information regarding the status of the environment and ichthyofauna. They can even be used, in combination with other methods, to study fish populations (e.g., Axford 1979). Studies of angling pressure and catches are performed with three basic methods: monitoring anglers while fishing (the so-called creel census), questionnaire surveys, and catch return surveys. This last method has a long history, an excellent example of which is salmon angling in the British River Severn, where it became a statutory requirement to submit catch returns with the 1938 fishing season (Churchward and Hickley 1991). In Poland, the first time questionnaire surveys were used in such studies was in 1978-1979, and the results referred to the overall pressure placed on particular categories of waters (Bnińska and Leopold 1987), as well as catches of

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particular species throughout the country (Leopold et al. 1980, Leopold and Bnińska 1987).

In Poland, the catch return method (so-called registers) was first applied by the Polish Anglers' Association in 1986 in chosen regional departments, and the results of the analyses for the Krosno region were presented by Wołos and Piskorski (1991). During this period, registering catches was required in just two regional departments of the PAA. This type of angling catch registration was introduced nationwide much earlier in Slovakia (Hensel 1996), Hungary (Pinter 1996), and the Czech Republic (Vacha 1998).

Angling in dam reservoirs has not been studied with much intensity. Initial studies of this appeared in the Russian literature and focused primarily on large reservoirs on the Volga, including the Saratov, Kuybyshev (Bolotov et al. 1974, Fatchullin 1975a, b, c), and Rybinsk (Poddubnyj et al. 1978). The work by Wołos and Piskorski (1991) was based on catch registers, and discusses the results of angling catches in three dam reservoirs located in the drainage basin of the mid Vistula on the San (Solina and Myczkowce Dam Reservoirs) and Wisłok (Sieniawa Dam Reservoir) rivers. Additionally, three dam reservoirs on the Soła (Żywiec Dam Reservoir), Dunajec (Rożnów Dam Reservoir), and San (Solina Dam Reservoir) rivers were studied using the creel census method. Begun in the 1990s and continued into the 2000s, studies of angling in dam reservoirs were undertaken in a range of new PAA departments, including Jelenia Góra, Legnica, Wałbrzych, Wrocław (Mioduszevska and Wołos 2006), and Radom (Wołos et al. 2005). Studies were continued in the Katowice department of the PAA and focused on the socioeconomic analysis of the anglers (Wołos et al. 1998), and the species structure of the four largest dam reservoirs, i.e., Łąka, Przeczyce, Dzieńkowice, and Kozłowa Góra (Wołos et al. 2000).

The aim of the present work was to evaluate the state of fish populations based on the analysis of angler catch registers from 22 dam reservoirs located in the catchment area of the upper Vistula and Warta rivers, which are fished based on an agreement by three PAA departments, Bielsko-Biała, Częstochowa, and Katowice. The trophic status of these reservoirs was determined based on the state of the bream

population expressed as its percentage share in catches and the sizes of individual bream caught. Two reservoirs were used to demonstrate the impact stocking had on angling catches, and thus, indirectly on the state of the ichthyofauna inhabiting these two basins.

Materials and Methods

The basis for the current work is catch registers kept by anglers who are members of the Polish Anglers' Association departments in Bielsko-Biała, Częstochowa, and Katowice. In 2005, these three departments had a total of 62,163 members. Since 1994, they have required that members keep catch registers, and the current study was based on those from the five-year period from 2001-2005. A total of 178,410 records were analyzed from this period, which is an average of 35,682 records annually, and this means that the sample of registers analyzed represents 57.4% of the total number of members of the three PAA departments studied. The registers chosen for the current study were those that contained data concerning catches made in the 22 dam reservoirs exploited by the three PAA departments. The list of all the reservoirs (and their surface areas) is presented in Table 1, which highlights the variation in the size of the studied reservoirs; the largest had a surface area of 1,100 ha (Tresna Dam Reservoir) and the two smallest were the Gzel (29 ha) and the Pniowiec (31 ha). Twenty-one reservoirs are situated in the catchment basin of the Vistula, Poland's largest river, while just one, the Poraj Dam Reservoir, was located in the upper Warta, the largest tributary to the Oder, Poland's second largest river. The combined surface area of the dam basins was 5,701.9 ha.

The registration system the anglers used required them to record data at the conclusion of each day's fishing. The data recorded included the date, the fishing ground, the combined weight and the number of each fish species caught. The fishing grounds were also included in the register, and numerical codes were used to note the species.

Table 1

Dam reservoirs under study and their areas

Reservoir	Area (ha)	Reservoir	Area (ha)
Tresna	1100.0	Buków I, II	118.5
Dzieńkowice	700.0	Chechło-Nakło	90.0
Kozłowa Góra	526.8	Niebozowy	76.7
Poraj	497.0	Pogoria I	73.0
Przeczyce	430.7	Horniok	65.2
Rybnik	398.0	Chechło near Chrzanów	54.0
Porąbka	380.0	Sosina	51.3
Łąka	320.0	Odra I, III	43.3
Pławniowice	244.2	Pniowiec	31.0
Pogoria III	207.0	Gzel	29.0
Paprocany	138.2	Total	5701.9
Dzierżno	128.0		

The following parameters were analyzed as part of the study of angler catch registers that referred to each of the 22 dam reservoirs in the 2001-2005 period: number of anglers registering catches, total number of angling days, total number of fish catches registered (kg), mean number of angling days per angler, annual mean fish catches per angler (kg), yield (kg ha^{-1}), total catch of particular species (kg), total catch of particular species (indiv.), average weight of one individual of each species (kg), the share of the total weight of each species in the total catches (%).

In order to determine the fish population status in the studied dam reservoirs, the percentage shares of the particular species registered in catches made in 22 reservoirs in the 2001-2005 period are presented. Additionally, to illustrate the changes occurring in the ichthyofauna of these reservoirs, two species groups were chosen, i.e., three basic cyprinid species (carp, *Cyprinus carpio* (L.), bream, *Abramis brama* (L.), roach, *Rutilus rutilus* (L.)) and three basic predatory species (pike, *Esox lucius* L., pikeperch, *Sander lucioperca* (L.), perch, *Perca fluviatilis* (L.)). Considering how significant to anglers the species of carp, pike, and pikeperch are, the percentage structures of catches registered in 2005 in three reservoirs with the highest percentage of these species are presented. These are the dam reservoirs of Chechło near Chrzanów (highest percentage of carp), Dzieńkowice (the highest share of pike), and Tresna (the highest share of pikeperch). Considering the fact that a significant number of the studied reservoirs are highly

eutrophic, the catch structure of Rybnik Reservoir is presented since the highest percentage of bream occurred there, and this species is an indicator of progressing eutrophication. In this part of the analyses, only data from 2005 were used since this was the first year that the PAA department in Katowice had jurisdiction over the Rybnik basin, which meant that this was the first time anglers were required to keep registers.

Since fish populations in dam reservoirs are shaped to a significant degree by stocking programs, examples are presented from two basins, Chechło near Chrzanów and Dzieńkowice, where stocking efforts are substantial. In order to compare the stocking of various species (the stocking material released ranges from hatch to 2+ age group fish), the stocking effort is presented as the cost according to the current price of the various forms of stocking material.

Results

The data presented on angling pressure and registered angling catches in the 2001-2005 period in 22 reservoirs located in the Vistula and Warta catchment area are presented in Table 2. The most anglers registered catches in 2003 (25,084), while the least did so in 2005 (19,864). In the 2001-2005 period, the annual mean of catch registers collected and analyzed was 23,231. The data regarding angling pressure indicate that the highest pressure, measured as

Table 2

Basic angling pressure data and registered catches in 22 dam reservoirs

Year	Number of anglers	Average number of fishing days angler ⁻¹	Average daily catch angler ⁻¹ (kg)	Average annual catch angler ⁻¹ (kg)	Total annual catch (tons)
2001	23,531	11.29	0.61	6.94	163.2
2002	25,003	12.61	0.64	7.11	203.3
2003	25,084	12.51	0.64	8.13	200.4
2004	22,674	12.58	0.60	7.99	170.2
2005	19,864	13.49	0.70	7.51	187.7
Mean	23,231	12.50	0.64	7.54	185.0

the mean number of angling days, was noted in 2005, while the lowest was in 2001. The annual mean angling pressure was 12.5 days' angling angler⁻¹ in the 2001-2005 period. The largest total angling catch in the 22 dam reservoirs studied was made in 2002, while the lowest was in 2001. The mean for the 2001-2005 period was 185 tons. The largest daily catch per angler was noted in 2005, while the highest annual catch per angler was in 2003. The corresponding lowest figures were noted in 2004 and 2001, respectively. The mean for the 2001-2005 period analyzed was 0.64 kg day⁻¹ angler⁻¹ and 7.54 kg year⁻¹ angler⁻¹.

In total, 22 fish species were registered in the catches in 2001-2005 (Table 3). The decided dominants in the catches were the two cyprinid

Table 3

Species composition of angler catches in studied dam reservoirs in 2001-2005

Scientific name	Common name	Share in the total catch (%)	Frequency of occurrence (%)
Cyprinidae			
<i>Cyprinus carpio</i> L.	Common carp	32.5	100
<i>Abramis brama</i> (L.)	Bream	25.7	100
<i>Rutilus rutilus</i> (L.)	Roach	12.0	100
<i>Carassius carassius</i> (L.)	Crucian carp	1.8	100
<i>Tinca tinca</i> (L.)	Tench	1.6	100
<i>Ctenopharyngodon idella</i> (Val.)	Grass carp	1.2	100
<i>Leuciscus idus</i> (L.)	Ide	0.6	100
<i>Leuciscus cephalus</i> (L.)	Chub	0.5	63.6
<i>Abramis bjoerkna</i> (L.)	White bream	0.4	95.5
<i>Aspius aspius</i> (L.)	Asp	0.3	36.4
<i>Alburnus alburnus</i> (L.)	Bleak	0.2	77.3
<i>Chondrostoma nasus</i> (L.)	Nase	0.1	50.0
<i>Barbus barbus</i> (L.)	Barbel	0.1	22.7
Esocidae			
<i>Esox lucius</i> L.	Pike	8.3	100
Percidae			
<i>Sander lucioperca</i> (L.)	Pikeperch	8.2	100
<i>Perca fluviatilis</i> L.	Perch	4.9	100
Anguillidae			
<i>Anguilla anguilla</i> (L.)	European eel	0.6	100
Siluridae			
<i>Silurus glanis</i> L.	Wels	0.6	100
Salmonidae			
<i>Salmo trutta m. fario</i> (L.)	Brown trout	0.1	59.1
<i>Oncorhynchus mykiss</i> (Walbaum)	Rainbow trout	0.1	27.3
Thymallidae			
<i>Thymallus thymallus</i> (L.)	Grayling	0.1	22.7
Gadidae			
<i>Lota lota</i> (L.)	Burbot	0.1	9.1

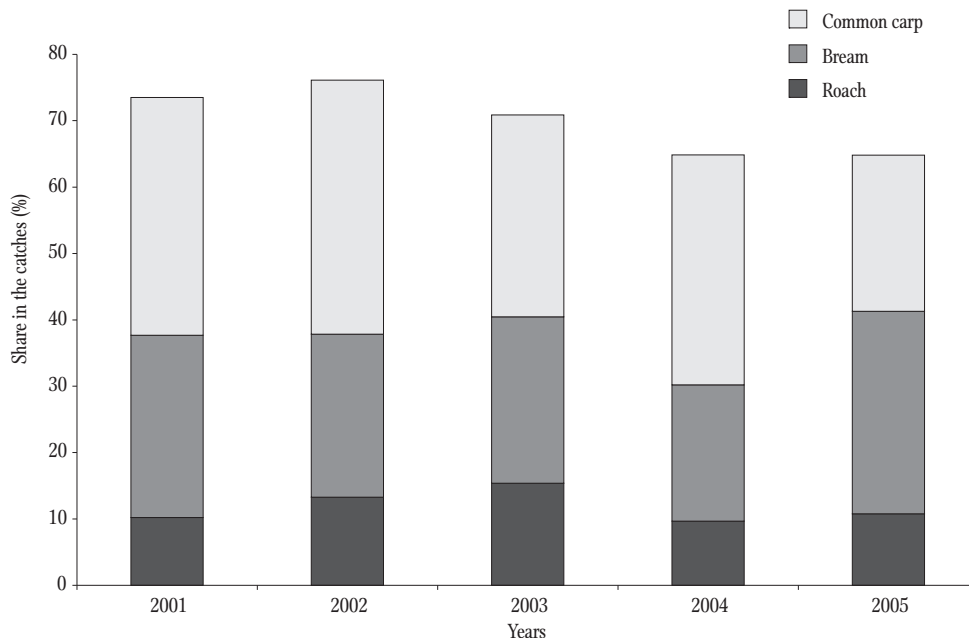


Figure 1. Share of basic cyprinids in angler catches in studied dam reservoirs in 2001-2005.

species: carp (32.5%) and bream (25.7%). In addition to these species, the shares of roach (12.0%), pike (8.3%), pikeperch (8.2%), and perch (4.9%) were distinctly apparent. The combined total of these six species was 91.6% of the total weight of fish caught by anglers in the studied dam reservoirs in the 2001-2005 period. It is worth mentioning here that the three most important cyprinid species (carp, bream, roach) comprised in excess of 70% of the total angling catch, while the three most important predatory fish (pike, pikeperch, perch) comprised more than 21%. In total, the anglers registered catches of 22 fish species, but, with the exception of the six most important species, the share of none of them exceeded 2%.

The highest share of total carp, bream, and roach catches was registered in 2002, at 76.1%, while the lowest quantity was recorded in 2005 (64.8%). The highest share of carp in the species structure of the catches was noted in 2002, when it was 38.3% of the total weight of angling catches, while it was the lowest in 2005 (23.5%). In the case of bream, the highest share was noted in 2005 (30.5%) and the lowest in 2004 (20.5%). With roach, the corresponding figures were in 2003 (15.4%) and 2004 (9.7%). Generally, it can be said that during the analyzed period of

2001-2005 the share of carp, bream, and roach in the total catches registered by anglers in the 22 dam reservoirs studied decreased (Fig. 1).

The situation with regard to the three most important predatory species (i.e., pike, pikeperch, perch) was inverse. While the total share of pike, pikeperch, and perch in the registered angling catches generally increased during the 2001-2005 period, the most significant increase was in 2005, when it was 26.1%, and the lowest was in 2002 at 16.3% (Fig. 2). The highest share of pike in the species structure of the catches was noted in 2005 at 10.5% of the total weight of angling catches, while the lowest was noted in 2002 at 6.0%. In the case of pikeperch, the highest share was in 2004 (11.0%) and the lowest was, similarly to pike, in 2002 (6.0%). The corresponding figures for perch were noted in 2001 (5.2%) and, similarly to both pike and pikeperch, in 2002 (4.4%).

Among the 22 dam reservoirs analyzed, the species structure of angling catches noted in 2005 in three reservoirs (Chechło near Chrzanów, Dzieńkowice, Tresna) were interesting. Thus, it is worthwhile to examine in more detail the species structure in these three reservoirs. In the Chechło Reservoir near Chrzanów (Fig. 3), carp was the decided

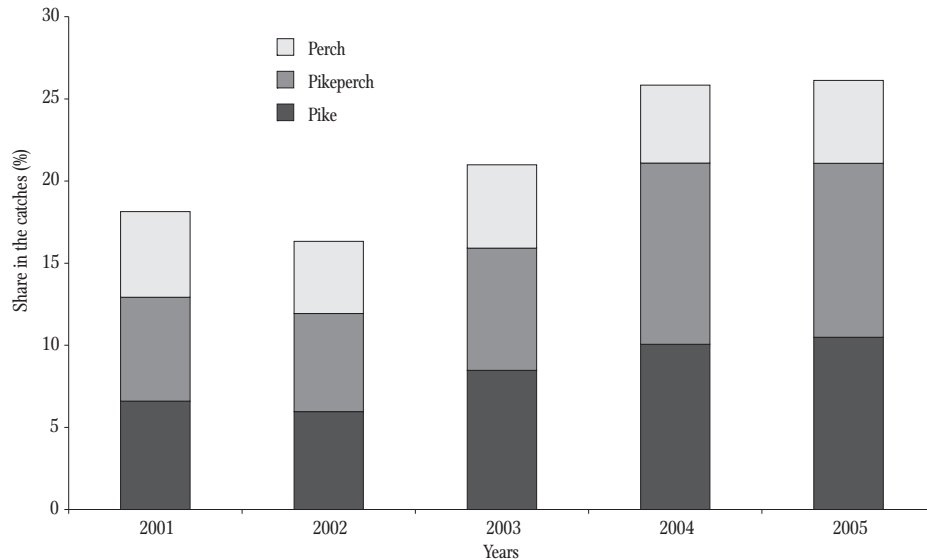


Figure 2. Share of basic predatory species in angler catches in studied dam reservoirs in 2001-2005.

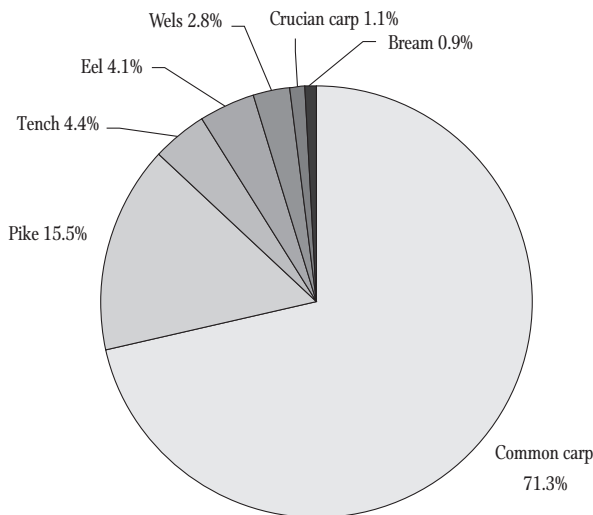


Figure 3. Species composition of stocking Chechło near Chrzanów Dam Reservoir in 2001-2004 (100% = 94,545 zlotys).

dominant in the catches with a share of 64.7% and a mean individual weight of 1.60 kg. The next fish in the catch species structure included the predatory pike and wels, *Silurus glanis* L., as well as the bream. The shares of these species were, respectively, 13.7, 6.0, and 5.9% (Table 4). The mean weights of the individuals of this species were 1.75, 5.13, and 0.29 kg. It is worthwhile at this point to mention that the yield of the registered angling catches in Chechło Reservoir near Chrzanów was 28.60 kg ha⁻¹ in 2005. Although the yield of the registered angling catches in 2005 was clearly lower (at 12.89 kg ha⁻¹) in the Dzieńkowice

Reservoir, the species structure was as equally as interesting (Table 4). Carp dominated with a mean weight of 1.61 kg with a 40.3% share, but, as was the case in the reservoir discussed earlier, the subdominant was pike, a predatory species whose share rose to 19.80%, while the mean weight of individuals caught was 1.28 kg.

The next species in the angling catch structure was bream with a mean weight of 0.59 kg (13.4%), and small-sized roach (mean weight 0.14 kg; 10.4%). Thus, as is apparent from the preceding, although the species structure of the ichthyofauna was not as attractive from the angling perspective as was that of the Chechło Reservoir near Chrzanów, it was, nonetheless, very attractive especially due to the carp and pike that occur in large numbers. While this situation was also the result of appropriate stocking, in a reservoir as large as the Dzieńkowice (700 ha), carp originating from stocking was not fully capable of pushing out bream, as they had done in the Chechło Reservoir near Chrzanów. However, it did limit its population enough so that individuals were of a relatively high individual weight, which makes this species an attractive angling catch. The Tresna Reservoir (1100 ha) has an even larger surface area than does the Dzieńkowice. The angling catches made here in 2005 (Table 4) were dominated by pikeperch (the share was as high as 27.8% and the mean individual weight

Table 4

Species composition of anglers' catches in 4 selected dam reservoirs in 2005 (% in total catch)

Species	Dam reservoirs			
	Chechło near Chrzanów	Dzieńkowice	Tresna	Rybnik
Common carp	64.7	40.3	19.6	4.3
Pike	13.7	19.8	13.7	2.7
Wels	6.0	1.1	0.1	1.3
Bream	5.9	13.4	14.2	72.8
Roach	3.2	10.4	11.0	5.2
Pikeperch	2.0	4.1	27.8	2.9
Grass carp	1.5	0.8	0.9	1.2
Perch	1.3	7.1	6.8	2.5
Tench	0.5	0.9	0.4	0.9
Eel	0.5	0.4	0.3	0.6
Crucian carp	0.4	0.6	0.3	3.9
Ide	0.3	0.1	1.5	0.3
Chub	0.0	0.4	1.1	0.2
Bleak	0.0	0.1	1.1	0.0
Other	0.0	0.5	1.2	1.2

was 1.52 kg). The next largest share was of carp (19.6%), large bream (14.2%), pike (13.7%), and small perch (11.0%). The mean weights of the individuals of these species caught were 1.70, 1.03, 1.60, and 0.14 kg, respectively. The situation with regard to the interaction of carp and bream was analogous to that in the Dzieńkowice Reservoir. The difference was that in the Tresna the most common fish in the species structure was not carp or pike, but pikeperch. It is reasonable to assume this is a result of stocking management.

The angling catch structure noted in Rybnik Reservoir (398 ha) in 2005 can be presented as an example of what can be referred to as "reverse" angling catch structure (which, as one assumes, originates from the species structure of the ichthyofauna). Bream was the decided dominant at a share of 72.8% (Table 4) and a mean individual weight of 0.58 kg. Roach was a subdominant with a mean weight of 0.27 kg, but with a share of just 5.2%. Third place was occupied by carp with a share of 4.3%. With

such a significant domination of cyprinids, especially bream, the combined share of the basic predators (pike, pikeperch, perch) totaled only 8.1%. This state of affairs, especially with such strong domination by bream, which is an eutrophication indicator species, might attest to the degree to which this process has progressed in the Rybnik Reservoir. This might also indicate that the ichthyofauna structure in this reservoir is not attractive to anglers.

Examples of stocking management having a certain, or even significant, degree of influence on the species structure of the catch obtained by anglers are those in the Chechło (near Chrzanów) and Dzieńkowice reservoirs that were performed in the 2001-2004 period (thus during the period immediately preceding the angling catches in 2005; see the species structure presented in Table 4). In the species structure of the stocking values in the Chechło Reservoir near Chrzanów (Fig. 3), carp was the decided dominant with a share of 71.3%, while the second was pikeperch with a total stocking value of 15.5%. The stocking values of tench, *Tinca tinca* (L.) and eel, *Anguilla anguilla* (L.) can also be mentioned although they were not significant in comparison to those of the preceding two species at 4.4 and 4.1%, respectively. Figure 4 is a graphic presentation of the species structure stocking values in the Dzieńkowice reservoir. The decided dominant in this structure was carp with a 48.4% share and pike with a 35.2%

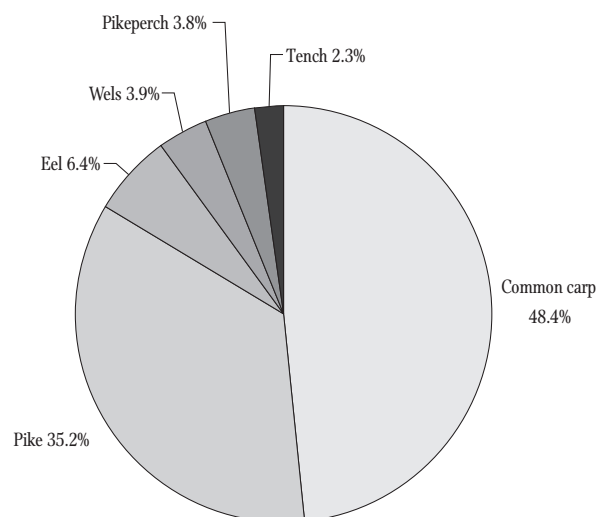


Figure 4. Species composition of stocking Dzieńkowice Dam Reservoir in 2001-2004 (100% = 339,213 zlotys).

share. In the overall stocking value, the shares of the stocking values of eel (6.4%), wels (3.9%), and pikeperch (3.8%) can also be mentioned.

The share of bream in the species structure of angling catches is not the only way to determine the degree of eutrophication in a reservoir. The mean individual weight of this fish is also an indicator. Figure 5 is a graphic representation of the mean weight of bream individuals caught in 2005 in the 22 analyzed dam reservoirs located in the Vistula and Warta catchment. The mean bream weight was clearly the highest in the Tresna and Porąbka reservoirs (at 1.03 and 0.97 kg, respectively). In the Dzieńkowice, Rybnik, Pławniowice, Sosina, Chechło-Nakło, Horniok, Łąka, Pogoria I, Poraj, Pogoria III, Dzierżno, and Gzel reservoirs the mean weight of the bream caught ranged from 0.4 to 0.6 kg, while in the reservoirs of Kozłowa Góra, Pniowiec, Nieboczowy, Buków I, II, Przeczyce, Odra I, III, Chechło near Chrzanów, and Paprocany, it did not exceed 0.4 kg. It is plausible to assert that such a distribution of the dam reservoirs analyzed according to the mean weight of the bream caught is covered by the degree of the eutrophication process; however, it does appear that this cannot be considered in isolation of the share of bream in the species structure of the angling catches registered in these reservoirs.

Figure 6 is a graphic representation of the bream share in overall registered catches in 2005 in the 22 analyzed dam reservoirs. This figure indicates that Rybnik Reservoir was in the leading position with a bream share of total angling catches at 72.8%. In the reservoirs of Poraj, Łąka, Dzierżno, Przeczyce, and Gzel, the share of bream fluctuated from 30 to 60%. In the reservoirs of Paprocany, Porąbka, Pławniowice, Pniowiec, Kozłowa Góra, and Pogoria I, the share of eel ranged from 15 to 30%, while in the remaining reservoirs (Tresna, Dzieńkowice, Pogoria III, Odra I, III, Buków I, II, Sosina, Nieboczowy, Horniok, Chechło near Chrzanów, Chechło-Nakło) the share of bream did not exceed 15%, but was also not lower than 5%.

Discussion

One of the features of angling is the selectivity of the catches. The analysis of catch selectivity is most frequently connected to evaluating the impact of angling pressure on fish populations, the functioning of aquatic ecosystems, and fisheries management. The study by Wołos (1994) indicated that anglers had a clear preference for predatory species and that the order of preferred species was pike, eel, perch, and pikeperch. The study cited focused on the fish populations of lakes that were slightly or moderately eutrophic and in which there was an appropriate balance between predatory and the less valuable cyprinid species. This situation changes drastically when the eutrophication process is advanced enough that populations begin to be dominated by species whose development is stimulated by more eutrophic aquatic basins. In such reservoirs, the angling pressure, as it were, "shifts" from the predatory species to common cyprinids, including excessively developing populations of bream and roach. The situation was similar in the populations studied in the 22 dam reservoirs, which, in the 2001-2005 period, were the populations that dominated the angling catches, and to which carp was added thanks to stocking. The fundamental importance of stocking management in these reservoirs is reflected in the fact that a 32.5% share of carp was the decided dominant, while the combined percentage of these three cyprinid species was about 70% of the total weight of fish caught. Among the 22 reservoirs analyzed, the highest percentage of carp (64.7%) was registered in the Chechło Reservoir near Chrzanów. Vostradovsky (1991) called attention to the special status of carp in Czech dam reservoirs by using tagging methods to evaluate the effectiveness of stocking with this species in the Lipno Reservoir. Wołos et al. (1998) also did this by evaluating the effectiveness of carp stocking by analyzing angling registers from 16 dam reservoirs fished by the PAA department in Katowice.

A clear symptom of progressing eutrophication in the studied dam reservoirs is the significant share of bream (25.7%), which is viewed as one of the best

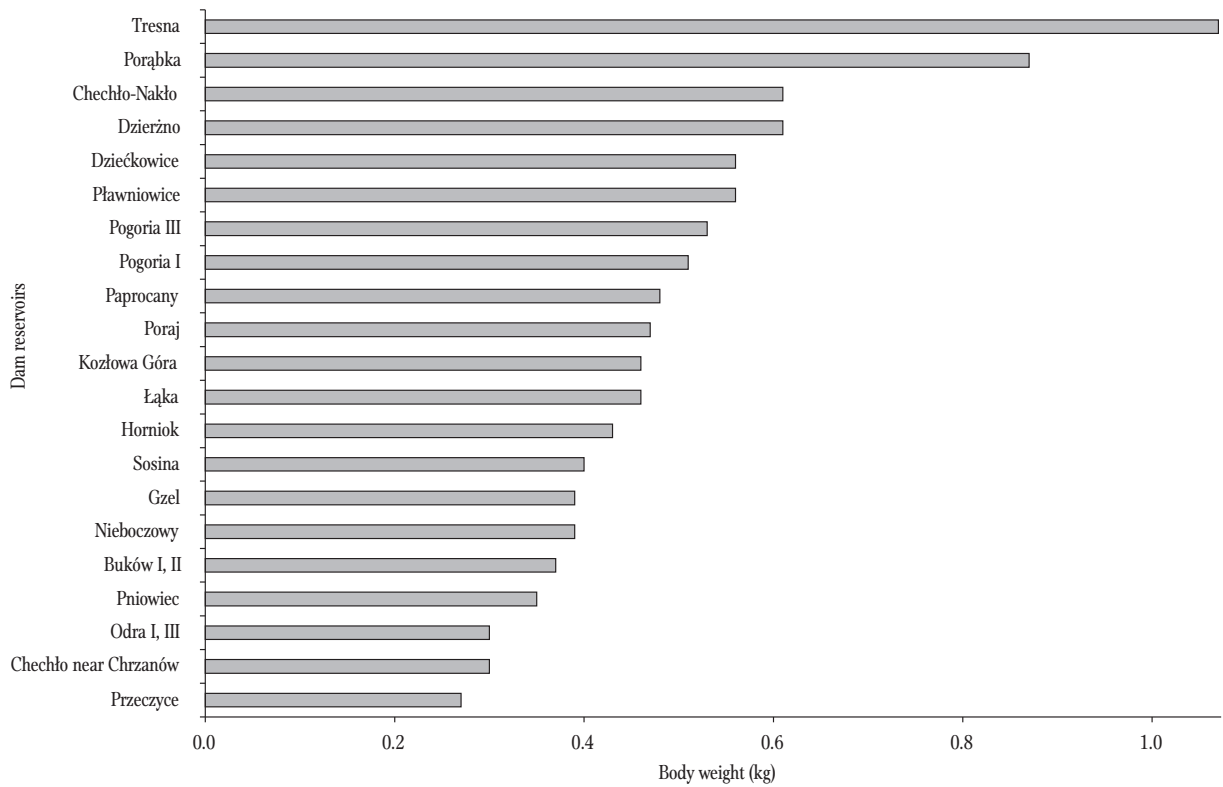


Figure 5. Average weight of bream in studied dam reservoirs in 2005.

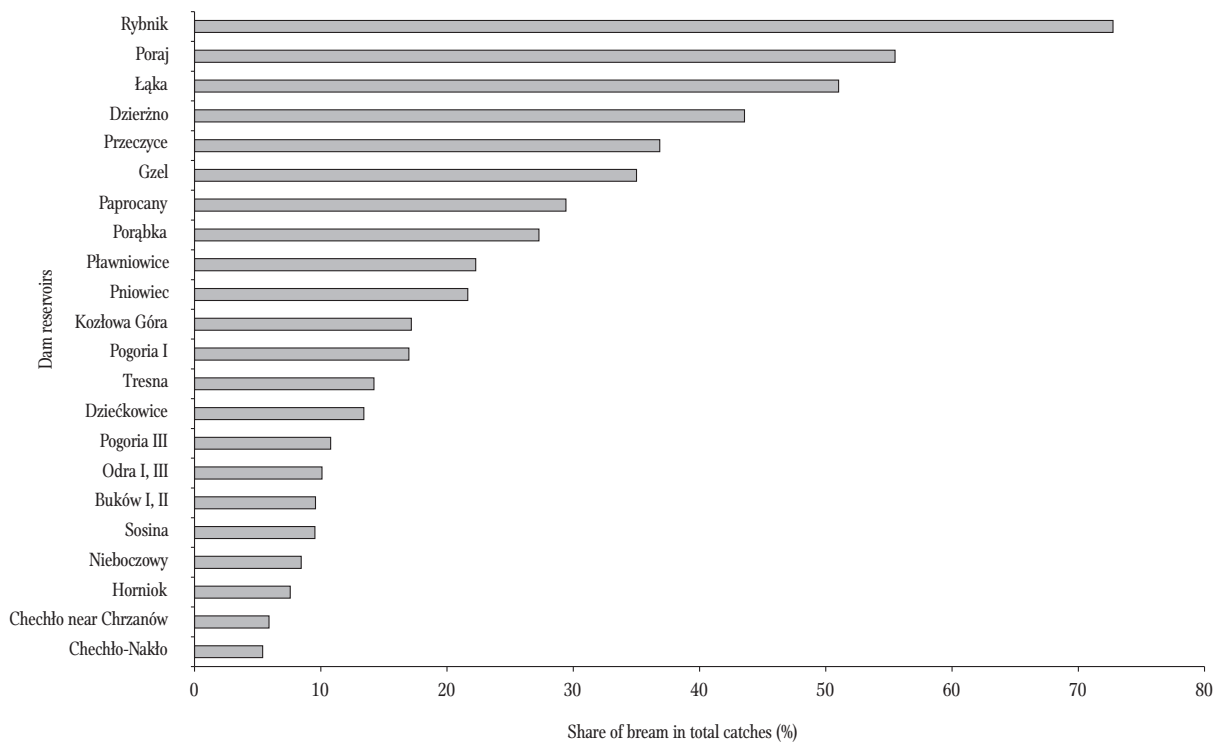


Figure 6. Share of bream in angler catches in studied dam reservoirs in 2005.

indicator species of eutrophication (among others, Leopold et al. 1986). The population status of this species is varied in this group of dam reservoirs, which is manifest in the range of the bream percentage share in the various reservoirs from barely 5-10% in six of them to more than 50% in three, with the maximum share at 72.8% in the angling catches in Rybnik Reservoir. The weight registered for the bream caught fluctuated widely from about 1 kg in two reservoirs located the farthest up the catchment area of the upper Vistula (Tresna and Porąbka) to 0.28-0.36 kg in eight other dam reservoirs.

It is possible to conclude that, thanks to the intense carp stocking of reservoirs (i.e., the Chechło Dam Reservoir near Chrzanów), small cyprinid species such as bream or roach were practically eliminated (and also indirectly from the ichthyofauna), while the catch of predators that control the populations of bream and roach remained at a satisfactory level thanks to stocking as well (this topic will be discussed further). This leads to the conclusion that, thanks to well-managed stocking, even highly eutrophic reservoirs can attain a species structure that is attractive to anglers.

The results of registering angling catches in 22 dam reservoirs indicated that the high angling catch of cyprinids, mainly small bream and roach, that is comparable or even decidedly higher than commercial fishing catches, is becoming an exceptionally advantageous alternative in aquatic ecosystems and angling-fisheries management (in addition to stocking predatory species) for regulating less valuable fish populations. This positive aspect of angling in dam reservoirs was pointed out by Fatchullin (1975b, 1975c) in studies of angling catches in the Saratov and Kuybyshev dam reservoirs on the Volga River. This is also confirmed by studies conducted in the Goczałkowice Dam Reservoir (which provides drinking water to Upper Silesia), in which catches registered by anglers in 2003 indicated that bream comprised as much as a 77.9% share of the catches, while in the same year this species comprised 76.4% of the fish weight caught by commercial fishers (Falkowski 2006). Similar conclusions were reached by Draszkievicz-Mioduszevska and Wołos (2007)

in their analysis of angling catch registers from the PAA department in Toruń.

A distinct correlation was identified in the sample of 22 reservoirs studied currently; namely, that when the share of bream is smaller, the share of carp is higher. This was the case in the Chechło Reservoir near Chrzanów, where the share of bream was just 5.9%, while that of carp was nearly 65%. The cause of this might have been twofold. Firstly, as a flexible species it can exclude, for example, bream, from the same food niche, thus lowering its numbers. Secondly, anglers prefer carp to bream for both sporting and culinary reasons. The shifting of angler fish preferences towards bream was identified earlier by Wrona and Guziur in their questionnaire study of fishers fishing the highly eutrophic Poraj Reservoir (Wrona and Guziur 2000, 2006).

The results presented indicate that the stocking conducted had a significant impact on the species composition of angling catches, and thus an intermediary effect on the ichthyofauna in the studied dam reservoirs. In addition to carp, predatory species are important in stocking management, including primarily pike, and to lesser extent pikeperch, wels, and eel. Evidence of this is the cost of stocking in the Chechło near Chrzanów and Dzieckowice dam reservoirs. Firstly, 15.5% of the stocking budget was spent on pike, while this species contributed 13.7% to the catch in 2005. A significantly larger sum was dedicated to pike stocking in the Dzieckowice Reservoir; 35.2% of the stocking budget was spent on pike, while its share in the registered angling catches was the highest among all 22 of the reservoirs studied at 19.8% of the weight of caught fish. In light of the data presented regarding stocking and catches, the impact of the former on the catch of the basic species stocked is indisputable. The results presented of the analysis of the catch registers in the 2001-2005 period indicate there is a certain tendency that is becoming apparent within two separate species groups, namely cyprinids and predators. Each of these two groups is comprised of three basic species. Cyprinids are represented by carp, bream, and roach, and in the five-year study period it is apparent that the significance of these three species is decreasing. The predatory species of pike,

pikeperch, and perch exhibit a tendency to increase which is due to the increasing percentage share of pike and pikeperch. As a result of these inverse tendencies, the total share of predatory fish in the last of the studied years (2005) was 26.1%, while the percentage of cyprinids in the same year was 64.8%. During the first year of the study (2001), the shares of these were 18.1 and 73.5%, respectively. To reiterate the preceding, it can be put forward that progressing eutrophication and stocking policy are the principle factors that determine the state of the fish populations in dam reservoirs located in the catchment area of the upper Vistula and Warta, and both of these factors have a decisive impact in shaping the species structure of catches made and registered by anglers.

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Streszczenie

Ocena stanu pogłowia ryb w zbiornikach zaporowych usytuowanych w dorzeczu górnej Wisły i Warty, na podstawie rejestrów połowów wędkarskich

Celem opracowania jest ocena ichtiofauny w 22 zbiornikach zaporowych o łącznej powierzchni 5701,9 ha, usytuowanych w dorzeczu górnej Wisły i Warty i użytkowanych przez okręgi Polskiego Związku Wędkarskiego w Bielsku-Białej, Częstochowie i Katowicach. Oceny dokonano w oparciu o analizy rejestrów połowów wędkarskich dokonywanych w latach 2001-2005. Średnia roczna liczba rejestrów w tym okresie wynosiła 35682. W odłowach wędkarskich wystąpiły 22 gatunki ryb, przy czym dominującą frakcją (91,6%) odłowów całkowitych stanowiło 6 gatunków: karp, leszcz, płóc, szczupak, sandacz i okoń. Wykazano, że istnieje znaczne zróżnicowanie struktur gatunkowych odłowów wędkarskich w poszczególnych zbiornikach, przy czym w zdecydowanej większości z nich odłowy były zdominowane przez trzy gatunki karpowate (karp, leszcz i płóc). Najwyższy udział karpia (64,7%) zanotowano w odłowach ze zbiornika Chechło koło Chrzanowa, a leszcza (72,8%) w zbiorniku Rybnik. Z kolei najwyższe udziały gatunków drapieźnych zanotowano w zbiornikach Tresna i Dzieckowice, przy czym w tym pierwszym odsetek sandacza wynosił aż 27,8%, a w drugim

szczupaka 19,8%. W okresie 2001-2005 w całości rozpatrywanych zbiorników zaobserwowano spadek udziału wymienionych trzech gatunków karpowatych z 73,5 do 64,8% oraz wzrost udziału gatunków drapieźnych z 18,1 do 26,1%. Na przykładzie dwóch zbiorników (Chechło koło Chrzanowa i Dzieckowice) przedstawiono rolę gospodarki zarybieniowej w kształtowaniu struktury pogłowia ryb bytującego w tych zbiornikach. Ponieważ leszcz jest jednym z najważniejszych gatunków wskaźnikowych dla procesu eutrofizacji, przedstawiono dane dotyczące udziału procentowego oraz średniej wielkości łwionych osobników tego gatunku w poszczególnych zbiornikach zaporowych. Zdecydowanie największe osobniki leszcza (średnio powyżej 0,8 kg) łwione były w dwóch zbiornikach położonych najwyżej w dorzeczu Wisły (Tresna i Porąbka). Zdecydowanie najmniejsze osobniki (poniżej 0,3 kg) łwiono w zbiornikach Odra I, III, Chechło koło Chrzanowa i Przeczyce. Przedstawione wyniki wskazują, że na stan pogłowia ryb w badanych zbiornikach największy wpływ ma proces eutrofizacji oraz wielkość i struktura gatunkowa zarybień.