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RESEARCH ARTICLE

Assessing angling catches in dam reservoirs on the example of Zegrze Dam Reservoir

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Wiesław Wiśniewolski, Arkadiusz Wołos, Irena Borzęcka

Abstract. Three methods were used to estimate the size and structure of angling catches in Zegrze Dam Reservoir in the 1999-2001 period. The material analyzed comprised data collected from direct monitoring (798 times), 153 questionnaires, and 687 reports. The catch structure according to the questionnaires and direct monitoring was similar. Recreational anglers who completed the questionnaires reported catches of 14 fish species; three of these (bream, *Abramis brama* (L.), roach, *Rutilus rutilus* (L.), and white bream, *Abramis bjoerkna* (L.)), comprised 51.6% of the total catch weight. The share of predatory fish comprising pike, *Esox lucius* L., pikeperch, *Stizostedion lucioperca* (L.), and wels, *Silurus glanis* L., was 31.1% of the total catch weight. The anglers who were monitored directly caught 12 species of fish, and bream dominated the catch weight at 55.0%. The share of predatory species was 33.4%. The anglers using the fishing camps demonstrated the greatest interest in predatory species, which comprised a total of 35.4% of the overall biomass of their catch. The estimated size of the catch according to questionnaires was 42842 kg or 13.0 kg ha^{-1}, while the fishing intensity was 0.20 kg $fisher^{-1}$ $hour.^{-1}$. According to direct monitoring, the size of the annual catch was 33544 kg, which corresponds to an effectiveness of 10.2 kg ha^{-1}. The results indicate that the questionnaire and direct monitoring methods are compatible, and that it is generally necessary to choose uniform study methods. When using the questionnaire method, it is essential to verify the results obtained through direct monitoring at the fishing grounds. The method of catch reporting by the fishers using the fishing camp is only of auxiliary significance.

Keywords: angling catches, fish stock, dam reservoirs

W. Wiśniewolski [✉], I. Borzęcka
Department of River Fisheries
The Stanisław Sakowicz Inland Fisheries Institute in Olsztyn
Główna 48, Żabieniec, 05-500 Piaseczno, Poland;
Tel./Fax: +48 22 7562044,+48 22 7562088;
e-mail: rzeki@infish.com.pl

A. Wołos
Department of Fisheries Bioeconomics
The Stanisław Sakowicz Inland Fisheries Institute in Olsztyn, Poland

Introduction

The primary function of fisheries management is catch exploitation. When traditional river fisheries collapsed (Bauch 1958, Denzer 1966, Wiśniewolski 1987), the catch system changed. In many basins, the primary, and, not infrequently, the only method for catching fish is angling (Schmidt 1975, Wołos 2000). Significant quantities of fish are caught with this method, and the magnitude of these catches is highly variable. According to Bieniarz and Epler (1993), the size of these catches can range from 3.5 to as much as 13.2 kg ha^{-1}. Wiśniewolski et al. (2004) estimated this to range from 12 to 30 kg ha^{-1}, while Nikanorov (1980) estimated a value even as high as 200 kg ha^{-1}. The disparity among these data indicate just how important it is to gather information on the magnitude of angling exploitation, which influences the state of the ichthyofauna (Axford 1979) and is essential for conducting rational fisheries management (Wiśniewolski 2002). Angling catches are commonly estimated by

monitoring anglers directly in the fishing grounds (Bieniarz et al. 1990, Wiśniewolski 2002) and the analysis of logs completed by the anglers (Pinter 1996, Wołos 2000). The results obtained with these methods can differ (Zalewski and Sumorok 1984, Wrona and Guziur 2006), which is why opinions are divided regarding the reliability of them.

The aim of the study was to describe angling catches in Zegrze Reservoir. The results obtained from direct monitoring, questionnaires, and reports were compared.

Materials and methods

Study area

The Zegrze Dam Reservoir was created when the Narew River was dammed about 20 km north of Warsaw. It is a shallow (mean depth approximately 3 m, maximum depth 10 m), lowland dam reservoir with a surface area of 3300 ha. The Mazowiecki Chapter of the Polish Anglers' Association in Warsaw is the fisheries manager of this basin. Anglers exploit this reservoir throughout the year. Ice-fishing is the preferred method in winter, but after the ice melts, small boat and shore fishing methods are applied. Net fishing is also conducted in this basin. Since 1986, the Inland Fisheries Institute in Olsztyn has been conducting scientific research in the reservoir to determine the impact fisheries and angling exploitation have on the ichthyofauna assemblage (Wiśniewolski 2002).

Study methods

Angling catches in the Zegrze Reservoir in the 1999-2001 period were evaluated based on the following: 1) written questionnaires completed by anglers at the end of the fishing seasons; 2) the results of direct monitoring of anglers during fishing; 3) daily reports from angling camps (Table 1). The questionnaire was completed by anglers independently and then turned in when they purchased an angling permit for the subsequent season. They were asked to provide the following information: the number of angling days in subsequent months; average time spent in the fishing grounds; quantity and weight of fish caught according to species; the preferred species; fishing method (from boats, from the shore, ice-fishing). Direct monitoring was performed by recording the total number of anglers (N=1934) fishing in the reservoir, and performing random spot checks of the catches made by individual anglers (N=798). Monitoring was performed 12 times from May to October 2000, and ten times during the winter season from December 1, 2000 to March 15, 2001. Daily catch reports were compiled by employees at the angling camps when anglers returned borrowed boats; the data recorded included the fish species caught, the size of the catch (number of fish and their weight), and the length of time spent fishing. A total of 687 reports were obtained.

Table 1
Sources of data used to evaluate angling catches in Zegrze Reservoir in 1999-2001

	Number of data analyzed in subsequent years			
Data collecting method	1999	2000	2001	Total
Questionnaires	91	62		153
Monitoring catches from spring to autumn				
Registered anglers		1827		1827
Anglers checked		693		693
Ice fishing monitoring				
Registered anglers			107	107
Anglers checked			105	105
Reports from fishing camps		349	338	687

Data analysis

The data were used to determine the angling pressure on the fish assemblages inhabiting the reservoir, size and structure of catches, intensity of catches, fishing effort expended, and catch preferences. The monitoring of anglers conducted in 2000-2001 was divided into working days and holidays. The observations permitted forming an overall picture of the angling exploitation throughout the reservoir. During the spring-autumn season, observations were planned

and performed on 128 working days and 56 holidays, while in winter on 64 working days and 22 holidays. All of the fishing anglers were counted, and spot checks of catches were performed at random. The quantity and weight of the caught fish were recorded by species and the angling method used was noted. The amount of time spent angling was recorded to the nearest full hour up to the monitoring check; for example, if the fishing time was 1, then $0 < t \leq 1$; if it was 2, then $1 < t \leq 2$, etc. Based on these interviews with anglers, the fishing time in winter was an average of five hours daily and eight hours in the spring-autumn season. The frequency of anglers fishing was calculated for working days and holidays, as was the mean catch per unit effort (CPUE – kg angler^{-1} hour^{-1}). The estimated catch effort, referred to as "angler days" is the product of the mean number of anglers (based on observations) and the number of working days and holidays in the fishing season. The mean daily angling catch and the number of angler days was the basis for estimating the total fish catch in the reservoir. The intensity of the catches was calculated based on direct observations and angling questionnaires. The intensity of fish catches was calculated as the quotient between the number of anglers in a month and the sum of all anglers fishing in one year.

A ranking scale was used to determine the sequence of angler species preference. Species ranked first by anglers were awarded 3 points, those ranked second – 2 points, and those ranked third – 1 point. The sum total of all the points for each of the species mentioned by the anglers was used to calculate the "attractiveness" of each of the species (%).

RESULTS

Intensity of fish catches

The intensities of fish catches calculated based on direct observations and angling questionnaires were similar (Fig. 1). The distribution of fishing pressure throughout the year that was determined based on the questionnaires indicated that there was a continual increase in angling frequency from April (5.2% angling days) to July (20.2% angling days). The frequency of angling determined from direct monitoring was of a similar distribution. Angling pressure is the highest from June to August (18.7-17.0% angling

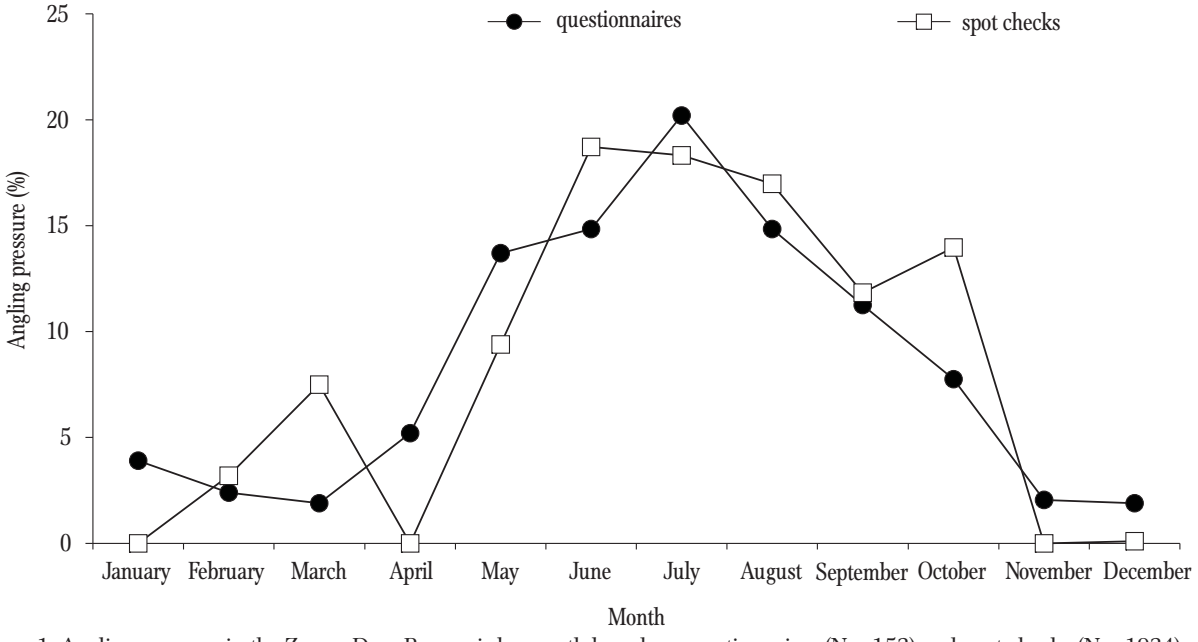

Figure 1. Angling pressure in the Zegrze Dam Reservoir by month based on questionnaires (N = 153) and spot checks (N = 1934).

Table 2
Angler catch composition (in % weight) in Zegrze Reservoir in 1999-2001 based on questionnaires, direct monitoring, reports from fishing camps

Species	Questionnaires	Direct monitoring in spring-autumn	Direct monitoring in winter	Reports from fishing camps
Bream	32.1	55.0	55.2	31.4
White bream	11.6	0.3		0.7
Roach	7.9	0.2	7.4	0.9
Crucian carp	2.3			
Tench	0.6		3.3	
Carp	2.1	0.1		0.3
Perch	10.3	9.8	28.2	25.6
Pike	13.1	12.7		22.6
Pikeperch	10.2	9.9		8.9
Asp	0.4	0.9		3.9
Eel	1.4			
Chub	0.3			
Wels	7.8	10.8		3.9
Ide	0.1			
Ruffe			5.9	
Others		0.4		1.8

days). There is also an increase in angling at the end of February and beginning of March, which is the final period of ice-fishing (Fig. 1).

Data from the questionnaires indicated that 37.8% of the anglers fished from the shore, while only 12.5% fished from boats. However, observations made during monitoring indicated that 64.5% of anglers with permits to fish during the spring-autumn season fished from the shore, while 35.5% fished from boats. All of the active anglers practiced ice-fishing during the winter season. On working days during the spring-autumn season, an average of 134 anglers fished the reservoir, while 223 did so on holidays. In winter an average of 53 anglers fished on working days, while 135 fished on holidays.

Structure of angling fish catches

The anglers who completed the questionnaires noted catching 14 fish species (Table 2). The three most frequently caught species were bream, *Abramis brama* (L.), roach, *Rutilus rutilus* (L.), and white bream, *Abramis bjoerkna* (L.), which combined comprised 51.6% of the total biomass of fish caught. The share of the three basic predatory species of wels, *Silurus glanis* L., pike, *Esox lucius* L., and pikeperch, *Sander lucioperca* (L.) was 31.1% of the biomass of fish caught. The share of other predatory species was 12.4% and included pikeperch, *Perca fluviatilis* L., asp *Aspius aspius* (L.), eel, *Anguilla anguilla* (L.), and European chub, *Leuciscus cephalus* (L.). The share of other cyprinid fish species such as Prussian carp, *Carassius auratus gibelio* (Bloch), tench, *Tinca tinca* (L.), and carp, *Cyprinus carpio* L.) was very low and comprised a total of 5.0% of the biomass of the fish caught (Table 2).

Twelve species of fish were caught by the anglers that were monitored during the May to October period (Table 2). Bream was the dominant by weight, and comprised 55.0% of the catch. The share of roach and white bream combined was just 0.5% of the biomass of the fish caught; however, the share of the basic predatory species such as wels, pike, and

Table 3
Species composition of angling catches (mean ± SD) based on direct monitoring or reports from fishing camps in Zegrze Reservoir in 2000-2001

	direct monitoring – spring-autumn		direct monitoring – winter		reports from fishing camps	
Species	indiv. angler $^{-1}$ hour $^{-1}$	kg. angler^{-1} hour^{-1}	indiv. angler $^{-1}$ hour $^{-1}$	kg. angler^{-1} hour^{-1}	indiv. angler $^{-1}$ hour $^{-1}$	kg. angler^{-1} hour^{-1}
Bream	0.10±0.30	0.07±0.88	0.29±0.63	0.10±0.22	0.27±0.70	0.45±1.35
White bream	0.03±0.15	0.00±0.02			0.00	0.00
Roach	0.01±0.07	0.00±0.01	0.33±1.04	0.01±0.04	0.01±0.13	0.00±0.03
Percj	0.12±0.38	0.02±0.10	0.46±1.35	0.04±0.13	0.47±0.88	0.08±0.14
Pike	0.01±0.08	0.02±0.26			0.06±0.16	0.10±0.42
Pikeperch	0.01±0.04	0.01±0.25			0.03±0.12	0.08±0.42
Wels	0.00±0.02	0.00±0.40			0.01±0.04	0.09±0.68
Chub	0.00	0.00				
Ide	0.00	0.00				
Crucian carp	0.00	0.00				
Ruffe	0.00±0.04	0.00±0.00	0.45±1.01	0.01±0.03		
Asp	0.00	0.00			0.01±0.05	0.02±0.10
Tench			0.01±0.03	0.00±0.03		
Total	0.28	0.12	1.54	0.16	0.86	0.81

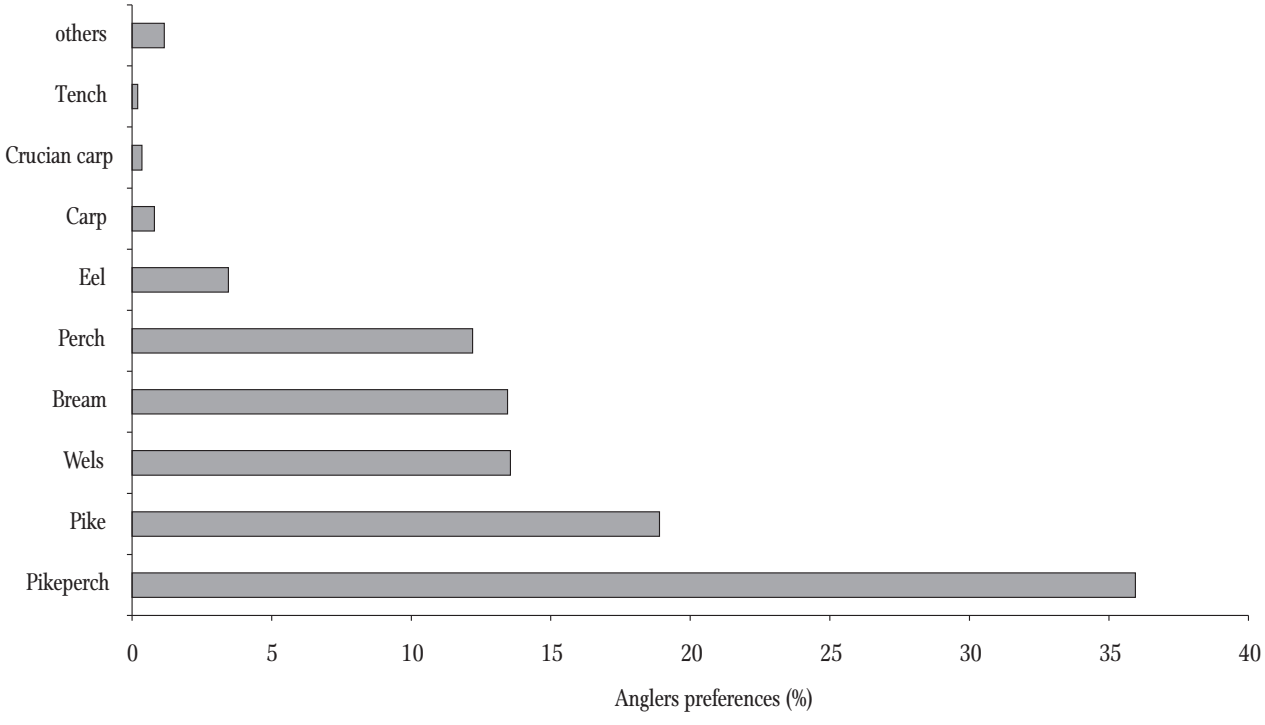

Figure 2. Species preferences of anglers fishing in Zegrze Dam Reservoir in 1999 and 2000 based on questionnaires (rank sums = 100%).

pikeperch was 33.4%. The share of perch was also high at 9.8%, while other species comprised only 1.3% of the overall weight of the fish caught. The anglers who were monitored in the winter period caught five species of fish. The dominants by weight were bream at 55.2% and perch at 28.2%. The share of other species such as ruffe, *Gymnocephalus cernuus* (L.), roach, and tench was 16.6%.

According to reports completed by fishers who rented boats from the fishing camps, 11 species were caught, and bream and perch dominated by weight at 31.4 and 25.6%, respectively. The share of predators (pike, wels, pikeperch) comprised 35.4% of the overall biomass of the fish caught. White bream and roach comprised just 1.6% of the total catch, while other species comprised 6.0% (Table 2).

Preferred species

The data from the questionnaires indicated that the anglers considered 12 species as desirable catch. A share of 94% comprised the five most preferred species. The preferred species were pikeperch (36.0%) and pike (18.9%), followed by wels (13.6%), bream (13.5%), and perch (12.2%). The anglers expressed little interest in carp, Crucian carp, and tench (Fig. 2).

Fishing effort and intensity

The anglers who filled out questionnaires caught a total of 7367.7 kg fish, and the mean catch size per angler was 48.15 kg. Each angler fished an average of 40.4 days per year. According to the declarations in the questionnaires, the daily catch was 1.19 kg, on average, or 0.20 kg hour^{-1} assuming that the fishing day was 6.1 hours.

Random checks of angler catches performed as part of direct monitoring indicated that 1022 fish of a combined weight of 385.2 kg were caught in the spring-autumn period. These anglers caught an average of 0.28 fish weighing 0.12 kg per hour (Table 3), which meant that they caught 0.96 kg fish during an 8-hour angling day. During the winter, spot checks of anglers indicated that they caught 566 fish with a combined weight of 74.7 kg. These anglers caught an average of 1.54 fish weighing 0.16 kg per hour (Table 3), or 0.80 kg fish during a 5-hour angling day. The catch reports from anglers who borrowed boats from the fishing camps indicated that 3932 fish with a combined weight of 3642.5 kg were caught. The average angler caught 0.86 fish weighing 0.81 kg (Table 3). The average daily catch for 8 hours was 6.48 kg.

Direct monitoring from spring until autumn confirmed that on working days an average of 134 anglers fished Zegrze Reservoir daily, while on holidays there was an average of 223. The fishing effort on working days was determined at 17152 angling hours, and on holidays it was 12488. The fishing effort for the entire season was 29640 angling days. At an average daily catch of 0.96 kg fish per angler, the entire spring-autumn season catch was 28454.4 kg fish. During the winter, an average of 53 anglers were registered on working days, while on holidays this figure increased to 135. The fishing effort was estimated on working days to be 3392 angling days, while on holidays it was 2970. The combined fishing effort in the winter season was estimated to be 6362 angling days, while the total angling catches were estimated at 5089.6 kg fish. The estimated size of the annual catch in Zegrze Reservoir based on direct monitoring of angling catches was 33544.0 kg, which corresponds to a yield of 10.2 kg fish per hectare.

Discussion

Angling catches in Zagrze Reservoir were estimated with three methods: questionnaires completed by anglers at the conclusion of the season; direct monitoring through random spot checks of anglers in the fishing grounds; daily reports completed at the fishing camps. These provided important information regarding the size and characteristics of angling exploitation in this basin. While some of the data obtained with these three methods corresponded, there was also significant divergence among them.

While there are differences in monthly fishing pressure figures from the questionnaire and direct monitoring methods, the annual figures and distributions throughout the year are similar. Pressure increases in May, when the closed season for pike ends, and then again July at the height of the vacation season. The significant disparity in fishing pressure noted between these two methods in March and October could have resulted from too few questionnaires in relation to direct monitoring. This does not, however, alter the character of the relationships that were observed. These are confirmed by the results of studies on angling catches in the Rożnów Dam Reservoir (Bieniarz et al. 1990), where no anglers were observed from November to March, and low frequency was noted in April and October. The high frequency of anglers fishing this reservoir in July and August at the height of the angling season determined the size of the annual catch. Variability in angler pressure in subsequent years within the range of 60 to 80 anglers per acre in Clear Lake, Iowa, USA and the intensification of catches in the summer months were also confirmed by Di Costanzo and Ridenhour (1957). The attractiveness of the fishing grounds and access to the waters also influence fluctuations in the variability observed (Skrzypczak et al. 2006).

The results of the species structure of angling catches obtained through direct monitoring and from questionnaires indicate that predatory species are in the leading positions. The concurrence of the monitoring and questionnaire results indicate that anglers commit to memory catches of predatory fish, and this is evidence of the reliability of the questionnaire data. The results of angler preference studies confirm this as the first three positions are held by predatory species (Fig. 2). With more common species such as bream, roach, and white bream, recalling the actual size of the catch might have been difficult when the anglers completed the questionnaires at the end of the fishing season, which explains the differences in the results obtained with these two methods.

The preference for predatory fish is not only typical of the anglers fishing in Zegrze Reservoir. The results of angling catches made in Clear Lake, Iowa, USA also indicate that the share of three species of predatory fish (bullhead, yellow bass, *Morone mississippiensis* Jordan & Eigenmann, yellow perch, *Perca flavescens* (Mitchill)) ranged from 75.1 to 91.9% of the total catch in the 1953-1956 period (Di Costanzo and Ridenhour 1957). In winter angling catches made near the heated water discharge from the Steam Power Plant into the Patuzent River in Maryland, USA, 84% of the catch comprised the predatory species white perch, Morone americana (Gmelin) (Moore and Frisbie 1972). In the first years that the Siemianów Reservoir existed, catches of pike and perch comprised 90% of the overall weight of angling catches. After a decade, the structure of the catches changed diametrically as the share of predatory fish fell to 10%, while more than 80% of the catch weight comprised roach, bream, and Crucian carp (Wiśniewolski 2002). Further, the clear preference among anglers for predatory species is not always reflected in the structures of their catches. The dominant species in angling catches in Poland is often bream, which comprises from 45 to 76% of the biomass of total catches (Wołos 2008).

Very important aspect of evaluating angling exploitation is to estimate total angling catches. Results from direct monitoring indicate that the fishing effort was 29640 angler days in the spring-autumn season and 6362 in the winter season. It was impossible to establish this from the questionnaire data since it is unknown what share of anglers fishing the basin participated in the study. However, the mean annual angling catch per fisher (48.15 kg) is known from the questionnaire data as is the mean number of days fished (40.4), which permitted calculating the mean daily catches (1.19 kg). If 6.1 hours is the mean fishing day, as declared in the questionnaires, then catches can be estimated at 0.20 kg angler^{-1} hour^{-1}. The catch per unit effort from direct monitoring was 0.12 kg angler^{-1} hour^{-1} in the spring to autumn period, and 0.16 kg angler^{-1} hour^{-1}. Daily angler catch was thus 0.96 kg (8 hours x 0.12 kg) and 0.80 kg (5 hours x 0.16 kg). The total annual angling catch in the Zegrze Reservoir was estimated at 33544 kg (29640 angler days x 0.96 kg + 6362 angler days x 0.80 kg) or 10.2 kg ha^{-1}. Returning to the results of

the mean catch according to the anglers who filled out questionnaires, which was 1.19 kg day^{-1}, and using the value for the annual fishing effort of 36002 angler days obtained from the direct monitoring, it is possible to estimate annual fish catches by those who completed questionnaires at 42842 kg or 13.0 kg ha^{-1}. The two methods produced different estimates of catch size; the differences in the values of these were 9298 kg for the total catch and 2.8 kg when recalculated per hectare. The difference between the total catch values obtained from questionnaire data and direct monitoring was of the order of 21%. This is a substantial difference, but the order of the estimated size remains the same for both methods, as does the number of species caught determined with these two methods (14 and 11).

Nikanorov (1980), who conducted observations of angling catches in two dam reservoirs located in the upper Volga River cascades, reported that three to four times more anglers fished in the winter than in the summer season. The greatest increases in angling pressure were noted in winter in March and then in summer in August. The numbers of anglers fluctuated during the years in question from 82700 to 290930. They caught 13 species of fish and the mean daily catch ranged from 0.94 to 1.30 kg angler^{-1} day^{-1}. The total catches from this basin were estimated to range from 43450 kg to 178100 kg throughout the period studied. Using the same estimation method, the total angling catch differed fourfold among the years studied. Doubtless, the variation in the numbers of anglers fishing in subsequent years influenced this. During studies in the Rożnów Reservoir, more than 6000 anglers were monitored directly. The mean daily catch per angler was 1.59 kg fish. Bream dominated the catches, and this species comprised a mean of 88.8% of the biomass of caught fish (Bieniarz et al. 1990). The data presented in Bieniarz et al. (1990) permit estimating the annual fishing effort at 22768 angler days and the total catches at 34152 kg. In the Poraj Dam Reservoir the average angler caught an average of 0.62 kg fish. The mean fishing effort was estimated at 150820 angling days, while the total catch comprising at least 12 species was 95464 kg or 192.0 kg ha^{-1}. The catch structure was dominated by bream (50.8%) and roach (21.9%), while 9.1% were predatory fish (Wrona and Guziur 2006). Thus, high fishing pressure and angler frequency influence the results of the total catches. The examples from the literature that are discussed confirm the results of the evaluation of angling exploitation in Zegrze Reservoir that were obtained through questionnaire and direct monitoring methods. The species structure of the angling catches noted for Zegrze Reservoir determined with the questionnaire, direct monitoring, and fishing camp report methods are very similar with regard to the catch of predatory species at 31.1%, 33.4%, and 35.4%, respectively. The results regarding the particular species of predatory fish caught were also similar as follows: pike – 13.1 and 12.7%; pikeperch – 10.2 and 9.9%; wels – 7.8 and 10.8%. There were differences, however, in the reports from fishing camps. The share of pike was nearly twice as high as the value noted in both the questionnaire and direct monitoring, while the value for wels was over twofold lower. The same trend was noted for perch at 10.3, 9.8, and 25.6%, respectively. The share of bream in the catches that was calculated based on data from questionnaires (32.1%) and reports from fishing camps (31.4%) was nearly the same. However, the share of bream in the catches according to direct monitoring observations was 55.0%. The results regarding catches also differ; the shares of roach and white bream in the total catch calculated based on data from the questionnaires were 7.9 and 11.6%, respectively, while the shares of these species noted during direct monitoring were very low (0.2 and 0.3%, respectively). The share of roach and white bream were also very low (0.9% and 0.7%, respectively) according to the fishing camp reports (Table 2). The anglers using the fishing camps were clearly more interested in catches of predatory fish, than in those of bream, and were uninterested in catches of roach and white bream. The particular interests of the small group of anglers which fishes only from boats indicated that observations of their catches in this reservoir are only of auxiliary importance when evaluating the overall angling catch.

The results obtained with the three methods applied in the current study are presented in tabular form (Table 4). The marking system used follows: + indicates similar results; - indicates opposing results; +/- means indicates ambiguous results. A simple comparison of the results obtained with the questionnaire and direct monitoring methods indicates that they are similar with regard to the following: distribution of fishing pressure, preferences, number of species, catch species structure. Differences do occur in the relation of the share of particular species in the catch weight. The results regarding predatory fish are similar, in contrast to those obtained for the other species. Distinct differences among the three study methods were also noted in estimations of catch per unit effort, total catch, and catch per unit of surface area. It should be underscored that while there were difference in the absolute catch values, they were of a similar order.

Table 4

Comparison of results of angling catch evaluations based on questionnaires and direct monitoring. + indicates similar results; - indicates opposing results; +/- indicates ambiguous results

Evaluation elements compared	Similarity among methods
Annual distribution of fishing pressure	+
Angler preferences	+
Number of species recorded	+
Species structure of catch	+
Relation of shares of species in catch weight	+/-
Catch per unit effort (kg 1 angler^{-1} 1 hour^{-1})	-
Estimated total annual catch	-
Catch per surface area unit (kg 1 ha^{-1})	-

The comparative analysis of methods for evaluating angling pressure indicate that is it essential to choose uniform study methods if the end results are to be reliable. This study proves that questionnaire and direct monitoring methods are, generally speaking, comparable. With questionnaire methods, it is essential to perform periodical verification of the results received. This is achieved by performing spot checks at random among the anglers in the fishing grounds. The method of filling in reports at the camps is of only of auxiliary significance since the group of anglers this applies to is narrow and does not include the whole angling population.

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Streszczenie

Oszacowanie połowów wędkarskich w zbiornikach zaporowych na przykładzie Zbiornika Zegrzyńskiego

W latach 1999-2001 oszacowano trzema metodami wysokość i strukturę odłowów wędkarskich w Zegrzyńskim Zbiorniku Zaporowym. Przeprowadzono 798 bezpośrednich kontroli, zebrano 153 ankiety i 687 raportów. Struktura połowów wyglądała podobnie wg ankiet i bezpośredniej kontroli. Wędkarze wypełniający ankietę deklarowali łowienie 14 gatunków ryb, a trzy z nich: *Abramis brama* (L.), płoć, *Rutilus rutilus* (L.) i krąp, *Abramis bjoerkna* (L.) stanowiły łącznie 51,6% ogólnej masy odłowów. Udział gatunków drapieżnych szczupak, *Esox lucius* L., sandacz, *Stizostedion lucioperca* (L.) i sum, *Silurus glanis* L wyniósł 31,1% masy. Wędkarze bezpośrednio kontrolowani łowili 12 gatunków ryb, a w masie odłowów dominował leszcz (55,0%). Udział podstawowych gatunków drapieżnych wyniósł 33,4%. Największe zainteresowanie gatunkami drapieżnymi wykazywali wędkarze korzystający z baz wędkarskich, w których połowach udział drapieżników wyniósł łącznie 35,4% ogólnej biomasy ryb. Oszacowana wielkość odłowu według ankiet wyniosła 42842 kg, tj. 13,0 kg ha^{-1}, a intensywność połowu kształtowała się na poziomie 0,20 kg $wędkarz^{-1}$ $godz.^{-1}$. Według bezpośredniej kontroli roczna wielkość odłowów wyniosła 33544 kg, co odpowiada wydajności 10,2 kg ha^{-1}. Wyniki wskazują na równoważność metod ankietowej i kontroli bezpośrednich oraz na potrzebę wyboru jednorodnej metody badawczej. W przypadku badań ankietowych niezbędna jest okresowa weryfikacja uzyskiwanych wyników dokonywana metodą bezpośredniej kontroli na łowisku. Metoda raportowania odłowu wędkarzy z baz wędkarskich posiada natomiast wyłącznie wartość pomocniczą.