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Short communication

THE ICHTHYOFAUNA OF THE GOCZAŁKOWICE DAM RESERVOIR IN SOUTHERN POLAND IN THE 1986-2001 PERIOD

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ABSTRACT. The aim of this study was to describe the ichthyofauna composition of the Goczałkowice Dam Reservoir based on records in fisheries logs of commercial catches conducted in this basin over a 16-year period (1986-2001). The results indicate that the Goczałkowice Reservoir was managed appropriately during this period. The dominant species in the reservoir was bream at 49.74% of the overall biomass of all the fish caught. The second most common fish was a mix of small fish (31.62%). Evidence of the rational management of this basin is that 17% of the ichthyofauna are predacious fish, with pikeperch comprising 56% of all the predacious fish caught.

Key words: ICHTHYOFAUNA, DAM RESERVOIR, GOCZAŁKOWICE RESERVOIR

Studies of the characteristics of the ichthyofauna of Polish dam reservoirs were initiated as soon as the reservoirs were put into operation after 1945 (Backiel et al. 1956, Kaczyński 1974, Wiśniewolski 1994, Wiśniewolski et al. 2001). Located in the valley of the Upper Vistula, the Goczałkowice Dam Reservoir was created in the 1950-1955 period when the river was dammed at kilometer 67. The reservoir was created to meet municipal and industrial water needs as well as to provide important storage capabilities (Krzyżanek and Kownacki 1987, Starmach and Jelonek 1996). Maintaining the necessary water purity level for municipal requirements (Starmach 1994) is impossible without proper fisheries management (Erdmański 1996). In recent decades, fisheries and angling managers together have come to the conclusion that determining limits for angling catches is a key element in the exploitation management of dam reservoirs (Bieniarz et al. 1990a, b, Bieniarz and Epler 1993, Wołos and Grzegorczyk 1999, Augustyn 2000, 2001, Wołos et al. 2000).

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The aim of the current study was to characterize the ichthyofauna of a dam reservoir in which fisheries have been appropriately and systematically managed for many years (Riss 1986, Starmach 1994).

The Goczałkowice Dam Reservoir is one of the largest such basins in southern Poland. The dam is 2980 m in length and 16 m in height. The shape of the basin is elongated along an east-west axis, and its maximum length, including the backwater, is as much as 20 km, while the width does not exceed 6 km. The shoreline is poorly developed and is from 30 to 45 km in length depending on the water level (Falkowski and Wołos 1998). At an exploitation level of 255.2 m above sea level, the surface area of the reservoir is 2990 ha, and the volume is 120.2 million m^3. The long-term water level variation ranges from 0.9 to 3 m, while the surface area of emerged terrain ranges from 300 to 1300 ha. Water exchange occurs every 90 to 180 days (Krzyżanek and Kownacki 1987). According to various estimations, the average depth of the basin ranges from approximately 2 m (Falkowski and Wołos 1998) to 5.3 m (Krzyżanek and Kownacki 1987). Shallow areas were the depth does not exceed 1.5 m have a surface area of approximately 800 ha. Water is drained from the reservoir only through lower sluices or spillways when water levels are high. The average velocity of the reservoir outflow is 10 $m^3 s^{-1}$ and does not exceed 20 $m^3 s^{-1}$. One of the shortcomings of the dam is that there are no fish ladders. The dam effectively blocks the ecological flow of the Vistula River and renders impossible the restoration of diadromous fish populations to the upper Vistula drainage basin (Wiśniewolski 2003). The water in the reservoir comes from the Vistula River (80%), drainage canals (10%), Bajerka Stream (4%), and atmospheric precipitation. Starmach and Jelonek (1996) classified the reservoir primarily as class II purity, and it does not pose a serious sanitary threat.

The source material for the study was comprised of data from fisheries logs from 1986 to 2001 and annual management reports for the Goczałkowice Reservoir from the 1986-1987, 1991-1995, 1996-1998 periods. These were made available by the Upper Silesia Water Supply System – Fish Hatchery in Łąka (Poland). The data used came from the "Register of Fish Caught" section of the management logs and the section regarding catches from the annual fisheries reports. Since the data used to characterize the ichthyofauna referred to commercial catches, only the weight of the fish was used. Riss (1986) reported that the surface area of the reservoir exploited for fisheries was 2400 ha, and this figure was used to calculate fisheries efficiency.

The Goczałkowice Reservoir was classified as moderately warm with an average annual temperature of 10.2°C, with thermal stratification occurring only in winter (Mastyński and Wajdowicz 1991). The moderate depths of the reservoir had a beneficial impact on the oxygen conditions and facilitated the accelerated exchange of mineral compounds between the water and the bottom sediments (Falkowski and Wołos 1998). Nineteen fish species from five families were noted in the catches made in the 1986-2001 period: European eel, *Anguilla anguilla* (L.), pike, *Esox lucius* L., pikeperch, *Sander lucioperca* (L.), perch, *Perca fluviatilis* L., wels catfish, *Silurus glanis* L., bream, *Aramis brama* (L.), tench, *Tinca tinca* (L.), carp, *Cyprinus carpio* L., roach, *Rutilus rutilus* (L.), ide, *Leuciscus idus* (L.), rudd, *Scardinius erythrophthalmus* (L.), grass carp, *Ctenopharyngodon idella* (Val.), Crucian carp, *Carassius carrasius* (L.), white bream, *Blicca bjoerkna* (L.), bighead carp, *Aristichthys nobilis* (Rich.), European chub, *Leuciscus cephalus* (L.), belica, *Leucaspius delineatus* (Heck.), bleak, *Alburnus alburnus* (L.), ruffe, *Gymnocephalus cernua* (L.).

The commercial catch data from the 1986-2001 period (Table 1) indicated that bream was clearly the dominant species comprising as much as 49.74% of the weight of all fish caught. The second position was held by the so-called small fish mix (white bream, European chub, bleak, ruffe, belica, ide), which comprised 31.62% of the fish caught and corresponds to observations made in other dam reservoirs (Mastyński 1986, Falkowski and Wiśniewolski 2003). The Goczałkowice Reservoir differs from others in that that share of pikeperch in the fish caught was 12.56% and that of eel was 3% (Table 1). The share of pike was relatively high (1.25%) as was that of perch (0.91%). The share of the remaining species ranged from 0.4% (Crucian carp) to 0.01% (roach, rudd, tench) (Table 1). In total the share of predatory species in the ichthyofauna of the Goczałkowice Reservoir was high at 17.77%. This is a rare phenomenon and only serves to emphasize the effects of well-managed fisheries. In the past sixteen years, a total of 668886 kg of fish have been caught in the 2400 ha of the Goczałkowice Reservoir that is exploited; the average fisheries efficiency is 17.42 kg ha^{-1}. The average annual catch for this period was 41805 kg of fish at various efficiencies for various fish species (in kg ha^{-1}: eel 0.52; pikeperch 2.19; pike 0.22; wels catfish 0.001; perch 0.16; bream 8.66; roach/rudd 0.21).

TABLE 1

Fish biomass (kg) from the Goczałkowice Dam Reservoir (2990 ha) in the 1986-2001 period

Years	Eel	Pikeperch	Pike	Wels catfish	Perch	Bream	Roach +rudd	Crucian carp	Carp	Tench	Silver carp	Grass carp	Other small fish	Total
1986	1844	8104.5	625	0	753	21181	756	34	307	-	-	32	4424	38069.5
1987	1611	5600.5	103	0	411.5	28599	922	19	177.5	6.5	-	36.5	7226	44712.5
1988	2171	7231	931.5	0	857	23948	706	30	67	15.5	20	48	25116	61141
1989	2328.5	4720	645	0	548.5	35402	414	0	209	13	3	181.5	20574	65038.5
1990	1563.8	5514	466.5	0	813.4	45562	995	7	98	26	-	28	15823	70896.7
1991	1444.5	5511.5	308	0	179.5	43646	347	5	55	0	24	13	0	51533.5
1992	2043.5	5600.5	460	0	44	29182	176	13	17	1	8	8	6435	43988
1993	2860.5	5570.3	489.7	11	94	13523	1164	9.5	7	0	360	26	15833	39948
1994	1760.7	7096	692.7	0	66	15530	185	13	12	0.3	6	10	19500	44871.7
1995	774.5	4515	726.4	2	99	10853	89	0	0	0	50	27	10608	27743.9
1996	379	4675	1001.5	25	141	7124	166	254	8.5	11.5	10	56	22459	36310.5
1997	548	4301	954.4	34	463	8659	99	176	15	5.5	50	10	12629	27943.9
1998	180	2194	242	29.1	206	8540	541	81	159.5	0	341	73.5	17061	29648.1
1999	162.8	3598	438.8	146.9	377	12906	1100	440	1	0	81	12	9149	28412.5
2000	127.4	3499.5	215.7	103.8	479	15776	366	1106.5	75	1	29	22	11308	33108.9
2001	236.8	6257	82.5	8	571.5	12300	174	468	188.5	0	35	9	5188	25518.3
Total	20036	83987.8	8382.7	359.8	6103.4	332731	8209	2656	1397	80.3	1017	592.5	203333	668886
Percentage share	3.00	12.56	1.25	0.05	0.91	49.74	0.01	0.40	0.21	0.01	0.15	0.09	31.62	100

Fisheries management in water system supply reservoirs is difficult. Biomanipulation must be performed in a way which ensures that the active exploitation of the fish stocks, the selective protection of brood stocks, and the appropriate stocking structure impact the ichthyofauna composition in a way that improves the sanitary conditions of reservoir waters (Wajdowicz 1986, 1988). During the 16-year period analyzed, a fisheries efficiency of 17.42 kg ha^{-1} was calculated from the average annual catch of 41.8 tons and the exploited area of 2400 ha; this is higher than the average efficiency of 16.27 kg ha^{-1} from eight dam reservoirs selected by Mastyński (1986). Efficiency in the Goczałkowice Reservoir in the following four-year periods was: 1986-1989 – 21.69 kg ha^{-1}; 1990-1993 – 21.48 kg ha^{-1}; 1994-1997 – 14.25 kg ha^{-1}; 1998-2001 – 12.11 kg ha^{-1}. These figures clearly indicate a downward trend that was probably caused by the substantial decline in populations of non-predatory species, mainly of bream, which is fished without a legal size limit. Decreasing fisheries exploitation following overfishing has meant that the bream stock has a high condition coefficient. In accordance with biomanipulation theory, pike and pikeperch populations receive primary support in the Goczałkowice Reservoir and are stocked with material from artificial spawning. This produced clearly evident effects – 18% of all the fish caught were predacious. This figure is approaching the predator-non-predator ratio of 25:75% proposed by Mastyński and Wajdowicz (1991). Starmach (1994) also suggested that predators comprise 30% of the reservoir population. The analyses indicated that the management of the Goczałkowice Reservoir fisheries had a positive impact on the aquatic environment and the composition of its ichthyofauna. The results of the biomanipulation methods applied were positive and should be continued. Annual catches stabilized at 30 tons thanks to the bream population, which had a high condition coefficient, and the population of predatory fish of approximately 18%, which exhibited a growing trend. All of the effects achieved indicate that the fisheries of this reservoir are being managed appropriately and in accordance with the principles that should guide management in dam reservoirs.

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STRESZCZENIE

ICHTIOFAUNA ZBIORNIKA ZAPOROWEGO GOCZAŁKOWICE, POŁUDNIOWA POLSKA, W LATACH 1986-2001

Celem pracy było określenie składu ichtiofauny zbiornika zaporowego Goczałkowice, na podstawie wyników odłowów prowadzonych w przeciągu 16 lat (1986-2001), odnotowywanych w księgach gospodarczych. Dominującą pozycję w ichtiofaunie zbiornika zajmował leszcz, stanowiąc 49,74 % ogólnej biomasy wszystkich złowionych ryb (tab. 1). Drugą pozycję stanowiła drobnica (31,62%). Dowodem racjonalnie prowadzonej gospodarki rybackiej jest niemal 18% udział gatunków drapieżnych w ichtiofaunie zbiornika. Sandacz stanowił 12,5% biomasy wszystkich odłowionych ryb, węgorz 3%, szczupak 1,25% i okoń 0,91%. Średnia roczna wydajność zbiornika Goczałkowice w badanym okresie wynosiła 17,42 kg ha^{-1} i wykazywała tendencję spadkową. Wyniki przeprowadzonej analizy gospodarki rybackiej wskazują, że zarządzanie zbiornikiem na przestrzeni badanego okresu było prawidłowe.