Acta Hydrobiol., 42 (2000), 3/4, 231–240. Cracow, December 2000

Description and projected changes in the ichthyofauna of the River Skawa in the area of the future dam reservoir at Świnna Poręba (southern Poland)*

Krzysztof KUKUŁA

Hugo Kołłątaj Agricultural University, Department of Economics,
ul. Ćwiklińskiej 2, 35-601 Rzeszów, Poland
(e-mail: kkukula@ar.rzeszow.pl)

(Received 20 January 2000, Accepted 31 October 2000)

Abstract – In the area of the greatest effects of the future dam reservoir at Świnna Poręba the most numerous species in the ichthyofauna of the River Skawa and its affluents were *Leuciscus cephalus* (L.), *Phoxinus phoxinus* (L.), *Barbus petenyi* Heckel, and *Barbatula barbatula* (L.). A distinct decrease in the numbers of *Chondrostoma nasus* (L.) and *Barbus barbus* (L.) was recorded. After a long-term formation the composition of the ichthyofauna will approximate to that found in other dam reservoirs in the Carpathian tributaries of the Vistula.

Key words: fish community, dam reservoir, submontane river.

1. Introduction

The ichthyofauna of the River Skawa was investigated in the 1950s (W. Kołder unpubl.) then in the 1970s and 1980s (Bieniarz and Epler 1972, Włodek 1975, Skóra and Włodek 1989, 1991). During the period of those investigations distinct changes appeared in the composition of the ichthyofauna in the Skawa catchment basin (Skóra and Włodek 1991). The currently constructed Świnna Poręba dam reservoir will induce further transformations of the ichthyofauna both below and above the dam. The changes may manifest characters similar to those recorded in other rivers (Skóra and Włodek 1988, Penczak et al. 1993, Lusk 1995*a*).

The aim of the present work was to evaluate the current condition of the ichthyofauna in the River Skawa and its tributaries in the zone of the strongest impact of the future Świnna Poręba Reservoir.

* The investigation was carried out within the project "The system of minimisation of environmental changes induced by the construction of the Świnna Poręba dam reservoir" (No. 10.76/C.S4-7/94).

2. Study area, material and methods

The River Skawa is a Carpathian tributary of the Vistula. It is 96 km in length with a catchment basin of about 1160 km^2, about 94% of the basin lying in a mountainous region (Punzet 1976). The investigation covered the River Skawa within the reach from the town of Zembrzyce (19°35'E, 49°45'N; about 310 m a.s.l.) to Graboszyce (19°27'E, 49°57'N; about 230 m a.s.l.), and the largest tributaries of the Skawa in their mouth sections. Material was collected at 10 stations (Fig. 1, Table I) on 14–15 October 1995 (Stations 1, 4–6) and on 27–28 August 1997 (Stations 1–4 and 7–10). The stations were 200 m and in the tributaries 150 m in length. An impulse generator (350 V; 3.5 A; 20–100 Hz) was applied in electrofishing, using the single catch method. The caught fish were measured, weighed, and then returned to the river. In the period 10–25 August 1997 polling data were collected from anglers fishing in former gravel pits lying in the area of the future reservoir.

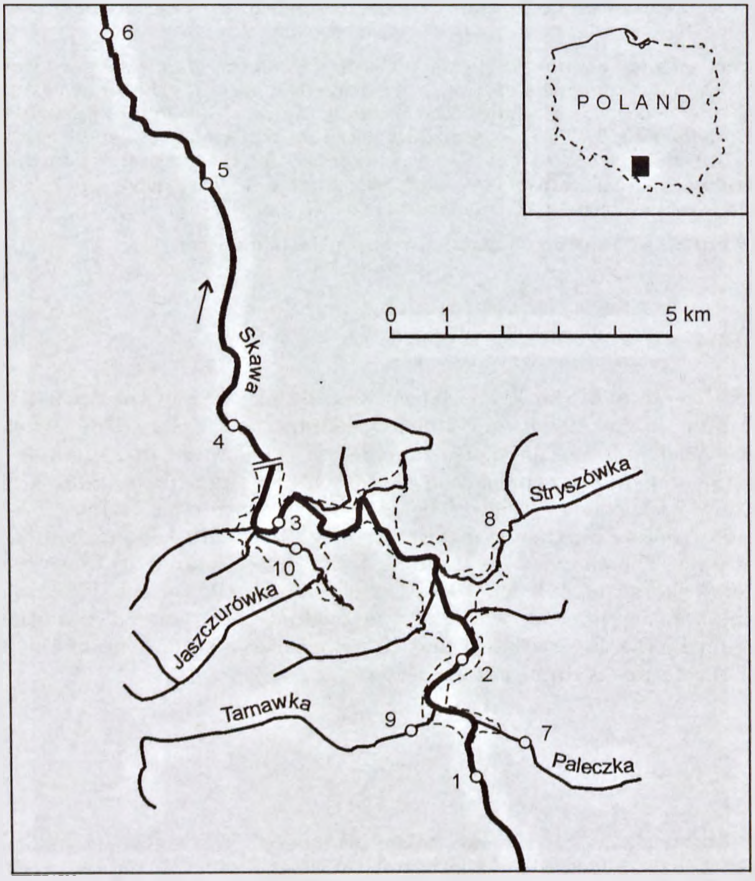

Fig. 1. Location of the sampling stations (1–10) on the River Skawa and its tributaries.

Table I. Characteristics of investigated sites on the River Skawa and its tributaries.

No. of Station	River/Locality	Width (m)	Depth (m)		Bottom substrate
			Mean	Max.	
1	Skawa/Zembrzyce	9–15	0.3	0.6	large stones, stones, gravel
2	Skawa/Skawce	8–25	0.4	1.0	large stones, rocks, gravel
3	Skawa/Mucharz	12–20	0.3	0.7	large stones, rocks
4	Skawa/Jaroszowice	10–20	0.3	0.8	stones, gravel
5	Skawa/Witanowice	10–30	0.3	1.0	stones, large stones, gravel
6	Skawa/Graboszyce	10–40	0.3	1.2	stones, large stones, gravel, sand
7	Paleczka/Zembrzyce	2–10	0.2	0.6	large stones, gravel
8	Stryszówka/Stryszów	2–5	0.2	0.5	stones, gravel
9	Tarnawka/Tarnawa Dolna	2–4	0.2	0.4	large stones, stones
10	Jaszczurówka/Mucharz	2–5	0.3	0.8	gravel, stones, sand, mud

3. Results

The total number of 3718 fish with the weight of 197.5 kg was caught. They belonged to 16 species representing 6 families (Table II). In the collected material chub, *Leuciscus cephalus* was most numerous, constituting 27.38% of the total number of fish caught and 34.02% of the biomass. A more than 10% participation in the number of caught fish was determined in the case of minnow, *Phoxinus phoxinus*, spotted barbel, *Barbus petenyi*, and stone loach, *Barbatula barbatula*. With respect to biomass the nase, *Chondrostoma nasus* and spotted barbel had a considerable share (Table II).

In the entire investigated reach of the Skawa chub, spotted barbel, common barbel, *Barbus barbus*, stone loach, and gudgeon, *Gobio gobio* were found in all the collected samples (Figs 2, 3). In the middle course of the Skawa from Zembrzyce to Jaroszowice (Stations 1–4) the most numerous species was chub (from 14% at Station 1 in 1995 to 43.4% at Station 4 in 1995). Another numerous species was spotted barbel (from 10.9% at Station 4 in 1995 to 32.9% at the same station in 1997). At Station 1, lying in the highest river course, stone loach and nase periodically occurred in very great numbers (48% in 1995 and 27% in 1997, respectively). In the middle course of the Skawa chub, spotted barbel, nase, and common barbel prevailed with respect to biomass. At Stations 1 and 4 two catches were conducted. At both stations much more abundant catches were recorded in 1997. At Station 1 the differences were particularly striking in 1997, since of 14 fish species recorded seven had not been noted in the first catch. An exceptionally high participation of nase was also observed (Figs 2 and 3).

In the lower reach of the Skawa chub dominated with a great participation of bleak, *Alburnus alburnus*, and roach, *Rutilus rutilus*. In respect of biomass a large share of nase was also determined at Station 5 (about 29%). Barbel was most numerous at Station 4 in 1997, constituting 13.48% of all the fish and 25.32% of the biomass. Nase which was not recorded at Station 1 in the catches of 1995, became the dominant species in the following season (27% of numbers and 69% of the biomass of fish caught). Brown trout was not numerous in the Skawa, being encountered slightly more frequently in the section from Station 3 to Station 4 (to 5% of total number at Station 4 in 1995). Grayling, *Thymallus thymallus* was very rarely encountered. It constituted only 0.16% of the caught fish (Table II).

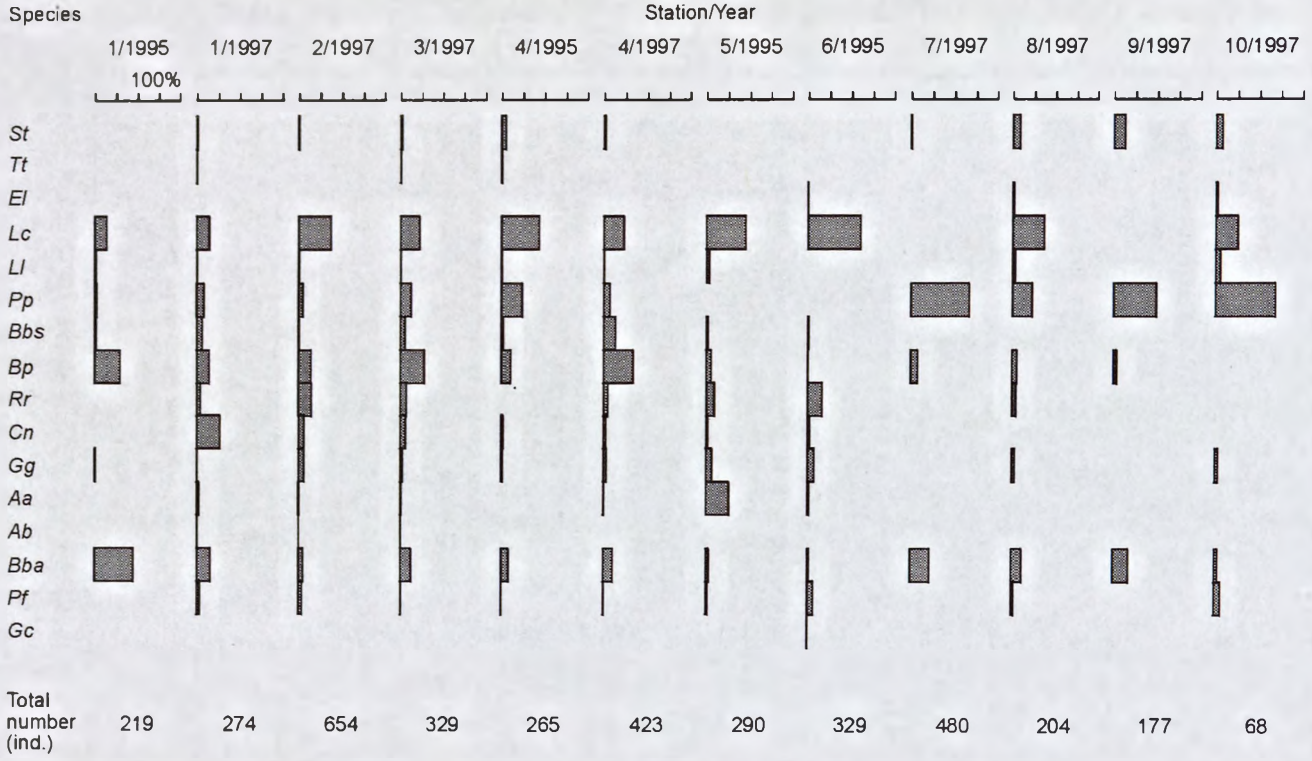

Fig. 2. Relative abundance (%) of particular fish species in the River Skawa drainage basin: *Aa* – *Alburnus alburnus* (L.), *Ab* – *Alburnoides bipunctatus* (Bloch), *Bba* – *Barbatula barbatula* (L.), *Bbs* – *Barbus barbus* (L.), *Bp* – *B. petenyi* Heckel, *Cn* – *Chondrostoma nasus* (L.), *El* – *Esox lucius* L., *Gc* – *Gymnocephalus cernuus* (L.), *Gg* – *Gobio gobio* (L.), *Lc* – *Leuciscus cephalus* (L.), *Ll* – *L. leuciscus* (L.), *Pf* – *Perca fluviatilis* L., *Pp* – *Phoxinus phoxinus* (L.), *Rr* – *Rutilus rutilus* (L.), *St* – *Salmo trutta* m. *fario* L., *Tt* – *Thymallus thymallus* (L.).

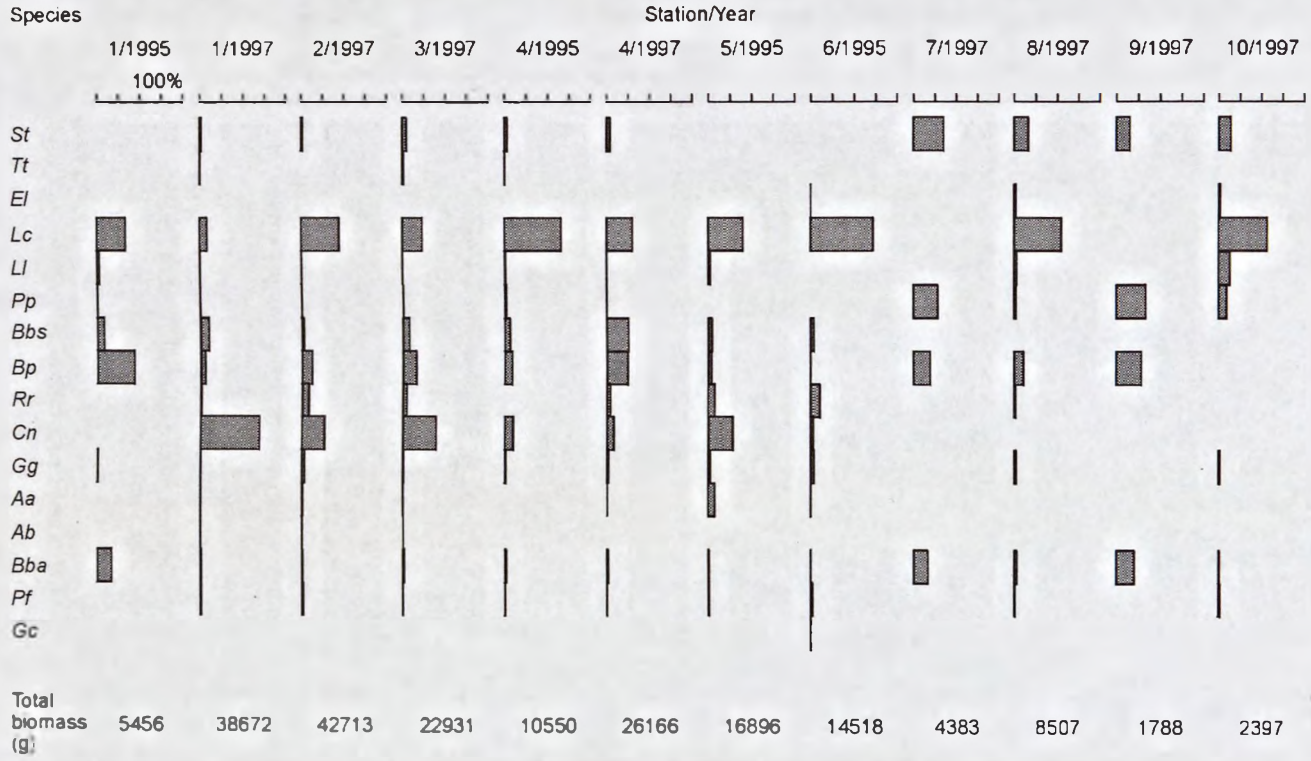

Fig. 3. Relative biomass (%) of particular fish species in the River Skawa drainage basin: *Aa* – *Alburnus alburnus* (L.), *Ab* – *Alburnoides bipunctatus* (Bloch), *Bba* – *Barbatula barbatula* (L.), *Bbs* – *Barbus barbus* (L.), *Bp* – *B. petenyi* Heckel, *Cn* – *Chondrostoma nasus* (L.), *El* – *Esox lucius* L., *Gc* – *Gymnocephalus cernuus* (L.), *Gg* – *Gobio gobio* (L.), *Lc* – *Leuciscus cephalus* (L.), *Ll* – *L. leuciscus* (L.), *Pf* – *Perca fluviatilis* L., *Pp* – *Phoxinus phoxinus* (L.), *Rr* – *Rutilus rutilus* (L.), *St* – *Salmo trutta* m. *fario* L., *Tt* – *Thymallus thymallus* (L.).

Table II Results of electrofishing in the River Skawa drainage basin

Species	Number		Biomass	
	ind.	%	g	%
Salmonidae				
Salmo trutta m. *fario* L.	92	2.47	7797	3.95
Thymallidae				
Thymallus thymallus (L.)	6	0.16	483	0.24
Esocidae				
Esox lucius L.	5	0.13	286	0.14
Cyprinidae				
Leuciscus cephalus (L.)	1018	27.38	67187	34.02
– *leuciscus* (L.)	36	0.97	2054	1.04
Phoxinus phoxinus (L.)	710	19.10	3057	1.55
Barbus barbus (L.)	116	3.12	15381	7.79
– *petenyi* Heckel	539	14.50	23278	11.79
Rutilus rutilus (L.)	244	6.56	8908	4.51
Chondrostoma nasus (L.)	174	4.68	57374	29.05
Gobio gobio (L.)	126	3.39	3440	1.74
Alburnus alburnus (L.)	96	2.58	1797	0.91
Alburnoides bipunctatus (Bloch)	4	0.11	95	0.05
Balitoridae				
Barbatula barbatula (L.)	475	12.78	4339	2.20
Percidae				
Perca fluviatilis L.	76	2.04	2009	1.02
Gymnocephalus cernuus (L.)	1	0.03	35	0.02
Total	3718	100	197522	100

In the investigated tributaries of the Skawa the composition of ichthyofauna was similar in the streams Paleczka (Station 7) and Tarnawka (Station 9). With respect to numbers, minnow and stone loach prevailed here while brown trout had a pronounced share in the total biomass. The ichthyofauna community of the Stryszówka Stream (Station 8) was composed of 10 species, with chub as the dominant. Minnow was fairly numerous while brown trout constituted an important part of the biomass. Station 10 differed distinctly from the above stations, the smallest number of fish having been caught there.

The data collected on the basis of information obtained from anglers permit an approximate evaluation of the fish stock in water bodies formed in post-gravel pits in the region of Stations 2 and 3. The species most numerously represented here were roach, crucian carp, *Carassius carassius* (L.), chub, perch, gudgeon, bleak, pike, tench, *Tinca tinca* (L.), and common carp, *Cyprinus carpio* L. Moreover, some anglers reported sporadic catches of grass carp, *Ctedopharyngodon idella* (Val.) and bream, *Abramis brama* (L.). In water bodies periodically or permanently connected with the River Skawa or its tributaries abundant occurrence of chub was observed.

4. Discussion

In relation to earlier data (Skóra and Włodek 1991), in the middle course of the Skawa (Stations 1–4) the greatest reduction in number concerned minnow, barbel, and nase while the numbers of chub and stone loach increased. Brown trout still had a small participation in the ichthyofauna of this part of the Skawa. At Stations 5 and 6 the composition of ichthyofauna also differed from that recorded in previous years. The characteristic trait was the distinct dominance of chub with a great share first of bleak (Station 5) and then of roach (Station 6). In this zone a decrease in number of nase and barbel in comparison with the earlier data (Bieniarz and Epler 1972, Skóra and Włodek 1991, Kołder unpubl.) was the most distinct.

The investigation conducted at Stations 1 and 4 in 1995 and repeated in 1997 showed significant quantitative and qualitative differences in the ichthyofauna of the Skawa. In the first year of the investigation the composition of the fish community was to a great degree affected by the very low water level in several previous years. This was associated with a low content of dissolved oxygen and a high level of pollution, causing a small participation of salmonids, nase, and barbel in the middle course of the river. The reduced number of the species mentioned above was accompanied by a pronounced increase in the number of stone loach and spotted barbel. The higher water level in 1996 and the flood of 1997 might have brought about a shift in the distribution range of some fish species. From Sucha Beskidzka to the village Mucharz greater number of nase, roach, and perch occurred, while the share of brown trout also increased. In 1997 the flood brought about a pronounced decrease in the density of benthic invertebrates, particularly in the lower river course (to 8 times), smaller changes being noted in the middle course (the density of benthos reduced by half) (Szczęsny 1998). It may be that the better conditions of feeding in the upper course of the river induced the migration of fish.

In the analysed material brown trout occurred more frequently than was reported by Skóra and Włodek (1991), although most individuals caught here were small, owing to poaching, as in many other Carpathian tributaries of the Vistula (Skóra and Włodek 1988, 1989, Skóra et al. 1994). In spite of a temporary increase in the numbers of nase and barbel in 1997, these species manifest a declining tendency in the catchment basin of the Skawa. This process is observed in numerous other basins, chiefly owing to hydraulic constructions on rivers and to water pollution (Peňáz and Jurajda 1993, Lusk 1995*a*, 1995*b*, 1996, Marszał and Przybylski 1996). The water quality of the River Skawa and its tributaries is poor, of quality class III (Gałaś 1998), and further deteriorates below the town of Wadowice (Szczęsny 1998). That is why the species formerly numerous in the middle and lower course of the river (Skóra and Włodek 1991) disappear. The construction of the Świnna Poręba impoundment will intensify this tendency.

The formation of fishery resources of the future reservoir at Świnna Poręba will be affected to the greatest degree by the ichthyofauna of the Skawa and of the numerous water bodies in post-gravel pits in the river valley. In the Świnna Poręba Reservoir the process of ichthyofauna succession will be similar to that observed in other dam reservoirs constructed on the Carpathian tributaries of the Vistula (Wajdowicz 1979, Jelonek and Starmach 1988). In the first phase rheophilous species, above all chub, nase and barbel, will dominate in the reservoir. The flooded meadows and fields will ensure good feeding conditions for riverine and lacustrine species, bringing about an increase in the numbers of roach and perch. This is

highly probable since the two species are fairly numerous in the Skawa and some of its tributaries. The abundance of fry of roach, perch, and bleak will ensure good feeding conditions for pike. Single specimens of pike were recorded in Stryszówka and Jaszczurówka while still greater number was found in post-gravel ponds in the region of Skawce and Mucharz. Hence this predator will occur in great numbers during the first years after filling of the reservoir. A situation of this kind was observed in almost all the dam reservoirs in Poland (Mastyński 1985). In the second phase of ichthyofauna succession the number of rheophilic fish will fall although their participation, particularly of nase and chub, may still be great. In the general balance roach, perch, bleak, and pike will also play an important role. In connection with a great number of crucian carp, common carp, and tench in post-gravel ponds their share can be significant for a short time, even if no further stocking with these species is conducted. However, it is highly probable that in a longer span of time the situation will be analogous to that previously recorded in the investigations on other Carpathian dam reservoirs. In commercial (Mastyński 1985) and anglers' catches (Bieniarz and Epler 1993, Bieniarz et al. 1990*a*, 1990*b*) the share of carp and above all of tench and crucian carp was small in these water bodies. The obtained data suggest that the participation of bream may at first be small. This species did not occur in electrofishing in the Skawa, being only sporadically noted in angling catches in post-gravel ponds. Nase may take its role, since in some dam reservoirs its dominance was observed in the case of absence of bream (Mastyński 1985). At each stage of the ichthyofauna formation the quality of water flowing into the reservoir will play a highly significant role. Currently, waters of the Skawa and its tributaries are eutrophic (Gałaś 1998).

The shape of the bottom and the frequent variation of water level (Gałaś 1998) will not offer good reproduction conditions for most fish species in the reservoir, necessitating constant stocking. The ichthyofauna succession will occur under the impact of the introduced species. The character of the reservoir suggests that such species as pikeperch, *Stizostedion lucioperca* (L.) or eel, *Anguilla anguilla* (L.) and, perhaps, lake trout, *Salmo trutta* m. *lacustris* L. might play this role. However, a drastic reduction of other predators and proper quality of the water flowing into the reservoir should precede the introduction of lake trout. It is difficult to meet these two conditions. It seems that after the initial success the stocking with lake trout may give effects similar to those observed in the Solina Reservoir where a few promising years were followed by the decline of this species (Wajdowicz 1976). After a long-term formation the ichthyofauna of the Świnna Poręba Reservoir will be similar to that found in the Solina Reservoir (Wajdowicz 1979) and in the more distant future to the community recorded in the Rożnów Reservoir (Jelonek and Amirowicz 1987).

The construction of dam reservoirs is also accompanied by changes in the composition of ichthyofauna above and below the reservoir (Penczak et al. 1984, Backiel 1985, Lusk 1995*a*). In the case of the River San changes in the thermal conditions of the river below the Solina Reservoir brought about a downward shift of zones with the more abundant occurrence of nase and barbel while above the reservoir the populations separated by it declined (Kukuła 1999). As in the San and in the Dunajec below the Czorsztyn Reservoir (Starmach 1998, Kukuła 1999), below the Świnna Poręba dam reservoir the zone of occurrence of rheophilous cyprinid fish may be shifted and the numbers of brown trout and grayling may increase. It will only be possible, however, if a suitable class of water quality is ensured. Above the reservoir periodical increases in the number of perch, roach, and bleak may occur. They will compete with native species colonising the upper

part of the basin. In the upper course of the River San perch had a fairly large share in the biomass and in some streams reached an altitude of 640 m (Kukuła 1999). A similar tendency to the migration of perch and roach from dam reservoirs to the upper course of rivers was also observed in other catchment basins (Skóra and Włodek 1988, Penczak 1989).

Acknowledgements – The author wishes to thank Doc. Dr. B. Szczęsny of the Cracow Nature Protection Institute of the Polish Academy of Sciences for help in organizing field investigations and also A. Sokołowicz, MSc, J. Cisek, MSc, P. Puszkarewicz, MSc, and R. Seryło, MSc for their assistance in fish catches.

References

Backiel T. 1985. Fall of migratory fish populations and change in commercial fisheries in impounded rivers in Poland. In: Alabaster J.S. (ed.) Habitat modification and freshwater fisheries. Butterworths, London–Boston, 28–41.

Bieniarz K. and Epler P. 1972. Ichthyofauna of certain rivers in Southern Poland. Acta Hydrobiol., 14, 419–444 [in Polish with English summary].

Bieniarz K. and Epler P. 1993. Fish catching by anglers in the Solina Dam Reservoir Rocz. Nauk. PZW, 6, 5–18 [in Polish with English summary].

Bieniarz K., Epler P. and Achinger J. 1990*a*. Fish catching by the Żywiec Dam Reservoir Rocz Nauk. PZW, 3, 7–14 [in Polish with English summary].

Bieniarz K., Epler P. and Sych R. 1990*b*. Fish catching by anglers in the Roznów Dam Reservoir. Rocz. Nauk. PZW, 3, 15–31 [in Polish with English summary].

Galas A. 1998. Prognoza oddziaływania zbiornika Świnna Poręba na środowisko [Prognosis of influence of Świnna Poręba Reservoir on environment]. In: Paulo A. (ed.) Sozologia na obszarze antropopresji na przykładzie zbiornika Świnna Poręba [Sozology on area under anthropopressure on the example of the Świnna Poręba Reservoir]. Kraków, AGH, 103–115 [in Polish].

Jelonek M. and Amirowicz A. 1987. Density and biomass of fish in the Roznów Reservoir (Southern Poland). Acta Hydrobiol., 29, 243–251.

Jelonek M. and Starmach J. 1988. Environmental characteristics of affluents of the Dobczyce Reservoir (Southern Poland) in the preimpoundment period (1983–1985). 3. Ichthyofauna. Acta Hydrobiol., 30, 305–316.

Kukuła K. 1999. Ichthyofauna of the upper San drainage basin. Arch. Ryb. Pol., 7, 307–319.

Lusk S. 1995*a*. Influence of valley dams on the changes in fish communities inhabiting streams in the Dyje River drainage area. Folia Zoologica, 44, 45–56.

Lusk S. 1995*b*. The status of *Chondrostoma nasus* in waters of the Czech Republic. Folia Zoologica, 44 (Suppl. 1), 1–8.

Lusk S. 1996. Development and status of populations of *Barbus barbus* in the waters of the Czech Republic. Folia Zoologica, 45 (Suppl. 1), 39–46.

Mastyński J. 1985. Fish farming economy and production possibilities of selected barrage reservoirs in Poland. Roczn. AR w Poznaniu, 146, 5–91 [in Polish with English summary].

Marszał L. and Przybylski M. 1996. Threatened and rare fish species in Central Poland. Zoologica Poloniae, 41, 61–72 [in Polish with English summary].

Peňáz M. and Jurajda P. 1993. Fish assemblages of the Morava River: longitudinal zonation and protection. Folia Zoologica, 42, 317–328.

Penczak T. 1989. The ichthyofauna of the Pilica River drainage basin. Part II. Post impoundment study. Rocz. Nauk. PZW, 2, 116–186 [in Polish with English summary].

Penczak T., Mahon R. and Balon E.K. 1984. The effect of an impoundment on the upstream and downstream fish taxocenes. Archiv Hydrobiol., 99, 200–207.

Penczak T., Galicka W., Grzybkowska M., Koszaliński H., Janiszewska M., Temech A., Zaczyński A., Głowacki Ł. and Marszał L. 1993. Impact of the Jeziorsko Reservoir on the Warta River water quality, fish populations and their food base (1985–1992). Rocz. Nauk. PZW, 6, 79–114 [in Polish with English summary].

Punzet J. 1976. Hydrological characteristic of the River Skawa and its more important tributaries. Acta Hydrobiol., 18, 353–381.

Skóra S. and Włodek J.M. 1988. Ichthyofauna of the Soła River and its tributaries. Rocz. Nauk. PZW, 1, 97–121 [in Polish with English summary].

Skóra S. and Włodek J.M. 1989. Ichthyofauna of the Wieprzówka River drainage basin. Rocz. Nauk. PZW, 2, 100–115 [in Polish with English summary].

Skóra S. and Włodek J.M. 1991. Ichthyofauna of the Skawa River drainage basin. Rocz. Nauk. PZW, 4, 47–64 [in Polish with English summary].

Skóra S., Włodek J.M., Augustyn L. and Nawrocki J. 1994. Ichthyofauna of the Biała Dunajcowa River catchment area. Rocz. Nauk. PZW, 7, 19–37 [in Polish with English summary].

Starmach J. 1998. Ichthyofauna of the River Dunajec in the region of the Czorsztyn–Niedzica and Sromowce Wyżne dam reservoirs (southern Poland). Acta Hydrobiol., 40, 199–205.

Szczęsny B. 1998. Charakterystyka hydrobiologiczna Skawy w rejonie projektowanego zbiornika Świnna Poręba [Hydrobiological characteristics of the River Skawa in the region of planned Świnna Poręba Reservoir]. In: Paulo A. (ed.) Sozologia na obszarze antropopresji na przykładzie zbiornika Świnna Poręba [Sozology on area under anthropopressure on the example of the Świnna Poręba Reservoir]. Kraków, AGH, 47–62 [in Polish].

Wajdowicz Z. 1976. The biological characteristics of lake trout (*Salmo trutta* m. *lacustris* L.) from Wdzydze, released into dam reservoirs. Acta Hydrobiol., 18, 101–125.

Wajdowicz Z. 1979. Development of the ichthyofauna in the cascade of the River San. Acta Hydrobiol., 21, 73–90 [in Polish with English summary].

Włodek J.M. 1975. Wstępne wyniki badań ichtiofauny trzech dorzeczy Zachodniej Małopolski (Raby, Skawy, Soły) [Preliminary results of investigations of ichthyofauna of three drainage basins in Western Małopolska (Raba, Skawa, Soła rivers)]. Post. Nauk Roln., 75, 107–121 [in Polish].