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**DOMINANCE AND OCCURRENCE CONSTANCY OF THE FISH SPECIES  
IN THE LOWER PŁONIA RIVER**

**DOMINACJA I STAŁOŚĆ WYSTĘPOWANIA GATUNKÓW RYB  
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The fish fauna of the lower Płonia River, above and below, the discharge point of the partly treated manure from the Pig Farm at Kołbacz—was surveyed in the years of 1992–1994. Electrofishing conducted four times on the same sections of the river yielded a total of 5 773 fishes, representing 21 species. The fishes belonged to 8 families and they were assigned to four feeding guilds. The highest occurrence constancy index (100%) was observed in roach, perch, and pike. The above species represented also the highest dominance index (67.71, 14.77, and 4.07% respectively).

INTRODUCTION

There have been no published accounts on the fish-fauna composition of the Płonia River. The occurrence of the stream morphotype of the brown trout, *Salmo trutta morpha fario* was reported by Seligo (1902) while the occurrence of the orfe, *Leuciscus idus* (L.), and the crucian carp, *Carassius carassius* (L.)—by Borne (1882). A random study on the occurrence of the fish species in the drainage basin of the Płonia River was carried out by Trzebiatowski et al. (1988). The Płonia constitutes a part of the catchment area of the Odra River as its left-bank tributary. The Płonia, in its lower stretch, receives a small left-bank tributary (from Zaborsko Lake) which, since 1972 has been burdened by the partly-treated sewage containing manure from industrial-scale pig farm at Kołbacz. The farm belongs to the Experimental Station of the Animal Breeding Institute of the Polish Academy of Sciences. The present study was aimed at monitoring changes in the fish fauna composition, levels of species dominance and the occurrence constancy of the fishes inhabiting the river. Electrofishing was carried out within 1992–1994—twenty years after the first discharge of the sewage from the above-mentioned farm to the Płonia River.

### Description of the drainage basin of the Płonia River

The drainage basin of the Płonia River is located in the north-eastern part of the Myślubórz Lake District and in the southern part of the Szczecin Lowland. Its area covers 1 173 km<sup>2</sup> (Anonymous 1949). The river originates in a place located in a distance of 1.5 km east from the town of Barlinek. It starts its flow from Uklejno Lake. The surface of the lake is elevated 68 m above sea level. After covering 82.2 km the Płonia empties to Lake Dąbie, located in the estuary system of the Odra River, 0.5 m above sea level (Duda 1975; Chełkowski et al. 1989). The average approximated vertical drop of the Płonia is 0.8‰, while its flow through the river-mouth transect—1.9 m<sup>3</sup>/s (Chełkowski et al. 1984; Anonymous 1997). In its course the river flows through 6 lakes: Płoń (area of 822.8 ha), Miedwie (3 759.4 ha), Żelewo (101.5 ha), Płonno (13.09 ha), Cysterskie (3.57 ha), and Klasztorne (3.77 ha) (Filipiak and Sadowski 1994). The river stretch below Lake Miedwie (14.1 m above sea level) down to Lake Dąbie, has been regarded as the lower Płonia (Duda 1975; Chudecki 1979). The lower Płonia is 22.3 km long and its average approximated vertical drop is 0.6‰.

### Description of the sewage dumping site

The technology used in the pig farm at Kołbacz assumes the annual production of 36.5 thousand of fatteners. The average number of the animals reared there does not exceed 24–27 thousand of individuals yearly. The manure flows gravitationally through a canal to the equalizing tank, where it is subjected to mechanical and biological pre-treatment (Węckowicz and Tereszczak 1985). In each given 24-hour period some 150 m<sup>3</sup> of the pre-treated sewage flows through a 1.6-km-long melioration ditch to Zaborsko Lake. This lake, in the early years of the sewage discharge played a significant role in a self-purification process. Presently it is a dead body of water and its bottom is covered with a thick layer of sediment. The water from this lake (light amber in color) flows through a 0.25-km-long canal to Płonno Lake through which the Płonia River flows through (Fig. 1). Summarized results of the water analyses of the Płonia conducted in the years of 1991 and 1996 and obtained from the State Environmental Protection Agency—being the closest available data—are presented in Tab. 1. The samples of the water were taken from the Płonia River from two sites: above the sewage discharge (from a canal leaving Lake Miedwie) and below the sewage discharge of the pig farm (from the villages of Kołbacz and Jezierzycze) (Fig. 1). It is evident from the above-mentioned analyses that the water taken below the sewage discharge from the villages of Kołbacz and Jezierzycze had worse purity parameters compared to the water from above the sewage discharge point which is expressed by the values of BOD<sub>5</sub>, phosphorus and nitrogen (Tab. 1).

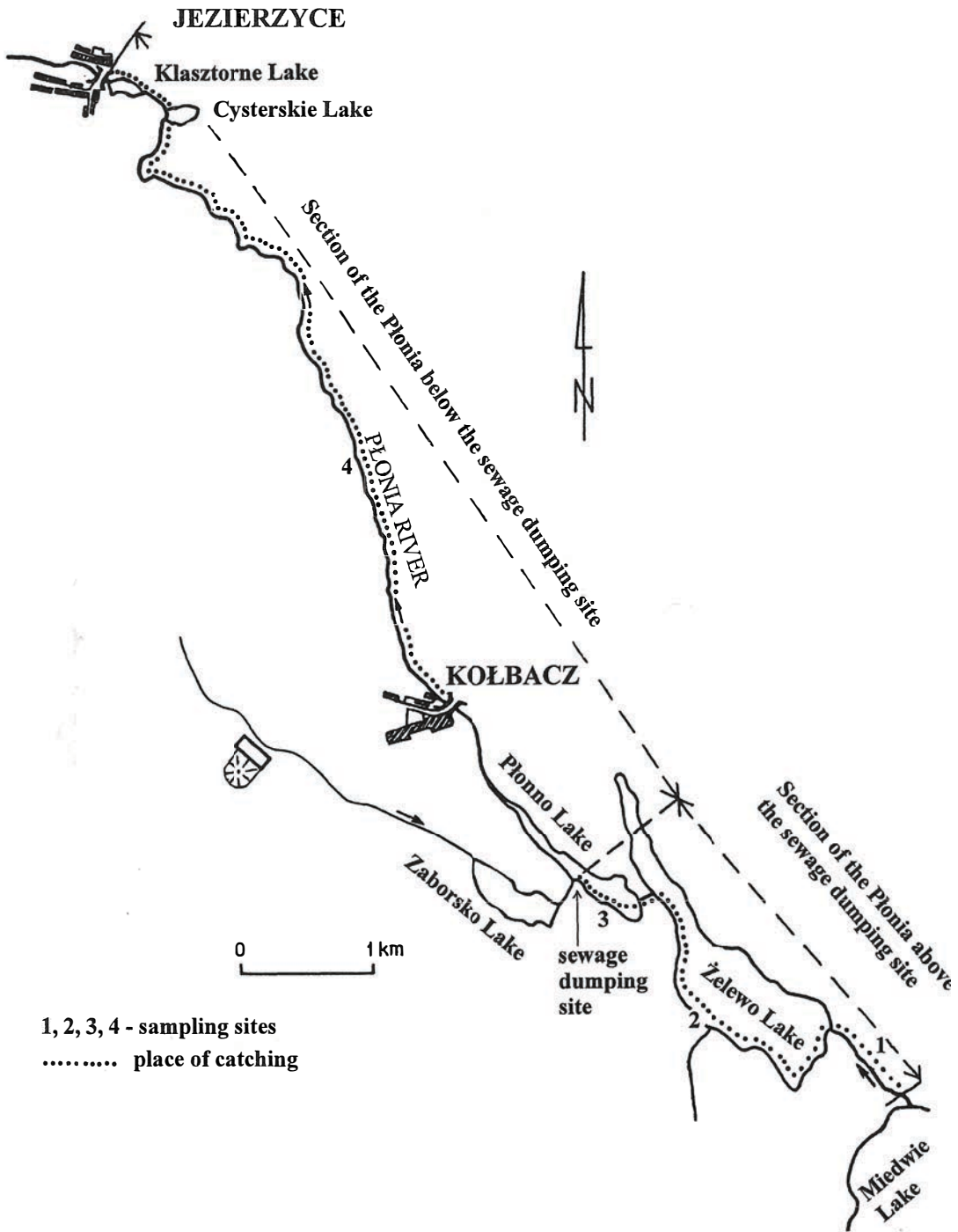


Fig. 1. Sampling sites and places of catching

Table 1

## Hydrochemical characteristics of the lower Piłonia River

Sampling site	Year; date	Value	Water temperature [°C]	pH	Oxygen [mg O <sub>2</sub> /dm <sup>3</sup> ]	BOD <sub>5</sub> [mg O <sub>2</sub> /dm <sup>3</sup> ]	Phosphates [mg P/dm <sup>3</sup> ]	Total Phosphorus [mg P/dm <sup>3</sup> ]	Ammonia Nitrogen [mg N/dm <sup>3</sup> ]	Nitrates [mg N/dm <sup>3</sup> ]	Nitrites [mg N/dm <sup>3</sup> ]	TKN [mg N/dm <sup>3</sup> ]	TDS	
"Canal"	1991 14 Jan 30 Dec	n	27	20	27	27	27	5	27	27	16		27	
		min	0.0	8.0	7.3	1.1	0.03	0.10	0.01	0.07	0.002		327	
		mean	8.2		11.5	2.6	0.23	0.21	0.06	0.20	0.003		380	
		max	23.0	9.1	15.2	5.6	0.45	0.27	0.15	0.42	0.010		446	
	1996 29 Nov 21 Oct	n	12	12	12	11	12	12	12	12	12	12	12	12
		min	0.0	7.8	8.7	1.0	—	0.05	—	—	—	—	0.75	353
		mean	8.0		11.7	3.4	0.12	0.13	0.06	0.14	0.001		1.12	390
		max	20.8	8.8	13.9	9.2	0.26	0.22	0.13	0.38	0.005		1.80	451
Kołbacz	1991 14 Jan 30 Dec	n	28	28	28	28	27	5	28	27	16		28	
		min	0.0	7.7	2.3	2.7	0.04	0.13	—	0.10	0.002		328	
		mean	8.5		10.4	4.1	0.46	0.27	0.50	0.26	0.018		395	
		max	23.5	8.9	19.4	6.5	1.26	0.53	1.90	0.87	0.120		491	
	1996 29 Nov 21 Oct	n	12	12	12	12	12	12	12	12	12	12	12	12
		min	0.0	7.7	9.1	1.6	—	0.08	0.02	—	—	—	1.10	323
		mean	8.1		11.7	3.7	0.16	0.18	0.15	0.14	0.010		1.68	391
		max	20.3	8.8	15.5	6.2	0.52	0.33	0.45	0.31	0.053		2.23	432
Jezierzyce	1991 14 Jan 30 Dec	n	28	28	28	28	20	5	28	28	16		28	
		min	0.0	7.6	1.9	1.0	0.21	0.16	0.04	0.12	0.006		350	
		mean	8.6		9.2	3.4	0.45	0.37	0.45	0.37	0.026		395	
		max	23.5	8.7	17.0	6.2	1.00	0.84	1.45	1.00	0.110		465	
	1996 29 Nov 21 Oct	n	12	12	12	12	12	12	12	12	12	12	12	12
		min	0.0	7.6	6.6	1.7	—	0.07	0.02	—	—	—	1.2	356
		mean	8.0		10.2	3.8	0.19	0.19	0.26	0.28	0.011		1.84	402
		max	20.3	8.6	14.3	6.0	0.62	0.28	0.68	1.60	0.033		3.23	459

TKN, Total Kjeldahl Nitrogen;

TDS, Total Dissolved Solids.

## MATERIAL AND METHODS

Electrofishing was carried out on four sampling sites (Fig. 1). Site 1 covered a “called” canal linking Lake Miedwie with Żelewo Lake. Its length is 875 m, average width—17.4 m and depth—1.0 m. In a distance of 225 m from Lake Miedwie there is a four-chamber weir designed to control the level of the lake, which is associated with the intake of drinking water for the city of Szczecin. The weir obstructs upstream migrations of fishes. The fishes were sampled three times (1992–1993) in the “canal”, each time on the same stretch of 650 m (from the weir to Żelewo Lake) and once—in 1994 on a stretch of 300 m (Tab. 2). In total, during the three-year period, a combined length of 2 250 m of the canal length was sampled on site 1.

Table 2

Location of the fishing sites and the length of the sampled sections of the lower Płonia [m]

No.	Name and location of site	Date of catch				Total
		31 Aug and 2 Sep 1992	22–23 Jun 1993	5–6 Oct 1993	13–14 Sep 1994	
Section above the sewage dumping site						
1	“Canal” *	650	650	650	300	2 250
2	Żelewo Lake**	2 300	2 300	2 300	1 250	8 150
3	Płonno Lake***	600	600	600	—	1 800
	Total	3 550	3 550	3 550	1 550	12 200
Section below the sewage dumping site						
4	Płonia ****	2 600	2 600	2 600	5 100	12 900
	Total					25 100

\* between weir (bridge) and Żelewo Lake

\*\* between the “canal” mouth and the river flow-out (along the southern shore)

\*\*\* between Żelewo Lake and the sewage dumping site

\*\*\*\* between the bridge in Kołbacz and the village of Jezierzycze

Directly after site 1, there was site 2—Żelewo Lake. The catches were conducted along the southwestern shore of this body of water on a combined distance of 2 300 m—between the mouth of the “canal” and the flow-out point of the river. Within 1992–1993 the catches were conducted three times on the same 2 300-m-long stretch, while in 1994—only once on a stretch 1 250 m long. The electrofishing on site 2 covered a combined length of 8 150 m of the shore.

The next—site 3 consisted of two parts. The first part—150 m long—was the Płonia River flowing between Żelewo Lake and Płonno Lake. The second part—450 m long—was a section of Płonno Lake from the site where the Płonia enters the lake to the dumping site of partly treated sewage of the Kołbacz farm. In total, site 3 was 600 m long. The catches were conducted there three times between 1992 and 1993.

The last—site 4—studied within 1992–1993 stretched on the Płonia River from the bridge in the village of Kołbacz to the beginning of the forest and its length was 2 600 m. In 1994 this sampling site was extended for another 2 500 m to the village of Jezierzycze. The average width of the entire stretch sampled, was 13.5 m, while its depth was 0.5–1.0 m. The average summer water flow on this site was 0.4 m/s. The extension of the last sampling stretch in 1994 was caused by the need to have uniform lengths of the shore sections surveyed each year on each site. Electrofishing was conducted 15 times in all, on four sampling sites. The combined length of all surveyed stretches was 25 100 m. In this number, three stretches located above the discharge point of sewage covered a total of 12 200 m, while the fourth “contaminated” section—12 900 m (Tab. 2). The length of the sections of the Płonia River and the vertical drop rates were calculated based on a topographic map (scale 1 : 25000).

The electrofishing was conducted with a gasoline-powered generator (PAB) equipped with a typical attachment, transforming alternating current into direct current (220 V; 5–6 A) (Penczak 1976). The catches were conducted by professional fishermen. They operated the generator with a single anode-dip-net of the mesh size of 11 mm. While on the river, they operated from a boat passively floating down the stream, while on a lake—they used oars to propel the boat. Identification of the acquired material was aided by a number of publications (Staff 1950; Gaśowska 1962; Brylińska 1986; Rolik and Rembiszewski 1987). In the subsequent analysis of the material two basic biocenotic indices were calculated: dominance structure (D)<sup>\*</sup> and occurrence constancy (C)<sup>\*\*</sup> (Koszaliński et al. 1989; Witkowski et al. 1991, 1992; Kuszniierz et al. 1994). For more accurate description of the habitat of the lower Płonia in the vicinity of the sewage discharge spot, the fishes were also divided into ecological reproductive guilds (Balon 1964, 1975, 1981; Witkowski 1979, 1984). The taxonomic system adopted follows that of Brylińska (1986).

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\*  $D = (n_i / N \times 100)$  where:  $n_i$ —number of individuals of species “i” in sample; N—number of all specimens in sample

\*\*  $C = (N_a / N_n \times 100)$  where  $N_a$ —number of sites where the species occurs;  $N_n$ —total number of sites

## RESULTS

## Sampling site 1

Four catches conducted on this site yielded a total of 2 130 fishes. They represented 15 species. The first catch provided 9 species, second—11, third—12, while the fourth—only 4 species (Tab. 3). Analysis of the data presented in the above-mentioned table indicates, that compared to the first—the second catch yielded 4 new species (bleak, white bream, spined loach, three-spined stickleback). The third catch provided only two new species, (chub and rudd) which were not present in the earlier catches. The fourth catch did not deliver any new species. The quantitative analysis shown that the most abundant were: roach (a total of 1 341 ind.), perch (423 ind.), and pike (89 ind.). Their dominance index (D) values were: 62.95, 19.85, and 4.17 respectively. The quantities of the remaining 12 species, which were not present in all catches, ranged from 1 ind. (chub, spined loach, burbot, and zander) to 100 ind. (ruffe). It should be emphasised that on site 1, as many as 8 species (orfe, rudd, tench, white bream, spined loach, burbot, three-spined stickleback, and zander) had very low dominance index values, not exceeding 0.5% (Tab. 3).

Table 3

Frequency (n) and values of the dominance index (D) of fish species acquired on site 1 ("Canal")

No.	Species	Date of catch								Total	
		31 Aug 1992		22 Jun 1993		05 Oct 1993		14 Sep 1994			
		n	D	n	D	n	D	n	D	n	D
1	<i>Esox lucius</i> L.	60	16.81	4	0.58	12	1.38	13	6.31	89	4.17
2	<i>Rutilus rutilus</i> (L.)	152	42.68	504	72.63	506	57.96	179	86.89	1341	62.95
3	<i>Leuciscus cephalus</i> (L.)					1	0.11			1	0.04
4	<i>Scardinius erythrophthalmus</i>					5	0.58			5	0.23
5	<i>Tinca tinca</i> (L.)	5	1.40	1	0.14	2	0.23			8	0.37
6	<i>Gobio gobio</i> (L.)	6	1.62	1	0.14	20	2.29			27	1.26
7	<i>Alburnus alburnus</i> (L.)			53	7.64	9	1.03	2	0.97	64	3.00
8	<i>Blicca bjoerkna</i> (L.)			1	0.14	9	1.03			10	0.46
9	<i>Cobitis taenia</i> L.			1	0.14					1	0.04
10	<i>Anguilla anguilla</i> (L.)	34	9.52	5	0.72	17	1.95			56	2.63
11	<i>Lota lota</i> (L.)	1	0.28							1	0.04
12	<i>Gasterosteus aculeatus</i> L.			2	0.29	1	0.11			3	0.14
13	<i>Stizostedion lucioperca</i> (L.)	1	0.28							1	0.04
14	<i>Perca fluviatilis</i> L.	95	26.61	120	17.29	196	22.45	12	5.83	423	19.85
15	<i>Gymnocephalus cernuus</i> (L.)	3	0.84	2	0.29	95	10.88			100	4.69
	Total	357	100.00	694	100.00	873	100.00	206	100.00	2130	100.00



### Sampling site 2

During four sampling seasons, the catches conducted in the coastal zone of Żelewo Lake yielded a total of 483 fishes which was almost 4.5 times fewer, than at the former site (Tabs. 3, 4). The first catch gave 10, while the second—8, third—9, and fourth—6 fish species. Compared to the first one, the second catch provided 3 new species (orfe, white bream, and weather loach), while the third and fourth—both yielded 1 new species (bleak and ruffe respectively) which were not present in earlier catches on this site. A total of 15 fish species was acquired from Żelewo Lake. The dominant species were: roach, perch, and eel. The dominance index (D) values were: 59.42, 17.18, and 12.42 respectively. Similarly as on site 1, almost half of the species was represented by single specimens, that is why the dominance index for bleak, white bream, common bream, spined loach, weather loach, burbot, and ruffe did not exceed 0.5% (Tab. 4).

**Table 4**

Frequency (n) and values of the dominance index (D) of fish species acquired on site 2 (Żelewo Lake)

No.	Species	Date of catch								Total	
		31 Aug 1992		22 Jun 1993		05 Oct 1993		14 Sep 1994			
		n	D	n	D	n	D	n	D	n	D
1	<i>Esox lucius</i> L.	5	5.62	5	5.37	5	2.84	6	4.80	21	4.35
2	<i>Rutilus rutilus</i> (L.)	16	17.98	56	60.21	115	65.34	100	80.00	287	59.42
3	<i>Leuciscus cephalus</i> (L.)			1	1.08	4	2.27	1	0.80	6	1.24
4	<i>Scardinius erythrophthalmus</i>	3	3.37							3	0.62
5	<i>Tinca tinca</i> (L.)	2	2.25	8	8.60	1	0.57			11	2.28
6	<i>Gobio gobio</i> (L.)	2	2.25			1	0.57			3	0.62
7	<i>Alburnus alburnus</i> (L.)					1	0.57			1	0.21
8	<i>Blicca bjoerkna</i> (L.)			1	1.08	1	0.57			2	0.41
9	<i>Cobitis taenia</i> L.	1	1.12			1	0.57			2	0.41
10	<i>Anguilla anguilla</i> (L.)	1	1.12							1	0.21
11	<i>Lota lota</i> (L.)			1	1.08					1	0.21
12	<i>Gasterosteus aculeatus</i> L.	40	44.94	13	13.98			7	5.60	60	12.42
13	<i>Stizostedion lucioperca</i> (L.)	1	1.12							1	0.21
14	<i>Perca fluviatilis</i> L.	18	20.23	8	8.60	47	26.70	10	8.00	83	17.18
15	<i>Gymnocephalus cernuus</i> (L.)							1	0.80	1	0.21
Total		89	100.00	93	100.00	176	100.00	125	100.00	483	100.00

### Sampling site 3

As mentioned earlier, there were only three catches conducted in Płonno Lake, constituting sampling site 3. All of them were performed on a relatively short stretch—600 m. The first catch yielded 516, second—886, and the third—65 fishes. In all, 1 467 fishes, representing 13 species, were collected (Tab. 5). The first catch yielded 12, second—10, and third—6 fish species. Compared to the first, the second catch provided 1 new species



(bleak), whereas the third catch did not yield any new species. This fact was an excuse for not doing the fourth catch as it was done on other sampling sites. As it was mentioned earlier the catches were conducted only in the southwestern part of the lake and they were stopped before the zone affected by the sewage discharged from the Kołbacz farm. It is possible that this zone constituted a barrier limiting movements of the fishes between the southern and southeastern part of the lake. Consequently in this “unpolluted” part of Płonno Lake there were probably higher concentrations of fishes. As a result, in Płonno lake there were 3 times more fish caught than in Żelewo Lake. It must be also emphasised that the combined length of shores surveyed, was only 1 800 m in Płonno Lake, which was 4.4 times less than the shore length explored in Żelewo Lake (Tabs. 2, 5).

**Table 5**

Frequency (n) and values of the dominance index (D) of fish species acquired on site 3 (Płonno Lake)

No.	Species	Date of catch						Total	
		31 Aug 1992		22 Jun 1993		05 Oct 1993			
		n	D	n	D	n	D	n	D
1	<i>Esox lucius</i> L.	42	8.14	4	0.45	7	10.77	53	3.61
2	<i>Rutilus rutilus</i> (L.)	336	65.12	766	86.47	38	58.46	1140	77.71
3	<i>Leuciscus cephalus</i> (L.)	1	0.19					1	0.07
4	<i>Leuciscus idus</i> (L.)	15	2.91	19	2.14	3	4.62	37	2.52
5	<i>Scardinius erythrophthalmus</i>	13	2.52					13	0.89
6	<i>Tinca tinca</i> (L.)	28	5.43	15	1.69	5	7.69	48	3.27
7	<i>Alburnus alburnus</i> (L.)			16	1.81			16	1.09
8	<i>Blicca bjoerkna</i> (L.)	1	0.19	17	1.92			18	1.23
9	<i>Carassius carassius</i> (L.)	1	0.19	2	0.22			3	0.20
10	<i>Cobitis taenia</i> L.	4	0.78	1	0.11			5	0.34
11	<i>Anguilla anguilla</i> (L.)	18	3.49	2	0.22	3	4.62	23	1.57
12	<i>Lota lota</i> (L.)	1	0.19					1	0.07
13	<i>Perca fluviatilis</i> L.	56	10.85	44	4.97	9	13.84	109	7.43
	Total	516	100.00	886	100.00	65	100.00	1467	100.00

In all three catches on site 3, the following 6 species were present: roach, perch, pike, tench, orfe, and eel. The three former species were the most abundant, attaining the following values of the dominance index: 77.71, 7.43, and 3.61%, respectively (Tab. 5). Similarly as on the former sampling sites, also at the site 3, some of the species were represented by single specimens (chub, crucian carp, spined loach, burbot), so the values of their dominance index did not exceed 0.5%.

## Sampling site 4

The catches begun below the bridge in Kołbacz which is located on the Płonia 1 625 m below the discharge point of the sewage from the farm. The first three catches, conducted on the length of 2 600 m each, yielded 720, 112, and 502 fishes respectively. The fourth catch, conducted on the length of 5 100 m yielded 353 fishes. Summing up, on the length of 12 900 m a total of 1 693 fishes was acquired. The fishes represented 16 species (Tab. 6). The first catch yielded 10, the second and the third—11 each, while the fourth—only 8 fish species. Compared to the first, the second catch yielded 4 new species (chub, blue bream, weather loach, European catfish). The third catch had two new species (gudgeon and zander), whereas the fourth catch did not have any new species. In all sampling seasons the following fishes were present: roach, perch, and pike. Their dominance indices were: 67.39, 14.06, and 4.25% respectively. Similarly as in earlier-described sites almost half of the species was represented by single specimens (common bream, white bream, weather loach, European catfish, burbot, zander, and spined loach) so the values of their dominance indices did not exceed 0.5% (Tab. 6).

Table 6

Frequency (n) and values of the dominance index (D) of fish species acquired on site 4

No.	Species	Date of catch								Total	
		31 Aug 1992		22 Jun 1993		05 Oct 1993		14 Sep 1994			
		n	D	n	D	n	D	n	D	n	D
1	<i>Esox lucius</i> L.	40	5.51	12	10.71	15	2.99	5	1.42	72	4,25
2	<i>Rutilus rutilus</i> (L.)	444	61.16	59	52.68	363	72.31	275	77.90	1141	67,39
3	<i>Leuciscus cephalus</i> (L.)			6	5.36	4	0.80	4	1.13	14	0,83
4	<i>Leuciscus idus</i> (L.)	30	4.13	7	6.25	21	4.18			58	3,42
5	<i>Tinca tinca</i> (L.)	3	0.41	5	4.46	4	0.80	2	0.57	14	0,83
6	<i>Gobio gobio</i> (L.)					21	4.18	10	2.83	31	1,83
7	<i>Alburnus alburnus</i> (L.)	20	2.76			12	2.39	11	3.12	43	2,54
8	<i>Abramis brama</i> (L.)	2	0.27							2	0,12
9	<i>Abramis ballerus</i> (L.)			1	0.89			2	0.57	3	0,18
10	<i>Cobitis taenia</i> L.	1	0.14							1	0,06
11	<i>Misgurnus fossilis</i> (L.)			2	1.79					2	0,12
12	<i>Silurus glanis</i> L.			2	1.79					2	0,12
13	<i>Anguilla anguilla</i> (L.)	47	6.47	11	9.82	4	0.80			62	3,66
14	<i>Lota lota</i> (L.)	1	0.14	4	3.57	2	0.40			7	0,41
15	<i>Stizostedion lucioperca</i> (L.)					3	0.59			3	0,18
16	<i>Perca fluviatilis</i> L.	138	19.01	3	2.68	53	10.56	44	12.46	238	14,06
	Total	726	100.00	112	100.00	502	100.00	353	100.00	1693	100.00

### Dominance index of individual species and ecological guilds of fishes

A total of 21 fish species was recorded in the entire area studied (Tab. 7). The upper “unpolluted” part of the studied section of the Płonia River yielded 19 species, while the lower “polluted” stretch—as few as 16 species. The upper part did not have common bream and European catfish while the lower part—ruffe, white bream, crucian carp, and three-spined stickleback. The observed differences in the abundance of the fish species between both stretches of the lower Płonia may suggest, that five above-mentioned species avoided waters contaminated with sewage from the farm. On the other hand, the presence in both stretches as many as 14 fish species, in this number fishes rather sensitive for “organic” contaminants as: burbot, chub, orfe, gudgeon, or spined loach may indicate a weak effect of the farm sewage on changes on the specific composition of fish-fauna of the lower Płonia.

**Table 7**

Dominance index (D) and ecological guild of fishes acquired in the lower Płonia  
(data based on all years of the study)

No.	Species	Fish presence		Dominance index D (%)	Ecological group
		Above sewage dumping site	Below sewage dumping site		
1	<i>Anguilla anguilla</i>	+	+	3.48	Special pelagophilous
2	<i>Lota lota</i>	+	+	0.17	Partly pelagophilous
3	<i>Leuciscus cephalus</i>	+	+	0.28	Litophilous
4	<i>Rutilus rutilus</i>	+	+	67.71	Phyto-litophilous
5	<i>Leuciscus idus</i>	+	+	1.75	
6	<i>Alburnus alburnus</i>	+	+	2.14	
7	<i>Perca fluviatilis</i>	+	+	14.77	
8	<i>Gymnocephalus cernuus</i>	+	–	1.75	
9	<i>Esox lucius</i>	+	+	4.07	Phytophilous
10	<i>Tinca tinca</i>	+	+	1.40	
11	<i>Scardinius erythrophthalmus</i>	+	–	0.36	
12	<i>Blicca bjoerkna</i>	+	–	0.52	
13	<i>Abramis brama</i>	–	+	0.07	
14	<i>Abramis ballerus</i>	+	+	0.05	
15	<i>Carassius carassius</i>	+	–	0.05	
16	<i>Cobitis taenia</i>	+	+	0.14	
17	<i>Misgurnus fossilis</i>	+	+	0.05	
18	<i>Silurus glanis</i>	–	+	0.03	
19	<i>Stizostedion lucioperca</i>	+	+	0.06	
20	<i>Gobio gobio</i>	+	+	1.05	Psammophilous
21	<i>Gasterosteus aculeatus</i>	+	–	0.05	Ariadnophilous

The highest values of the dominance indices ( $D$ ), based on the all catches from the entire study area were recorded for roach, perch, pike, and eel (67.71, 14.77, 4.07, and 3.48% respectively). The species collected can be assigned to seven, varying in reproductive requirements, ecological guilds. The highest value of the dominance index ( $D = 88.14\%$ ) was recorded in the phyto-litophilous guild comprising 5 species only. Far larger species group (11) belonged to the second most dominant guild ( $D = 6.82\%$ )—phytophilous. The remaining five ecological guilds namely: special pelagophilous, partly pelagophilous, lithophilous, psammophilous, and ariadnophilous were represented by single fish species. The number of fish in these guilds was small, and consequently the values of the dominance index were also small and they ranged from 0.05 (ariadnophilous guild—represented by the three-spined-stickleback) to 3.48% (pelagophilous guild—represented by eel).

#### Occurrence constancy index of fish species

The values of this index were calculated based on all catches conducted on two principal areas of the present study: below (first three sites) and above (site 4) the dumping site of the sewage from the farm. It is evident from the data in Tab. 8, that in both aforementioned areas, the highest—100% occurrence constancy index was attained by three fish species only, namely pike, roach, and perch. The values for the remaining species were highly variable and they ranged from 9% (zander and weather loach) to 82% (tench)—above the sewage discharge point; and from 25% (common bream, crucian carp, spined loach, weather loach, European catfish, zander) to 100% (tench) below the sewage dumping site. It must be emphasised that in the majority of fishes there were small differences in the values of the occurrence constancy index. It suggests that the variable water quality within the area studied did not have a major effect on the presence of fish species. From ecological and fisheries point of view, the most objective seems to be the index  $C$ —calculated jointly for all 15 catches (Tab. 8). As many as 8 fish species reached values between 0 and 24%, 6 species—values within 25–49%, 2 species—within 50–74%, and 5 species (pike, roach, perch, tench, and eel)—attained the highest values between 75 and 100%.



Table 8

## Occurrence constancy of the species acquired in the lower Płonia

No.	Species	Presence of fishes in the sections of the lower Płonia																Occurrence constancy index C (%)		
		Above sewage dumping site												Below sewage dumping site				Sewage dumping site		Jointly
		"Canal"				Zelew Lake				Płonno Lake				dumping site				Above	Below	
Catch number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4				
1	<i>Esox lucius</i> L.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	100	100	100	
2	<i>Rutilus rutilus</i> (L.)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	100	100	100	
3	<i>Leuciscus cephalus</i> (L.)	-	-	+	-	-	-	-	+	-	-	-	+	+	+	+	18	75	33	
4	<i>Leuciscus idus</i> (L.)	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	54	75	60	
5	<i>Scardinius erythrophthalmus</i>	-	-	+	-	+	-	-	-	+	-	-	-	-	-	-	27	—	20	
6	<i>Tinca tinca</i> (L.)	+	+	+	-	+	+	+	-	+	+	+	+	+	+	+	82	100	87	
7	<i>Gobio gobio</i> (L.)	+	+	+	-	+	-	+	-	-	-	-	-	-	+	+	45	50	47	
8	<i>Alburnus alburnus</i> (L.)	-	+	+	+	-	-	+	-	-	+	-	+	-	+	+	45	75	53	
9	<i>Blicca bjoerkna</i> (L.)	-	+	+	-	-	+	+	-	+	+	-	-	-	-	-	50	—	40	
10	<i>Abramis brama</i> (L.)	-	-	-	-	+	-	+	-	-	-	-	+	-	-	-	18	25	20	
11	<i>Abramis ballerus</i> (L.)	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	—	50	13	
12	<i>Carassius carassius</i> (L.)	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	18	25	13	
13	<i>Cobitis taenia</i> L.	-	+	-	-	+	-	-	-	+	+	-	+	-	-	-	36	25	38	
14	<i>Misgurnus fossilis</i> (L.)	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	9	25	17	
15	<i>Silurus glanis</i> L.	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	—	25	7	
16	<i>Anguilla anguilla</i> (L.)	+	+	+	-	+	+	-	+	+	+	+	+	+	+	-	82	75	80	
17	<i>Lota lota</i> (L.)	+	-	-	-	+	-	-	-	+	-	-	+	+	+	-	27	75	40	
18	<i>Gasterosteus aculeatus</i> L.	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	18	—	13	
19	<i>Stizostedion lucioperca</i> (L.)	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	9	25	13	
20	<i>Perca fluviatilis</i> L.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	100	100	100	
21	<i>Gymnocephalus cernuus</i> (L.)	+	+	+	-	-	-	-	+	-	-	-	-	-	-	-	36	—	27	
Number of species		9	11	12	4	10	8	9	6	12	10	6	10	11	11	8				

+ present;  
absent

## DISCUSSION

According to the biological inventory conducted by Trzebiatowski et al. (1988) 16 years after the production of pigs started in Kołbacz, there were 10 fish species occurring above the farm: pike, roach, gudgeon, white bream, weather loach, eel, burbot, three-spined stickleback, and perch. Below the sewage dumping site there were 9 species: pike, roach, orfe, gudgeon, bleak, eel, burbot, and perch. Also in the present study (conducted within 1992–94) fish like pike, roach, eel, burbot, and perch were recorded. The array of fish species recorded from the lower Płonia, below Lake Miedwie by Trzebiatowski et al. (1988) did not contain 8 fish species found in the present study (rudd, common bream, blue bream, crucian carp, spined loach, European catfish, zander, and ruffe). Borne (1882) studying the Płonia recorded the presence of crucian carp, orfe, and even stream morphotype of the brown trout.

The lower Płonia above- and below the sewage dumping site is inhabited by 2 protected fish species—spined loach and weather loach (Anonymous 1995). The above species occur rarely, which is indicated by small values of the dominance index (D): 0.14% (spined loach) and 0.05% (weather loach). The dominance index reached also a small value for blue bream (0.05%). Considering the abundant occurrence of this species in Lake Dąbie—the body of water receiving the waters of the Płonia (Kompowski 1991, 1995; Karabanowicz and Kompowski 1994) it can be concluded that in the lower Płonia this fish did not find suitable habitat conditions. On the other hand relatively high value of the dominance index of the catches of pelagophilous eel ( $D = 3.48\%$ ) can be an evidence for the natural recruitment or montée stocking of the lower Odra system (where the Płonia empties). A justification to such a statement may be the information obtained from the Szczecin Maritime Authority—confirming eel stocking of the Szczecin Lagoon in 1989 and 1990. Those eels were able to migrate to the Płonia. This may explain a high and stable dominance of the eel in the lower Płonia River, both above-and below the sewage discharge point. It must be emphasized, however, that more eels occurred above (139) than below (62) the sewage dumping site. The catches conducted in the lower Płonia by Trzebiatowski et al. (1988) and the present study did not yield representatives of the family Petromyzonidae. The reason for that may be a general difficulty in acquiring cyclostomes with an electrofishing device.

## CONCLUSIONS

1. Abundant fish-fauna consisting of 21 species, present in the Płonia River, may be regarded as an evidence of favorable environmental conditions present in this river
2. Partly treated sewage of the Kołbacz farm discharged to the Płonia did not have any distinct effect on the composition of the fish-fauna, which is confirmed by the presence,



in the lower part of the studied stretch, of 76% of fish species recorded within the entire study area.

3. The index of species dominance for the most abundant fishes in the area studied—roach and perch—reached similar values for both sections: above- (67.8 and 15.0% respectively) and below (67.3 and 14.0%) the sewage dumping site.
4. The highest values of the occurrence constancy index in the present study were attained by pike, roach, perch, tench, and eel.

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## DOMINACJA I STAŁOŚĆ WYSTĘPOWANIA GATUNKÓW RYB W DOLNEJ PŁONI

### STRESZCZENIE

Rzeka Płonia, prawobrzeżny dopływ dolnej Odry, przyjmuje w swym biegu mały ciek do którego uchodzą częściowo oczyszczone ścieki gnojowicy wielkotowarowej fermy trzody chlewnej w Kołbaczu. Badania nad kształtowaniem się rybostanu zasiedlającego dolną Płonię powyżej i poniżej zrzutu tego ścieku prowadzono na podobnie długich odcinkach w latach 1992–1994. Elektropułowy prowadzone z łodzi jednym anodoczerpakiem dostarczyły 5773 ryby prezentujące 21 gatunków wchodzących w skład 8 rodzin i 7 grup rozrodczych. W odcinku Płoni powyżej zrzutu ścieku wystąpiło 19, a poniżej zrzutu 16 gatunków ryb. Odcinek Płoni powyżej zrzutu ścieku dostarczył 2,4 razy więcej ryb w stosunku do odcinka rzeki leżącego poniżej zrzutu ścieku. W dolnej Płoni powyżej i poniżej zrzutu ścieku wskaźnikiem stałości  $C = 100\%$  charakteryzowały się 3 gatunki ryb: płoć, okoń i szczupak, które również miały największe wskaźniki dominacji  $D$ , odpowiednio 67,71; 14,78 i 4,07%

Received: 19 February 1999

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