Arch. Pol. Fish.	Archives of Polish Fisheries	Vol. 11	Fasc. 2	165-179	2003

CHARACTERISTICS OF SEA TROUT (*SALMO TRUTTA* M. *TRUTTA*) FROM THE DRWĘCA RIVER BASED ON SCALE SAMPLES COLLECTED BETWEEN 1988-1992

Irena Borzęcka

The Stanisław Sakowicz Inland Fisheries Institute in Olsztyn, Poland

ABSTRACT. The spawning stock of migratory sea trout in the Drwęca River was investigated 20 years after the Vistula River was dammed near Włocławek (1968). Fish scales and data were obtained from fish traps and anglers fishing in the lower Drwęca River. The age structure of sea trout which enter the Drwęca River to spawn and the percentage of them which are repeat spawners are presented taking into consideration the stocking coefficient. The age distribution was as follows: specimens returning to the river after one year in the sea - age A.0+ - 1.3%; age group A.1+ - 36.6%; age group A.2+ - 52.9%. The latter had spent three growth seasons in the sea and was the most numerous. Fish from age group A.3+ comprised an average of 8.5% of the samples. Repeat spawners comprised 4.3%. In addition to the more numerous summer sea trout, winter sea trout still occur in the Drwęca River, although they currently constitute only about 10% of all sea trout.

Key words: SEA TROUT (*SALMO TRUTTA* M. *TRUTTA*), AGE STRUCTURE, SUMMER STOCK, WINTER STOCK, SPAWNING MARKS

INTRODUCTION

The Drwęca River is 207 km long and reaches the Vistula River 50 km below the dam in Włocławek. It is probably the only lower Vistula system river in which sea trout (*Salmo trutta* m. *trutta*) used to and still do spawn in great numbers (Willer 1929 after Backiel 1964, Bontemps 1995). Some of its tributaries have mountain stream characteristics such as slopes of up to 6‰ and gravel-stony bottoms which provide sea trout with good spawning grounds (Backiel 1964, Szczepański 1994). In the 1990s single sea trout spawners and redds were observed in the Drwęca tributaries Brynica and Pissa (Dębowski and Radtke 1999). In 1961 the Drwęca and some of its tributaries were designated as nature reserves and catches of migratory salmonids were banned. Significant efforts have been made to protect sea trout, for which the Drwęca River system is a spawning ground. For many years this river has been stocked with sea trout material of Vistula origin, and spawners are also taken from it for selection and reproduction (Bartel 1993). Bontemps (1995) described the age structure of the spawning stock in the Drwęca River in the late 1980s based on the returns of tags from specimens which returned for spawning and which had been tagged as smolts.

The aim of this work was to use a random sample of scales to describe the sea trout stock which concentrates in the Drwęca River during the spawning season. The age structure in both the riverine and sea life cycle stages of this species was determined, as was the frequency of occurrence of specimens which were repeat spawners. The issue of whether or not the sea trout occurring in the Drwęca River retain traits of the former Vistula population was addressed, and more importantly, it was investigated if the two spawning stocks of winter and summer sea trout which were once observed in the Vistula River still exist (Dixon 1931, Żarnecki 1963, Borzęcka 1998).

MATERIALS AND METHODS

Scales were collected from 174 sea trout specimens caught from 1988 to 1992 in a fish trap located in Lubicz and by anglers fishing in the lower Drwęca River from January to November. In addition to the scale samples, information on the time the fish were caught, fish length, and sometimes fish weight and sex were recorded. The samples from 1988 and 1989 contained sea trout which had been tagged as smolts in the spring of 1987; this permitted verifying determinations of the sea age of the studied fish. The description of a picture of a salmonid scale is usually denoted as A.B+, where A is the number of annual rings formed on the scale during the riverine period, and B – the number of annual rings formed during the growth period in the sea, + is the growth zone of the scale between the last ring formed in the sea and the margin, although the fish can attain this increment in the year it is caught or in the previous year. The first step in determining sea trout age was to identify the number of rings formed in the sea and measure the marginal increments – the measure of this was the number of sclerites beyond the last annual ring formed in the sea. This measure was used to check the age determinations. More importantly, it was used to determine when the fish left the sea to ascend the river. Knowing the time at which the fish began the spawning migration allowed particular sea trout specimens to be assigned to either the winter or summer spawning stock (Żarnecki 1963, Borzęcka 1998). The scales were also used to determine which specimens were repeat spawners. The condition of the fish comprising the spawning stock in the Drwęca River was determined using the Fulton coefficient, as follows:

$$F = \frac{W100}{L^3}$$, where L - *longitudo caudalis* (cm), W – fish weight (g)

The dependence between fish weight and length was also determined, as follows:

$$W = aL^b$$, where a and b – coefficients determined from empirical data.

RESULTS

There are three main annual migrations of adult sea trout in the lower Vistula River: fish which ascend the river in winter or in summer to spawn and those which descend the river to the sea after spawning. These ascending and descending migrations peak in different months; November-December and July-August-September are the periods when the two major migrations, winter and summer, are forming, while kelts descend to the sea in late fall and early spring (Fig. 1, Part A). The sample material from the Drwęca River was collected in all months except December. Since the scale samples came from anglers and were not collected systematically in particular seasons,

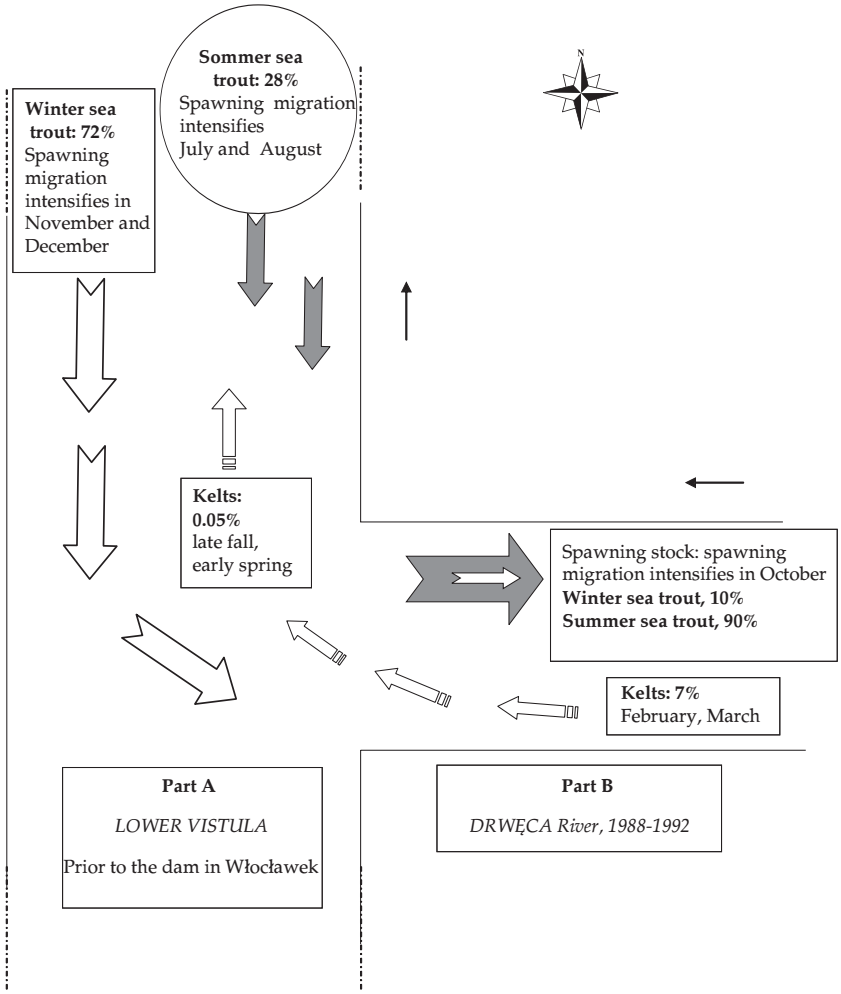

Fig. 1. Sea trout migrations in the Vistula River prior to damming in 1968 and in the Drwęca River in 1988-1992. The percentage of kelts was calculated in relation to all fish in the samples, the percentage of winter and summer sea trout in relation to spawning fish.

it was essential to develop a general method for identifying the seasonal stocks and detailed criteria for classifying specimens which would spawn in the following year, those which had spawned in the current year and those which were spent.

The size of the marginal increments on the scales of the sea trout from the Drwęca River exhibited significant variability, with small, average and large increments noted on the scales of fish from the same age groups (Fig. 2). The degree of scale resorption was also very diverse; this refers to the magnitude of scale structure loss which occurs mainly in the caudal and lateral sections due to physiological changes in the fish during the spawning migration and spawning itself. Based on the marginal increments and the degree of scale resorption, the time the fish was caught and their condition determined with the Fulton coefficient, the three following groups of sea trout were identified in the Drwęca River (Fig.1, Part B):

1. The first group was comprised of specimens caught by anglers between January and June. They had large marginal increments from the previous year and a low degree of scale resorption (Photo 1). The condition coefficient of specimens from this group exceeded 1.2. It was assumed that these were sea trout which had

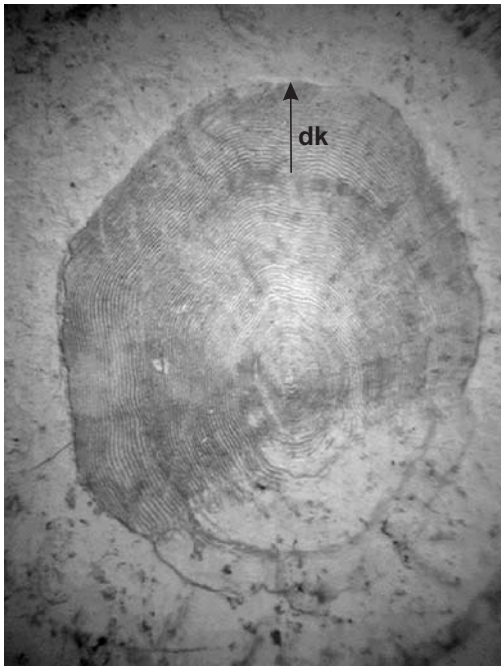

Photo 1. Scale picture of a sea trout caught in the Drwęca River in May 1991. Fish length - 70 cm, weight - 3.3 kg, age - 2.2+. Marginal increment (dk) formed in the previous year. Winter sea trout.

Photo 2. Scale picture of a sea trout caught in the Drwęca River in fall 1990. Fish length - 59 cm, age - 2.1+. Marginal increment (dk) is small and was formed in the year the fish was caught.

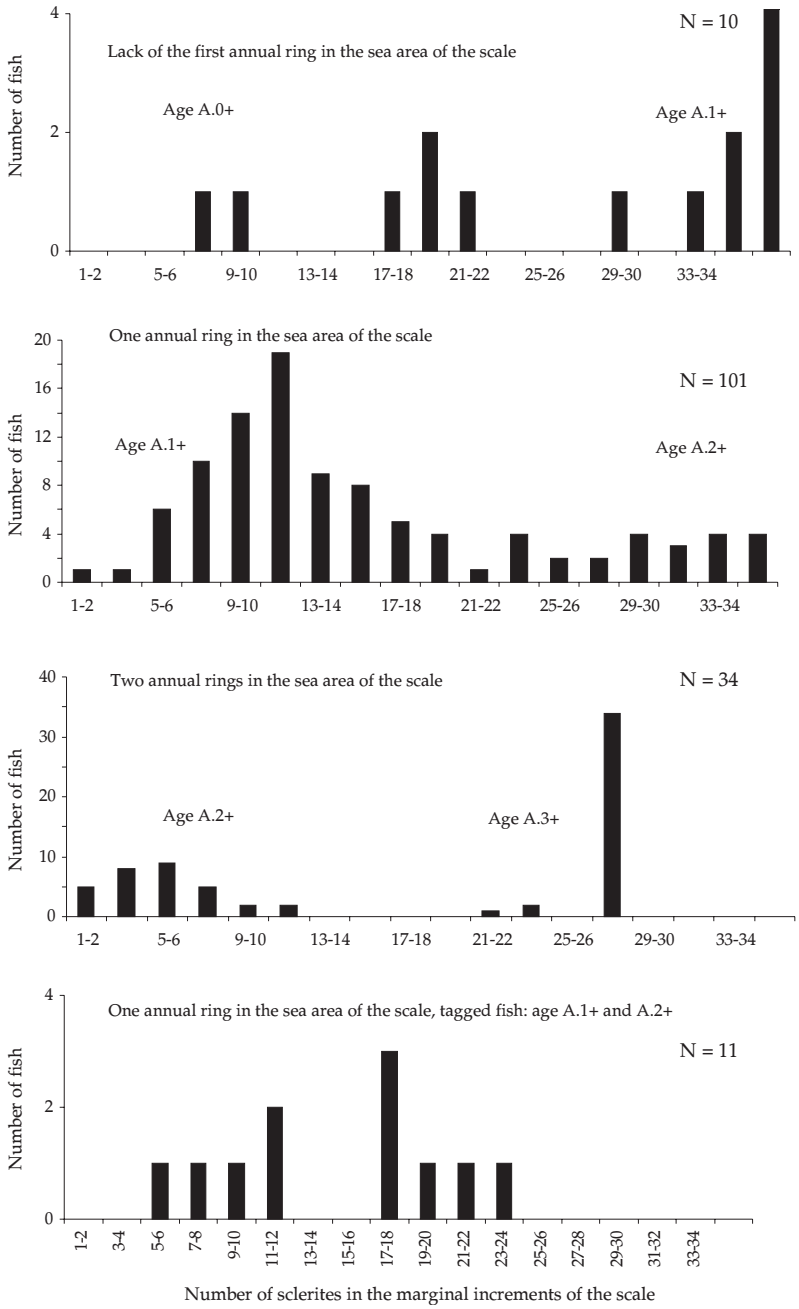

Fig. 2. Size distributions of marginal increments on sea trout scales from the Drwęca River. The number of sclerites was the measure of increments, N – number of fish.

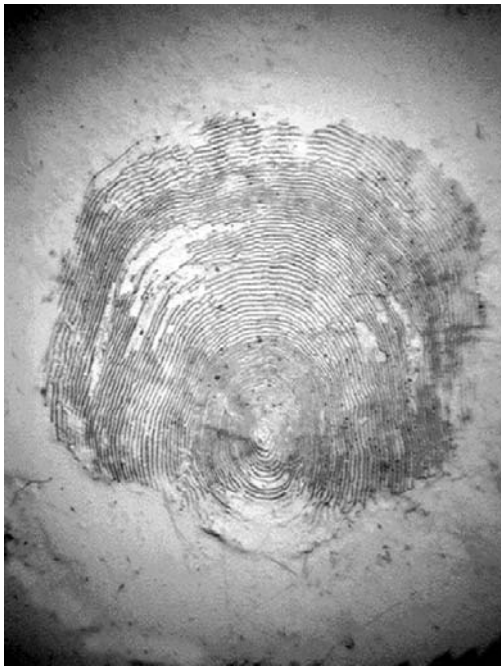

Photo 3. Scale picture of a sea trout caught in the Drwęca River in winter 1992. Kelt-male aged - 2.1+. Scale resorbed, especially in the caudal section. Fulton coefficient F = 0.84.

Photo 4. Scale picture of a sea trout caught in the Drwęca River in fall 1988. Fish age - 2.1+. Marginal increment (dk) formed in the year the fish spawned. Fish tagged in spring 1987 as a 2+ smolt.

ascended the river early in the year preceding spawning, and thus they exhibited features of the former winter trout. They constituted 10.3% of the entire sample.

2. The second group was comprised of specimens caught in summer and early fall. The scales had either a small (average) marginal increment that had formed in the year they were caught or a large increment from the previous year. These were fish which would soon spawn and there was clear scale resorption – they corresponded to summer Vistula sea trout and Pomeranian sea trout (Photo 2).
3. The third group was comprised of specimens caught in winter. Their scales had large marginal increments which were most frequently highly resorbed (Photo 3). The Fulton condition coefficient was below 1.0. These fish were regarded as spent kelts and constituted an average of 6.9% of the samples.

The scales from fish of known ages which were caught in the fall of 1988 had one ring that had formed in the sea and a small marginal increment from that year, thus their age corresponded to the number of rings A.1+ (Photo 4). Specimens caught in

Photo 5. Scale picture of a sea trout caught in the Drwęca River in October 1989. Fish age - A.2+. Marginal increment (dk) is large and formed in the year preceding spawninig. Fish tagged in spring 1987 as a 2+ smolt.

1989 also had one ring that had formed in the sea, so the picture of the scale was denoted as A.1+; however, the marginal increment was large and from a whole year, so the age was denoted as A.2+ (Photo 5). Thus, in both cases, the age determined from the scales corresponded to the data obtained from fish tagging.

Of the whole sample, 5.7% of the sea trout did not have the first annual ring which formed in the sea on their scales; 1.2% of these fish returned to the river in the same year they had left it, so they were aged A.0+. Sea trout aged A.1+ constituted from 36.2% to 73.1% of the sample in subsequent years (average of 46.3%). The most numerous group of fish in the samples, at an average of 48.8%, was that which ascended the Drwęca River in their third year in the sea, i.e., at the age of A.2+. Fish aged A.3+ which had spent four seasons in the sea constituted an average of 3.7% of the samples (Table 1).

TABLE 1

Age distribution of the spawning stock of sea trout from the Drwęca River in the sea stage of the life cycle, based on samples from 1988 to 1992; 12 kelts disregarded

Sample from year	Sea trout age								
	A.0+		A.1+		A.2+		A.3+		total
	specimens	%	specimens	%	specimens	%	specimens	%	specimens
1988 N = 26	0	0	19	73.1	6	23.1	1[x]	3.8	26
1989 N = 47	1	2.1	19	40.4	26[x]	55.3	1[x]	2.1	47
1990 N = 9	0	0	6	66.7	2[x]	22.2	1[x]	11.1	9
1991 N = 50	0	0	19	43.2	22	50.0	3	6.8	44
1992 N = 42	1	2.8	14	38.9	21[x]	58.3	0	0	36
Total	2	1.2	75	46.3	79	48.8	6	3.7	162

[x] *denotes an individual in sample with a spawning mark; in total, there were seven repeat spawners, i.e., 4.3% of the sample*

Since the presence of sea trout in the Drwęca River is largely thanks to annual stocking, an attempt was made to adjust the age structure according to the numbers of smolts released. Table 2 presents the distribution of the numbers of subsequent smolt generations in stocking, and the values at the bottom are the transformed coefficients. The numbers in particular age groups divided by the appropriate coefficient yielded the hypothetical, standard age distribution (Table 3) at a constant level of smolt recruitment to the sea. This confirms that the majority of the fish in the Drwęca River spawn at the age of A.2+.

TABLE 2

Age distribution of the sea trout spawning stock from the Drwęca River in the sea stage of life with divisions into spawning years and smolt generations. The stocking intensity is described by the abundance of each generation (Table 1 expanded)

Spawning year	Year descended to sea	Smolt generation							
		1985	1986	1987	1988	1989	1990	1991	1992
	Stocking in thousands	10	10	50	50	100	100	100	50
1988	Fish age	A.3$^+$	A.2$^+$	A.1$^+$	A.0$^+$				
	Abundance	1	6	19	0				
1989	Fish age		A.3$^+$	A.2$^+$	A.1$^+$	A.0$^+$			
	Abundance		1	26	19	1			
1990	Fish age			A.3$^+$	A.2$^+$	A.1$^+$	A.0$^+$		
	Abundance			1	2	6	0		
1991	Fish age				A.3$^+$	A.2$^+$	A.1$^+$	A.0$^+$	
	Abundance				3	22	19	0	
1992	Fish age					A.3$^+$	A.2$^+$	A.1$^+$	A.0$^+$
	Abundance					0	21	14	1
	Stocking coefficient*	0.2	0.2	1	1	2	2	2	1

* *stocking coefficient 1 = 50000 individuals*

TABLE 3

Standard age structure of sea trout spawning stocks from the Drwęca River. Age determined in the sea stage of fish life. Abundance presented at stable smolt recruitment coefficient of 1 = 50000 individuals (Table 2 transformed)

Spawning stock		Fish age				Total
Year	Abundance	A.3$^+$	A.2$^+$	A.1$^+$	A.0$^+$	
1988	N	5	30	19	0	54
	%	9,3	55.6	35.2	0	100
1989	N	5	27	18	1	51
	%	9.8	52.9	35.3	2.0	100
1990	N	1	2	3	0	6
	%	16.7	33.3	50.0	0	100
1991	N	3	11	10	0	24
	%	12.5	45.8	41.7	0	100
1992	N	0	10	7	1	18
	%	0	55.6	38.9	5.6	100
Average standard distribution	N	13	81	56	2	153
	%	8.5	52.9	36.6	1.3	100

A decided majority of sea trout specimens in the samples, an average of 87.8%, reached the smolt stage after two years in the river. This age group constituted 77.3% in 1988, 91.2% - 1989, 87.5% - 1990, 91.3% - 1991, and 86.8% - 1992. The fish which reached the smolt stage in one year constituted an average of 6.8%, and the specimens with three years in the river constituted an average of 5.4% (Fig. 3).

The fish which repeated spawning comprised from 0% to 22% in particular years, and the long-term weighted average of frequency of occurrence of fish with spawning marks in the Drwęca River samples was 4.3 %.

Fish length varied from 40 to 89 cm. The average length of fish caught in the trap was 67.9 cm. Anglers caught larger specimens at an average of 74.1 cm. Females dominated the samples at 73%; their average length was 70.8 cm and average weight – 3.97 kg. The males were smaller with an average length of 64.0 cm and an average weight of 3.0 kg. The Fulton condition coefficient was 1.09 for males and 1.08 for females (Fig. 4).

DISCUSSION

The peak of the sea trout spawning migration in the Drwęca River occurs in October (Bontemps 1995, Bartel and Bontemps 1995); however, the period when the spawning migration begins and the fish ascend the river is extended over time, which is reflected by the high variability in the size of the marginal increments on the scales and the time when the fish were caught (Fig. 2 and 5). The fish ascended the river even before the increments had formed in the sea in the year of the migration, or they exhibited only small increments. Alternatively, large increments which had formed in the sea were visible on the scales; these might have formed in the year the fish ascended or in the previous year (Sych 1967, Borzęcka 1991). Three main sea trout groups in the Drwęca River were identified based on these assumptions and the degree of scale resorption: spent kelts, "summer" sea trout specimens which were ready for spawning, and specimens with characteristics of "winter" sea trout, i.e., those which had waited in the river for one year for the spawning season. Since the trap gear was not set during the smolt migration season, this group of fish was not represented in the study material. The samples from 1988 and 1989 were especially interesting, as they included 11 fish which had been tagged as smolts and released into the Drwęca River in March 1987. This provided a rare opportunity to verify the scale age determinations.

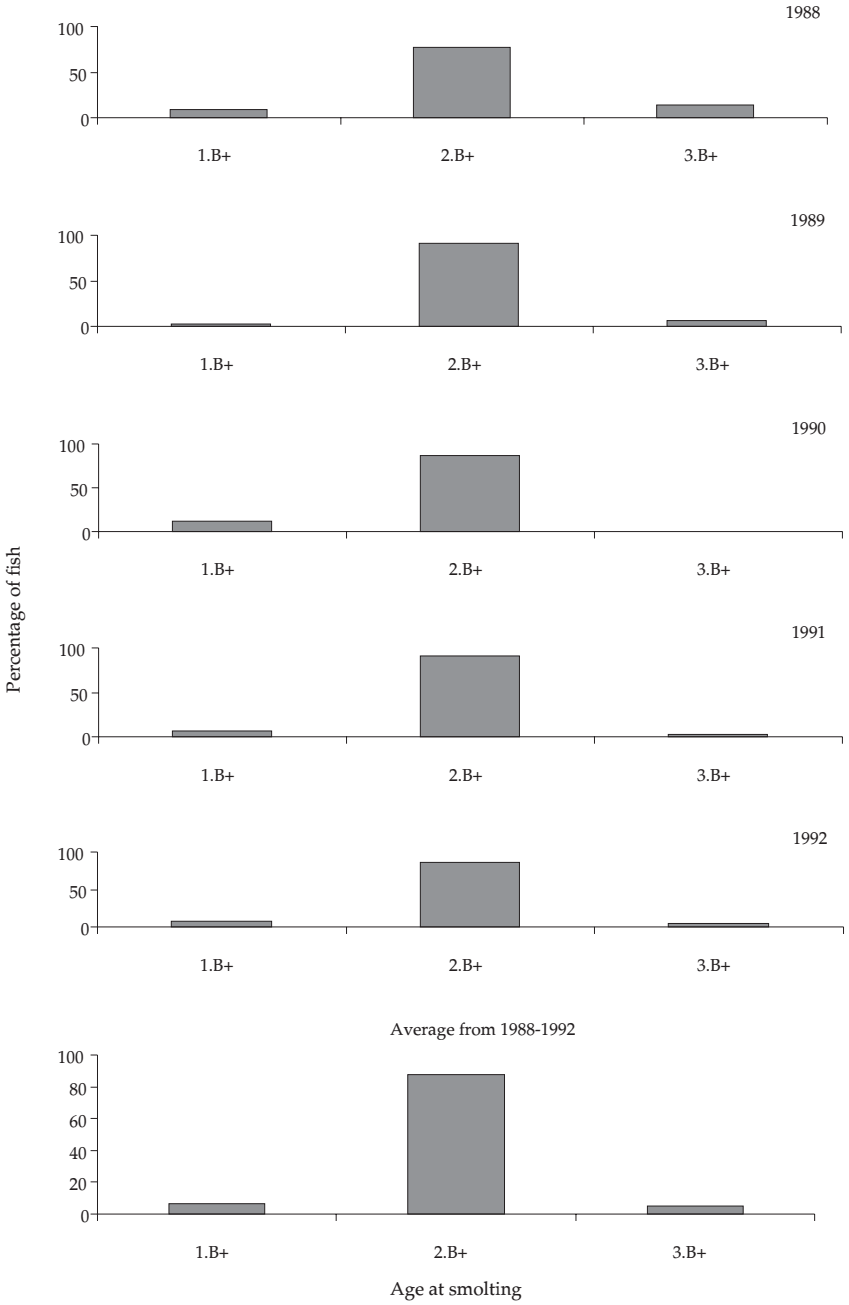

Fig. 3. Age structure of sea trout spawning stock in the Drwęca River in the riverine stage of life, based on samples from 1988-1992.

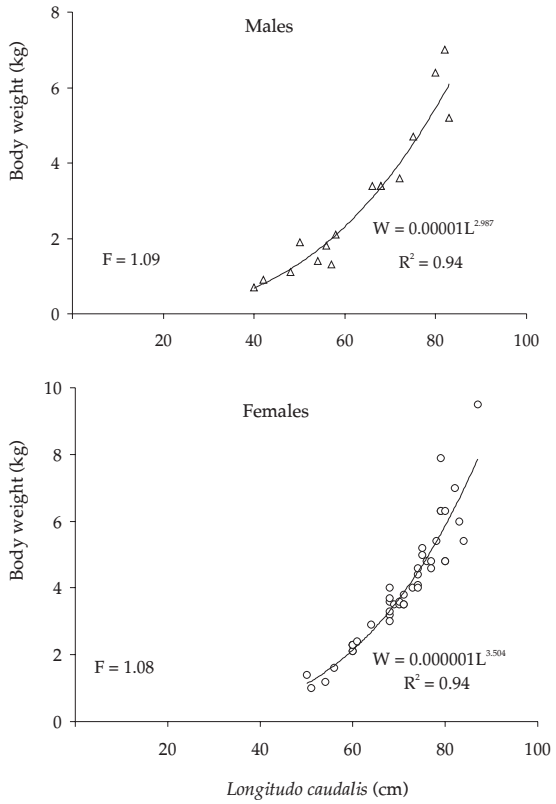

Fig. 4. Dependence of body weight on length (*l. caud*.) for sea trout males and females in the Drwęca River; F = condition coefficient.

The spawning stocks in the Drwęca River were dominated (at almost 88%) by fish which had reached the smolt stage after two years in the river. A similar age distribution was noted in the former winter spawning stock. Among the ascending "summer" sea trout, those which had stayed in the river for one year before reaching the smolt stage were the most numerous (Borzęcka 1999). It seems, however, that in this case the clear domination of age group 2 smolts is closely related with the age structure of the stocking material, which, in 1987-1990, consisted mostly of age group 2 smolts (Bontemps 1995).

The description of the age structure included changes in the numbers of smolts as these were present in the Drwęca River almost entirely as a result of high stocking levels that fluctuated annually. Table 3 presents the hypothetical, standard age distribution which would occur at a stable stocking level. It is clear that the sea trout spawning stock in the Drwęca River was comprised mainly of fish which had spent

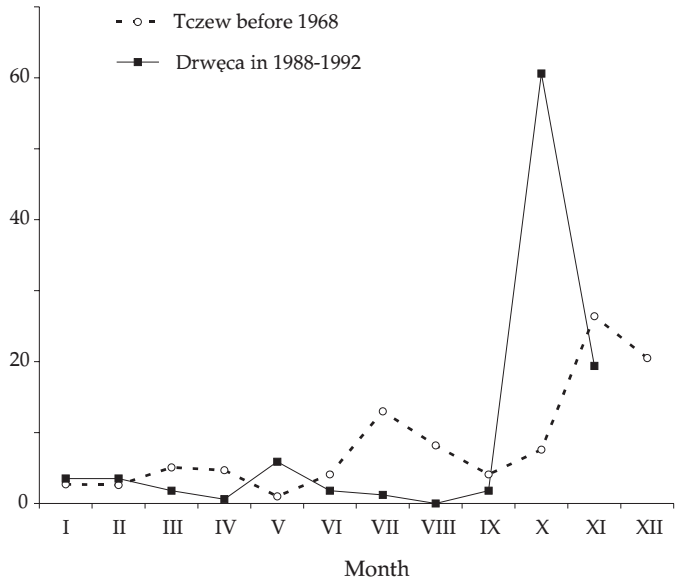

Fig. 5. Distribution of sea trout catches in particular months: in the Vistula River near Tczew before 1968 (nets) and in the Drwęca River in 1988-1992 (angling catches and fish trap).

three growth seasons in the sea – they constituted about 53% of the fish. About 37% of the fish were aged A.1+. Specimens which had spent either longer or shorter periods in the sea were not numerous in the samples - sea trout aged A.0+ constituted 1.3% of the spawning stock, and fish aged A.3+ constituted 8.5%. These figures correspond to the tendencies once exhibited by Vistula sea trout (Borzęcka 1999).

An average of 4.3% of the fish returned to the river for repeat spawning, as was indicated by the spawning marks on the scales (Table 1). These marks occur on the scales of migratory salmonids during compensatory body growth following spawning and are a reflection of scale rebuilding after losses incurred through resorption during spawning migrations (Backiel and Sych 1958). This figure is almost four-fold higher than the long-term average (1.3%) determined for the former Vistula sea trout which undertook spawning migrations (Borzęcka 1999). This is probably because the migration route to the Drwęca River, which is located closer to the Vistula River mouth, is significantly shorter that the previous sea trout migration route which extended as far as 1000 km to the mountain tributaries of the Vistula River at the foot of the Carpathian Mountains (Dixon 1931, Żarnecki and Kołder 1955).

The occurrence of repeat sea trout spawners and kelts, which remained in the spawning grounds longer, even until March, confirms that the Drwęca River still provides good conditions for sea trout spawning.

Females constituted 73% of the sample of fish for which sex had been determined. In former sea trout spawning stocks, sexual disproportion was even more pronounced. The average long-term frequency of occurrence of females in samples of winter stocks of Vistula sea trout in 1960-1968 was 88.6%, and in those of "summer" sea trout – 78.5% (Borzęcka 2001).

The next issue addressed in this paper was if, in spite of disturbances in fish populations caused by the construction of the dam in Włocławek which prevented migration to the upper Vistula River spawning grounds, the two distinct spawning migration seasons still existed among the Vistula sea trout. Stocking is conducted annually to preserve the Vistula sea trout stock, and this means that there is human intervention in sea trout reproduction. The origin and selection of parental material, smolt cultivation conditions, and the choice of areas to be stocked can all disrupt the diversity of spawning migration times which are characteristic in the Vistula. This is especially true of the winter stock of Vistula sea trout, which was once the most abundant stock but is currently in decline (Dixon 1931, Chrzan 1947, Borzęcka 1998). A total of 10.2% of the specimens from the sample exhibited traits of the former winter sea trout. This indicates that it still occurs in the Drwęca River drainage area and may become genetic resources to use during in restitution projects (Sych 1998). This presents issues related to the protection of this group of fish in the spawning grounds as well as the necessity of providing juvenile sea trout with a safe environment in the Drwęca River and unconstrained access to the Baltic Sea. The Drwęca River should be designated as a reserve and a gene bank of natural stocks of Vistula sea trout. This would require every angling catch in the river drainage area to be reported and scale samples to be collected in order to monitor the state of the population.

REFERENCES

Backiel T. 1964 - Fish populations in the Drwęca River system - Rocz. Nauk Rol. 84(B): 193-211 (in Polish).

Backiel T., Sych R. 1958 - Resorption and spawning marks of sea trout scales in Polish waters - Rocz. Nauk Rol. 73-B: 119-158 (in Polish).

Bartel R. 1993 - Present situation of the Vistula sea trout - Arch. Pol. Fish. 1: 101-111.

Bartel R., Bontemps S. 1995 - Possibility of natural spawning of Vistula River Sea trout in the Drwęca River - ICES.C.M.1995/M: 35.

Bontemps S. 1995 - Sea trout ascending the Drwęca River - Rocz. Nauk. Pol. Zw. Węd. 8: 53-74 (in Polish).

Borzęcka I. 1991 - A methodical problem of ageing salmon and sea trout in the spawning season - Working document to the ICES Workshop on Scale Reading for Baltic Salmon - Appendix 2: 1-3.
Borzęcka I. 1998 - The historical picture of summer and winter sea trout occurrence in the Vistula River - Bull. Sea Fish. Inst. Gdynia 3(145): 51-56.
Borzęcka I. 1999 - The age of migrating Vistula sea trout and the variability of smolt recruitment to the sea before damming the river - Bull. Sea Fish. Inst. Gdynia 3(148): 3-21.
Borzęcka I. 2001 - Growth of Vistula sea trout (*Salmo trutta* m. *trutta* L.) based on adults caught in the Vistula River prior to the construction of the dam in Włocławek - Bull. Sea Fish. Inst. Gdynia 2(153): 3-12.
Chrzan F. 1947 - Salmonid issues in Poland - Morski Instytut Rybacki w Gdyni (manuscrtipt) (in Polish).
Dębowski P., Radtke G. 1999 - Sea trout in the Brynica River - Rocz. Nauk. Pol. Zw. Węd. 12: 105-111 (in Polish).
Dixon B. 1931 - Age and growth rate of sea trout (*Salmo trutta*) in the Reda and Dunajec rivers - Prace Dz. Ekon. i Organiz. Rybactwa PAN Gosp. Wiejskiej 46 (in Polish).
Sych R. 1967 - Age determination of sea trout (*Salmo trutta* L.) during annual ring formation - Rocz. Nauk Rol. H-90-2: 305-325 (in Polish).
Sych R. 1998 - Restitution program of migratory fish in Poland – from the origin to initial realization - Idee Ekologiczne 13: 71-86 (in Polish).
Szczepański Z. 1994 - Studies of the effectiveness of natural spawning of migratory sea trout in the Drwęca River drainage area. Using streams in the Drwęca River drainage area for smolt cultivation - Komun. Ryb. 4: 21-25 (in Polish).
Żarnecki S., Kołder W. 1955 - Observations of fish migrations through the fish ladder in Rożnów and Czchów - Rocz. Nauk Rol. 69(B): 501-525 (in Polish).
Żarnecki S. 1963 - Occurrence of seasonal populations of Atlantic salmon (*Salmo salar* L.) and sea trout (*Salmo trutta* L.) in the Vistula River - Acta Hydrobiol. 5: 254-294.

STRESZCZENIE

CHARAKTERYSTYKA TROCI (*SALMO TRUTTA* M. *TRUTTA*) Z DRWĘCY NA PODSTAWIE MATERIAŁU ŁUSKOWEGO ZEBRANEGO W LATACH 1988-1992

Po przegrodzeniu w 1968 r. Wisły zaporą pod Włocławkiem zamykającą, dawny szlak migracji ryb wędrownych w górę rzeki, Drwęca stała się ostatnim wiślanym dopływem, do którego nadal licznie wstępuje na tarło troć wiślana. W tej pracy, starano się scharakteryzować strukturę stada tarłowego troci w Drwęcy w latach 1989-1992 oraz zbadać, czy zachowały się charakterystyczne dla Wisły dwa ciągi tarłowe, zimowy i letni (rys. 1 A). Na podstawie łusek troci chwytanych w smołówkę i przez indywidualnych wędkarzy, wyróżniono trzy grupy ryb: osobniki z małym przyrostem krawędziowym i wyraźną już resorpcją łuski – odpowiednik „letniej" troci wiślanej i troci pomorskiej, osobniki z dużym zeszłorocznym przyrostem krawędziowym na łusce i słabą jeszcze resorpcją – odpowiednik dawnej troci „zimowej" oraz ryby o silnie zresorbowanych łuskach i niskim współczynniku kondycji Fultona, które uznano za spływające po tarle kelty (rys. 1 B).

Okres pobytu troci w rzece do osiągnięcia stadium smolt wyglądał następująco: 6,8% ryb osiągnęło stadium smolt po jednym roku pobytu w wodzie słodkiej, trocie po dwurocznym pobycie w rzece stanowiły średnio 87,8%, a trzyrocznym – średnio 5,4% (rys. 3). Ryby powracały do rzeki najczęściej po trzech sezonach troficznych w morzu tj. w wieku A.2+, średnio 48,8%. Osobniki w wieku A.0+ stanowiły 1,2%, a ryb w wieku A.1+ było od 36,2% do 73,1%; średnio 46,3%. Trocie po czterech sezonach w morzu, czyli w wieku A.3+ stanowiły w próbach średnio 3,7% (tab. 1). Wieloletnia średnia ważona częstość występowania ryb ze znakiem tarłowym wyniosła w próbach z Drwęcy 4,3% - w poszczególnych latach od 0% do 22% (tab. 1).

W grupie troci o znanej płci przeważały samice, stanowiły one 73% materiału. Średnia długość samic wynosiła 70,8 cm przy średniej masie 3,97 kg. Samce były mniejsze, miały średnio 64,0 cm długości i 3,0 kg

masy. Współczynnik kondycji Fultona wyniósł dla samców 1,09, a dla samic 1,08 (rys. 4).

W próbach z roku 1988 i 1989 wystąpiły trocie znakowane w stadium smolt wiosną 1987 r., co pozwoliło na zweryfikowanie oznaczeń wieku morskiego badanego materiału (fot. 4 i 5).

W badanym materiale przeważała troć „letnia", jednak zaobserwowano ok. 10% osobników wykazujących cechy dawnej troci „zimowej". Ta grupa pojawia się więc nadal w dorzeczu Drwęcy i może stać się źródłem zasobów genetycznych do wykorzystania w pracach restytucyjnych.

CORRESPONDING AUTHOR:

Irena Borzęcka
Instytut Rybactwa Śródlądowego
Zakład Rybactwa Rzecznego
Żabieniec
05-500 Piaseczno
Tel./Fax:+48 22 7562044, 7562088; e-mail:rzeki@infish.com.pl