

Zygmunt CHEŁKOWSKI

Fish biology

**BIOLOGICAL CHARACTERISTICS OF SEA TROUT SMOLTS
(*SALMO TRUTTA M. TRUTTA L.*) GROWN FROM FRY
RELEASED IN THE STREAM OSÓWKA**

**BIOLOGICZNA CHARAKTERYSTYKA SMOLTÓW TROCI WĘDROWNEJ
(*SALMO TRUTA M. TRUTTA L.*) WYROSŁYCH W POTOKU OSÓWKA Z
WSIEDŁONEGO NARYBKU**

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In spring 1987 the fry of sea trout was introduced into the upstream of Osówka. Smolts grown from this material were caught during three successive years after the fish release, with the aid of fish trap situated in the middle course of the stream. Sex, condition and coefficient of gonads development, as well as length, weight and factor condition of smolts of the known age were determined.

INTRODUCTION

The survival rate of juveniles of sea trout (*Salmo trutta m. trutta L.*) grown in Osówka stream, from the introduction of fry to the downstream migration, appeared to be ca three times higher than the survival rate of feeding larvae of sea trout till the period of descending [Chełkowski 1993]. Undoubtedly the biological characteristics of smolts grown in Osówka from the introduced fry of known age when comparing to the data given by Chełkowski [1990, 1992] concerning sea trout smolts grown in the same stream from the feeding larvae of as well known age, could demonstrate not only the cognitive but also practical value.

The present paper is third in a series of studies on sea trout smolts grown in Osówka stream from the fry released [Chełkowski 1993, 1993a].

MATERIAL AND METHODS

Osówka is one of the small left-side tributaries of lower Odra river, having its source in Warszawskie Hills reaching 131 m over the sea level. No salmonids were found in the indigenous ichthyofauna [Chełkowski 1993]. 3080 individuals of sea trout fry in the age of 10 weeks, at the mean length of 30.7 ± 0.66 mm and weight of 281.6 ± 5.66 g were released into the upper course of Osówka on 7 May, 1987 [Chełkowski 1993]. The fry was obtained from eggs of sea trout captured in the river Rega in autumn, 1986, being under incubation in the deep water, at constant temperature of 8°C. Next the fry was transferred to the rotary pond being swelling with the same water and fed by dry drop-stuff till the day previous to the release [Trzebiatowski et al. 1992]. Smolts grown from this material were caught during their descent to the sea with the aid of fish trap located in the middle current of stream, working from the 1 March to 15 July 1988, 1989 and 1990, i.e. in three successive years after the release. Smolts in Pomeranian rivers migrate downstream in spring [Chełkowski 1990; Dębowski et al. 1992], and their stay in the river till the period of descent is limited from 1 to 3 years [Chrzan 1959; Dixon 1931; Dębowski et al. 1992]. Length (l. caud.) in mm and weight in g of gutted and non-gutted smolts (without the alimentary tract, heart, liver, milt and gonads) were estimated. Sex was determined from gonads; their development was established according to 8-stage Maier's scale [Meisner 1948]. Next the weight of gonads was recorded with the accuracy to 1 mg in order to calculate the coefficients of gonad maturity demonstrating the per cent ratio of gonads weight to the weight of fish body. Coefficients of condition of sea trout smolts following the Fulton's formula were calculated in order to show their stage of condition [Opuszyński 1979] for gutted and non-gutted fish, what is suggested by Clark and Nikolski [according to Suvorov 1948]. The length-weight relationship of the sea trout smolts from Osówka stream was established, too, by the means of power function:

$$W = k * L^n$$

where: W = weight of whole fish; L = length in mm; k and n - coefficients [Szypuła 1988; Opuszyński 1979; Graa 1978].

RESULTS

Fish catches performed in the Osówka stream yielded a total of 284 sea trout smolts, including 275 specimens caught in the period from 5 March to 25 May, 1988 and 9 - from 18 March to 4 May, 1989. However in the catches in 1990 no smolts were found (Tab. 1). Moreover, in the first year of capture, 6 individuals in stage "parr" were collected.

Bearing in mind the lack of salmonids in indigenous ichthyofauna in Osówka stream as well as the period of life of juveniles studied, the sea trout smolts obtained in 1988 composed a group of 1-yr-old fish, while those captured in 1989 - a group of 2-yr-old one. As can be seen from the data presented, among smolts descending to the sea, 1-yr-old ones are considerable predominant (96.8 %), while compared to 2-yr-old (3.2 %) smolts.

Morphological differences of gonads examined of smolts from Osówka stream enabled the sex determination. The sex was determined for 273 specimens (96.1 %) in the sample investigated, however, in 11 cases in 1-yr-old group of smolts it was impossible. The stage of development of gonads studied allow to assign both ovaries and testes to the juvenile stadium - the first stage of development according to Maier's scale.

Table 1

Number of sea trout smolts obtained in the Osówka stream with respect to age and sex

Age	n*			
	Females	Males	Sex non determined	Total
1	138	126	11	275
2	7	2	-	9
Total	145	128	11	284

* Number of fishes

Basing on the group of 148 smolts (107 females and 41 males) with the weight of gonads recorded, coefficients of gonads maturity were established. The calculations performed showed the average value of 0.16 for ovaries and 0.08 for testes in relation to the weight of whole fish and 0.18 and 0.08, respectively, to the weight of gutted fish (Tab. 2).

Table 2

Coefficients of gonads maturity of smolts from the Osówka stream with respect to age

Age	n	$\bar{x} \pm m$	δ	V	Range
Whole fishes					
Females					
1	100	0.16 ± 0.005	0.047	28.67	0.06 - 0.31
2	7	0.15 ± 0.020	0.050	25.76	0.15 - 0.30
Total	107	0.16 ± 0.005	0.047	28.83	0.06 - 0.31
Males					
1	40	0.07 ± 0.01	0.036	49.63	0.03 - 0.19
2		0.23			
Total	41	0.08 ± 0.01	0.043	56.35	0.03 - 0.23
Gutted fishes					
Females					
1	100	0.18 ± 0.01	0.052	29.32	0.06 - 0.33
2	7	0.21 ± 0.02	0.051	24.67	0.16 - 0.32
Total	107	0.18 ± 0.005	0.053	29.26	0.06 - 0.33
Males					
	40	0.08 ± 0.01	0.040	50.02	0.03 - 0.22
2	1	0.24			
Total	41	0.08 ± 0.01	0.047	55.8	0.03 - 0.24

 \bar{x} - arithmetic mean, $\pm m$ - standard error, δ - standard deviation,

V - coefficient of variability.

Per cent ratio of ovaries weight to the weight of gutted 1-yr-old smolts reaches the mean value of 0.08, while for 2-yr-old - 0.24. The similar, although slightly lower values of coefficients of gonads maturity were obtained for the weights of whole smolts. Data presented indicate for the increase of coefficients of gonads maturity of 2-yr-old smolts when compared to 1-yr-old ones.

In the material investigated 145 females (53.1 %) and 128 males (46.9 %) with the sex determined were found. Females feebly predominated when compared to males, with sex ratio 1,1:1, respectively.

In the group of 1-yr-old fish females are also found more often (52.3 %) than males (46.9 %), while in 2-yr-old ones females prevailed considerably (77.8 %) (males - 22.2 %) (Tab. 1).

1-yr-old smolts were noticed in all nine 1-cm classes of length, ranging from 110 to 199 mm, while 2-yr-old males and females, probably in respect of low number of the fish examined, do not occur in all nine 1 cm length classes in the range of 150-249 mm (Tab.3).

Table 3

Frequency of occurrence of (specimens) females and males of sea trout smolts from the Osówka stream with respect to age and length classes

Age	Length class (mm)	Sex			
		Females	Males	Sex non-determined	Total
1 +	110 - 119	1	1	-	2
	120 - 129	7	5	1	13
	130 - 139	26	17	1	44
	140 - 149	32	35	4	71
	150 - 159	35	32	2	69
	160 - 169	19	21	2	42
	170 - 179	15	11	1	27
	180 - 189	1	3	-	4
	190 - 199	2	1	-	3
	Total	138	126	11	275
2 +	150 - 159	-	1	-	1
	210 - 219	2	-	-	2
	220 - 229	4	1	-	5
	240 - 249	1	-	-	1
	Total	7	2	-	9
In general		145	128	11	284

In the group of 1-yr-old smolts males and females predominate in two 1 cm length classes, covering the range from 140 to 159 mm. A total of 67 (48.6 %) females and 67 (53.2 %) males were found in these two length classes.

Disregarding both sex and age groups, sea trout smolts grown in the Osówka stream from the fry released, occurred in the greatest number in the length range of 140-149 mm (71 individuals - 25 %).

Further studies concerning the sex showed the same period of descending both for males and females.

The mean length of smolts studied ($n=284$) amounted to 153.3 mm, ranging from 118 to 245 mm. 1-yr-old sea trout smolts from Osówka stream attain the mean length of 151.2 mm (118-195 mm), while 2-yr-old - 217.1 mm, with the range of 153-245 mm. The mean length in females amounted to 154.1 mm (range: 119-245 mm), while in males - 152.6 mm, covering the range from 118 to 228 mm. The mean length in 1-yr-old females amounted to 150.5 mm, ranging from 119 to 195 mm, when in males - 159 mm with the range of length 118-191 mm. The mean length of 2-yr-old females was 224.7 mm (213-245 mm), and males 190.5 mm (153-228 mm). Thus the conclusion may be drawn on the similar mean lengths and length ranges, both for the whole period of study as well as in the successive years of life, particularly in the first one (Tab. 4).

Table 4

Length (mm) of sea trout smolts from the Osówka stream with respect to age

Age	n	$\bar{x} \pm m$	δ	V	Range
1	275	151.2 ± 0.87	14.500	9.59	118 - 195
2	9	217.1 ± 8.09	24.269	11.18	153 - 245
Total	284	153.3 ± 1.12	18.855	12.30	118 - 245
Females					
1	138	150.5 ± 1.28	15.001	9.97	119 - 195
2	7	224.7 ± 3.69	9.765	4.35	213 - 245
Total	145	154.1 ± 1.80	21.720	14.10	119 - 245
Males					
1	126	152.0 ± 1.25	14.034	9.23	118 - 191
2	2	190.5			153 - 228
Total	128	152.6 ± 1.37	15.449	10.13	118 - 228

The mean weight of whole smolts amounted to 40.8 g, covering the range from 16.3 to 171.8 g, while of gutted ones - 37.3 g (15.0-159.1 g). The mean weight of 1-yr-old whole smolts amounted to 38.2 g, of gutted ones - 34.9 g, when in 2-yr-old whole and gutted smolts - 118.1 g and 109.8 g, respectively. Further studies showed, that 1-yr-old gutted males attained slightly higher mean weight (35.4 g), while compared to the gutted 1-yr-old females (34.5 g), and in the group of 2-yr-old fish females attained considerably higher weight (120.2 g) when compared to males (73.2 g). Calculations performed for the whole period of investigations showed, that the mean weight was higher in the gutted females (38.6 g) when compared to the gutted males (36.0 g). The similar values of weights were found in the group of non-gutted females and males (Tab. 5).

Additionally, the trend of weights of sea trout smolts examined was worked up, in 1-cm classes of length with regard to both sexes. It was found out, that weights of males and females in particular length classes were found ranging widely however in the similar ranges, as it could be observed in the group of smolts grown from the larvae feeding in the Osówka stream [Chełkowski 1992].

Table 5

Weight (g) of sea trout smolts from the Osówka stream with respect to age

Age	n	$\bar{x} \pm m$	δ	V	Range
Whole fishes					
1	275	38.2 ± 0.69	11.398	29.80	16.3 - 84.5
2	9	118.1 ± 12.14	36.424	30.84	35.0 - 171.8
Total	284	40.8 ± 1.13	19.067	46.76	16.3 - 171.8
Gutted fishes					
1	275	34.9 ± 0.63	10.516	30.10	15.0 - 78.0
2	9	109.8 ± 11.11	33.344	30.38	33.0 - 159.1
Total	284	37.3 ± 1.05	17.724	47.50	15.0 - 159.1
Whole fishes Females					
1	138	37.6 ± 0.99	11.609	30.84	19.5 - 84.5
2	7	129.6 ± 9.15	24.216	18.69	89.4 - 171.8
Total	145	42.1 ± 1.94	23.342	55.47	19.5 - 171.8
Males					
1	126	38.8 ± 1.00	11.171	28.79	16.3 - 70.8
2	2	78.0			35.0 - 121.0
Total	128	39.4 ± 1.17	13.242	33.60	16.3 - 121.0
Gutted fishes Females					
1	138	34.5 ± 0.91	10.686	31.01	17.6 - 78.0
2	7	120.2 ± 8.25	21.831	18.16	84.0 - 159.1
Total	145	38.6 ± 1.80	21.670	56.14	17.6 - 159.1
Males					
1	126	35.4 ± 0.92	10.383	29.35	15.0 - 66.0
2	2	73.2			33.0 - 113.4
Total	128	36.0 ± 1.09	12.384	34.43	15.0 - 113.4

Bearing that fact in mind the sex was disregarded, only the trend of weights of smolts examined occurring in 14 length classes was worked up, separately for the gutted and non-gutted fishes (Tab. 6). The mean weights of whole smolts increases in the successive length

classes from 21.7 g in the lowest class (110-119 mm) to 171.8 g in the highest one (240-249 mm). The average weight of whole smolts in the most numerous length class (140-149 mm) amounted to 33 g. Similarly, the mean weights of the gutted smolts increase in the consecutive classes of length from 19.2 to 159.1 g, with the average weight in the most numerous length class (140-149 mm) amounting to 29.8 g.

Table 6

Weight (g) of sea trout smolts from the Osówka stream with respect to length classes

Length class (mm)	n	Weight of whole fish		Weight of gutted fish	
		\bar{x}	Range	\bar{x}	Range
110 - 119	2	21.7	21.6 - 21.8	19.2	19.0 - 19.3
120 - 129	13	21.7	16.3 - 26.2	19.9	15.0 - 24.0
130 - 139	44	26.4	20.4 - 34.5	24.0	19.0 - 30.5
140 - 149	71	33.0	24.0 - 43.4	29.8	21.9 - 39.3
150 - 159	70	40.0	29.4 - 52.0	36.6	27.0 - 45.5
160 - 169	42	46.5	31.7 - 58.5	43.0	30.6 - 54.0
170 - 179	27	54.7	40.6 - 63.0	50.2	38.8 - 59.0
180 - 189	4	67.3	61.5 - 76.5	61.9	57.3 - 68.0
190 - 199	3	74.6	68.6 - 84.5	69.1	63.4 - 78.0
200 - 209	-	-	-	-	-
210 - 219	2	103.6	89.4 - 117.8	97.0	84.0 - 110.0
220 - 229	5	129.8	117.0 - 149.8	120.4	110.8 - 138.0
230 - 239	-	-	-	-	-
240 - 249	1	171.8	-	159.1	-
Total	284	40.8	16.3 - 171.8	37.3	15.0 - 159.1

As can be seen from further study, the mean weight of entrails of sea trout smolts from Osówka stream was 3.5 g, what is adequate for 8.6 % of weight of whole fish. The mean weighed of per cent contributions of smolts entrails in the weight of whole fish ranged from 6.4 to 11.5 in the particular 1 cm length classes.

Results of investigation performed so far allowed to calculate the mean increments of length and weight of the gutted smolts in successive years of river life. They amounted to 120.5 mm and 34.6 g in the first year of life and 65.9 mm and 74.9 g in the second one. Therefore the increment of length in the second year obtained only 54.7 % when compared to the first year, whereas the increment of weight increased by 216.5 % while compared to the increment in the first year of life. Thus the increment of length in the second year of river life decreases, while the increment of weight when compared to the first year of life, clearly increases.

The relationship length-weight of sea trout smolts from the Osówka stream can be described as follows:

$$W = 1.374^{-5} * L^{2.95099}$$

Fig. 1 presents this relationship expressed as the power curve graphically.

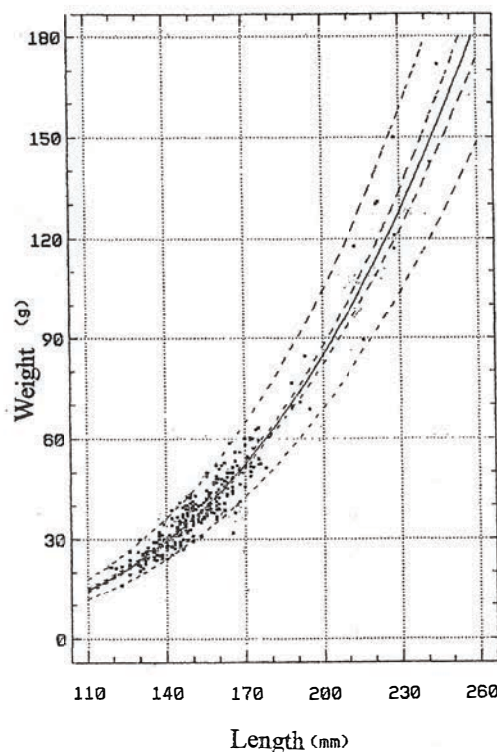


Fig. 1 Length-weight relationship of the whole sea trout smolts from Osówka
 $W = 1.374 \cdot L^{2.94099}$ ($r=0.96$)

The stage of condition of smolts from the Osówka stream was observed, too, basing on the coefficient of condition. The mean coefficient of condition for whole period of study reached the value of 1.08 varying from 0.71 to 1.37 for whole fishes and 0.99, ranging from 0.68 to 1.22, for the gutted ones. Ranges obtained indicate for high variability of stage of condition of smolts migrating downstream in Osówka (Tab. 7). Therefore the trend analysis of stage of condition of smolts in the length classes was performed.

Table 7

Coefficient of condition (K) of sea trout smolts from the Osówka stream

n	$\bar{x} \pm m$	δ	V	Range
Whole fishes				
284	1.08 ± 0.01	0.112	10.35	0.71 - 1.37
Gutted fishes				
284	0.99 ± 0.01	0.093	9.44	0.68 - 1.22

It appeared, that the mean coefficients of condition of smolts occurring in fourteen 1 cm classes of length in the range 110-249 mm obtained values pretty equal from 1.0 to 1.3, predominantly 1.1 for the whole fishes and from 1.0 to 1.2, mostly 1.0 for the gutted ones (Tab.8). However ranges of hesitations of coefficients of conditions in particular length classes indicate for quite different stage of condition of smolts examined.

By the means of fish trap located in Osówka stream in 1988 6 specimens of 1-yr-old trouts were captured, possessing coloration indicating for the "parr" stage. From this part of fish one-third was caught in the third decade of April and 5 in the first decade of May. Therefore they were collected in the period of intensity of smolts migrating in Osówka stream [Chelkowski 1993]. Three females and three males of length ranging from 118 to 135 mm and of weight of whole fishes 17.6-29.0 g and gutted ones 16.3-26.0 g, with the gonads in the juvenile stage in the first stage in Maier's scale, were found in the material. Lengths and weights of the trout in the parr stage cover the lower range of lengths of smolts from Osówka.

Table 8

Coefficient of condition (K) of sea trout smolts from the Osówka stream with respect to length classes

Length classes (mm)	Weight of whole fishes			Weight of gutted fishes	
	n	K		K	
		\bar{x}	Range	\bar{x}	Range
110 - 119	2	1.3	-	1.2	1.1 - 1.2
120 - 129	13	1.1	0.9 - 1.3	1.0	0.8 - 1.2
130 - 139	44	1.1	0.9 - 1.4	1.0	0.9 - 1.2
140 - 149	71	1.1	0.9 - 1.4	1.0	0.7 - 1.2
150 - 159	70	1.1	0.9 - 1.3	1.0	0.8 - 1.2
160 - 169	42	1.1	0.7 - 1.3	1.0	0.7 - 1.2
170 - 179	27	1.1	0.8 - 1.2	1.0	0.7 - 1.1
180 - 189	4	1.1	1.0 - 1.2	1.0	-
190 - 199	3	1.0	0.9 - 1.2	1.0	0.9 - 1.1
200 - 209	-	-	-	-	-
210 - 219	2	1.1	0.9 - 1.2	1.0	0.8 - 1.1
220 - 229	5	1.1	1.0 - 1.3	1.1	0.9 - 1.2
230 - 239	-	-	-	-	-
240 - 249	1	1.2	-	1.1	-
Total	284	1.1	0.7 - 1.4	1.0	0.2 - 1.2

In the autumn 1990, after the third season of spring catches of smolts grown from the fry released, the inquiries after trouts in Osówka began, which ones, according to Żarnecki [1961] could stay in the stream creating the resident form called *Salmo trutta m. fario*. However catches performed by the current-generating unit did not supply these fishes. So the conclusion may be drawn on migrating downstream of the trouts survived from the fry released in the stage of smolt or parr.

THE COMPARISON OF BIOLOGICAL CHARACTERS OF SEA TROUT SMOLTS GROWN IN OSÓWKA FROM THE LARVAE FEEDING AND FRY

Chełkowski [1990, 1992] dealt with biological characters of sea trout smolts grown in Osówka stream from the larvae feeding of length 21.6 mm and weight 108.3 g introduced in spring. The larvae came from eggs of the sea trout spawners from Rega, being under incubation in the surface water. The fry released to the Osówka stream in spring, on the other hand, came also from parental forms of sea trout from Rega, however the eggs incubation as well as rearing of juveniles took place in the deep water. The fry when compared to the larvae feeding, possessed larger by 9.1 mm mean length and higher by 177.3 mg mean weight. Variabilities occurring during the growth period should be taken into consideration as well while comparing smolts grown in Osówka stream from different stocking material.

The river period of life of sea trout smolts grown in Osówka stream from the larvae feeding, according to Chełkowski [1990, 1992], was limited to 1-3 years, while in sea trout smolts grown in the same stream from the fry released was shorter, amounting to 1-2 years. Independently on the stocking material released, the most numerous were 1-yr-old smolts. In this group occurred 89.5 % smolts grown from the larvae feeding and 96.8 % grown from the fry released. Contribution of smolts in two remaining age groups are considerably lower. In the 2-yr-old smolts, 8.9 % of fishes grown from the larvae feeding and 3.2 % - nearly three times less - grown from the fry released occurred. The contribution of 3-yr-old smolts grown from the larvae feeding amounted to 1.6 % and 0 % grown from the fry released. It seems that sea trout smolts grown in Osówka stream from the fry released reduce the river period of life when comparing to smolts grown from the larvae feeding.

Stage of gonads development of two compared groups of sea trout smolts of Osówka stream appeared to be similar. Ovaries and testes of smolts grown from larvae feeding, according to Chełkowski [1992], as well as from fry were in the juvenile stadium, in the first stage of Maier's scale. Coefficients of gonads maturity, too, were similar in two compared smolts groups from Osówka. Ovaries of smolts grown from the larvae feeding reached the mean value of 0.2 and for fry 0.18, while testes - 0.07 and 0.08, respectively, in relation to the weight of gutted fish.

Ratio females-males in the two compared groups of sea trout smolts grown in Osówka stream also seems to be an interesting phenomenon. Females are more numerous, while compared to males, both in smolts grown from the larvae feeding, according to Chełkowski [1992] and in smolts grown from the fry released. However the females-males ratio in groups compared was different. Pretty wider females:males ration occurred in smolts grown from the larvae feeding (1.7:1), when the narrower one in smolts grown from fry (1.1:1).

Sea trout smolts grown in Osówka stream from the larvae feeding, according to Chełkowski [1990] attain the mean length of 149 mm and weight of gutted fish 30.7 g in the first year of life, length 200.1 mm and weight 83.2 g in the second year of life and length 252.5 mm and weight 182.2 g in the third one. On the other hand, smolts grown in Osówka from the fry attain the mean length of 151.2 mm and weight of the gutted fish of 34.9 g and length of 217.1 mm and weight 109.8 g in the second year of life. Therefore sea trout smolts grown from the fry released attain feebly higher mean length and weight when compared to the sea trout smolts grown from larvae feeding (Fig. 2), during the consecutive years of river life.

Increments of length and weight established for the sea trout smolts grown in Osówka stream confirm this observation, except for the length of 1-yr-old smolts. In the group of 1-yr-old fish sea trout smolts grown from the larvae feeding reached slightly higher increments

of length (127.4 mm), while comparing to smolts grown from the fry (120.5 mm). The difference was small, amounting to 6.9 mm (Tab. 9).

Sea trout smolts from the upper Parsęta, thus from the same area of the country where Osówka stream is located, grown from the larvae feeding, according to Dębowski et al. [1992] attain the following mean length: 1-yr-old - 144 mm, 2-yr-old - 186 mm or 194 mm and 3-yr-old - 223 mm. Therefore in the successive years of river life the mean lengths of smolts grown in upper Parsęta from the larvae feeding reach also lower mean values when compared to the smolts grown in Osówka stream from the fry and very similar to the lengths of smolts grown in the Osówka from the larvae feeding.

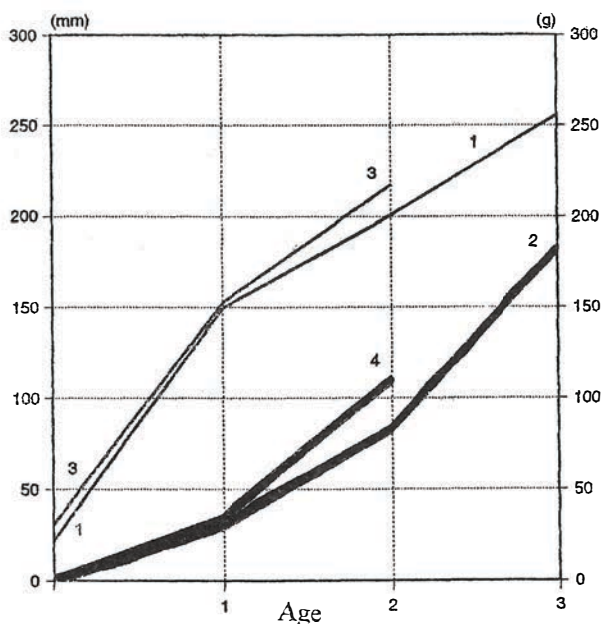


Fig. 2 Length and weight of gutted sea trout smolts from Osówka in the years of life: 1-length and 2-weight of fishes grown from larvae feeding, according to Chełkowski (1990): 3-length; 4-weight of fishes grown from the fry (from the examination)

Table 9

Comparison of length and weight increments of sea trout smolts gutted grown in the Osówka stream from the larvae feeding, according to Chełkowski (1990, 1992) and from the fry

Age	Larvae feeding		Fry	
	Length (mm)	Weight (g)	Length (mm)	Weight (g)
1	127.4	30.6	120.5	34.6
2	51.1	52.5	65.9	74.9
3	52.4	99.6		

Coefficients of condition, indicating the stage of condition of descending sea trout smolts from Osówka grown from larvae feeding, according to Chełkowski [1992] reach the values of 1.089 for whole fishes and 1.071 for gutted ones. However in the present study coefficients of condition reach 1.08 for non-gutted and 0.99 for gutted ones. As can be seen from the data presented sea trout smolts grown in Osówka stream from the larvae feeding and fry are in the similar stage of condition.

Additionally the comparison was made concerning length-weight relationships of sea trout smolts grown in Osówka, from the larvae feeding, according to Chełkowski [1990], and from the fry in 1 cm length classes, calculated involving the parameters of power function. Data obtained are presented in Table 10, in Fig. 3 being graphically expressed as power curves. It appeared that sea trout smolts grown from the fry attain in the successive twelve 1 cm length classes covered the range from 110 to 229 mm slightly higher weights when compared to smolts grown from the larvae feeding. In the two extreme high length classes, above 229 mm, smolts grown from the larvae feeding reached higher weights in relation to the smolts grown from fry. Such length-weight relationship is influenced from one side by smolts grown in Osówka from the fry reached length up to 245 mm, weight to 171.8 g and 1-3 years of river life and, from the other side, by smolts grown from the larvae feeding attaining larger length up to 260 mm, higher weight to 206.5 g and the period of river life longer by 1 year.

Table 10

Comparison of weight (g) of whole sea trout smolts from the Osówka stream grown from: a - fry, b - larvae feeding, according to Chełkowski (1990) calculated from the parameters of power function

Length class (mm)	a	b	a - b
110 - 119	14.5	12.6	1.9
120 - 129	18.8	16.6	2.6
130 - 139	23.8	21.3	2.5
140 - 149	29.6	26.9	2.7
150 - 159	36.3	33.5	2.8
160 - 169	43.9	41.0	2.9
170 - 179	52.5	49.6	2.9
180 - 189	62.1	59.3	2.8
190 - 199	72.9	70.3	2.6
200 - 209	84.8	82.6	2.2
210 - 219	97.9	96.3	1.6
220 - 229	112.3	111.5	0.8
230 - 239	128.1	128.2	-0.1
240 - 249	145.2	146.5	-1.3

In the group of 1-yr-old sea trout smolts from Osówka stream, grown from the larvae feeding, according to Chełkowski [1990] 7 trouts in the stage parr occurred. Among 1-yr-old descending smolts grown from the fry in Osówka stream 6 trouts in stage parr was obtained.

However the per cent ratio of trouts in the parr stage to smolts obtained grown from the fry was 2.7 times lower when comparing to the contribution of trout in parr stage grown in the Osówka stream from larvae feeding. Length of sea trout in the parr stage grown from larvae feeding, according to Chełkowski [1990] ranged from 90 to 125 mm, while from the fry - 118 to 135 mm. It seems interesting when observed the trend of length of sea trout smolts in parr stage comparing to the length of smolts grown in Osówka. Length of smolts grown from the larvae feeding, according to Chełkowski [1990] covered the range from 111 to 260 mm, while from the fry - 118-245 mm. It appeared that length of trout in parr stage grown from the larvae feeding is smaller when compared to smolts length or it is involved in lower ranges of smolts length, whereas length of trout grown from the fry is involved in lower ranges of smolts length.

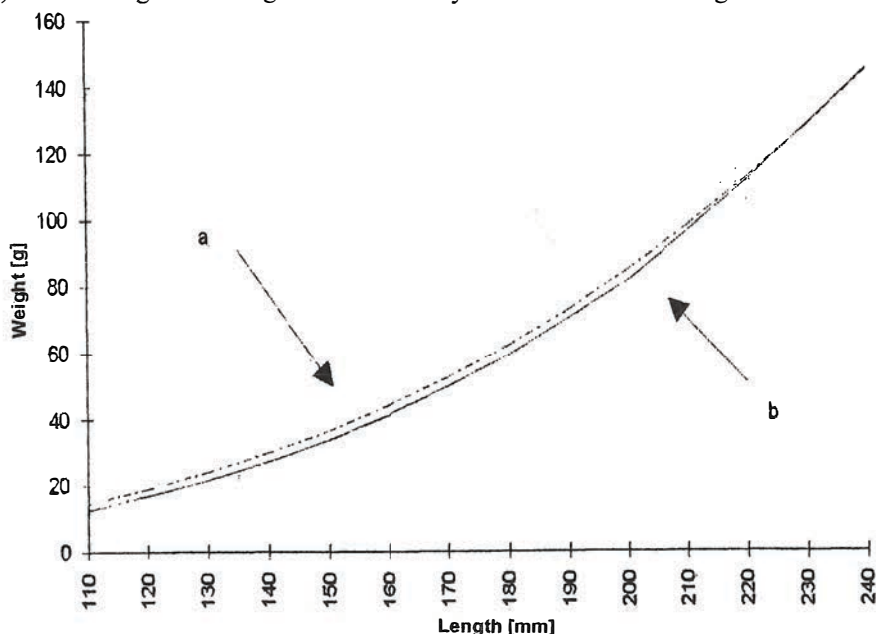


Fig. 3 Comparison of power curves of length-weight relationship of the whole sea trout smolts from Osówka grown from:

a - fry from the study ($W = 1.374^{-5} * L^{2.95099}$), b - larvae feeding, according to Chełkowski (1990) ($W = 4.8676^{-6} * L^{3.14195}$).

CONCLUSIONS

Sea trout smolts grown in Osówka stream from the fry released:

- descend to the sea demonstrating the females:males ratio as 1.1:1.0;
- spend 1–2 years in the river;
- migrate downstream mostly as 1-yr-old fishes (96.8 %), in smaller degree as 2-yr-old (3.2 %), in the proper condition expressed by the coefficient of condition of 0.99, with gonads in the juvenile stage of the coefficient of ovaries maturity 0.18 and testes 0.08 in relation to the weight of gutted fish;
- attain the mean length of 153.3 mm and weight of whole fish 4.08 g, in 1-yr-old fishes - length of 151.2 mm and weight 38.2 g and 2-yr-old ones - 217.1 mm and 118.1 g, respectively.

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BIOLOGICZNA CHARAKTERYSTYKA SMOLTÓW
TROCI WĘDROWNEJ (*SALMO TRUTTA M. TRUTTA L.*) WYROSŁYCH
W POTOKU OSÓWKA Z WSIEDLONEGO NARYBKU

STRESZCZENIE

Potok Osówka bierze początek ze Wzgórz Warszawskich i uchodzi do dolnej Odry jako jej lewobrzeżny dopływ. W składzie rodzimej ichtiofauny Osówki ryby łososiowate nie występują. Do górnej Osówki 7 maja 1987 r. wsiedlono 3080 sztuk dziesięciodniowego narybku troci wędrownej, uzyskanego na wodzie głębinowej o stałej temperaturze 8°C. Wyrosłe z tego materiału smolty łowiono w trakcie ich spływania do morza przy użyciu samolówki zainstalowanej w środkowym biegu potoku, czynnej w okresie od 1 marca do 15 lipca, w trzech kolejnych latach po zarybieniu. Ogółem pozyskano 284 smolty. Wśród spływających smoltów było 96,8 % jednorocznych i 3,2 % dwuletnich. Gonady smoltów znajdowały się w młodocianym stadium rozwoju. Współczynnik dojrzałości jajników osiągnął średnią wartość 0,18, a jąder - 0,08 w stosunku do masy ryb patroszonych. Samice reprezentowane były nieco liczniej w stosunku do samców (1,1:1). Smolty troci osiągnęły średnią długość 153,3 mm i średnią masę 40,8 g. Tempo szybkości przyrostu długości i masy było podobne.

Zależność zachodzącą między długością a masą całych smoltów z Osówki można wyrazić równaniem:

$$W = 1.374^{-5} * L^{2.95099}$$

Średni współczynnik kondycji patroszonych smoltów troci z Osówki osiągnął wartość 0,99.

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