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Fish biology

**BIOLOGICAL CHARACTERISTICS OF SEA TROUT (*SALMO TRUTTA* L.)
SMOLTS OF KNOWN AGE FROM OSÓWKA STREAM**

**CHARAKTERYSTYKA BIOLOGICZNA SMOLTÓW TROCI (*SALMO TRUTTA* L.)
O ZNANYM WIEKU WYROSŁYCH W POTOKU OSÓWKA**

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In spring 1984 sea trout larvae were released into the upper stretch of Osówka Stream. Smolts grown from this material were caught in three consecutive years after the fish release, using a fish trap placed in the middle course of the stream. The materials were used to determine fish sex and sex ratio, gonad condition and development, length and weight of males and females; and condition of sea trout smolts of known age.

INTRODUCTION

Information on the biology of sea trout (*Salmo trutta* L.) smolts grown in natural conditions of Pomeranian rivers is limited to a few papers only (Chełkowski 1966, Chełkowski 1978, Chełkowski and Chełkowska 1982). There are no data on biological characteristics of sea trout smolts of known age in these rivers that would also be related to fish sex. It seems that more detailed data on the biology of such smolts from Osówka Stream might be of cognitive as well as practical value. The paper represents a continuation of studies on sea trout smolts in Osówka Stream (Chełkowski, 1990a, 1991).

MATERIALS AND METHODS

Osówka is a small stream, 13 km in length, a left-side tributary of lower Oder River. Upper stretch of this stream was used in the experiment, 4 km from the stream source, of 19% slope (Chełkowski, 1990). Electric fish catches were performed in spring 1984 to remove weed fish, but only some sticklebacks (*Pungitius pungitius* L.)

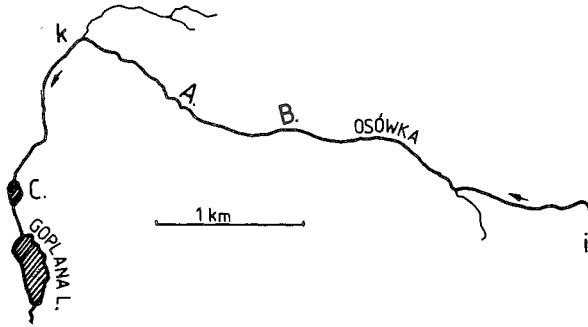


Fig. 1. Upper stretch of Osówka Stream. Section into which Sea Trout larvae were released, A–B; point at which the fish trap was placed, C

were caught. On 19 April 5402 indiv. of sea trout larvae were released into the middle part of A–B section of the stream (Fig. 1). Smolts migrating downstream were caught in three consecutive years by a fish trap located at point "C" of the middle stream course. Smolts were caught into the trap only in these three years; before the experiment there were no sea trout smolts in this part of Osówka Stream (Chełkowski 1966, 1967, 1969, 1974, 1978, Chełkowski, Chełkowska, 1982, Chrzan 1959, Dixon 1930, 1931, Sych 1967). The fish trap consisted of a net sack, mesh size 10 mm, stretched over a metal frame hung in a monk of a small flow-through pond 0.2 ha in area. The pond gathers water from Osówka Stream (Chełkowski, 1991). The trap operated since 21 March till 15 June; it was controlled twice daily, at 7.00 and 19.00 hours. It should be underlined that in Pomeranian rivers i.e. in the region of the studies, smolts migrate downstream only in spring, from the third decade of March till the first of June (Chełkowski, Chełkowska, 1981, 1982). Fish caught by the trap were identified to species. Sea trout smolts were divided into parr and smolt stage. Length (*l. caudalis*) was recorded up to 1 mm and weight up to 0.1 g. Fish sex was determined on the basis of gonads. Gonad development was recorded according to the 8-degree scale of Maier (Chełkowski 1974). Gonad weight up to 1 mg was also determined in order to estimate the coefficient of gonad development (% of gonad weight in total smolt weight). Weight of gutted fish was determined with the same accuracy as for whole fish. Sex was determined from gonads examined under 5 x magnification. In order to assess the conditions of smolt growth in Osówka Stream, coefficients of fish condition (K) were used according to Fulton's equation:

$$K = \frac{G \cdot 100}{L^3}$$

where: G – fish weight in g,

L – fish length (*l. caudalis*) in cm.

Calculations were made separately for gutted and gutted fish, as recommended by Clark (after Suworow 1948).

RESULTS

Fish trap was placed from 6 April till 11 June in 1985, from 7 April till 7 June in 1986, and from 12 April till 8 May in 1987. 111 smolts and 7 parrs were caught in the first year, 11 smolts in the second, and 2 smolts in the third. Totally, 124 sea trout smolts and 7 parrs were obtained from the stream; the latter were discarded. Chełkowski (1990) found that salmonids did not occur in the ichthyofauna of Osówka Stream before the experiment. Hence, knowing the data of fish release, age of smolts could have been determined. Fish caught in 1985 were one-year old, in 1986 two-years old, and in 1987 three-years old (Tab. 1).

Table 1

Ratio between females and males of sea trout smolts from Osówka stream in particular age groups

Period of down – stream migration from-to	Age	n				%		
		♀♀	♂♂	indef- ter- mined sex	total	♀♀	♂♂	total
Apr 6 – Jun 11.85	1+	66	40	5	111	62.3	37.7	100
Apr 7 – Jun 7.86	2+	7	4		11	63.6	36.4	100
Apr 12 – Aug 5.87	3+	2			2	100		100
Total		75	44	5	124	63.0	37.0	100

Gonad analyses were performed. Growing part of the ovary was light orange. Egg primordia were noticeable under a magnification. On the other hand, testes were hardly visible in the abdominal cavity, light pink in the anterior part. The gonads were classified as being in juvenile stage according to the scale used.

Morphological differences in the gonads made it possible to determine sex of 119 smolts (96%). Sex of 5 one-year old fishes (4%) could not have been established. Females were more frequent (63%) compared to males (37%). Age of female smolts in Osówka Stream was 1 to 3 years, and of males 1 to 2. Percentage ratio of females to males aged 1+ and 2+ was similar. And thus, in smolts aged 1 year there were 62.3% females and 37.7% males, and in smolts aged 2 years the respective percentages were 63.6% and 36.4% (Table 1). One – and two-year-old females and males were present in all 1 cm length classes (Table 2). Also within the whole material (irrespective of smolt age) females and males were present in almost all length classes (Table 3). It was also found that females and males migrated downstream in the same period in consecutive years

Table 2

Frequency of occurrence of females and males of sea trout smolts
from Osówka stream in age and length classes (ind. IV)

Age	Length class (mm)	sex			
		♀♀	♂♂	indeter- mined sex	total
1+	110–119	1	—	1	2
	120–129	1	2	—	3
	130–139	8	5	—	13
	140–149	26	13	1	40
	150–159	19	13	2	34
	160–169	6	3	1	10
	170–179	5	2	—	7
	180–189	1	1	—	2
total		66	40	5	111
2+	170–179	1	—	—	1
	180–189	1	—	—	1
	190–199	2	1	—	3
	200–209	2	2	—	4
	210–219	1	—	—	1
	220–229	—	1	—	1
total		7	4	—	11
3+	240–249	1	—	—	1
	250–259	—	—	—	—
	260–269	1	—	—	1
total		2	—	—	2
totally		75	44	5	124

(Table 4). One-year old females and males were most frequent. There were much less 2-year-old females and males, and 3-years old smolts were infrequent and represented by females only (Table 5).

In order to obtain a more precise characteristic of gonad development, coefficient of development was calculated for 92 smolts (62 females and 30 males) for which gonad weight was also recorded. Calculations made for ungutted fish showed that coefficient of ovary development reached 0.19 on the average, and of testes 0.06, the range of variations being 0.1–0.32 for the former and 0.03–0.11 for the latter. Similar values

Table 3

Frequency of occurrence of females and males of sea trout smolts from Osówka stream in length classes (ind. IV)

Length class (mm)	Sex			
	♀♀	♂♂	indeter- mined sex	total
110–119	1	–	1	2
120–129	1	2	–	3
130–139	8	5	–	13
140–149	26	13	1	40
150–159	19	13	2	34
160–169	6	3	1	10
170–179	6	2	–	8
180–189	2	1	–	3
190–199	2	1	–	3
200–209	2	2	–	4
210–219	1	–	–	1
220–229	–	1	–	1
230–239	–	–	–	–
240–249	1	–	–	1
250–259	–	–	–	–
260–269	1	–	–	1
total	75	44	5	124

were obtained for one-, two- and three-year-old smolts. In addition to this, coefficients of gonad development were calculated for gutted fish. As might have been expected, these values were a little higher (Table 6).

One year old female smolts from Osówka Stream were 150 mm long on the average, the range of variation being 119–182 mm. Length of males was 148 mm on the average, varying within the range of 128–180 mm. Average length of two-years old females was 196 mm, varying from 172 to 215 mm, and of males 207 mm, varying from 197 to 225 mm. Average length of three-years old females was 253 mm, the variations being 245–260 mm. Totally, average length of smolts from Osówka Stream amounted to 157 mm for females and 153 mm for males (Table 7).

Table 4

Frequency of occurrence of females and males of sea trout smolts from Osówka stream in age groups and period of downstream migration

Age	Period of catches	♀♀	♂♂	Total
1+	Apr 1-10	1	1	2
	Apr 11-20	—	—	—
	Apr 21-30	7	7	14
	May 1-10	25	14	39
	May 11-20	29	15	44
	May 21-31	3	3	6
	Jun 1-10	—	—	—
	Jun 11-20	1	—	1
total		66	40	106
2+	Apr 1-10	2	—	2
	Apr 11-20	—	—	—
	Apr 21-30	1	1	2
	May 1-10	1	1	2
	May 11-20	—	—	—
	May 21-31	—	—	—
	Jun 1-10	3	2	5
total		7	4	11
3+	Apr 1-10	—	—	—
	Apr 11-20	1	—	1
	Apr 21-30	—	—	—
	May 1-10	1	—	1
total		2	—	2
totally		75	44	119

Table 5

Share of females and males of sea trout smolts from Osówka stream in age groups (%)

Sex	Age						Total	
	1		2		3			
	n	%	n	%	n	%	n	%
females	66	88.0	7	9.3	2	2.7	75	100
males	40	90.9	4	9.1	—	—	44	100

Table 6

Coefficients of gonad development for sea trout smolts from Osówka stream in age groups

age	n	\bar{x}	σ	v	range of variations
weight of ungutted fish – females					
1+	58	0.16 ± 0.006	0.047	25.89	0.10–0.32
2+	2	0.27	–	–	0.25–0.28
3+	2	0.22	–	–	0.17–0.27
total	62	0.19 ± 0.006	0.048	25.42	0.10–0.32
males					
1+	27	0.06 ± 0.005	0.024	39.33	0.03–0.11
2+	3	0.11	–	–	0.11
3+	–	–	–	–	–
total	30	0.06 ± 0.005	0.027	45.00	0.03–0.11
weight of gutted fish – females					
1+	58	0.20 ± 0.007	0.054	28.0	0.11–0.35
2+	2	0.30	–	–	0.28–0.31
3+	2	0.23	–	–	0.18–0.28
total	62	0.20 ± 0.007	0.056	27.81	0.11–0.35
males					
1+	27	0.06 ± 0.005	0.024	39.6	0.03–0.11
2+	3	0.12	–	–	0.11–0.12
3+	–	–	–	–	–
total	30	0.07 ± 0.005	0.028	40.0	0.03–0.12

Table 7

Length of sea trout smolts from Osówka stream in age groups (mm)

age	females					males				
	n	\bar{x}	σ	v	range	n	\bar{x}	σ	v	range
1+	66	150±1.5	12.538	8.4	119±182	40	148±2.0	12.649	8.6	128–180
2+	7	196±4.8	12.838	6.6	174–215	4	207±6.3	12.569	6.1	197–225
3+	2	253	–	–	245–260	–	–	–	–	–
Σ	75	157±2.8	24.225	15.4	119–260	44	153±3.2	21.319	13.9	128–225

Table 8

Weight of sea trout smolts from Osówka stream in age groups (g)

Females						Males				
age	n	\bar{x}	$\bar{\sigma}$	v	range	n	\bar{x}	$\bar{\sigma}$	v	range
before gutting										
1+	66	33.6 ± 1.1	8.838	26.3	17.9±57.7	40	33.1±1.4	9.133	27.6	18.1—67.4
2+	7	85.7±7.4	19.602	22.9	52.1—116.2	4	92.2±11.1	22.226	24.1	70.1—120.8
3+	2	195.3	—	—	184. —206.5	—	—	—	—	—
Σ	75	42.8± 3.6	31.123	72.7	17.9—206.5	44	38.4±3.04	20.140	45.8	18.1—120.8
after gutting										
1+	66	31.0±1.0	8.131	26.2	16.0±52.9	40	30.5±1.34	8.464	27.8	16.7—60.0
2+	7	80.9±7.4	19.139	23.7	48.0±110.5	4	86.3±10.6	21.160	24.5	65.0—113.7
3+	2	182.8	—	—	171.5—194.5	—	—	—	—	—
Σ	75	39.7±3.4	29.387	74.0	16.0—194.5	44	35.6±2.9	18.965	53.3	16.7—113.7

Table 9

Weight of sea trout smolts from Osówka stream in length classes (g)

Length class (mm)	n	\bar{x}	range	\bar{x}	range	n	\bar{x}	range	\bar{x}	range
110-119	1	19.5	—	17.5	—	—	—	—	—	—
120-129	1	17.9	—	16.0	—	2	20.6	18.1-23.0	18.9	16.7-21.1
130-139	8	24.8	24.0-28.3	22.5	19.4-25.5	5	25.2	23.0-28.7	23.0	20.0-26.2
140-149	25	30.0	25.2-33.7	26.6	22.7-31.4	14	29.3	23.9-36.0	26.7	22.0-32.0
150-159	19	34.5	26.7-44.9	32.3	24.5-44.0	13	34.2	29.4-38.4	31.8	27.8-36.2
160-169	6	43.5	34.3-51.2	39.2	31.7-47.8	3	42.0	33.4-44.5	39.6	36.8-43.0
170-179	6	52.8	48.0-57.7	48.6	44.2-52.9	2	51.9	51.8-52.0	49.1	48.7-49.4
180-189	2	65.3	55.4-75.1	61.6	52.0-71.3	1	67.4	—	60.0	—
190-199	2	85.2	85.2-85.2	80.0	80.0-80.0	1	80.1	—	75.5	—
200-209	2	93.0	89.2-96.7	88.4	84.2-92.5	2	83.8	70.0-97.6	78.0	65.0-91.0
210-219	1	116.2	—	110.5	—	—	—	—	—	—
220-229	—	—	—	—	—	1	120.8	—	113.7	—
230-239	—	—	—	—	—	—	—	—	—	—
240-249	1	184.0	—	171.5	—	—	—	—	—	—
250-259	—	—	—	—	—	—	—	—	—	—
260-269	1	206.5	—	194.5	—	—	—	—	—	—
total	75					44				

One-year smolts (females and males) were most frequent in the length class 130–169 mm. This length range embraced 87.9% of females and 87.5% of males. Two-years old smolts were most numerous within the length range 190–209 mm (Table 2). Generally smolts 130–169 mm in length were most frequent. This range embraced 85.3% of all females and 84.1% of all males (Table 3).

Data presented in Table 8 reveal that average weight of ungutted females was 42.8g and of males 38.4 g, the range of variations being 17.9–206.5 g for the former and 18.1–120.8 for the latter. One-year old females reached average weight of 33.6 g and males 33.1 g; two-years old females attained 85.7 g and males 92.7 g, and three-years old females weighed 195.3 g on the average. Lower values were obtained for gutted smolts. Weight of females and males was also established for length classes (Table 9). It appeared that both average weights and range of variations in particular length classes were similar for females and males.

Condition coefficients were also calculated. Values of this coefficient were similar for females and males in particular length classes. In view of this, analyses were made for all fish ($n = 124$) irrespective of sex. Average coefficient of fish condition amounted to 1.089, the range of variations being 0.765–1.251 for ungutted fish, and 1.011 at variations 0.706–1.166 for gutted fish (Table 10). The highest coefficients were obtained for ungutted 3+ smolts, slightly lower for 2+ fish, and the smallest for 1+ smolts. Similar trend was noted for gutted fish (Table 11). Hence, it may be concluded that older smolts were better fed. Condition coefficients were also analysed in length classes (Table 12). It was found that many length classes were characterized by similar range of the condition coefficients. However, average values confirmed the trend of increasing condition with increasing fish length.

Table 10

Coefficients of condition of sea trout smolts from Osówka stream

n	fish weight	\bar{x}	σ	v	range
124	after gutting	1.089 ± 0.009	0.098	9.00	0.765–1.251
124	before gutting	1.011 ± 0.008	0.092	9.10	0.706–1.166

Average coefficients of condition were also determined for age groups, separately for 75 females and 44 males. Calculations presented in Table 13 revealed that coefficients of condition of females and males in particular age groups and periods of downstream migration were similar. On the other hand, values of these coefficients tended to decrease with the period of downstream migration, this being especially noticeable for smolts aged one year, and for two-years old females. It appeared that smolts which undertook downstream migration earlier in the season were better fed than those which started to migrate later.

Table 11

Coefficients of condition of sea trout smolts from Osówka stream in age groups

Age	n	\bar{x}	Range
before gutting			
1+	111	0.988	0.765–1.229
2+	11	1.082	0.876–1.169
3+	2	1.213	1.175–1.251
Σ	124	1.098	0.765–1.251
after gutting			
1+	111	0.911	0.706–1.097
2+	11	1.021	0.812–1.144
3+	2	1.137	1.107–1.166
Σ	124	1.011	0.706–1.166

Table 12

Coefficients of condition of sea trout smolts from Osówka stream in length classes

Length class (mm)	n	\bar{x}	Range	\bar{x}	Range
before gutting			after gutting		
110–119	2	1.068	0.980–1.157	0.976	0.914–1.038
120–129	3	0.959	0.854–1.097	0.875	0.763–1.006
130–139	13	1.048	0.875–1.223	0.958	0.795–1.097
140–149	40	0.998	0.853–1.176	0.919	0.758–1.011
150–159	34	0.943	0.765–1.173	0.880	0.706–1.049
160–169	10	1.001	0.837–1.229	0.907	0.774–0.993
170–179	8	0.970	0.903–1.068	0.900	0.839–0.989
180–189	3	1.070	0.919–1.156	0.988	0.863–1.073
190–199	3	1.104	1.048–1.132	1.037	0.988–1.062
200–209	4	1.062	0.876–1.139	0.999	0.812–1.090
210–219	1	1.169	1.169	1.144	1.144
220–229	1	1.061	1.061	0.998	0.998
230–239	–	–	–	–	–
240–249	1	1.175	1.175	1.106	1.106
250–259	–	–	–	–	–
260–269	1	1.251	1.251	1.166	1.166
total	124	1.089	0.765–1.251	1.011	0.706–1.166

Table 13

Coefficients of condition of sea trout smolts from Osówka stream in age groups and periods of downstream migration

Age	Period of downstream migration	Females			Males		
		n	before gutting	after gutting	n	before gutting	after gutting
1+	05.04–09.04	1	1.173	1.049	1	1.156	1.029
	21.04–27.04	7	0.999	0.906	7	1.046	0.957
	03.05–10.05	25	0.977	0.912	14	0.981	0.909
	11.05–19.05	29	0.964	0.843	15	0.950	0.883
	21.05–30.05	3	1.082	0.962	3	1.080	0.970
	11.06.	1	1.223	1.068	–	–	–
	total	66	0.985	0.888	40	0.993	0.916
2+	01.04–10.04	2	1.132	1.062	–	–	–
	21.04–30.04	1	1.115	1.052	1	1.048	0.988
	01.05–10.05	1	0.989	0.911	1	1.116	1.041
	01.06–10.06	3	1.146	1.102	2	0.969	0.905
	total	7	1.115	1.056	4	1.025	0.960
3+	11.04–20.04	1	1.175	1.107	–	–	–
	21.04–10.05	1	1.251	1.166	–	–	–
	total	2	1.213	1.137	–	–	–
Total		75			44		

Table 14

Average lengths and weights of sea trout smolts from Pomeranian rivers (mm)

River	length		weight*		weight**		Comments (author)
	females	males	females	males	females	males	
Mołstowa	148	142	33.7	27.8	30.8	25.6	Chełkowski Z., Chełkowska B. (1982)
Osówka	157	153	42.8	38.4	39.7	35.6	this study

* before gutting

** after gutting

DISCUSSION

Information on sea trout smolts grown in natural conditions of Pomeranian rivers was most thoroughly dealt with by Chełkowski and Chełkowska (1982). This work was based on the analysis of smolts from Mołstowa River and it can be used as an interesting comparative material.

Gonads of smolts from Osówka Stream as well as from Mołstowa River were in juvenile stage of development, the coefficients of gonad development being similar in the two rivers. And thus, average coefficient of gonad development for smolts from Osówka amounted to 0.19 for females and 0.06 for males, whereas these values were 0.21 and 0.07 respectively for smolts from Mołstowa. Both in Osówka Stream and in Mołstowa River females were more numerous. In Osówka Stream females represented 62.3% and males 37.7%, the respective percentages for Mołstowa River being 55.3% and 44.7%.

Average length of females and males was a little higher in Osówka Stream than in Mołstowa River. However, length differences between the sexes were small: only 9 mm for females and 11 mm for males. On the other hand, it appeared that females and males from Osówka Stream were heavier than sea trout smolts from Mołstowa River (Table 14).

Frequency of occurrence of female and male smolts in particular length classes was similar in the two rivers. In Osówka as well as in Mołstowa length class 140–149 mm was most frequent. Also range of variations of smolt length was similar in the two rivers. Female smolts in Osówka Stream were 119–260 mm in length, and in Mołstowa River 104–239 mm. The respective values for males were 128–225 in Osówka Stream and 105–194 mm in Mołstowa River. On the other hand, smolts in Osówka were heavier (in particular length classes) than in Mołstowa.

A comparison was made of the frequency of occurrence of female and male smolts in Osówka Stream and Mołstowa River. It appeared that sea trout smolts from Mołstowa River (females and males) were aged one, two, and three years. In Osówka Stream females also represented these three age groups, but only one- and two-years old males were caught. One-year old smolts were most numerous both in Osówka and Mołstowa. Less fish belonged to age group two. Age group three was least frequent. However, percentage values differed considerably, especially as regards one- and two-year-old smolts (Table 15).

Finally, comparisons were made of smolt length and weight in the two rivers. Data presented in Table 16 reveal that length as well as weight of smolts in Osówka Stream were slightly higher than in Mołstowa River.

CONCLUSIONS

The studies revealed that:

- gonads of female and male sea trout smolts from Osówka Stream were in juvenile

Table 15

Coefficients of gonad development for sea trout smolts from
Osówka stream in age groups

River	Sex	Age			Comments (author)
		1	2	3	
Mołstowa	females	51.7	43.9	4.4	Chełkowski Z., Chełkowska B. (1982)
	males	54.6	44.3	1.1	
Osówka	females	88.0	9.3	2.7	this study
	males	90.9	9.1	—	

Table 16

Average length and weight of sea trout smolts
from pomeranian rivers in age groups (mm, g)

Sex	Age	Length		Weight			
		Rega*	this study	Rega*		this study	
				a	b	a	b
females	1	134	150	25	23	34	31
	2	158	196	39	36	86	81
	3	191	253	69	63	195	183
males	1	133	148	22	20	33	31
	2	155	207	35	32	92	86
	3	177	—	53	49	—	—

* Chełkowski Z., Chełkowska B. (1982)

a — after gutting

b — before gutting

stage; coefficient of gonad development reached an average value of 0.19 for ovaries and 0.06 for testes;

– females of sea trout smolts in Osówka Stream were more frequent than males; 0.6 male occurred per one female;

– rate of growth in length and weight was similar for female and male smolts of sea trout;

– females and males of sea trout smolts in Osówka River were most numerous in the length range 130–169 mm. 86.7% of females and 81.8% of males belonged to this range;

- period of river life of sea trout smolts in Osówka Stream was 1–3 years for females and 1–2 years for males. One-year old females represented 88%, two-years old 9.3% and three-years old 2.7%. One-year old males represented 90.9% and two-years old 9.1%;
- average coefficient of condition of sea trout smolts from Osówka Stream amounted to 1.09 for ungutted and 1.01 for gutted fish.

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CHARAKTERYSTYKA BIOLOGICZNA SMOLTÓW TROCI (*SALMO TRUTTA* L.)
O ZNANYM WIEKU WYROSŁYCH W POTOKU OSÓWKA

STRESZCZENIE

Do górnego biegu potoku Osówki wsiedlono wiosną 1984 r. wylęg troci (*Salmo trutta* L.). Smolty wyrosłe z tego wylęgu łowiono w trzech kolejnych latach po zarybieniu na samołówkę usytuowaną w środkowym biegu Osówki. Ogółem odłowiono 124 smolty. Ponieważ w zespole ichtiofauny Osówki nie występują ryby łososiowate, smolty pozyskane w 1985 r. należały do 1-no rocznych, w 1986 r. do 2-wu rocznych, a w 1987 r. do 3-y rocznych. W materiale wystąpiło 63% samic i 37% samców. Wiek samic wynosił od 1 do 3 lat, a samców od 1 do 2 lat. Gonady samic i samców znajdowały się w młodocianym stadium rozwoju. Współczynnik dojrzałości jajników osiągnął średnią wartość 0.19 a jąder 0.06. W opracowaniu przedstawiono długość i masę samic i samców. Okazało się, że wzrost na długość i masę samic i samców młodzieży troci w Osówce do fazy smoltyzacji przebiega w podobnym rytmie. Współczynnik odżywienia smoltów przybrał wartość 1.089 dla ryb nie wypatroszonych i 1.09 dla ryb wypatroszonych. Starsze wiekiem smolty były lepiej odżywione od młodszych.

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Received: 1990.02.16

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