Zygmunt CHEŁKOWSKI

Fish Biology

STUDIES ON TROUT (*SALMO TRUTTA* L.) WILD SMOLTS
OF THE RIVER REGA

STUDIA NAD SMOLTAMI TROCI *Salmo trutta* L. POCHODZENIA NATURALNEGO
RZEKI REGI

The paper describes length, weight, age, and growth rate as well as seasons of trout wild smolts seaward migration from the Pomeranian river Rega. Since scales of smolts were at the stage of annual rings formation, age determinations were preceded by counting rings and analysing marginal increments. In order to obtain information on smolt condition, a nourishment index was calculated from the Fulton formula.

INTRODUCTION

The object of the studies was to describe length, weight, growth rate, and seasons of the seaward migration of trout (*Salmo trutta* L.) wild smolts; the migration takes place down the 199.1 km long Pomeranian river Rega which drains into the South-West Baltic Sea (Fig. I). The studies presented are a continuation of work commenced in 1965 (Chełkowski 1966, 1967, 1967a).

Information on the Pomeranian rivers' wild smolt of trout is scant. Data given by Henking (1916, 1929, 1931) and Eichelbaum (quoted by Henking, 1916) concern salmon and trout together as the two species were treated jointly at that time (Kaj, 1953; and others). Dixon (1930, 1931), Chrzan (1959, 1969), and Chełkowski (1967b, 1969, 1974) based their investigations exclusively on adult trout scales.

Fig. 1. River Rega and its geographic position (site of trout capture)

MATERIAL AND METHODS

Smolts were caught by means of a trap mounted at the fourteenth kilometer of the river in the Trzebiatów water works emergency canal (Chełkowski, 1966). The trap was working in 1963, 1964, 1965, and 1974 from March through November. A daily catch was stored in a cage. At the end of each decade the smolts caught were examined, the species being ascertained at first (Schechtel, 1925; Berg, 1948; Żarnecki, 1961; Chełkowski, 1964, 1970). The fishes were subsequently weighed, measured and a few scales were taken out of each. The *longitudo caudalis* was measured to the nearest mm; the fish weight was determined to the nearest g. Scales were extracted from the first and second rows above the lateral line on the left side the body, between the dorsal and adipose fins. Jokiel (1958) and Grudniewski (1961) observed the trout scales to appear first on those spots. Also Dannewig and Host (1931) recommend to collect scales from those parts of the fish body.

Table 1

Number of smolts examined

year		1965	1966	1967	1974	total	
month	decade	ind.	ind.	ind.	ind.	ind.	%
March	3	—	1	—	—	1	0.5
April	1	—	—	4	9	13	6.8
	2	1	14	8	7	30	15.7
	3	26	31	10	3	70	36.7
May	1	11	5	18	15	49	25.7
	2	8	—	6	10	24	12.6
	3	—	—	—	2	2	1.0
June	1	—	—	—	2	2	1.0
Total		46	51	46	48	191	100.0

191 trout smolts were caught for examination (Table 1). No salmon smolts were found in the catches. The individuals examined had been derived from natural spawning and from hatcheries (Chełkowski, 1974).

Age and growth rate of smolts were determined from scales. With this purpose in mind, 3 scales were taken from each fish individual examined, the scales being then cleaned by rinsing in a weak (about 3%) ammonia solution. In case of obtaining scales difficult to read, a new batch consisting of the same number was taken. The scales of 170 individuals, i.e., 89% of the examined number of fish, were studied. Owing to regenerated scales and difficulties in interpreting the scales with poorly visible rings, 21 (11%) fishes from various length classes were rejected. Age was determined according to recommendations given by Sych (1971). The Dahl-Lea back calculation method (Nall, 1930) was applied to growth rate computation. The back calculations were based on fish length and scale oral radius measurements, the latter performed with a 0.01 mm accuracy under a Zeiss measuring microscope.

"An annual ring is possible to be detected only after a new annual increment has been started; a marginal increment, therefore, will be always present and the scales will be always denoted A+" (Sych, 1967b).

In the present study, a minimum marginal increment was expressed as at least one clearly visible wide sclerite with a well-marked beginning of a second one behind the last annual ring. Annual rings were counted basically twice in order to avoid possible errors. The first count was made at 40–100 magnification of a stereomicroscope in transmitted light, whereas the second count was made on the scale, 17.5 times magnified, projected on a screen. The compatibility of the two counts made on various occasions from 1–3 scales seemed to ensure an appropriate division of the fishes studied into the 1+, 2+, and

3+ groups. The counts were repeated, had any discrepancy in counts occurred. The paper by Sych (1967) was taken advantage of when interpreting annual rings.

The scales examined were observed to be at the stage of new rings formation. In order to arrive at a proper discrimination of newly-formed and old rings, a distribution of marginal increments (dk^*) in 1+, 2+, and 3+ smolts was plotted similarly to the procedure described by Sych (1967a, 1967b) who had done that for adult and post-smolt trout (Fig. 2). The presence of two peaks enabled to divide the fishes (increments) into age classes. Observations on the nature of scales marginal increments, length, and weight of fish further supported the division assumed.

Fig. 2. Marginal increments (dk) distribution in trout smolts P — ad hoc division increments into the current and last — year's one —

* it is, according to Backiel (1962) and Sych (1967b), a fish growth corresponding to the scale growth from the last annual ring to the margin.

Table 2

Growth rate and length increments of trout smolts in connection with Fig. 2 (mm)

No of annual rings	Marginal increments		n	l						t						Mean weight (g)
	description	range (mm)		1	+	2	+	3	+	1	+	2	+	3	+	
1+	$P > dk$	25–31	8	115	143					115	28					30
1+	$P < dk$	80–125	56	84	187					84	103					70
2+	$P > dk$	10–25	74	77	–	177	195			77	–	100	18			79
2+	$P < dk$	43–65	22	81	–	171	223			81	–	90	52			114
3+	$P > dk$	10–22	10	80	–	155	–	212	228	80	–	75	–	57	16	122
Total	n		170	170	–	106	–	10	–	170	–	106	–	10	–	170
	$\bar{x}$		–	82	–	174	–	212	–	82	–	96	–	57	–	81

Smolts of trout

The 1+ fishes (n-8) with "smaller" marginal increments ($P > dk$) showed wide marginal sclerites; 96.4% of the (n-56) ones with "larger" marginal increments ($P < dk$) showed a narrow zone of marginal sclerites, while 3.6% showed an inconspicuously narrow zone.

The 2+ fishes (n-74) with "smaller" marginal increments ($P > dk$) showed wide marginal sclerites, while 95.5% and 4.5% of fishes (n-22) with "larger" marginal increments ($P < dk$) showed, respectively, narrow and inconspicuously narrow sclerite zones.

Finally, the 3+ fishes (n-10) with "smaller" marginal increments ($P > dk$) showed wide marginal sclerites.

The 1+ smolts with "small" newly-started marginal increments ($\bar{dk} = 28$ mm) were considered yearlings. As seen from various reports, the fishes of this group showed a mean length and weight of 143 mm and 30 g, respectively (Table 2).

The 1+ smolts with "large", almost one year increments ($\bar{dk} = 103$ mm) were grouped with the two-years-old fishes; they showed a mean length and weight of 187 mm and 70 g, respectively.

The 2+ smolts with "small" newly-started marginal increments ($\bar{dk} = 18$ mm) were grouped also with the two-years-old fishes. Their mean length and weight were calculated as 195 mm and 79 g, respectively.

The 2+ smolts with "large", almost one year increments ($\bar{dk} = 52$ mm) were grouped with the three-years-old fishes. Their mean length and weight were 223 mm and 114 g, respectively.

The 3+ smolts with "small" newly-started increments ($\bar{dk} = 16$ mm) were grouped with the three-years-old fishes as well. Their mean length and weight were 228 mm and 122 g, respectively.

As seen from the above comparison, the 1+ smolts with "large" marginal increments and the 2+ ones with "small" increments are similar with respect to their length and weight. The 2+ smolts with "large" increments are, as can be noted, similar to the 3+ ones with "small" marginal increments.

RESULTS

The observations carried out over four years show the river Rega smolt to descend to the sea in spring. They appear down the river from March 29 through June 8. The majority migrates during the 2nd and 3rd decades of April and 1st and 2nd decades of May. During those periods, 97.5% of fish were caught. The remaining 2.5% were caught in the 1st decade of March, 3rd decade of May, and 1st decade of June (Table 1). No trout smolts were caught in other seasons of the year.

In the Pomeranian rivers: Gowienica, Ina, and lower Odra, the trout smolt migration pattern is similar to that in the Rega as revealed by our observations. Also the studies by

Fig. 3. Seasons of trout smolt migrations and river Rega mean water temperatures ($^{\circ}\text{C}$)

Henking (1916) allow to presume that salmonid smolts grown in Parsęta, another Pomeranian river, descend to the sea in spring.

The smolts were caught in the lower Rega during a vernal increase in water temperature from 3.7 to 15.4 $^{\circ}\text{C}$ (Fig. 3). The largest numbers of fishes were obtained when water temperatures reached 7.2–10.1 $^{\circ}\text{C}$ in 1965, 6.5–11.6 $^{\circ}\text{C}$ in 1966, 9.4–11.9 $^{\circ}\text{C}$ in 1967, and 7.6–11.1 $^{\circ}\text{C}$ in 1974 (Fig. 4,a-d). Definitely the highest numbers of smolts migrated to the sea at the 7–11 $^{\circ}\text{C}$ range of water temperature.

Length of the smolts caught ($n = 191$) ranged within 126–261 mm with a mean length of 196.32 ± 1.76 mm. More detailed data on length are summarised in Table 3. The lengths were similar in consecutive years.

Mean lengths of trout smolts from a number of Pomeranian rivers, calculated from scales of adult fishes, ranged within 168–186 mm (Table 4). Thus the mean length of the smolts examined is slightly larger. It should be borne in mind, however, that our studies concern the actual measured on capture while the other authors' data are derived from back calculations of annual increments, no marginal increment being considered, at least in a certain batch of fishes.

A selective action of the trap used cannot be excluded when looking for an explanation of large mean length.

b) 1966 r.

a) 1965 r.

Table 3

Smolt length (mm)				
year	n	M±m	σ	̄
1965	46	190.11 ± 3.48	23.61	12.42
1966	51	198.78 ± 2.73	19.48	9.80
1967	46	202.78 ± 4.31	29.21	14.40
1974	48	193.48 ± 3.36	23.31	12.05
Total	191	196.32 ± 1.76	24.32	12.39

The fish length distribution is summarised in Table 5; the range is 12–27 cm.

The fishes examined in term of their length weighed, on the average, 81.96 ± 2.07 g) (Table 6). Mean weights of smolts in length classes are given in Table 7.

The smolts examined were at the age of 1–3, usually 2; 76.5% of fishes were of the latter age.

According to Chrzan (1959) and Chełkowski (1967, 1969, 1974), trout smolts of many Pomeranian rivers spend from one to three years in the river (Table 8), which has been confirmed by the present studies.

The one-year-old Rega trout smolts measured and weighed, on the average, 143 mm and 30 g, respectively; an average two-years-old fish was 192 mm long and weighed 75 g, while a three-years-old one showed an average length of 225 mm and weighed 117 g.

The back-calculated data were used to find growth rate of the smolts. As the data gathered in Table 2 show, a fast growth takes place in the 1st and 2nd year of life. A slight slow-down appeared in the third year. A mean length attained by smolts in the first year of life in the river was 82 mm, in the second and third year – 174 and 212 mm, respectively. Yearly increments in the 1st, 2nd, and 3rd year were 82, 96 and 57 mm, respectively.

In order to acquire information on the condition of smolts, a nourishment index was calculated from the Fulton formula:

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

where:

G = fish weight (g),

L = longitudo caudalis (cm).

The calculations were performed for fish of a well-determined age (n-170). A mean value of the index was 1.04 ± 0.0069 . Mean values of the index in each age group are similar and amount to 1.02, 1.05, and 1.03 in the age groups 1 (n-8), 2 (n-130), and 3 (n-32), respectively.

Table 4

Length of trout smolts in Pomeranian rivers
(mm)

River	Age			Total mean	Remarks
	1	2	3		
Rega	143 (126–149)	192 (150–230)	225 (190–257)	196	present studies
Reda				174	calculated from adult fish scales Chrzan 1959*
Łeba				178	„ „
Słupia				175	„ „
Wieprza				183	„ „
Paręta				186	„ „
Pomeranian rivers	125	158	190		Chrzan 1969**
Gowienica	80	163	246	169	females Chełkowski 1967 b*
		165	220	168	males „ „
Rega	122 (100–150)	172 (120–230)	218 (170–280)	170	Chełkowski 1974**

* — data from back calculations, no correction for curvilinearity

** — data from back calculations corrected for curvilinearity, ranges in brackets

Table 5

Trout smolts in length classes (mm)

Length class (mm)	1965		1965		1967		1974		total	
	ind.	%	ind.	%	ind.	%	ind.	%	ind.	%
120–129	1	2.2							1	0.5
130–139	–	–							–	–
140–149	3	6.5	1	2.0	2	4.3	1	2.1	7	3.7
150–159	1	2.2	1	2.0	2	4.3	–	–	4	2.1
160–169	3	6.5	–	–	1	2.2	10	20.9	14	7.3
170–179	2	4.3	3	5.9	5	10.9	3	6.2	13	6.8
180–189	5	10.9	9	17.6	3	6.5	3	6.2	20	10.5
190–199	14	30.5	11	21.6	5	10.9	6	12.5	36	18.8
200–209	10	21.7	6	11.7	4	8.7	9	18.8	29	15.2
210–219	4	8.7	11	21.6	10	21.7	9	18.8	34	17.8
220–229	1	2.2	6	11.7	4	8.7	3	6.2	14	7.4
230–239	–	–	1	2.0	4	8.7	3	6.2	8	4.2
240–249	2	4.3	2	3.9	4	8.7	1	2.1	9	4.7
150–259					1	2.2			1	0.5
260–269					1	2.2			1	0.5
Total:	46	100.0	51	100.0	51	100.0	48	100.0	191	100.0

Table 6

Smolt weight (g)

year	n	$M \pm m$	σ	ϑ
1965	46	75.74 ± 3.85	26.08	34.44
1966	51	84.15 ± 3.24	23.13	27.48
1967	46	91.49 ± 5.07	34.37	37.57
1974	48	76.46 ± 3.97	27.51	35.98
Total	191	81.96 ± 2.07	28.63	34.93

Table 7

Weight of smolt in length classes
(g)

Length class (mm)	ind.	mean weight	range
120–129	1	19.5	
130–139	—	—	
140–149	7	31.5	30– 33
150–159	4	38.3	36–43
160–169	14	41.7	35– 48
170–179	13	54.1	49– 63
180–189	20	66.6	60– 76
190–199	36	76.2	65– 85
200–209	29	84.2	70– 96
210–219	34	98.2	75–115
220–229	14	110.5	100–124
230–239	8	122.6	105–158
240–249	9	137.0	130–145
250–259	1	177.6	
260–269	1	166.0	
Total	191		

Table 8

Age of Pomeranian rivers trout back-calculated from adult fish scales
(%)

River	Author	Age group		
		I	II	III
Rega in the present studies		4.7	76.5	18.8
Reda	Chrzan 1959	20.5	72.7	6.8
Łeba	Chrzan 1959	8.9	86.7	4.6
Słupia	Chrzan 1959	9.1	86.4	4.5
Wieprza	Chrzan 1959	6.5	85.8	7.7
Parseća	Chrzan 1959	8.5	86.3	5.2
Pomeranian rivers	Chrzan 1969	15.0	77.0	8.0
Gowienica	Chełkowski 1967b	0.8	92.06	7.14
Słupia	Chełkowski 1969	3.19	92.11	4.7
Grabowa	Chełkowski 1969	3.08	92.30	4.62
Uniesta	Chełkowski 1969	0.66	94.08	5.25
Parseća	Chełkowski 1969	2.17	91.16	6.67
Rega	Chełkowski 1969	8.22	85.61	6.17
Rega	Chełkowski 1974	13.19	78.97	7.84

Recapitulation and conclusions

The trout juveniles studied were found to be at the full smolt stage (Chełkowski, 1966).

The trout smolts appear in the lower Rega, i.e., just at the river mouth, from March 29 to June 8. The migration peak takes place in the 2nd and 3rd decades of April and in the 1st and 2nd decades of May, at the water temperatures of 7–11°C.

Mean length and weight of smolts were 196.32 ± 1.76 mm and 81.96 ± 2.07 g, respectively.

Smolt scales were beginning to form annual rings. Some fishes did have new rings, others did not.

The age determination in smolts calls for counting annual rings and calculating marginal increments "dk". The 1+ fishes with $dk \leq 31$ mm were ascribed to the 1+ age class; the 1+ ones with $dk \geq 80$ mm and 2+ ones with $dk \leq 25$ mm were ascribed to the 2+ group, while the 2+ fishes with $dk \geq 43$ mm and the 3+ ones with $dk \leq 22$ mm were grouped with the 3+ class.

All the 1+ smolts examined showed newly-formed marginal increments; 56.9% of the 2+ smolts showed new increments while the remaining 43.1% possessed the previous year's increments only. A small percentage (31.2%) of the 3+ fishes showed newly-started increments, the remaining 68.8% displaying the previous year's increments. Thus it can be concluded that younger smolts tend to start annual rings earlier. Similar observations were made with respect to other fish species (Backiel, 1962; Ciepielewski, 1971).

Trout juveniles at the smolt stage spend from 1 to 3 years in the river. In the population studied, 4.7%, 76.5%, and 18.8% were contributed by the one-, two-, and three-years-old fishes.

The one-year-old migrating smolts attain, on the average, 143 mm length and 30 g weight; 192 mm and 75 g are the average length and weight, respectively, of the two-years-old-ones, while 225 mm and 117 g are the average values for the three-years-old ones.

The condition of descending one-, two-, and three-years-old smolts, as expressed by the Fulton nourishment index, is similar and averages 1.03.

Regarding practical conclusions emerging from the studies presented, it seems worthwhile to bring up the subject of the season of stocking the Pomeranian rivers with smolts reared in hatcheries. The cultured smolts should be released to the open waters at the time of wild smolts' migration, i.e., in April and May. Owing to a sufficiently low temperature of water needed for smolt transportation, the most suitable time seems to be the late March-early April with the water temperature of 4–8°C.

REFERENCES

- Backiel T., 1962: Determination of time of annuals formations of fish scales. *Acta Hydrobiol.*, 4: 393–411.
- Berg L.S., 1948: Ryby presnych wod SSSR i sopredelnykh stron. T. 1 Moskva.
- Chełkowski Z., 1964: Łosoś czy troć? [Salmon or trout?], *Wiad. wędk.* 5.
- Chełkowski Z., 1966: Charakterystyka smoltów troci (*Salmo trutta morpha trutta* L.) rzeki Regi. [Characteristics of trout (*Salmo trutta morpha trutta* L.) smolt of the river Rega]. *Prz. Zool.* X.4.
- Chełkowski Z., 1967: The Periods of the Descent to the Sea of the Trout Smolts of the Rega River. ICES Anadromous and Catadromous Fish. Cttee. No 7.
- Chełkowski Z., 1967a: Okresy zstępowania smoltów troci (*Salmo trutta morpha trutta* L.) rzeki Regi. [The seasons of trout (*Salmo trutta morpha trutta* L.) smolt seaward migration from the river Rega]. VII Zjazd Pol. Tow. Hydrob. Warszawa. Streszczenia referatów. [Summary].
- Chełkowski Z., 1967b: Troć (*Salmo trutta morpha trutta* L.) rzeki Gowienicy. [Trout (*Salmo trutta morpha trutta* L.) of the river Gowienica]. *Prz. Zool.* XI.
- Chełkowski Z., 1969: Pogłowie troci (*Salmo trutta trutta* L.) rzek przy morskich Pomorza. [Population of trout (*Salmo trutta trutta* L.) in the coastal Pomeranian rivers]. *Prz. Zool.* 1.
- Chełkowski Z., 1970: Description of meristic features of salmon trout (*Salmo trutta trutta* L.) from the rivers of Pomerania district. *Zesz. Nauk. WSR Szczecin.* (31) *Acta Ichthyol.* I.
- Chełkowski Z., 1974: Studia nad biologią troci (*Salmo trutta* L.) rzeki Regi. [Studies on biology of trout (*Salmo trutta* L.) of the river Rega]. *Akademia Rolnicza Szczecin – rozprawy nr 37.*
- Chrzan F., 1959: Łosoś i troć w polskich połowach na Bałtyku w latach 1945–1955. [Salmon and trout in the Polish Baltic catches in 1945–1955]. *Prace Mor. Inst. Ryb.* 10/A.
- Chrzan F., 1969: Biologiczna charakterystyka łososia (*Salmo salar* L.) z rzeki Drawy oparta na badaniu łusek. [Scalesbased biological characteristics of salmon (*Salmo salar* L.) of the river Drawa]. *Prace Mor. Inst. Ryb.* 15a.
- Ciepielewski W., 1971: Tworzenie się pierścienia rocznego na łuskach sielawy (*Coregonus albula* L.). [Formation of annual ring on scales of allen, *Coregonus albula* L.]. *Rocz. Nauk Rol.* 93-H-3.

- Dannevig A., Host P., 1931: Sources of error computing L.1, L.2, L.3, from the scales taken from different parts of the fish. Journ. du Cons. 6, 1.
- Dixon B., 1930: Troć rzeki Redy. [Trout of the river Reda]. Pam. P.I.N.G.W. Puławy 11, 1.
- Dixon B., 1931: Age and growth rate of the sea-trout (*Salmo trutta* L.) of the rivers Reda and Dunajec. Journ. du Cons. 6, 3.
- Grudniewski C., 1961: Rozwój niektórych morfologicznych cech okresu larwalnego troci jeziorowej (*Salmo trutta morpha lacustris* L.) z jeziora Wdzydze. [Development of some morphological larval features in lake trout (*Salmo trutta morpha lacustris* L.) of the Lake Wdzydze]. Roczn. Nauk Rol. D-93.
- Henking H., 1916: Die Lachsfrage im Ostseegebiet II. Repp. et Proc. verb. d.Cons. Intern. pour L'Expl. de la Mer., Copenhagen.
- Henking H., 1929: Untersuchungen an Salmoniden I. Rapp. et Proc. Verb. d.Cons. Intern. pour L'Expl. de la Mer., Copenhagen.
- Henking H., 1931: Untersuchungen an Salmoniden. II Rapp. et Proc. verb. d.Cons. Intern. pour L'Expl. de la Mer., Copenhagen.
- Jokiel J., 1958: Łosoś (*Salmo salar* L.) rzeki Wisły. [Salmon (*Salmo salar* L.) of the river Vistula]. Roczn. Nauk Rol. Ser. B, 73, 2.
- Kaj J., 1953: Restytucja łososia (*Salmo salar* L.) w rzekach polskich w oparciu o jego naturalne tarliska w rzece Drawie i Gdździe. [Reintroduction of salmon (*Salmo salar* L.) in Polish river based on natural spawning grounds in the river Drawa and Gwda]. Roczn. Nauk Rol. B-67-1.
- Nall G.H., 1930: The life of the sea trout. London.
- Romanowski W., 1951: Zastosowanie statystyki matematycznej w doświadczalnictwie. [Mathematical statistics in experiments]. Warszawa.
- Schechtel E., 1925: Łosoś (*Salmo salar* L.) i troć (*Salmo trutta* L.). Salmon (*Salmo salar* L.) and trout [*Salmo trutta* L.]. Roczn. Nauk Rol. i Leś. 14, Poznań.
- Sych R., 1967: Interpretacja łusek troci (*Salmo trutta* L.) z rzeki Wisły. [Interpretation of scales of trout (*Salmo trutta* L.) from the river Vistula]. Acta Hydrol. 5, 9.
- Sych R., 1967a: Ocena wiarygodności łuskowych oznaczeń wieku ryb na przykładzie troci (*Salmo trutta* L.). [Estimation of reliability of scale-based age determination with trout (*Salmo trutta* L.) as an example]. Roczn. Nauk Rol. H-90-2.
- Sych R., 1967b: Oznaczenie wieku troci (*Salmo trutta* L.) w okresie formowania się pierścieni rocznych. [Age determination of trout (*Salmo trutta* L.) in the season of annual rings formation]. Roczn. Nauk Rol. H-90-2.
- Sych R., 1971: Elementy teorii oznaczania wieku ryb według łusek. Problemy wiarygodności. [Elements of theory of scalebased age determination. Problems of reliability]. Roczn. Nauk Rol. H-93-1.
- Szmidt P., 1947: Migracji ryb. [Migrations of fishes]. Izd. Akad. Nauk SSSR Moskwa.
- Żarnecki S., 1961: Łosoś (*Salmo salar* L.) i troć (*Salmo trutta* L.) w aspekcie rewolucyjnym. [Evolutionary aspects of salmon (*Salmo salar* L.) and trout (*Salmo trutta* L.)]. Kosmos A, 5.

STUDIA NAD SMOLTAMI TROCI *SALMO TRUTTA* L. POCHODZENIA NATURALNEGO RZEKI REGI

Streszczenie

Praca przedstawia wyniki badań nad smoltami troci (*Salmo trutta* L.) wyrosłymi w naturalnych warunkach i spływającymi pomorską rzeką Regą do Bałtyku. Ryby łowiono za pomocą samolówki zainstalowanej na czternastym kilometrze Regi. Materiał pozyskiwano w latach 1963, 1964, 1967 i 1974. Ogółem do badań pozyskano 191 smoltów.

Z przeprowadzonych badań wynika, że młodzież znajdowała się w pełnym stadium „smolt”.

Smolty troci pojawiają się w dolnej części Regi tj. przed samym ujściem do morza, w okresie od 29 marca do 8 czerwca. Główny okres spływania przypada na II i III dekadę kwietnia oraz I i II dekadę maja, przy temperaturze wody od 7 do 11°C.

Średnia długość smoltów wyniosła $196,32 \pm 1,76$ mm, a średni ciężar $81,96 \pm 2,07$ g.

Łuski smoltów znajdowały się w okresie formowania pierścieni rocznych. Część osobników posiadała nowy pierścień, część jeszcze go nie posiadała. Określenie wieku smoltów wymaga liczenia pierścieni rocznych i obliczenia przyrostów krawędziowych „dk”*. Do ryb wieku 1+ zaliczono grupę ryb 1+ z dk ≤ 31 mm, do wieku 2+ zaliczono grupę 1+ z dk ≥ 80 mm i grupę 2+ z dk ≤ 25 mm oraz do wieku 3+ zaliczono grupę ryb 2+ z dk ≥ 43 mm i grupę 3+ z dk ≤ 22 mm.

W materiale wszystkie smolty w wieku 1+ posiadały nowo założony przyrost skrajny. W grupie wieku 2+ większa część (56,9%) posiadała nowo założony przyrost, a mniejsza część (43,1%) przyrost ubiegłoroczny. W grupie wieku 3+ tylko niewielka część (31,2%) posiadała nowo założony przyrost, a większa część (68,8%) przyrost ubiegłoroczny. Stąd wniosek, że młodsze wiekiem smolty wcześniej zakładają pierścienie roczne. Podobne obserwacje odnoszą się do innych gatunków ryb (Backiel 1962, Ciepielewski 1971).

Okres życia rzeczno-młodzieży troci w stadium smolt obejmuje od 1 do 3 lat. Na jednoroczne przypada 4,7%; dwuletnie 76,5% i trzyletnie 18,8% badanego pogłowia.

Jednoroczne spływające smolty osiągają przeciętnie długość 143 mm i ciężar 30 g; dwuletnie 192 mm i ciężar 75 g oraz trzyletnie 225 mm i ciężar 117 g.

Kondycja zstępujących smoltów jedno-, dwu- i trzyletnich wyrażona współczynnikiem odżywienia wg wzoru Fultona jest podobna i wynosi średnio 1,03.

Z praktycznych wniosków wypływających z badań warto podnieść sprawę okresu wsiedlania do cieków pomorskich smoltów wyrosłych w ośrodkach zarybieniowych. Jak się wydaje smolty z hodowli winny być wsiedlane do wód otwartych w okresie spływania smoltów dzikich, tj. w kwietniu i maju. Wydaje się, że ze względu na potrzebę wody o odpowiednio niskiej temperaturze do ich transportu, za najodpowiedniejszy termin należy uznać przełom marca i kwietnia przy t° wody 4–8°C.

3. Хелковски

ИССЛЕДОВАНИЕ СМОЛТОВ КУМЖИ (*SALMO TRUTTA* L.) ЕСТЕСТВЕННОГО ПРОИСХОЖДЕНИЯ ИЗ РЕКИ РЕГИ

Р е з ю м е

В работе представлены результаты исследований, проведенных на смолтах кумжи (*Salmo trutta* L.), выросших в естественных условиях и скатывающихся вниз по реке Реге в Балтийское море. Рыбу ловили при помощи самоловного устройства, установленного на четырнадцатом километре р. Реги. Материал для исследований брали в 1963, 1964, 1967 и 1974 гг. В общем для исследо-

* за Backielem (1962) i Sychem (1967b) jest to przyrost ryby odpowiadający przyrostowi łuski od ostatniego pierścienia rocznego do krawędzi.

ваний был взят 191 экз. смолтов. Из проведенных исследований становится очевидным, что молодь кумжи находилась в полной стадии "смолт".

Смолты кумжи появляются в нижних участках Реги, точнее в самом её устье, с 29-го марта по 8-е июня. Кульминационный период ската приходится на II и III декаду апреля и I и II декаду мая при температуре воды от 7 до 11°C.

Средняя длина смолтов равнялась $196,32 \pm 1,76$ мм, а средний вес - $81,96 \pm 2,07$ г.

Чешуя смолтов находилась в стадии формирования годовых колец. Часть особей имела новое кольцо, часть - ещё не имела его.

Для определения возраста смолтов необходимо подсчитать годовые кольца и вычислить краевые приросты "dk".

К рыбам в возрасте 1+ отнесли группу рыб 1+ с $dk \leq 31$ мм, к рыбам в возрасте 2+ отнесли группу рыб 1+ с $dk \geq 80$ мм и группу 2+ с $dk \leq 25$ мм, к возрастной группу 3+ отнесли группу рыб 2+ с $dk \geq 43$ мм и группу 3+ с $dk \leq 22$ мм.

В исследуемом материале все смолты в возрасте 1+ имели новообразовавшиеся краевые приросты. В возрастной группе 2+ большая часть (56,9%) имела новообразовавшиеся приросты, а меньшая часть (43,1%) - только прошлогодний прирост. В возрастной группе 3+ только небольшая часть (31,2%) имела новообразовавшиеся приросты, а большая часть (68,8%) - прошлогодний прирост. Из этого следует, что у более молодых смолтов годовые кольца образуются раньше. Подобное явление наблюдается и у других видов рыб (Баккелль 1962, Чепелевски 1971).

Речной период жизни молоди кумжи в стадии "смолт" продолжается от 1 до 3 лет. На годовиков приходится 4,7%, на двухлетков - 76,5% и на трёхлетнюю молодь - 18,8% от общего числа исследуемой рыбы.

Однолетние скатывающиеся смолты достигают в среднем 143 мм длины и 30 г веса; двухлетние - 192 мм длины и 75 г веса; трёхлетние - 225 мм и 117 г.

Кондиция скатывающихся одно-, двух- и трёхлетних смолтов, выраженная коэффициентом упитанности по формуле Фюльтона, подобна и составляет в среднем 1,03.

Рассматривая практические выводы, вытекающие из проведенных исследований, необходимо обратить особое внимание на время вселения во впадающие в моря реки смолтов, выращенных в рыбопитомниках. Думается, что последних следует вселять в открытые воды в период ската диких смолтов, т.е. в апреле и в мае. Поскольку для их транспортировки необходима вода относительно низкой температуры, наиболее благоприятным периодом вселения следует считать конец марта - начало апреля, когда температура воды равна 4-8°C.

Received: 28 II 1978 r.

Address:

Dr Zygmunt Chełkowski
Instytut Akwakultury i Techniki Rybackiej
71-550 Szczecin, ul. Kuzimierza Królewicza 4
Polska-Poland