

Zygmunt CHEŁKOWSKI, Bożena CHEŁKOWSKA, Mirosław CIUPIŃSKI

Fish biology

PERIOD OF DOWNSTREAM MIGRATION OF SEA TROUT (*SALMO TRUTTA* L.) SMOLT GROWN IN GOWIENICA RIVER

OKRES SPŁYWANIA SMOLTÓW TROCI (*SALMO TRUTTA* L.)
W RZECE GOWIENICY

Department of Salmonid Fish, University of Agriculture, Szczecin, Poland

The period and intensification of downstream migration of sea trout smolts (*Salmo trutta* L.) grown in natural condition in the drainage basin of Gowienica river, being a part of lower Odra system (in 5 consecutive years: 1980–1984), as well as water temperature in the lower section of Gowienica in this period is demonstrated in the present paper.

INTRODUCTION

The phenomenon of period of downstream migration of sea trout (*Salmo trutta* L.) smolts grown in natural condition in Pomeranian rivers was studied by Chełkowski (1978, 1990), Chełkowski and Chełkowska (1981). However there is an evident lack on



Fig. 1. Location of Gowienica river basin
 ----- State border

information on sea trout smolts grown in the Pomeranian river Gowienica. Therefore it became an object of investigation in Gowienica in consecutive five years 1980–84 (Fig.1). Assuming the age of sea trout smolts, being estimated by reading scales of fish grown in Pomeranian rivers according to Dixon (1931) and Chrzan (1959) as well as from river Gowienica, according to Chełkowski (1967), as ranging from 1 to 3 years, thus data on smolts of seven generations (1977–83) can be found in the work presented.

MATERIAL AND METHODS

The drainage basin of Gowienica, contributing a part of lower Odra system, is situated in the centre of Szczecin Plain, containing the area of 364.9 square kilometers (Anonymus, 1949). Gowienica is 79.5 km long with an average slope (falling gradient) being 0.84 %.

Migrating downstream in Gowienica sea trout smolts were collected with the aid of winged trap (Świniarski, 1975). The river was divided by a long codend in the 12.6 km from the mouth of Szczecin Firth. The trap consisted of two 10 m long and 2.5 m high wings with mesh diameter of 15 mm and a long codend with 10 mm mesh diameter. Section of river with sandy even bottom with sharp sides was chosen as a place for the winged trap, in the region of "back up" built by weir of non-working water factory situating in the bridge in the village Widzieńsko (Fig. 1). The catch of fish was controlled at 7 a.m. and 7 p.m., from 1 March to 15 July, i.e. in slightly wider period when comparing to period of downstream migration in Pomeranian rivers (Chełkowski, 1978, 1990; Chełkowski and Chełkowska, 1981). After the registration of number of fish captured, smolts were released back to Gowienica, below the weir mentioned above. The fish being released were not able to follow up the river because of construction of weir,

therefore they could not be caught again. The weir increased the Gowienica water level height to 2 m.

Usually the water run out through a gap formed by removal of some flashboards. During high water levels, the water overflowed. Subsequently, the water cascaded onto the weir bottom, made of a 7 m long flat platform situated 0.5 m above the average low water level.

The sea trout grown in Baltic Sea enter the Gowienica river to spawn (Chełkowski, 1966, 1967). However, during the period of experiment, as well as at least through 3 years before, the migration could take place only in lower section of river, up to the weir in Widzieńsko, being an obstacle for further fish trip. Upper and middle part of drainage basin of Gowienica above the weir, on the other hand, was stocked with sea trout hatch. Amounts of hatch released, which from the smolts studied were recruited, were ranging within 186.5–238.0 thousands of individuals per year (Bartel and Zieliński, 1977–1983 and reports of Polish Anglers Society).

During the morning control of the trap, water temperature was registered with the accuracy to 0.1°C.

RESULTS

Throughout five years of investigation in Gowienica river 2010 individuals of sea trout smolts (*Salmo trutta* L.) were caught. The largest number of fish was collected in 1980 (n=917), while the smallest one in 1981 (n=110). In remaining 3 years (1982–1984), 219 to 460 specimens were captured (Table 1).

Table 1

Number of sea trouts smolts captured in Gowienica river during the downstream migration (individuals)

| Year | Month and decades | | | | | | | | | Total |
|-------|-------------------|-------|-----|-----|-----|-----|-----|------|----|-------|
| | March | April | | | May | | | June | | |
| | III | I | II | III | I | II | III | I | II | |
| 1980 | | | 278 | 59 | 362 | 158 | 35 | 24 | 1 | 917 |
| 1981 | 2 | 41 | 29 | 6 | 19 | 3 | 6 | 4 | | 110 |
| 1982 | 21 | | 19 | 26 | 41 | 100 | 12 | | | 219 |
| 1983 | | 11 | 68 | 85 | 82 | 98 | 11 | | | 355 |
| 1984 | | 6 | 44 | 125 | 132 | 4 | 42 | 45 | 11 | 409 |
| Total | 23 | 58 | 438 | 301 | 636 | 363 | 106 | 73 | 12 | 2010 |

As can be seen in the catch record, smolts were being caught in the period of 12th April – 12th June in 1980, 24th March – 10th June in 1981, 27th March – 28th May in 1982, 2nd April – 31st May in 1983 and 6th April – 18th June in 1984. The data reported showed that downstream migration of smolts in Gowienica is being undertaken in the period of 24th March to 18th June, and in the successive years of study it was limited to 6–8 decades. The shortest period was in 1983, from the first decade of April to the third decade of May. The longest one was in 1981 and 1984 – in the first year from the third decade of March to the first decade of June, and in the second year from the first decade of April to the second decade of June. In remaining years the period of downstream migration took 7 decades, from the second one of April to second of June in 1980, and from the third decade of March to third of May, 1982 (Table 1).

Further analysed data allowed to show some periods of intensification of downstream migration of sea trout in Gowienica river in the consecutive years of investigation. The peak downstream migration was found out in the first decade of April in 1981, first one of May in 1980 and 1984 and in the second decade of May in 1982 and 1983.

During the whole 5– year period of catch, smolts migrated mostly in the first decade of May (636 individuals – 31.6 %), and intensification of downstream migration took place in the period of 4 decades: from the second of April to the second of May. In this time 1736 specimens (86.5 %) were collected. In the remaining period of downstream migration, taking third decade of March – first of April and third one of May – second of June, the number of downstream migrating smolts was small, amounting to 272 individuals (13.5 %) (Table 1).

Throughout the downstream migration of sea trout smolts, the temperature of water was controlled. Data collected allowed to find the mean decade temperature of water during the downstream migration of smolts, separately for particular years of study (Table 2). It appeared that smolts migrate downstream at average decade temperature increasing from 6.3°C to 17.0°C. Then the frequency of downstream migration of smolts for the whole period of examination was summarized in 1 – degree intervals of temperature was compared (Table 1). Results showed the highest intensification of downstream migration at temperature of water amounting to 10°C ($n = 447$, 22.2 %). In the range of 8 – 13°C the prevailing amount of smolts ($n = 1577$, 78.5 %) migrated. As can be seen from the data analyzed, the downstream migration of smolts in lower Gowienica begins at temperature 5°C and finishes at 19°C. However in the range of extreme temperatures, i.e. 5 – 7°C and 14 – 19°C, less amount of smolts migrated.

Table 2

Decade mean water temperatures (°C) in Gowienica river during the downstream migration of smolts

| Year | Month and decades | | | | | | | | |
|------|-------------------|-------|------|------|------|------|------|------|------|
| | March | April | | | May | | | June | |
| | III | I | II | III | I | II | III | i | II |
| 1980 | | | 7.9 | 7.2 | 9.0 | 11.1 | 12.7 | 14.5 | 14.5 |
| 1981 | 7.9 | 8.6 | 9.0 | 7.1 | 9.4 | 15.6 | 15.1 | 17.0 | |
| 1982 | 6.9 | 7.6 | 7.0 | 8.2 | 9.3 | 13.7 | 14.8 | | |
| 1983 | | 6.3 | 8.3 | 10.9 | 11.7 | 14.5 | 13.9 | | |
| 1984 | | 9.6 | 10.1 | 9.4 | 11.8 | 12.7 | 14.9 | 15.3 | 16.0 |

Data presented in Table 3 allowed to estimate model of dependence of downstream migrations of smolts in Gowienica river on water temperature with the aid of Marquardt's method (Czerwiński et al., 1986). The diagram (Fig. 2) showed the course of this dependence in the form of bell curve. Downstream migration of smolts in Gowienica river is significantly dependent on the water temperature at the level of significant $\alpha = 0.05$, what is confirmed by coefficient of determination $R^2 = 0.81$. It indicates, that such arrangement of downstream migration of sea trout smolts in Gowienica river can be explained as being dependent in as many as 81 % on water temperature (presented in Table 3).

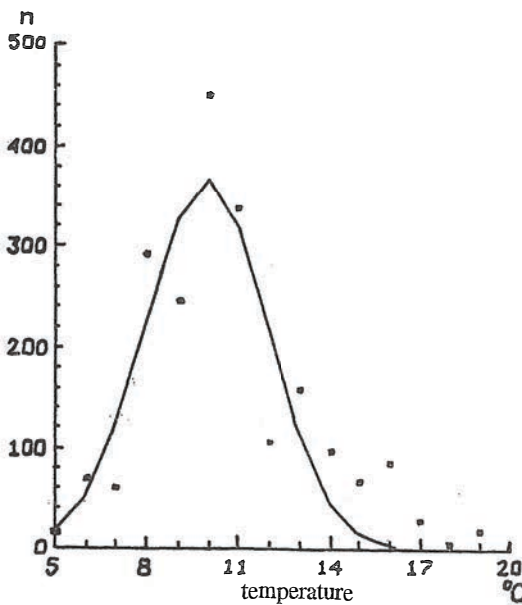


Fig. 2. Dependence of downstream migration of sea trout smolts on water temperature in Gowienica river: $y = 366.6 [-0.13 (T - 9.96)]$
 y – number of smolts migrating

Table 3

Number of sea trout smolts migrating in dependence on water temperature of Gowienica

| °C | 5* | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|----|-----|-----|-----|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|
| n | 17 | 69 | 59 | 290 | 245 | 447 | 335 | 105 | 156 | 94 | 65 | 84 | 25 | 4 | 16 |
| % | 0.9 | 3.4 | 2.9 | 14.4 | 12.2 | 22.2 | 16.7 | 5.2 | 7.8 | 4.7 | 3.2 | 4.2 | 1.2 | 0.2 | 0.8 |

* – ranges of temperature (5 = 4.5 – 5.4; 19 = 18.5 – 19.4)

COMPARISON OF DATA OBTAINED WITH SMOLTS FROM POMERANIAN RIVERS

Data concerning the period of intensification as well as water temperature during the downstream migration of smolts studied in Gowienica and Pomeranian rivers – Rega, Osówka, Mołstowa (Chełkowski 1978, 1990; Chełkowski and Chełkowska, 1981) appeared to be similar. Downstream migration in rivers mentioned takes place from March 29 to June 11, while in Gowienica from March 24 to June 18. The intensification of downstream migration in these rivers occurs in the period of the second decade of April – third decade of May, when in Gowienica in the second decade of April – second decade of May. Period of downstream migration of smolts in Pomeranian rivers occurs at the temperature of water ranging from 7.3–18.0°C, while in Gowienica at 5.0–19.0°C. The peak of downstream migration of smolts in Pomeranian rivers was found out at water temperature from 6.9 to 14.6°C, in Gowienica being 8.0–13.0°C.

CONCLUSIONS

Downstream migration of smolts grown in Gowienica takes place in spring, embracing the period from the 3rd decade of March to the 2nd decade of June. The intensification of downstream migration was stated in the period taking four successive decades: 2nd of April – 2nd of May.

Smolts migrate downstream in Gowienica at water temperature increasing from 5 to 19°C. The intensification of downstream migration occurs at temperature of water 8.0 – 13.0°C.

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STRESZCZENIE

W okresie od 1 marca do 15 lipca w kolejnych pięciu latach 1980 – 1984 przegradzano dolną Gowienicę żakiem skrzydłowym w celu pozyskania spływających do morza smoltów troci (*Salmo trutta* L.) wyrosłych w warunkach naturalnych zlewni. Ogółem pozyskano w tym okresie 2010 smoltów. Okazało się, że smolty troci spływały wiosną w okresie od 24 marca do 28 czerwca. Nasilenie spływania przypadało na okres od drugiej dekady kwietnia do drugiej dekady maja. W tym okresie pozyskano 1738 sztuk (86.5%) smoltów, a w pozostałym 272 sztuki (13.5%). Smolty spływały przy średniej dekadowej temperaturze wody rosnącej od 6.3 do 17.0°C, a najliczniej przy temperaturze 10.0°C.

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Author's address:

Prof. tit. D.Sc. Zygmunt Chełkowski
Department of Salmonid Fish
University of Agriculture in Szczecin
Kazimierza Królewicza 4
71-550 Szczecin
Polska (Poland)