

Arch. Ryb. Pol.	Archives of Polish Fisheries	Vol. 8	Fasc. 2	149-159	2000
--------------------	---------------------------------	--------	---------	---------	------

## EFFECTIVENESS OF STOCKING TAGGED SEA TROUT SMOLTS INTO REDA RIVER AND PUCK BAY

*Ryszard Bartel*

The Stanisław Sakowicz Inland Fisheries Institute in Olsztyn

ABSTRACT. Studies were carried out on the distribution, growth, and efficiency stocking of tagged sea trout smolts into the Reda River and the Puck Bay. 13880 individuals of tagged, one, two and three years old sea trout smolts were released in 1964-1971. Tag returns were low, from 0.1 to 3.4. They were related to stocking site and fish age. Fish growth rate was high: average body length after the first year spent in the sea was 43.9 cm, and body weight – 1668 g, after the second year – 63.9 cm and 3279 g, and after the third year – 70.2 and 4207 g. Tagged trout were found throughout the Baltic Sea, reaching the region ICES-28. Most trout (63%), however, were harvested in the region ICES-26. Polish fishermen caught 71.1% of tagged fish. As regards foreign crews the highest share of tagged trout were harvested by Danes – 15.9%.

Key words: SEA TROUT, SMOLT, TAGGING, DISTRIBUTION, GROWTH, EFFECTIVENESS  
OF STOCKING

### INTRODUCTION

Sea trout (*Salmo trutta* L.) from the Reda River have been harvested by professional fishermen but also poachers. Catches have been sporadically registered. Majority of the studies on sea trout concern its morphometric characteristics (Dixon 1931 a) and evaluation of growth using scale analysis (Dixon 1931 b, Chrzan 1959). Two races were distinguished in Reda sea trout: "black" and "silvery", differing as to the growth rate (Dixon 1931 b).

In the sixties and the seventies the regional directory board of the Polish Anglers Association in Gdańsk carried out electrofishing of sea trout spawners in the lower Reda River. Trout fry was obtained from the fertilised eggs and reared until smolt stage in the Fish Stocking Centre of the Polish Anglers Association in Rumia. The smolts were then released either to the Reda River or to the Puck Bay.

The aim of the present study was to evaluate stocking efficiency, distribution, and growth of Reda sea trout.

## MATERIAL AND METHODS

Smolts reared in the Fish Stocking Centre of the Polish Anglers Association in Rumia were obtained from the spawners harvested using electric gear in 1964-1971 in the Reda River, and in 1964 in the Pogorzelnica River, a tributary of the Łeba River.

The smolts were tagged with celluloid tags fastened under the anterior part of dorsal fin using a single silver or monel wire, and released to the lower Reda River in Mrzezino, and to the Puck Bay (Fig. 1).

13880 smolts were released in 1965-1974: 10693 fish aged 1-3 years were released to the Reda River and 3187, 2-3 years old fish to the Puck Bay (Tab. 1).

**TABLE 1**

Experimental data, and stocking efficiency for tagged sea trout smolts released to the Reda River and the Puck Bay in 1965-1974

No.	Released					Harvested				Average mass (g)	Stocking efficiency index
	Date	Site	Age	Number of ind.	Average length (cm)	Younger fish <sup>1/</sup>		Older fish <sup>2/</sup>			
1	16.07.65	Reda	1+	927	21.7	3	0.3	1	0.1	7760	8.3
2	16.07.66	Reda	1+	1687	16.1	1	0.1	3	0.2	2200	3.9
Totally sea trout aged 1+				2614		4	0.2	4	0.2		
3	10.05.73	Reda	1-2	1100	18.5	–	–	8	0.7	2930	21.3
4	6-7.04.67	Reda	2	2426	17.8	10	0.4	16	0.7	2206	14.5
5	19.05.71	Reda	2	1138	21.2	–	–	6	0.5	2760	5.7
6	18.05.72	Reda	2	986	20.7	6	0.6	12	1.2	2590	31.5
7	13.03.74	Reda	2	697	19.8	4	0.6	8	1.1	3462	39.7
Totally sea trout aged 2+				5247		20	0.4	50	0.8		
8	16.05.68	Reda	3	939	21.8	2	0.2	21	2.2	2525	56.5
9	18-20.05.68	Reda	3	790	24.9	–	–	27	3.4	2695	92.1
Totally sea trout aged 3+				1729	–	2	0.2	48	2.8		
Totally sea trout aged 1-3				8079	–	22	0.3	102	1.3		
10	28-29.04.67	Zat. Pucka	2	2514	17.7	3	0.1	18	0.7	2004	14.3
11	18.05.68	Zat. Pucka	3	673	23.7	–	–	18	2.7	2262	60.5
Totally sea trout aged 2-3				3187	–	3	0.1	36	1.1		
Totally sea trout experiments 1-11				13880		29	0.2	138	1.0		

1/ the fish caught until the end of July of the year in which they were released

2/ the fish caught after the end of July of the year in which they were released

Among the released fish, only 167 were caught: 29 “younger” fish harvested until July of the same year in which they were released, and 138 “older” individuals caught later.

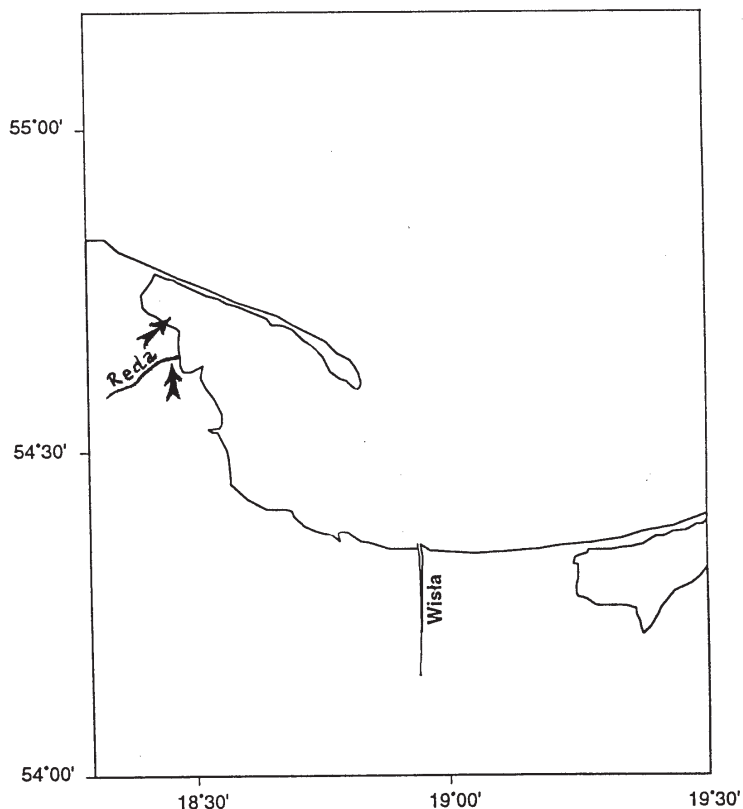


Fig. 1. Stocking sites (arrows) of tagged sea trout

Stocking efficiency was expressed by the ratio of weight of the fish caught to 1000 released smolts. If the information on fish weight was not available, average weight of the caught fish was used for the calculations.

## RESULTS AND DISCUSSION

### TAG RETURNS

Very small number of tags were returned. Average returns were 1% from "older" fish and 0.2% from "younger" ones. The highest return rate was obtained from 3 years old smolts released to the Reda River in 1968. Return rate averaged 0.8% among the 2 years old smolts, ranging from 0.5% to 1.1%. The lowest return rate was obtained for the fish released to the Reda River in summer, 0.2% on the average. Among 2 and 3

year-old smolts released into the Puck Bay the returns were similar as for the fish of the same age from the Reda River (Tab. 1). The results were low and similar to the return rates for the trout released in autumn (Bartel 1988). Such poor stocking efficiency might have resulted from environmental conditions rather than the quality of the stocking material. The latter was good as indicated by much higher returns of the fish of the same origin introduced into the Łeba River and Gulf of Gdańsk. Among 3 years old smolts released to the Łeba River in 1968, 22.8% of returns were obtained for "older" fish, and among 2 years old ones released in 1967-1974 the average rate of returns was 4.2% (2.4-9.7%). Stocking of the Gulf of Gdańsk was more efficient. In the group of 2 years old smolts introduced in 1971-1974, average return rate was 9.9% (4.1-18.8%), and as regards 3 years old ones released in 1968 and 1972 it was 34.4% and 16.6% respectively (Bartel 1988).

Similarly low results were obtained for the fish introduced into the Puck Bay after several months of cage rearing. The highest returns of 6.6% were noted for the fish kept in cages for 354 days, until they reached average body length of 23.2 cm (16-37 cm) (Kozioł and Pelczarski 1995). The authors were of the opinion that very low return rate resulted from the fact that only few fishermen who fished in the Puck Bay sent the tags back; 50% of tags were returned by 6 fishermen, while total number of registered fishing boats in the Puck Bay and the Gulf of Gdańsk was 80. Thus, it is possible that also in the present study low return rates were caused mainly by poor response of the fishermen.

#### **GROWTH RATE OF THE SEA TROUT RELEASED TO THE REDA RIVER AND THE PUCK BAY**

After the first year of sea life, tagged sea trout from the Reda River caught from November to March reached average body length of 53.9 cm and weight of 1668 g. Fish length was 63.9 cm after 2 years of sea life, and weight 3279 g, while after 3 years the respective values were 70.2 cm and 4207 g (Tab. 2). These values were higher than those obtained from scale analysis for Reda sea trout caught in 1928 (Dixon 1931 b) and for fish from the Łeba River (Chrzan 1959) or the Rega River (Chełkowski 1974). Fish growth was similar to that observed in tagged sea trout smolts released to the Grabowa River (Bartel 1987), but lower than the results obtained for summer and winter Vistula sea trout, sea trout from the Dunajec River, as well as from the scale analysis (Dixon 1931 b, Żarnecki 1963, Sych 1970), or from direct measurements of tagged fish (Backiel and Bartel 1967, Pałka and Bieniarz 1983). More rapid growth

TABLE 2

Average body length (cm), and weight (g) of tagged sea trout released to the Reda River and the Puck Bay

Fish age	Months	Length (cm)			Mass (g)		
		mean	from	to	mean	from	to
A.0+	VIII	50.9 (8)	32.5	65	1420 (8)	350	2400
A.0+/1+	XI-III	53.9 (27)	40	66	1668 (27)	650	3200
A.1+	IV-VII	51.9 (10)	28	77	1763 (9)	210	4200
A.1+	VIII-X	62.3 (15)	56	70	2806 (16)	1500	4200
A.1+/2+	XI-III	63.9 (29)	47	78	3279 (28)	1100	7700
A.2+	IV-VII	75.0 (1)			3700 (1)		
A.2+	VIII-X	83.5 (2)	82	85	4283 (3)	2200 +	6950
A.2+/3+	XI-III	70.2 (6)	54	80	4207 (6)	1840 -	6500

Note: number of returns in parentheses

TABLE 3

Average body length of various age groups of sea trout from Polish rivers (according to various authors)

River	Sex	Age					Author	Comments <sup>2/</sup>			
		River			Sea						
		I	II	III	I	II			III	IV	V
Vistula winter		9.4	18.2		55.2	66.1	79.9	90.6		Żarnecki 1963	SR
Vistula summer		8.4	18.6		50.0	62.9	76.6	98.2	103.0	Żarnecki 1963	SR
Vistula			15.3		45.2	67.7	79.9			Sych 1970	SR
			(14.2-16.5)		(38.2-48.2)	(63.8-70.5)	(78.0-81.1)				
Vistula summer			16.2		47.4	68.3	75.3			Backiel, Bartel 1967 acc. to untreated data	TE
Dunajec winter					53.7	69.5	79.4			Pałka, Bieniarz 1983	TE
Dunajec		8.6	17.4		47.6	63.0	80.7	83.8		Dixon 1931 b	SR
Dunajec		6.8	12.0	19.1	48.6	70.1	76.1			Dixon 1931 b	SR
Reda					42.7	64.0	78.1			Chrzan 1959	SR
Reda „silver”		8.6	18.4		41.1	55.4	70.2	76.0		Dixon 1931 b	SR
Reda „silver”		8.0	17.3	23.4	46.7	63.5	72.0			Dixon 1931 b	SR
Reda „black”		9.0	16.1		39.4	54.3	58.9	60.0		Dixon 1931 b	SR
Reda „black”		7.3	13.4	19.7	45.1	62.7				Dixon 1931 b	SR
Reda					53.9	63.9	70.2			Bartel own data	TE
Rega		12.2	17.2	21.8	44.1	56.8	67.8	79.3	87.3	Chełkowski 1974	SR
Mean for 5 rivers <sup>1/</sup>	♀				56.1	66.3	74.6	81.9	86.0	Chełkowski 1969	SR
					58.0	68.9	77.5	85.4	93.0		
Łeba					41.0	60.0	73.4			Chrzan 1959	SR
Grabowa	♀				56.3	66.4	75.7	81.3	85.0	Chełkowski 1969	SR
					58.6	67.4	77.0	87.2			
Grabowa					51.2	62.3	68.0			Bartel 1987 b	TE

<sup>1/</sup> Rega, Parsęta, Unieście, Słupia and Grabowa<sup>2/</sup> SR – scale readings

TE – tagging experiments

was also observed for sea trout from Pomeranian rivers (Chełkowski 1969) (Tab. 3). Average body weight of all caught tagged sea trout was 2555 g, at average body length 58.7 cm.

The largest Reda sea trout of 85 cm were bigger than "black" individuals from the Rega River (34-71 cm) and were similar to "silver" individuals of 40-80 cm (Dixon 1931 b).

Growth rate of Reda sea trout in the first year of sea life was higher than of Pomeranian fish (Chrzan 1959), and similar to that of the Vistula sea trout (Chrzan 1959, Sych 1967, Backiel and Bartel 1967, Pałka and Bieniarz 1983) and of tagged sea trout from the Wieprza River (Bartel 1987). After 2 years of sea life, however, average body weight of Reda sea trout was lower than of the fish from other Polish rivers (Tab. 4).

**TABLE 4**

Average individual body weight<sup>1</sup> of various age groups of sea trout caught in the sea

River	Fish number	Age				Author	Comments <sup>2/</sup>
		I	II	II	III		
Vistula	1506	1115	4066	6889		Sych 1967	SR
Vistula winter	85	1594	3828	6650		Pałka, Bieniarz 1983	TE
Vistula summer	165	1741	3896	5408		Backiel, Bartel 1967 acc. to untreated data	TE
Vistula	1127	1980	3650	6800	9460	Chrzan 1959	SR
Reda	161	900	3420	6210		Chrzan 1959	SR
Reda	61	1668	3279	4207		Bartel own materials	TE
Łeba	45	830	2930	4990		Chrzan 1959	SR
Słupia	45	830	2930	4990		Chrzan 1959	SR
Wieprza	535	990	3540	6500		Chrzan 1959	SR
Grabowa	58	1707	3550			Bartel 1987 b	TE

<sup>1</sup> average body weight of fish calculated from the back-readings of average body length and transformed to weight. Calculations refer to fish caught in November-March period.

<sup>2</sup> SR – scale reading, TE – tagging experiments

## DISTRIBUTION OF TAGGED TROUT FROM THE REDA RIVER

In the first months after introduction until the end of July of the first year of life in the sea trout from the Reda River were caught in the Gulf of Gdańsk region, especially in the Reda mouth, and in the Reda River itself (Fig. 2).

Later on, tagged sea trout were observed in south and central Baltic Sea. Fish from the Reda River migrated far northward from the site of their release, and reached the

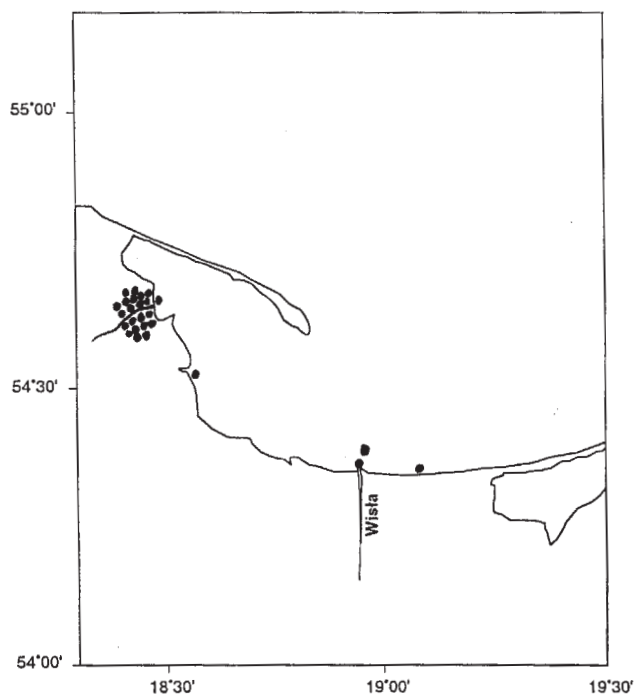


Fig. 2. Catching sites of "younger" tagged sea trout. Each dot indicates one individual

regions ICES-27 and 28, extending up to  $50^{\circ}00'$  and  $58^{\circ}30'$  respectively. They migrated also westward up to the region ICES-24 near the Uznam Island and the Peene River. According to the tag return report, the highest number of tagged sea trout were caught in statistical region ICES-26 (Tab. 5). Among 87 fish harvested in this region, most were caught inshore, in the Puck Bay near Gdynia, in the Vistula River mouth, and along the Vistula spit (Fig. 4). Considerable number of tagged trout were harvested in the Reda River. From among 18 individuals electrofished in the Reda River, representing 13% of all caught sea trout, one fish 32.5 cm long and weighing 350 g probably did not reach the sea.

TABLE 5

Distribution of tagged Reda fish in south Baltic Sea

	Subregions ICES					Reda	Łeba	Totally	NN
	24	25	26	27	28				
Fish number	8	9	87	4	9	18	2	137	1
%	5.9	6.6	63.5	2.9	6.6	13.1	1.5	100	-

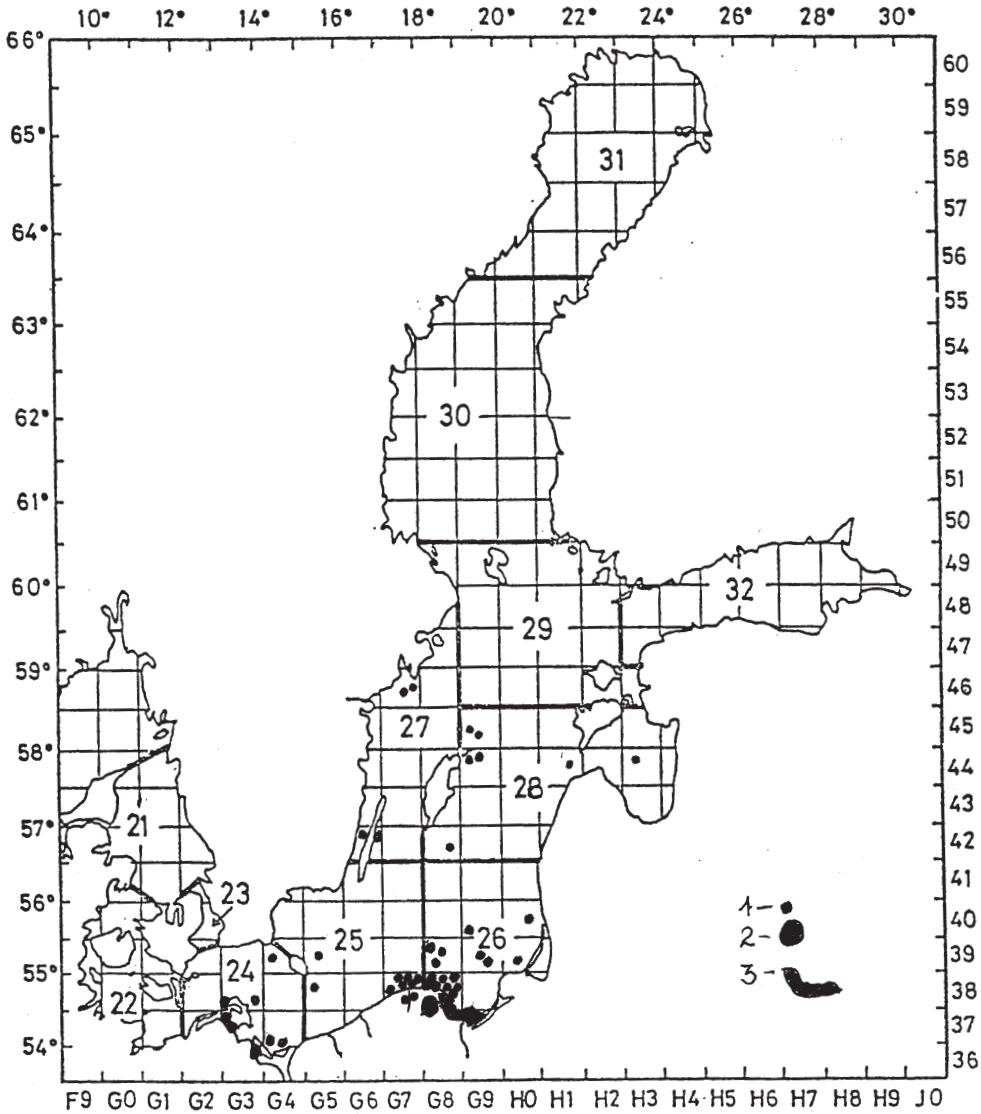


Fig. 3. Catching sites of the tagged sea trout released to the Reda River and the Puck Bay. 1 - one individual caught, 2 - 18 individuals caught, 3 - 68 individuals caught. Numbers indicate ICES regions.

It is difficult to determine whether the distribution of Reda sea trout differed from that of tagged Vistula sea trout which were caught in Bothnia and Gulf of Finland (Backiel and Bartel 1967), where Reda sea trout were not observed. The differences might have resulted from lower returns of Reda sea trout. Tagged sea trout



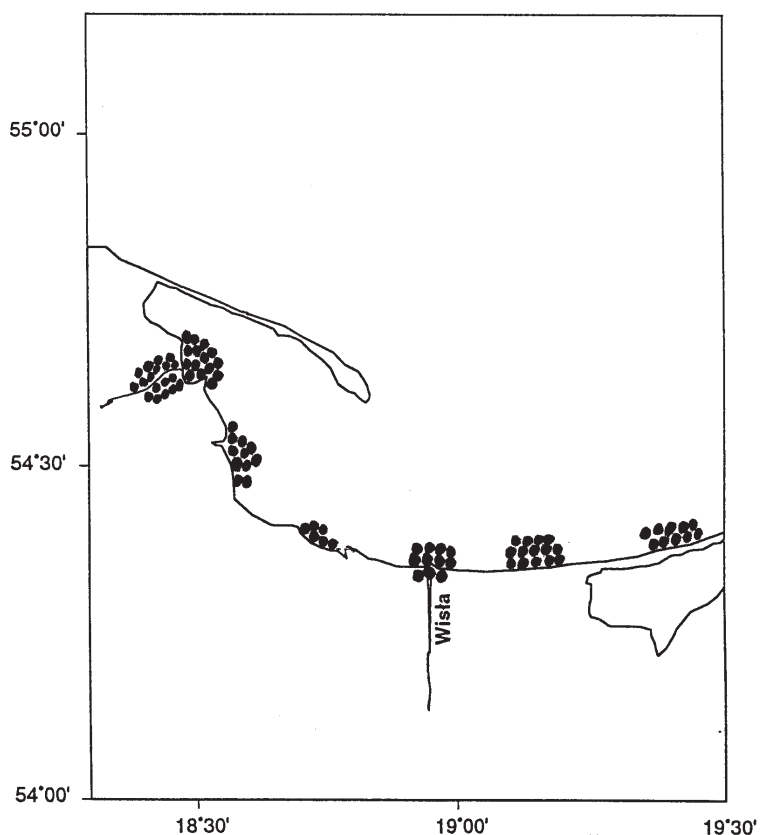


Fig. 4. Catching sites of "older" tagged sea trout in the Gulf of Gdansk region. Each dot indicates one individual.

smolts released to the Reda and Vistula rivers were most often caught in the Gulf of Gdansk region, contrary to the fish released into Wieprza, which were very rarely observed there (Bartel 1987).

#### CATCHES OF REDA TROUT IN VARIOUS COUNTRIES

Majority of tagged Reda sea trout (71.7%) were caught by Polish fishermen. The remaining 28.3% of returns were obtained from Danish (15.9%), German (5.1%), Swedish (4.4%), Latvian (1.5%), Russian and Finnish crews (0.7% each).

#### STOCKING EFFICIENCY

Very low return rate of the tags (Tab. 1) resulted in very low stocking efficiency, ranging from 3.9 kg to 92.1 kg. It was related to the age and size of the released fish

(Tab. 1). The highest stocking efficiency was obtained for 3 years old smolts. The efficiency values for the fish released to the Reda River and the Puck Bay were similar to the results obtained for the fish introduced to the Wieprza River, ranging from 0 to 125 kg (Bartel 1987). Stocking efficiency obtained in the present study was, however, much lower comparing to the results of introduction of sea trout smolts to the Vistula (Backiel and Bartel 1967, Pałka and Bieniarz 1983).

## CONCLUSIONS

1. Very low efficiency of the Reda River and the Puck Bay stocking with sea trout smolts resulted from very low rate of tag returns by the fishermen.
2. Sea trout from the Reda River performed long migrations, and some 1/3 were caught by the foreign crews.
3. Reda sea trout showed fast growth, the largest individuals reached 85 cm.
4. Stocking efficiency indices calculated for the Reda sea trout from the tag return reports were lower comparing to similar indices for the same species from another Polish rivers.
5. The results of the experiment showed that the pattern of migrations of the Reda sea trout is different than of the populations from the neighbouring rivers. That difference suggests the necessity to maintain the Reda population, and of further stocking with smolts.

## REFERENCES

- Backiel T., Bartel R. 1967 – O efektach zarybiania smoltami troci na tle wyników ich znakowania – Roczn. Nauk Roln. Ser. H 90: 365-388
- Bartel R. 1987 – Distribution, migrations and growth of tagged sea trout (*Salmo trutta* L.) released into the catchment area of the Wieprza River – Biul. Mor. Inst. Ryb. (Bull. Sea Fish. Inst.) 3-4 (101-102): 14-22
- Bartel R. 1988 – Variability of sea trout returns as shown from long-term tagging experiments with hatchery - reared parr and smolts – Biul. Mor. Inst. Ryb. (Bull. Sea Fish. Inst.) 5-6 (109-110): 27-36
- Chełkowski Z. 1969 – Pogłowie troci (*Salmo trutta trutta* L.) rzek pomorskich Pomorza – Przegl. Zool. 13: 72-91
- Chełkowski Z. 1974 – Studia nad biologią troci (*Salmo trutta* L.) rzeki Regi – Rozprawy AR Szczecin 37
- Chrzan F. 1959 – Łosoś i troć w polskich połowach na Bałtyku w latach 1945-55 – Pr. Mors. Inst. Ryb. Gdynia 10, A: 273-340
- Dixon B. 1931a – Morphometrical features of the sea trout of Polish rivers – J. Cons. Int. Explor. Mer. 6 (1): 94-102
- Dixon B. 1931b – The age and growth rate of the sea trout *Salmo trutta* of the rivers Reda and Dunajec – J. Cons. Int. Explor. Mer. 6: 449-457
- Kozioł M., Pelczarski W. 1995 – Opóźnione zarybienie trocią wędrowną Zatoki Puckiej – Biul. Mor. Inst. Ryb. /Bull. Sea Fish. Inst. Res. Rep. 3 (135): 41-44

- Pałka W., Bieniarz K. 1983 – Wędrowniki, wzrost i eksploatacja troci dunajeckiej (*Salmo trutta* L.) na tle wyników znakowania – Roczn. Nauk Roln. Ser. H 100: 71-94
- Sych R. 1970 – Some comparisons on the background of an eleven-year study on the growth of sea-trout (*Salmo trutta* L.) – Acta Hydrobiol. 12 (2/3): 225-249
- Żarnecki S. 1963 – Występowanie populacji sezonowych u łososia atlantyckiego (*Salmo salar* L.) oraz u troci (*Salmo trutta* L.) w rzece Wiśle – Acta Hydrobiol. 5, 2-3: 255-294

## STRESZCZENIE

### EFEKTYWNOŚĆ ZARYBIANIA REDY I ZATOKI PUCKIEJ ZNAKOWANYMI SMOLTAMI TROCI

Celem pracy było określenie rozsiedlenia, wzrostu i efektywności zarybiania znakowanymi smoltami troci wpuszczonymi do Redy i Zatoki Puckiej. W latach 1964-1971 wypuszczono 13 880 znakowanych jedno-, dwu- i trzyletnich troci. Uzyskano niskie procenty zwrotów od 0,1 do 3,4; wiązały się one z miejscem wypuszczenia smoltów i ich wiekiem. Wzrost znakowanych troci był dobry, po pierwszym roku pobytu w morzu trocie osiągały długość 43,9 cm i masę 1668 g, po drugim roku odpowiednio 63,9 cm i 3279 g, a po trzecim roku długość 70,2 cm i masę 4207 g. Znakowane trocie wędrowały po całym Bałtyku docierając do podrejonu ICES – 28, ale najwięcej złowionych troci pochodziło z podrejonu ICES – 26, ponad 63%. Rybacy polscy złowili 71,7% znakowanych troci. Z pozostałych państw największy udział mieli rybacy duńscy – 15,9%.

#### ADRES AUTORA:

Prof. dr hab. Ryszard Bartel  
Instytut Rybactwa Śródlądowego w Olsztynie  
Pracownia Rybactwa Rzecznego  
ul. Reduta Żbik 5  
80-761 Gdańsk