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STOCKING OF SEA TROUT *(Salmo trutta m. trutta)* SMOLTS IN POLAND. PART II. FACTORS INFLUENCING RECAPTURES AND VERIFICATION OF ESTIMATES

Piotr Dębowski, Ryszard Bartel

River Fisheries Laboratory of the Inland Fisheries Institute

A B S T R A C T. Recaptures of tagged of sea trout smolts released in 1961 - 1986 depended on the place of rearing and on at least two other variables. In case of releases into the Vistula River system the rate of recapture was related to the distance of the releasing place from the sea and to calendar years, exhibiting a decreasing trend. Releases to the Pomeranian rivers and directly to the sea were significantly affected by the mean length of tagged smolts and also by the calendar years. These relationships determined c. 40 % of variation of effects i.e. of weights of recaptured fish per 1000 released smolts. They were used for estimation of expected commercial catches resulting from smolt stocking in 1972 - 1986 and from natural reproduction. The estimated catches differed by an order of magnitude from the real catches. Possible sources of bias were discussed.

Key words: TAGGED SMOLTS, SMOLT LENGTH, REARING AND RELEASE PLACE, MULTIYEAR TREND

INTRODUCTION

As shown in Part I of the study on sea trout stocking (Bartel and Dębowski, this volume) the recapture rates varied greatly, from 0 to 1116 kg per 1000 of tagged smolts. It was found that these rates differed between groups released to the Vistula River system, to the Pomeranian rivers and to the sea. However, the published accounts have reported about various factors, other than release place, affecting recapture rates. Most often these rates were related to the smolt size (Backiel, Bartel 1967; Bartel 1988; Pałka, Bieniarz 1983, Salminen 1991; Sych et al. 1978). This relationship resembled a parabola (Sych et al. 1978) or an exponential function (Backiel and Bartel 1967).

Survival of released smolts was found to depend on rearing conditions and on applied measures (Strange et al. 1978; Wedemeyer et al. 1980; Soivo, Virtanen 1985; Stefansson, Hansen 1989; Terhune et al. 1990). Stress resulting from capture, transport and liberation could also influence survival (Wedemeyer 1972; Barton et al. 1980; Soivo, Virtanen 1982; Hansen, Jonsson 1988). Smolts remaining at release places were exposed to mass predation by birds and by fishes of prey (Elson 1975; Bakstanskij et al. 1976; Bertmar 1982; Larsson 1985; Hvidsten, Mokkelgjerd 1987; Hvidsten, Hansen 1988; Hvidsten, Lund 1988) and to poachers (Bartel, unpublished). The period of staying around release places depends on the smoltification degree and on water temperature and that is why the time of liberation can be the key factor influencing recapture rates (Hansen 1987; Hansen, Jonsson 1989; Larsson 1977). Several publications demonstrated importance of the place of stocking; the best results followed liberations to the sea, the worst - to the upper reaches of rivers (Bartel 1988; Einarsson et al. 1987; Eriksson 1989; Gunnerod et al. 1988, and see also Bartel, Debowski - this volume).

In this paper we investigate possible effects of several of the above mentioned factors on stocking success and we try to verify a method of assessment of sea trout smolt stocking results.

MATERIAL AND METHODS

Results of 135 sea trout smolt tagging experiments carried out by the River Fisheries Laboratory of the Inland Fisheries Institute (Appendix 1) are used in this paper. Tagging methods and verification of data on recaptures were described in Bartel and Dębowski (this volume).

Analysis of factors

The following factors possibly affecting recaptures were considered:

- origin of parents of the released smolts,
- place of rearing (fish farm) where fish were grown; there were 21 such places but we analyzed only the ones wherefrom at least 8 tagging experiments originated,
- mean standard length of smolts (l. caudalis, mm) in every experiment (symbol MLEN),
- calendar year of release, abridged to two digits, e.g. 67 for 1967 (YEAR),
- the week of release counted from the beginning of the calendar year (WEEK),
- distance of the release place from the sea in km along the river course (DIST).

All experiments were divided into three release groups: SEA - liberations to the Bay of Gdansk, POM - to the Pomeranian rivers, WIS - to the Vistula River system (see Bartel, Dębowski - this volume). Each release group was treated separately.

TABLE 1

List of stocking efficiency indices

E0 - total weight of fish recaptured in the year of liberation
E1 - as above for fish recaptured in the next year after release
E2 - as above for fish recaptured during the second year after release
E3 - as above for fish recaptured during the third and later years after release
ET = E0 + E1 + E2 + E3
LE0 = ln(E0 + 1) and similarly LE1, LE2, LE3, LET

Results of experiments were expressed in terms of efficiency indices being total weights of recaptured fish (kg) per 1000 released smolts (Table 1). Since distributions of particular indices were not normal (chi^2 test) nonparametric statistical tests were used.

Relationships between efficiency indices and four factors (MLEN, YEAR, WEEK, DIST - independent variables) were assumed to fit multiple regressions model as follows:

$$y = b_0 + b_1 MLEN + b_2 DIST + b_3 YEAR + b_4 WEEK$$

where y represents any log transformed efficiency index (Table 1). The method of stepwise variable selection was used. Independent variables showing regression coefficients not significantly different from zero were eliminated.

Model verification

In order to verify predictions of stocking effects by means of the above model we used data on sea trout stocking in Poland in 1972 through 1986 collated in annual reports on salmonid fisheries by the River Laboratory[1]. These data for each year included: place of smolt liberation, date of liberation, number of fish, mean individual weight (W, g) converted to mean length (L, mm) on the basis of measurements of 100 smolts reared in the Institute's ponds at Oliwa, according to the formula:

$$ln(L) = [ln(W) + 10.386] \cdot 2.792^{-1}$$

A 10 % correction was applied as advised by Nielsen and Schoch (1980).

1 These reports (in Polish) were prepared by R. Bartel and Z. Zieliński for the years 1972 to 1986 (incl.) annually under the title " Sprawozdanie z "Serwisu" informacyjnego gospodarki łososiowej za rok....® , IRS, Zakład Upowszechniania Postępu, Olsztyn, in a small number of copies.

In the period 1972-1986 there were 410 sea trout smolt liberations releasing a total of 4 282 549 fish (Table 2). Expected efficiency (i.e. kg of catch per 1000 smolt, see Table 1) for each year after liberation according to the appropriate models was multiplied by numbers (thousands of) of stocked fish (N); thus expected catch in the year of liberation was $Y0 = N \cdot EO$, in the next year $Y1 = N \cdot E1$, and $Y2 = N \cdot E2$, $Y3 = N \cdot E3$, the latter included small catches in the third and later years after liberation.

Catches (Y_k) during any calendar year (k) consisted of fish originating from stocking in that year ($Y0_k$) and from stocking in preceding years i.e. $Y1_{k-1}$, $Y2_{k-2}$, $Y3_{k-3}$ hence:

$$Y_k = Y0_k + Y1_{k-1} + Y2_{k-2} + Y3_{k-3}$$

Since data on smolt stocking comprise the period 1972 - 1986 we could assess expected (conjectural) sea trout catches for the period 1975-1986 (Table 2). These hypothetical catches were compared with the real Polish inshore sea trout catches (Bartel 1989). Offshore catches were not included as it was impossible to separate sea trout from Atlantic salmon landings. However, the former were considerably lower than the inshore ones and partly compensated by, also difficult to estimate, salmon inshore catch.

TABLE 2

Annual stocking of smolt (S), expected catches (TC) and real catches (RC). For details see text.

YEAR	S	TC (kg)	RC (kg)
1972	270 000		
1973	190 000		
1974	192 000		
1975	485 000	5 319	127 800
1976	189 000	3 028	140 400
1977	319 000	5 443	104 400
1978	252 000	5 127	132 400
1979	155 000	3 504	113 400
1980	250 000	3 536	87 100
1981	224 000	3 114	88 700
1982	233 000	4 116	141 000
1983	315 000	2 952	133 000
1984	261 000	8 275	226 000
1985	334 000	5 980	166 000
1986	614 000	1 957	140 000

TABELA 3

Mean efficiency indices for releases to the sea of smolts originating from the Vistula (Wis, n=11) and of smolts originating from Pomeranian rivers (Pom, n=4) both reared at OLIWA farm, and for the latter group reared at RUMIA farm (n=7).

	OLIWA Wis	OLIWA Pom	RUMIA Pom
E0	22.4	27.0	9.7
E1	114.1	186.4	50.1
E2	127.6	117.3	23.0
E3	47.0	21.2	4.0
ET	312.0	351.9	86.8

RESULTS

1. Effects of origin and rearing place of smolt

Possibilities of assessment of the influence of origin and of smolt rearing locality were limited due to large number of the latter, therefore, small number of observations within an "origin+locality" class. We could compare mean efficiency indices for the releases to the sea (SEA releases group) of smolts originating from the Vistula and from the Pomeranian rivers, both reared in Oliwa farm (Table 3). The mean indices do not differ significantly (Mann-Whitney test, $\alpha=0.05$) implying that results of stocking (i.e. recapture rates) were not affected by the origin of smolt parents. On the other hand the efficiency indices for smolts of the Pomeranian origin reared in Oliwa were higher than the indices for smolts reared in Rumia farm.

Similar comparisons were made for the origin groups WIS and POM (Table 4). Consistently better results were achieved from smolts reared at Oliwa than those from Podkomorzyce and Czarci Jar and from smolts from Rumia then those from Damnica.

2. Multiple regression model

Highly significant relationships were found between almost all efficiency indices and some of the assumed independent variables (Table 5). Determination coefficients for successive years after release (Led ... Led) ranged between 0.193 and 0.429, they were higher for total efficiencies (LET) except in POM group. In all cases two independent variables were significant in their effects on recaptures.

TABELA 4

Comparison of efficiency indices for various rearing farms releasing smolt to Pomeranian (POM) and to Vistula (WIS).

	POM R - Rumia (20) D - Damnica (11)	WIS C - Czarci Jar (9) O - Oliwa (8) P - Podkomorzyce (8)
E0	R > D	
E1	R > D	O > P
E2	R > D	O > P
E3	R > D	O > C
ET	R > D	O > C

All differences at the level α=0.01 (Kruskal-Wallis test). Number of experiments in brackets.

During the considered period (1961-1986) results of stocking tagged smolt became worse and worse (Fig. 1) and therefore factor YEAR was significant for prediction of stocking efficiency. This relationship was less pronounced in case of the year of release (Table 5, Led). In the groups of stocking the sea (SEA) and of stocking Pomeranian rivers (POM) the mean length of smolts (MLEN) exerted a significant positive influence on recapture efficiency (Fig. 2). This factor appeared insignificant in WIS group but the distance of release place from the sea showed a rather strong negative effect (Fig. 3).

3. Verification of the model

Application of the above discussed relationships between numbers of released smolts and recaptures (expressed in terms of weight) to the available data on stocking resulted in estimates of expected catches of sea trout originating from the stocking (Table 2). In relation to the real catches they appeared several tens times smaller (Table 2, Fig. 4). Obviously, a certain fraction of the real sea trout stock originated from natural reproduction and from stocking rivers with alvins (fry).

It is assumed that natural spawning in Polish rivers produced 50 000 smolts annually. Records on fry stocking for the period 1972-1986 show that between 2 and 6.3 million alvins were released annually. In Pomeranian rivers survival of these fish to the smolt stage amounted to c. 1 % (Chełkowski, Chełkowska 1981; Dębowski et al. 1992). Therefore the number of smolts originating from these stocking was from 20 to 63 thousand fish. It is further assumed that in 1970 and 1971 (for which data of fry

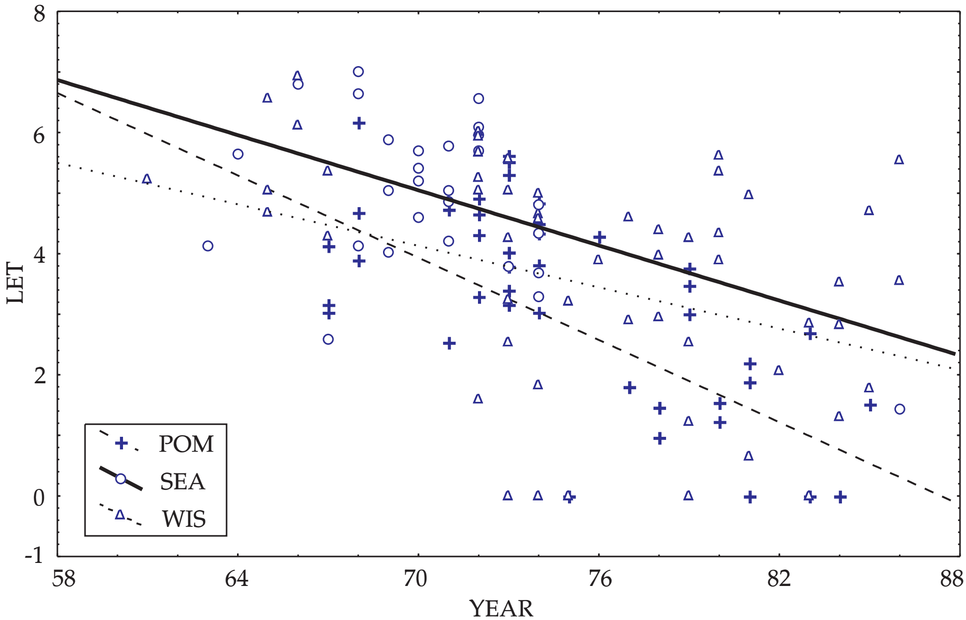

Fig. 1. Stocking efficiency of tagged smolt (LET) versus year of release.

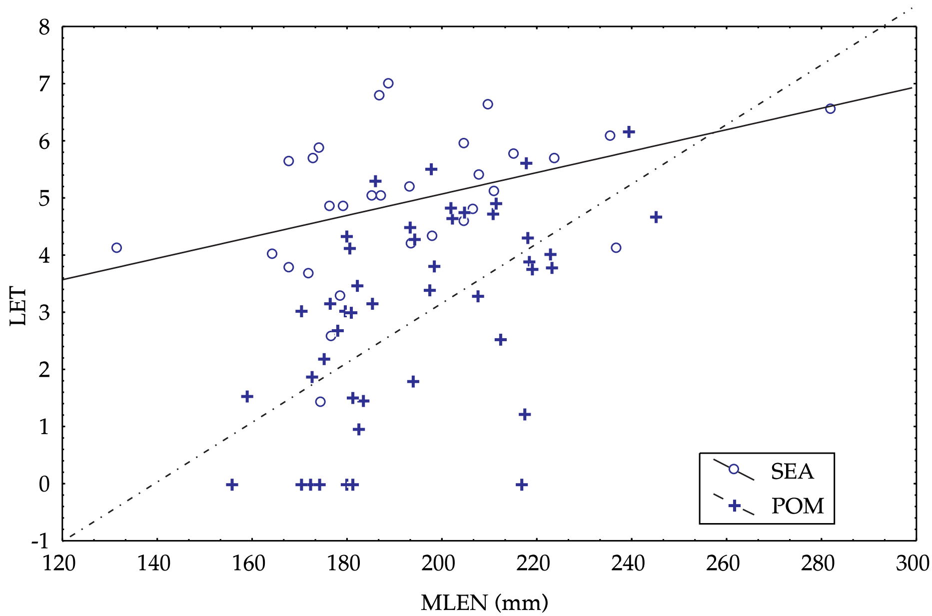

Fig. 2. Stocking efficiency (LET) versus mean smolt length (MLEN).

TABELA 5

Multiple regression of stocking efficiencies (y) on four independent variables: mean smolt length (MLEN), distance of release place from the sea (DIST), year of release (YEAR), time of release in the year (WEEK).

	y	R^2	b0	b1 (MLEN)	b2 (DIST)	b3 (YEAR)	b4 (WEEK)
SEA n=30	LE0	0.308	-3.114	0.0295	-	-	-
	LE1	0.372	11.826	0.0204	-	-0.1648	-
	LE2	0.216	11.447	0.0237	-	-0.1794	-
	LE3	-	-	-	-	-	-
	LET	0.462	12.769	0.0217	-	-0.1700	-
POM n=47	LE0	0.429	1.187	0.0264	-	-0.0719	-
	LE1	0.403	4.222	0.0394	-	-0.1280	-
	LE2	0.365	7.346	0.0238	-	-0.1350	-
	LE3	0.193	9.664	-	-	-0.1158	-
	LET	0.416	7.367	0.0369	-	-0.1561	-
WIS n=58	LE0	0.278	1.435	-	-0.0015	-	-
	LE1	0.297	11.272	-	-0.0023	-0.1068	-
	LE2	0.252	-0.266	-	-0.0031	-	0.2229
	LE3	0.354	13.358	-	-0.0024	-0.1395	-
	LET	0.434	13.221	-	-0.0034	-0.1147	-

For regression equation see text.
y - respective indices as in Table 1, R2 - determination coefficients, b0....b4 - respective regression coefficients. All regressions significant at the α=0.01.

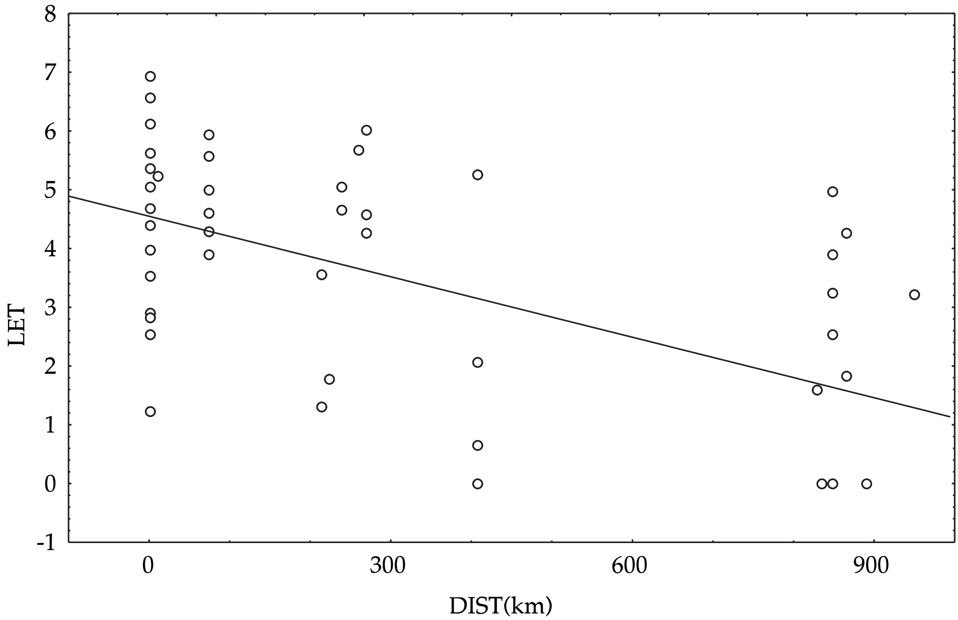

Fig. 3. Stocking efficiency (LET) versus distance of release place from the sea (DIST) for liberations to the Vistula River system.

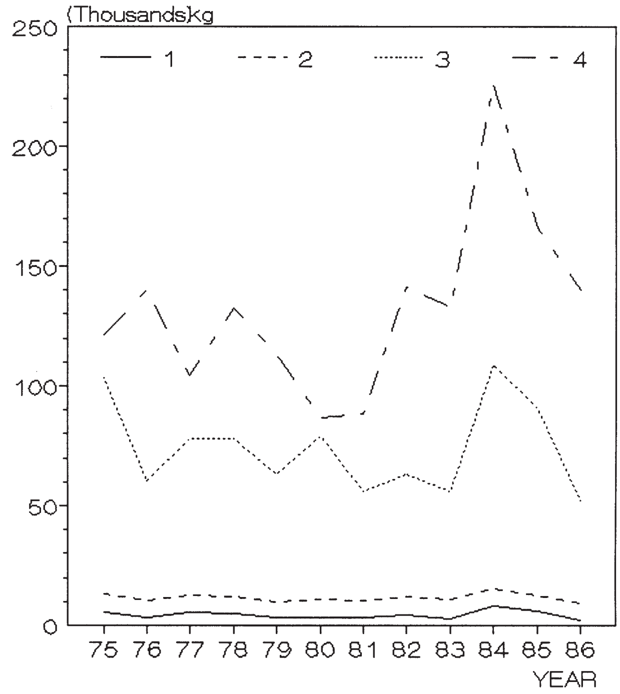

Fig. 4 Catches of sea trout expected from: the smolt stocking (1), from the stocking and natural production (2), from the two former sources corrected for tag losses (3), real catches (4).

stocking are missing) 2 million fry were released each year and that smolts from these kind of stocking were 2 years old. It follows then that total amount of smolts originating from natural spawning and fry stocking (further referred to as "natural smolts) in the period 1972-1986 was from 70 to 95 thousand annually.

In order to estimate expected catches of these fish three other assumptions are necessary:

1 - natural smolts are of better quality and each such a smolt is equivalent to 2 smolts reared at farms (such a ratio had been applied by ICES for many years);

2 - natural smolts were exploited in the same way as the tagged smolts, hence, distribution of recaptures (catch of a cohort in subsequent years) of natural smolts was the same as the tagged ones;

3 - most of the natural smolt production originated from Pomeranian rivers and that majority of fry stocking was performed into these rivers these smolts behaved as the tagged ones released to Pomeranian rivers (POM group).

Taking into account these assumptions and respective data it was found that expected catches from natural spawning and fry stocking ranged from 6541 to 7965 kg annually. What follows is that the sum of expected catches had not exceeded 16 ton in any year and it still remained many times lower than the real catches (Fig. 4). Even so it is interesting that the expected catches correlate with the real ones, r = 0.65, implying a certain effect of stocking on catch.

DISCUSSION

Comparison of real catches with that expected on the basis of tagging experiments (Tale 2) implies that such a discrepancy could result from the faulty method of tagging and of recapture recording of tagged fish. Loss of tags (discussed in Part I, Bartel and Dębowski - this volume) was considered the main source of errors. In order to illustrate effects of tag losses we apply formulas developed by Wiśniewolski and Nabiałek (1993) on the basis of experiments with common carp in ponds. Re-arranging their equations we got:

$$N_t = RA_t \cdot a_t \qquad \text{and} \qquad a_t = EXP(-0.1231185 + 0.092065 \cdot t)$$

where N_t is survival (%) at time t in terms of months after tagging, RA_t is percentage of fish that retained tags attached with a simple wire, and a_t - is the time dependent multiplier increasing tag recoveries as if no tag were lost.

Assuming time t for each year after tagging as the period between liberation and the middle of that year we arrived at multipiers a_t as follows:

for the year of stocking	$a_0 = 1.47$
for the next year after stocking	$a_1 = 3.21$
for the second year after stocking	$a_2 = 9.68$
for the third year after stocking	$a_3 = 29.23$

Expected catches in the year k resulting from stocking in 4 preceding years (for Y_k, see above) were then corrected as follows:

$$Y_{sk} = 1.47 \cdot Y0_k + 3.21 \cdot Y1_{k-1} + 9.68 \cdot Y2_{k-2} + 29.23 \cdot Y3_{k-3}$$

Expected catches corrected in this way were more than a dozen times greater than uncorrected. Catches originating from natural smolts (fry stocking and natural spawning) were also corrected and so the new expected catches were obtained (Fig. 4).They still appeared several times lower than the real ones.

One has to remember, however, that the applied corrections were developed for different fish, in a different environment, and were extrapolated from a 15 month experiment to over 40 month. Perhaps that is why application of these corrections to some most effective sea trout experiments (with high recoveries) resulted in unrealistic estimates like an efficiency of more than 2000 kg from 1000 released smolts.

For the sake of illustration let us conclude that the average annual catch expected from smolt stocking (as estimated from the model) amounted to 3% of real mean annual catch, if natural spawning and fry stocking were included the expected catch raised to 9 %, and if the above described correction for tag los were taken into account then the expected catch amounted to 56 % of the real (average) catch. This conjectural conclusion shows significance of tag losses. Still the expected catch appear highly underestimated and it can be considered that the causes are increased mortality of tagged fish and incomplete reporting of recaptured tagged fish.

Increased mortality of released smolts was discussed in our previous paper (Bartel, Dębowski - this volume). It could be high and can markedly decrease recaptures.

The immediate contact with sea trout fishermen often showed that they had not returned all recovered tags and had kept whole sets of old, non recorded tags. Among those operating at the same fishing grounds some dispatched a lot of tags with proper descriptions while some others did not do it at all. Also a considerable number of sea trout, especially in Pomeranian rivers, were victims of poachers who, obviously, did not return tags.

It is difficult to assess the fraction of captured but not reported tagged fish. This source of error was briefly discussed in Part I of this work by Bartel and Dębowski (this volume).

It is quite possible that this fraction changed during the analyzed period which reflected the attitude of fishermen to the research on sea trout. The relative level of reward for each returned tag had probably a certain influence and it may be inferred that this influence was significant.

One can infer from the above discussion that:

1 - stocking efficiencies were highly underestimated.

2 - the underestimation increased in subsequent years after release which results in shifting catch distributions in years to the left in relation to the real ones,

3 - comparisons of results can be made only in case of the same type of tag,

4 - assessment of the influence of particular factors on stocking (liberation) results concerns their relative significance but not their absolute effects.

The regression models took into account four independent variables only and they explained less than half of the variability of efficiency indices. Smolt growing conditions have probably substantially contributed to this variability as shown by the evaluation of the influence of rearing places.

The year of release appeared a very important factor. The decreasing trend of tagging efficiency in the investigated period could arise from diminishing quality of tagging operations, from decreasing quality of smolt and from deterioration of environmental conditions. The first cause does not seem likely since the tagging team and the way of operations had remained practically unchanged over the considered period. There is no sound circumstances for the conjecture that smolt quality had deteriorated. The smolts originated from many farms situated in various regions of the country. There was no indication that the mean length of smolt - the only trait of smolt quality available - had continuously been changing in a definite way.

Thus, it looks like the observed trend resulted from environmental changes. This conjecture is supported by the fact that a decrease of stocking efficiency had been observed also in Finland with respect to both sea trout (Ikonen, Auvinen 1982a) and salmon (Ikonen, Auvinen 1982b; Kuikka 1991). A similar decreasing trend occurred in releasing of tagged sea trout smolt to the Dunajec River during 1964-1966 (Pałka, Bieniarz 1983) an later (Bartel 1988). It has to be mentioned, however, that results of tagging after 1986 (unpublished data) and the cited Finnish studies show that by the end of 1980-ties recoveries had raised. This indicates that the suggested environmental shifts had not been irreversible.

The influence of smolt size on recaptures have often been ascertained. In this study this relationship was found insignificant in the liberations to the Vistula system and was eliminated from the model. In this group of releases the place of liberation appeared of vital importance. Efficiency of stocking lower Vistula was about the same as that of the sea but with respect to the tributaries of the upper and middle Vistula course the efficiency was close to that for Pomeranian rivers. This can indicate that not so much the distance from the sea but the size of the stocked river determined resulting recaptures. It was stated that smolt mortalities just after release was most effective in recaptures (Bartel, Dębowski - this volume). Such mortalities obviously depend more on local conditions than on the distance from the sea. In smaller rivers the released smolt have less chance of hiding and were more endangered by predators and poachers than in large rivers. Such a conjecture could explain worse results of stocking Pomeranian rivers and Vistula tributaries than the Vistula itself.

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STRESZCZENIE

ZARYBIANIE SMOLTAMI TROCI WĘDROWNEJ (*Salmo trutta m. trutta* L.) W POLSCE. CZĘŚĆ I. CZYNNIKI WPŁYWAJĄCE NA EFEKTYWNOŚĆ I WERYFIKACJA DANYCH ZE ZNAKOWAŃ.

W latach 1961-86 przeprowadzono 135 eksperymentów, w których poznakowano 183206 smoltów troci (Zał.1). Dokonano analizy wpływu różnych czynników na efektywność tych zarybień. Stwierdzono, że zależała ona od miejsca wychowu smoltów a nie stwierdzono wpływu pochodzenia tarlaków. Przeprowadzono analizę regresji wielokrotnej efektywności w kolejnych latach od zarybienia od : roku (YEAR) i tygodnia (WEEK) zarybienia, średniej długości smoltów (MLEN) i odległości miejsca zarybienia od morza (DIST)(Tab.5). Dla zarybień morza stwierdzono istotną zależność efektywności od YEAR i MLEN (R2=0.462 dla efektywności całkowitej), dla zarybień rzek pomorskich - od YEAR i MLEN (R2=0.416) i dla zarybień rzek dorzecza Wisły - od YEAR i DIST (R2=0.434).

Na podstawie równań regresji i danych o zarybieniach smoltami i wylęgiem troci w latach 1972-86 przy założeniu produkcji naturalnej smoltów na poziomie 50 tys. szt. rocznie obliczono spodziewane połowy przemysłowe. Te teoretyczne połowy porównano z rzeczywistymi połowami troci (Rys.4). Różnice między nimi były bardzo duże. Przedyskutowano tę rozbieżność. Za główną jej przyczynę uznano wady zastosowanej metody czyli znakowania: gubienie znaczków przez ryby, nieprzysyłanie pozyskanych znaczków i podwyższoną śmiertelność poznakowanych ryb. Zastosowanie formuł matematycznych opisujących tempo odpadania znaczków a opracowanych przez Wiśniewolskiego i Nabiałka (1993) dla ryb karpiowatych, zredukowało niedoszacowanie połowów do średnio mniej niż 50% połowów rzeczywistych.

ADRES AUTORÓW:

Prof. dr hab. Ryszard Bartel
Dr Piotr Dębowski
Instyt ut Rybactwa Śródlądowego
Pracownia Rybactwa Rzecznego
80-761 Gdańsk
Reduta Żbik 5

APPENDIX

List of smolt tagging experiments

.1. Years of release
.2. Consecutive number of the week in the year of release
.3. River system or sea
.4. Distance, km, of the release place from the sea
.5. Origin of smolt parents
.6. Place of rearing
.7. Average length of smolt
.8. Number of released smolt
.9. Number of recovered tags with proper data

.1.	.2.	.3.	.4.	.5.	.6.	.7.	.8.	.9.
61	18	VISTULA	11	VISTULA	OLIWA	164.91	7851	462
63	24	SEA	0	VISTULA		131.45	278	7
64	23	SEA	0	VISTULA	OLIWA	167.82	366	34
65	20	VISTULA	2	VISTULA	OLIWA	187.92	772	203
65	22	VISTULA	2	VISTULA	OLIWA	143.96	1015	29
65	23	VISTULA	240	VISTULA	OLIWA	163.18	430	14
66	22	SEA	0	VISTULA	OLIWA	186.94	301	70
66	22	VISTULA	2	VISTULA	OLIWA	192.20	1867	487
66	22	VISTULA	2	VISTULA	OLIWA	164.19	368	59
67	10	VISTULA	74	VISTULA	KWIDZYŃ	182.10	672	99
67	13	REDA	7	POMERANIA	RUMIA	179.42	2428	26
67	14	ŁEBA	1	POMERANIA	RUMIA	180.36	1775	49
67	17	ŁEBA	1	POMERANIA	RUMIA	176.45	1225	12
67	17	SEA	0	POMERANIA	RUMIA	176.76	1300	9
67	19	VISTULA	2	VISTULA	OLIWA	217.88	724	154
68	17	SEA	0	VISTULA	OLIWA	188.79	1986	678
68	19	SEA	0	POMERANIA	OLIWA	209.71	1200	471
68	19	REDA	3	POMERANIA	OLIWA	218.37	939	23
68	19	SEA	0	POMERANIA	RUMIA	236.70	673	17
68	20	ŁEBA	1	POMERANIA	RUMIA	239.13	425	96
68	20	REDA	3	POMERANIA	RUMIA	244.84	790	29
69	17	SEA	0	VISTULA	OLIWA	187.15	650	66
69	17	SEA	0	VISTULA	OLIWA	164.15	873	43
69	18	SEA	0	VISTULA	OLIWA	174.02	825	160
70	14	SEA	0	VISTULA	OLIWA	193.15	877	56
70	14	SEA	0	VISTULA	OLIWA	207.76	623	128
70	14	SEA	0	VISTULA	OLIWA	204.50	798	62
70	15	SEA	0		OLIWA	223.59	449	87
71	12	SEA	0	VISTULA	OLIWA	179.05	1069	123
71	13	SEA	0	VISTULA	OLIWA	185.13	594	63
71	14	SEA	0	POMERANIA	OLIWA	193.33	21	2
71	14	SEA	0	POMERANIA	OLIWA	176.24	642	55
71	20	ŁEBA	1	MIXED	RUMIA	210.75	1546	73
71	20	REDA	3	MIXED	RUMIA	212.26	1138	6
71	20	SEA	0	MIXED	RUMIA	210.90	298	43
71	20	ŁEBA	1	MIXED	RUMIA	204.60	767	39

71	20	SEA	0	MIXED	RUMIA	214.97	665	171
72	9	DRWĘCA	408	VISTULA	CZARCI J.	184.43	4257	299
72	11	GRABOWA	3	POMERANIA	BUKOWO	201.92	1840	116
72	12	PARSĘTA	1	POMERANIA	MOKRE	217.87	1823	93
72	12	SEA	0		OLIWA	282.00	185	52
72	12	SEA	0	POMERANIA	OLIWA	235.49	871	169
72	14	VISTULA	2	VISTULA	KWIDZYŃ	174.60	1462	70
72	14	SEA	0	VISTULA	KWIDZYŃ	172.83	1489	181
72	14	VISTULA	270	VISTULA	KWIDZYŃ	173.55	1000	131
72	14	VISTULA	261	VISTULA	KWIDZYŃ	175.41	997	95
72	15	VISTULA	74	VISTULA	KWIDZYŃ	173.91	9984	1281
72	19	DUNAJEC	830	VISTULA	CZATKOW.	179.81	2264	2
72	19	ŁEBA	1	POMERANIA	RUMIA	211.41	3009	150
72	20	REDA	3	POMERANIA	RUMIA	207.43	991	17
72	20	SEA	0	POMERANIA	RUMIA	204.58	994	171
73	10	ŁUPAWA	1	POMERANIA	OSOWO	197.73	979	112
73	12	SŁUPIA	1	POMERANIA	SIEMIANI.	223.04	2600	58
73	15	VISTULA	240	VISTULA	KWIDZYŃ	167.61	1000	54
73	15	VISTULA	270	VISTULA	KWIDZYŃ	167.12	998	40
73	16	SEA	0	VISTULA	KWIDZYŃ	167.84	1000	9
73	16	VISTULA	74	VISTULA	KWIDZYŃ	180.48	2468	268
73	16	VISTULA	2	VISTULA	KWIDZYŃ	167.89	1000	87
73	17	DUNAJEC	848	POMERANIA	CZATKOW.	172.08	1871	0
73	17	WIEPRZA	25	POMERANIA	MOKRE	222.61	2086	84
73	17	ŁEBA	1	POMERANIA	RUMIA	217.73	597	65
73	18	DUNAJEC	848	VISTULA	ZAWADA	192.33	747	3
73	18	DUNAJEC	848	VISTULA	ZAWADA	191.10	3436	36
73	18	ŁEBA	1	POMERANIA	RUMIA	185.90	1694	141
73	18	REDA	3	POMERANIA	RUMIA	185.18	1100	8
73	19	WIEPRZA	1	POMERANIA	BUKOWO	197.38	674	9
74	10	ŁEBA	1	POMERANIA	RUMIA	193.01	1825	63
74	10	REDA	7	POMERANIA	RUMIA	198.10	697	13
74	10	SEA	0	POMERANIA	RUMIA	197.85	1423	57
74	14	VISTULA	240	VISTULA	KWIDZYŃ	176.98	991	35
74	14	VISTULA	74	VISTULA	KWIDZYŃ	169.54	2033	85
74	14	VISTULA	270	VISTULA	KWIDZYŃ	178.87	990	33
74	16	SEA	0	POMERANIA	RUMIA	171.81	1169	21
74	16	ŁEBA	1	POMERANIA	RUMIA	179.93	1098	28
74	19	DUNAJEC	835	VISTULA	ZAWADA	172.75	545	0
74	19	DUNAJEC	865	VISTULA	ZAWADA	174.92	984	3
74	19	DUNAJEC	850	VISTULA	PORĄBKA	142.57	295	0
74	19	KAMIENI.	890	VISTULA	ZAWADA	174.69	1000	0
74	19	DUNAJEC	850	VISTULA	ZAWADA	176.75	646	0
74	23	SEA	0	POMERANIA	RUMIA	178.44	1075	15
74	23	ŁEBA	1	POMERANIA	RUMIA	170.32	1148	10
75	14	PARSĘTA	1	POMERANIA	DAMNICA	173.94	1100	1
75	14	ŁUPAWA	40	POMERANIA	DAMNICA	172.16	1061	1
75	16	WIEPRZA	1	POMERANIA	DAMNICA	179.95	1182	0
75	16	SŁUPIA	1	POMERANIA	DAMNICA	180.42	1086	0
75	17	ŁUPAWA	1	POMERANIA	DAMNICA	181.61	999	0
75	17	SŁUPIA	1	POMERANIA	DAMNICA	181.11	1050	0

75	17	WIEPRZA	1	POMERANIA	DAMNICA	182.17	1042	0
75	19	SAN	951	POMERANIA	WOŁKOW.	164.04	613	10
75	19	WISŁOK	844	POMERANIA	FOLUSZ	180.05	1195	0
75	19	DUNAJEC	835	POMERANIA	ZAWADA	172.62	3457	1
76	14	ŁUPAWA	1	POMERANIA		194.14	1297	33
76	16	VISTULA	74	VISTULA	KWIDZYŃ	169.97	1200	20
77	9	VISTULA	2	VISTULA	PODKOM.	192.56	999	12
77	10	SEA	0	VISTULA	PODKOM.	189.11	997	2
77	10	VISTULA	74	VISTULA	KWIDZYŃ	177.53	1300	54
77	12	REGA	75	POMERANIA	JAŹWINY	193.82	1699	6
78	10	VISTULA	2	VISTULA	PODKOM.	177.43	1069	11
78	11	VISTULA	2	VISTULA	KWIDZYŃ	190.82	799	26
78	11	VISTULA	2	VISTULA	PODKOM.	179.41	1097	7
78	14	ŁEBA	1	POMERANIA	RUMIA	183.15	2000	2
78	15	WIEPRZA	1	POMERANIA	DAMNICA	182.45	2100	1
79	14	ŁEBA	1	POMERANIA	RUMIA	182.18	2953	39
79	14	VISTULA	2	VISTULA	PODKOM.	172.45	1995	13
79	14	VISTULA	2	VISTULA	PODKOM.	179.84	1997	11
79	14	DRWĘCA	408	VISTULA	CZARCI J.	188.90	2000	0
79	16	SŁUPIA	1	POMERANIA	DAMNICA	218.90	1150	21
79	16	SŁUPIA	1	POMERANIA	DAMNICA	180.68	500	7
79	18	DUNAJEC	865	POMERANIA	ROŻNÓW	188.69	2000	51
80	12	VISTULA	2	VISTULA	PODKOM.	191.02	1000	21
80	13	VISTULA	2	POMERANIA	OLIWA	187.03	1004	71
80	16	VISTULA	2			207.13	1000	90
80	17	DUNAJEC	848	POMERANIA	ROŻNÓW	210.29	1999	31
80	18	SŁUPIA	1	POMERANIA	DAMNICA	217.29	4020	3
80	23	SŁUPIA	1	POMERANIA		158.92	2997	4
81	11	DRWĘCA	408	POMERANIA	CZARCI J.	169.15	1998	2
81	14	SŁUPIA	1	POMERANIA	RUMIA	170.40	1000	0
81	15	WIEPRZA	1	POMERANIA	ROŻNÓW	172.61	999	2
81	15	WIEPRZA	1	POMERANIA	ROŻNÓW	175.05	998	2
81	16	DUNAJEC	848	POMERANIA	ZAWADA	196.98	2000	100
82	13	DRWĘCA	408	POMERANIA	CZARCI J.	183.25	2000	1
83	9	SŁUPIA	1	POMERANIA	PODKOM.	177.76	1000	10
83	15	VISTULA	2	VISTULA	WIKLINO	176.54	1075	11
83	15	DRWĘCA	408	VISTULA	CZARCI J.	190.29	1000	0
83	16	REGA	1	POMERANIA	ZABRODZ.	216.81	1000	3
84	10	VISTULA	2	MIXED	PODKOM.	182.18	1575	124
84	14	DRWĘCA	214	MIXED	CZARCI J.	230.96	798	7
84	14	VISTULA	2	MIXED	CZARCI J.	230.25	791	32
84	19	PARSĘTA	1	POMERANIA	WIKLINO	155.69	1099	0
85	14	VISTULA	2	VISTULA	PODKOM.	211.68	1000	86
85	17	DRWĘCA	223	VISTULA	CZARCI J.	215.09	991	3
85	18	PARSĘTA	1	POMERANIA	MIASTKO	181.06	948	1
86	18	VISTULA	74	VISTULA	KWIDZYŃ	176.51	716	66
86	19	DRWĘCA	214	VISTULA	CZARCI J.	193.57	409	3
86	21	SEA	0	VISTULA	RUMIA	174.41	1300	3