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REPORT ON PARR POPULATION DENSITIES, TAGGING EXPERIMENTS AND RIVER CATCHES OF THE SALMON STOCK OF THE RIVER SIMOJOKI IN 1972 - 1980

by

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Abstract

The salmon stock of the River Simojoki was studied in 1972-1980 by electrical fishing, sampling of sea running smolts by means of smolt traps and tagging experiments of smolts. Data on salmon catches in the river were gathered in 1970, 1972 and 1979.

The mean parr population densities varied 6.4 to 9.1 parr/100 m^2 in 1972-1976 in undisturbed rapid areas and 0.7 to 3.6 parr/100 m^2 in areas excavated for timber floating. After restoration works in 1976-1977 the mean population densities were 4.7 to 9.7 parr/100 m^2. The number of sea running smolts varied between 12 000 and 67 000 smolts in 1977-1980. According to the tagging experiments about 1 % of the tagged salmon were fished from the river. Decline in the river catches and parr population densities was observed at the end of the 1970's.

Résumé

Le stock de saumon de la rivière Simojoki a été étudié en 1972-80 par peche electrique, par échantillonnage de saumoneaux d'aval au moyen d'un collecteur de saumoneaux d'aval et par des expériences de marquage individuel des saumoneaux d'aval. Des statistiques de prises de saumon dans la rivière ont été recueillies en 1970, 1972 and 1980.

Les densités moyennes de population de saumoneaux étaient de 6.4 à 9.1 saumoneaux/100 m^2 en 1972-76 dans les zones rapides non perturbées, de 0.7 à 3.6 saumoneaux/100 m^2 dans les zones excavées pour le flottage du bois. Après des travaux de restauration en 1976-77, les densités moyennes de population étaient de 4.7 à 9.7 saumoneaux/100 m^2. Le nombre de saumoneaux d'aval variait entre 12000 et 67000 annuellement en 1977-80. D'apres les expériences de marquage, environ 1 % des saumons marqués ont été pechés en rivière. Un déclin des prises de rivière et des densités de population de saumoneau a été observé à la fin des années 70.

Introduction

The River Simojoki, one of the last Baltic salmon rivers in Finland, flows into the northern Bothnian Bay. The spawning areas of salmon reach up to 110 km from the mouth of the river, including altogether 277 hectares of rapids. The lower reaches of the river have been excavated for effektive timber floating in the 1950's (TOIVONEN 1966). In 1976-1977 restoration works was carried out in order to return the smolt production of salmon to these areas.

The salmon stock of the River Simojoki has been investigated since 1972. The aim was to investigate the population densities of salmon parr in undisturbed and excavated rapids and the smolt production of the river. Another objective was to compare salmon catches yielded by wild and hatchery-reared smolts in the sea and river, the results of which have already been discussed by Toivonen (1977). In connection to these investigations the age distribution and sex ratio of salmon parr and smolts was studied by Jutila (1980). After restoration work the influence of these activities on the parr population densities was observed as well.

Material and methods

Salmon parr densities were investigated in 1972-1980 by means of electrical fishing with the exception of 1974, when a high flood prevented the fishing. Altogether 570 to 7290 m^2 of the rapids in trial areas, averaging 50 to 150 m^2 were fished and closed with nets. One to three fishing runs with electric current of 400 to 800 V were used to estimate the population densities of salmon parr by successive removal method.

From 1972 to 1980 about 100 to 4200 sea running salmon smolts were fished by the means of a smolt trap at the mouth of the river. Altogether 9273 smolts (70 to 1990 smolts per year) were tagged with Carlin tags and released in the estuary area

during this period. Since 1977 another smolt trap has been used 32 km up the river. Smolts collected by this trap were marked, by clipping out the adipose fin, for future indentification when recaptured in the lower trap. The number of migrated smolts was calculated by means of mark-recapture data. The age distribution of smolts was determined annually from scales of 60 to 500 fish.

Satistics of salmon catches in the river were gathered in 1970, 1972 and 1979.

Results

The mean population densities of salmon parr varied yearly between about 5 and 10 parr/100 m^2 in the undisturbed rapid areas (Table 1). In the excavated rapids the corresponding numbers during 1972-1976 were about 1 to 4 parr/100 m^2. After restoration works of the rapids the population densities of salmon parr have usually been a little higher, but exact results are not ready yet.

A decline was observed in parr population densities in the upper reaches of the river during the latter half of the 1970's. At first this development was observed in the uppermost rapids like Iso Paju. At the end of the period normal population densities was found only in the lower most third of the river (Figures 1 and 2).

The smolt migration in the River Simojoki starts when the temperature of river water rises above + 10°C, usually at the end of May. Migration continues to the end of June (Figures 3, 4 and 5). At the beginning of smolt run the late high floods have postponed the trappings in many years. In cold springs the run started even as late as in June or ceased temporarily during sudden cold periods.

The salmon smolts of the River Simojoki migrate into the sea at age of two to four years (Table 2). The most common age of the smolt was three years. In three years out of nine

most smolts were two-years-old. In two years the percentage of four-years-old smolts rised over 10 %

The number of sea running smolts varied in different years between 12000 and 67000. The numbers were as follows:

Year	Number of smolts
1977	28 700
1978	66 800
1979	11 700
1980	13 800

Nearly all the salmon catch yielded by the salmon smolts of the River Simojoki has been fished in the sea (Table 3). Only 1.26 % of the tagged wild salmon were recaptured by river fishery and 0.93 % of the recaptures were from the River Simojoki.

The salmon catches in the River Simojoki have dropped considerably during the 1970's. Statistics have been collected from three years:

Year	Salmon catch in the River Simojoki
1970	1 277 kg
1972	725 "
1979	429[x] "

x) by Water Research Bureau of North Finland

Discussion

Factors affecting the on habitat selection and parr population densities of salmon and trout in different salmon rivers is widely discussed by Karlström (1977a). Toivonen (1974) and Jutila (1978) have discussed the results of electrical fishing carried out until 1976 in the River Simojoki. The population densities of salmon parr in the River Simojoki of the same

order as Karlström (1977a) has found in the River Rickleå, which flows into the southern Bothnian Bay, and a little higher than in Swedish rivers emptying into the northern Bothnian Bay. Besides other factors, such as flow and temperature conditions, one reason for higher density of salmon parr, compared to the Swedish rivers in the same area, may be that trout is lacking in the River Simojoki. Thus there is no interspecific competition for food in the rapids.

The changes in parr population densities caused by excavating the rapids and destroying the structure of the river bed and similar as Karlström (1977b) has stated for the Rivers Skellefte älv and Ängesån. Although all results after restoration work are not yet available, have the increased parr population densities been observed in many of the lower most rapids. Because of insufficient restoration work positive effect are not as evident as Karlström (1977b) has shown in the Swedish rivers.

The fast dropping of parr population densities in the upper reaches of the river toward the end of the 1970's occurred a little later than in the River Torne älv, reported by Karlström (1977b). It demonstrates, that not enough of spawning salmon have ascended to the upper most part of the river to give full reproduction capacity to these areas. The main reason for this development is regarded to be the increased sea fishery, which has endangered the maintenance of wild salmon stocks in the northernmost rivers of Baltic.

The smolt migration from the River Simojoki occurs at the same time and temperatures as Österdahl (1966) has stated for the River Rickleå. The start and duration of the smolt run varies yearly from one to two weeks depending on the date when the temperature of river water rises over + 10^{o}C and on the development of water temperatures during the following period. It must be mentioned in this connection, that in small rivers like the River Simojoki water warms considerable earlier in spring than

in great mountain rivers like the River Torne älv. Thus smolt migration from different river occurs at a little different times, which may have an effect on the survival of post-smolts in the sea.

The age distribution of smolts corresponds to the mean smolt ages, which Järvi (1938) has found on basis of adult salmon fished in neighbouring rivers. The differences between years demonstrate though, that abundances of different year classes may vary quite considerably. This observation was later supported by calculatings of the numbers of migrating smolts since 1977.

The recapture numbers of tagging experiments in the River Simojoki demonstrates that in the 1970's the main factor regulating the alarming development of the river catches, parr densities and smolt production is the increased sea fishery. If this development continues further, only stocking with hatchery-reared parr of smolts carried out already in the River Torne älv, may maintain the salmon stock of the River Simojoki.

References

JÄRVI, T.H. 1938: Fluctuations in the Baltic stock of salmon. - Rapp. P.-v. Réun.Cons.int.Explor.Mer, 106: 1-114.

JUTILA, E. 1978: Simojoen lohenpoikasten esiintyminen, kasvu ja vaellus mereen. - Pro gradu-työ, Helsingin yliopiston limnologian laitos. 67 pp. (Mimeo).

JUTILA, E. 1980: The influence of sexual maturation of male salmon parrs on the sex ratio of salmon parrs and smolts. 2 pp. (Mimeo).

KARLSTRÖM, Ö. 1977a: Biotopval och besättningstäthet hos lax- och öringungar i svenska vattendrag. - Rep.Inst.Freshw. Res. Drottningholm, 6, 72 pp.

KARLSTRÖM, Ö. 1977b: Effects of human activities on the population densities of salmon and trout parr in Swedish rivers. Institute of Zoology, Univ. of Uppsala. 7 pp. (Mimeo).

TOIVONEN, J. 1966: Simojoen lohenpoikastuotanto. - Suomen kalastuslehti 73: 128-132.

TOIVONEN, J. 1974: Kemijoen vaelluskalojen istutustarpeen laskentaperusteista (Basis for estimating the need for stocking migratory fish in the River Kemijoki). - Riista- ja kalatalouden tutkimuslaitos, kalantutkimusosasto. Tiedonantoja no 1: 1-21.

TOIVONEN, J. 1977: Difference in recaptures of wild and hatchery-reared salmon smolts. - ICES, Doc.C.M. 1977/M:7 (Mimeo).

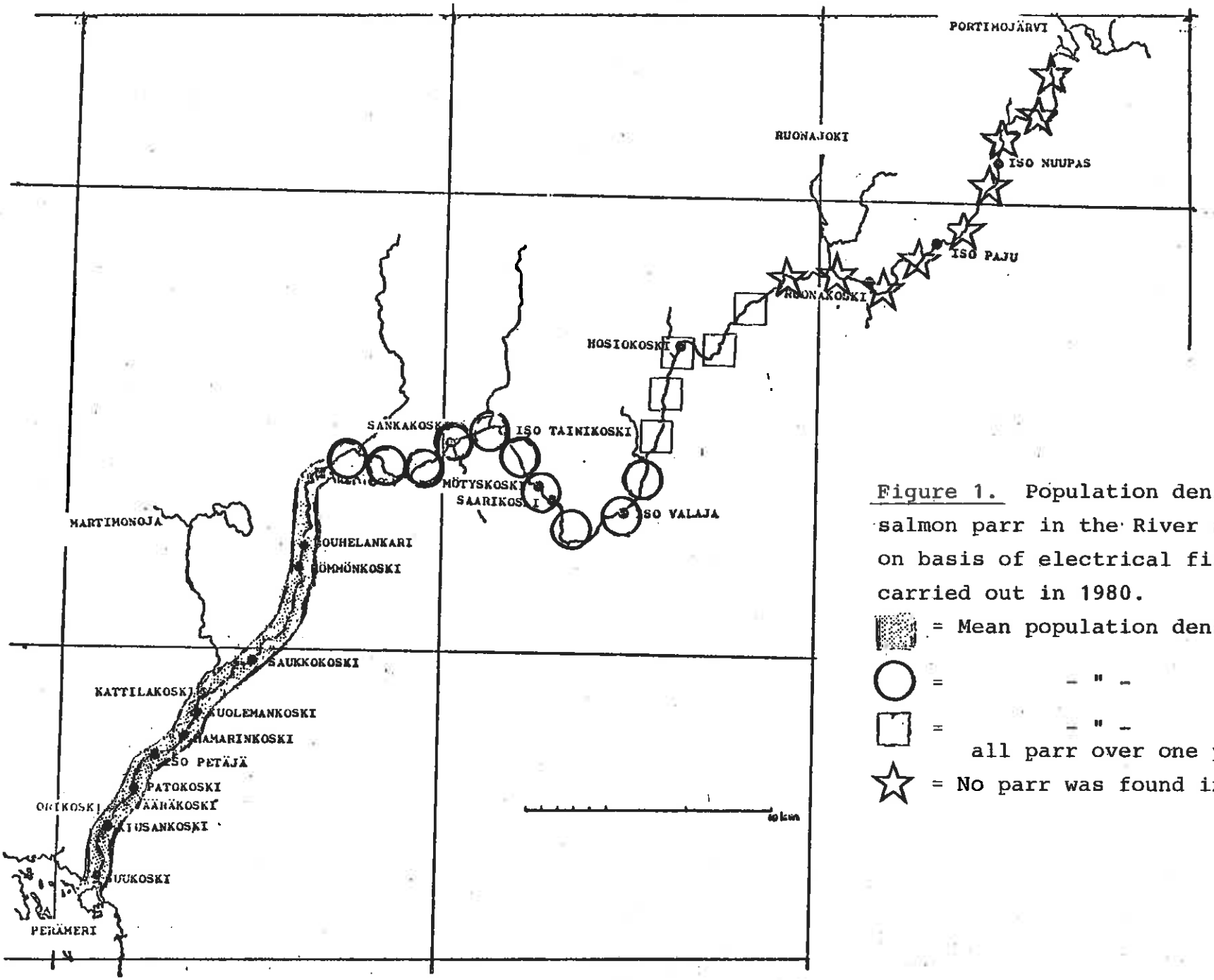

Figure 1. Population density of salmon parr in the River Simojoki on basis of electrical fishings carried out in 1980. Parr/100 m^2

= Mean population density 12.0

= - " - 1.5

= - " - 4.6

all parr over one year old

= No parr was found in 1980

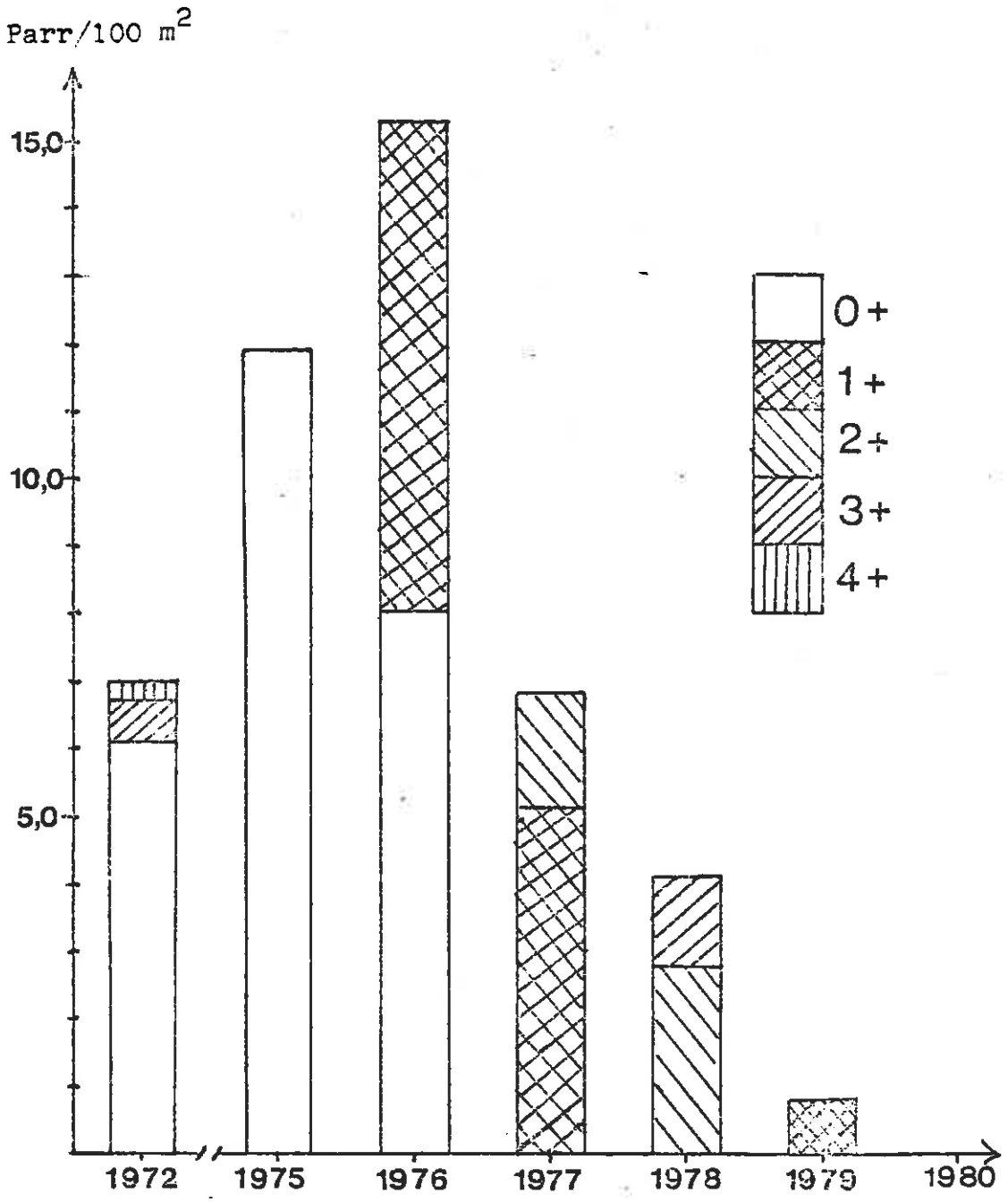

Figure 2. Population density and age distribution of salmon parr in the Rapid Iso Paju on basis of electrical fishings in 1972 - 1980.

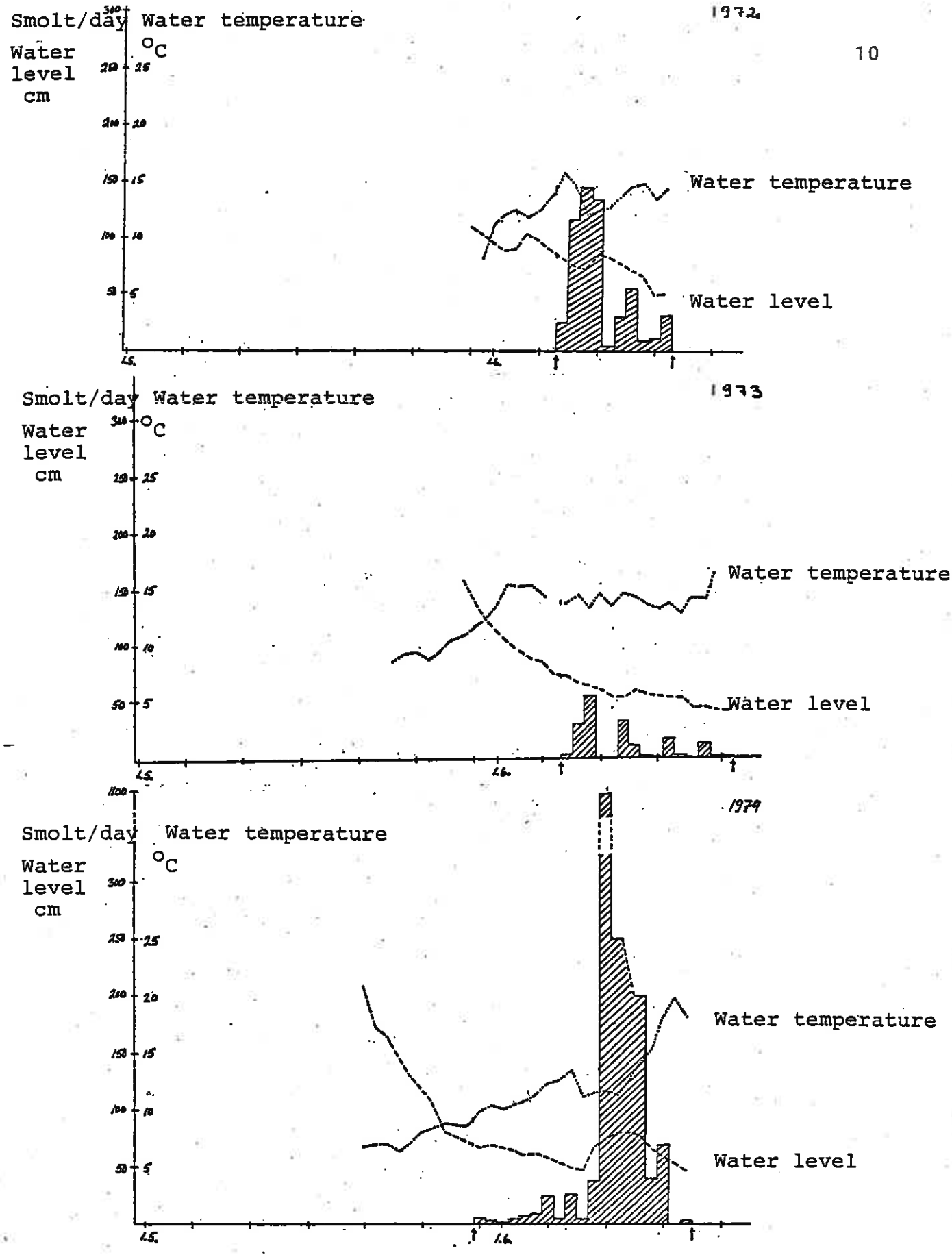

Figure 3. Migration of salmon smolts from the River Simojoki into the Bothnian Bay. Daily numbers of salmon smolts trapped at the mouth of the river in springs 1972, 1973 and 1974.

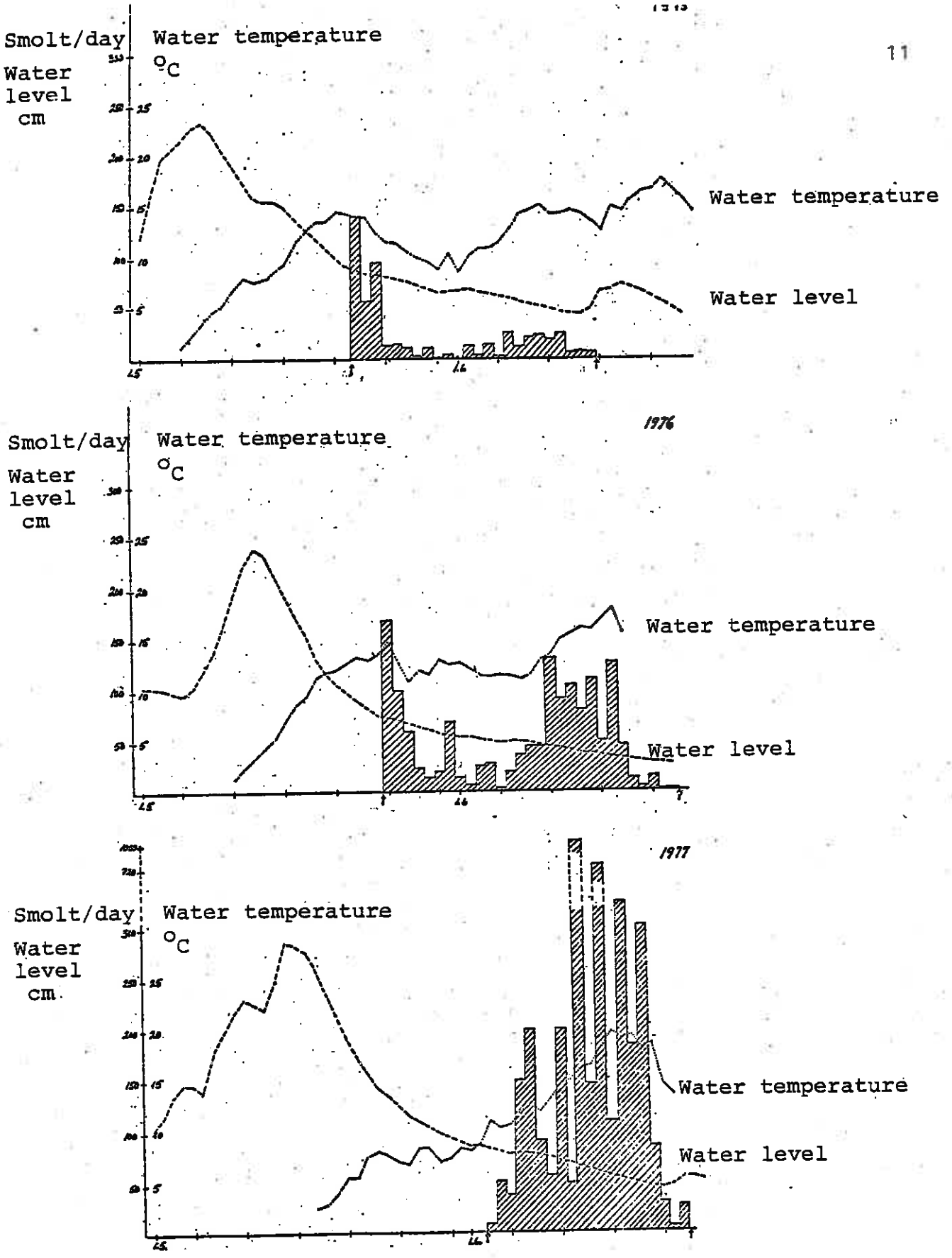

Figure 4. Migration of salmon smolts from the River Simojoki into the Bothnian Bay. Daily numbers of salmon smolts trapped at the mouth of the river in springs 1975, 1976 and 1977.

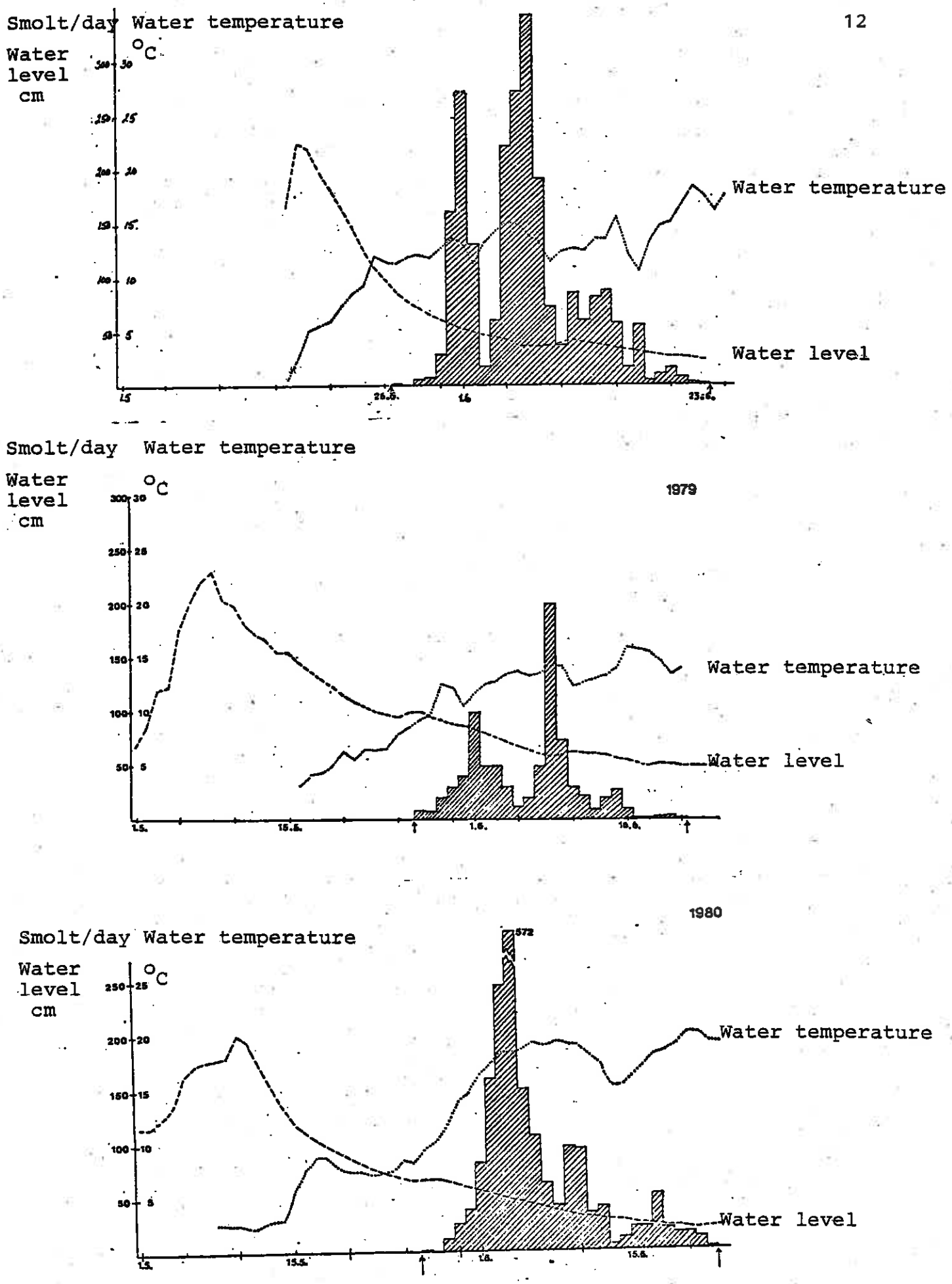

Figure 5. Migration of salmon smolts from the River Simojoki into the Bothnian Bay. Daily numbers of salmon smolts trapped at the mouth of the river in springs 1978, 1979 and 1980.

Table 1. Estimated population density of salmon parr in the River Simojoki. Years 1972 - 1980.

Year	Undisturbed rapid areas			Excavated rapid areas		
	Fished area m^2	Number of sampled parr	Salmon parr/100 m^2	Fished area m^2	Number of sampled parr	Salmon parr/100 m^2
1972	446	24	6.4	124	3	2.9
1973	240	17	8.4	1549	9	0.7
1975	1022	61	7.1	566	17	3.6
1976	1036	79	9.1	447	6	1.6
1977	1701[x]	139[x]	9.7[x]	-	-	-
1978	2576[x]	184[x]	7.7[x]	-	-	-
1979	2600[x]	71[x]	4.7[x]	-	-	-
1980	2691[x]	195[x]	8.4[x]	-	-	-

x Includes restored rapid areas

Table 2. Age distribution of salmon smolts in the River Simojoki. Years 1972 - 1980.

Year	Number of smolts in sample	Age distribution %		
		2	3	4
1972	63	19.0	68.3	12.7
1973	52	59.6	32.7	7.7
1974	99	38.4	57.6	4.0
1975	77	22.9	77.1	0.0
1976	482	72.8	26.2	1.0
1977	331	48.6	51.4	0.0
1978	501	0.8	95.2	4.0
1979	202	8.9	69.8	21.3
1980	161	53.4	41.0	5.6

Table 3. Recaptures from tagging experiments of wild salmon smolts in the River Simojoki. Taggings in 1972 -1980. Sub-division 61 = River Iijoki, 62 = River Olhavanjoki, 64 = River Simojoki.

Sub-division		Sea	River	Totally
24	Number	33	-	33
	%	2.18	-	2.18
25	Number	162	-	162
	%	10.71	-	10.71
26	Number	99	-	99
	%	6.54	-	6.54
27	Number	147	-	147
	%	9.72	-	9.72
28	Number	373	-	373
	%	24.65	-	24.65
29	Number	79	-	79
	%	5.22	-	5.22
30	Number	163	-	163
	%	10.77	-	10.77
31	Number	436	2	438
	%	28.82	0.13	28.95
32	Number	2	-	2
	%	0.13	-	0.13
61	Number	-	2	2
	%	-	0.13	0.13
62	Number	-	1	1
		-	0.07	0.07
64	%	-	14	14
			0.93	0.93
Totally	Number	1494	19	1513
	%	98.74	1.26	100.00