International Council for the Exploration of the Sea

C.M. 1991/M:23
Ref. J
ANACAT Committee/
Ref. Baltic Fish Committee

PAPER

REPORT ON TAGGINGS OF THE SALMON STOCK IN THE RIVER TORNIONJOKI, FINLAND

by

A. Ahvonen[1], V. Pruuki[1] and J. Janatuinen[2]

Finnish Game and Fisheries Research Institute,
[1]Fisheries Division
[2]Aquaculture Division

P.O. Box 202, SF-00151 Helsinki, Finland

ABSTRACT

The remaining wild stocks of Baltic salmon are very small in number. The decline of the wild stocks is based on the water level regulation and the damming of the reproduction rivers. The few reproductive stocks are weakened by overfishing. The Tornionjoki River has been one of the most important smolt-producing rivers in the Baltic catchment, but the size of the spawning stock has fallen to a critically low level during the last decades. The state and the exploitation of the Tornionjoki salmon stock has been studied by Carlin-taggings. Over 16,000 smolts were tagged between 1982 and 1989. Most of the recaptures (about 68 %) were made in the Baltic Main Basin (sub-divisions 24-29), while the river mouth yielded about 12 % and the river itself only 1 % of the total returned. The rest of the tags were found mainly in the Gulf of Bothnia (sub-divisions 30 and 31). Recapture quantities of the Tornionjoki salmon were somewhat smaller than the recapture quantities of the other rivers in the same sub-division. Age group composition of the stocked Tornionjoki salmon differed also from salmon stocked in the other rivers. It was evident that some of the differences could be explained by the size of the smolts used in stockings. Exploitation during the sea phase is so intensive that the number of spawners returning to the reproduction river can not safeguard the stock.

Introduction

Remaining wild stocks of Baltic salmon are very small in number. Decline of the wild stocks is based on water level regulation and damming of the reproduction rivers. The few remaining reproductive stocks are weakened by overfishing. One of the last free-flowing - and thus potentially reproductive rivers in the Baltic catchment is the Tornionjoki River (Fig. 1). The Tornionjoki river has even been one of the most important smolt-producing rivers in the Baltic, but the size of the spawning stock has been overfished to a critically low level during the last decades. The present natural production level is estimated to be 10-30 % of the original of 500,000 smolts per year (Anon. 1991). The catch of salmon from the Tornionjoki river was, in the beginning of this century, about 100,000 kg per year (Pruuki et al. 1985). In the middle of the 1980's the annual catch from the river was at the lowest, about 2,000 kg, but during the last years has been on a level of 10,000 kg (Anon. 1991).

The intention of this paper is to present a review of the tagging experiment data of the Tornionjoki salmon of the 1980's. Results were compared with previous results from the 1960's and '70's and with corresponding data from the 1980's of other Finnish rivers in the same area.

Material and methods

The data considered in this paper consists of Baltic salmon tagging experiments made in 1982-1989 on the Finnish side of the Tornionjoki River. The results were compared with tagging experiments made in the other Finnish rivers in the northern part of the Gulf of Bothnia (ICES sub-division 31), and corresponding to the year. In the case above, the rivers were the Kemijoki, Oulujoki and Iijoki (Fig. 1). The total number of Carlin-tagged smolts in the Tornionjoki River was 16,345 stocked in 21 groups and in the other rivers 143,221 in 193 groups (Table 1). All the smolts were hatchery-reared and they were released after 2 or 3 years of rearing. A major part of the smolts stocked in the Tornionjoki river was produced in the Särkijärvi hatchery in Northern Finland. Taggings accomplished with one year old reared smolts were disregarded.

Results of the taggings in other rivers in sub-division 31 were processed as one group. Taggings of 1989 were accepted for the last year of the calculations, while later releases have been a subject to fishing for, at most, one year, before the moment of data processing in May 1991. The experiments have been carried out by Finnish Game and Fisheries Research Institute.

Separation of the sea phase into different stages was applied of a separation done by Ikonen & Auvinen (1984), as follows:

Year		Month of recapture		Gear of recapture*)		Stage
	(and)		(and)		(then)	
Stocking year		all		all		Post smolt
2nd year		<5		all		Post smolt
2nd year		>4		2		Grilse
2nd year		all		1		Feeding
>2nd year		all		1		Feeding
>2nd year		all		2		Spawning

*)Gear 1 = driftnet or longline
Gear 2 = other gears

In some calculations, the year was divided into three (fishery) seasons, as follows:

Month		Season
1-4	=>	1
5-8	=>	2
9-12	=>	3

Results

Recapture quantities

The recapture rate of all the taggings of Tornionjoki as a mean value of stocking groups was 6.1 % (S.D. 4.3 %) and of the other Finnish rivers in sub-division 31, 7.9 % (S.D. 5.0 %). Recapture rates were, in general, relatively similar according to the stocking year in both groups mentioned (table 2). The catch per 1000 released smolts in all the taggings of Tornionjoki was 246 kg, and in the other rivers about 50 kg more (Table 3). The catch per 1000 released in all the data

was connected to the size (length) of the smolts. For instance, in length classes 14-18 cm, the catch per 1000 released smolts was 132-242 kg, and in classes 19-24 cm, the catch was 320-672 kg (Table 4).

Geographical distribution of recoveries

Most of the recaptures (=68 %) after the stocking year were made in the Baltic Main Basin (sub-divisions 24-29). The Gulf of Bothnia (sub-divisions 30-31, including the mouth of the Tornionjoki,) yielded 29 % of the recoveries after the stocking year. In fact, 41 % of the recoveries in the Gulf of Bothnia were made near the mouth of the Tornionjoki river, (rectangles 1 & 2, Fig. 1) i.e., 12 % of the total. Only 1.0 % of tagged salmons were recaptured after the stocking year in the Tornionjoki river itself (Table 5). Geographical distribution of recoveries according to the age of the salmon is plotted in Fig. 2. A plot of all the recoveries is represented in Fig. 3, in comparison with a plot of recoveries of tagging experiments made in other rivers in sub-division 31.

Recapturing gears

In the 1980's, over half of the stocked salmon of the Tornionjoki were recaptured with driftnets, and 10 % were fished with longlines. These gears were used in sub-divisions 24-30. The share of the trapnets was 21 %, all caught in subdivisions 30-32. The use of anchored nets yielded 13 % of the recoveries (Table 6).

Age group composition

The most represented age group (47 %) among the recoveries of salmon stocked in the Tornionjoki river was agegroup A.1 (2nd year of sea phase). The frequency of age group A.2 was 42 %, A.3 was 7 % and A.0 4 %. The recoveries of salmon stocked to the other rivers in sub-division 31 had the same order of frequency among age groups, but the age group composition as a whole was younger (Table 7).

Sex ratio

The sex ratio of all the reported values for that variable (n=165) was 56 % for male and 44 % for female in the data of the Tornionjoki. In the data of other rivers the ratio was 51 % and 49 %. In both data, males were dominant in the northern part of the Gulf of Bothnia and in the rivers flowing there (sub-division 31). Southwards, females were more dominant (Table 8). During the post-smolt stage, females represented 58 % of all the data. The grilse-period was dominated clearly by males recaptured in the northernmost sub-division (=31). During the feeding migration, most of the salmon caught in the Main Basin were females (82 %). The spawning period was again dominated by males (57 %) (Table 9).

Mean weights of recaptured salmon

The mean weight of the recaptured Tornionjoki salmon was about 3.8 kg, compared to 3.6 kg of salmon stocked in the other rivers in sub-division 31 (counted as a weighted mean in the figures in table 10). The annual mean weight of the Tornionjoki salmon in the catches of the Baltic Main Basin was 3.4 kg during the second year of the sea phase (A.1) and 5.0 kg during the third year (A.2) (Table 10).

Discussion

Recapture quantities

The recapture rate of the Tornionjoki was, without a doubt, higher than the rates of the 1960's (1,3-2,2 %) and, on average, higher than the recapture rate of the only tagging of the 1970's (4,3 %) (comp., Pruuki et al. 1985). In fact, the recapture rate of the 1980's was only lower in the case of stocking year 1989, which was not completed at the moment of data evaluation. The high recapture rates of today can truly be described as results of the development in rearing and hatchery techniques that have lead to a better quality of smolt.

Exceptional salmon catches and C.P.U.E.'s of the year 1990 in the Baltic (Anon. 1991) can also be found out here in the form

of catch per 1000 released smolts. High catches were mainly due to the high survival rate of post-smolts in the smolt year class 1988.

In comparison with the other taggings of the same sub-division during 1980's, the recapture rates of the Tornionjoki were clearly lower. This was found also as a dimension of the catch per 1000 released smolts. Recapture rates of different stocking years varied relatively similarly in both groups of the stocking areas. A good indicator of the recapture success in general was the length of the smolts at release.

Geographical distribution of recoveries

Recaptures after the stocking year were, on a large geographical scale, mostly distributed as they were during the 1960's and '70's (Pruuki et al. 1985). The recapture rate was 3 %-units smaller than previously reported in the sub-divisions of the Baltic Main Basin, after the marking experiments of 1980's. Correspondingly, the recapture level of the 1980's was somewhat higher in the mouth of Tornionjoki river and as well as in the Gulf of Finland. An explanation for that difference is an uncommonly successful smolt year class of 1988, which made fishing unprofitable in the Baltic Main Basin in 1990 after the market was ruined, as a result of oversupply and a collapse in the salmon price. This allowed exceptional catches along the coast of Finland. But it is still worth of noting that the relative number of recoveries made after the stocking year in the Tornionjoki river has not changed if compared with the taggings of the 1960's and '70's. The distribution in every age group was quite similar to the situation in the 1960's and '70's (see Pruuki et al. 1985).

Recapturing gears

The most common gear of recapture in the 1960's was the longline, but already during the 1970's most of the tagged Tornionjoki salmon were caught with drifting nets (40 %), while the use of longlines yielded 24 % and trapnets 20 % (Pruuki et al. 1985). The development has continued on in the 1980's where over half of the recaptures have been caught with

driftnets, only 10 % with longlines, but about 21 % with trapnets.

The examination of recapturing gears was confused by incomplete reports of gears and recapturing areas. It was obvious that the incomplete reporting of the same variables was not evenly distributed, and the information concerning the area and the gear of recapture was most imcomplete in the Baltic Main Basin.

Age group composition

During the 1960's and '70's the age group composition of recoveries (see Pruuki et al. 1985) was older (and the mean annual weights were lighter) than it was during the 1980's. Previously, the frequency of age group A.1 was 31 % and the frequency of agegroup A.2 was 45 %, while during the 1980's the order was reverse with the figures 47 % and 42 %. On the other hand, the frequency of recoveries from the stocking year (A.0) has sunk from 18 % to 4 %. One possible reason for the last difference might be the size and quality of the smolts used in stockings. It could also be caused by a different reportage of the recoveries in the 1960's when Carlin-taggings were totally new. In the data of the 1980's, the age group composition of the Tornionjoki as a whole was older than in compared stocks. Because there were not any notable differences in the migration or exploitation of these stocks, it is possible that the growth of the Tornionjoki salmon was slower than in compared stocks.

Sex ratio

The sex ratios of the sea phase stages showed that male and female salmon have different life and migration cycles. Migration of males is in general shorter in time and distance, and a great deal of males turn back towards spawning river already as grilse at age A.1(+). Females migrate in average to more southern parts of the Baltic and they stay in feeding areas longer than males. During a long feeding-spawning migration, the number of females is also reduced relatively more than males. After the sea phase there are only some female spawners reentering the reproduction river. Data from

the Tornionjoki as well as from other rivers were with regard to processed variables, mostly inadequate in their lack of information on sexes. In an examination of sex ratios of the different sea phase stages, both data were therefore combined. The combination was supposed to be supported by fairly similar general sex ratios (Table 8).

Mean weights of recaptured salmon

In a seasonal comparison, there was no clear differences between the salmon of Tornionjoki and those stocked in other rivers. The comparison was rendered by a low number of observations in many sub-groups. Annual mean weights of sea phase recaptures of the Tornionjoki salmon were lighter in the age group A.1 than the salmon of other rivers. In the second most common age group A.2, the situation was converse. Although no unquestionable differences in mean weights were found, the results referred to, as stated in connection with age groups, that the growth of the Tornionjoki salmon was slower than that of the compared rivers. In general, the evaluation of growth was found to be complicated by combination of a high fishing mortality and a sharp size-selection, i.e. the minimum permitted size of exploitation of 60 cm.

If compared to the tagging results of the Tornionjoki of the 1960's and 1970's, mean annual weights of the 1980's were without a doubt higher. For instance, the mean weight of age group A.2 in the older results was 3.6 kg (Pruuki et al. 1985), while during the 1980's it was 4.8-5.0 kg in the sea catches. Higher weights in later results agree with a correspondingly younger age group composition.

Connection between smolt-size and later size of salmon

Salminen (1991) has also studied tagging experiment data from sub-division 31. He found a positive regression of length at recapture on smolt length. The data examined in this paper gave in the preliminary analysis the same kind of results regarding the regression of weight at recapture on the smolt-size. It is evident that one factor affecting the population parameters of stocked salmon is the size of the smolts used in

stockings. The smolts of the Tornionjoki were clearly smaller than the smolts of compared rivers (Table 1; the difference was significant in the t-test too) and this can explain part of the difference between the stocks. It is also important to notice that Carlin-tagging itself weakens the growth of smolts, and this affect can be emphasized whether smaller the smolts are (Isaksson & Bergman 1978).

Conclusions

According to the tagging experiments made during the 1980's, there were no radical differences found in population character or fishery-related figures between the salmon stocked in the Tornionjoki river and those of other rivers in the same area. The age group composition of the Tornionjoki salmon was somewhat older than in compared data. That could mean that the growth of the Tornionjoki salmon was correspondingly slower, because both groups encountered the same high fishing mortality after they had reached the minimum permitted size of exploitation, (=60 cm), and migration (routes) seemed to be similar. The differences obtained in population character were probably caused, at least partly, by the size of smolts used in stockings. The growth of salmon should be investigated still further.

A major part of the Tornionjoki salmon are caught in the Baltic main basin, and almost all end in a coastal or rivermouth fishery. Only marginally few salmon can avoid intensive fishing and survive to return to the spawning habitats of the river. If fishing effort remains at as high level as it has been, there will not be much hope for the Tornionjoki salmon to exist or even be revived as a naturally reproductive salmon stock.

References

Anon. 1991. Report of the Baltic salmon and trout assessment working group. ICES C.M. 1991/Assess:13. 99 p.

Ikonen, E. & Auvinen, H. 1984. Migration of salmon in the Baltic Sea, based on Finnish tagging experiments. ICES C.M. 1984/M:4.

Isaksson, A. & Bergman, P.K. 1978. An evaluation of two tagging methods and survival rates of different age and treatment groups of hatchery-reared Atlantic salmon smolts. J. Agr. Res. Iceland 10(2):74-79.

Pruuki, V., Anttinen, P. & Ahvonen, A. 1985. Tornion-Muonionjoen kalataloustutkimus. Riista- ja kalatalouden tutkimuslaitos, kalantutkimusosasto. Monistettuja julkaisuja 32. 238 p. ISBN 951-9092-52-8. (In Finnish).

Salminen, M. 1991. Variation of growth rate, tag-recovery rate and temporal distribution of tag-recoveries in Baltic salmon tagging experiments. ICES C.M. 1991/M:28. (mimeo).

Table 1. Releases of tagged salmon-smolts and general recapture rates in the river Tornionjoki river according to stocking group, and releases in the other rivers in ICES sub-division 31, according to stocking year. In the case of Tornionjoki, recaptures are not (fully) completed if year is greater than 1987. In the case of other rivers, mean lengths are weighted means of group-means.

TORNIONJOKI RIVER:

YEAR	FISH FARM	NUMBER OF SMOLTS	MEAN LENGTH (mm)	RECAPT. RATE %	CATCH(kg) PER 1000 SMOLTS
1982	MONTTA	988	.	3.7	100
1982	MONTTA	989	.	5.1	160
1985	SÄRKIJÄRVI	977	151	3.1	150
1985	SÄRKIJÄRVI	989	151	7.7	360
1985	SÄRKIJÄRVI	996	141	5.3	242
1986	TAIVALKOSKI	499	200	7.8	305
1986	TAIVALKOSKI	500	200	11.2	441
1986	TAIVALKOSKI	498	200	6.4	276
1986	SÄRKIJÄRVI	940	158	4.7	226
1987	SÄRKIJÄRVI	998	156	2.8	110
1987	SÄRKIJÄRVI	996	158	2.1	90
1987	SÄRKIJÄRVI	998	160	2.6	117
1987	SÄRKIJÄRVI	998	154	1.9	65
1988	TAIVALKOSKI	500	194	18.0	718
1988	TAIVALKOSKI	498	188	16.1	671
1988	SÄRKIJÄRVI	498	150	5.8	282
1988	SÄRKIJÄRVI	293	147	5.1	205
1988	SÄRKIJÄRVI	200	145	7.0	300
1989	TAIVALKOSKI	997	207	5.3	140
1989	TAIVALKOSKI	999	198	6.0	183
1989	SÄRKIJÄRVI	994	157	1.1	29
ALL		16345	169	6.1	246

OTHER RIVERS:

YEAR	NUMBER OF GROUPS	NUMBER OF SMOLTS	MEAN LENGTH (mm)
1982	16	15068	182
1985	28	26954	189
1986	36	33657	193
1987	34	30235	198
1988	25	25180	197
1989	13	12127	195
ALL	152	143221	193

Table 2. Recapture rates of salmon of the Tornionjoki and other rivers in sub-division 31 as mean percentages of the tagging groups of the stocking year. Recaptures of stocking year 1988 are not complete if 'Year of recapture' is greater than 3, and of stocking year 1989 if 'Year after release' is greater than 2.

		YEAR OF RECAPTURE (Age)								
		1 (A.0) %	2 (A.1) %	3 (A.2) %	4 (A.3) %	≥4 (≥A.3) %	All %	All S.D.	All N	Number of groups
RIVER	STOCKING YEAR									
Tornion-joki	1982	0.5	1.8	1.5	0.7	0	4.5	1.0	88	2
	1985	0	1.0	3.4	0.9	0.2	5.4	2.3	159	3
	1986	0.4	3.8	2.8	0.5	0	7.5	2.8	171	4
	1987	0.3	0.5	1.4	0.4	.	2.4	0.4	94	4
	1988	0.3	4.5	5.5	0.3	.	10.4	6.1	228	5
	1989	0.3	3.2	0.8	.	.	4.1	2.6	124	3
	ALL	0.4	2.7	2.9	0.6	0.2	6.1	4.3	864	21
Other rivers	STOCKING YEAR									
	1982	0.5	2.1	3.1	1.0	0.6	6.4	2.9	977	16
	1985	0.4	4.8	4.6	0.9	0.3	10.8	4.6	2905	28
	1986	0.4	3.8	2.8	0.4	0	7.1	5.3	2638	36
	1987	0.3	2.4	1.9	0.5	.	4.8	3.3	1385	34
	1988	0.6	6.5	5.7	0.2	.	12.8	3.1	3213	25
	1989	0.3	3.6	0.5	.	.	4.0	1.8	516	13
	ALL	0.4	3.9	3.2	0.6	0.5	7.9	5.0	11634	152

Table 3. Catch (kg) per 1000 released smolts of the Tornionjoki and other rivers in sub-division 31, as means of the tagging groups of the stocking year. Recaptures are not complete if stocking year=1988 and 'Year of recapture' is greater than 3 and if stocking year=1989 and 'Year after release' is greater than 2.

		YEAR OF RECAPTURE (Age)							
		1 (A.0) Mean	2 (A.1) Mean	3 (A.2) Mean	4 (A.3) Mean	≥4 (≥A.3) Mean	All Mean	All S.D.	Number of groups
RIVER	STOCKING YEAR								
Tornion-joki	1982	1	12	70	44	0	130	42	2
	1985	0	24	153	66	14	250	105	3
	1986	1	134	137	37	0	312	92	4
	1987	1	11	55	29	.	95	23	4
	1988	1	128	294	22	.	435	240	5
	1989	1	82	35	.	.	118	80	3
	ALL	1	74	140	39	14	246	181	21
Other rivers	STOCKING YEAR								
	1982	1	45	120	61	36	234	121	16
	1985	1	148	207	67	20	433	205	28
	1986	1	124	129	26	0	272	233	36
	1987	1	63	78	34	.	167	124	34
	1988	2	181	304	18	.	494	151	25
	1989	1	100	21	.	.	114	47	13
	ALL	1	115	151	43	30	297	214	152

Table 4. Catch (kg) per 1000 released smolts of the Tornionjoki and other rivers in sub-division 31, as means of the tagging groups of the stocking year in different length classes of the smolts. Length classes 14 and 26 are in brackets because of only one observation (=group).

LENGTH CLASS cm (+/- 0.5 cm)	YEAR OF RECAPTURE 1 (A.0) Mean	2 (A.1) Mean	3 (A.2) Mean	4 (A.3) Mean	≥4 (≥A.3) Mean	All Mean	All S.D.	Number of groups
(14	.	34	109	93	.	242	.	1)
15	0	38	146	30	14	207	112	7
16	1	24	76	33	.	132	67	8
17	1	59	94	44	30	188	140	15
18	1	90	106	46	16	227	155	28
19	1	120	179	37	29	320	206	40
20	1	135	184	42	25	350	267	31
21	1	142	160	44	.	346	187	10
22	4	132	172	44	.	340	162	11
23	2	178	194	44	.	394	213	12
24	4	361	265	32	.	672	614	2
(26	.	.	14	.	.	14	.	1)
ALL	1	113	152	41	25	294	213	166

Table 5.

Sub-divisions of recaptures of tagged salmon of the Tornionjoki river according to stocking year. Recaptures of stocking year are excluded. Mouth of the Tornionjoki river means rectancles 1 and 2 in sub-division 31 (Fig. 1). Recaptures of sub-division 31 exclude recaptures at the mouth of the Tornionjoki river.

	STOCKING YEAR							
	1982	1985	1986	1987	1988	1989	ALL	ALL
SUB-DIVISION OF RECAPTURE	%	%	%	%	%	%	%	N
24	2	7	7	2	.	.	3.1	15
25	13	31	37	30	19	22	25.5	124
26	4	24	27	21	4	5	14.0	68
27	2	.	4	2	2	5	2.5	12
28	5	18	17	19	22	22	18.3	89
29	4	3	2	5	8	5	4.5	22
30	25	3	.	1	12	16	9.0	44
31	38	5	2	6	4	5	8.0	39
32	.	.	1	4	2	4	1.8	9
Mouth of the Tornionjoki river	7	7	3	9	25	12	11.9	58
Tornionjoki r.	.	1	.	.	2	3	1.0	5
Other rivers	.	1	.	.	.	1	0.4	2
ALL, %	100	100	100	100	100	100	100.0	—
ALL, N	55	82	98	53	118	81	—	487

Table 6. Recapturing gear of the tagged salmon of the Tornionjoki river. Subdivision 67 = Tornionjoki river, 99 = other rivers. "Net" in gear column refers to anchored gillnets.

	SUB-DIVISION							
GEAR	24-29	30	31	32	67	99	ALL	ALL
	%	%	%	%	%	%	%	N
Driftnet	78	34	.	.	.	.	54	274
Longline	13	17	.	11	.	.	10	51
Trapnet	.	26	79	89	.	.	21	104
Trawl	0	4	.	.	.	.	1	3
Net	9	19	21	.	29	.	12	63
Others	0	.	.	.	71	100	2	8
ALL, %	100	100	100	100	100	100	100	__
ALL, N	332	47	106	9	7	2	__	503

Table 7. Distribution of the year of recapture (age at recapture) and seasons according to sub-divisions. Stock-column 67=Tornionjoki and 31=other rivers.

		YEAR OF RECAPTURE (age)													
		1 (A.0)			2 (A.1)			3 (A.2)			4 (A.3)			ALL	
SUB-DIVISION OF RE-CAPTURE	STOCK	SEASON 1	2	3	1	2	3	1	2	3	1	2	3		
		%	%	%	%	%	%	%	%	%	%	%	%	%	N
24-29 & 32	31	0	0	1	3	4	51	19	11	7	2	1	1	100	5224
	67	.	.	1	1	4	42	18	13	14	4	2	1	100	398
30	31	0	13	6	3	19	12	10	20	11	2	3	1	100	902
	67	.	5	5	2	15	15	18	20	14	3	2	2	100	65
31	31	1	14	1	2	47	5	0	26	1	0	3	0	100	1731
	67	1	7	.	5	51	.	1	28	1	.	6	.	100	134
Rivers	31	.	54	5	1	21	11	.	7	1	.	2	.	100	198
	67	.	47	.	.	24	6	.	12	.	.	6	6	100	17
All	31	0	6	2	3	15	36	14	15	6	2	2	1	100	8055
	67	0	3	1	2	16	29	14	17	11	3	3	1	100	614

Table 8. Sex ratios of the salmon of the Tornionjoki and other rivers in sub-division 31 according to area of recapture.

Stocking river	Sub-division (or area) of recapture	Males %	Females %	All n
Tornion-joki	24-29	26	74	54
	30	33	67	15
	31	80	20	81
	32	0	100	3
	Rivers	75	25	12
	ALL	56	44	165
Other rivers	24-29	21	79	737
	30	46	54	252
	31	73	27	989
	32	48	52	44
	Rivers	72	28	107
	ALL	51	49	2129
ALL	24-29	21	79	791
	30	45	55	267
	31	73	27	1070
	32	45	55	47
	Rivers	72	28	119
	ALL	51	49	2294

Table 9. Sex-ratios of all the data for different stages of the sea phase and recapture areas. In the table, M=male and F=female.

SUB-DIVISION OF RECAPTURE	STAGE								STAGE			
	Post-smolt		Grilse		Feeding		Spawning					
	M %	F %	M %	F %	M %	F %	M %	F %	Post N	Gri N	Fee N	Spa N
24-29	15	85	48	52	18	82	34	66	20	44	629	98
30	64	36	71	29	24	76	42	58	14	73	87	93
31	56	44	93	7	67	33	47	53	27	530	180	333
32	.	.	83	17	38	62	27	73	0	12	13	22
Rivers	38	62	100	0	80	20	58	42	39	48	20	12
ALL	42	58	88	12	29	71	43	57	100	707	929	558

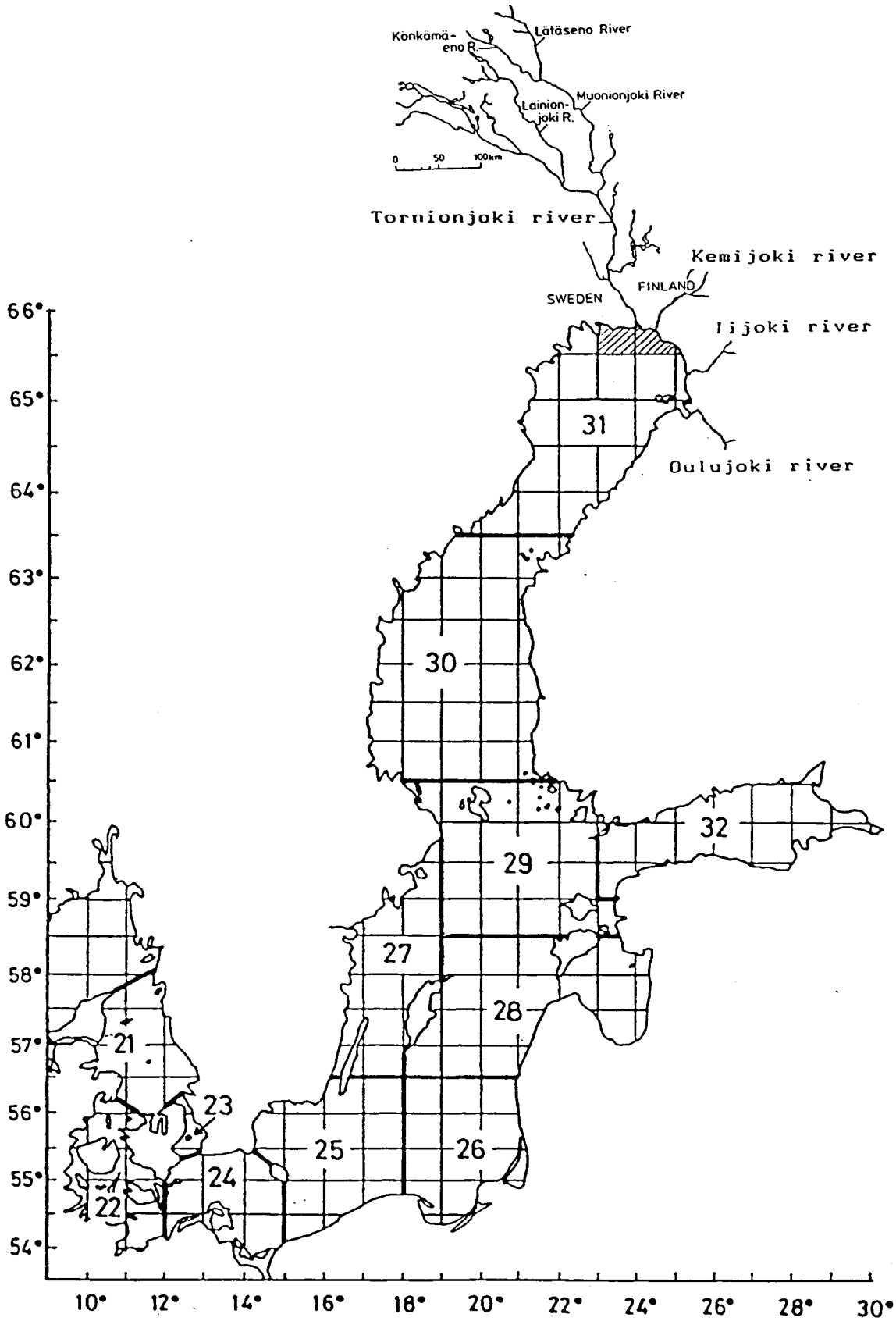

Fig. 1. The main drainage system of the Tornionjoki river and the lower parts pf the rivers in comparison in sub-division 31. Mouth of the Tornionjoki (rectangles 1 & 2) is shaded.

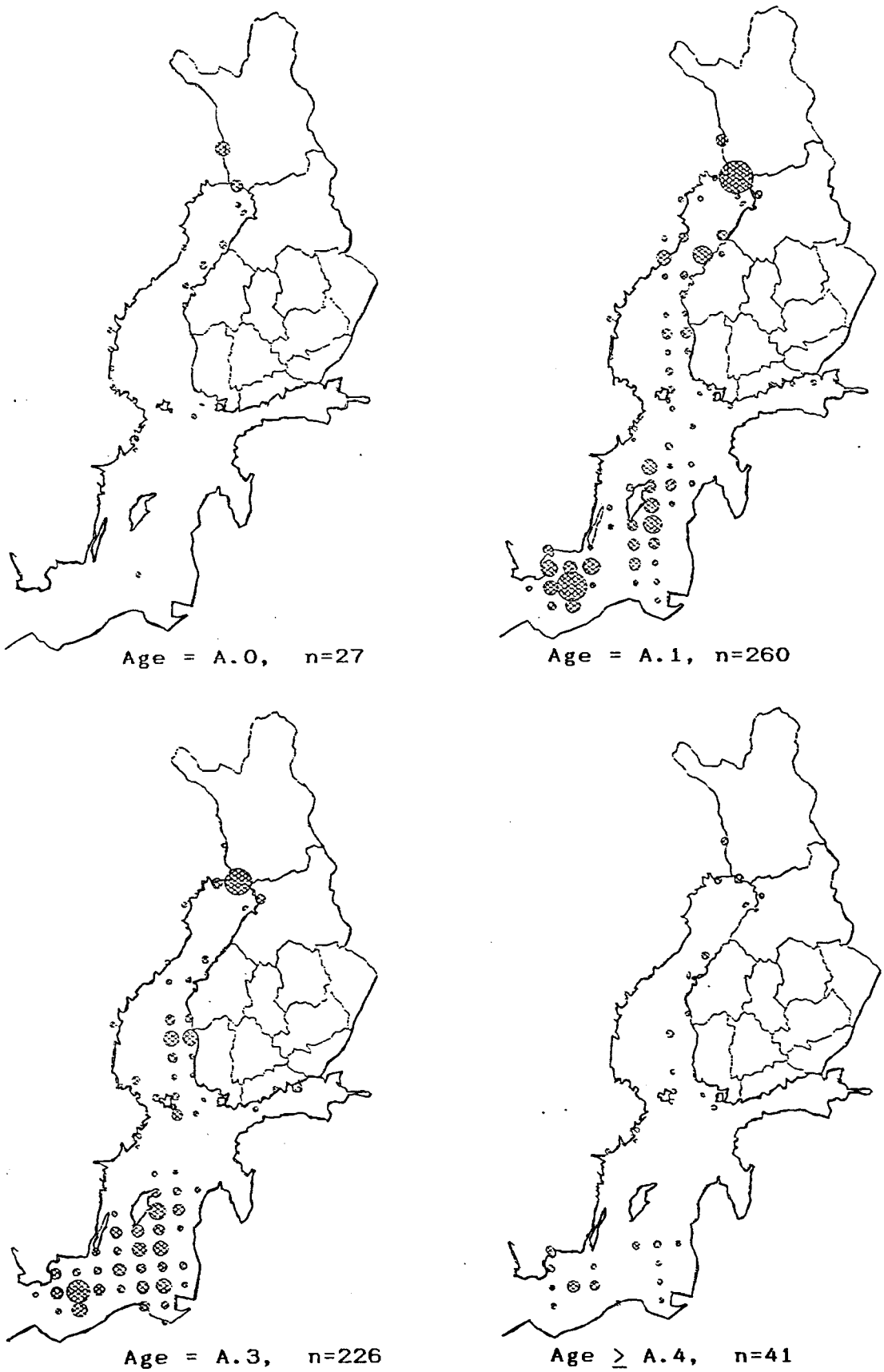

Fig. 2. Recaptures of the Tornionjoki according to the age of the salmon.

Tornionjoki
n=552

Other rivers
n=10525

Fig. 3. All recaptures of the Tornionjoki and other rivers in sub-division 31.