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RESULTS OF THE ATLANTIC SALMON TAGGING IN THE SOVIET UNION

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Norwegian investigations on salmon showed that this fish species performing downstream migrations to rivers of Soviet Union are partially fished in coastal areas of Norway. The first salmon fish tagged with Norwegian tag was recovered in the Vyg River running along the territory of the USSR in 1935 (Berg, 1935). Then, in 1936 eighteen individuals of salmon tagged were recovered in different rivers falling into the Barents and the White Seas, as well as on the Tersky Shore of the White Sea (Danilchenko, 1938). Those salmon fishes tagged in Norway in the Breivik Area (West Finmark) were taken one or one and a half month later.

More detailed data on salmon tagging in the waters off the coasts of Norway were obtained during the last years. Those data allow to conclude that of each 100 salmon tagged in different

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areas of Norway about 50 fishes are usually, recovered while fishing with bag nets, but only I7 specimens of each I00 salmon tagged are recovered in the Finmark Area, where the fishing intensity may be higher in comparison to other areas and where up to 20% - 30% of the total Norwegian catch are taken. The rest of 33 salmon avoid to be recovered as they appear tp be beyond the limits of the Norwegian areas of fishery and migrate to the rivers of the Soviet Union. Thus, 2/3 of catch taken in the Finmark Area consist of salmon moving to the Soviet Union rivers (Bakshtansky, I970). This index should be considered as the minimum one as the Norwegian catches consist for 80% - 90% of fish taken in the coastal waters, and tagged salmon moving to the Soviet Union rivers are partially caught there.

A low condition factor of salmon taken in the waters near the northern Norwegian Shore testifies also on the fact that salmon caught there were still feeding far from their native river.

The condition factor of salmon caught at sea with long-line makes up 0.8 - 0.9 on the average, and that one for salmon taken near the northern Norwegian Shore is usually I.0 - I.I (Rosseland, I969).

This index for salmon caught near the southern Norwegian Shore, as well as for those moving to the Soviet Union rivers is equal to I.I - I.2 - I.3 correspondingly.

The collection of tags was ameliorated in the Soviet Union during the last years. Thus, data on 240 Norwegian tags were collected for the period I962 - 1972. Those tags were used for

salmon tagging mainly in the Norwegian coastal waters while fishing with bag net and in the less number in time of the long - line marine fishery. We possess data on areas of tagging only for 38 salmons, of them 36 were tagged during the bag net fishery in the Breivik area and only 2 specimens at sea. Those individuals were recaptured in the Soviet Union waters 37 days later (9 + 97), two ones were taken again in a year after their tagging. An average moving speed of those salmons was 33 km per day and it fluctuated within the ranges from 7 up to 79.5 km.

Thus a conclusion may be made that close to the Norwegian coast are caught both salmon moving rapidly to their native rivers running along the territory of the Soviet Union and salmon continuing to feed on. Of 240 tags, their greatest number - 89 were recovered in the rivers of the Murmansk Shore of the Kola Peninsula, 43 tags were found with fish inhabiting the rivers of the Tersky Shore, 54 ones - in the Pechora River and I8 - in other rivers of the Arkhangelsk district, 36 tags did not bear the information needed.

The greatest number of Norwegian tags were found on salmon inhabiting close to the Murmansk Shore, it appears that those fishes move close to the Norwegian shores and therefore they may be more intensively caught both with bag and drift nets. Small sized salmon keeping in waters of Tersky Shore and the Varzuga River were very seldom bearing Norwegian tags. Decrease in the mean weight of salmon inhabiting the waters of the Murmansk Shore testifies also on a great effect of foreign fishery, most likely of the drift one.

Table I. Mean weight of salmon (kg) inhabiting the Kola Peninsula

Years	Murmansk Shore	Tersky Shore and the Varzuga River
1946 - 1950	5.2	3.1
1951 - 1955	5.2	2.9
1956 - 1960	4.8	2.9
1961 - 1965	3.7	2.9
1966 - 1970	3.2	3.0

The development of marine longline fishery in the Norwegian Sea makes an additional adverse effect on the stocks of our home salmon. It is clear that this fishery is based on salmon originated from the Norway and the Soviet Union rivers proportionally to the stocks of those countries. As the total salmon stock can not be great in the Norwegian Sea, thus, even a relatively small marine catches may effect considerably salmon catches in home waters.

According to data on tagged salmon caught with long lines in the Norwegian Sea (ICES, CM 1973/ M:5), 88.6% of salmon tagged were recaptured in the waters of Norway, and 11 4% - in those of the Soviet Union. A real number of our salmon taken with long-lines in the Norwegian Sea should be much higher, as salmon tagged are intensively fished near the Northern Norwegian Shore on their way to home rivers.

In order to study migrations and the effect of the foreign fishery on our salmon stocks, works on tagging of the Atlantic salmon smolts and kelts were conducted at a larger scale.

Tagging of smolts has been begun since I969 and is continued up to now. For this purpose a modified Carlin type tag was used there, it was attached to a stainless wire having diameter 0.2 mm. Urethan and quinaldine were used as narcotics. Areas of tagging and releasing the youngs, data on the number of youngs released and the results of tagging are given on Table 2.

8237 smolts were registered to be tagged to I972, of them 5330 were grown at fish rearing stations and 2907 were wild salmon. The total value characterizing their return was equal to 30 individuals (0.36%) late in I973, of that number 0.II% made fish grown at plants and 0,82% - wild salmon. The return of tagged wild young fish appeared to be higher, namely, from 0.I3% up to 2.0% and that one of fish grown at plants was much less, from 0 up to I%. The greatest return was obtained from salmon taken in the waters of the Porya River pouring into the Kandalakshsky Gulf of the White Sea, w. where the youngs were tagged just at the estuary. The mean return of the youngs tagged in the Porya River made I.6% for the period from I970 to I973, and the return of non - tagged downstream smolts this river to sea was equal to 2.4% in I970. Thus, the mortality caused by tags and (or) by the tags loss was insignificant.

Of total 30 salmons tagged, 4 ones were caught in the Norwegian Sea, 4 indiduals near the Norwegian Shore and one fish - in the Norwegian Sea or close to the Norwegian Shore (not known), 3 salmons were taken near the Soviet Union Shore and I8 - in the rivers of

Table 2. The results of tagging the Atlantic salmon smolts

Year of tagging	Number of fish tagged		Area of smolts tagging and release	Areas of recapture and number of years passed at sea										Total number of fish returned			
	Grown at fish-rearing station	Wild		Norwegian Sea		Unknown Area	Norwegian Shore		The USSR Shore			USSR rivers		Grown at fish-rearing station		Wild	
				1 year	2 years	2 years	1 year	2 years	1 year	2 years		1 year	2 years and more	number	%	number	%
1969	600		Taybolsky fish-rearing station, Murmansk Shore of the Kola Peninsula, Kola River									4	1	6	1		
1970	986		Knyazhegubsky fish-rearing station, Southern Shore of the Kandalakshsky Gulf											-	-		
1970		100	Porya River, southern shore of the Kandalakshsky Gulf				1					1				2	2
1971	805		Taybolsky fish-rearing station, Kola River													-	-
1971	2939		Kandalakshsky fish-rearing station, Southern Shore of the Kandalakshsky Gulf, Luvenga River													-	-
1971		700	Porya River		1	1		1		1		1	7			12	1.7
1971		1507	Zimnaya Zolotitsa River, Eastern Shore of the White Sea		1							1				2	0.1
1972		600	Porya River	1			2		2			3				8	1.3
TOTAL:																	
in pieces						9						21					
in %						30						70					

the USSR. Thus, 30% of all the salmons tagged were recaptured in the Norwegian Sea and close to the Norwegian Shore and 70% - in the USSR waters.

As the recovery was mainly obtained due to the tagging of smolts in the Porya River, it is appropriate to consider it separately. Of 23 salmons tagged, II.4% were caught at the Norwegian Sea, 20.5% - near the Norwegian Shore, I3.6% - close to the shore of the Soviet Union and 54.5% - in the USSR rivers. The conclusion may be made that salmons have been already caught on their way home to the Porya River in time of the foreign fishery (3I,9%). Of course those data should be considered as the preliminary ones.

Taking into account the fact that the Norwegian tags are recovered especially often on salmon inhabiting the waters of the Murmansk Shore and of the Pechora River, it may be supposed that the salmon populations of those Soviet Union areas may be fished even more intensively in time of the foreign fishery. Salmon catches taken with set and drift nets near the Norwegian Shore are given in the official statistics as "catches taken in home waters". But, in reality they should be characterized as "catches taken in territorial water of Norway", as a great number of salmons taken has there origine in the USSR rivers.

Works on tagging of a light - coloured spring kelt were conducted on the Varzuga at a fish - counting barrage in twelve kilometres from the estuary within the period from I968 to I97I. Tags type "hydrostatic" more seldom" "plat" ones were used for tagging. Tags were attached to the fore part of the dorsal fin with help of a capron thread in I968, and some later - with stain-

less wire. Data on tagging and return of tags are given in Table 3.

Table 3. Tagging of kelts inhabiting the Varzuga River and the tag recoveries

Year of tagging	Number of specimens tagged	General return		Return in the Varzuga River		Return in other areas		Return of tag one or two years later			
								White Sea area		Norwegian Shore	
		Number of specimens	%	Number of specimens	%	Number of specimens	%	Number of specimens	%	Number of specimens	%
1968	221	9	4.07	6	67	3	33	-	-	-	-
1969	1149	41	3.57	17	41.5	24	58.5	7		1	
1970	44	8	18.18	7	87.5	1	12.5	1			
1971	509	14	2.75	7	50	7	50	1		1	
TOTAL:	1923	72	3.74	37	51.4	35	48.6	9	81.8%	2	18.2

It is shown on the Table that 1.923 kelts were tagged throughout the four year period, the total return was equal to 72 specimens or 3.74%. Of them, 37 salmons tagged or 51.4% were recovered in the Varzuga River, almost half of salmon tagged, namely, 35 specimens or 48.6% were caught in other areas, mainly, on fishing places, in the White Sea and, as a rule, far from the estuary of the Varzuga River. The greatest number of salmons were caught in time of the tagging season, 11 salmon fishes or 15.3% were taken the next year, of them 2 specimens or 18.2% - close to the Norwegian Shores. One of these fishes was caught by a Danish vessel on February 18, 1970 in 40 miles from the north - north -

west of the Andenes town, that fact was registered some 237 days later after the tagging process and the fish weighed 2.5 kg; the other salmon fish was caught by a Norwegian vessel near the westerr part of the Mageröy Island on June I5, I972, this individual weighed 3.I kg.

Data obtained on kelts migrations in the White Sea are of a special interest. The main recovery areas within the White Sea of salmons tagged, the duration of their migration and minimum speeds are given below on Table 4.

Table 4. Areas of tagged kelts recoveries, number of days after their tagging and their migration speeds in the White Sea x/

Area of recovery and the di tance from their place of tagging, km	Number of days after the tagging process	Minimum speed, km/day
1	2	3
Koyda, 5I2	22	23.3
	2I	24.4
	30	I7.I
	29	I7.7
	28	I8.3
	23	22.3
	503	
Maida, 432	29	I4.5
	50	8.6
	50	8.6
	30	I4.4
	45	9.6
	45	9.6

x/ The minimum speed was determined only in cases, when the migration period of kelts was shorter than the period preceeding the return migration to the Varzuga River.

I	II	2	II	3
		I6		27.0
		24		I8.0
		24		I8.0
		I4		30.9
		I3		33.2
		534		
Megra, 402		20		20.I
Ruchyi, 372		2I		I7.7
		2I		I7.7
		I8		20.7
Nenoksa, 372				
Kozly, 322		54		6.0
isl. Jagry, 402		27		I4.9
Lopshenga, 270		4I		6.6
		max. 38		
Gridno, 202		29		7.0
Zhemchuzhnaya Guba, 252		25		I0.I
Kashkarantsy, 76		II5		
Chavanga, 92		5		I8.4
Chapoma, I88		3I		6.I
		I20		
Chapoma-Strelnya, I80		465, 45		4.0
Varzuga		6I, 78, 93, I05, I08, II7, II9, II9, I20, I20, I24, I28, I33, I33, I34, I35, I40, I54, I62, I63, I65, I67, I70, I73, I73, I90, 360, 466		
				Mean Speed I6.03

Data on some salmons caught not far from the estuary of the Varzuga River are not included into the Table. Data given in Table 4 show that the greatest number of salmons tagged were caught in the mouth of the White Sea within the area Ruchyi – Koyda, as well as in the Varzuga River. In other areas of the White Sea there were taken only 7 individuals that makes 10% of all salmons tagged and caught later in the White Sea bassin.

Salmons migrating to the eastern shore of the White Sea mouth possess the highest speed, the mean speed of kelts caught in that area made about 20 km/day (from 8.6 up to 33.2 km/day). The movement speeds of salmons taken in other areas of the White Sea are considerably less, usually, below 10 km/day. A low rate of speed contrary to a high one testifies on the fact that salmons are moving not in a single direction but in different ones as it is observed in time of the feeding period.

Data given in Table 4 allow us to conclude that kelts begin to return to the Varzuga River after their feeding period in 61 days as minimum, mainly, in 100 – 170 days. The maximum period following the tagging process of kelts caught in the White Sea during the same season was equal to 54 days, usually that factor was much less, namely, 20 – 30 days. Therefore, the conclusion may be made that all the kelts both keeping in the Varzuga River and those staying for some time into the areas of the White Sea more rich with food go out from that sea to feed. The migrations of tagged kelts in the White Sea early and late of the feeding period are schematically shown in the Fig. I.

The Figure shows that the greatest number of kelts move after their downstream migbation from the Varzuga River to the eastern part of the White Sea estuary, where water is freshened somewhat, and moving by that way kelts may soon appear beyond the limits of the White Sea. Their less part stay for a short period in the White Sea in the areas of herring accumulation, i.e. in the Dvinsky Gulf, in the waters of the Tersky Shore and in the Kandalakshsky Gulf though in a less number. The return migration of kelts after their feeding has place also in the waters along the eastern shore of the White Sea estuary, then along the Tersky Shore, usually, their migration path is observed beyond the limits of set nets ranges. Kelts approach the estuary of the Varzuga River from east, west of the Sea and direct from it like salmon moving to spawn for the first time.

Kelts were caught beyond the limits of the White Sea exclusively near the coast line of the Northern Norway, but, it does not mean that all the kelts from the Varzuga River feed in the Norwegian Sea. Kelts must pass I200 km at the minimum moving by their usual way across the eastern part of the White Sea estuary to the Norwegian Sea even if Nord - Cape. The mean speed of kelts migration within the Sea waters of the area of the North - West Atlantic was equal to I0 - 20 British miles per day (R.E. Gutting and A.L. Meistes, I967) that makes I6 - I9 km. According to our data, the mean moving speed of kelts into sea waters within the North - West Atlantic area made I6 km/day. Thus, their whole way up to the Norwegian Sea limit and back, i.e. 2400 km, kelts may pass during I50 days.

The Table 4 shows that kelts caught in the Varzuga River spent from 61 up to 190 days throughout the same year. 17 kelts or 65,4% spent into the Sea less the 150 days (according to data given in Table 4), therefore, it may be concluded that they could not reach limits of the Norwegian Sea. Of course, such a calculation confirms only the fact that a small number of kelts returning the Varzuga River already in autumn could nevertheless reach the eastern part of the Norwegian Sea, if the kelts moved in that direction. But, during the spring - summer period salmons feeding in the north - east Atlantic migrate from west to east. Therefore, it may happen that all the kelts will not go far to the west during that period, they only will be feeding in the areas lying in the most eastern areas, i.e. in the Barents Sea. But, the kelts that will move to the river the next year (11 specimens or 15.3% considered here), are, firstly, feeding in the Barents Sea as well, then gradually with the autumn cooling of sea water they leave this area for the Norwegian Sea and pass there the whole winter period. Therefore, the foreign fishery may effect only that part of kelts.

Thus, works on salmon tagging conducted in the high sea and close to the Norwegian Shore, as well as tagging of smolts and kelts in the Soviet Union testify on an intensive foreign fishery of the Atlantic salmon going to the USSR rivers. Therefore, unilaterial measures on regulation of the Atlantic salmon fishery realized by the Soviet Union can not be effective enough in order to maintain their stocks.

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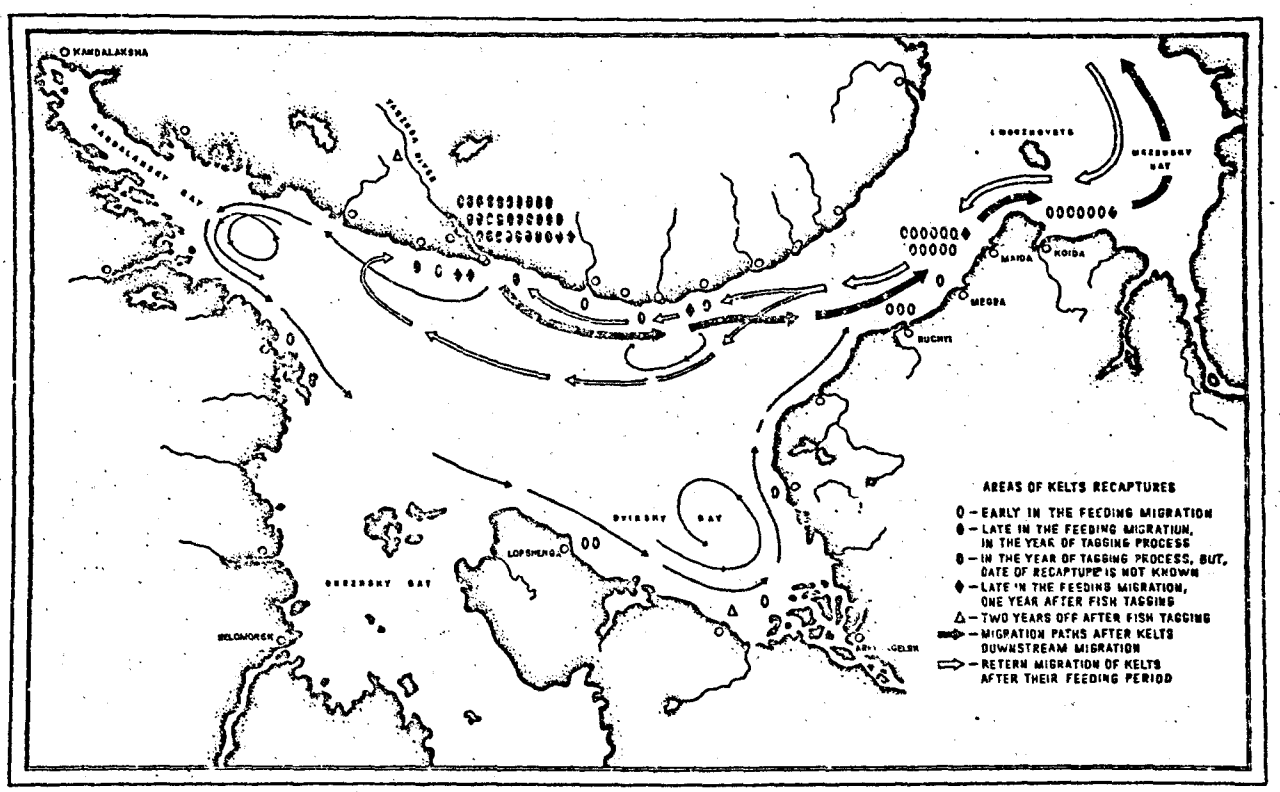
Caption to the figure I

Schematic map of migrations for the Atlantic kelts salmon in the White Sea.



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