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MARKING AND TAGGING OF SMOLTS OF ATLANTIC SALMON (SALMO SALAR L.) IN THE RIVER ÚLFARSÁ, SOUTHWEST ICELAND, AND THEIR RETURNS IN THE SPORTS FISHERY AS ADULT SALMON

by
Thór Gudjónsson
Institute of Freshwater Fisheries
Vagnhofda 7
112 Reykjavík, Iceland

Abstract

Atlantic salmon smolts were caught on their seaward migration in fyke nets in the river Úlfarsá in southwest Iceland from 1947 to 1970 for marking and tagging purposes. Marking of 10,550 smolts by fin clipping resulted in an average return of 4.7% of mature salmon, mostly grilse, in the sports fishery, whereas 1,401 smolts, most tagged with Carlin fish tags gave a return of only 1.2%. The time of seaward migration occurred mostly in May and June after the temperature of the river water had approached 10° C and remained at 10° C or more. The heaviest parts of the runs most often took place within the period from 20 May to 10 June. The forked length of the smolts was from 9 to 19 cm, commonly 12 to 13 cm. The smolt catches in the fyke nets varied from year to year, strongly influenced by the volume of flow and fluctuations in flow during the annual smolt migrations. The average annual smolt production in the Úlfarsá was estimated to be close to 6,000 smolts.

Introduction

A marking and tagging program of Atlantic salmon smolts in the river Úlfarsá in Southwest Iceland was carried out from 1947 through 1970. The program was started as a participation in a plan for international co-operation in marking salmon agreed upon at the meeting of the Salmon and Trout Committee of

the International Council for the Exploration of the Sea in Copenhagen in 1945. The scheme was further discussed and planned at the meeting of the Committee held in Stockholm in 1946. The plan was to mark clean salmon, smolts and kelts. Iceland was unable to participate in marking clean salmon since no bag net fishery existed in the country, but partook in the scheme by marking and tagging smolts and tagging kelts.

The Ölfarsá river system

The Ölfarsá is a small river at the outskirts of the City of Reykjavík emptying into the Faxa Bay. It is about 18 km in length with Lake Hafravatn on the river system (Figure 1). The lake is 1.02 km^2 in area and its surface is at 78 m above sea level. The average depth is 8 m and the greatest depth is 28 m. The length of the river above the lake is about 8 km of which about an 800 m stretch is passable for fish up to a waterfall. The length of the river below the lake is 10.4 km. The drainage area of the river system is 54 km^2, the average flow being 1,600 l/sec., varying between 165 to 12,000 l/per sec. In 1953 a dam was built across the Ölfarsá about 4 km above the estuary. From the reservoir above the dam 220 to 230 l/per sec. of water was abstracted and piped to a fertilizer factory located on the coast below. The water abstraction was supposed to affect the living condition for fish in the river below the dam.

Species of fish in the river system

In the Ölfarsá river system are found all the five native species of fish occurring in fresh water in Iceland. The Atlantic salmon is the dominant species in the river. Sea trout frequent the river but on a smaller scale. In Lake Hafravatn are non-migratory brown trout (Salmo trutta) and Arctic char (Salvelinus alpinus) as well as sticklebacks (Gasterosteus aculeatus). The European eel (Anguilla anguilla) is also found in the river system. Angling is the only method of fishing allowed in the river. It was performed with two rods daily seven days a week during the fishing season which lasted for three months annually beginning in early June.

Methods

Salmon smolts as well as sea trout smolts and larger sea trout were caught in the spring on their seaward migration in fyke nets for marking and tagging. The marking was carried out each year by clipping two fins, always the adipose fin alternately together with either one of the ventral fins, the anal fin or in one case the dorsal fin. At the beginning of the program satisfactory salmon smolt tags were not available. Plastic tags with silver wire attachment were used with little success previously to the introduction of the Carlin fish tag. A fyke net was set in May in a pool located a short distance above the estuary. Leads from the opening of the fyke net obliquely upstream to the river banks on either side were anchored at the banks. This fyke net was fished all the years. It will be named the lower fyke net henceforth. Another fyke net was operated from 1966 to 1970 1.3 km upstream from the lower one, henceforth referred to as the upper fyke net. The lower fyke net was operated annually from 14 to 76 days, the average annual fishing period being 38 days. The fyke nets were lifted daily with a few exceptions. Occasionally floods or damages by man interrupted the operation.

Marking and returns

During the years 1947 to 1970 11,951 salmon smolts were marked by fin clipping or tagged with attached fish tags with running numbers. The total number of fin clipped smolts were 10,550. The annual number of fin clipped smolts varied from none in 1949 to 1,312 in 1967, the average number being 458, see Table 1. Information was obtained on the catch of 488 fin clipped smolts caught as mature salmon, the return being 4.7%. Most of the salmon were caught in the Ölfarsá, 453 in number (92.8%). The rest were caught in the neighbouring rivers and in the Kollafjördur Experimental Fish Farm. Of the 488 fish reported 407 (83.4%) were caught after one year, 69 (14.1%) after two years amd 12 (2.5%) after three years. The percentage returns of fin clipped salmon varied from year to year from zero to 9.5% with one exception of 21.4% when there were only 14 smolts fin clipped and three reported caught.

Tagging and recaptures

Tagging of salmon smolts took place from 1948 to 1950 and from 1956 to 1970. The total number of smolts tagged was 1,401, the highest number tagged during one season was 203 smolts (1957). The recapture of tagged smolts as mature salmon was poor, only 1.2%. One reason for these small returns was that the Carlin tags used seemed to be too heavy to carry for smolts less than 13 cm in length. An unusual tag return was reported in 1948. A tagged smolt was retrieved from the stomach of a cod 35 cm in length caught in the sea off the island of Videy a few miles away from the estuary of the Úlfarsá five days after the smolt had been tagged.

Smolt length

Fork length of a number of smolts was measured in 1947 and yearly from 1949 to 1970. Their length varied from 9 to 19 cm. Their average length in three of the fishing periods was between 11 and 12 cm, in 12 between 12 and 13 cm and in 8 between 13 to 14 cm. In 1966 to 1970 larger smolts were selected for tagging and were the only ones measured for length. Their average lengths those years were from 12.9 to 13.8 cm. The smallest average length of smolts of 11.3 cm occurred in 1950, the year after the unusually cold spring and summer of 1949 (Figure 2).

Time of seaward migration

The smolts migrated seawards mostly in May and June. The run started when the river water warmed up over 9° C, which was most often around 20 May. The temperature of the river water fluctuated almost daily, most during the first part of the run. When the temperture went up to 10° C and over some smolts would run, but it would stop when the temperture went down. When the temperature stayed at 10° C and higher the main run would continue, but it fluctuated in number from day to day with one or more peaks (Figure 3). When there was unusually warm weather during the month of May the run took place mostly in May as it did in 1950, 1956 and in 1964. The run occurred on the other

hand very late like in the cold spring of 1949, when the main run came about in late June. The runs were most often heaviest within the period of the 10 last days of May and the 10 first days of June.

Annual smolt catches

The annual smolt catches in the lower fyke net from 1947 to 1970 varied from 27 smolts in 1962 to 1,077 in 1960, the average annual catch being 385 smolts. The catches were nine times within 400 smolts, 13 times from 400 to 800 and once 1,077 smolts. The biggest catch in one year was 1,477 smolts made in 1967 in both fyke nets. The catchability of the fyke nets varied depending among other things on the volume of flow of water and the drift in the river at various times during the yearly fishing periods. Low water levels seemed to have affected the catches in 1955 (113 smolts) and in 1965 (49 smolts), but the low water level through the fishing period in 1958 had less effect since the catch that time was 529 smolts. The most favourable condition for catching smolts in the lower fyke net seemed to have been when the volume of flow was between 400 and 1,100 l/sec. during the annual fishing period (Figure 5). The catches were in 14 cases from 338 to 1,077 smolts in the lower fyke net with 11 of them between 400 and 800. The average volume of flow was in four cases from 1,110 and 1,330 l/sec. and the average annual catch 138 smolts. The volume of flow fluctuated considerably during the fishing periods these years. In one case was the volume of flow 2,170 l/sec. and the catch was 582 smolts.

Smolt production

An assessment was made of smolt production in the Ölfarsá. Fin clipped smolts caught in the lower fyke net during 13 fishing periods and ranging in numbers from 401 to 799, totalled 7,283. The sum of reported angling catches of adult salmon in the Ölfarsá in the years following the ones of marking was 2,563. Of these, 317 were fin clipped. By applying the Petersen's estimate the outcome for the average smolt

production in the Ölfarsá for these years was 5,895 smolts.

Rate of passage of smolts

An example of the rate of passage of hatchery reared smolts was made available when 629 tagged smolts were liberated into the Ölfarsá on 29 May 1967 in two lots. One lot of 319 smolts was released near the top of the Ölfarsá about 10 km upstream from the estuary and the other one of 310 smolts below the dam in the river about 4 km upstream from the estuary. Three smolts from the lot released at the top of the river were caught in the upper fyke net, one after one day, one after 12 days and the third one after 23 days. The dam on the river has possibly slowed down the seaward migration of two of the smolts. It is most likely that the smolt caught one day after being released has mistakenly been liberated with the lot released below the dam. Of the other lot 21 smolts (6.8%) were caught in the upper fyke net 2.2 km downstream from the place of release, 9 after one day, 10 after two days and one each after four and five days. One of the tagged smolts caught in the upper fyke net turned up in the lower fyke net two days later.

Discussion

The lack of suitable external tags for using on salmon smolts at the onset of the marking and tagging program started in 1947 was the reason why fin clipping was resorted to in the program, and this method was kept up until the end of it, since it gave better returns than tagging. The majority of the smolts was too small to carry the tags in use. The fin clipping method has its shortcomings since the missing fins on adult salmon may pass the anglers unnoticed, in spite of much effort calling their attention to the marking and tagging program and requesting their assistance by reporting salmon with missing fins or tags. Thus it is to be expected that the returns reported were somewhat lower than they had actually been.

The average return of 4.7 % of fin clipped smolts in the Ölfarsá from 1947 to 1970 was compared with 8 years of tag

returns at the nearby river, the Ellidaár, from 1975, 1985 and 1988 to 1993. The returns there were from 5.4 to 20.8 %, six of the years from 8.1 to 12.7 %. The figures acquired at the Ellidaár included all the adult salmon runs, while the figures from the Úlfarsá were based on anglers catches. The smolts in the Ellidaár were tagged by micro-tags and attendants monitored anglers catches daily for tags. This ensured good returns of tagged fish in the Ellidaár. The annual catches of the total runs for the above mentioned eight years in the Ellidaár were from 34 to 49 % (Antonsson and Guðjónsson, 1994a).

The average annual smolt length in the Úlfarsá was most often between 12 and 13 cm when measured arbitrarily, its length range being 9 to 19 cm. In the Ellidaár the average smolt length was in three of the eight years mentioned above within 12.5 to 13 cm and four times within 13.2 to 13.9 cm, its length range being 9 to 19.5 cm (Ísaksson et al., 1978 and Antonsson og Guðjónsson, 1989, 1990, 1991, 1992a, 1993a, 1994a and 1995). For comparision, the average length of smolts from three other rivers was available. The average smolt length in the river Bugda in southwest Iceland for 1982, 1983 and 1985 was 13.8, 13.9 and 15.9 cm repectively, the length range being 10.1 to 18.8 cm. These smolts had as juveniles been feeding in Lake Medalfellsvatn and at the top of the Bugda (Einarsson, 1986 and Einarsson et al., 1990). In the Núpsá in northwest Iceland the average annual length of smolts for the years 1987 to 1991 was from 12.7 to 13 cm, the smolt length being mainly between 11 and 15 cm (Tómasson, n.d.). The average smolt length for the Vesturdalsá in northeast Iceland was 12.4, 11.9 and 11.6 cm in the years 1989, 1991 and 1992 respectively, the length range being from 8.5 to 20 cm. (Antonsson, 1990 and Antonsson og Guðjónsson, 1992b, 1993b).

A paper dealing with the time of seaward migration of salmon smolts in the Úlfarsá and the four other rivers mentioned above is being presented at the 1995 meeting of the Anacat Committee; comments on the subject are offered in that paper (Antonsson et al., 1995).

The annual smolt catches in the fyke nets in the Úlfarsá

aried considerably, the number of smolts caught in the lower fyke net being from 27 in 1962 to 1,077 in 1960, as mentioned previously (Table 1). Great fluctuations have also been experienced in smolt catches in a Wolf grid-type trap employed in the Ellidaár, where during the period between 1988 and 1994 the catches varied from 352 smolts in 1989 to 3,569 in 1988 (Antonsson og Guðjónsson, 1989, 1990, 1991, 1992a, 1993a, 1994a, 1995).

Attempts were made to estimate smolt production in the Úlfarsá the results being near to 6,000 smolts. This falls close to the estimate of ca. 6,000 made by Tómasson (1975). The estimated annual smolt production in the Ellidaár from 1989 to 1994 was from 18,000 to 27,500 (Antonsson og Guðjónsson, 1995).

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FIGURE 1. ÚLFARSÁ RIVER SYSTEM

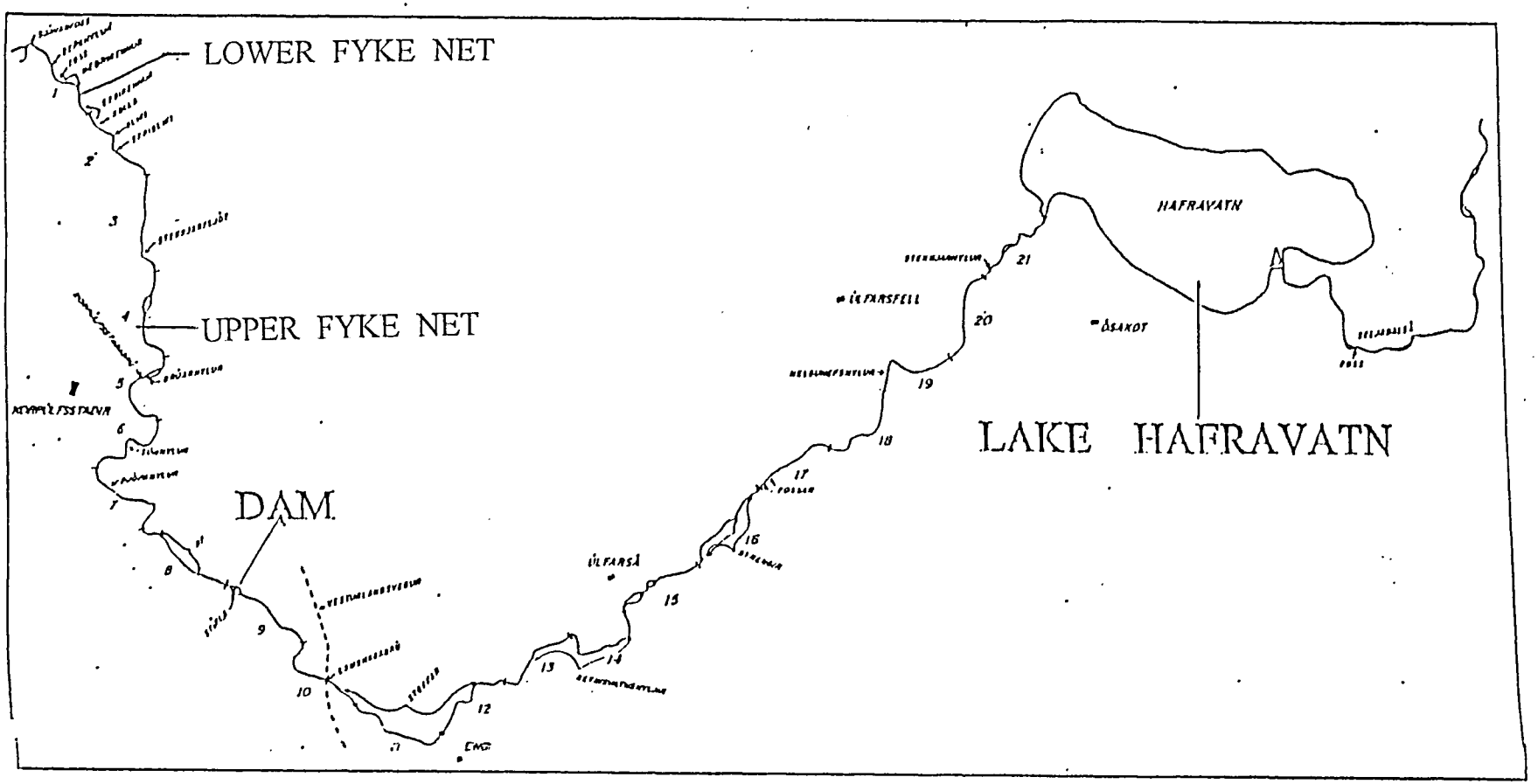

Table 1. Marked and tagged Atlantic salmon smolts caught in two fyke nets in the river Ölfarsá from 1947 to 1970 and returns of adult salmon

Year	Marked		Tagged	Total	Returns			
					Marked		Tagged	
1947	401		-	401	38	9,5%	-	
1948	297		118	415	5	1,7%	1	0,8%
1949	-		61	61	-	-	-	-
1950	100		4	104	1	1,0%	-	-
1951	43		-	43	2	4,6%	-	-
1952	582		-	582	19	3,3%	-	-
1953	547		-	547	16	2,9%	-	-
1954	799		-	799	60	7,5%	-	-
1955	113		-	113	4	3,5%	-	-
1956	576		177	753	17	3,0%	-	-
1957	14		203	217	3	21,4%	2	1,0%
1958	491		38	529	32	6,5%	-	-
1959	470		121	591	4	0,9%	-	-
1960	946		131	1077	29	3,1%	1	0,8%
1961	275		63	338	15	5,5%	1	1,6%
1962	3		24	27	-	-	-	-
1963	474		63	537	11	2,3%	2	3,2%
1964	704		63	767	33	4,7%	1	1,6%
1965	42		7	49	2	4,8%	-	-
1966	649	(620)	83	732	14	2,3%	3	3,6%
1967	1312	(1229)	154	1466	94	7,6%	3	1,9%
1968	701	(675)	60	761	35	5,2%	2	3,4%
1969	766	(764)	15	781	45	5,9%	-	-
1970	245	(241)	16	261	9	3,7%	1	6,3%
	10550		1401	11951	488		17	
		10406			4,7%		1,2%	

In all, 10,550 smolts, caught in two fyke nets, were marked (fin clipped). Of these, 144 smolts, caught in the upper fyke net, were recaught in the lower fyke net and tagged there with Carlin fish tags. These are subtracted from the 10,550 smolts when the percentage of returns is calculated.

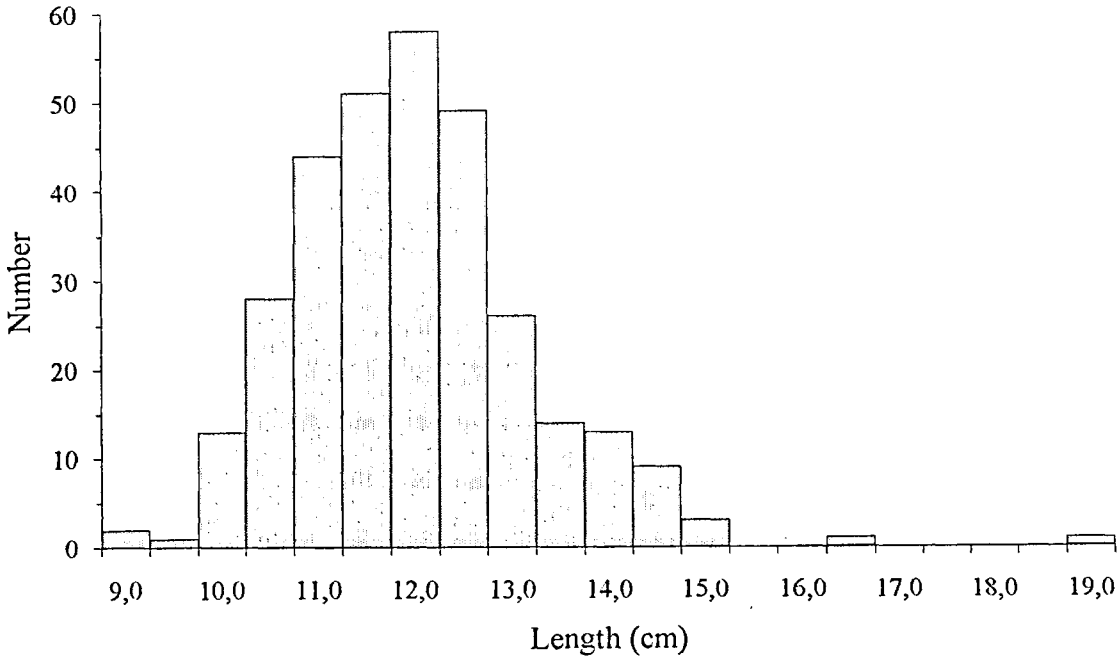

Figure 2. Length frequency of 313 Atlantic salmon smolts caught in the lower fyke net on their seaward migration in the Úlfarsá 1952, average length being 11.3 cm.

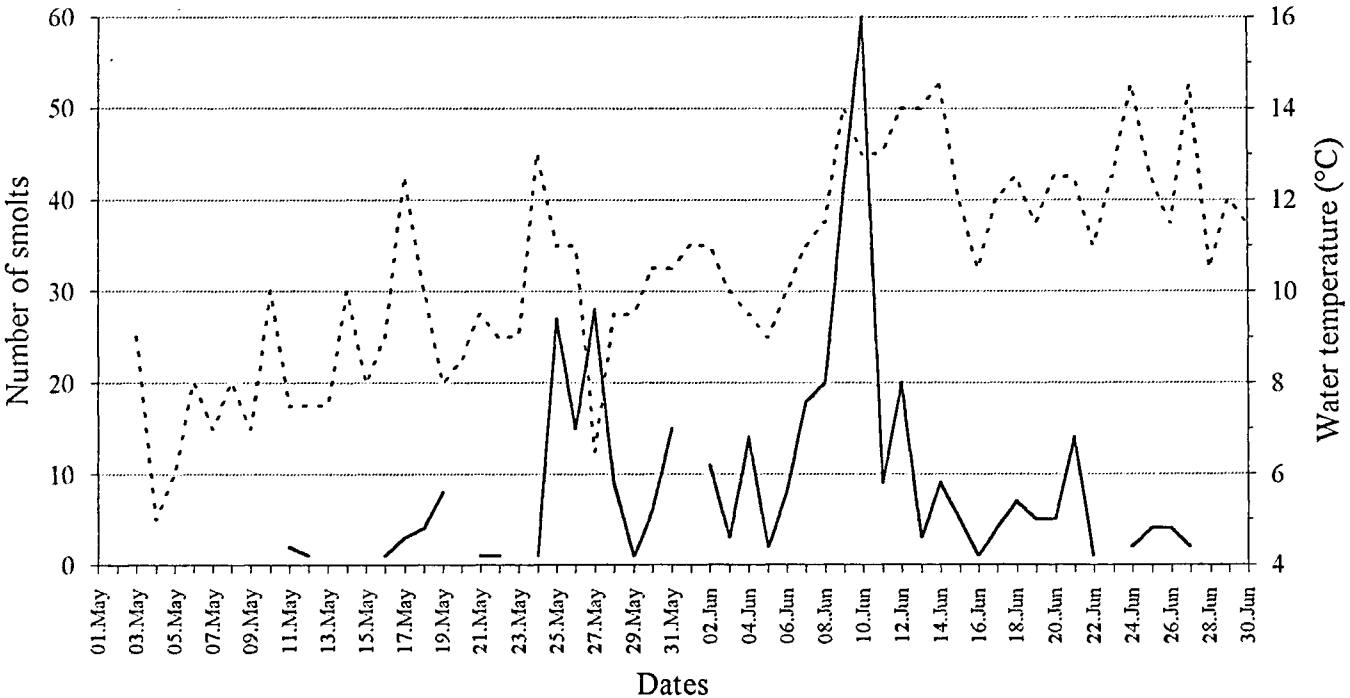

Figure 3. Daily catches of Atlantic salmon smolts in 1947 caught in the lower fyke net in the Úlfarsá (solid line) and the daily river water temperature measured in the morning (broken line).

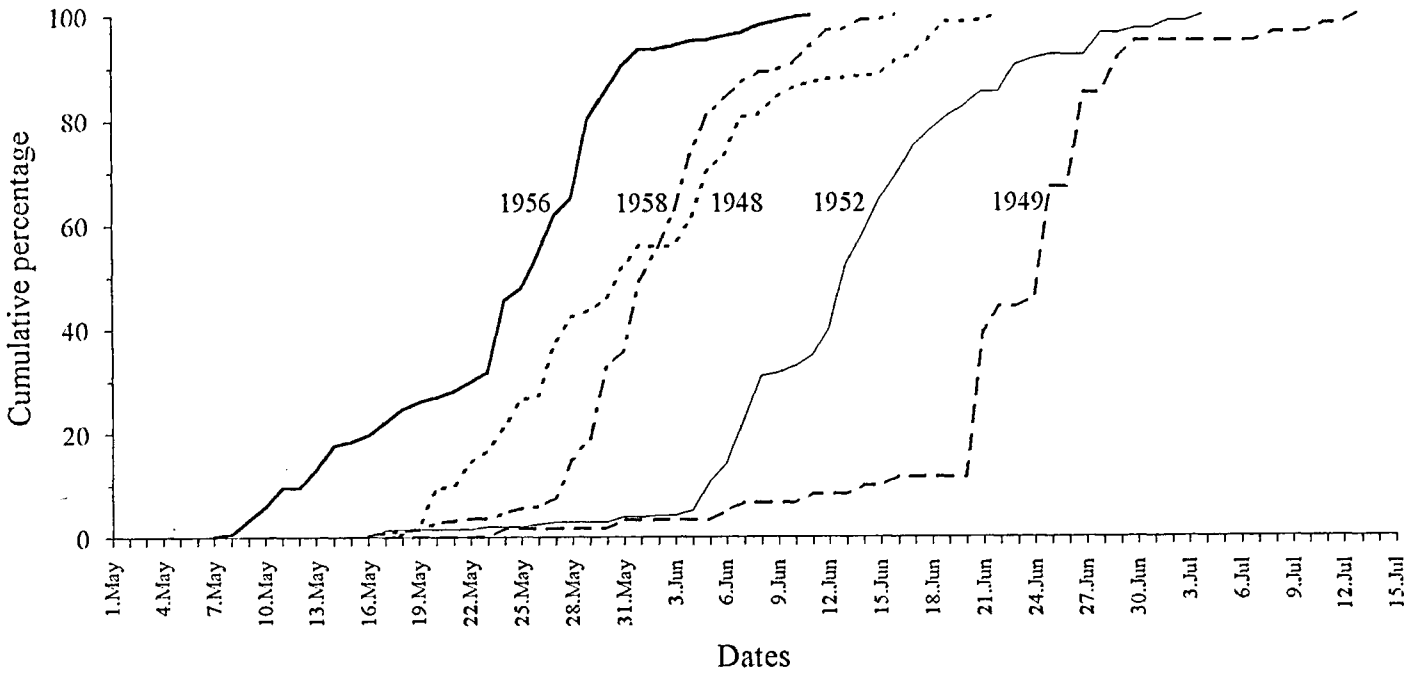

Figure 4. Cumulative capture of descending Atlantic salmon smolts caught in the lower fyke net in the Úlfarsá in 1948 (N=415), 1949 (N=61), 1952 (N=582), 1956 (N=753) and 1958 (N=529).

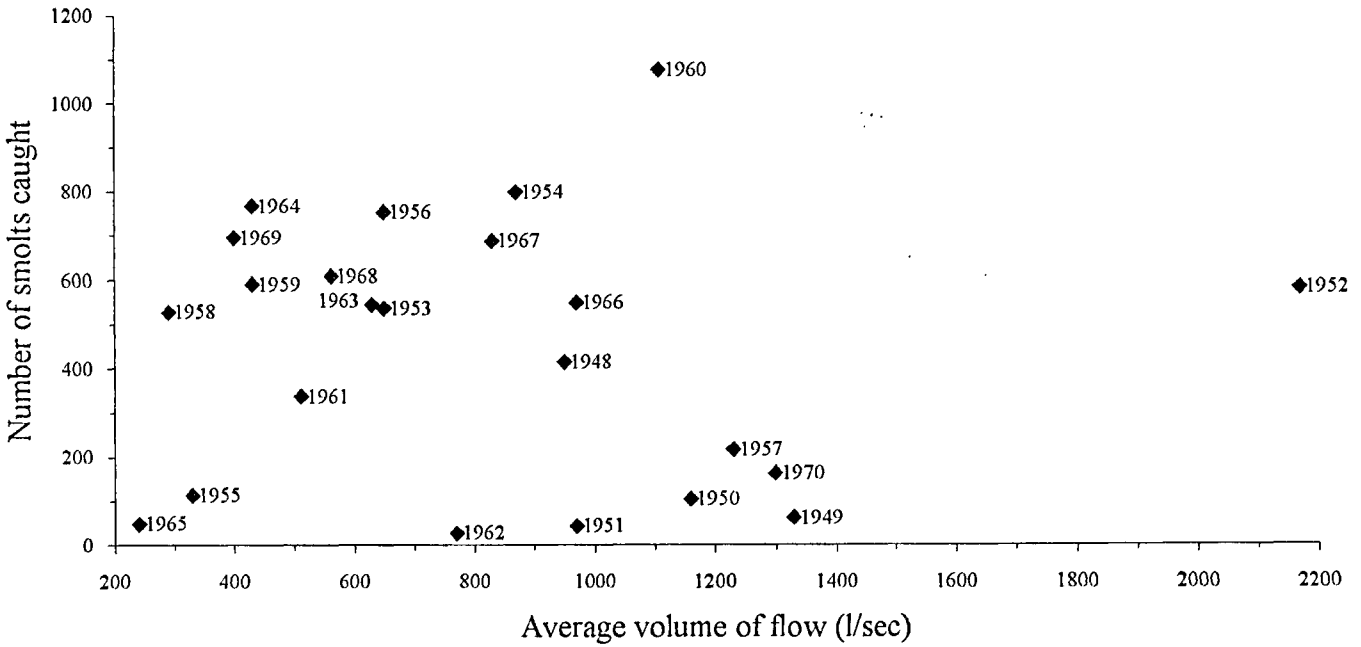

Figure 5. The annual catches of Atlantic salmon smolts in the lower fyke net in the Úlfarsá and the average volume of flow during the smolt fishing periods.