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**Status of the Atlantic salmon population of
Conne River, Newfoundland, in 1991**

by

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Abstract

Results obtained from a fish counting fence provided the basis for the assessment of the Conne River Atlantic salmon stock in 1991. Returns to home waters (river and estuary) were 2402 salmon < 63 cm in length and 89 salmon > 63 cm in size. This represented a decrease by 55% for small salmon and 76% for large salmon from 1990. Sea survival was estimated to be only 4.0% (3.7-4.3%), a drop of 43% from the previous year. Estimated egg deposition from small and large salmon was 3.981×10^6 eggs; only 51% of the target requirement. A simulation analysis was used to derive an 'average' estimate of past returns for the period 1976-85 relative to the current target requirement of 4000 fish. Results indicated that on average, target requirements were met or exceeded. A mark-recapture study suggested a smolt run in 1991 of 77628 (64723-90533). Using a simulation approach, expected returns of 1SW salmon in 1992 could be 5529 (3500 - 7244) salmon with a high probability that returns in 1992 should be higher than those observed in 1990 and 1991.

Résumé

L'évaluation de la population de saumons de l'Atlantique dans la rivière Conne (T.-N.) en 1991 est fondée sur les résultats obtenus à un barrage de dénombrement du poisson. Quelque 2 402 saumons < 63cm et 89 saumons \geq 63 cm ont remonté dans les eaux d'origine (rivière et estuaire). Les montaisons étaient inférieures, de 55 % dans le cas du petit saumon et de 76 % dans celui du gros saumon, à celles de 1990. Le taux de survie en mer n'atteignait que 4,0 % (3,7-4,3 %), ce qui représente une baisse de 43 % par rapport à l'année précédente. La ponte estimée des petits et des gros saumons était de $3,981 \times 10^6$ oeufs, soit 51 % de la cible (7,8 millions d'oeufs) seulement. Au moyen d'analyses en simulation, on a établi une estimation «moyenne» des remontées antérieures (1976-1985) par rapport à la cible actuelle, qui est de 4 000 poissons. Les résultats ont révélé que la cible a été atteinte ou dépassée en moyenne. D'après une expérience de marquage-recapture 77 628 saumoneaux (64 723-90 533) ont remonté la rivière en 1991. On a déterminé, par simulation, que les montaisons de saumons unibermarins pourraient être de 5 529 (3 500 - 7 244) poissons en 1992 et qu'il était fort probable que les montaisons totales soient supérieures à celles de 1990 et 1991.

Introduction

Conne River, SFA 11 (Fig. 1) flows into Bay D'Espoir on the south coast of insular Newfoundland. It is a sixth-order river with a drainage area of 602 km² and a total length of 193 km. Since 1986, a fish counting fence has been operated to enumerate the upstream migrating population of Atlantic salmon. Mark-recapture studies were initiated in 1987 to survey the number of migrating smolts. Both of these operations continued in 1991. This paper summarizes returns of adult salmon to Conne River in 1991 and provides a forecast of one-sea-winter (1SW) returns for 1992 using a simulation approach. An estimate of past returns to Conne River (1976-85) relative to the current target spawning requirement is also reviewed.

Background

As in past years, Atlantic salmon stocks of the Conne River potentially could contribute to commercial, recreational, and native food fisheries during 1991. The opening and closing dates for these fisheries are summarized in Table 1. A commercial quota of 25 t remained in effect for SFA 11 in 1991. A major change to the management plan for Conne River in 1991 was the introduction of a recreational fishery quota of 100 small salmon. This was based on a predicted low return of adult salmon for that year. Restrictions to native food fisheries were as in past years: 1) a total quota of 1200 salmon; 2) fishing was restricted to the Conne River estuary and the use of two trap nets or a combination of one trap net and two gillnets; 3) mesh size of the gillnets was restricted to 127 mm or larger; 4) maximum weekly harvest levels were 200 fish from June 3-9, 400 fish from June 10-23, with the remainder of the quota during the other weeks of the fishery. The food fishery was allowed to open June 3, 1991. Both recreational and food fisheries were prohibited from retaining salmon > 63 cm, although salmon of this size found dead in the food fishery gear could be retained and counted against the quota.

Methods

1. Landings in 1991

Data on landings in the recreational fishery were collected by Department of Fisheries and Oceans (DFO) Fisheries Officers and guardians and processed by DFO Science Branch personnel. Estimates of the recreational catch below the fish counting fence (first allowed in 1989) were obtained from Science Branch staff operating the fish counting fence. Landings in the native food fishery were obtained from the Conne River Native Band Council. Commercial landings for Statistical Section 36 of SFA 11 were obtained from Fisheries Statistics and Systems Branch of DFO.

2. Biological characteristics

Biological characteristic information on adult salmon, including fork length, whole weight, age and sex, was obtained from sampling salmon caught in the recreational fishery. Additional data were also obtained from sampling fish at the fish counting fence (N = 11). Biological data from Atlantic salmon

smolts were obtained from specimens sampled at the downstream counting trap. Comparisons of the river age distribution of smolts in year i with grilse in year $i+1$ were carried out using likelihood ratio statistics (G^2 - test). Analyses of smolt condition factor, whole weight, and fork length were performed on rank transformed data (Conover 1980; Conover and Iman 1981).

3. Estimated returns and spawning escapement

Adult Atlantic salmon migrants were enumerated at a fish counting fence, located about 1 km upstream from the mouth of the Conne River (Fig. 1), which operated from May 26 to August 18, 1991 (Table 2). Total returns (TR) were estimated from:

$$TR = Fc + Mb + Rb + Cn$$

where, Fc is the count of fish at the counting fence
 Mb is the known mortalities below the counting fence
 Rb is the estimated recreational catch below the fence
 Cn is the estimated number of Conne River origin salmon caught in the native food fishery.

Spawning escapement (SE) was estimated as:

$$SE = Fr - Ma - Ra$$

where, Fr is the number of fish released at the counting fence
 Ma is the known number of mortalities above the fence
 Ra is the estimated recreational catch above the fence.

In past years, an estimate of unrecorded mortalities, which could include natural mortality in the river prior to spawning and illegal removals, were incorporated into the process of determining virtual egg deposition. This value was 5% of the number of fish released from the fence. CAFSAC has decided that this is not appropriate and recommended expressing only the 'potential' egg deposition relative to the target. For this reason, estimates of egg deposition for previous years have been revised upwards by a small amount. As in past years, egg deposition was calculated separately for salmon < 63 cm and salmon ≥ 63 cm and then totaled.

Egg deposition = spawners x % female x fecundity at size.

An estimate of fecundity was obtained from the relationship derived in 1987 (October 27-30) from ripe salmon (Dempson et al. 1987):

$$\text{Fecundity} = 0.1988(\text{fork length, cm})^{2.3942} \quad (r^2 = 0.48, P < 0.001)$$

where length is the mean length of female salmon < 63 cm in size sampled in 1991.

An estimate of the egg deposition from salmon ≥ 63 cm in size was obtained using the same length-fecundity relationship for salmon < 63 cm, with the same data for mean length (67.8 cm) and percent females (71%) as used in past years (Dempson 1989, 1990).

The target spawning requirements were the same as in past years at 7.8 million eggs, equivalent to about 4000 salmon < 63 cm in size.

4. Historical spawning escapements in Conne River

In order to evaluate past escapements relative to the current target spawning requirement of 4000 1SW fish, a retrospective approach was applied to determine what escapements there may have been in the years prior to the installation of the fish counting fence in 1986. Angling catches for the 10 year period 1976-1985 were chosen. Average number of rod-days fishing effort for this period was 4523 in contrast with the more recent period (1986-1990) of 4735 rod-days. Average catch, however, was 2184 from 1976-85 while only 1400 from 1986-90. From the fence operations on Conne River (1986-1990), estimates of angling exploitation rate have been obtained and found to vary from 0.181 to 0.285 (Dempson 1990).

Using these exploitation rates in a simulation model, an estimate of the average number spawners could be obtained and expressed as a proportion of the current target number of fish required. Exploitation rates were drawn randomly from a uniform distribution between 0.181 and 0.285 and applied to the recorded angling catches from 1976-1985. Numbers of spawners were then calculated by subtracting out the angling catch. The estimated spawning escapement was then expressed as a proportion of the 4000 1SW fish target. This procedure was repeated 1000 times to generate a distribution of the average estimated escapement for the period 1976-1985 as a proportion of current target.

5. Forecast of 1992 returns

A mark-recapture study was carried out to estimate the smolt production in 1991. The study was similar to those carried out in 1987-90, the design of which is summarized in Dempson and Stansbury (1991).

During 1991, 2753 smolts were tagged and released at the upstream partial counting fence site (Fig. 1). At the downstream recapture site, 9486 smolts were caught including 398 tagged smolts. From the estimate of the number of smolts obtained, a forecast of 1SW returns in 1992 was derived using a simulation approach. The simulation approach incorporates into the forecast the uncertainty in the number of smolts migrating in 1991, and in the smolt to adult survival rates as derived during the past four years. The approach to forecast 1992 returns was as follows:

- estimate the smolt to adult survival rate where the number of smolts are drawn randomly from a normal distribution using data from the smolt mark-recapture estimate from the past four years (1987/88 to 1990/91);
- apply the survival rate from above to the 1991 mark-recapture estimate of the number of smolts which is also drawn randomly from a normal distribution;

- repeat the above steps a large number of times (say 5000) and generate a distribution of expected 1SW returns for 1992.

Results and Discussion

1. Landings in 1991

Table 3 summarizes the commercial landings of small and large salmon from Statistical Section 36, SFA 11, from 1974-91. Preliminary landings in 1991 of 2.0 t of small salmon and 8.8 t of large salmon were 19% higher than in 1990; this increase was due to a 52% increase in the amount of large salmon caught. Landings, however, were still below previous 5- and 10-year means (Table 3).

Landings in the recreational fishery are summarized in Table 4 and Figure 2. Native food fishery catches are also summarized in Table 4. A total of 108 small salmon were reportedly caught in the 1991 sport fishery (quota = 100) which closed at midnight on June 28. This was the lowest catch on record. Despite the low angling catch, angling exploitation rate to June 28 was still 0.245 indicating that about one of every four fish that had returned to the river by this date was removed by the sport fishery. The native food fishery reported a catch of 281 small salmon and 3 large salmon (72% female, N=275), and similarly was the lowest catch recorded apart from 1987 when the fishing gear was inoperable for most of the fishing season.

2. Biological characteristics

Biological characteristic information was obtained from 246 smolts and 39 1SW fish during 1991. Six previous spawners were also sampled (Table 5). The percentage females in both outgoing smolts and 1SW adult returns were the lowest recorded.

There were significant differences in smolt condition factor ($P = 0.0001$), whole weight ($P = 0.0001$), and fork length ($P = 0.0001$) among years with contrasts indicating that all three variables in 1991 were significantly different in comparison with the average of the other years. As observed last year, the river age distribution of smolts in 1990 was similar to that of the returning grilse in 1991 ($G^2 = 3.27$, $P = 0.35$)

3. Estimated returns and spawning escapement

There were 2086 salmon < 63 cm and 87 salmon > 63 cm counted at the fish counting fence on Conne River in 1991 (Table 6). This represents a decrease of 52% in the number of small salmon and 76% in the number of large salmon in comparison with 1990. Peak run of salmon was in standard week 27 (July 2-8) with the single largest daily run on July 5 (190 fish; Fig. 3). In past years over 1000 salmon have been counted passing through the fence on some days. Figure 4 illustrates the run timing of small salmon to the Conne River counting fence for 1986-91. The median and 25th. and 75th. percentiles of the run are shown and highlight the anomalous condition in 1991 with respect to the late run of fish to the fence by comparison with other years. Cooler water temperatures prevailed during the spring at Conne River in 1991 (Table 7). It is noted, however, that the median timing of the estuarine food fishery catch

in 1991 (N=284) was only about 5 days later than the average timing in past years. In general, median timing of the run to the river (=fence) is about one week later than median timing in the food fishery.

Total returns of adult salmon to Conne River (and estuary) in 1991 are summarized in Tables 8 and 9. The forecast of returns to Conne River in 1991 were expected to be low (Table 10) based on the lower smolt run in 1990. Actual returns, however, were lower than forecast and indicated that sea survival of smolts decreased to only 4% (3.7-4.3%) in contrast with earlier values of 7- to 10% (Table 11).

In past years (Dempson 1990) it was observed that there was a differential survival between age 3+ and 4+ smolts with the younger smolts having the higher survival rate. While this was not apparent in 1990, it did occur again in 1991 (Table 12). The reasons for this are not clear at this time.

Spawning escapement in 1991 was estimated to be 2062 small salmon and 87 large salmon, the lowest values recorded (Tables 8 and 9). Mean length of female small salmon in 1991 was 52.0 cm, which results in a mean number of eggs per female of 2552. With 70% of the run made up of female salmon, the number of eggs per fish is 1786. Estimated total number of eggs deposited were:

small salmon = 3.684 million eggs (2062 x 0.70 x 2552)

large salmon = 0.298 million eggs (87 x 0.71 x 4817)

for a total egg deposition of 3.981 million, only 51% of the current target egg requirement.

4. Historical spawning escapements in Conne River

Figure 5 illustrates the resulting distribution of the average ratio of the 4000 fish target spawning requirement that had been met over the period 1976-85 (a ratio of 1 indicates an escapement equal to the target of 4000 fish). If the exploitation rates chosen (0.181-0.285) were appropriate, then it is evident that there is a high probability that, on average for this period of time, spawning escapements of 4000 1SW fish have been met or exceeded (average of about 7383 spawners in contrast with 6273 from 1986-88).

The above exercise was repeated with exploitation rates ranging from 0.25-0.35 (about 30% higher than initial values). With these rates the conclusion remains the same. Exploitation rates of 0.35-0.45 would have been required to yield a result where the target of 4000 fish was never achieved.

5. Forecast of 1992 returns

The estimated number of smolts in 1991 was 77628 (95% confidence limit = 64723-90533) (Table 13). It was estimated that 80% of the smolts in 1991 were river age 3, the highest proportion observed over the five years that data were available. The percentage of smolts at each river age and the estimated number of smolts in each age group are summarized in Tables 13 and 14, respectively.

The distribution of expected adult returns is illustrated in Figure 6. A point estimate of the number of 1SW salmon expected to return to Conne River in 1992 is 5529 but could range from 3493-7244. As Figure 7 illustrates, there is a high probability that 1992 returns will exceed those of 1990 and 1991. Specifically, there is about an 80% chance that at least 4960 fish should return in 1992, but only a 20% probability that more than 5900 fish will come back. Again it is stressed that sea survival cannot be predicted and that should adverse environmental conditions prevail and affect survival of the 1991 smolt class, then as occurred in 1991, 1992 returns could be lower. At a sea survival of 4%, which was the value recorded in 1991, returns in 1992 could be only 2589-3621 salmon. The need to carry out in-season evaluations cannot be underestimated in order to ensure conservation targets are achieved.

In view of the anomalous oceanic environmental conditions that prevailed in 1991, a pre-season forecast of 1529 salmon surplus to requirements for 1992 (5529 - 4000 target = 1529) has been provided. This is based on the mean forecast from the simulation analysis assuming average sea survival in 1991-92. In-season assessment of the returning numbers of salmon should be used to update advice if necessary.

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Table 1. Opening and closing dates for 1991 Atlantic salmon recreational, commercial (SFA 11), and native food fisheries potentially harvesting salmon of Conne River origin.

Fishery	Season
Recreational ¹	June 15 - September 2
Commercial ²	June 5 - Quota
Native Food ³	June 3 - July 31

¹River closed June 29 when quota of 100 fish was reached.

²Commercial fishery closed because of quota restriction on June 29, 1991.

³Food fishery closed on July 19, 1991.

Table 2. Summary of dates of operation for downstream smolt mark-recapture studies, and upstream adult fence counts at Conne River, Newfoundland.

Year	Smolt mark-recapture studies		Adult counting fence	
	Start	Finish	Start	Finish
1986			May 12	Sept 10
1987	April 26	June 16	May 18	Sept 8
1988	May 9	June 14	May 21	Aug 29
1989	May 9	June 15	May 20	Aug 28
1990	May 3	June 20	May 23	Aug 6
1991	May 3	June 16	May 26	Aug 18

Table 3. Commercial landings (t) of Atlantic salmon in Statistical Section 36, SFA 11, 1974-91.

Year	Small	Large	Total	Proportion small
1974	14.2	37.5	51.7	0.28
1975	22.5	24.3	46.8	0.48
1976	20.1	51.8	71.9	0.28
1977	3.3	13.0	16.3	0.20
1978	1.3	3.9	5.2	0.25
1979	3.6	8.7	12.4	0.29
1980	13.2	8.0	21.3	0.62
1981	2.9	8.7	11.7	0.25
1982	9.1	12.4	21.5	0.42
1983	5.5	7.2	12.7	0.43
1984	4.8	6.7	11.5	0.42
1985	14.8	23.9	38.7	0.38
1986	17.6	11.4	29.0	0.61
1987	7.7	8.5	16.3	0.47
1988	1.7	2.5	4.2	0.40
1989	5.5	6.1	11.7	0.47
1990	3.3	5.8	9.1	0.36
1991 ¹	2.0	8.8	10.8	0.19
Mean				
1981-90	7.3	9.3	16.6	0.42
1986-90	7.2	6.9	14.1	0.46

¹Preliminary information only for 1991.

Table 4. Atlantic salmon landings (in numbers of fish) in the sport fishery 1953-91, and in the native food fishery, 1986-91, for the Conne River.

Year	Sport fishery			Native food fishery			
	Effort rod days	Salmon		Quota	Salmon		
		<63 cm	≥63 cm		Total	<63 cm	≥63 cm
1953	445	138	26	164			
1954	134	120	23	143			
1955	99	303	37	340			
1956	308	476	36	512			
1957	413	369	23	392			
1958	610	480	55	535			
1959	555	393	18	411			
1960	89	387	0	387			
1961	644	491	0	491			
1962	769	873	11	884			
1963	855	1007	10	1017			
1964	1073	1296	25	1321			
1965	1242	983	39	1022			
1966	1436	879	43	922			
1967	1629	570	3	573			
1968	2379	1724	49	1773			
1969	2909	1751	38	1789			
1970	2909	1673	66	1739			
1971	3483	1707	33	1740			
1972	3194	2509	42	2551			
1973	3427	2139	10	2149			
1974	4033	1988	17	2005			
1975	3800	1903	17	1920			
1976	3894	1931	27	1958			
1977	3375	1665	5	1670			
1978	3122	1735	7	1742			
1979	2147	1010	0	1010			
1980	3512	2238	14	2252			
1981	5029	2691	2	2693			
1982	5268	3302	24	3326			
1983	6972	2192	21	2213			
1984	6709	2343	0	2343			
1985	5202	2729	0	2729			
1986	6038	2060	0	2060	1200	519	3 ^a 522
1987	4979	1598	0	1598	1200	18	0 18
1988	5504	1544	0	1544	1200	607	2 609
1989	4414	1036	0	1036	1200	381	1 382
1990	2740	767	0	767	1200	959 ¹	11 970
1991	679	108	0	108	1200	281	3 284
Mean							
1986-90	4735	1401					
1981-90	5286	2026					

^aDead in trap.

¹Total for 1990 does not include approximately 50 fish found dead and partially destroyed in traps.

Table 5. Summary of biological characteristic information for Atlantic salmon samples from Conne River, Newfoundland, 1986-90.

Class	Year	N	Length (mm)			Weight (g)			River Age (y)			Sex ratio %	
			Mean	SD	Min-max	Mean	SD	Min-max	Mean	SD	Min-max	N	female
smolt	1986	145	153	12.0	125-210				3.25	0.48	2-5		
	1987	271	144	16.5	106-198	29.1	9.8	11.5-73.8	3.32	0.54	2-5	270	77
	1988	328	147	15.7	102-201	32.2	10.4	12.4-78.8	3.38	0.51	3-5	327	73
	1989	288	152	21.3	98-265	35.0	14.0	9.8-123.2	3.24	0.53	2-5	288	79
	1990	271	148	21.2	100-253	30.5	13.1	10.3-122.8	3.29	0.47	2-5	271	74
	1991	246	153	19.9	104-244	33.5	13.6	12.6-112.5	3.19	0.44	2-5	245	66
1 SW	1986	357	506	23.0	440-570	1451	220.4	900-2900	3.38	0.57	2-5	356	76
	1987	372	509	23.4	430-580	1493	245.9	600-2600	3.19	0.46	2-5	326	78
	1988	267	506	26.1	440-600	1352	226.5	1000-2200	3.14	0.42	2-4	261	80
	1989	140	512	23.3	460-580	1411	201.7	1000-2000	3.18	0.50	2-5	135	79
	1990	174	508	23.4	449-575	1454	184.4	1100-2000	3.27	0.52	2-5	141	81
	1991	39	514	22.8	455-552	1364	174.7	1000-1700	3.18	0.39	3-4	33	70
2 SW	1986	1	630			2600			3.00			1	100
	1989	2	665	21.2	650-680	2700			3.50	0.71	3-4	1	100
PS	1986	2	580	28.2	560-600	2100	424.3	1800-2400	3.00			2	100
	1987	5	536	23.2	520-576	1680	277.5	1400-2100	3.00	0.71	2-4	4	100
	1988	5	556	24.1	530-590	1640	260.8	1500-2100	2.80	0.84	2-4	5	40
	1989	19	649	55.4	550-710	2163	763.3	1500-3500	3.05	0.23	2-4	8	63
	1990	3	564	51.4	505-601	-	-	-	3.33	0.58	3-4	-	-
	1991	6	624	71.4	548-720				3.50	0.55	3-4	1	100

Table 6. Weekly summary of numbers of Atlantic salmon enumerated at the counting fence on Conne River, Newfoundland, 1986-1991.

Date	Week	Number of Fish											
		Small						Large					
		1986	1987	1988	1989	1990	1991	1986	1987	1988	1989	1990	1991
May 14-20	20	0	0	0	0			2	0	0	0		
May 21-27	21	0	0	0	0	0		4	0	0	0	0	
May 28-Jun 3	22	6	2	0	3	0		14	0	0	10	0	
Jun 4-10	23	108	17	11	38	1		42	15	7	2	0	2
Jun 11-17	24	870	1905	652	946	82	44	87	294	123	85	37	9
Jun 18-24	25	2690	3713	1939	2119	569	137	160	116	119	154	110	16
Jun 25-Jul 1	26	1899	1514	2256	856	1706	234	67	38	114	31	127	16
Jul 2-8	27	612	515	730	216	115	739	7	7	16	3	44	18
Jul 9-15	28	848	1374	769	248	588	584	13	17	5	9	21	7
Jul 16-22	29	263	32	344	3	172	178	4	0	17	0	20	9
Jul 23-29	30	114	126	91	15	88	83	0	4	3	0	2	5
Jul 30-Aug 5	31	54	3	268	4	0	14	2	0	11	0	0	1
Aug 6-12	32	7	25	1	21	0	65	0	1	2	0	0	4
Aug 13-19	33	2	0	0	0	-	27 ²	0	0	0	0	-	
Aug 20-26	34	11	6	57	0	-	-	0	0	1	0	-	
Aug 27-Sep 2	35	31	38	0	0	-	-	1	0	0	0	-	
Sep 3-9	36	0	417 ¹	-	-	-	-	0	0	-	-	-	
Total		7515	9687	7118	4469	4321	2105	397	498	418	319	361	87

¹Includes estimate of 400 fish in lower part of the river at the time the counting fence was removed in 1987.

²Includes estimate of 19 fish in lower part of the river at the time the counting fence was removed in 1991.

Table 7. Summary of mean weekly water temperatures (°C) and water levels (cm) at the counting fence on Conne River, Newfoundland, 1986-1991.

Date	Week	Mean water temperature						Mean water level						
		1986	1987	1988	1989	1990	1991	1986	1987	1988	1989	1990	1991	
May 7-13	19	7.5	-	-	12.9	6.6	8.4	32.0	-	-	-	65.3		
May 14-20	20	12.3	8.3	-	11.0	9.6	7.1	26.0	44.6	-	27.5	47.5		
May 21-27	21	11.1	11.4	15.6	14.5	7.5	8.2	36.5	28.2	18.6	22.0	41.8	49.8	
May 28-Jun 3	22	11.3	13.1	12.0	14.6	12.5	9.4	39.9	15.5	25.2	46.8	26.2	40.8	
Jun 4-10	23	12.2	14.1	10.3	16.4	13.6	10.8	61.1	13.0	68.1	34.4	21.9	22.3	
Jun 11-17	24	13.4	14.5	15.1	14.3	16.4	12.8	35.2	32.5	49.8	16.7	11.9	21.8	
Jun 18-24	25	15.8	16.1	15.9	17.9	13.8	14.9	24.0	22.3	42.3	14.0	59.9	16.2	
Jun 25-Jul 1	26	15.3	16.7	15.1	19.0	17.6	17.5	22.7	17.1	51.9	12.9	42.1	8.6	
Jul 2-8	27	15.3	18.8	16.7	17.2	17.5	15.1	33.3	11.3	67.0	5.6	19.1	6.9	
Jul 9-15	28	16.0	22.1	17.8	18.4	16.9	16.9	33.4	3.1	30.4	15.8	12.3	6.1	
Jul 16-22	29	17.7	20.8	18.8	18.5	18.8	19.6	30.5	-1.0	16.7	34.1	9.1	4.9	
Jul 23-29	30	19.3	20.5	19.3	18.9	20.5	19.5	20.4	-1.6	9.4	20.7	23.6	9.4	
Jul 30-Aug 5	31	16.8	20.4	20.2	19.6	19.0	18.3	20.0	-3.0	16.6	20.1	14.1	2.1	
Aug 6-12	32	20.1	20.1	20.8	20.4	21.4	15.3	13.4	-7.4	9.3	31.6	10.0	21.4	
Aug 13-19	33	19.4	17.2	17.8	20.3	-	19.4	9.2	-8.9	3.8	30.4	-	13.6	
Aug 20-26	34	18.9	18.3	15.6	18.3	-	-	3.0	-1.6	18.7	15.9	-	-	
Aug 27-Sep 2	35	15.5	16.8	17.6	14.0	-	-	9.6	-0.5	14.0	15.0	-	-	
Sep 3-9	36	14.8	14.8	-	-	-	-	10.3	-4.3	-	-	-	-	
Average		16.0	17.8	17.1	17.0	14.7	14.2	26.0	8.5	30.2	22.7	27.8	15.2	

Table 8. Total estimated returns of small salmon to Conne River, Newfoundland, with a summary of mortalities and removals, and estimated spawning escapement, 1986-91.

	Year					
	1986	1987	1988	1989	1990	1991
<u>Returns to Conne R.</u>						
Food Fishery (estuary)*	766	451	506	317	840	234
Angling below fence				180	213	70
Mortalities below fence	21	17	3	2	3	2
Fence count	7515	9287	7118	4469	4321	2086
Estimated count		400				19
Total	8302	10155	7627	4968	5377	2411
1) Released at Fence	7515	9687	7118	4469	4321	2105
<u>Removals and mortalities</u>						
Mortalities above fence	27	21	7	4	2	5
Angling above fence	2060	1598	1544	856	554	38
Brood stock removal		245				
2) Total	2087	1864	1551	860	556	43
<u>Spawning escapement</u>						
(1) - (2)	5428	7823	5567	3609	3765	2062
<u>Egg deposition</u>						
x 10 ⁶	9.86	14.66	10.65	6.95	7.50	3.68
% of target met	126	188	137	89	96	47

* Food fishery includes fish caught in the estuary for tagging studies in 1986 and 1987. Proportions of Conne River origin fish in 1986 and 1987 were 0.792 (N=967) and 0.914 (N=493) respectively. For remaining years, the weighted mean (0.833) was used.

Table 9. Total estimated returns of large salmon to Conne River, Newfoundland, with a summary of mortalities and removals, and estimated spawning escapement, 1986-91.

	Year					
	1986	1987	1988	1989	1990	1991
<u>Returns to Conne R.</u>						
Food Fishery (estuary)*	14	18	2	1	11	2
Angling below fence						
Mortalities below fence	1	0	0	0	0	0
Fence count	397	498	418	319	361	87
Estimated count						
Total	412	516	420	320	372	89
1) Released at Fence	397	498	418	319	361	87
<u>Removals and mortalities</u>						
Mortalities above fence	1	0	0	0	0	0
Angling above fence	0	0	0	0	0	0
Brood stock removal		10				
2) Total	1	10	0	0	0	0
<u>Spawning escapement</u>						
(1) - (2)	396	488	418	319	361	87
<u>Egg deposition</u>						
x 10 ⁶	1.48	2.07	1.77	1.09	1.23	0.30
% of target met	19	27	23	14	16	4

* Food fishery includes fish caught in the estuary for tagging studies in 1986 and 1987. Proportions of Conne River origin fish in 1986 and 1987 were 0.792 (N=967) and 0.914 (N=493) respectively. For remaining years, the weighted mean (0.833) was used.

Table 10. Comparison of 1SW salmon forecasts in year i-1 with actual returns in year i for Conne River, Newfoundland.

	Return year				
	1988	1989	1990	1991	1992
Forecast	7900-8800	6180-6798	6824-7896	4539-5324	3500-7244
Actual return	7627	4968	5383	2410	
Return/forecast	86.7-96.5	73.1-80.4	68.2-78.9	45.3-53.1	

Table 11. Smolt to adult survival for Conne River Atlantic salmon.

	Number of smolts year i	Number of grilse year i-1	% survival	Confidence limit
1987	74585	7627	10.2	9.3-11.3
1988	68938	4968	7.2	6.6-7.9
1989	76424	5383	7.0	6.4-7.8
1990	60885	2410	4.0	3.7-4.3

Table 12. Estimates of smolt to adult survival by age class for Conne River and Northeast Brook, Trepassey, Newfoundland.

Smolt class	Age class	Conne River			Northeast Brook		
		Smolt year i	Grilse year i + 1	% survival	Smolt year i	Grilse Year i + 1	% survival
1987	3	49226	6113	12.4	368	45	12.2
1987	4	22375	1285	5.7	713	44	6.2
1988	3	43431	3691	8.5	547	33	6.0
1988	4	24818	1029	4.1	927	29	3.1
1989	3	54261	3651	6.7	376	22	5.9
1989	4	18342	1547	8.4	1158	42	3.6
1990	3	42619	1977	4.6			
1990	4	17048	433	2.5			

Table 13. Estimated size of the Conne River, Newfoundland, Atlantic salmon smolt population, 1987-91, as determined from mark-recapture studies. Mean river age, percentage of smolts at each river age and sample size are also presented.

Year	N tagged	Population estimate	95% confidence interval	Coefficient of variation	Mean river age (y)	Percent in each age group				N
						2	3	4	5	
1987	4975	74585	67597-81573	5.1	3.3	2	66	30	2	271
1988	3235	68938	62976-74900	4.6	3.4	0	63	36	1	328
1989	2699	76424	69123-83733	5.1	3.1	3	71	24	2	288
1990	3719	60885	56042-65728	4.3	3.3	1	70	28	1	271
1991	2753	77628	64723-90533	8.8	3.2	1	80	18	1	246

Previous smolt estimates based on Darroch's model were:

1987 72752
 1988 60360
 1989 78588

Table 14. Estimated total number of smolts in each age group, for Conne River, Newfoundland, 1987-91.

Year	River age (y)				Total
	2	3	4	5	
1987	1492	49226	22375	1492	74585
1988	0	43431	24818	689	68938
1989	2293	54261	18342	1528	76424
1990	609	42619	17048	609	60885
1991	776	62103	13973	776	77628

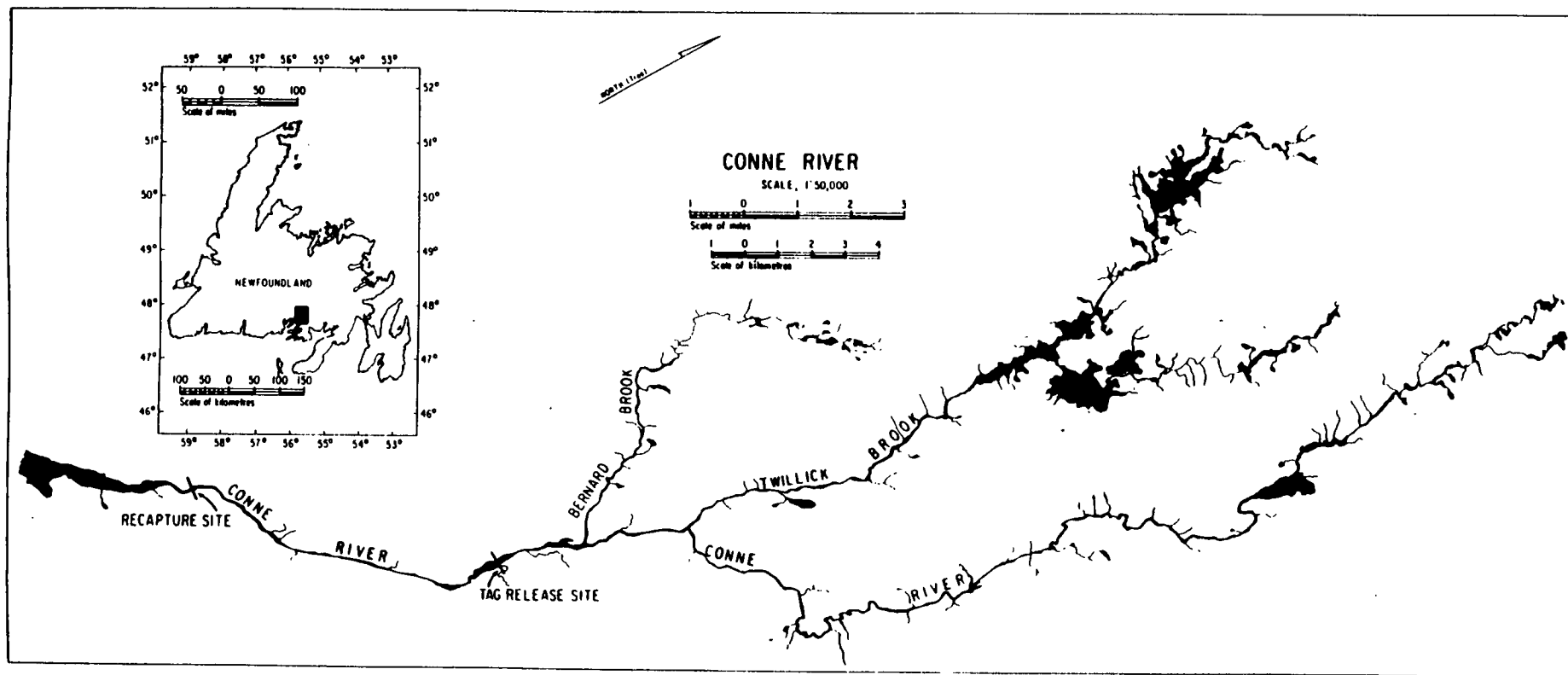


Fig. 1. Conne River, Newfoundland, SFA 11, illustrating the location of the fish counting fences used the mark-recapture survey. Recapture site is also the location of the upstream adult counting fence.

CONNE RIVER

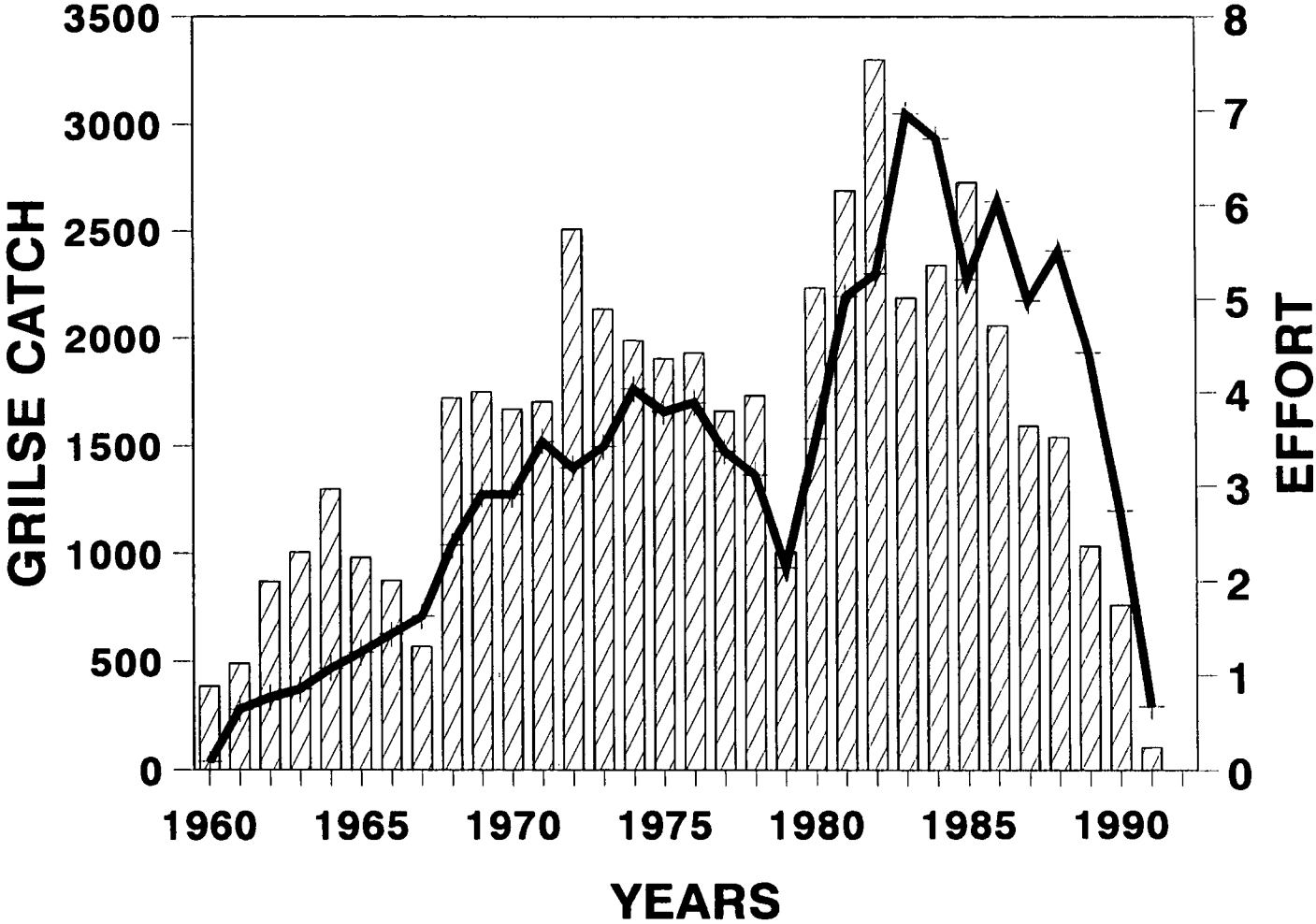


Fig. 2. Summary of the small salmon recreational catch (bars) and effort (rod-days in thousands) (line) for Conne River, Newfoundland, SFA 11, 1960-91.

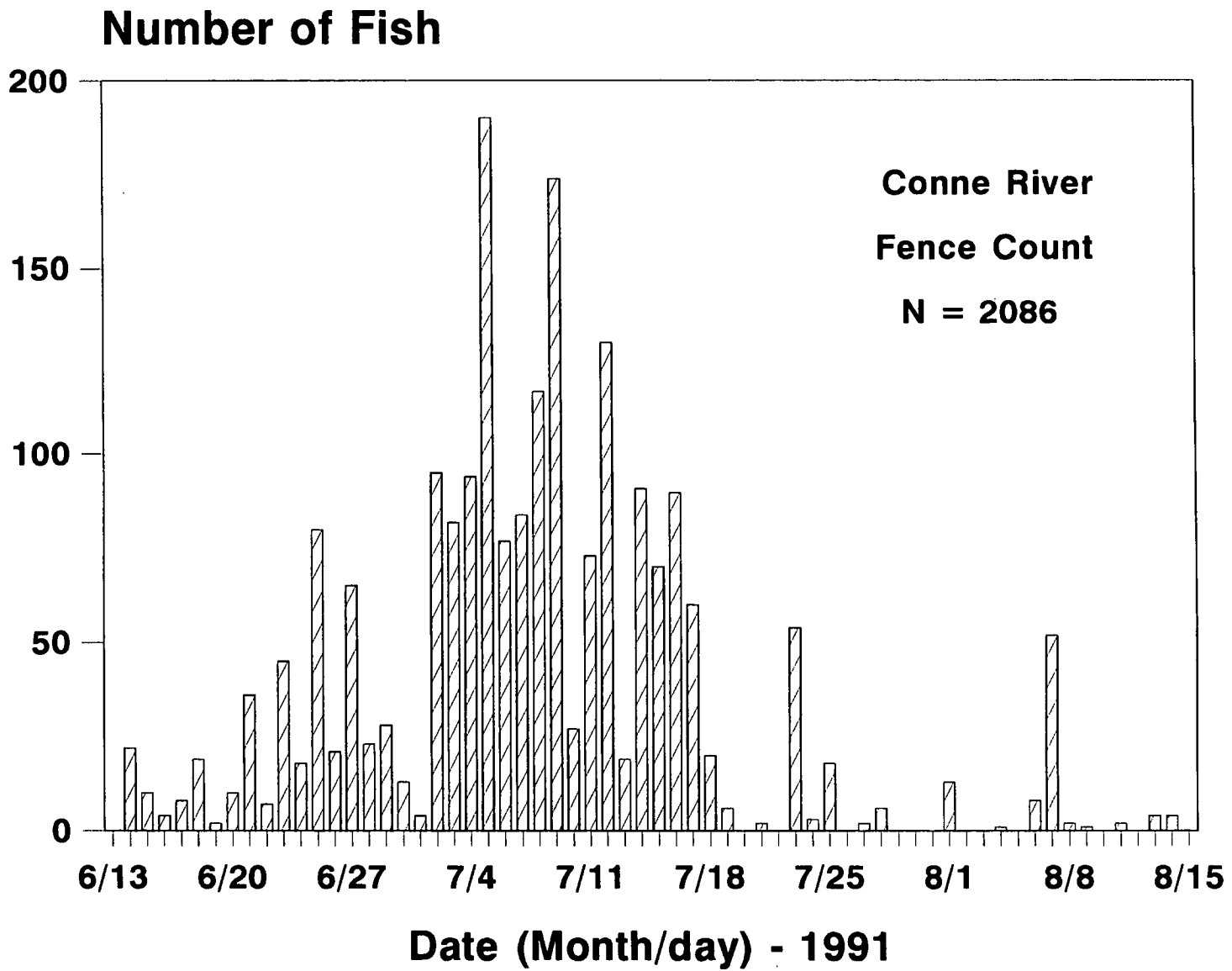


Fig. 3. Daily counts of small salmon at the fish counting fence on Conne River, 1991.

Year

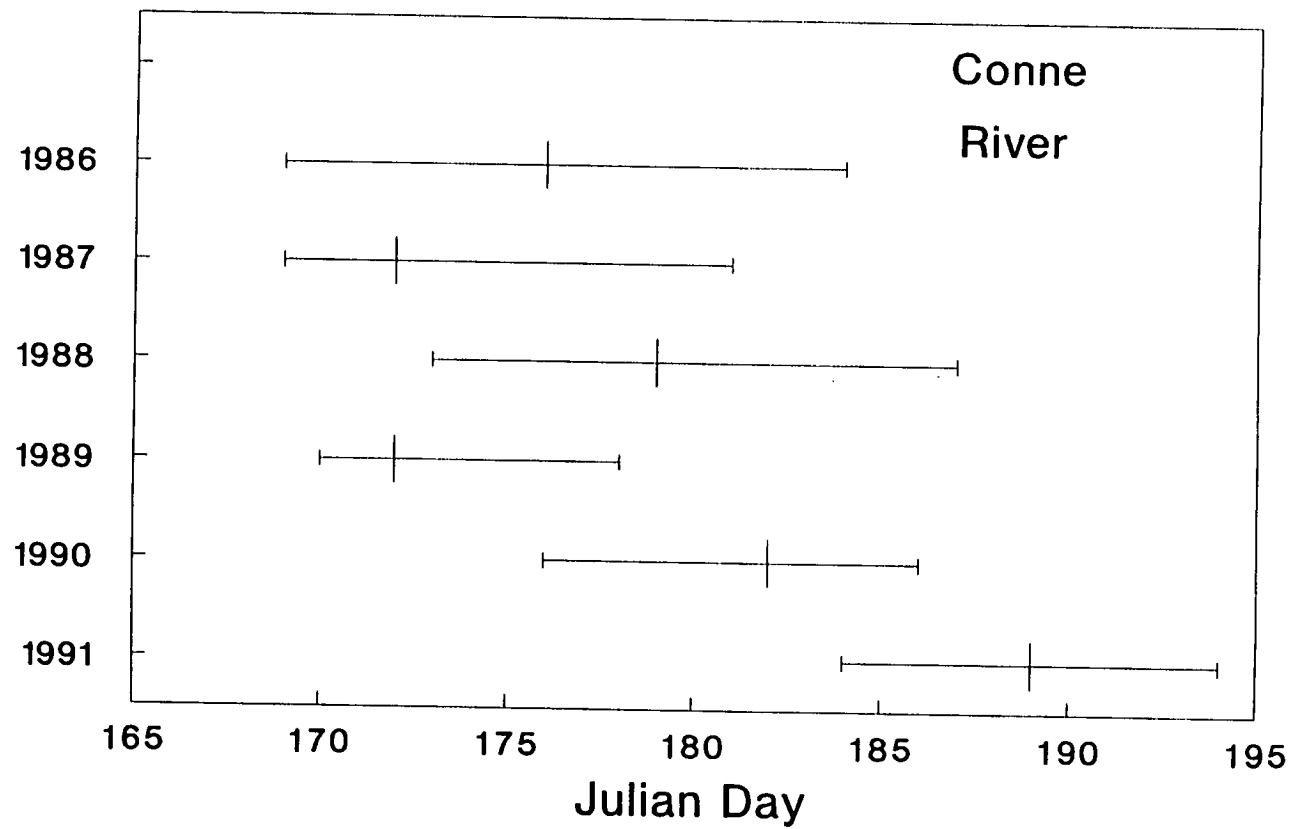


Fig. 4. Run timing of small salmon in Conne River, 1986-91. The median point, along with the 25th and 75th percentiles are illustrated.

Number of Runs

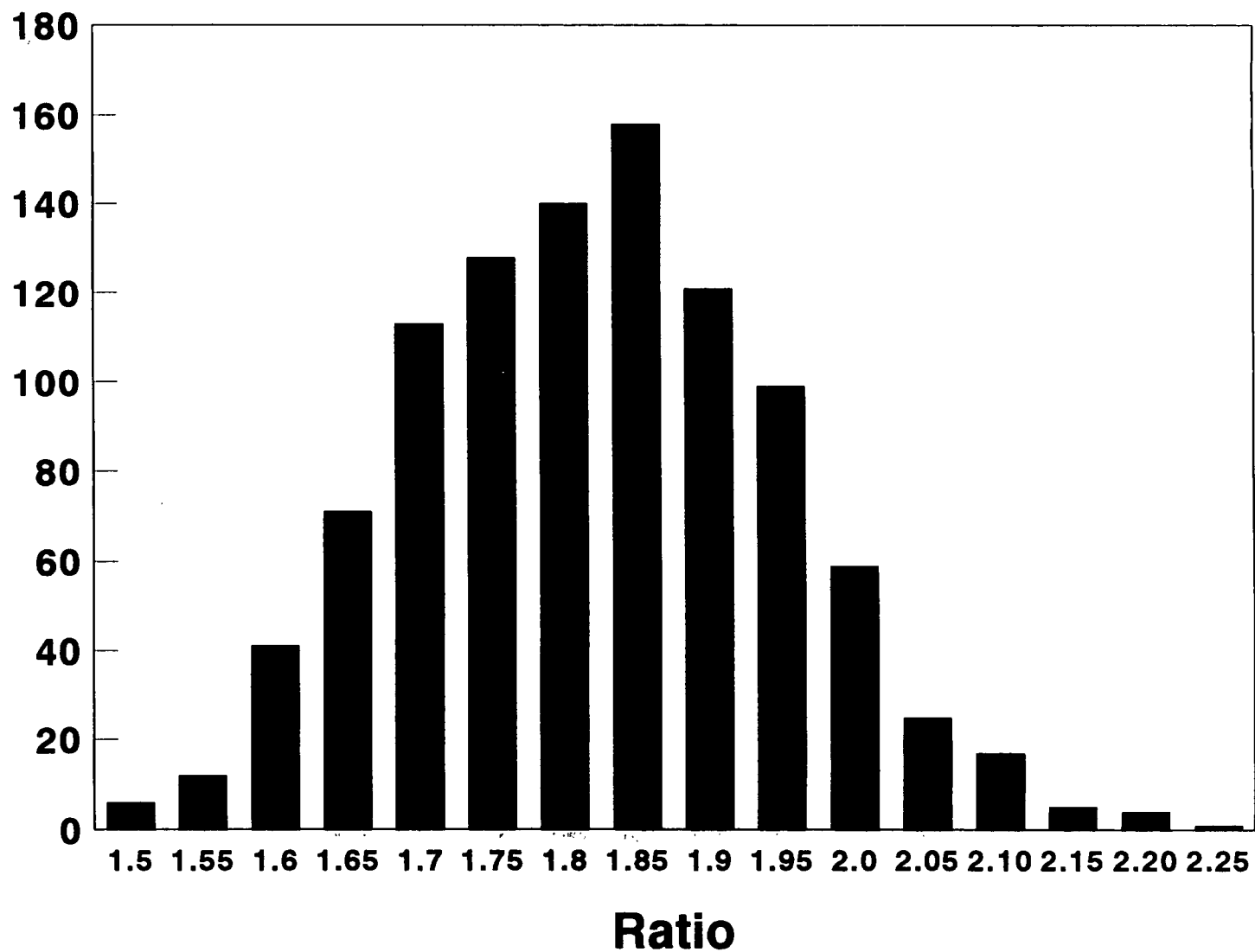


Fig. 5. Average estimated escapement of small salmon to Conne River, Newfoundland, for the period 1976-85 as a ratio of the current target requirement of 4000 fish. A ratio of 1.0 would indicate that the target was met while greater than 1.0 suggests that the target was exceeded. Escapement was estimated from exploitation rates chosen randomly from a uniform distribution between 0.181-0.285.

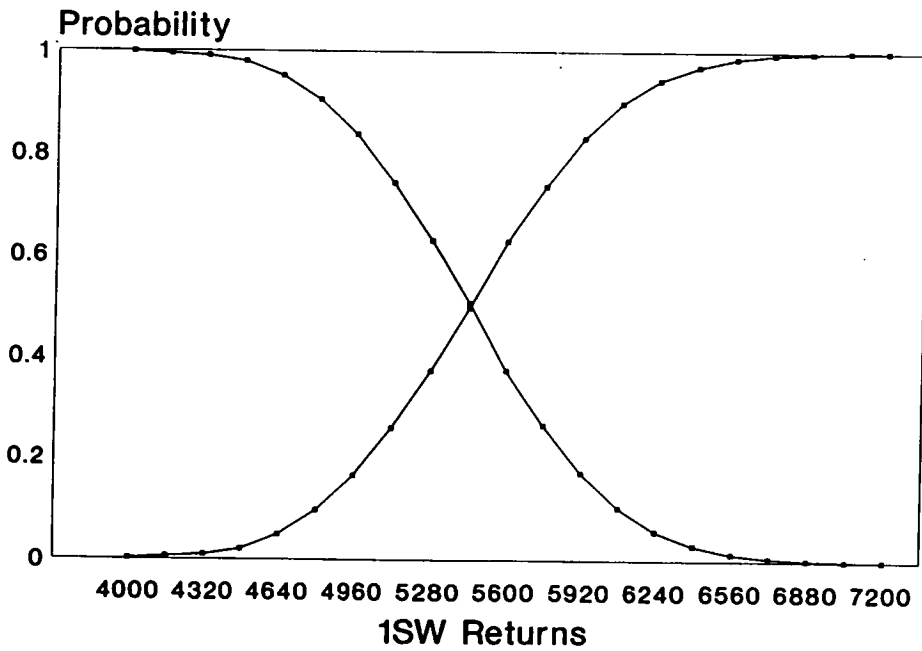
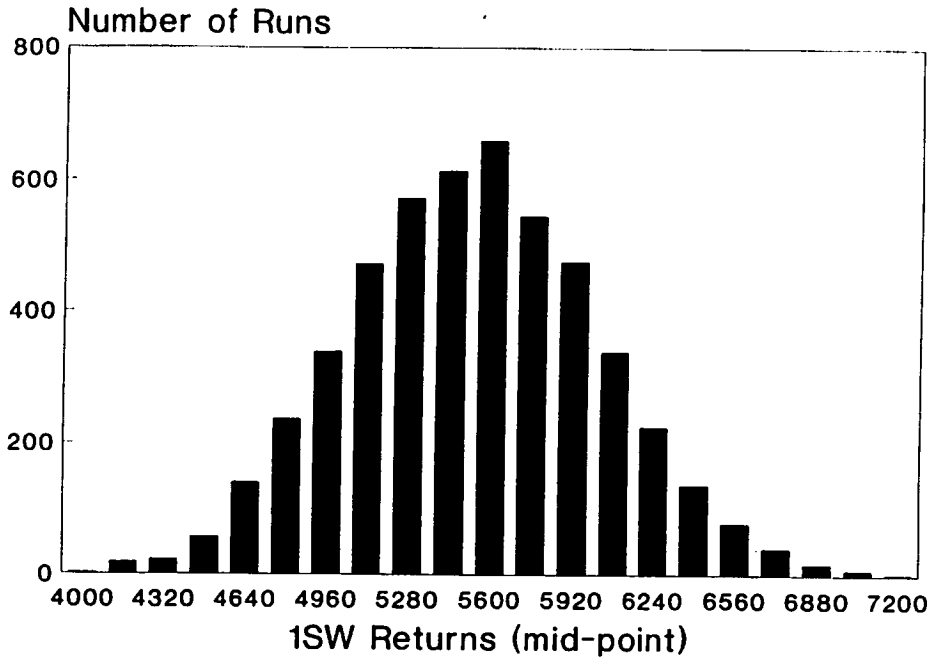


Fig. 6. Frequency distribution of estimated return of 1SW salmon to Conne River, 1992 (upper). Lower figure illustrates the cumulative probability and 1-cumulative probability of the estimated returns of 1SW salmon to Conne River.