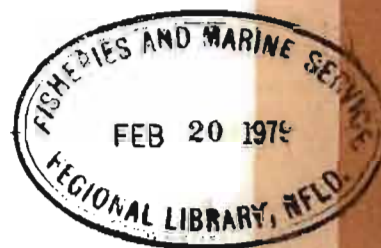


Fishway and Counting Fence Data — 1975 and 1976

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Fisheries and Marine Service

Data Report 59

May 1978

FISHWAY AND COUNTING FENCE DATA - 1975 AND 1976

by

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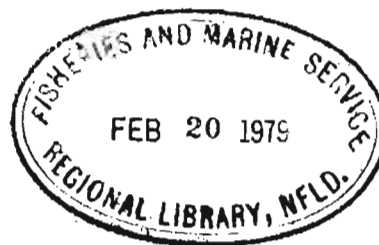
This is the second Data Report from the
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ABSTRACT

Moore, R. B. 1978. Fishway and counting fence data - 1975 and 1976.

Fish. Mar. Serv. Data Rep. 59: 64 p.

Enumerations of Atlantic salmon and other fish migrants at 9 fishways, 2 counting fences and a turbine by-pass in insular Newfoundland are tabulated weekly for 1975 and 1976. Previous yearly counts are recorded at each facility. Impact on enhancing the respective Atlantic salmon populations is also discussed.

Key words: fishway, counting fence, Atlantic salmon, enumeration, enhancement.

RÉSUMÉ

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Fish. Mar. Serv. Data Rep. 59: 64 p.

Nous donnons les résultats des dénombrements hebdomadaires de 1975 et 1976 des saumons atlantique et d'autres poissons migrateurs dans neuf passes migratoires, deux barrières de comptage et une passe d'évitement des turbines, à Terre-Neuve. Les dénombrements des années antérieures sont recueillis à chacune des installations. Nous discutons finalement de l'effet de ces installations sur l'augmentation des populations respectives du saumon atlantique.

Mots clés: passe migratoire, barrière de comptage, saumon atlantique, dénombrement, mise en valeur.

INTRODUCTION

The 1975-76 Fishway and Counting Fence Data Report is the third in a series of reports published by the Newfoundland Freshwater and Anadromous Fisheries Management Program (FAFMP). Reports from 1955 to 1973 were compiled annually by the Resource Development Branch and its predecessor (Fish Culture Development Branch), but were unpublished.

This report summarizes data obtained in 1975 and 1976 on migrations of Atlantic salmon (*Salmo salar* L.) through fishways and temporary counting fences in Newfoundland. It outlines the problems encountered in operating the facilities during these years, and attempts to assess the influence that they had on enhancing the respective Atlantic salmon populations. Details of construction and design have not been discussed. This information has been documented by Porter and Davis (1974), and Anderson and McDonald (1978).

METHODS

In 1975, nine fishways, one temporary counting fence, and one turbine by-pass facility (Fig. 1) were operated in insular Newfoundland. Six of these fishways (Northeast River, Terra Nova River (upper), Middle Brook, Indian River, Lomond River, and Torrent River) were attended and operated by fisheries guardians of the Conservation and Protection Branch. They were normally checked twice daily. The other three fishways (Bishop's Falls, Great Rattling Brook (Camp I), and Grand Falls), the turbine by-pass facility at Bishop's Falls, and the temporary counting fence at Western Arm Brook were maintained and operated by personnel from FAFMP. Manpower cutbacks in recent years have forced FAFMP to curtail monitoring two other fishways on Salmon Brook (Gander River), and lower Terra Nova River.

All fishways operated in 1975, except Middle Brook, were again operated in 1976. Enumeration at Middle Brook fishway was discontinued due to a manpower shortage, although the facility was open to the annual migration. An additional temporary counting fence was installed on Little Red Indian Brook, Exploits River.

Most fishways have wooden counting traps. The size of the counting trap is determined by the fishway design but each has a V-shaped entrance through which fish pass, are held, counted, sized, and released via a movable back door. Problems have arisen in the past in estimating the size of fish as they are not removed, weighed, or handled. To aid in estimating the size of the migrants in 1975, 62-cm sticks were placed in the bottom of traps, and fish judged to exceed this length were classed as large salmon.

The new fishway at Grand Falls, Exploits River, has an aluminum brailer basket which is used to both capture the fish and lift them into a tank vehicle for transfer into the upper watershed.

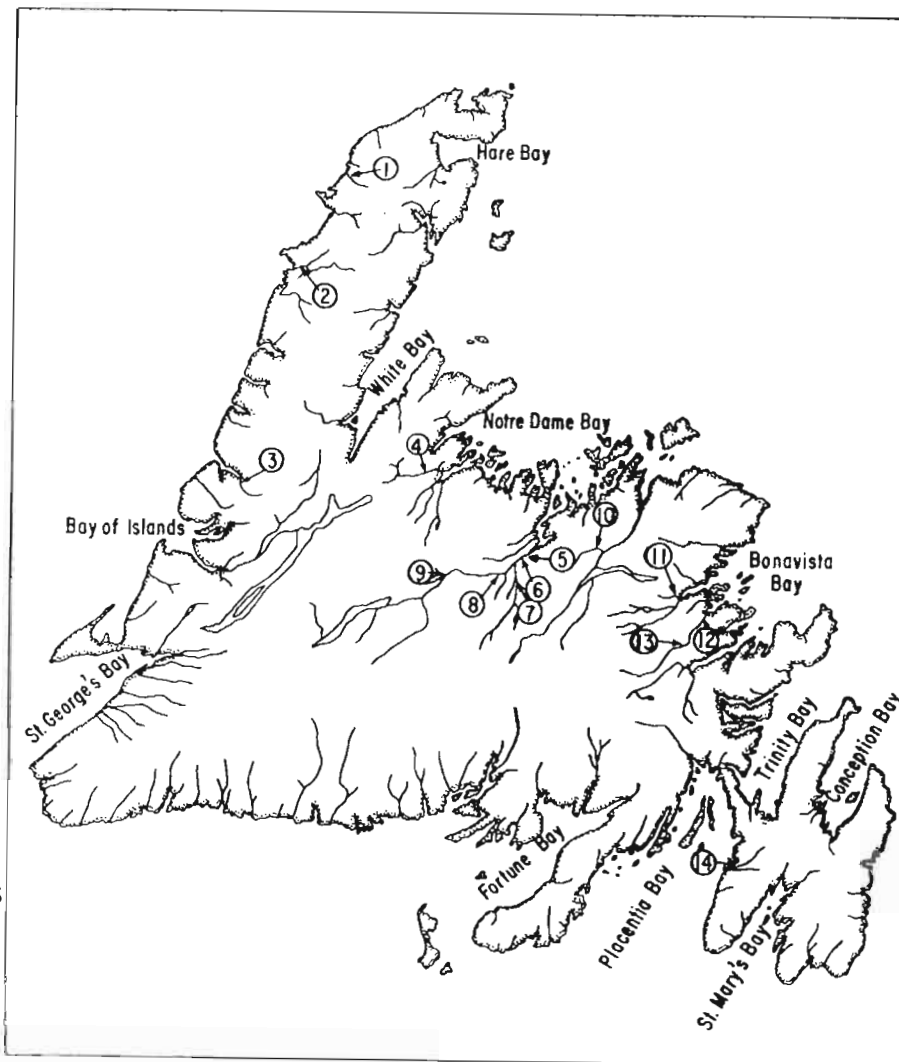


Fig. 1. Location of major fishways and counting fences in insular Newfoundland.

No.	Location	Facility	Coordinates
1	Western Arm Brook	Counting fence	51°11'24"N, 56°46'04"W
2	Torrent River	Fishway	50°36'50"N, 57°08'22"W
3	Lomond River	Fishway	49°23'17"N, 57°43'09"W
4	Indian River	Fishway	49°30'44"N, 56°06'45"W
5	Exploits River (Bishop's Falls)	Fishway	49°00'45"N, 55°28'15"W
6	Exploits River (Bishop's Falls)	Turbine by-pass	49°00'56"N, 55°28'20"W
7	Exploits River (Gt. Rattling Brook)	Fishway	48°55'33"N, 55°31'18"W
8	Exploits River (Grand Falls)	Fishway	48°55'55"N, 55°40'20"W
9	Exploits River (Lt. Red Indian Bk.)	Counting fence	48°57'25"N, 56°05'00"W
10	Gander River (Salmon Brook)	Fishway	49°00'02"N, 54°53'42"W
11	Middle Brook	Fishway	48°48'31"N, 54°13'16"W
12	Terra Nova River (Lower)	Fishway	48°36'08"N, 54°04'43"W
13	Terra Nova River (Upper)	Fishway	48°32'43"N, 54°10'48"W
14	Northeast River	Fishway	47°17'08"N, 53°47'37"W

Proper operation of fishways involves regulation of water discharge through them. There appear to be certain critical levels at which salmon most readily move into these facilities and they are maintained by stop logs at the exit. The problem of limited manpower again makes this procedure possible only at some facilities and there are indications from counting trap operators that migrants may be discouraged by insufficient discharge.

Temporary counting fences often have two or more counting traps and are under full-time surveillance. Migrants do, however, hold up at these structures and display a reluctance to enter the counting traps. The reason is unknown, although light-colored trap bottoms appear to increase the reluctance.

NORTHEAST RIVER (PLACENTIA) Fishway

The fishway on Northeast River is located at km 9.7. It is a bevel-notch weir type that was built in 1965 to provide access over a 6.7 m falls (Big Falls). It was constructed after blasting in 1955 failed to make the falls navigable to salmon. The problem was so severe that in 1963 fish had to be moved above the falls with dipnets, not only to prevent physical damage resulting from unsuccessful passage attempts, but to eliminate a serious threat from poachers attracted by a large concentration of fish.

Completion of the fishway has not entirely solved the problem at the falls however, since salmon continue to hold up in a pool at the base. This is a common fishway problem, the fish apparently preferring certain conditions of discharge, light, or temperature before moving over elevated riverbed.

Full-scale monitoring of the Northeast River fishway commenced in 1972. Partial counts of salmon migration had been previously obtained at the fishway in 1968 and at a temporary counting fence, located at km 0.8, in 1971 (Fig. 2). Operations from 1972 to 1976 were fairly successful although low water levels in 1975 forced a closure of the facility and washouts in previous years had enabled migrants to move into the upper reaches without being counted. Northeast River is noted for extremes in discharge, thus making it difficult to maintain monitoring equipment in position.

DATA

In 1975, there were 221 Atlantic salmon counted at the fishway on Northeast River of which 84% were grilse. The facility was open from 28 June to 30 October. The first adult salmon was enumerated on 9 July and the last on 13 September. The recorded peak of migration occurred from 20 to 26 July during which time 42% of the total run was counted (Table 1). Unfortunately, a hole was found at this time and a number of adults were observed by-passing the counting trap. The length of time that the hole existed is unknown so no estimate of unmonitored fish was made. Considering that the escapement occurred during peak migration, this number may be

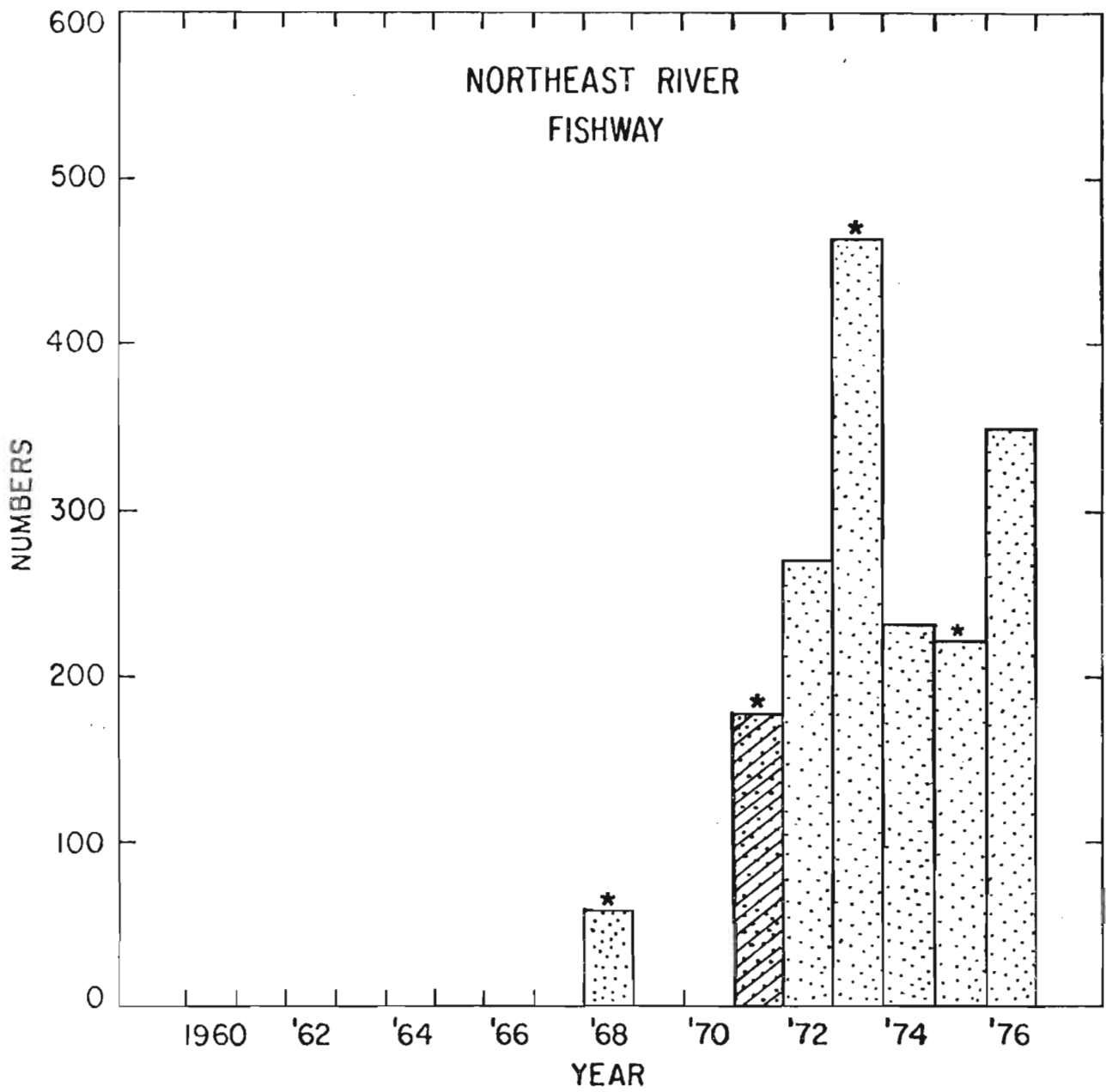


Fig. 2. Escapement of Atlantic salmon through the Northeast River fishway, 1968-76. Adult count at a temporary counting fence in 1971 is included. Asterisks indicate partial counts.

substantial. In 1975, the timing of fish movement into the facility was affected by its closure for 26 days due to low water levels.

In 1976, fishway operation was from 28 June to 5 September, when the counting trap was displaced by flood waters. However, the count was considered complete as only three fish were enumerated during the previous week. A total of 350 was counted with over 25% during the first 3 weeks (Table 1). The first fish entered the fishway one day after operations commenced and the last fish was released just prior to the washout. Eighty-four percent of the 1976 migration were grilse.

No migrants other than salmon have used the fishway during the last 2 years, although previously some sea-run brook trout (*Salvelinus fontinalis*) and American eels (*Anguilla rostrata*) were noted.

A comparison of the salmon migration through the Northeast River fishway for 1975 and 1976 indicates a substantially higher migration in 1976. In fact, the 350 fish counted in 1976 were the second highest on record, exceeded only by the 463 fish in 1973 (Table 2). In contrast, the 1975 migration was the lowest recorded, due possibly to uncounted escapement and frequent trap closures.

DISCUSSION

The Northeast River fishway has functioned well in allowing Atlantic salmon to traverse a difficult obstruction. It has eliminated death and injury to migrants that were once common during the pre-fishway period (Traverse 1972) and reduced incidents of poaching. The salmon population has not shown the effect of this increased accessibility by significant increase in numbers. For example, with the exception of 1973, migration through the fishway has shown no real increase since 1972 (Table 2). This has been attributed to environmental damage done by silting. The silting originated from road construction along the river bank and is estimated by Porter and Davis (1974) to have destroyed up to 50% of the total salmon population. Their conclusion was based on the fact that a spawning area which may have contained up to 1200 redds in 1963 had only 8 and 6 redds in 1966 and 1969, respectively. Additional redds were believed to have been covered and subsequently smothered by silting.

Examination of angling data for Northeast River reveals no significant increase in the salmon population. A breakdown of the data into 5-year means shows that from 1952 to 1971 the angled catch remained relatively stable, increasing slightly only between 1972 and 1976. The effort, however, increased by greater than 100% over pre-1972 levels, and theoretically should have been reflected in a correspondingly higher angled catch. It did not and the mean catch per unit efforts (CUE) calculated to be 0.25 and 0.30 for 1952-56 and 1957-61, respectively fell during the last 10 years (1967-71) (1972-76) to 0.17 and 0.12, respectively (Table 3). Although a decline in fish numbers is suggested, the low CUE's likely reflect the increased effort. Both fishway counts and angled catch tend to indicate a relatively unchanged population size.

Table 1. Weekly escapement of Atlantic salmon through Northeast River fishway, 1975 and 1976.

Week (ending)	1975 Escapement				Week (ending)	1976 Escapement			
	grilse*	salmon**	total	% grilse		grilse	salmon	total	% grilse
28-6-75	0	0	0	0	26-6-76	0	0	0	0
5-7-75	0	0	0	0	3-7-76	13	3	16	81
12-7-75	14	0	14	100	10-7-76	36	6	42	86
19-7-75	0	0	0	0	17-7-76	28	4	32	88
26-7-75	85	7	92	92	24-7-76	24	5	29	83
2-8-75	23	6	29	82	31-7-76	38	10	48	79
9-8-75	10	6	16	63	7-8-76	73	18	91	80
16-8-75	32	11	43	74	14-8-76	35	5	40	88
23-8-75	11	3	14	79	21-8-76	22	2	24	92
30-8-75	2	1	3	67	28-8-76	17	3	20	85
6-9-75	1	0	1	100	4-9-76	7	0	7	100
13-9-75	8	2	10	100	11-9-76	1	0	1	100
Total	185	36	221	84	Total	294	56	350	84

* grilse (< 2.7 kg)
 ** salmon (≥ 2.7 kg)

Table 2. Escapement of Atlantic salmon through Northeast River fishway, 1968-76.

Year	Grilse	Salmon	Total	% Grilse
1968*	57	11	68	84
1971+	159	21	180	88
1972	236	34	270	100
1973*	399	64	463	86
1974	224	9	233	96
1975*	186	36	222	84
1976	294	56	350	84
Mean 1972-76	268	33	308	89

* Partial counts only
 + Fence count

Table 3. Angled catch, effort and catch per unit effort (CUE) of Atlantic salmon, Northeast River, 1952-76.

Year	Effort (rod days)	Catch			CUE	% Grilse
		grilse	salmon	total		
1952	175	57	0	57	0.33	100
1953	219	24	3	27	0.12	89
1954	137	28	8	36	0.26	78
1955	153	61	5	66	0.43	92
1956	392	83	0	83	0.21	100
Mean 1952-56	215	51	3	54	0.25	91
1957	649	196	2	198	0.31	99
1958	175	79	14	93	0.53	85
1959	292	118	0	118	0.40	100
1960	399	80	0	80	0.20	100
1961	310	54	0	54	0.17	100
Mean 1957-61	367	105	3	109	0.30	96
1962	1135	46	0	46	0.04	100
1963	340	61	0	61	0.18	100
1964	345	66	5	71	0.21	93
1965	296	38	0	38	0.13	100
1966	282	163	0	163	0.58	100
Mean 1962-66	480	75	1	76	0.16	99
1967	504	62	3	65	0.13	95
1968	1467	125	0	125	0.09	100
1969	130	66	2	68	0.52	97
1970	111	77	3	80	0.72	96
1971	740	148	4	152	0.21	97
Mean 1967-71	590	96	3	99	0.17	97
1972	538	49	0	49	0.08	100
1973	1720	238	0	238	0.14	100
1974	1721	142	0	142	0.08	100
1975	877	121	4	125	0.14	97
1976	1164	147	1	148	0.13	99
Mean 1972-76	1214	139	1	140	0.12	99

TERRA NOVA RIVER Upper Fishway

The Terra Nova River has two fishways located on its main stem. The lower fishway is situated at km 8.0 and the upper at km 22.5. Both facilities were constructed in the 1950's to allow salmon access to the upper reaches of the river system. Prior to that time, salmon experienced great difficulty in getting over the lower obstruction, a 3-4 m high falls, and were completely halted at the upper Terra Nova Falls (8.5 m). At the lower falls salmon continue to use a runaround or move directly over the falls when river discharge is suitable. This prevents any accurate estimate of total escapement.

Although the upper passage facility opened an additional 27.4 km of main stem for parr rearing and some excellent spawning habitat on Pinsents Brook and Butts Brook, a large area of the system still remains inaccessible to migrants. Mollyguajack Falls, a 6.4 m obstruction at km 49.6, is believed to be a complete barrier, no anadromous fishes having been observed above it.

Monitoring of salmon run at the lower fishway was begun in 1956 but discontinuation in 1973 was due to a shortage of manpower and funds (Fig. 3). During the early years of operation, some difficulty was experienced with low discharges through the facility but this was corrected with a roll dam in 1959.

The upper fishway has been operated and monitored since 1955 (Fig. 3). It, too, had problems in early years during periods of low discharge but this was corrected in 1961 by lowering the entrance of the fishway. No major problems were experienced after that date.

DATA

In 1975, there were 830 adult salmon recorded at the upper fishway; 94% were grilse. Seventy percent of the migration in 1975 occurred between 12 July and 9 August with the first fish being recorded on 28 June and the last on 20 September (Table 4). Five ouananiche were also enumerated at the facility.

The number of adult salmon enumerated at the upper fishway in 1976 was 383, of which 90% were grilse. The first fish was recorded on 2 July and the last on 28 August. The peak of migration was recorded during the 2-week period ending 7 August, when 49% of the total fishway escapement was enumerated (Table 4).

The upper Terra Nova fishway operated without difficulty in 1975 and 1976. The hesitancy of fish to move into the counting trap, a phenomenon observed in 1974 and believed to have been caused by the light-colored floor of a newly installed counting trap, did not occur during 1975 or 1976. Overwinter weathering of the bottom appears to have eliminated the problem.

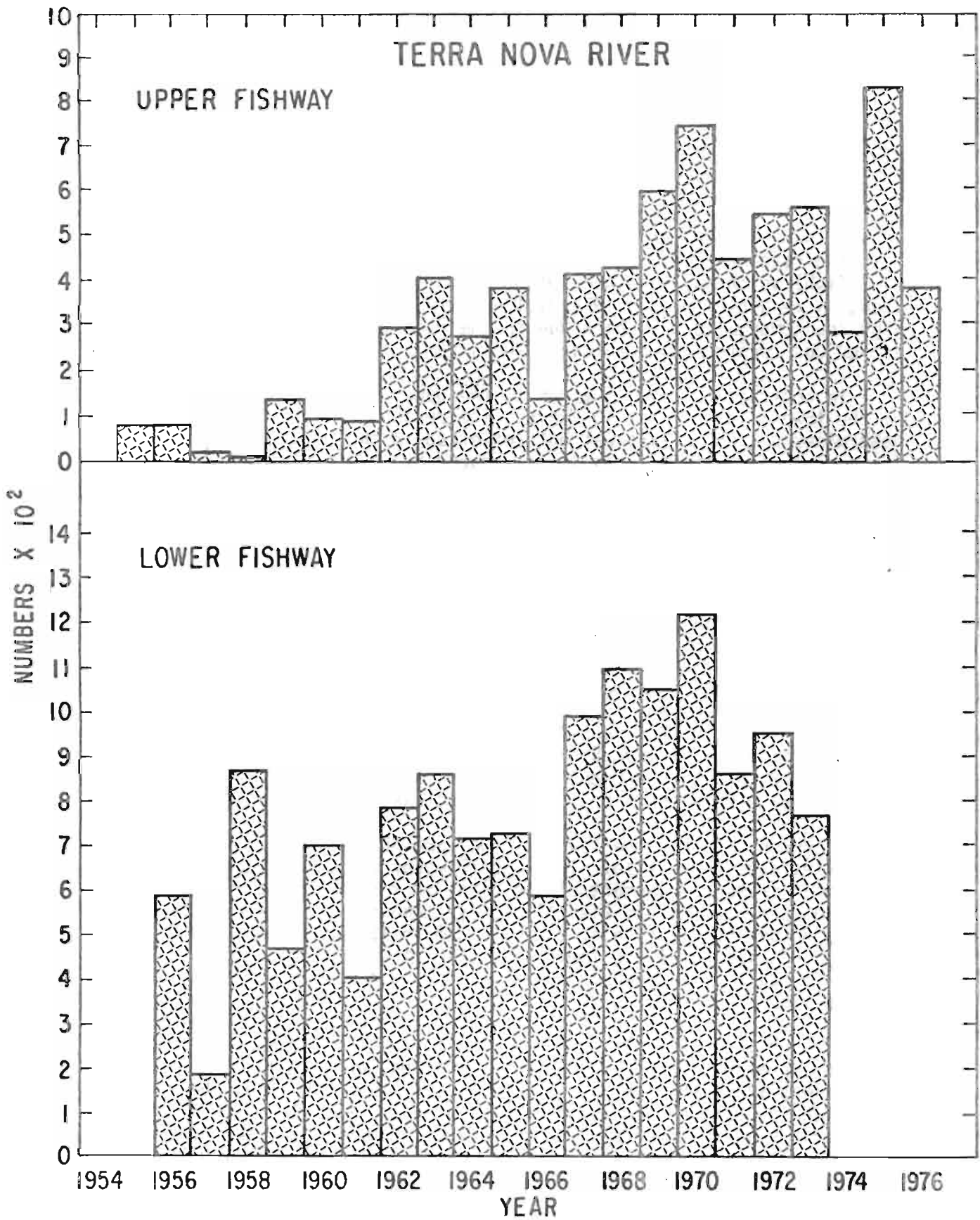


Fig. 3. Escapement of Atlantic salmon through the upper (1955-76) and lower Terra Nova River fishways (1956-73).

DISCUSSION

Escapement of salmon through the upper Terra Nova River fishway in 1975 was the highest ever recorded, being 193% higher than the previous year (1974) and 116% greater than the 1976 count. It exceeded the previous record migration of 733 fish in 1970 by 13% (Table 5). This substantial increase in fishway utilization may be attributed to a higher than average run to the whole river system. Angling data for 1975 indicate that the sports harvest was the second highest recorded (508 fish) which may have been in part owing to the increased effort, though a record effort in 1974 yielded only 248 fish (Table 6). This high count may also have been due to the fact that it was the progeny of a previous record escapement in 1970 (assuming 3+ smolt; Blair 1952).

In contrast to 1975, the run to the upper fishway in 1976 was one of the lowest in the past 10 years. The reason for this is difficult to determine, as the decline was not reflected in the 1976 angling data. The angling harvest (431 fish) was reduced by only 15% from 1975 compared with a 54% reduction in the fishway count. The CUE was higher in 1976 than in 1975 and would suggest a similar or even an increased migration in 1976 (Table 6). The low fishway count may be due to a greater angling catch than that recorded or, more likely, illegal harvesting.

Escapement of salmon to the Terra Nova River appears to have increased since fishway construction. Counts through the upper fishway show a substantial increase particularly since 1962, the first year that it was readily passable after alterations in 1961. During the first 7 years of monitoring (1955-61) the mean escapement through the fishway was 69 fish. In the subsequent 15 years, 1962-76, the mean escapement rose to 446 fish. Although this cannot all be attributed to additional population above the fishway, it undoubtedly had an influence from 1967 onwards. Other factors, such as a reduced sports fishery effort between 1966 and 1970, may also have contributed to the increased escapement (Table 5).

Although data for the lower fishway are not complete, an increase appears evident there also. The first 11-year operation period, 1956-66, had a mean salmon escapement of 444 fish. During the next 7 years this mean had increased to 625 fish (Table 7). Again, this may have been influenced by installation of the roll dam in 1959, the reduced angling effort, and closure of the commercial fisheries in Middle Arm but increased production above the upper fishway may also have made a substantial contribution.

The angling data, although believed to be incomplete prior to 1964, show an improvement since the 1950's. The mean angled catch from 1952 to 1959 was 144 fish with a CUE of 0.12. From 1960 to 1969, the mean increased to 297 fish and the CUE rose by a substantial 267%. Again, the increase may be due to a reduced effort; however, it seems reasonable to assume that the population had increased. By the 1970's (1970-76), the mean annual sports harvest had risen to 410 and, although the CUE decreased to 0.35, it appears that this was due mainly to an increased effort (Table 6).

The low counts in 1974 and 1976 may be a preliminary warning of future changes in stock size. Optimism generated by the record 1975 count may not be justified. This is supported by the dismal sports harvest in 1974 when the CUE was calculated to be 0.12, the lowest since the early 1950's.

Table 4. Weekly escapement of Atlantic salmon through the Terra Nova River upper fishway during 1975 and 1976.

Week (ending)	1975 Escapement				Week (ending)	1976 Escapement			
	grilse	salmon	total	% grilse		grilse	salmon	total	% grilse
21-6-75	0	0	0	0	19-6-76	0	0	0	0
28-6-75	0	1	1	0	26-6-76	0	0	0	0
5-7-75	7	2	9	78	3-7-76	2	0	2	100
12-7-75	52	10	62	84	10-7-76	7	1	8	88
19-7-75	163	5	168	97	17-7-76	46	8	54	85
26-7-75	124	6	130	95	24-7-76	53	6	59	90
2-8-75	160	5	165	97	31-7-76	80	8	88	91
9-8-75	108	7	115	94	7-8-76	92	6	98	94
16-8-75	51	3	54	94	14-8-76	24	2	26	92
23-8-75	35	4	39	90	21-8-76	27	5	32	84
30-8-75	27	3	30	90	28-8-76	15	1	16	94
6-9-75	31	1	32	97					
13-9-75	18	1	19	95					
20-9-75	6	0	6	100					
Total	782	48	830	94	Total	346	37	383	90

Table 5. Escapement of Atlantic salmon through Terra Nova River upper fishway, 1955-76.

Year	Grilse	Salmon	Total	% Grilse
1955	53	24	77	69
1956	32	44	76	73
1957	21	1	22	95
1958	10	0	10	100
1959	120	20	140	86
1960	86	0	86	100
1961	74	1	75	99
1962	284	4	288	99
1963	372	35	407	91
1964	246	18	264	93
1965	334	51	385	87
1966	134	2	136	99
1967	373	42	415	90
1968	409	28	437	94
1969	463	136	599	77
1970	563	170	733	77
1971	316	121	437	72
1972	330	202	532	62
1973	340	222	562	60
1974	161	122	283	57
1975	782	48	830	94
1976	346	37	383	90
Mean 1955-59	47	18	65	72
Mean 1960-64	212	12	224	95
Mean 1965-69	343	52	395	87
Mean 1970-74	342	167	509	67
Mean 1975-76	564	43	607	93

Table 6. Angled catch, effort and catch per unit effort of Atlantic salmon, Terra Nova River, 1952-76.

Year	Effort (rod days)	Catch			CUE	% Grilse
		grilse	salmon	total		
1952	1421	119	23	142	0.09	84
1953	1706	151	13	164	0.10	92
1954	1003	72	13	85	0.08	85
1955	335	178	16	194	0.58	92
1956	2685	198	18	216	0.32	92
Mean 1952-56	1430	144	17	161	0.11	89
1957	569	73	3	76	0.13	96
1958	590	123	12	135	0.23	91
1959	959	120	20	140	0.15	86
1960	463	157	8	165	0.36	95
1961	623	117	14	131	0.21	89
Mean 1957-61	641	118	11	129	0.20	91
1962	777	254	25	279	0.36	91
1963	1160	274	29	303	0.26	90
1964	699	334	5	339	0.48	99
1965	787	327	10	337	0.43	97
1966	117	224	2	226	1.93	99
Mean 1962-66	708	283	14	297	0.42	95
1967	557	337	2	339	0.61	99
1968	143	319	12	331	0.23	96
1969	1477	523	0	523	0.35	100
1970	285	443	18	461	1.62	96
1971	1458	402	11	413	0.28	97
Mean 1967-71	784	405	9	413	0.53	98
1972	456	467	11	478	1.05	98
1973	1044	334	1	335	0.32	99
1974	2098	243	5	248	0.12	98
1975	1723	506	2	508	0.30	99
1976	1236	424	7	431	0.35	98
Mean 1972-76	1311	395	5	400	0.31	99

Table 7. Escapement of Atlantic salmon through the Terra Nova River lower fishway, 1956-73.

Year	Grilse	Salmon	Total	% Grilse
1956	558	36	594	94
1957	141	41	182	77
1958	677	195	872	78
1959	394	67	461	85
1960	490	217	707	69
1961	318	99	417	76
1962	496	275	771	64
1963	551	320	871	63
1964	419	297	716	58
1965	474	254	728	65
1966	368	220	588	63
1967	613	359	972	63
1968	715	374	1089	66
1969	658	393	1051	63
1970	754	470	1224	62
1971	580	277	857	68
1972	603	347	950	64
1973	455	299	754	60
Mean 1956-60	452	111	563	80
Mean 1961-65	452	249	701	64
Mean 1966-70	622	363	985	63
Mean 1971-73	546	308	854	64

MIDDLE BROOK Fishway

Middle Brook flows into Freshwater Bay, Bonavista Bay, near the community of Gambo. It drains an area of 275 km²; the main stem (including standing water) is 48.8 km in length and is fed by 19.3 km of tributary streams. The system contains five major ponds: Butts Pond, Square Pond, First and Second Burnt Ponds, and Rodney Pond and was considered for hydro development in the late 1950's but the plans were not implemented. Except for log-driving and saw-mill operations in the 1920's and a provincial park on Square Pond, the system has remained in its natural state.

A falls located at km 2.4 was believed to have been a partial obstruction to Atlantic salmon prior to 1954 when a concrete fishway was constructed. It provided access to an area previously attainable only by fish passage through an extremely difficult runaround. In 1972, a conduit fence was placed in front of this runaround to ensure that all migrants passed through the fishway. In 1975 and 1976, the conduit fence was replaced with a dam that eliminated discharge through the runaround and directed the water into the fishway, thus augmenting low water flows, especially in 1975.

Migration of Atlantic salmon at Middle Brook fishway was monitored from 1956 to 1959, and from 1972 to 1975 (Fig. 4). In addition to Atlantic salmon, resident and sea-run brook trout, and brown trout (*Salmo trutta*) have been observed in the fishway and ouananiche, landlocked Arctic char (*Salvelinus alpinus*) and smelt (*Osmerus mordax*) also exist elsewhere in the system (Leggett 1965).

DATA

Recorded escapement through the Middle Brook fishway in 1975 was 855 fish. An additional 313 fish were counted in the fishway and were assumed to have moved through the counting trap. The total escapement for 1975 is thus considered to be 1128 fish of which 99% were grilse. The first fish moved into the counting trap on 25 June and the last fish was enumerated on 12 September. The first peak of migration occurred during the week ending 19 July. However, a subsequent peak was also observed during the week of 2 August. These 2 weeks accounted for 39% of the total escapement (Table 8). Salmon were sometimes reluctant to move into the counting trap and this was attributed to high water temperatures that in some areas exceeded 29°C. In addition to making migrants extremely listless, this may have caused in excess of 30 mortalities that occurred in the fishway during this time, 27.8°C being considered the upper lethal limit for Atlantic salmon (Garside 1973). Only salmon were recorded utilizing the facility in 1975. Due to a severe manpower shortage the fishway was operated for only a short period in 1976 and no count of migrants was obtained.

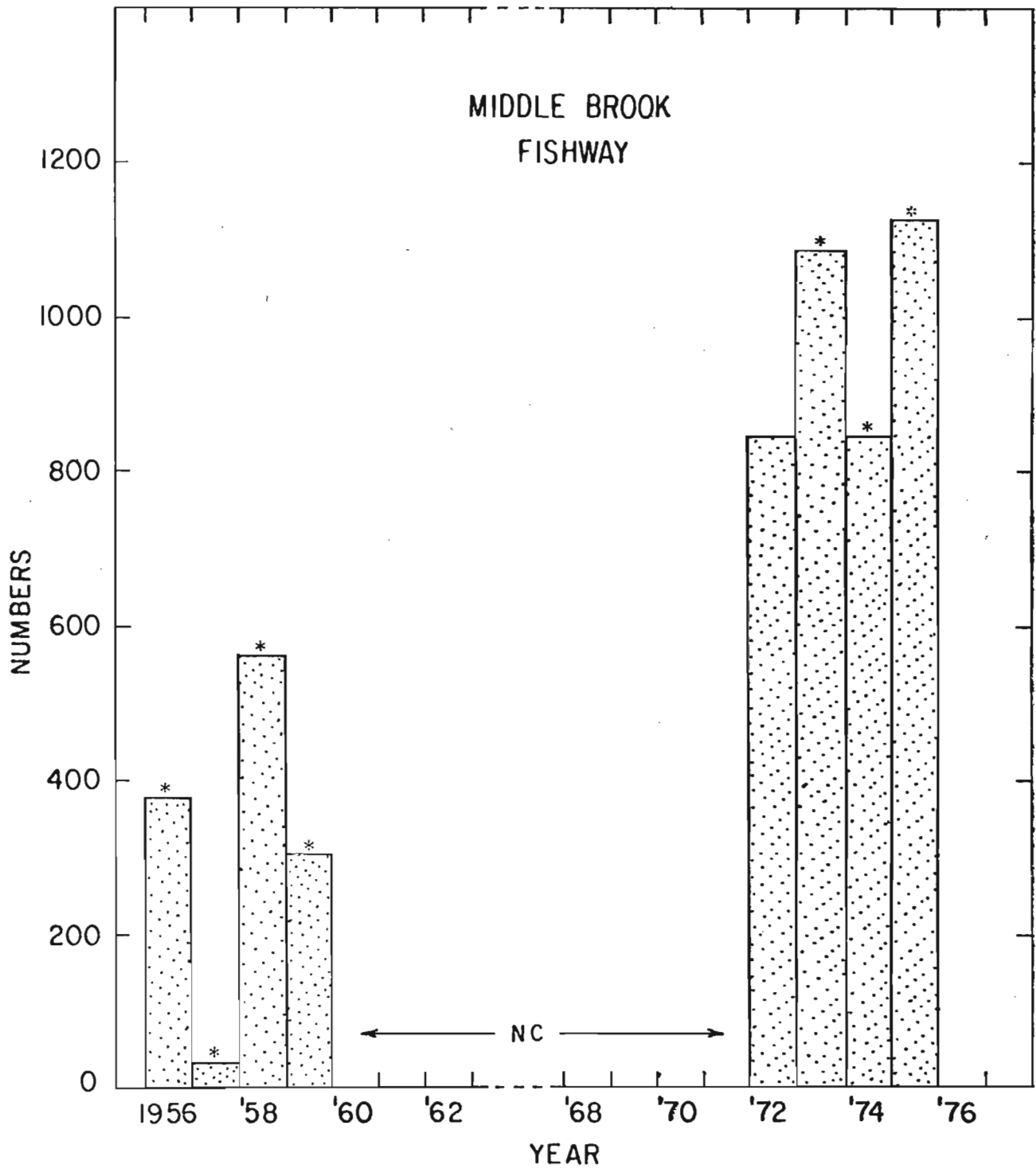


Fig. 4. Escapement of Atlantic salmon through the Middle Brook fishway, 1956-76. Asterisks indicate partial counts.

DISCUSSION

Mean annual escapement of Atlantic salmon to the Middle Brook fishway during 1956-59 was approximately 350 adults (range 30-563). When monitoring was resumed in 1972-75, the mean annual run had increased to 977 fish (range 847-1126) (Table 9). It is not certain that this increase was real since in the 1950's, migrants were able to avoid the fishway and move directly over the falls via a runaround. In 1970, this access was blocked and all migrants had to move through the facility. Undoubtedly, this increased the salmon count over previous years.

Although it is difficult to assess the Middle Brook salmon population from the fishway count, the sports fishery data indicate that there may have been some increase in stock size since fishway construction. For example, the mean salmon catch for 1952-56 was 76 fish. The mean for 1972-76 was 300 adult salmon, an increase of 295% over the previous period. This larger catch may have been due to an increase in effort from a mean of 604 rod days in 1952-56 to one of 1059 rod days in 1972-76. During the same periods, mean catch per unit effort rose from 0.12 in 1952-56 to 0.28 in 1972-76. This significant increase may indicate a larger population of salmon available for exploitation. Mean CUE was 0.33 for the period 1962-66, and individual years have been above 0.19 since 1962. The one exception was in 1974 when the CUE dropped to 0.16, a trend observed throughout the Province during that year (Table 10). Thus there is some evidence that the salmon run to Middle Brook has increased since the 1950's. However, it is by no means conclusive and has not been as great as would be anticipated if the upper watershed had been inaccessible prior to fishway construction. Although the fishway has allowed all migrants to move upstream without serious delay, it appears that a significant number of adults were successful in surmounting the falls prior to 1954.

Table 8. Weekly escapement of Atlantic salmon through Middle Brook fishway, 1975.

Week (ending)	1975 Escapement			
	grilse	salmon	total	% grilse
28-6-75	12	0	12	100
5-7-75	94	2	96	98
12-7-75	152	5	157	97
19-7-75	234	2	236	99
26-7-75	93	0	93	100
2-8-75	200	0	200	100
9-8-75	161	0	161	100
16-8-75	76	0	76	100
23-8-75	55	0	55	100
30-8-75	18	0	18	100
6-9-75	11	0	11	100
13-9-75	13	0	13	100
Total	1119	9	1128	99

Table 9. Escapement of Atlantic salmon through Middle Brook fishway, 1968-75.

Year	Grilse	Salmon	Total	% Grilse
1956*	324	56	380	85
1957*	28	2	30	93
1958*	332	231	563	59
1959*	295	13	308	96
1972	838	10	848	99
1973*	1079	9	1088	99
1974*	770	77	847	91
1975*	1119	7	1126	99
Mean 1956-59	245	76	321	76
Mean 1972-75	952	26	977	97

* Partial count.

Table 10. Angled catch, effort and catch per unit effort of Atlantic salmon, Middle Brook, 1952-76.

Year	Effort (rod days)	Catch			CUE	% Grilse
		grilse	salmon	total		
1952	894	71	1	72	0.08	99
1953	710	116	0	116	0.16	100
1954	360	57	0	57	0.16	100
1955	134	29	1	30	0.23	97
1956	923	95	7	102	0.32	93
Mean 1952-56	604	74	2	76	0.12	99
1957	289	144	0	144	0.50	100
1958	459	172	2	174	0.38	99
1959	427	160	4	164	0.38	98
1960	334	58	0	58	0.17	100
1961	208	30	2	32	0.15	94
Mean 1957-61	343	113	2	115	0.34	98
1962	459	174	0	174	0.38	100
1963	638	350	0	350	0.55	100
1964	1266	570	0	570	0.45	100
1965	1568	454	2	456	0.29	99
1966	1627	272	0	272	0.17	100
Mean 1962-66	1112	364	1	365	0.33	99
1967	965	217	0	217	0.22	100
1968	2014	374	0	374	0.19	100
1969	1704	389	2	391	0.23	99
1970	1111	323	2	325	0.29	99
1971	662	185	0	185	0.28	100
Mean 1967-71	1291	298	1	299	0.23	99
1972	287	224	0	224	0.78	100
1973	213	283	0	283	1.33	100
1974	1823	277	11	288	0.16	96
1975	1635	415	8	423	0.25	98
1976	1339	280	2	282	0.21	99
Mean 1972-76	1059	296	4	300	0.28	99

EXPLOITS RIVER Bishop's Falls Fishway

In 1909, Price (Nfld.) constructed a dam across the top of Bishop's Falls to maintain water reserves for operating a hydroelectric plant. The dam made this part of the river more difficult to salmon passage than previously but, after negotiating a 187 m rapids, some migrants could surmount, or pass through an opening in the dam's flashboard.

In 1959, a counting trap was placed at the rear of the flashboard opening at the Bishop's Falls dam and fish were enumerated. Passage of fish directly over the dam, however prevented a complete count. In 1960, access other than the counting trap was blocked and, from 1960 to 1970, complete enumeration of Atlantic salmon by this method was attempted. Operational problems, including washouts, enabled a complete count to be obtained during only 6 of these 11 years (Fig. 5).

In 1971, a permanent concrete notch-weir fishway was constructed at the site (km 2.4) in the hope of obtaining more accurate data on the annual migration. New flashboards were also installed which effectively prevented movement directly over the dam. A complete count was thereby obtained in 1972 but in 1973, when unusually high discharge damaged the flashboard, enumeration was suspended. In 1974, 1975, and 1976, no such problem occurred and the first complete counts since 1967 were obtained.

DATA

In 1975, the operation of Bishop's Falls fishway began on 15 June and by 10 September, when operations ceased, a record of 10,451 adult salmon had been recorded at the facility. The total was comprised of 86% grilse (Table 11). The first fish was recorded on 22 June, the last on 9 September, and the peak of migration occurred between 13 and 19 July. High water temperatures experienced in 1975 did not appear to affect the migration. Low water levels in 1975, which caused severe problems at other fishways and closures of angling on some river systems, did not occur at the Bishop's Falls facility or in the main Exploits River. Control of discharge in the system by Price (Nfld.) Ltd. apparently prevented this problem from occurring.

Low water levels did cause some problems at the Bishop's Falls fishway in 1976. Attraction flow at the fishway entrance was almost eliminated after Price (Nfld.) Ltd. instituted water conservation measures and reduced the river discharge. Migrating Atlantic salmon would have experienced difficulty in using the facility for at least 5 days between 17 and 24 July due to the low flow. Despite the discharge problem, operation of the facility from 9 June to 8 October was considered successful. A complete count of 4599 adults was recorded of which 89% were grilse. The peak of migration occurred between 24 and 31 July with the first migrant enumerated on 10 June and the last on 4 October (Table 11). In addition to Atlantic salmon, 44 sea-run brook trout, 4 resident brook trout, 2 ouananiche, and 1 eel utilized the fishway.

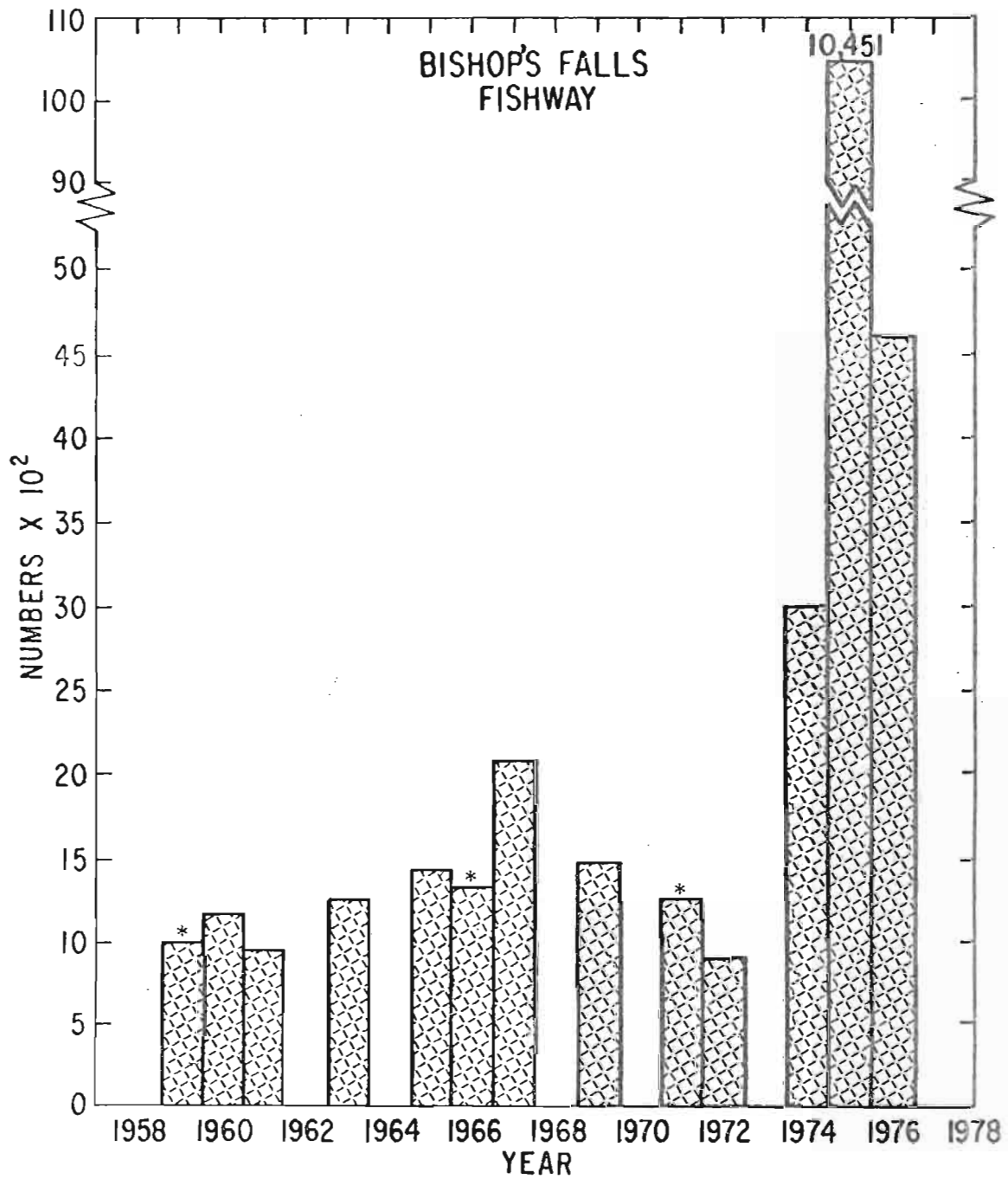


Fig. 5. Escapement of Atlantic salmon through the Bishop's Falls fishway, 1958-76. Asterisks indicate partial counts.

DISCUSSION

The contribution of the Bishop's Falls fishway to the enhancement of Atlantic salmon in the Exploits River has probably been limited. Migrants, prior to fishway construction, had free but sometimes limited access above the site and, although the fishway eliminated any possible migration difficulties, it did not open any previously unutilized stream habitat. The fishway and the previous counting trap has, however, served as a valuable tool for monitoring the size of the salmon population in the Exploits River. The fishway, located a mere 2.4 km from the river mouth, is believed to monitor all migrants entering the system with the exception of those harvested by the sports fishery. The count at the facility plus the angled catch is therefore thought to represent the entire adult salmon population of the Exploits River.

It is evident from the fishway count, particularly since 1974, that there has been a tremendous increase in the size of the salmon resource in the Exploits River system. During the first 6 years that complete counts were obtained (1960, 1961, 1963, 1965, 1967, 1969), the mean annual migration was 1397 fish. In 1972, 1974, 1975, and 1976, when complete counts were again obtained, the mean annual migration had increased to 4738 fish. The increase, although elevated considerably by the record run of 10,451 in 1975, is still substantial when compared with individual years. For example, the 1974 migration of 2994 fish is 117% higher than the previous 5-year mean while the 1976 count of 4599 fish is 233% higher (Table 12).

Angling data from the Exploits River indicate that the angled catch of Atlantic salmon has risen significantly during the past 3 years. Between 1954 and 1973, the mean annual catch was recorded as 533 fish with a high of 1317 fish angled in 1964 and a low of 79 fish recorded in 1954. By 1974 to 1976, the annual mean increased to 1561 fish with a high of 1934. The increase in catch is in part attributable to the drastic increase in effort expended to harvest the resource. The mean effort between 1954 and 1973 was 1690 rod days. Between 1974 and 1976, this mean effort increased to 5340 rod days or a 216% increase comparable to the 193% increase in angled catch (Table 13). Overall, the increased catch resulted directly from the increased effort made possible by the tremendous increase in escapement of salmon to the system.

Examination of CUE also indicated that the number of fish in the system increased. The mean CUE for 1974-76 was calculated to be 0.29. This is only slightly below the annual mean of 0.32 from 1954 to 1973. The CUE which would be expected to decline under a 200% increase in effort has remained fairly stable. In river systems, where there is no apparent change in salmon population size, CUE tends to decrease significantly with a substantial increase in effort.

The increase in the size of the Atlantic salmon population in the Exploits River system can be attributed to the successful transfer of adult salmon from Rattling Brook to Great Rattling Brook (1957-64); the success of the Noel Paul spawning channel (Farwell and Porter 1976) and the construction of the turbine by-pass facility for smolts at the hydroelectric plant (see p. 26) (Farwell 1972).

Table 11. Weekly escapement of Atlantic salmon through the Bishop's Falls fishway during 1975 and 1976.

Week (ending)	1975 Escapement				Week (ending)	1976 Escapement			
	grilse	salmon	total	% grilse		grilse	salmon	total	% grilse
21-6-75	0	0	0	0	12-6-76	1	0	1	100
28-6-75	1	3	4	25	19-6-76	0	0	0	0
5-7-75	54	37	91	59	26-6-76	1	0	1	100
12-7-75	1153	371	1524	76	3-7-76	3	0	3	100
19-7-75	3506	500	4006	88	10-7-76	119	27	146	82
26-7-75	2257	258	2515	90	17-7-76	511	99	610	84
2-8-75	1268	162	1430	89	24-7-76	942	87	1029	92
9-8-75	454	67	521	87	31-7-76	1379	149	1528	90
16-8-75	209	29	238	88	7-8-76	337	35	372	91
23-8-75	65	8	73	89	14-8-76	480	52	532	90
30-8-75	23	2	25	92	21-8-76	170	18	188	90
6-9-75	12	2	14	86	28-8-76	52	10	62	84
13-9-75	8	2	10	80	4-9-76	34	5	39	87
					11-9-76	44	6	50	88
					18-9-76	13	5	18	72
					25-9-76	12	0	12	100
					2-10-76	7	0	7	100
					9-10-76	1	0	1	100
Total	9010	1441	10451	86	Total	4106	493	4599	89

Table 12. Escapement of Atlantic salmon through the Bishop's Falls fishway, 1959-76.

Year	Grilse	Salmon	Total	% Grilse
1959*	887	119	1006	88
1960	1013	157	1170	87
1961	839	118	957	88
1962†	-	-	-	-
1963	1202	65	1267	95
1964†	-	-	-	-
1965	1228	203	1431	86
1966*	829	506	1335	62
1967	1372	710	2082	66
1968†	-	-	-	-
1969	979	498	1477	66
1970†	-	-	-	-
1971*	961	300	1261	76
1972	794	113	907	88
1973†	-	-	-	-
1974	2583	411	2994	86
1975	9010	1441	10451	86
1976	4106	493	4599	89
Mean 1960-61, 63, 65, 67, 69	1105	292	1397	86
Mean 1972, 74-76	4123	615	4738	87

* incomplete count

† no count

Table 13. Angled catch, effort and catch per unit effort for Atlantic salmon, Exploits River, 1954-76.

Year	Effort (rod days)	Catch			CUE	% Grilse
		grilse	salmon	total		
1954	424	77	2	79	0.19	97
1955	859	382	3	385	0.45	99
1956	1040	474	8	482	0.46	98
1957	1457	657	11	668	0.46	98
1958	420	477	81	558	1.33	85
Mean 1954-58	840	413	21	434	0.52	95
1959	717	258	59	317	0.44	81
1960	1558	446	43	489	0.31	91
1961	1050	245	14	259	0.25	95
1962	1797	732	53	785	0.44	93
1963	1712	452	55	507	0.30	89
Mean 1959-63	1367	427	45	472	0.34	90
1964	4459	1135	182	1317	0.30	86
1965	2636	392	27	419	0.16	94
1966	3183	693	32	725	0.23	96
1967	1960	368	13	381	0.19	97
1968	3332	848	51	899	0.27	94
Mean 1964-68	3115	688	61	749	0.24	92
1969	735	414	101	515	0.70	80
1970	1595	429	35	464	0.29	92
1971	1081	515	9	524	0.48	98
1972	1419	463	0	463	0.33	100
1973	2352	423	1	424	0.18	99
Mean 1969-73	1436	449	29	478	0.33	94
1974	4544	1077	57	1134	0.25	95
1975	5702	1565	54	1619	0.28	97
1976	5775	1880	54	1934	0.33	97
Mean 1974-76	5340	1510	53	1561	0.29	97

EXPLOITS RIVER
Bishop's Falls Turbine By-pass Facility

The Exploits River has two hydroelectric plants located on its main stem. The one at Grand Falls presents little problem to downstream migrating Atlantic salmon smolts and kelts, apparently due to the location of its water release gate. The other at Bishop's Falls posed a serious problem for downstream migrants prior to 1972. Mortality of both smolts and kelts at the site was believed to be extremely high (Farwell 1972). This was caused both indirectly from scale loss and stress, and directly from the turbulent waters and passage through the power turbines. Prior to 1972, some fish had been removed from the plant forebay by dip nets and seines. However, this proved unsatisfactory and, in 1972, a hole was created in the forebay wall which allowed migrants to by-pass the turbine. A counting trap was installed at the hole and fish enumeration commenced (Table 14). Improvements were undertaken in following years and by 1974 a complete by-pass facility with stepped pools was completed at the site. Although a complete count of downstream migrants cannot be obtained, due to passage both over the associated dam and through the turbine, the facility has provided a valuable yearly index of migration size. The only problem which persists is the failure of some smolts and kelts to utilize the facility and hold up in the forebay until late June. Fish delayed for these extended periods tend to show severe scale loss.

DATA

The turbine by-pass facility was operated in 1975 from 6 May to 10 September. During this time 17,326 smolts, 601 kelts, 223 resident brook trout, 6 ouananiche, and 8 American eels were enumerated (Table 15). Operations were hampered somewhat by wood and debris blocking the entrance but little down time resulted.

The reluctance of some smolts to enter the facility continued in 1975 and an effort was made to overcome the problem. A series of lights were installed at the facility entrance to encourage fish movement but it proved ineffective. Smolts and kelts that did move into the counting trap in July were in poor condition apparently again due to severe scale and weight loss.

In 1976, similar problems to 1975 were again noted but they were not as severe. Only a small number of smolts and kelts held up in the forebay and observed mortalities from high water temperatures and accumulation of debris in the counting trap were only 77 smolts and 8 kelts. The facility operated from 4 May to 21 July, during which time 16,420 smolts, 685 kelts, 3 parr, 65 resident and 5 sea-run brook trout were released below the turbines (Table 15). Peak of the smolt run occurred during the week of 12-19 June.

DISCUSSION

The Atlantic salmon population in the Exploits River has increased significantly in recent years. One of the contributing factors to this

has undoubtedly been the completion of the Bishop's Falls turbine by-pass facility. All downstream migrants that have been released at the Bishop's Falls site would potentially have gone through the power turbines. It has been estimated that mortality can exceed 37% in such structures (Farwell 1972). Assuming a 12-15% survival of smolt back to the fishery, the facility may be contributing in excess of 700 adults annually to the total Exploits salmon escapement.

Table 14. Counts of Atlantic salmon smolt and kelts obtained at the Bishop's Falls turbine by-pass facility between 1972 and 1976.

Year	Smolt	Kelt
1972	9500	180
1973	15125	219
1974	22141	746
1975	17326	601
1976	16417	685

Table 15. Weekly counts of Atlantic salmon smolt and kelt at the Bishop's Falls turbine by-pass facility in 1975 and 1976.

Week (ending)	1975 Count		Week (ending)	1976 Count	
	smolt	kelt		smolt	kelt
3-5-75	0	0	1-5-76	0	0
10-5-75	0	0	8-5-76	2	271
17-5-75	29	215	15-5-76	120	75
24-5-75	357	155	22-5-76	1674	106
31-5-75	729	23	29-5-76	4676	146
7-6-75	2542	49	5-6-76	822	7
14-6-75	3385	31	12-6-76	667	28
21-6-75	3294	108	19-6-76	4267	39
28-6-75	5360	19	26-6-76	2983	10
5-7-75	1310	0	3-7-76	778	2
12-7-75	46	1	10-7-76	318	1
19-7-75	10	0	17-7-76	86	0
26-7-75	0	0	24-7-76	27	0
2-8-75	0	0			
9-8-75	0	0			
16-8-75	0	0			
23-8-75	0	0			
30-8-75	118	0			
6-9-75	117	0			
13-9-75	29	0			
Total	17326	601	Total	16420	685

EXPLOITS RIVER
Great Rattling Brook (Camp I) Fishway

The Great Rattling Brook fishway (also known as Camp I fishway) was constructed in 1959 and provided passage over a 5.8 m falls. It opened to migrating Atlantic salmon approximately 236 km of stream habitat that previously had been utilized only by resident brook trout and ouananiche. Construction of the fishway was undertaken after a hydroelectric project on a neighbouring watershed (Rattling Brook) necessitated transfer of an Atlantic salmon population into the system. Some 2944 adult salmon were moved between 1957 and 1964.

Counts at the fishway which would include progeny of transferred fish and strays from the indigenous population below the obstruction were begun in 1960. These were continued successfully until 1972, when major modifications were required. These took 2 years. During this period, access to the upper watershed was not completely obstructed. Atlantic salmon were able to use a runaround near the fishway, while those that were unsuccessful in negotiating it are believed to have utilized Three Brooks, a small tributary located several hundred meters downstream from the fishway at Camp I. Fish counts were resumed in 1975 and continued in 1976 (Fig. 6).

DATA

Operation of the Camp I fishway in 1975 extended from 9 July to 10 September. During this period 6556 Atlantic salmon were recorded of which 92% were grilse. Peak migration occurred during the week ending 9 August (Table 16). Its timing may have been altered by the extremely low water levels and high water temperatures experienced. Although low discharge did not affect fishway operation, it did strand fish in pools throughout the tributary. Water temperature, recorded in excess of 29°C, may have caused some fish mortality.

Low water levels did not present any difficulty to migrating Atlantic salmon in 1976. High water levels, however, damaged the fishway in the latter part of the season and forced its closure from 8 to 15 September. With this exception, monitoring was conducted from 16 July to 8 October with some 3158 Atlantic salmon being enumerated, 4% of which were large salmon. Peak migration occurred from 25 to 31 July during which time 787 adults were counted. An enumeration of 63 fish on the first day of operation indicated that the fishway was not opened early enough to pinpoint the date when fish first reached the fishway (Table 16).

In 1976, 1142 salmon were removed from the fishway and transferred to Noel Paul spawning channel. Their offspring were used in 1977 to continue the stocking of unutilized and previously inaccessible stream habitat in the upper Exploits system. Removal of fish from the Great Rattling system is not expected to affect its population as a spawning escapement of 2016 fish, after transfer and angled catch, is believed to be sufficient to maintain its run at the present level.

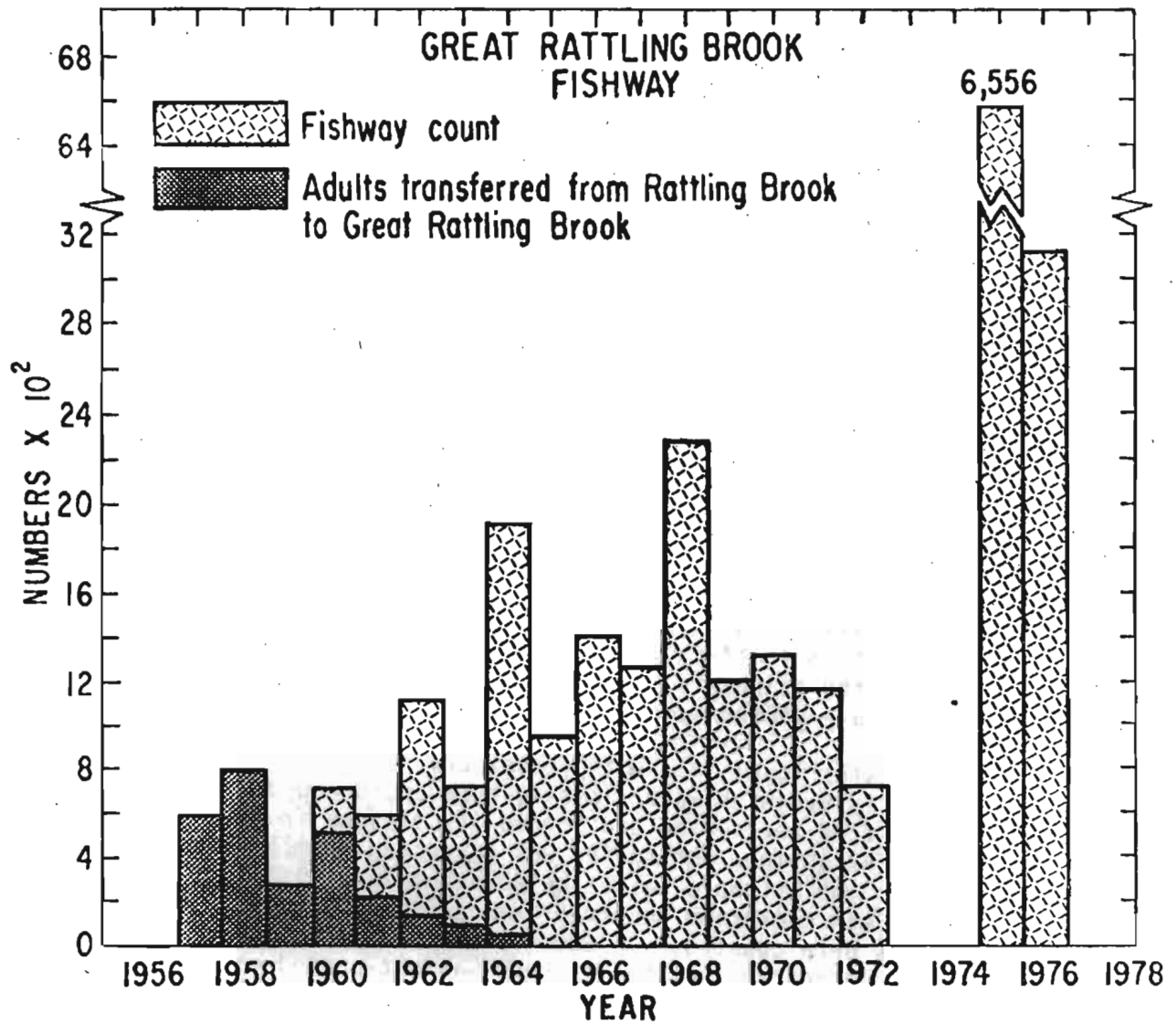


Fig. 6. Escapement of Atlantic salmon through the Great Rattling Brook fishway, 1960-76. Adults transferred from Rattling Brook, 1957-64, also indicated.

DISCUSSION

In 1960, when the Great Rattling Brook fishway was opened, 103 Atlantic salmon were recorded moving into previously inaccessible stream habitat. In 1976, after 17 years of successful migration and reproduction, 3158 fish were enumerated moving into the same area (Table 17). The increase is attributed to both straying from the population below the fishway and to the success of the Rattling Brook salmon transfer. The 1975 migration of 6556 fish was above anticipated levels and may in fact have been due to an unusually high migration to the river. The 1976 migration is probably a better indicator of actual production levels. Overall, it was estimated (Farwell and Porter 1976) that the stocking of adult Atlantic salmon in the newly accessible habitat of Great Rattling Brook increased the total production of this river by 2500 fish within 6 years after the initial transfer. It may have also contributed to the increase in percentage of large salmon recorded at Camp I since 1965 (Table 17). Post 1965 grilse to large salmon ratios are comparable to those of the transferred stock from Rattling Brook (Ducharme 1961; Sturge 1966).

There is speculation that some migrants using Great Rattling Brook system may be deflected from the main river due to a pollution barrier of toxic waste from Price (Nfld.) paper mill. The industry is located approximately 14 km upstream from the confluence of Great Rattling Brook to the main Exploits River.

Analysis of the Great Rattling Brook angling data since 1962 does not reflect the increased escapement evident from the fishway counts, the catch having ranged from 23 to 250 fish with a high 5-year mean of 95 fish (Table 18). The 1976 angled catch of 222 fish is the second highest recorded, possibly a result of a record effort of 1194 rod days. In 1975, with a record migration through the fishway, only 47 fish were angled with an effort of 527 rod days. Angling catches are probably lower than they would otherwise be due to the fact that the fishery on this tributary is confined to the area below the fishway (approximately 8 km). The upper 236 km consist mainly of steadies and small ponds which make legal angling difficult. In addition, angling has been prohibited above the fishway from 1975 to 1977.

Table 16. Weekly escapement of Atlantic salmon through the Great Rattling Brook fishway during 1975 and 1976.

Week (ending)	1975 Escapement				Week (ending)	1976 Escapement			
	grilse	salmon	total	% grilse		grilse	salmon	total	% grilse
12-7-75	13	3	16	81	17-7-76	59	14	73	81
19-7-75	80	9	89	89	24-7-76	379	18	397	95
26-7-75	226	42	268	84	31-7-76	746	41	787	95
2-8-75	1817	164	1981	92	7-8-76	678	11	689	98
9-8-75	2233	209	2442	91	14-8-76	381	3	384	99
16-8-75	972	90	1062	92	21-8-76	370	19	389	95
23-8-75	445	11	466	96	28-8-76	121	7	128	95
30-8-75	105	7	112	94	4-9-76	106	2	108	98
6-9-75	75	4	79	95	11-9-76	111	5	116	96
13-9-75	46	5	51	90	18-9-76	12	0	12	100
					25-9-76	61	0	61	100
					2-10-76	10	0	10	100
					9-10-76	3	1	4	75
Total	6012	544	6556	92	Total	3037	121	3158	96

Table 17. Escapement of Atlantic salmon through Great Rattling Brook fishway, 1960-76.

Year	Grilse	Salmon	Total	% Grilse
1960	94	9	103	91
1961	319	53	372	86
1962	1037	31	1068	97
1963	491	37	528	93
1964	1752	116	1868	94
1965	587	190	777	76
1966	942	470	1412	67
1967	822	382	1204	68
1968	1334	687	2021	66
1969	892	290	1182	75
1970	1023	199	1222	84
1971	902	261	1163	78
1972	495	234	729	68
1973*	-	-	-	-
1974*	-	-	-	-
1975	6012	544	6556	92
1976	3037	121	3158	96
Mean 1961-65	856	87	923	91
Mean 1966-70	1003	406	1409	71
Mean 1971-72	699	248	946	74
Mean 1975-76	4525	332	4857	93

* no count obtained.

Table 18. Angled catch, effort and catch per unit effort of Atlantic salmon in Great Rattling Brook, 1962-76.

Year	Effort (rod days)	Catch			CUE	% Grilse
		grilse	salmon	total		
1962	356	83	3	86	0.24	97
1963	204	34	3	37	0.18	92
1964	501	171	0	171	0.34	100
1965	289	46	0	46	0.16	100
1966	681	136	0	136	0.20	100
Mean 1962-66	406	94	1	95	0.23	98
1967	385	49	0	49	0.13	100
1968	900	229	21	250	0.28	92
1969	47	17	6	23	0.49	74
1970	284	87	4	91	0.32	96
1971	80	31	1	32	0.40	97
Mean 1967-71	339	83	6	89	0.26	92
1972	388	64	0	64	0.19	100
1973	497	109	0	109	0.22	100
1974*	-	-	-	-	-	100
1975	527	47	0	47	0.09	100
1976	1194	222	0	222	0.19	100
Mean 1972-73, 1975-76	652	111	0	111	0.17	100

* no count obtained

EXPLOITS RIVER Grand Falls Fishway

A collection facility was completed at Grand Falls in July 1974. It is the first phase of a fishway which will be extended to the top of the hydro dam, located at the crest of the falls, when the number of salmon migrants warrants it. The hydro dam was constructed in 1908. Presumably the salmon which were stocked as fry in Noel Paul's Brook and are homing back to that tributary will use the facility. A few adults have been released directly into the Exploits River above the obstruction.

Monitoring and collection of adult salmon at Grand Falls were conducted in 1974, 1975, and 1976 with varying success (Fig. 7)(Table 20). A major difficulty has been that fish do not migrate upstream as far as the fishway. It is thought that water quality downstream from the pulp and paper mill is so poor that migrants homing upstream of the mill may be deflected into unpolluted tributaries such as Great Rattling and Stoney brooks. Wilson (1974) indicates that quality of effluent from Price Mill could affect Atlantic salmon. Some improvement by waste dilution started in 1974, but it is generally agreed that this was not enough.

DATA

In 1975, operations commenced on 2 July and terminated on 10 September. During this period 338 adults were enumerated of which 90% were grilse. The first fish entered the fishway on 10 July; the peak of migration occurred between 19 and 26 July. The last fish was removed from the facility on 9 September (Table 19). Of these, 313 were transferred to Noel Paul spawning channel and 20 were released above Grand Falls. Five fish succumbed to high water temperatures and excessive handling. Twenty-five brook trout also passed through the fishway.

In 1976, the fishway count was 132 adults, the decrease being attributed to both the effect of mill effluent on behavior of the migrants and lower escapement to the river itself. All but three of these fish were grilse. The first migrants in 1976 were recorded on 18 July, the last on 4 September. The peak of migration in contrast to 1975 was between 1 and 7 August (Table 19). All fish were transferred, only three being lost due to handling. There were also 21 sea-run brook trout released from the facility in 1976.

DISCUSSION

The future of the salmon run above Grand Falls is uncertain. Talks between the Federal Government and Price (Nfld.) Ltd. concerning improvements in Exploits River water quality are ongoing. Their success may, in the end, also determine whether or not there will be salmon available to utilize the Grand Falls facility.

The possibility exists that poor water quality is not the only contributing factor to low salmon utilization of the Grand Falls fishway. Production and survival of juvenile fish in the Exploits system may be lower than anticipated, with the present adult return representative of

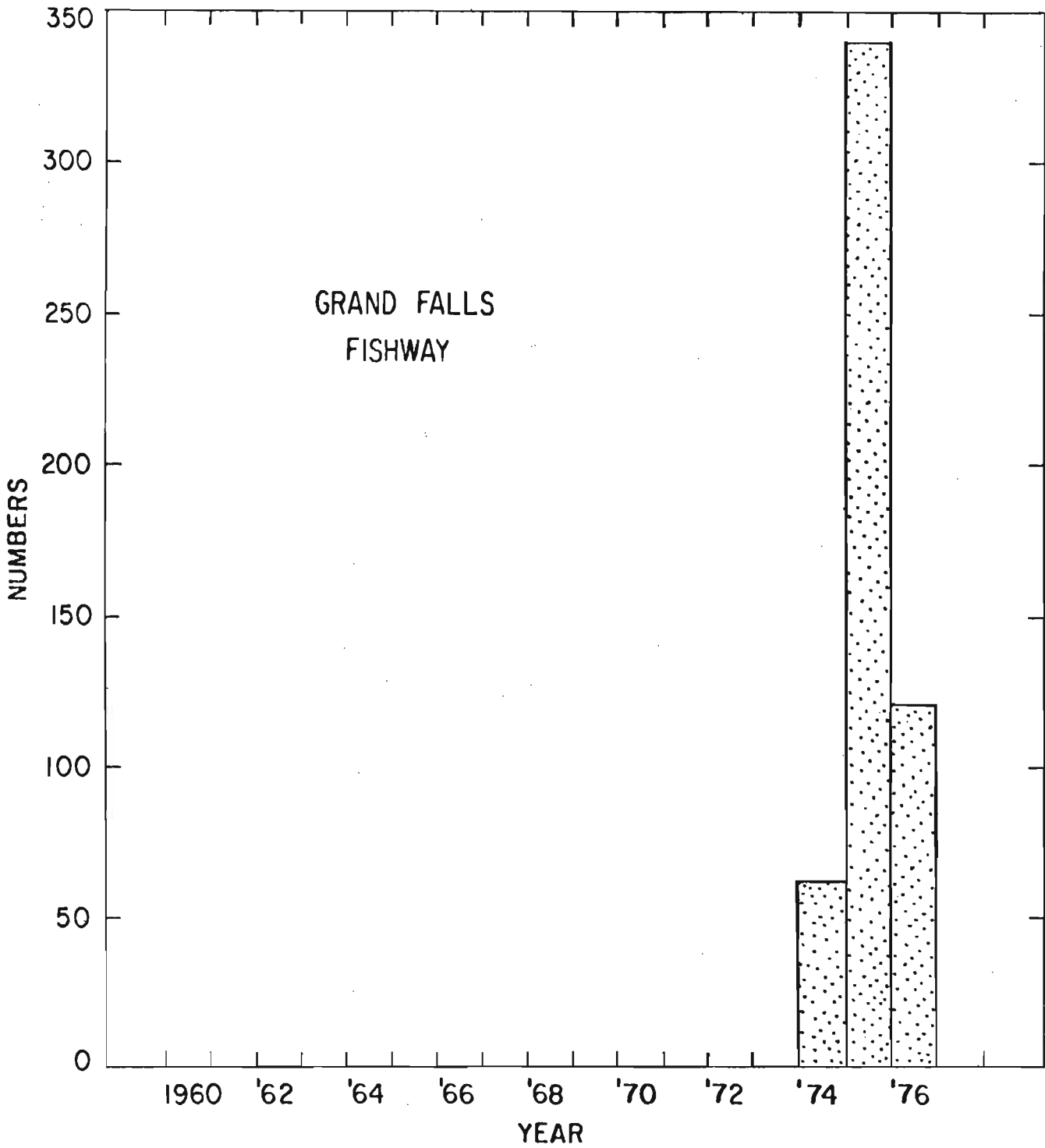


Fig. 7. Escapement of Atlantic salmon through the Grand Falls fishway, 1974-76.

the proportion of the Exploits River salmon population homing above Grand Falls. However, the extent of smolt migration at Bishop's Falls turbine by-pass facility, the high adult count at Bishop's Falls fishway and especially the tremendous increase in adult migration size in Great Rattling Brook would indicate that the existing adult counts at Grand Falls are far below expected.

Table 19. Weekly escapement of Atlantic salmon through the Grand Falls fishway during 1975 and 1976.

Week (ending)	1975 Escapement				Week (ending)	1976 Escapement			
	grilse	salmon	total	% grilse		grilse	salmon	total	% grilse
5-7-75	0	0	0	0	24-7-76	31	1	32	97
12-7-75	0	0	0	0	31-7-76	18	0	18	100
19-7-75	49	3	52	94	7-8-76	39	2	41	95
26-7-75	106	15	121	88	14-8-76	28	0	28	100
2-8-75	77	16	93	83	21-8-76	10	0	10	100
9-8-75	7	0	7	100	28-8-76	0	0	0	0
16-8-75	41	0	41	100	4-9-76	2	1	3	66
23-8-75	13	1	14	93	11-9-76	0	0	0	0
30-8-75	8	0	8	100	18-9-76	0	0	0	0
6-9-75	2	0	2	100	25-9-76	0	0	0	0
13-9-75	0	0	0	0					
Total	303	35	338	90	Total	128	4	132	97

Table 20. Escapement of Atlantic salmon through the Grand Falls fishway, 1974-76.

Year	Grilse	Salmon	Total	% Grilse
1974	63	0	63	100
1975	303	35	338	90
1976	128	4	132	97

EXPLOITS RIVER
Little Red Indian Brook Counting Fence

On 5 and 6 May 1976, a temporary counting fence was installed on Little Red Indian Brook, a tributary of Exploits River. Its purpose was to monitor downstream movement of ouananiche and determine if they were in numbers sufficient for a tagging program in 1977. The objective of the program was to determine whether ouananiche migrate as far as Bishop's Falls by-pass facility and into the open sea. The counting fence would also aid in determining the survival of anadromous fry to smolt. Fry were first released in the stream in 1976.

During the operating period, 6 May-24 September, 218 ouananiche, 234 parr, 24 fry, 130 trout, and 206 sticklebacks (*Gasterosteus aculeatus*) were counted at the fence. The peak of ouananiche run occurred during the week of 5 June when 112 were counted (Table 21).

Table 21. Weekly escapement of fish through the Little Red Indian Brook counting fence, 1976.

Week (ending)	Ouananiche		Fry	Brook Trout	Sticklebacks
	Smolt	Parr			
8-5-76	0	0	0	0	2
15-5-76	0	0	0	0	0
22-5-76	9	0	0	3	4
29-5-76	19	0	0	10	5
5-6-76	112	0	0	16	10
12-6-76	17	26	0	14	8
19-6-76	19	50	0	21	3
26-6-76	13	39	0	20	30
3-7-76	20	56	0	10	40
10-7-76	9	43	0	13	18
17-7-76	0	5	0	1	35
24-7-76	0	0	0	0	0
31-7-76	0	0	0	0	0
7-8-76	0	0	2	6	28
14-8-76	0	0	0	0	0
21-8-76	0	7	3	1	3
28-8-76	0	7	18	0	4
4-9-76	0	1	0	0	0
11-9-76	0	0	0	2	0
18-9-76	0	0	0	3	14
25-9-76	0	0	1	0	0
Total	218	234	24	130	204

INDIAN RIVER Fishway

The fishway on Indian River is located at km 6.3 and was built in 1957. It provides access over a 3.7 m falls that prior to fishway construction effectively blocked salmon migration at low and medium discharges. During years of consistently normal to high discharge, a large number of salmon may move directly over the obstruction rather than use the fishway.

Salmon counts through the fishway commenced in 1958 and with the exception of 1962 have been continued since that time (Fig. 8). In 1962, high water damaged the counting trap and monitoring was discontinued. There have been no major problems experienced in other years.

DATA

There were 799 Atlantic salmon enumerated at the Indian River fishway in 1975, of which 99% were grilse (Table 22). The first migrant passed through the facility on 30 June and the last one on 23 September. The peak of migration occurred between 17-23 August; however, extremely low water in July and early August delayed fish at the base of the falls and almost completely eliminated attraction flow from the fishway. The timing of the peak may, therefore, have been significantly altered. At least 200 salmon were estimated to have moved directly over the obstruction in spite of low discharge.

During 1976, the number of salmon moving through the fishway was down to 356 fish, only 3 of which were large salmon. The first fish was recorded on 2 July and the last on 8 October. The peak of migration, which took place during the week ending 31 July, was considerably earlier in 1975 and may indicate the delaying effect of low discharge (Table 22). Some 220 fish were removed from the counting trap and transferred to the Indian River spawning channel in 1976.

DISCUSSION

Indian River watershed has undergone some major changes in recent years. Construction of the fishway in 1957 provided a means for salmon to move over Indian River falls at all discharges. This had the potential of enlarging the salmon population by increasing spawning escapement to a previously under-utilized watershed. However, in 1961, before this project could be effective, a major portion of upper Indian River watershed was diverted by Bowaters Pulp and Paper Co. for hydroelectric power production. Even though a minimum flow of 0.57 cubic meters per second was supposed to be maintained in the original river channel, the diversion still left large areas of riverbed dry and unproductive for salmon. This alteration had the potential to greatly reduce the run of salmon to Indian River, conceivably noticeable within 4-5 years. That no such decline has taken place may be due to the establishment of Indian River spawning channel. Constructed in 1962, it was intended to offset the loss of spawning and rearing area projected as a result of the diversion.

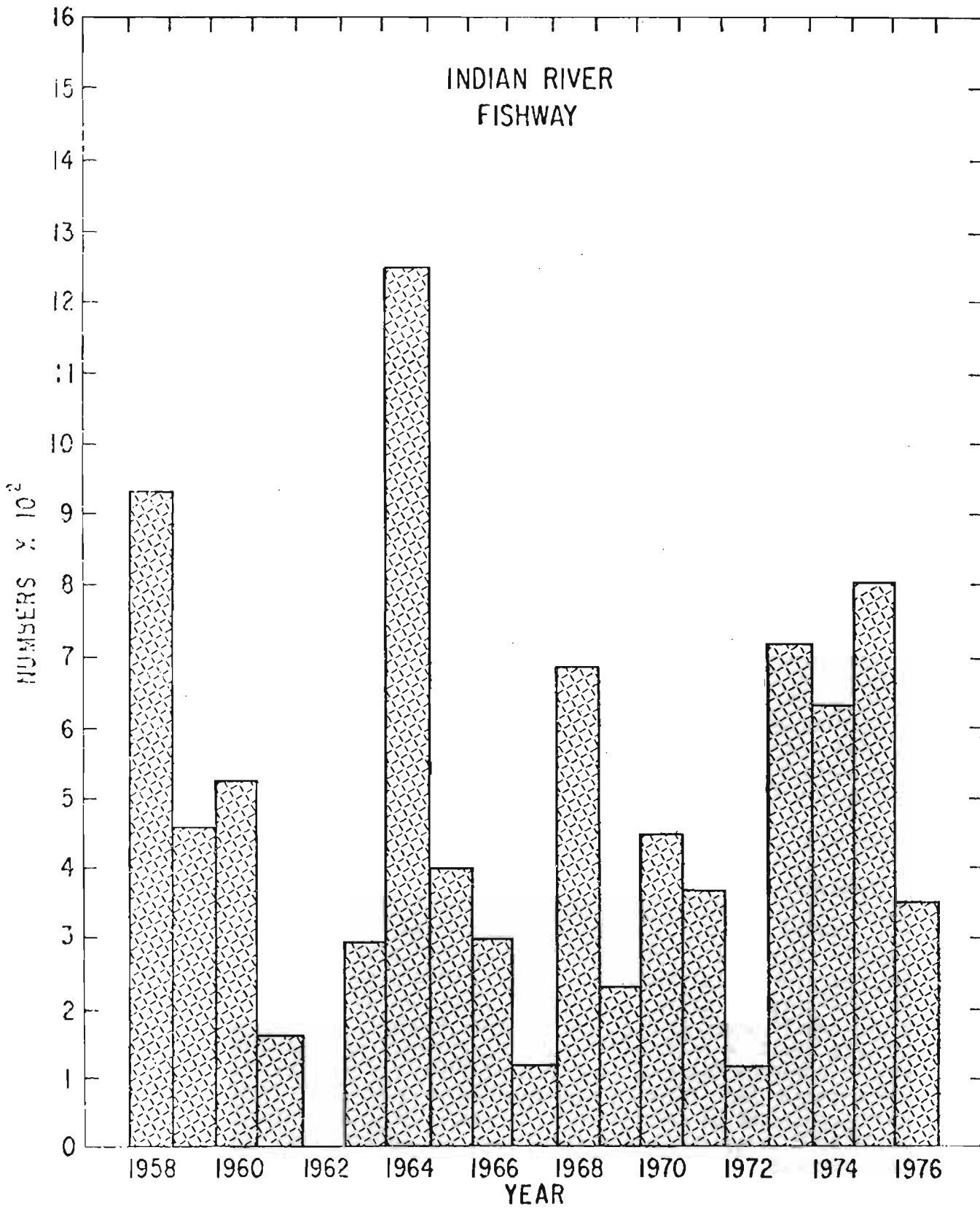


Fig. 8. Escapement of Atlantic salmon through the Indian River fishway, 1958-76.

In 1967, a wooden counting fence was installed on Indian River, approximately 11.6 km from the mouth, to assess the effect of the spawning channel on its salmon population. Smolts and adults were counted from 1967 to 1973 and with the exception of the first year, when there was a high smolt mortality due to poor fence design, counts are considered complete. The adult salmon count fluctuated greatly, while smolt numbers varied little from a mean of 10,567. It is also interesting to note that during the operating periods smolt counts showed no strong relationship with subsequent adult returns. It appeared that a low smolt count resulted in a low adult return, but a high smolt count did not necessarily mean a high adult return in the following year. In fact, the record low adult count of 109 through the fishway and 112 at the fence in 1972 occurred after a smolt migration in 1971 that was (assuming the return of 1-sea-year fish) only slightly below the mean migration rate (Table 24).

Yearly counts at the fishway revealed a wide range in numbers counted but, from calculated means (1958-76), the salmon population appears to have remained relatively stable. A slight decline between 1967 and 1971 was probably attributable to natural fluctuation in population size; there is not enough evidence to relate it to watershed manipulation. Caution, however, has to be exercised when using fishway data to judge total river escapement. For example, fence counts in 1972 and 1973 revealed similar counts to those at the fishway but in 1967 when 303 salmon were counted at the fence only 116 had previously been recorded at the fishway (Table 24).

Examination of the angling data also indicates considerable annual fluctuation in both number of angled fish and corresponding CUE's. The catch has ranged from 575 fish in 1964 to 101 in 1975 with CUE's being as high as 0.89 and as low as 0.24. However, no major changes in salmon population, which may have resulted from watershed alterations, are reflected in the data. The only trend that is evident commenced after 1966, when a similar decline to that recorded at the fishway was noted. In contrast to fishway data, where counts (1972-76) returned to pre 1966 levels after 1971, mean angled catch continued to be low in comparison with both the 1957-61 and 1962-66 mean counts. It is possible that angling data do not always reflect the true extent of an annual river escapement. In 1975 when a near record number of fish were enumerated at the fishway there was a record low number of fish angled in the sport fishery (Table 25). The similarity between fishway count means and angling data means from 1957 to 1971, however, would suggest a reduction in data collection in recent years.

Overall, the Indian River Atlantic salmon population appears to have remained stable since 1952 despite heavy odds against it. The future, however, is uncertain. The spawning channel was closed in 1975 and this action could affect the river's salmon population. It has been estimated that the spawning channel may have contributed up to 50% of the total run in recent years (Pepper et al. 1975).

In 1976, a project was initiated on the Indian River system to evaluate the potential of natural pond rearing in Atlantic salmon production. It involves the utilization of some 200 adult salmon at the spawning channel for 3 years, with their progeny subsequently transferred into suitable pond habitat. This may eventually offset a potential reduction in salmon stock that would otherwise have resulted.

Table 22. Weekly escapement of Atlantic salmon through the Indian River fishway, 1975 and 1976.

Week (ending)	1975 Escapement				Week (ending)	1976 Escapement			
	grilse	salmon	total	% grilse		grilse	salmon	total	% grilse
5-7-75	1	1	2	50	3-7-76	9	0	9	100
12-7-75	1	0	1	100	10-7-76	12	0	12	100
19-7-75	26	1	27	96	17-7-76	17	0	17	100
26-7-75	29	0	29	100	24-7-76	16	0	16	100
2-8-75	60	0	60	100	31-7-76	102	0	102	100
9-8-75	2	0	2	100	7-8-76	70	0	70	100
16-8-75	1	0	1	100	14-8-76	13	0	13	100
23-8-75	365	3	368	99	21-8-76	6	0	6	100
30-8-75	31	0	31	100	28-7-76	2	0	2	100
6-9-75	11	0	11	100	4-9-76	2	0	2	100
13-9-75	8	0	8	100	11-9-76	60	0	60	100
20-9-75	3	0	3	100	18-9-76	5	3	8	63
27-9-75	104	0	104	100	25-9-76	12	0	12	100
4-9-75	100	6	106	94	2-10-76	24	0	24	100
11-9-75	28	0	28	100	9-10-76	3	0	3	100
18-9-75	15	0	15	100					
25-9-75	3	0	3	100					
Total	788	11	799	99	Total	353	3	356	99

Table 23. Escapement of Atlantic salmon adults and juveniles through the Indian River counting fence, 1967-73.

Year	Adults			Juveniles	
	grilse	salmon	total	smolt	parr
1967	300	3	303	4654	777
1968	682	11	693	13128	912
1969	188	9	197	12263	584
1970	205	1	206	11604	780
1971	453	0	453	9622	1499
1972	109	0	109	13481	997
1973	703	12	715	9219	1282
Mean 1967-73	377	5	382	10567	976

Table 24. Escapement of Atlantic salmon through the Indian River fishway, 1958-76.

Year	Grilse	Salmon	Total	% Grilse
1958	843	80	923	91
1959	438	18	456	96
1960	494	25	519	95
1961	153	1	154	99
1962*	-	-	-	-
1963	267	22	289	92
1964	1199	45	1244	96
1965	394	0	394	100
1966	292	3	295	99
1967	116	0	116	100
1968	682	0	682	100
1969	222	3	225	99
1970	443	0	443	100
1971	364	0	364	100
1972	112	0	112	100
1973	714	3	717	99
1974	616	8	624	99
1975	788	11	799	99
1976	353	3	356	99
Mean 1958-61	482	31	513	94
Mean 1963-66	538	18	556	97
Mean 1967-71	365	1	366	100
Mean 1972-76	517	5	522	99

* no count obtained

Table 25. Angled catch, effort and catch per unit effort of Atlantic salmon, Indian River, 1952-76.

Year	Effort (rod days)		Catch		CUE	% Grilse
	grilse	salmon	total			
1952	358	232	12	244	0.68	95
1953	640	178	4	182	0.28	98
1955	499	219	2	221	0.44	99
1956	513	312	1	313	0.61	98
Mean 1952-53, 1955-56	503	235	5	240	0.48	98
1957	515	350	0	350	0.68	100
1958	601	422	7	429	0.71	98
1959	516	281	0	281	0.54	100
1960	565	172	8	180	0.32	96
1961	478	176	1	177	0.37	99
Mean 1957-61	535	280	3	283	0.53	99
1962	617	361	5	366	0.59	99
1963	601	218	6	224	0.37	97
1964	646	566	9	575	0.89	98
1965	729	254	4	258	0.35	98
1966	616	253	4	257	0.42	98
Mean 1962-66	642	330	6	336	0.52	98
1967	520	125	2	127	0.24	98
1968	622	350	1	351	0.56	99
1969	534	154	1	155	0.29	99
1970	482	191	0	191	0.40	100
1971	555	266	1	267	0.48	99
Mean 1967-71	543	217	1	218	0.40	99
1972	390	102	0	102	0.26	100
1973	720	372	2	374	0.52	99
1974	570	147	0	147	0.26	100
1975	396	101	0	101	0.26	100
1976	584	143	0	143	0.24	100
Mean 1972-76	532	173	1	174	0.33	99.5

LOMOND RIVER Fishway

The Lomond River fishway was constructed in 1960 at km 5.1. It provides access over a 7 m high falls that previously was a serious obstruction to migrating salmon. (A runaround was blasted in the falls in 1948 but this was unsuccessful.) Counts have been made at the fishway since 1961, with the exception of 1970, when there were insufficient funds to operate it (Fig. 9).

Operational problems have plagued the facility since its initial opening. They include major leaks in 1961, 1962, 1963, and 1965 which reduced the flow in the fishway and probably deterred salmon. These were corrected but low attraction flow was again a problem in 1969, this time due to low river discharge. It, too, was corrected and the facility made usable during all but very low discharges.

DATA

In 1975, low water levels, which forced closure of the river to the sport fishery, resulted in the elimination of flow through the fishway during periods of July and early August. As a result, only one adult salmon was enumerated in that year, on 16 July.

Low water levels persisted in 1976 and problems with attraction flow re-occurred. Sandbags were used to divert water into the fishway and an unsuccessful attempt was made to construct a permanent water diversion dam at the exit. Fortunately, the attraction flow was eventually increased by rainfall and 144 adults utilized the facility. Of these 92% were grilse. The first fish was enumerated on 26 June and the last on 21 August. Peak migration was recorded from 1 to 14 August, after a combination of water diversion and rainfall had made the facility operational (Table 26). Careful attention by the guardian to water flow characteristics through the fishway is also believed to have contributed significantly to the increased utilization.

DISCUSSION

In terms of utilization by Atlantic salmon the Lomond River fishway has probably not been worth the investment. It has been beset by flow problems since the initial opening and, during its first 9 years of operation, failed to pass more than 50 fish in any one year. The mean annual escapement from 1961 to 1969 was only 16 fish (Table 27). During 1967 and 1969 no migrants utilized the facility whatsoever. Since 1970, mean escapement (1971-76) has improved slightly (to 81) but annual counts of 6 and 1 were still recorded in 1971 and 1975. This may be partly due to overexploitation by the commercial and sports fisheries as well as to the fishway itself.

Riche (1973) estimated that the stream area below the Lomond River falls, including tributaries, had the potential to produce between 255 and 765 adult salmon per year. Assuming a 10% straying rate (Farwell and Porter 1976), only 25-76 fish would move into the fishway. The area

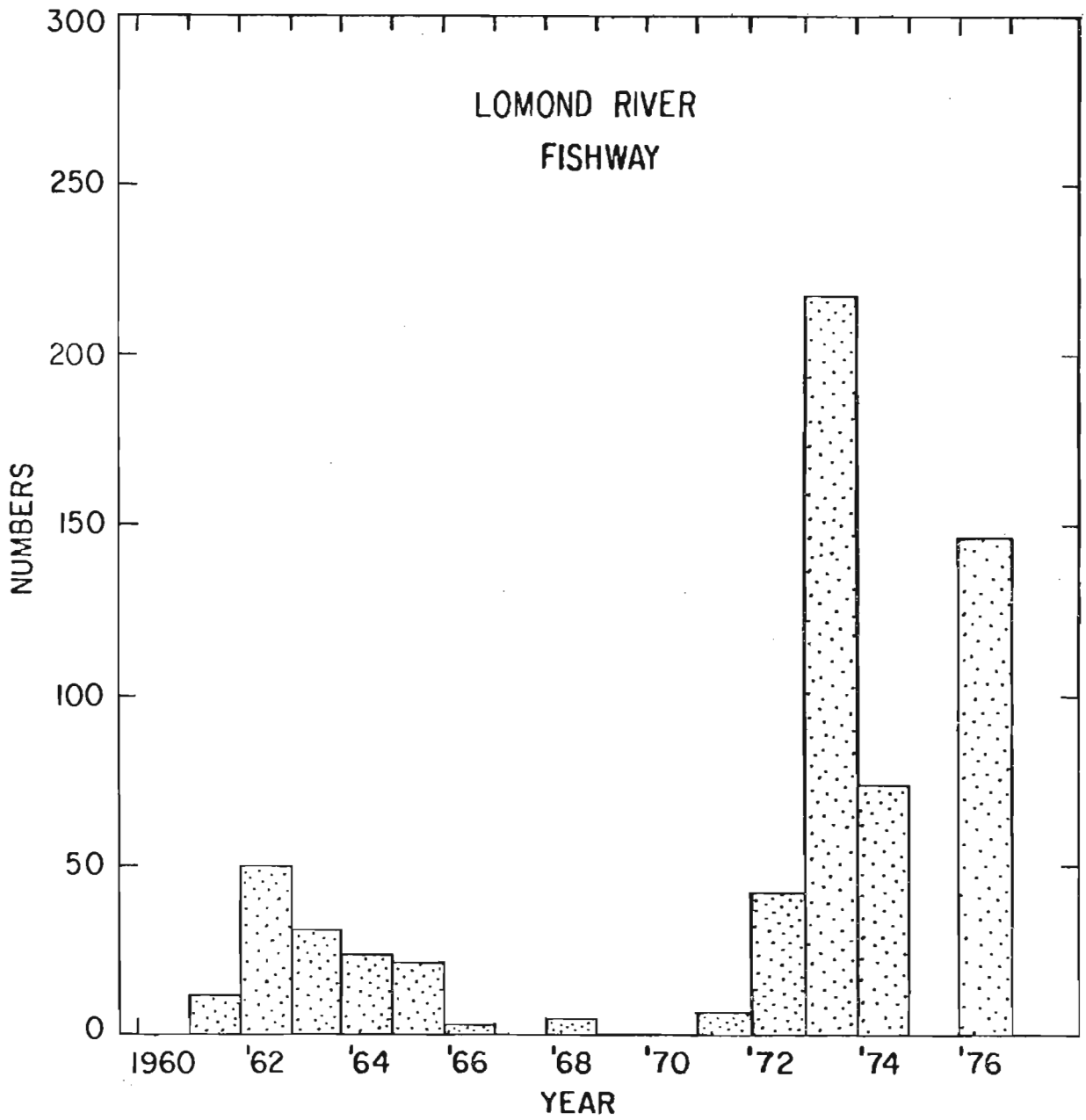


Fig. 9. Escapement of Atlantic salmon through the Lomond River fishway, 1961-76.

above the fishway has been estimated to have a production potential of between 150 and 466 fish per annum. However, it is doubtful, with the exception of 1973 and 1976, whether sufficient adults have moved into the area via the fishway to achieve this. Although some migrants may have by-passed the fishway since 1948, a counting fence installed above the falls in 1968 recorded only one salmon not enumerated in the fishway. Record migrations in 1973 and 1976 may indicate that the area above the obstruction is beginning, despite its limited utilization, to contribute to the Atlantic salmon production of Lomond River.

Annual migration has improved slightly since 1970, due mainly to large escapements of 218 and 144 fish in 1973 and 1976, respectively. Although these could be partially attributed to the attention given the facility by the counting trap attendant, they also correspond well with the sports fishery. This is particularly evident in 1976 when the catch (675 fish) was approximately 81% higher than in any previous year. Angled catch in 1973 was 341 fish which, although not a record, was substantially higher than catches in the previous 7 years. These high angling catches (1973, 1974, and 1976) may have been due to increased effort, which, in those years, was more than double any previous 5-year mean. The CUE in 1976, which was higher than calculated for 4 of the previous 5 years, may indicate an above average salmon migration. The 1973 CUE of 0.28 was also higher than the previous and following years, although this may have resulted from a slight reduction in effort (Table 28).

The sports fishery data since 1952 indicate, in contrast to fishway counts, that the salmon production in Lomond River is higher than Riche's potential estimates. The river has provided to the sport fishery in excess of 100 fish per year since 1952. Five-year means have reached 318 fish (1962-66) prior to 1970 and have not been below 149 (1952-56). Mean annual catches since 1972 have risen to 385 fish (1972-76) with catches consistently above 250 fish (Table 28). Assuming the sport fishery harvests between 20-25% of total river escapement (Porter 1975), the total run would have to range from 400 to 1500 fish per year. It is unlikely that the population is 1500, although the frequency of 300 plus harvests since 1960 seems to indicate that the population is increasing.

To date, the fishway on Lomond River has had only limited success in passing fish over the falls. It appears though, from years like 1973 and 1976, that given adequate river water levels and proper attention from attendants it can still provide a worthwhile function.

Table 26. Weekly escapement of Atlantic salmon through Lomond River fishway, 1976.

Week (ending)	1976 Escapement			
	grilse	salmon	total	% grilse
12-6-76	0	0	0	0
19-6-76	0	0	0	0
26-6-76	1	0	1	100
3-7-76	12	0	12	100
10-7-76	2	1	3	67
17-7-76	0	0	0	0
24-7-76	0	0	0	0
31-7-76	0	0	0	0
7-8-76	50	3	53	94
14-8-76	54	5	59	92
21-8-76	14	2	16	88
28-8-76	0	0	0	0
Total	133	11	144	92

Table 27. Escapement of Atlantic salmon through the Lomond River fishway, 1961-76.

Year	Grilse	Salmon	Total	% Grilse
1961	10	2	12	83
1962	44	5	49	90
1963	28	3	31	90
1964	24	0	24	100
1965	22	0	22	100
1966	2	0	2	100
1967	0	0	0	0
1968	4	1	5	80
1969	0	0	0	0
1970*	-	-	-	-
1971	6	0	6	100
1972	31	14	45	69
1973	108	110	218	50
1974	41	33	74	55
1975	1	0	1	100
1976	133	11	144	92
Mean 1961-69	15	1	16	94
Mean 1971-76	53	28	81	66

* No count obtained.

Table 28. Angled catch, effort and catch per unit effort of Atlantic salmon, Lomond River, 1952-76.

Year	Effort (rod days)	Catch			CUE	% Grilse
		grilse	salmon	total		
1952	545	194	44	238	0.44	82
1953	359	93	22	115	0.32	81
1954	423	81	27	108	0.26	75
1955	448	113	12	125	0.28	90
1956	306	130	28	158	0.52	82
Mean 1952-56	416	122	27	149	0.36	82
1957	254	116	14	130	0.51	89
1958	359	144	32	176	0.49	82
1959	419	196	65	261	0.62	75
1960	503	124	28	152	0.30	82
1961	403	160	33	193	0.48	83
Mean 1957-61	388	148	34	182	0.47	81
1962	778	201	32	233	0.30	86
1963	811	320	32	352	0.43	91
1964	971	349	24	373	0.38	94
1965	170	292	50	342	2.01	85
1966	347	229	61	290	0.84	79
Mean 1962-66	615	278	40	318	0.52	87
1967	568	217	21	238	0.42	91
1968	454	202	3	205	0.45	99
1969	391	147	5	152	0.39	97
1970	457	145	29	174	0.38	83
1971	217	54	1	55	0.25	98
Mean 1967-71	417	153	12	165	0.40	93
1972	1648	252	35	288	0.17	88
1973	1232	286	55	341	0.28	87
1974	1331	324	19	343	0.26	94
1975	773	258	20	278	0.35	96
1976	2054	650	25	675	0.33	96
Mean 1972-76	1408	354	31	385	0.27	92

TORRENT RIVER Fishway and Counting Fence

Torrent River has a vertical slot fishway located at km 2.4. It was constructed in 1964-65 to provide access over a 7.6 m falls and to open approximately 80 km of previously inaccessible stream habitat to Atlantic salmon. The area was previously occupied only by brook trout, sticklebacks, and eels.

The fishway has been operated from 1965 to 1976 (Fig. 10) with no major problems other than a reluctance of some migrants to enter the facility. The problem was in part attributed to low attraction flow at the fishway entrance and this was remedied in 1976 by removing a baffle and re-directing the attraction flow toward mid-stream. In addition, 11 holes were drilled through the top of the fishway near the entrance. It is hoped that the increased light through these ports will also encourage reluctant migrants.

A temporary counting fence has been operated on Main Parts Brook, a tributary of Torrent River, from 1972 to 1976 to monitor the migration of any transferred (see p. 52) or native salmon (via the fishway) into this tributary. In 1975, it was relocated from km 1.6 to the mouth of the tributary and adapted to enumerate smolts and kelts as well as upstream moving adults. The fence was reinstalled at the mouth in 1976 to continue this monitoring.

DATA

In 1975, the Torrent River fishway was operated from 21 June to 11 October. During this period, 216 adult Atlantic salmon were enumerated of which 88% were grilse (Table 29). Migration commenced on 6 July and concluded 11 October with 59% of the total fishway escapement occurring between 13 July and 2 August. Low water levels and high water temperatures apparently did not affect the migration. The temporary counting fence on Main Parts Brook was installed on 30 May and removed on 23 September. During the downstream monitoring period, 16 smolts, 23 parr, 91 trout, 4 eels, and 2 sticklebacks were enumerated. During the upstream period only 3 adults entered the counting trap. In addition, 223 grilse were transferred to the tributary from Western Arm Brook and released into the upper reaches as spawning stock.

The escapement of 388 salmon in 1976 was substantially greater than 1975, but with the same percentage of grilse. The first fish entered the facility at the same time (6 July) as in 1975. However, the 1976 migration continued until 16 October (Table 29). This extended migration was not unusual for Torrent River as migrants have been previously recorded moving above the falls in mid-November.

The 1976 smolt migration on Main Parts Brook also increased over 1975, 124 smolt being enumerated from 31 May to 29 June. Peak of migration occurred on 12 June when 50 smolts were counted. In addition, 17 parr, 28 trout, and 2 eels were recorded at the fence in 1976. Only two adults were counted on Main Parts Brook tributary from 7 July to 23 September. This count may have been depressed by the low water level which, in July and August, may have made the mouth of the tributary impassable.

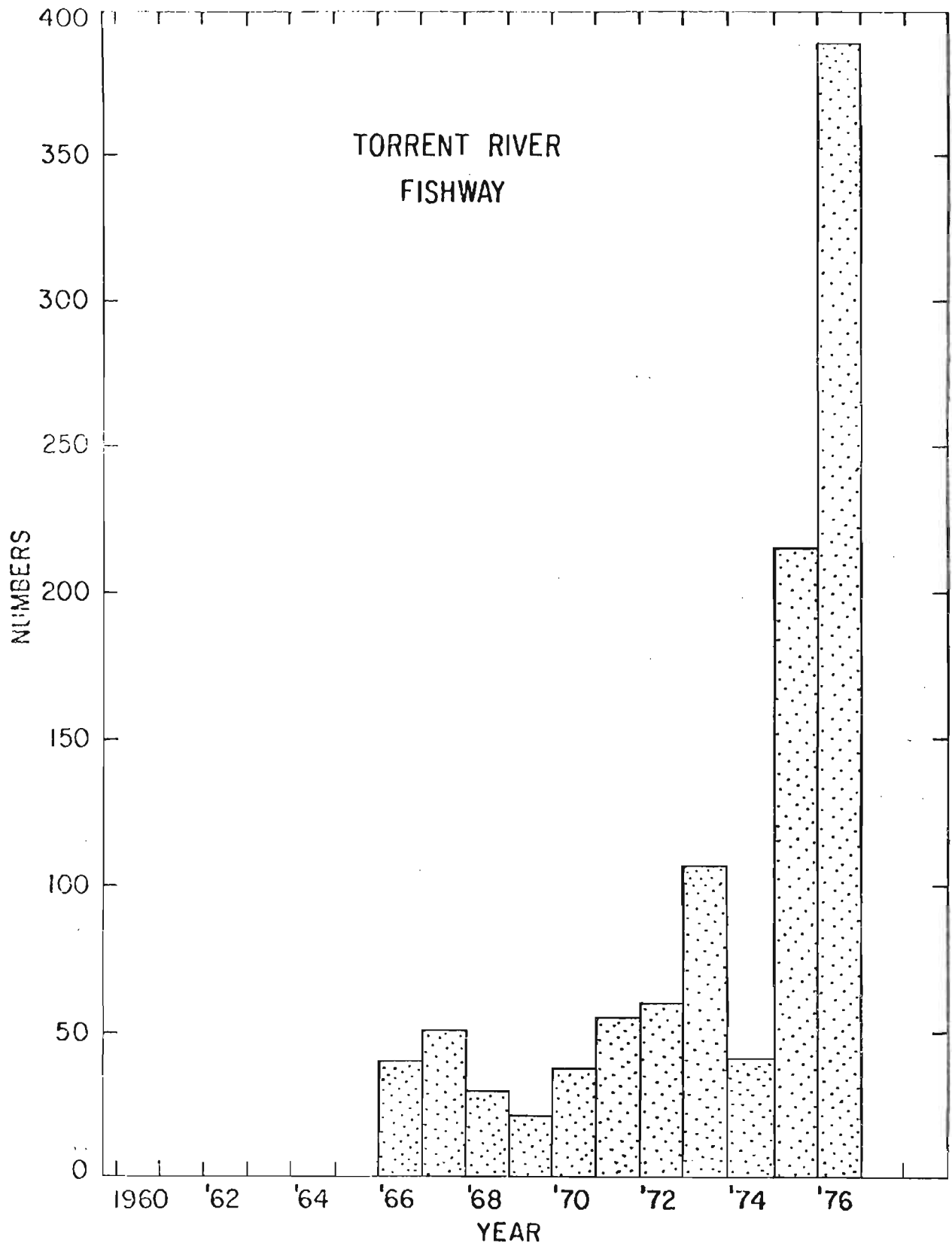


Fig. 10. Escapement of Atlantic salmon through the Torrent River fishway, 1966-76.

Torrent River Project

After the Torrent River fishway was completed in 1966, 60-70% of the Torrent River watershed became accessible to migrating Atlantic salmon. However, during the 5 years of fishway operations, an average of only 36 adult fish utilized the facility (Table 30). This low escapement was originally attributed to the fishway design and operation. However, a spawning survey in 1970 revealed that the population below the fishway numbered only about 250 and not the 1000-1200 fish first thought to reside there. It became apparent that the 360 adults (240 females and 120 males) required to seed the upper watershed could not be provided by the natural population through "straying" (Riche 1973). (Approximately 10% of an indigenous population below an obstruction could be expected to "stray" above if the means were provided (Farwell and Porter 1976).)

In 1970, a program was initiated to find a donor stream to stock Torrent River above the fishway. Initially, it was hoped that Big East River, Hawkes Bay, located approximately 1.6 km north of Torrent River, could provide the necessary fish but, due to extreme fluctuations in discharge on that system, capture facilities could not be operated on it. In 1971, Western Arm Brook, St. Barbe, located approximately 120.7 km from Hawkes Bay, was selected as a donor stream. A transfer program (via tank truck and helicopter) commenced in 1972 and continued annually to 1976 with 56, 203, 83, 223, and 100 fish being moved in successive years. Fluctuations in numbers of fish transferred up to 1975 were due to a small surplus stock at Western Arm Brook where 300 fish were required to maintain adequate production (Riche 1973). The 1976 transfer, which was originally slated to consist of 225 adults, was reduced when it became evident that a substantial natural migration would move through the fishway in that year and supply the bulk of the required spawning stock.

Results of the 5-year transfer program are expected in 1977 when 3-year smolts return to the Torrent River after 1-sea-year. The majority of adult returns from the transferred stock, however, are expected in 1978 when 4-year smolts home to the system.

DISCUSSION

Data available from fishway and fence counts, angling and electroseining give some indication that a population of Atlantic salmon is becoming established in the upper Torrent River watershed. The mean escapement of Atlantic salmon through the fishway since 1970 has increased from 36 fish per year (1966-70) to 96 fish (1971-75) (Table 30). Moreover, escapement in 1975 (216) was 102% higher than the previous record of 107 fish in 1973. The 1976 count was the highest ever recorded and, although the closure of the sport fishery in 1976 may have influenced this record run, the reduction should not have been significant. The sport fishery during the previous 23 years has not exceeded 171 fish with a mean annual angled catch of only 70 (Table 31). Allowing for a maximum harvest of 171 fish, the 1976 migration would have been comparable to 1975 and substantially higher than the previous record migration.

Data from the Main Parts Brook counting fence show no adults counted during the first 3-year operating period (unpublished data). However,

in 1975 and 1976 a total of 5 adults was enumerated. Smolts also not previously observed at the fence numbered 16 and 124 in 1975 and 1976, respectively. Although 1973 remedial work and relocation of the fence in 1975 may have contributed to the appearance of some fish, particularly adults, an increase in population appears certain.

Examination of the 1975 angling data shows an angled catch of 129 fish, the third highest ever recorded. Previous high catches in 1962 and 1963 were taken with angling efforts that exceeded the 1975 effort by 145% and 253%, respectively. The CUE in 1975 was calculated to be 0.35, a substantial increase over the previous 23 years when it was as low as 0.07 and never exceeded 0.25.

Electroseining on Main Parts Brook in 1972, 1973, 1974, 1975, and 1976 showed that the population of salmon has risen over 5 years. When electroseining was first conducted in 1972, no juvenile salmon were detected in Main Parts Brook. In 1973, a juvenile population of 0.1 parr per rearing unit (100 m²) was estimated to occupy the tributary. These fish were either landlocked or progeny from adults that had migrated into the system via the fishway. In 1974, electroseining revealed that the population had increased to 4 parr per unit, possibly due to introduction of Western Arm Brook fish. By 1975, and again in 1976, the concentration of juvenile salmon in the stream rose to an incredible 50.3 parr/unit and 41.9 parr/unit, respectively. The increase is attributed to the progeny of transferred individuals, and indicates that the species has successfully occupied this section of the Torrent River watershed. The reduction in parr per unit in 1976 may in fact be a characteristic of a stabilizing population and/or only a variation in electroseining technique and success.

It is interesting to note that the brook trout population in the tributary did not change significantly during the first 3 years of the transfer program. The trout per unit were calculated to be 24.6, 23.5, and 25.1 respectively in 1973, 1974, and 1975. In 1976, however, their population apparently underwent a drastic reduction, being calculated to number only 11.8 individuals per unit. The reason for the decline is unclear although competition with juvenile salmon, now more numerous and larger, may have been a factor. Lack of food, poor egg to fry survival or adverse environmental conditions may, however, have caused a decline in both populations.

Table 29. Weekly escapement of Atlantic salmon through Torrent River fishway, 1975 and 1976.

Week (ending)	1975 Escapement				Week (ending)	1976 Escapement			
	grilse	salmon	total	% grilse		grilse	salmon	total	% grilse
28-6-75	0	0	0	0	3-7-76	0	0	0	0
5-7-75	0	0	0	0	10-7-76	13	4	17	76
12-7-75	10	0	10	100	17-7-76	77	13	90	86
19-7-75	37	8	45	82	24-7-76	65	10	75	87
26-7-75	33	2	35	94	31-7-76	30	6	36	83
2-8-75	39	8	47	83	7-8-76	37	5	42	88
9-8-75	18	2	20	90	14-8-76	48	5	53	91
16-8-75	16	2	18	89	21-8-76	41	3	44	93
23-8-75	11	0	11	100	28-8-76	12	0	12	100
30-8-75	14	1	15	93	4-9-76	3	0	3	100
6-9-75	7	2	9	78	11-9-76	2	0	2	100
13-9-75	1	0	1	100	18-9-76	3	0	3	100
20-9-75	2	0	2	100	25-9-76	2	0	2	100
27-9-75	0	0	0	0	2-10-76	0	0	0	0
4-10-75	0	0	0	0	9-10-76	7	1	8	88
11-10-75	3	0	3	100	16-10-76	1	0	1	100
Total	191	25	216	88	Total	341	46	388	88

Table 30. Escapement of Atlantic salmon through the Torrent River fishway, 1966-76.

Year	Grilse	Salmon	Total	% Grilse
1966	40	0	40	100
1967	49	2	51	96
1968	29	1	30	97
1969	18	5	23	78
1970	36	2	38	95
1971	51	4	55	93
1972	57	3	60	95
1973	95	12	107	89
1974	38	3	41	93
1975	191	25	216	88
1976	341	47	388	88
Mean 1966-70	34	2	36	94
Mean 1971-75	86	9	96	90

Table 31. Angled catch, effort and catch per unit effort of Atlantic salmon, Torrent River, 1952-76.

Year	Effort (rod days)	Catch			CUE	% Grilse
		grilse	salmon	total		
1952	97	12	6	18	0.19	66
1953	169	4	9	13	0.08	31
1954	187	15	3	18	0.10	83
1955	184	22	15	37	0.20	59
1956	464	51	29	80	0.17	64
Mean 1952-56	220	21	12	33	0.15	76
1957	377	73	21	94	0.25	78
1958	594	24	34	58	0.10	41
1959	585	31	54	85	0.15	36
1960	401	54	32	86	0.21	63
1961	569	37	43	80	0.14	46
Mean 1957-61	505	44	37	81	0.16	54
1962	893	107	37	144	0.16	74
1963	1286	107	64	171	0.13	63
1964	593	66	40	106	0.18	62
1965	455	62	36	98	0.22	63
1966	794	43	13	56	0.07	77
Mean 1962-66	804	77	38	115	0.14	67
1967	598	36	11	47	0.08	77
1968	998	70	7	77	0.08	91
1969	315	41	4	45	0.14	91
1970	227	52	9	61	0.22	85
1971	333	53	5	58	0.17	91
Mean 1967-71	494	50	7	57	0.12	88
1972	306	22	3	25	0.08	88
1973	413	88	3	91	0.22	97
1974	400	58	4	62	0.17	94
1975	364	123	6	129	0.35	95
1976*	-	-	-	-	-	-
Mean 1972-75	371	72	4	77	0.21	95

* Angling prohibited

WESTERN ARM BROOK Counting Fence

In 1971, as part of the Torrent River Atlantic salmon enhancement program, a temporary counting fence was installed on Western Arm Brook, St. Barbe. Its main function was to obtain adult salmon for transfer to Torrent River (Riche 1973) but data on both juvenile and adult salmon populations were also collected. The results and analyses of these data have been published by Chadwick et al. (1978).

The Western Arm Brook counting fence has had no major operational problems since 1971 and all counts obtained are believed to be complete (Fig. 11). Low water levels and high water temperatures, which are observed almost annually, have not greatly affected operations. However, adult salmon are at times reluctant to move past the fence under such conditions. During initial operation in 1971, prolonged holding at high water temperatures in preparation for transfer did result in some fish mortality. In recent years, movement of the adults via helicopter has virtually eliminated such problems. The last transfer was in 1976 (see Torrent River).

DATA

In 1975, the Western Arm Brook counting fence was operated from 23 May to 3 October. Total downstream migration during this period was 9636 smolts, 127 parr, 125 sea-run and 733 resident brook trout, 610 smelt, 145 three spined stickleback, and 95 American eels. There were also 201 previous spawners or kelts recorded of which 199 were tagged and released.

The first smolt recorded in 1975 was on 23 May, the last on the 7th of July. The peak of migration occurred on 19 June when 1984 smolts or 21% of the total migration were enumerated (Fig. 12). The 1975 migration peak was slightly later than in 1973 and 1974 when peaks were recorded on 10 June and 15 June, respectively.

The adult run in 1975 commenced on 29 June and concluded 5 October. A total of 632 adults was enumerated with only one being a large salmon. The peak of the run occurred between 27 July and 2 August (Table 32). Of 223 transferred to Torrent River as part of the enhancement program, 10 succumbed to high water temperatures. Low water levels forced a closure of the sport fishery on 20 July, only 7 grilse being angled prior to this date (Table 33). Installation of an auxiliary fence upstream allowed a complete count to be obtained despite the low water level.

In 1976, the counting fence was operated from 19 May to 26 September. Counts of both smolts and spawning adults were down from the previous year probably due to normal fluctuations in population size. Smolt count in 1976 was 6259 with the first being enumerated on 20 May, and the last on 30 June. The peak of the migration occurred on 22 June, with 39% of the run distributed between 6 and 11 June (Fig. 13). Other fish observed moving downstream in 1976 included 391 sea-run and 17 resident brook trout, 926 smelt, 148 salmon parr, 30 American eels, and 16 sticklebacks.

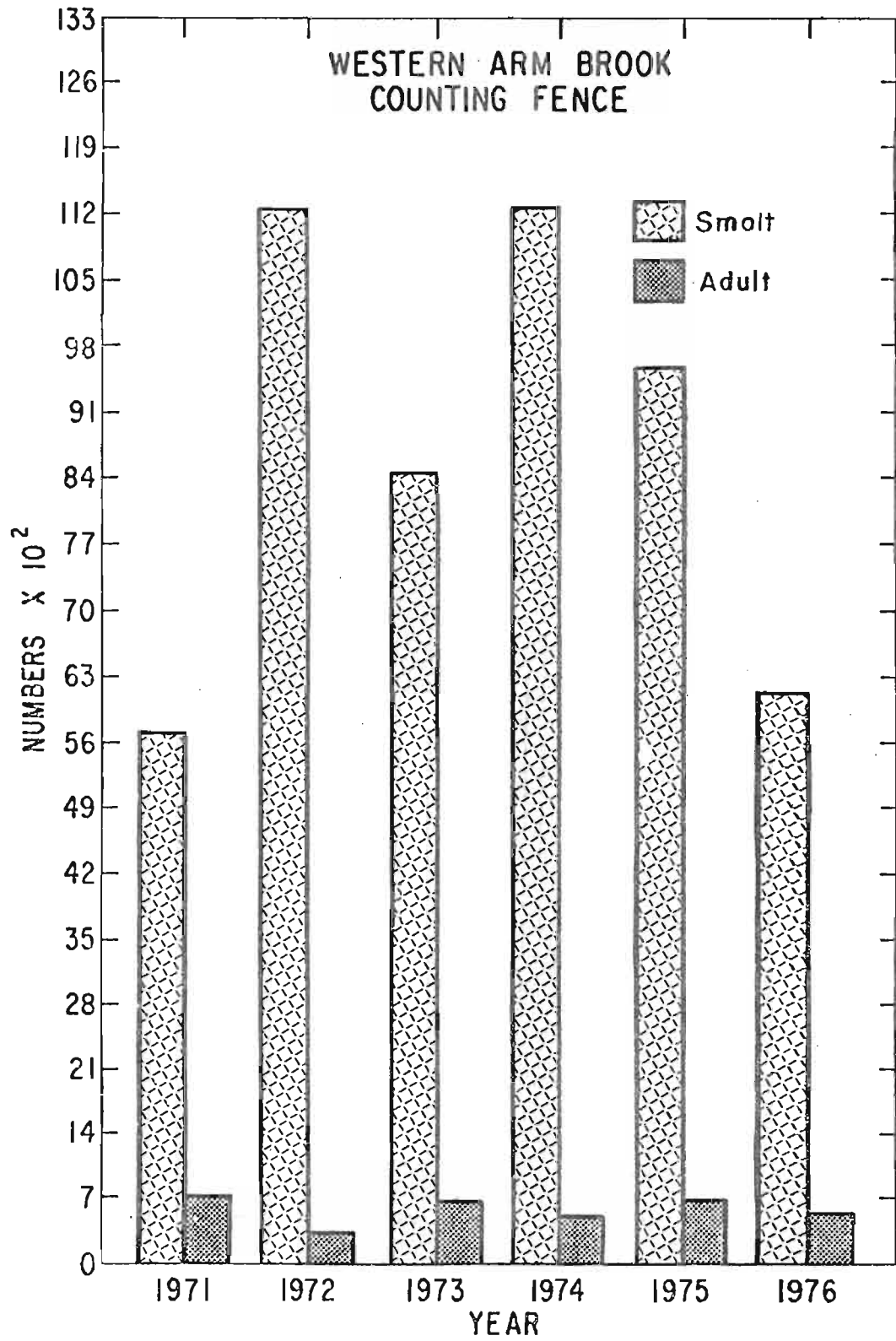


Fig. 11. Escapement of Atlantic salmon adults and smolts through the Western Arm Brook counting fence.

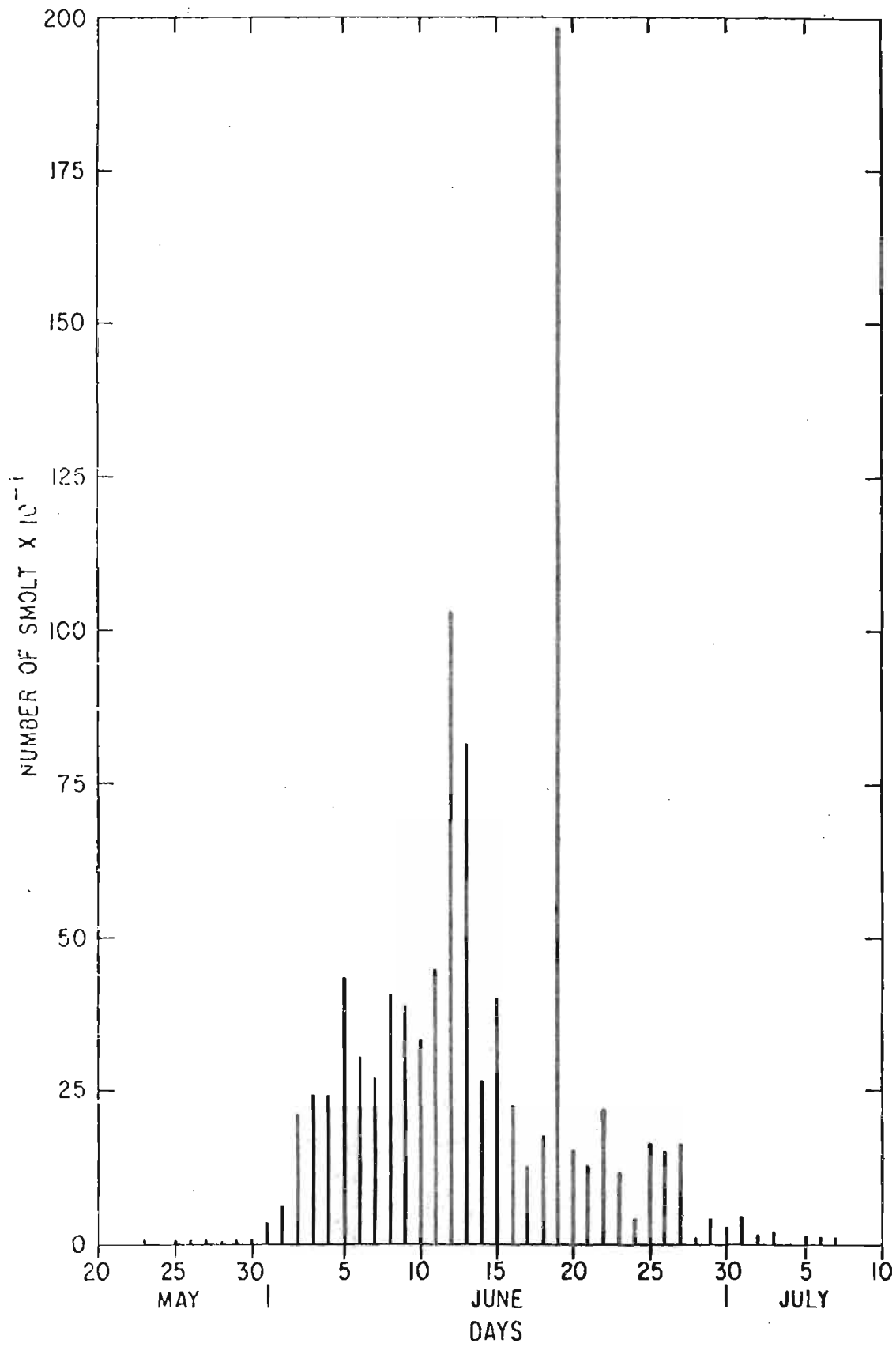


Fig. 12. Smolt count at the Western Arm Brook counting fence in 1975.

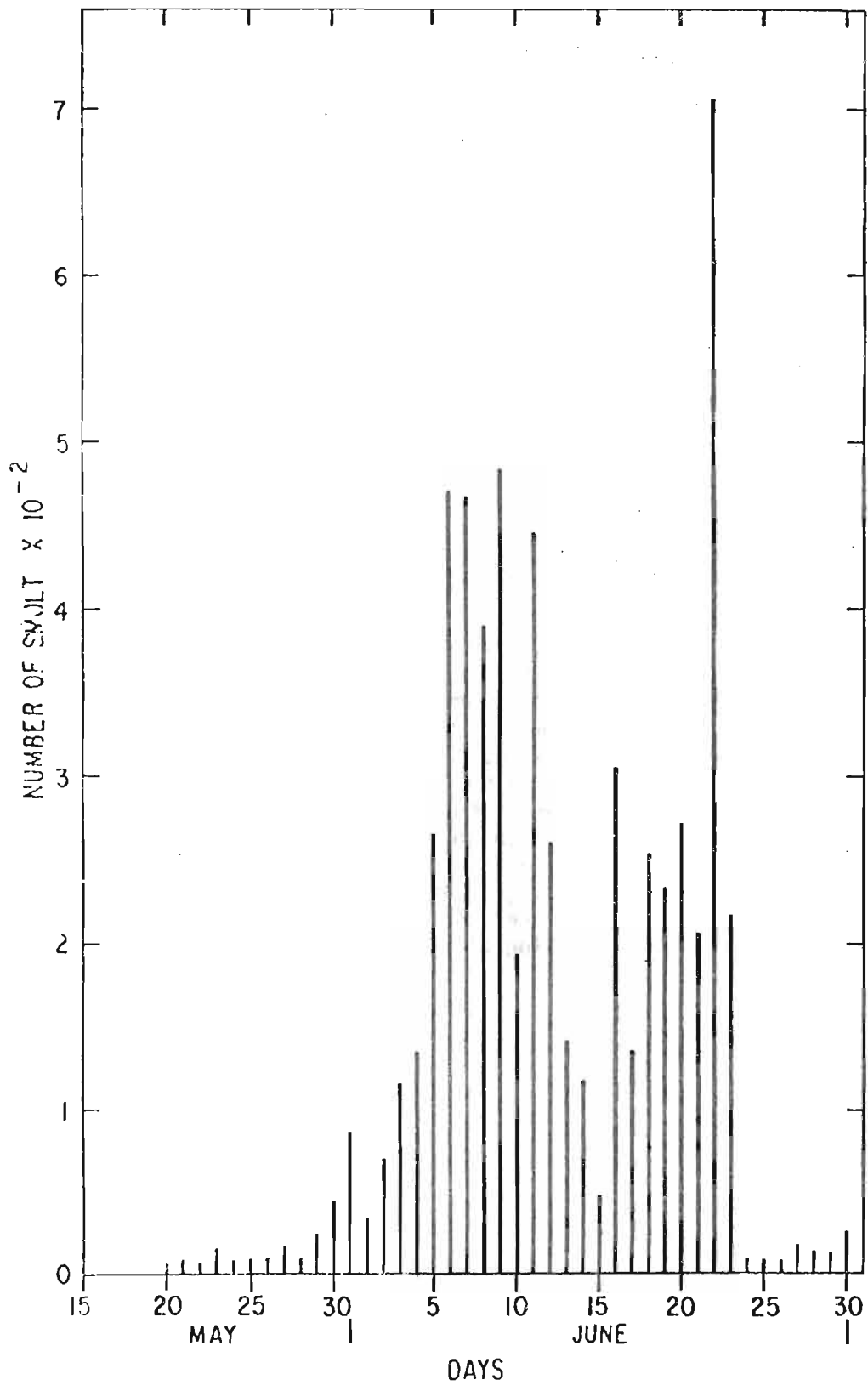


Fig. 13. Smolt count at the Western Arm Brook counting fence, 1976.

There were also 208 kelts counted in 1976 of which 185 were tagged and released downstream from the fence.

The adult Atlantic salmon count in 1976 was 520. All were grilse with the first fish appearing on 27 June and the last on 23 September. Peak of migration occurred during the week ending 14 August, just after the first significant rainfall in 2 months; apparently the timing was delayed due to high water temperatures and extremely low water levels (Table 32).

The sport fishery on Western Arm Brook was again closed prematurely in 1976. It closed on 18 July after water discharge dropped critically and water temperature exceeded lethal levels. The fishing season reopened on 14 August with a total seasonal harvest of 27 grilse being recorded.

DISCUSSION

The Torrent River enhancement project was completed in 1976 with the transfer of the last 100 Atlantic salmon adults. The project appears to have been a success (see p. 52) with a significant increase in salmon population anticipated within the next few years. Data collected at the site have also added to the knowledge of the Atlantic salmon species. Phase-out of the Western Arm Brook fence was scheduled for 1977; however, acquisition of additional data on the effects of population manipulation was thought desirable. At present, there appears to have been no adverse effects on the salmon population in Western Arm Brook from the operations of a temporary counting fence (Table 34). This is in contrast to a similar operation on Little Codroy River which, unfortunately, contributed to a serious decline in salmon stock size. The reason may be related to holding and tagging of seaward bound smolts, a procedure used only in the latter. The preliminary indication is that extended delay and, particularly, handling of smolts may cause significant mortality.

Table 32. Escapement of Atlantic salmon adults through the Western Arm Brook counting fence, 1975 and 1976.

Week (ending)	1975 Escapement			Week (ending)	1976 Escapement		
	grilse	salmon	total		grilse	salmon	total
28-6-75	0	0	0	26-6-76	0	0	0
5-7-75	6	1	7	3-7-76	10	0	10
12-7-75	29	0	29	10-7-76	74	0	74
19-7-75	116	0	116	17-7-76	78	0	78
26-7-75	111	0	111	24-7-76	54	0	54
2-8-75	155	0	155	31-7-76	26	0	26
9-8-75	53	0	53	7-8-76	43	0	43
16-8-75	16	0	16	14-8-76	159	0	159
23-8-75	90	0	90	21-8-76	55	0	55
30-8-75	11	0	11	28-8-76	12	0	12
6-9-75	0	0	0	4-9-76	2	0	2
13-9-75	30	0	30	11-9-76	3	0	3
20-9-75	0	0	0	18-9-76	0	0	0
27-9-75	13	0	13	25-9-76	4	0	4
4-9-75	0	0	0	1-10-76	0	0	0
11-9-75	1	0	1	8-10-76	0	0	0
Total	631	1	632	Total	520	0	520

Table 33. Combined angled catch, effort, and catch per unit effort for Atlantic salmon on Western Arm Brook and Eastern Arm Brook, 1961-76.

Year	Effort (rod days)	Catch			CUE	% Grilse
		grilse	salmon	total		
1961	3	1	0	1	0.33	100
1962	44	38	0	38	0.86	100
1963	97	86	0	86	0.90	100
1964	171	130	0	130	0.76	100
1965	214	123	0	123	0.57	100
1966	273	219	0	219	0.80	100
1967	261	192	0	192	0.74	100
1968	298	176	0	176	0.59	100
1969	296	323	13	336	1.14	96
1970	420	294	42	336	0.80	88
1971	128	205	0	205	1.60	100
1972	100	97	0	97	0.97	100
1973	409	243	0	243	0.59	100
1974	361	124	0	124	0.34	100
1975*	189	44	0	44	0.23	100
1976*	129	32	0	32	0.25	100

* Angling prohibited during part of season

Table 34. Counts of Atlantic salmon adults and smolt at the Western Arm Brook counting fence, 1971-76.

Year	Downstream migration		Upstream migration		
	smolt	kelt	grilse	salmon	total
1971	5734	210	unknown	unknown	732
1972	11906	95	309	9	318
1973	8484	302	555	29	584
1974	12055	199	399	3	402
1975	9636	201	631	1	632
1976	6259	208	520	0	520
Mean	9012	203	474	58	531

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