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**THE STATUS OF THE ATLANTIC SALMON STOCK  
OF HUMBER RIVER/BAY OF ISLANDS  
NEWFOUNDLAND**

by

**G. Chaput  
and  
C. Mullins**

**Science Branch, Gulf Region  
Department of Fisheries & Oceans  
P.O. Box 5030  
Moncton, New Brunswick, E1C 9B6**

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## ABSTRACT

The Humber River/Bay of Islands area is situated in western Newfoundland at the northern limit of Salmon Fishing Area 13. Bay of Islands commercial catch has averaged 7,420 small salmon (30% of SFA 13 catch) and 789 large salmon (18% of SFA 13 catch) by number between 1987 and 1990. Recreational catch of small salmon in 1990 from Humber River was 3,106 (46% of SFA 13 catch and 98% of Bay of Islands catch). Since 1985, recreational catch of small salmon has averaged 2,843 compared to 3,471 between 1976 and 1984. A total of 274 salmon (8% were large salmon,  $\geq 63$  cm fork length) were captured in the trapnet set at Wilds Cove, Humber Arm between June 9 and August 2, 1990. Of 214 small salmon marked and released, 27 tags were returned from the angling fishery, giving a minimum, unadjusted exploitation rate of 13.4%. After adjusting for estimates of tag loss/tagging mortality and nonreporting rate, an exploitation rate on small salmon of 25% was estimated. Egg deposition requirements for the Humber River were estimated at 27.7 million eggs or 18,452 salmon (small and large combined). Using the estimates of exploitation rate obtained in 1990, target egg depositions have been attained in 5 of 6 years at the minimum exploitation rate of 13.4%, but have never been attained at 25% exploitation rate. In 1990, egg depositions were estimated to have been 52% of requirement.

## RESUME

La rivière Humber et la région côtière de Bay of Islands sont situées sur la côte ouest de la province de Terre-Neuve, à l'extrémité nord de la Zone de Pêche au Saumon 13. Les débarquements de la pêche commerciale de la région de Bay of Islands sont, en moyenne, de 7,420 saumons de petite taille et 789 grands saumons (30% et 18% des débarquements de la Zone 13 respectivement) de 1987 à 1990. Les prises par la pêche sportive sur la rivière Humber en 1990 ont atteint 3,106 madeleinaux (taille inférieure à 63 cm) et représentaient 46% et 98% des prises sportives de la zone 13 et de la région de Bay of Islands respectivement. Les prises moyennes de madeleinaux de la rivière Humber ont été de 2,843 poissons de 1985 à 1989 contre 3,471 de 1976 à 1984. Du 9 juin au 2 août 1990, 274 saumons ont été capturés au filet-trappe, installé à Wilds Cove, dont 22 (8%) étaient de taille supérieure à 63 cm. Un total de 214 madeleinaux ont été marqués et relâchés. 27 recaptures ont été déclarées de les pêcheurs récréatif. Le rapport entre les étiquettes retournées et les saumons marqués implique un taux d'exploitation minimal de 13,4%. Des ajustements pour pertes d'étiquettes, mortalités de poissons marqués, ainsi que pour déclaration incomplète des recaptures, donnent un taux d'exploitation ajusté de 25% pour les madeleinaux en 1990. Le "niveau cible" d'oeufs requis pour la rivière Humber est de 27,7 millions d'oeufs, soit 18,452 saumons toutes tailles confondues. Pour les années 1985-90, l'utilisation d'un taux d'exploitation de 13,4% (calculé en 1990), conduit à estimer que pour 5 des 6 années, le "niveau cible" a été atteint. Un taux d'exploitation de 25% ne permet jamais d'atteindre ce même niveau. En 1990, pour un taux d'exploitation de 25%, le dépôt potentiel d'oeufs n'a représenté que 52% du "niveau cible".

## INTRODUCTION

The Bay of Islands coastal area is situated in western Newfoundland at the northern limit of Salmon Fishing Area 13 (SFA 13) (Fig. 1). Atlantic salmon are exploited commercially in the coastal areas while the recreational fishery harvests grilse in 3 of the 4 tributaries within the bay, the largest one being Humber River. The Humber River/Bay of Islands area is one of four river systems within Gulf Region, selected for a pilot study of the River/Zone Management Strategy.

The present document addresses three topics regarding the Atlantic salmon stock(s) of the Humber River/Bay of Islands region.

- 1) Descriptions of historical catch from the commercial and recreational fisheries in Bay of Islands and Humber River.
- 2) Description of a tagging program undertaken in 1990 to estimate the exploitation rate in the recreational fishery.
- 3) Description of the spawning requirements for the Humber River and an assessment of the spawning escapement to the Humber River in 1990.

## BACKGROUND

The Humber River flows into Humber Arm at latitude 48° 57' N and longitude 57° 53' west. Total drainage area of the tributaries flowing into Bay of Islands is 8124 km<sup>2</sup>, which is 93% of drainage area of Statistical area L and 57% of SFA 13 tributary drainage area. The Humber River comprises 95% of the Bay of Islands drainage area. Total length of all streams in the Humber River is 2450.5 km. Complete obstructions to migration within the Humber River include falls (Main Falls) at kilometre 112.6 from the mouth of the river and the power house at Junction Brook which obstructs all migrations into the Grand Lake system flowing into Deer Lake (Porter et al. 1974) (see Fig. 2).

## MATERIALS AND METHODS

Commercial catch statistics were compiled from purchase slip and Supplementary 'B' forms. Descriptions of methods used to process these data are provided in Claytor and Mullins (1990). Salmon Fishing Areas (SFA), statistical areas and sections and geographic areas used in the descriptions of catch are summarized in Table 1 and Figure 1.

Recreational catch statistics were compiled from DFO fisheries officer and guardian reports. Treatment of these data has been described in Mullins and Claytor (1989) and Mullins et al. (1989). Catch and effort for the Humber River are presented by river section (Fig. 2). Commercial and recreational harvest statistics are presented by standardized week (Table 2).

Between June 9 and August 2, 1990, a trapnet was fished at Wilds Cove, Humber Arm across from Corner Brook (Figure 1). The trapnet was constructed of 5.7 cm stretched mesh knotless netting of dimensions 18.9 m long by 3.7 m wide by 4.3 m deep. An inside run to shore of 7.6 cm netting, 90 m in length,

and an outside run into the channel of 7.6 and 5.7 cm mesh formed the wings of the trap. Effective depth of water at the trap ranged between 3.0 and 4.3 m of water. The opening faced into Humber Arm.

All Atlantic salmon captured at the trapnet were measured (fork length cm), scale sampled and marked with individually numbered blue Carlin tags using a single stainless steel wire attachment.

## RESULTS

### Commercial Catch

Commercial fishery seasons for area L have not changed substantially since 1978 (Table 3). In 1990, a quota of 35 metric tons was added to the seasonal closure of July 10, whichever came first. Numbers of licenses and licensed gear units have generally declined in Area L since 1975 passing from a peak potential effort of 412 in 1975 to 120 in 1985. Potential effort in Area L in 1990 was 43 licenses and 172 licensed gear units (Table 4).

Commercial catch of small salmon, by number, in Area L has ranged from a low of 2,046 in 1976 upwards to 14,651 in 1986 and has averaged 7,946 between 1984 and 1989 (Table 5). In 1990, 5,325 small salmon were harvested, representing 67% of the 1984 to 1989 mean catch (Table 5). Large salmon catch by number has ranged between 476 to 1,986. The 1990 large salmon catch of 758 represented 63% of the 1984 to 1989 mean catch. Area L catch has accounted for approximately 30% of SFA 13 catch (Table 5).

The Bay of Islands catch has represented approximately 92% of Area L small salmon catch and 79% of large salmon catch in the last 5 years (Table 6). Between 1987 and 1989, North Arm accounted for 53% to 85% of Bay of Islands catch by number, Humber Arm 11% to 22% and South Arm 1% to 11% (Table 6). Local sales estimates have represented between 6% and 17% of total Bay of Islands catch between 1987 and 1990 (Table 6).

In 1990, the weeks of maximum catch of small salmon (by number) were similar among the three areas, which contrasts with large salmon catch which occurred two weeks later in South Arm compared to the other two areas (Table 7). At Humber Arm and North Arm, large salmon peak catch occurred two weeks earlier than small salmon peak catch (Table 7). Peak catches in 1990 were approximately one week later than in 1989 (Table 7).

### Recreational Catch

The recreational catch of 1SW salmon from Bay of Islands tributaries ranged between 876 (1954) and 6153 (1975) and has accounted for a significant proportion of the grilse catch from SFA 13 (23.9 to 55.9%) and for the majority of the catch from Area L and Section 44 (78 to 100%) (Table 8). The number of large salmon angled from Bay of Islands tributaries prior to 1984 ranged between 27 (1979) and 553 (1970), accounting for a smaller proportion of SFA 13, Area L and Section 44 catches than did small salmon catch (Table 8). Humber River accounts for almost 100% of Bay of Islands catch of small and large salmon (Table 9). Small salmon catches from Cooks Brook and Goose Arm have been minimal since 1974 (Table 9).

Total effort on the Humber River in 1990 was 87% of pre-1985 mean and 93% of previous 5 year mean. The small salmon catch was estimated at 3054, 107% of 1985-1989 mean and 88% of pre-1985 mean (Table 10). Angling effort and catch has been concentrated at Big Falls (Fig. 2) accounting for between 23% and 48% of total Humber River effort, 23% to 65% of small salmon catch and 19% to 88% of large salmon

catch between 1974 and 1990 (Table 10). The distribution of the effort and catch on the Humber changed in 1990 relative to recent and historical distributions. The lower sections of the river (Lower Humber and Deer Lake) as well as Adies Stream received lower effort relative to previous 5 year mean effort (Table 10). Effort increased dramatically at Harriman's Steady (Table 10). Relative to pre-1985 effort distribution, Adies Lake and Harriman's Steady effort increased whereas lower effort was noted at Lower Humber, Deer Lake and Adies Stream (Table 10). Changes in distribution of grilse catches have been similar to the changes in effort. Catch of grilse at Harriman's Steady in 1990 was 242% of previous 5 year mean catch from that area, accounting for 25% of Humber River catch in contrast to 11% between 1985 and 1989 (Table 10). The imposition of hook and release management measures since 1985 makes it impossible to compare recent large salmon catches to historical catches.

The timing of effort and catch varies between sections on the river although among years, the week of peak effort and catch has been relatively constant (Table 11). Weeks encompassing 10% to 90% effort and catch intervals were more variable between years, 80% of effort on the Humber occurring over an 8 week period in 8 years between 1976 and 1990 while 80% of the grilse catch occurred during 7 weeks in 8 years out of 15 (Table 11).

### **Biological Characteristics and Estimation of Exploitation Rate**

Between June 9 and August 2, 1990, a total of 274 Atlantic salmon were captured in the trapnet at Wilds Cove, Humber Arm. Of these, 22 (8%) were large salmon (> 63 cm fork length). The small salmon had a mean fork length of 54.7 cm ( Fig. 3). Large salmon ranged up to 92 cm fork length with a mean length of 72.6 cm (Fig. 3). Of 29 grilse which were sacrificed, 69% were female. Smolt age distribution of the small salmon was 3% age 2, 87% age 3 and 10% age 4. Large salmon smolt ages were 5% age 2, 81% age 3 and 14% age 4.

Grilse catch occurred in four peaks, the most prominent one on July 7 (week 27) (Fig. 3). Large salmon catch was bimodal with a first peak during week 24 and a second peak in late summer during week 31 (Fig. 3). Catches at the trap increased substantially during week 27 which coincided with the closure of the commercial fishery in Bay of Islands in the early part of week 27 (July 3 midnight).

Of 214 small salmon tagged and released, 3 tags were returned from the commercial fishery, 12 were accounted for at counting fences and 27 were returned by anglers (Table 12). A total of 22 large salmon were tagged and released of which 2 were reported angled from the recreational fishery (Table 12).

Recaptures from the recreational fishery were evenly distributed across all tag groups, ranging between 8% and 23% of fish tagged (Table 12). Time at large prior to recapture varied according to section of river with the shortest times in the lower sections of the river and increasing with distance from the estuary (Table 13). The longest time before recapture in the recreational fishery was from Taylor's Brook (8 weeks) whereas the longest overall times were from the counting fence at Hughes Brook (11 weeks) (Table 13).

A minimum exploitation rate estimate was obtained using tag returns to tagged fish, without adjusting for tag loss/tagging mortality and nonreporting. Of the 214 small salmon marked and released, 12 never entered the river (3 from commercial, 9 from Hughes Brook). Of these 202 potential tags, 27 were returned by anglers, yielding a minimum exploitation rate of 13.4% on small salmon.

The exploitation rate adjusted for tag loss/tagging mortality and nonreporting was 25%. Tag loss/tagging mortality was estimated using the ratio of marked grilse to counts at the two counting fences. The North Brook counting fence was situated at the upper end of Deer Lake, (38 km upstream) whereas Hughes Brook was less than 2 km from the trapnet within the estuary. The longest times at large were obtained from Hughes Brook fish suggesting that tag loss was probably minimal for fish which did not undertake a lengthy

migration upriver. The resultant estimate for tag loss/mortality is 23% (Table 14). Available tags is therefore adjusted by a factor of 0.77 giving 156 tags available to the recreational fishery. This estimate of tag loss/mortality is based on the assumption that the trapnet captured similar proportions of Hughes Brook and North Brook fish, and by extension, Humber River fish.

An estimate of reporting rate was obtained by comparing the tag returns to harvest from Deer Lake section and the tags to counts at North Brook fence. These two sites are in close proximity to each other and a similar tag loss/mortality factor would be expected to have impacted on tagged salmon arriving at those sites. The overall reporting rate from the recreational fishery was estimated to be 69.8% (Table 14). Adjusted number of tags recovered in the angling fishery is therefore 39 (27 divided by 0.698). Using the adjusted tags available and the adjusted tags recovered, the exploitation rate was estimated at 25%.

### **Spawning Requirements for Humber River, Bay of Islands**

Minimum spawner requirements (minimum number of females to produce the required egg deposition) for the Humber River has been estimated at 18,452 salmon and Bay of Islands spawning requirements is 24,682 salmon (Porter and Chadwick 1983) (Tables 15 & 16). To ensure 1:1 sex ratio, minimum requirements would be increased by 18% equivalent to 21,756 salmon for Humber River (Table 16) and 29,125 for Bay of Islands.

### **Spawning Escapement to Humber River and Bay of Islands**

Spawning escapement to Humber River since 1985 was estimated from angling harvest and exploitation rates. Large salmon ( $\geq 63$  cm) angling catch since 1984 was not considered appropriate because of the imposition of hook and release regulations. Predicted catch of large salmon in 1985 to 1990 was estimated from the ratio large to small salmon catch based on smolt class escapement (large salmon catch year  $i$  / small salmon catch year  $i-1$ ). Using angling data from the Humber River for the years 1953 to 1983 gave an estimated large salmon catch equivalent to 7% of small salmon recreational catch. Egg depositions achieved were estimated from small and large salmon escapement.

Since 1985, target egg depositions for the Humber River have been attained or exceeded in 5 of the last 6 years when the minimum exploitation rate (ER) (13.4%) value is used (Table 17). Of the management measures which could have been instigated, including closure of the recreational fishery, closure of the commercial fishery in Humber Arm and in combination, target egg depositions would only have been attained at the adjusted (25%) and the upper (40%) ER values in 1987 and 1988 (Table 17). In 1990, Hughes Brook received 50% of required spawners which would suggest that the exploitation rate in the angling fishery is somewhere between 25% and 40% (Table 17).

## **DISCUSSION**

On the basis of the present spawning requirements, it is evident that the Humber River and the Bay of Islands rivers have been and remain underseeded. At an exploitation rate of 25%, an angling catch of 6,900 salmon would ensure sufficient spawners for the Humber River. This value has never been attained since 1953 although 1975 angling catch of 6,147 would have provided a calculated escapement of 89% of requirements.

An estimated escapement of 52% of spawning requirements in 1985 resulted in 52% spawning escapement in 1990. Returns in 1991 should be above 1990 values since 1986 escapement was 65% of requirements. Strong returns are expected in 1993 (from the 1988 escapement) whereas 1994 returns would be low resulting from the low escapement in 1989.

The assessment of the Humber River salmon stock would be improved by further refining the exploitation rate of the recreational fishery and validating the harvest statistics.

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Table 1. Boundaries of Statistical Areas and Statistical Sections of Salmon Fishing Area (SFA) 13 and communities within coastal areas of Bay of Islands.

Statistical Area	Section	Boundary
K	40	Cape Ray to Sandy Point
	41	Sandy Point to Cape St. George
L	42	Cape St. George to Long Point
	43	Long Point to Bluff Head
	44	Bluff Head to Cape St. Gregory

Section 44		
Bay of Islands Coastal Areas	Community Code	Map Index Figure 1
Bay of Islands South		
Lark Harbour	4402	2
York Harbour	4403	3
Woods Island	4424	4
Humber Arm		
Frenchman's Cove	4404	5
Benoits Cove	4405	6
Irishtown	4410	7
Summerside	4411	8
Meadows	4412	9
Gillams	4413	10
McIvers	4414	11
North Arm		
Cox's Cove	4415	12
North Arm	4426	13

Table 2. Standardized weeks used for summarizing catch and effort data.

Week	Time Period
18	April 30 to May 6
19	May 7 to 13
20	May 14 to 20
21	May 21 to 27
22	May 28 to June 3
23	June 4 to 10
24	June 11 to 17
25	June 18 to 24
26	June 25 to July 1
27	July 2 to 8
28	July 9 to 15
29	July 16 to 22
30	July 23 to 29
31	July 30 to Aug. 5
32	Aug. 6 to 12
33	Aug. 13 to 19
34	Aug. 20 to 26
35	Aug. 27 to Sept. 2
36	Sept. 3 to 9
37	Sept. 10 to 16
38	Sept. 17 to 23
39	Sept. 24 to 30
40	Oct. 1 to 7



Table 3. Atlantic salmon commercial fishing seasons for Area L.

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prior to 1978	15 May to 31 Dec.
1979 - 1983	1 June to 10 July
1984 - 1989	5 June to 10 July
1990	5 June to 10 July or 35 metric tons

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Table 4. Licensed gear units and total commercial licenses for Area L, 1975 to 1990. One licensed gear unit equals 50 fathom of gillnet.

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Year	Area L	
	Licensed Gear Units	Commercial Licenses
1975	412	140
1976	301	111
1977	270	97
1978	264	100
1979	247	93
1980	254	95
1981	253	94
1982	196	86
1983	258	82
1984	196	66
1985	120	30
1986	184	46
1987	184	46
1988	176	44
1989	148	37 *
1990	172	43

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\* as of April 1989

Table 5. Commercial catch of small and large salmon for SFA 13 and Area L, 1974 to 1990.

By Number	SFA 13			Area L			% of SFA 13		
	Small	Large	Total	Small	Large	Total	Small	Large	Total
1974	12858	5009	17867	2415	1414	3829	18.8	28.2	21.4
1975	8422	3289	11711	2816	858	3674	33.4	26.1	31.4
1976	15353	4573	19926	2046	825	2871	13.3	18.0	14.4
1977	14633	6482	21115	2657	1524	4181	18.2	23.5	19.8
1978	10136	3563	13699	2735	991	3726	27.0	27.8	27.2
1979	13661	1938	15599	3111	476	3587	22.8	24.6	23.0
1980	19554	5234	24788	8113	1818	9931	41.5	34.7	40.1
1981	15327	2260	17587	4230	687	4917	27.6	30.4	28.0
1982	11341	2425	13766	4875	993	5868	43.0	40.9	42.6
1983	12431	2936	15367	4203	647	4850	33.8	22.0	31.6
1984	14832	3294	18126	5757	1482	7239	38.8	45.0	39.9
1985	10144	2998	13142	3531	836	4367	34.8	27.9	33.2
1986	29675	6704	36379	14651	1986	16637	49.4	29.6	45.7
1987	24444	4655	29099	8310	851	9161	34.0	18.3	31.5
1988	32492	4295	36787	10668	1060	11728	32.8	24.7	31.9
1989	16491	4190	20681	4968	1093	6061	30.1	26.1	29.3
1990	16650	3226	19876	5325	758	6083	32.0	23.5	30.6
Minimum	8422	1938	11711	2046	476	2871	13.3	18.0	14.4
Maximum	32492	6704	36787	14651	1986	16637	49.4	45.0	45.7
Mean (74-89)	16362	3990	20352	5318	1096	6414	31.2	28.0	30.7

By Weight (kg)	SFA 13			Area L			% of SFA 13		
	Small	Large	Total	Small	Large	Total	Small	Large	Total
1974	19784	22886	42670	4114	7076	11190	20.8	30.9	26.2
1975	13220	15320	28540	4808	4145	8953	36.4	27.1	31.4
1976	24960	20176	45136	3683	3716	7399	14.8	18.4	16.4
1977	24199	29361	53560	5043	7064	12107	20.8	24.1	22.6
1978	17300	16247	33547	5465	4679	10144	31.6	28.8	30.2
1979	23091	8765	31856	6220	2189	8409	26.9	25.0	26.4
1980	40230	24826	65056	16200	8756	24956	40.3	35.3	38.4
1981	27232	10514	37746	8309	3577	11886	30.5	34.0	31.5
1982	19742	11188	30930	9317	4711	14028	47.2	42.1	45.4
1983	20336	12227	32563	7896	3164	11060	38.8	25.9	34.0
1984	27274	15120	42394	10939	6964	17903	40.1	46.1	42.2
1985	18612	13662	32274	6709	3931	10640	36.0	28.8	33.0
1986	51465	27859	79324	26808	8170	34978	52.1	29.3	44.1
1987	45042	21279	66321	16495	3911	20406	36.6	18.4	30.8
1988	57744	19848	77592	21246	4541	25787	36.8	22.9	33.2
1989	27729	18523	46252	9508	5189	14697	34.3	28.0	31.8
1990	29067	13942	43009	10647	3288	13935	36.6	23.6	32.4
Minimum	13220	8765	28540	3683	2189	7399	14.8	18.4	16.4
Maximum	57744	29361	79324	26808	8756	34978	52.1	46.1	45.4
Mean (74-89)	28623	17988	46610	10173	5111	15284	34.0	29.1	32.3

Table 6. Commercial catch by number and weight from Bay of Islands coastal areas and % local sales, 1987 to 1990.

Year	Coastal Areas									
	Bay of Islands		% of Area L		Bay of Islands S.		Humber Arm		North Arm	
	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
<b>By Number</b>										
1987	8060	728	97.0	85.5	30	15	834	146	7196	567
1988	9989	824	93.6	77.7	132	47	2268	155	7589	622
1989	4211	815	84.8	74.6	601	75	900	264	2710	476
1990	4983	579	93.6	76.4	521	24	1108	185	3354	370
<b>1987-1989</b>										
Mean	7420	789			254	46	1334	188	5832	555
<b>By Weight(kg)</b>										
1987	16000	3339	97.0	85.4	60	71	1670	693	14270	2575
1988	19894	3522	93.6	77.6	263	200	4358	704	15273	2618
1989	8064	3878	84.8	74.7	1000	334	1654	1204	5410	2340
1990	9963	2485	93.6	75.6	1035	87	2218	823	6710	1575
<b>1987-1989</b>										
Mean	14653	3580			441	202	2561	867	11651	2511

% Local Sales of All Salmon (kg)

Year	Coastal Areas							
	Bay of Islands		Bay of Islands S.		Humber Arm		North Arm	
	Weight	% Local	Weight	% Local	Weight	% Local	Weight	% Local
<b>By Numbers</b>								
1987	19339	16.9	131	100.0	2363	27.1	16845	14.8
1988	23416	14.0	463	100.0	5063	38.8	17891	4.8
1989	11942	13.6	1334	6.1	2858	38.6	7750	5.6
1990	12448	6.4	1122	0.0	3014	15.2	8284	4.1

Table 7. Timing of small and large salmon commercial catch by coastal area of the Bay of Islands, 1989 to 1990.

	Week of Maximum Catch	
	Small	Large
<b>By Number</b>		
1987 Bay of Islands South	27 & 28	27 & 28
Humber Arm	25	25
North Arm	26	26
1988 Bay of Islands South	23 to 25	23 to 25
Humber Arm	26	26
North Arm	26	26
1989 Bay of Islands South	25	24
Humber Arm	25	24
North Arm	25	23
1990 Bay of Islands South	26	26
Humber Arm	26	24
North Arm	26	24
<b>By Weight</b>		
1987 Bay of Islands South	27 & 28	27 & 28
Humber Arm	25	25
North Arm	26	26
1988 Bay of Islands South	23 to 25	23 to 25
Humber Arm	26	26
North Arm	26	26
1989 Bay of Islands South	25	24
Humber Arm	25	24
North Arm	25	23
1990 Bay of Islands South	26	26
Humber Arm	26	24
North Arm	26	24

Table 8. Recreational catch of 1SW and MSW Atlantic salmon from the Bay of Islands region, 1973 to 1990.

Year	Recreational Catch of 1SW				Recreational Catch of MSW			
	Bay of Islands	Bay of Islands, % of			Bay of Islands	Bay of Islands, % of		
		SFA 13	AREA L	Sec 44		SFA 13	Area L	Sec 44
1953	1260	28.0	90.7		149	11.5	64.8	
1954	876	34.1	88.1		137	15.8	69.9	
1955	1391	38.0	90.7		139	17.2	72.0	
1956	1103	23.9	77.7		114	7.9	40.3	
1957	1786	26.3	81.1		91	4.8	31.1	
1958	1687	33.1	87.9		195	9.9	47.6	
1959	1999	41.0	90.6		187	14.3	49.3	
1960	1943	31.9	90.0		179	19.3	55.2	
1961	1884	31.5	92.0		134	10.9	51.5	
1962	2411	25.6	82.0		110	7.5	32.7	
1963	3932	31.1	92.7		162	6.4	54.2	
1964	4832	33.7	89.6		273	10.8	42.0	
1965	4071	38.7	92.8		193	10.0	50.1	
1966	4118	51.0	93.0		322	17.1	74.4	
1967	2344	28.9	93.7		160	8.7	59.9	
1968	2477	29.6	90.1		96	8.4	59.3	
1969	4960	40.8	96.1		485	29.9	89.5	
1970	3445	35.4	96.1		553	33.7	93.1	
1971	4041	42.4	96.6		375	35.9	97.4	
1972	4065	48.4	97.2		221	20.0	95.3	
1973	3726	36.3	97.1	97.5	328	23.6	88.2	88.9
1974	2745	38.2	95.7	97.5	107	11.7	62.2	85.6
1975	6153	51.3	98.7	98.9	114	12.9	87.7	94.2
1976	5129	49.4	97.5	97.5	65	10.4	90.3	90.3
1977	2238	33.3	95.0	95.0	45	4.3	81.8	81.8
1978	2725	51.5	92.0	92.0	187	21.9	72.5	72.5
1979	3361	55.9	97.8	97.8	27	23.9	93.1	93.1
1980	3531	44.6	95.4	95.4	305	30.7	95.3	95.3
1981	4148	44.6	94.5	95.9	153	23.1	93.9	95.0
1982	4313	45.1	95.4	96.3	96	16.1	76.2	81.4
1983	3152	49.7	96.6	97.5	47	7.7	83.9	90.4
1984	2872	37.0	98.2	98.8	40	12.9	85.1	87.0
1985	2430	45.8	100.0	100.0	11	4.3	100.0	100.0
1986	3456	47.0	98.0	100.0	261	37.8	100.0	100.0
1987	3093	51.4	96.3	97.5	113	33.0	89.7	89.7
1988	4093	49.8	93.4	95.6	144	35.5	81.8	91.7
1989	1312	41.3	90.0	92.5	11	8.4	42.3	42.3
1990	3106	46.4	93.5	96.0	75	22.5	84.3	85.2

Data Sources: 1953 to 1986, Mullins et al. (1989).  
 1987 to 1988, Mullins and Claytor (1989).  
 1989, Claytor and Mullins (1990).

Table 9. Recreational catch of 1SW and MSW Atlantic salmon from Bay of Islands rivers, 1953 to 1990.

Year	1SW				Humber % of Bay of Islands	MSW				Humber % of Bay of Islands
	Humber River	Hughes Brook	Cooks Brook	Goose Arm		Humber	Hughes	Cooks	Goose Arm	
1953	1260	0	0		100	149	0	0		100
1954	876	0	0		100	137	0	0		100
1955	1376	0	0	15	99	138	0	0	1	99
1956	1076	0	0	27	98	110	0	0	4	96
1957	1778	0	0	8	100	89	0	0	2	98
1958	1686	0	0	1	100	194	0	0	1	99
1959	1996	0	0	3	100	187	0	0	0	100
1960	1938	0	0	5	100	178	0	0	1	99
1961	1867	0	0	17	99	134	0	0	0	100
1962	2390	0	0	21	99	108	0	0	2	98
1963	3898	0	0	34	99	160	0	0	2	99
1964	4681	0	125	26	97	268	0	3	2	98
1965	3951	0	98	22	97	193	0	0	0	100
1966	3989	0	43	86	97	322	0	0	0	100
1967	2252	0	71	21	96	160	0	0	0	100
1968	2168	57	236	16	88	96	0	0	0	100
1969	4459	74	416	11	90	478	7	0	0	99
1970	2785	211	423	26	81	526	27	0	0	95
1971	3949	44	48	.	98	375	0	0	.	100
1972	3961	55	47	2	97	219	0	1	1	99
1973	3411	177	133	5	92	304	24	0	0	93
1974	2742	.	2	1	100	107	0	0	0	100
1975	6147	4	2	0	100	114	0	0	0	100
1976	5102	6	0	21	99	61	0	0	4	94
1977	2158	64	4	12	96	45	0	0	0	100
1978	2722	.	0	3	100	187	.	0	0	100
1979	3343	.	0	18	99	27	.	0	0	100
1980	3512	.	0	19	99	303	.	0	2	99
1981	4132	.	0	16	100	153	.	0	0	100
1982	4287	.	0	26	99	95	.	0	1	99
1983	3110	.	0	42	99	47	.	0	0	100
1984	2872	.	0	.	100	40	.	0	.	100
1985	2430	.	0	.	100	11	.	0	.	100
1986	3456	.	0	.	100	261	.	0	.	100
1987	3074	.	4	15	99	113	.	0	0	100
1988	4042	.	16	35	99	144	.	0	0	100
1989	1217	.	33	62	93	10	.	1	0	91
1990	3054	.	17	35	98	75	.	0	0	100

Data Sources: 1953 to 1986, Mullins et al. (1989).  
 1987 to 1988, Mullins and Claytor (1989).  
 1989, Claytor and Mullins (1990)

Table 10. Effort (roddays) and recreational catch (number) of small and large salmon from sections of the Humber River, 1976 to 1990. River sections are shown in figure 2.

Effort (roddays) by location on Humber River									
Year	Humber River	Lower Humber	Deer Lake	Little Falls	Big Falls	Adies Stream	Adies Lake	Harrim. Steady	Taylor's Brook
1976	10489	1415	430	1620	4076	369	1125	1454	.
1977	6127	1243	494	778	2445	316	407	288	156
1978	7633	1312	883	1036	2390	491	598	503	420
1979	7961	1540	737	891	2696	441	274	1010	372
1980	8292	941	879	1365	3310	515	338	761	183
1981	8701	1355	701	914	3718	602	447	708	256
1982	8737	1240	206	1476	4194	318	370	816	117
1983	7746	1762	1224	945	1746	387	539	803	340
1984	7189	1359	322	1174	2412	377	6	1281	258
1985	7211	1196	570	1079	2807	479	798	282	.
1986	8635	1814	586	1082	2634	484	1570	465	.
1987	7250	1764	482	804	2377	129	641	1005	48
1988	8521	1247	144	1769	2894	512	630	923	402
1989	6014	749	434	783	1543	1200	220	713	372
1990	7008	805	193	980	2377	300	843	1319	191
Mean									
1985-1989	7526	1354	443	1103	2451	561	772	678	164
1976-1984	8097	1352	653	1133	2999	424	456	847	234
1990 as % of									
1985-1989	93	59	44	89	97	53	109	195	116
1976-1984	87	60	30	86	79	71	185	156	82

Grilse Catch (number) by location on Humber River									
Year	Humber River	Lower Humber	Deer Lake	Little Falls	Big Falls	Adies Stream	Adies Lake	Harrim. Steady	Taylor's Brook
1976	5102	433	298	730	1891	343	718	689	.
1977	2158	229	82	359	1207	98	37	118	28
1978	2722	138	214	600	1071	171	198	210	120
1979	3343	641	275	317	1200	191	158	415	146
1980	3512	195	158	712	1817	171	63	358	38
1981	4132	250	260	368	2226	375	242	327	84
1982	4287	107	53	677	2767	154	98	390	41
1983	3110	218	571	409	726	177	446	401	162
1984	2872	170	101	633	1069	210	3	532	154
1985	2430	38	319	382	989	210	423	69	.
1986	3456	238	239	496	1367	189	783	144	.
1987	3074	218	209	313	1234	50	355	673	22
1988	4042	225	57	929	1563	228	369	502	169
1989	1214	31	189	181	316	195	57	187	58
1990	3054	148	44	372	1138	107	434	763	48
Mean									
1985-1989	2843	150	203	460	1094	174	397	315	83
1976-1984	3471	219	205	499	1372	191	292	385	82
1990 as % of									
1985-1989	107	99	22	81	104	61	109	242	58
1976-1984	88	68	22	75	83	56	148	198	58

Table 10 (cont'd).

Year	Large Salmon Catch (number) by location on Humber River								
	Humber River	Lower Humber	Deer Lake	Little Falls	Big Falls	Adies Stream	Adies Lake	Harrim. Steady	Taylor's Brook
1976	61	18	0	5	14	4	10	10	.
1977	45	10	1	6	26	2	0	0	0
1978	187	6	19	32	111	16	1	2	0
1979	27	10	0	0	13	0	0	4	0
1980	303	19	4	99	157	10	10	4	0
1981	153	61	2	6	78	4	1	1	0
1982	95	32	1	4	53	2	0	3	0
1983	47	13	1	4	24	1	2	1	1
1984	40	2	0	5	27	0	0	6	0
1985	0	0	0	0	0	0	0	0	.
1986	0	0	0	0	0	0	0	0	.
1987	0	0	0	0	0	0	0	0	0
1988	144	4	0	30	86	16	0	0	8
1989	8	1	0	0	7	0	0	0	0
1990	75	54	0	7	14	0	0	0	0
Mean									
1985-1989	30	1	0	6	19	3	0	0	3
1976-1984	106	15	2	13	41	4	2	2	1
1990 as % of									
1985-1989	247	5400	.	117	75	0	.	.	0
1976-1984	70	352	0	53	34	0	0	0	0



Table 11. Frequency of modal week and weeks encompassing 10 to 90% of catch and effort for the recreational fishery from river sections within Humber River, between 1976 and 1990. Includes temporary river closures in some years. \* indicates 1990 value.

Modal Week	River Section on the Humber River								
	Humber River	Lower Humber	Deer Lake	Little Falls	Big Falls	Adies Stream	Adies Lake	Harrim. Steady	Taylor's Brook
25	0	0	0	1	1	0	0	0	0
26	*2	5	0	*3	*3	1	0	2	0
27	7	3	1	5	5	0	0	4	0
28	5	4	2	5	5	0	1	*6	0
29	0	1	2	0	0	0	1	3	2
30	1	*2	2	1	1	*2	0	0	2
31	0	0	3	0	0	2	0	0	1
32	0	0	*2	0	0	4	2	0	2
33	0	0	0	0	0	2	*3	0	2
34	0	0	2	0	0	1	3	0	2
35	0	0	1	0	0	3	3	0	*3
Sample Size	15	15	15	15	15	15	13	15	14

Weeks for 10-90% Catch	River Section on the Humber River								
	Humber River	Lower Humber	Deer Lake	Little Falls	Big Falls	Adies Stream	Adies Lake	Harrim. Steady	Taylor's Brook
0	0	0	0	0	0	0	1	0	0
2	0	0	0	0	0	0	1	0	0
3	0	1	2	2	3	1	0	0	2
4	0	3	*4	*3	*5	2	6	3	3
5	1	0	3	4	3	3	2	*6	*4
6	1	3	3	1	2	*6	*2	3	4
7	*8	5	2	3	1	0	1	1	1
8	4	*3	1	2	0	3	0	1	0
9	1	0	0	0	1	0	0	0	0
10	0	0	0	0	0	0	0	1	0
Sample Size	15	15	15	12	10	9	11	9	10

Table 11 (cont'd).

Effort (roddays)	River Section on the Humber River								
	Humber River	Lower Humber	Deer Lake	Little Falls	Big Falls	Adies Stream	Adies Lake	Harrim. Steady	Taylor's Brook
25	0	2	0	0	0	0	0	1	0
26	1	1	0	2	*3	1	0	2	0
27	8	6	0	*6	6	1	0	3	0
28	*5	2	2	4	5	0	1	5	1
29	0	2	1	3	0	0	1	*3	1
30	1	*2	3	0	1	*3	3	0	4
31	0	0	3	0	0	3	1	0	2
32	0	0	*2	0	0	3	3	1	1
33	0	0	1	0	0	3	1	0	*4
34	0	0	2	0	0	1	*2	0	1
35	0	0	1	0	0	0	1	0	0
Sample Size	15	15	15	15	15	15	13	15	14

Weeks for 10-90% Catch	River Section on the Humber River								
	Humber River	Lower Humber	Deer Lake	Little Falls	Big Falls	Adies Stream	Adies Lake	Harrim. Steady	Taylor's Brook
0	0	0	0	0	0	0	1	0	0
2	0	0	0	0	0	0	1	0	0
3	0	0	1	1	0	1	0	0	0
4	0	0	2	0	2	1	1	0	2
5	0	1	3	4	*6	4	4	3	*6
6	1	0	4	4	1	*4	*3	*4	2
7	3	3	3	*2	4	1	1	3	2
8	*8	*7	1	2	0	2	2	4	2
9	3	3	*1	2	2	2	0	0	0
10	0	1	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	1	0
Sample Size	15	15	15	15	15	15	13	15	14

Table 11 (cont'd).

Catch of Salmon	River Section on the Humber River								
	Humber River	Lower Humber	Deer Lake	Little Falls	Big Falls	Adies Stream	Adies Lake	Harrim. Steady	Taylor's Brook
23	1	0	0	0	1	0	0	0	0
24	1	0	0	0	1	0	0	0	0
25	2	0	0	2	2	0	0	1	0
26	*1	1	0	*1	*5	0	0	2	0
27	4	1	1	4	1	0	0	3	0
28	3	0	0	2	2	1	0	1	0
29	0	1	1	0	0	1	1	0	1
30	0	*2	0	1	0	0	0	1	0
31	0	3	0	0	0	0	0	0	0
32	0	2	0	0	0	2	0	0	0
33	0	1	2	0	0	1	1	0	1
34	0	0	1	0	0	2	2	0	0
35	0	0	1	0	0	1	1	0	0
37	0	1	0	0	0	0	0	0	0
Sample Size	12	12	6	10	12	8	5	8	2

Weeks for 10-90% Catch	River Section on the Humber River								
	Humber River	Lower Humber	Deer Lake	Little Falls	Big Falls	Adies Stream	Adies Lake	Harrim. Steady	Taylor's Brook
0	0	1	3	*1	*2	2	3	3	1
1	0	0	1	1	0	0	0	1	0
2	0	3	0	2	3	0	0	3	0
3	2	0	1	1	3	3	0	0	0
4	0	1	0	2	2	0	1	0	0
5	1	*2	1	1	1	2	0	1	1
6	0	1	0	0	0	0	1	0	0
7	1	1	0	0	0	0	0	0	0
8	4	1	0	0	0	1	0	0	0
9	*3	1	0	2	1	0	0	0	0
10	1	0	0	0	0	0	0	0	0
11	0	1	0	0	0	0	0	0	0
Sample Size	12	12	6	10	12	8	5	8	2

Table 12. Distribution of recaptures by standardized week tagging group from Humber River estuary trapnet, 1990. Proportion in angling after adjustment refers to tags recovered from angling after removing tags accounted for in commercial and at counting fences. Standardized weeks are described in table 2.

Standardized Week	Number Tagged	Recaptured				Proportion of tags accounted	Proportion in angling after adjustment
		Angling	Commercial	Counting Fences			
				Hughes	North		
<b>All Salmon</b>							
23	1	.	1	.	.	1.00	.
24	32	3	1	.	.	0.13	0.10
25	26	2	.	.	.	0.08	0.08
26	9	1	.	.	.	0.11	0.11
27	49	5	1	3	1	0.20	0.11
28	31	4	.	3	1	0.26	0.15
29	31	7	.	1	.	0.26	0.23
30	33	3	.	1	.	0.12	0.09
31	24	2	.	1	1	0.17	0.09
.	.	2	.	.	.	.	.
<b>Total</b>	<b>236</b>	<b>29</b>	<b>3</b>	<b>9</b>	<b>3</b>	<b>0.186</b>	<b>0.121</b>
<b>Small Salmon</b>							
23	1	.	1	.	.	1.00	.
24	25	3	1	.	.	0.16	0.13
25	24	2	.	.	.	0.08	0.08
26	9	1	.	.	.	0.11	0.11
27	49	5	1	3	1	0.20	0.11
28	31	4	.	3	1	0.26	0.15
29	27	6	.	1	.	0.26	0.23
30	29	2	.	1	.	0.10	0.07
31	19	2	.	1	1	0.21	0.12
.	.	2	.	.	.	.	.
<b>Total</b>	<b>214</b>	<b>27</b>	<b>3</b>	<b>9</b>	<b>3</b>	<b>0.196</b>	<b>0.134</b>
<b>Large Salmon</b>							
23	.	.	.	.	.	.	.
24	7	.	.	.	.	0.00	0.00
25	2	.	.	.	.	0.00	0.00
26	.	.	.	.	.	.	.
27	.	.	.	.	.	.	.
28	.	.	.	.	.	.	.
29	4	1	.	.	.	0.25	0.25
30	4	1	.	.	.	0.25	0.25
31	5	.	.	.	.	0.00	0.00
<b>Total</b>	<b>22</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.091</b>	<b>0.091</b>

Table 13. Time at large (weeks) of recaptures from tagging at the estuary trapnet, Humber River, 1990.

Weeks	Counting fences			Humber River Recreational								Weeks
	Commer- cial	Hughes Brook	North Brook	Lower Humber	Deer Lake	Little Falls	Big Falls	Harriman Steady	Adies Lake	Adies Stream	Taylor's Brook	
0	1	.	1	2	.	.	.	.	.	.	.	0
1	1	.	.	2	1	1	1	3	.	2	.	1
2	.	3	1	.	.	.	2	.	.	.	.	2
3	.	2	.	.	.	.	4	.	.	.	.	3
4	1	.	.	.	1	1	.	.	1	.	.	4
5	.	.	1	.	.	.	.	.	2	.	.	5
6	.	.	.	.	.	.	.	.	.	.	.	6
7	.	1	.	.	.	.	.	.	1	.	.	7
8	.	1	.	.	.	.	.	.	1	.	1	8
10	.	1	.	.	.	.	.	.	.	.	.	10
11	.	1	.	.	.	.	.	.	.	.	.	11
.	.	.	.	.	.	.	.	.	1	.	.	.

\* plus one recapture from the recreational fishery with unknown location and date

Table 14. Estimates of tag loss/tagging mortality and nonreporting rate from the recreational fishery, Humber River, 1990.

Tag loss/tagging mortality Estimate

Counting Fence	Obs. Count	Obs. Tags	Marked/ Total
Hughes Brook	106	9	0.0849
North Brook	46	3	0.0652

$$\begin{aligned}
 \text{Tag Loss} &= 1 - \frac{\text{Marked/Total from North Brook}}{\text{Marked/Total from Hughes Brook}} \\
 &= 1 - \frac{0.0652}{0.0849} \\
 &= 0.232
 \end{aligned}$$

Nonreporting Rate Estimate

Location	Obs. Count or Est. Harvest	Obs. Tags or Reported Tags	Marked/ Total
Deer Lake	44	2	0.0455
North Brook	46	3	0.0652

$$\begin{aligned}
 \text{Nonreporting rate} &= 1 - \frac{\text{Marked/Total from Deer lake}}{\text{Marked/Total from North Brook}} \\
 &= 1 - \frac{0.0455}{0.0652} \\
 &= 0.303
 \end{aligned}$$

Table 15. Drainage areas and estimated rearing area and spawning requirements for Area L, and Bay of Islands tributaries.

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	Drainage Area sq. km	Rearing Area 100 sq. m	Minimum Spawning Requirements (small + large)
Total for Area L	8,751	155,600	24682
Bay of Islands	8,124	120,752	19622
Cooks	101	1,474	357
Humber	7,679	115,307	18452
Hughes	132	1,221	215
Goose Arm	212	3,770 *	598 **

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Drainage area values from Mullins and Claytor (1989)  
Rearing area and spawner requirement values from Porter  
and Chadwick (1983)

\* estimated using rearing area/drainage area ratio for Area L  
 $155,600 / 8,751 = 17.781 * 212 = 3770$

\*\* estimated using spawners / drainage area for Area L  
 $24,682 / 8,751 = 2.820 * 212 = 598$

Table 16. Estimation of spawning requirements for the Humber River. All parameter values are from Porter and Chadwick (1983).

---

HUMBER RIVER

Rearing Units	115,307 (100 sq. m)
Optimal Egg Deposition	240 per rearing unit
Fecundity	1540 eggs/kg
Small - % overall	97
% female	53
mean wt	1.7 kg
Large - % overall	3
% female	90 +
mean wt	3.7 + kg

Number of spawners to obtain sufficient females:

Required spawners =                    egg requirements / eggs per spawner

$$\begin{aligned}
 & \text{Rearing Units * Optimal Egg Deposition} \\
 = & \text{-----} \\
 & (\% \text{grilse} * \% \text{female} * \text{mean wt} * \text{fecundity}) + (\% \text{large} * \% \text{female} * \text{mean wt} * \text{fecundity}) \\
 & 115,307 * 240 \\
 = & \text{-----} \\
 & (.97 * .53 * 1.7 * 1540) + (.03 * .90 * 3.7 * 1540) \\
 & 27,673,680 \\
 = & \text{-----} \\
 & 1,499.76 \\
 = & \quad 18452 \text{ --->> } \quad 9984 \text{ females} \quad (9485 \text{ small or } 95\%) \\
 & \quad \quad \quad \quad \quad 8468 \text{ males} \quad (7945 \text{ small or } 94\%)
 \end{aligned}$$

Number of spawners to obtain 1:1 sex ratio on spawning grounds

$$\begin{aligned}
 \text{Deficit males} &= 9984 - 8468 = 1516 \\
 \text{Spawners to obtain 1516 males} &= 3304 \quad (3122 \text{ small}) \\
 \text{Total Spawners Required} &= 18452 + 3304 = 21756 \quad (118\% \text{ of minimum}) \\
 \text{Total Small Required} &= 20552
 \end{aligned}$$


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Table 17. Estimates of percent of egg deposition requirements achieved for Humber River. Estimates are obtained on the basis of small and large salmon contributions.

Humber River							
Egg Deposition Requirements = 27.674 million							
Year	Exploitation Rate			Exploitation Rate			% of Required Escapement Hughes Brook
	13.4	25	40	13.4	25	40	
	All fisheries open			Recreational fishery closed			
1985	106.5	51.5	27.6	118.7	63.6	39.8	6
1986	135.5	64.6	33.9	152.8	81.9	51.2	30
1987	133.1	64.2	34.3	148.5	79.6	49.7	20
1988	160.7	76.7	40.4	181.0	97.0	60.6	15
1989	78.5	39.2	22.2	84.6	45.3	28.3	26
1990	110.7	52.2	26.9	126.0	67.5	42.2	49
	Humber Arm Commercial Closed Recreational Open *			Humber Arm Commercial Closed Recreational Closed			
1985							
1986							
1987	139.4	70.0	39.5	202.4	133.5	103.6	
1988	173.5	88.1	50.1	246.3	162.4	126.0	
1989	87.3	47.5	29.8	120.8	81.5	64.5	
1990	119.0	59.8	33.7	135.0	76.5	51.2	

\* recreational harvest of small salmon adjusted for releases from the commercial fisheries closure

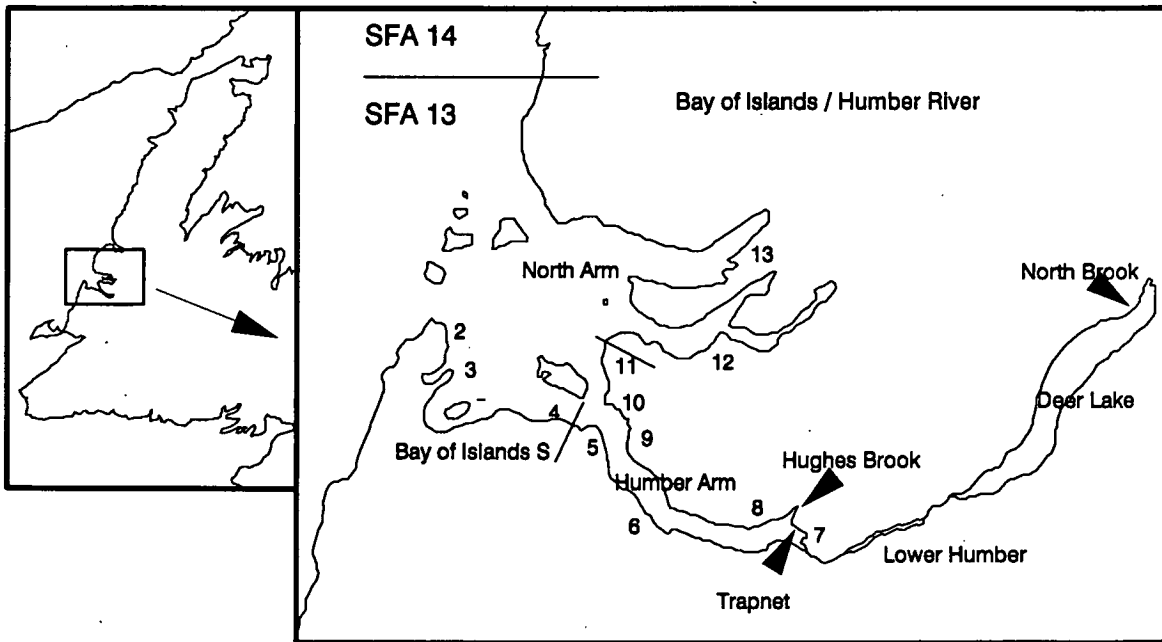


Figure 1. Coastal areas of Bay of Islands and Lower Humber River.

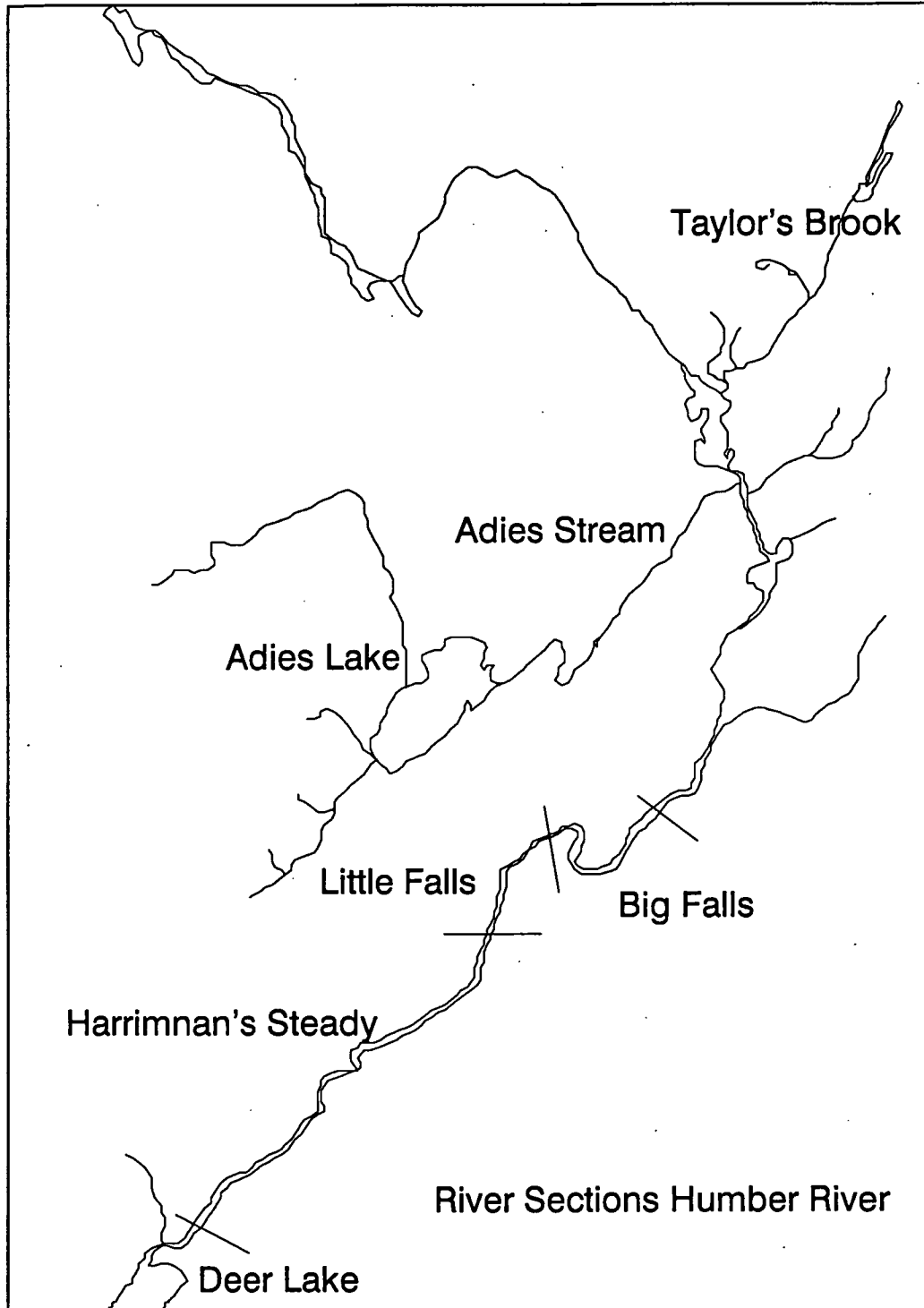
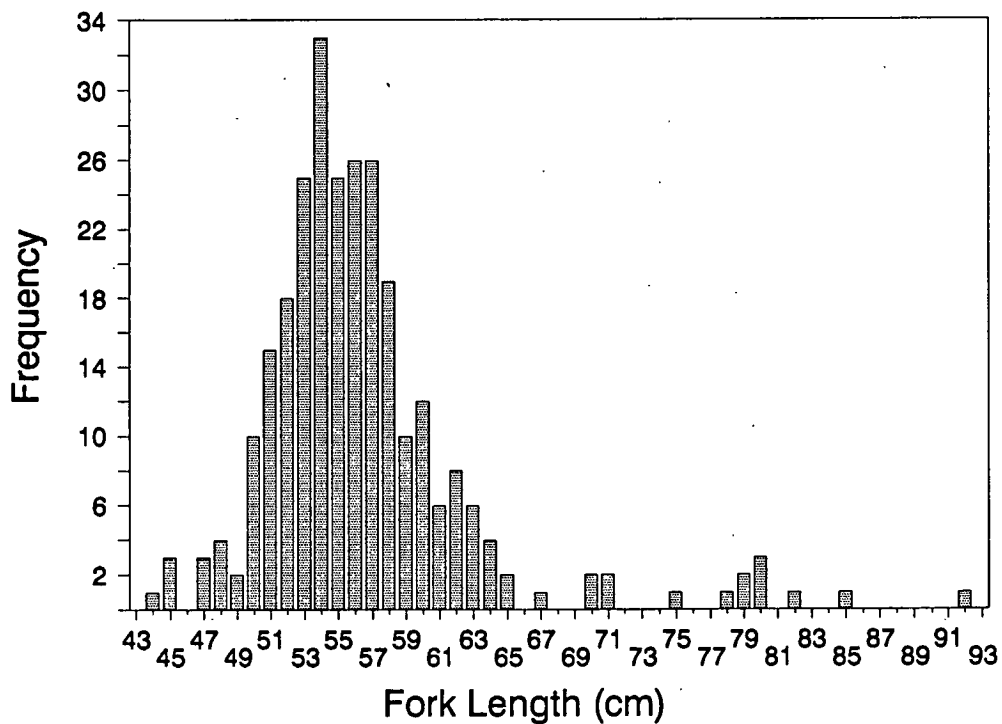


Figure 2. River sections of Humber River.

### Length frequency of salmon sampled from trapnet, 1990



### Catch (number) of small (<63 cm) and large salmon by date

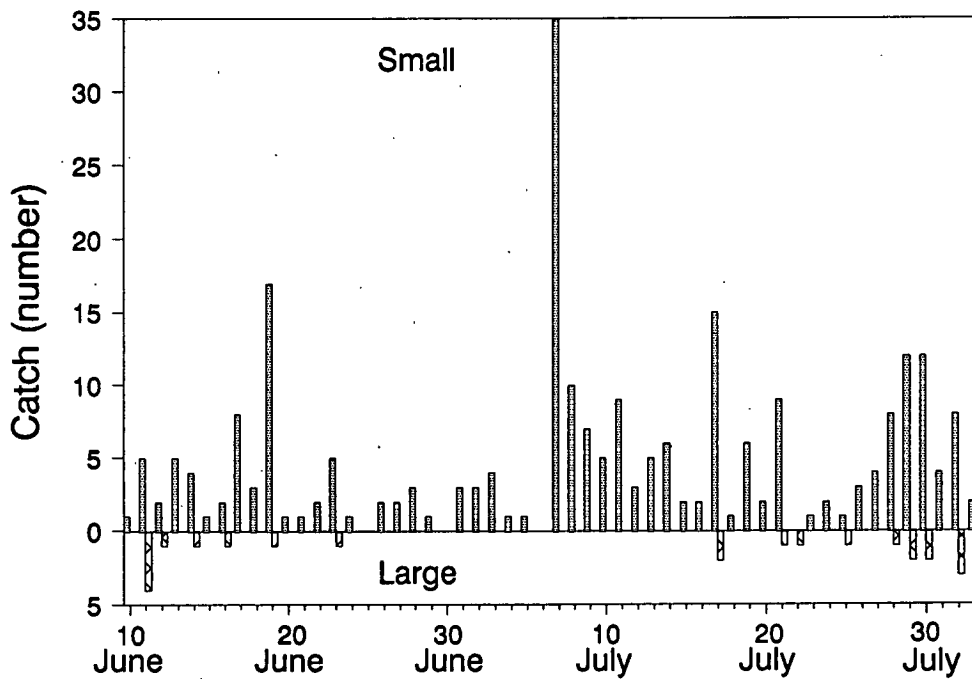


Figure 3. Length frequency and timing of catches of Atlantic salmon at the trapnet at Wilds Cove, Humber River, 1990.