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**THE STATUS OF THE ATLANTIC SALMON STOCK
OF HUMBER RIVER/BAY OF ISLANDS, NEWFOUNDLAND, 1991**

by

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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 (SFA) 13. The Bay of Islands commercial catches in 1991 of 2007 small (<2.7 kg round weight) and 244 large (≥ 2.7 kg round weight) salmon were 27% and 31% of the average catches for the coastal area for the period 1987 to 1989. The peak catch of small salmon was about two weeks later in 1991 relative to previous years but the large salmon catch peaked at about the same time as in previous years and two weeks earlier than the small salmon catch. The recreational catch of 1431 small salmon from the Humber River was less than 50% of the previous 5 year and long-term mean catches. Recreational effort in 1991 was 75% of previous years. Peak catches of small salmon (<63 cm fork length) in the recreational fishery in 1991 occurred one week later than usual. A creel survey, conducted at the Big Falls section of the Humber River provided an estimated small salmon catch of 450 (95% C.I. 354-546) whereas the river guardian estimate for the similar period was 493. A total of 109 salmon (4% were large salmon, ≥ 63 cm fork length) were captured in the trapnet at Wild Cove, Humber Arm between June 7 and Aug. 28, 1991. Of 64 small salmon marked and released, 9 were reported from the recreational fishery, giving a minimum exploitation rate (unadjusted for tag loss and reporting rate) of 0.164, which is very similar to the minimum rate of 0.134 for the 1990 fishery. The captures at the trapnet, returns to North Brook counting fence and the recreational catch of small salmon all indicate that the abundance of salmon in 1991 was about 50% of the 1990 abundance. The estimated egg deposition in the Humber River in 1991 was 45% of the target requirement of 27.7 million eggs. If both the recreational fishery and the Bay of Islands commercial fishery had been closed in 1991, returns to the Humber River would have provided at best 66% of the target egg 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 en 1991 se situaient à 2007 saumons de petite taille (<2.7 kg poids entier) et 244 grands saumons (≥ 2.7 kg poids entier) et ne représentaient que 27% et 31% des captures moyennes pour la période 1987 à 1989. La semaine du maximum des captures hebdomadaires de petit saumon en 1991 était retardée de deux semaines par rapport aux années précédentes mais les prises maximales de grand saumon étaient semblables aux années précédentes et devançaient les captures de petit saumon de deux semaines. Les prises par la pêche sportive sur la rivière Humber ont atteint 1431 petits saumons (<63 cm longueur à la fourche), équivalentes à 50% des moyennes antérieures tandis que l'effort en 1991 était équivalent à 75% des moyennes antérieures. La plus grande capture hebdomadaire de petit saumon dans la pêche sportive était retardée d'une semaine en 1991. Une enquête directe de la pêche sportive, effectuée à Big Falls de la rivière Humber, a estimé les captures à 450 saumons (intervalle de confiance de 95% = 354 à 546). L'estimation de l'agent de pêche pour la même période était 493 saumons. Du 7 juin au 28 août 1991, un total de 109 saumons, dont 4% étaient de grande taille (> 63 cm de longueur à la fourche), a été capturé au filet-trappe, installé à Wild Cove. Parmi les 64 saumons étiquetés, neuf recaptures ont été déclarées par les pêcheurs récréatifs. Le rapport entre le nombre de poissons marqués et le nombre d'étiquettes retournées donne un taux d'exploitation d'au moins 0.164, ce qui est semblable au taux de 0.134 estimé pour 1990. Les captures de saumon au filet-trappe, les retours à la barrière de dénombrement de North Brook et les prises sportives, indiquent tous que l'abondance du Saumon atlantique en 1991 était environ 50% du niveau de 1990. Le dépôt potentiel d'oeufs atteint en 1991 était équivalent à 45% du "niveau cible" de 27,7 million d'oeufs pour la rivière Humber. Si la pêche sportive de la rivière Humber et la pêche commerciale de Bay of Islands avaient été fermées en 1991, le dépôt potentiel d'oeufs n'aurait pu atteindre que 66% du "niveau cible".

INTRODUCTION

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

The total drainage area of the tributaries flowing into the Bay of Islands is 8124 km², which is 93% of the drainage area of Statistical Area L and 57% of SFA 13 drainage area. The Humber River comprises 95% of the Bay of Islands drainage area and flows into Humber Arm at latitude 48° 57'N and longitude 57° 53' W. The total length of all the 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 river mouth 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).

Management regulations of the commercial and recreational fisheries within Humber River/Bay of Islands area have changed since 1978 and are similar to those imposed for the fisheries within the province of Newfoundland and Labrador. The major changes have included:

- 1) the commercial fishery season was shortened in 1978 to June 1-July 10 from the previous May 15 to Dec. 31 season,
- 2) the introduction in 1984 of a regulation requiring the mandatory release in the recreational fishery of all salmon ≥ 63 cm fork length,
- 3) the introduction in 1987 of a seasonal bag limit for the recreational fishery of 15 small salmon (< 63 cm fork length) retained,
- 4) the imposition of a 35 metric ton quota in the commercial fishery for SFA 13 in 1990, and
- 5) a reduction in the commercial quota for SFA 13 to 25 metric tons in 1991 and a reduction in the recreational fishery seasonal bag limit to 10 small salmon.

The assessment of the status of the Atlantic salmon stock is based on the analysis of annual trends in the catches from the commercial and recreational fisheries and the spawning escapement is estimated using derived exploitation rates in the recreational fishery applied to the recreational fishery harvest estimates. The present document provides the catches, effort, and timing data for the commercial and recreational fisheries of Humber River/Bay of Islands for 1991. It follows the initial assessment presented for 1990 (Chaput and Mullins 1991) and addresses the following topics:

- 1) the verification of the recreational catch statistics collected by the Dept. of Fisheries and Oceans (DFO) river guardians for the Big Falls section of the Humber River by independent creel method,
- 2) an estimation of the exploitation rate by the recreational fishery on small salmon in 1991 by mark/recapture methods, and
- 3) updating of the biological characteristics of the Humber River/Bay of Islands Atlantic salmon stock.

MATERIALS AND METHODS

The commercial catch statistics were compiled from purchase slip and Supplementary 'B' forms (local sales estimates). The methods used to process these data are described by Claytor et al. (1991). The statistical areas, statistical sections, and coastal areas within SFA 13 are described in Table 1 and Fig. 1. The catches for the Bay of Islands coastal area are not yet available for the years prior to 1987.

The recreational catch statistics were compiled from Dept. of Fisheries and Oceans (DFO) fisheries officer and river guardian reports. The methods used for summarizing these data are described in Mullins and Claytor (1989) and Mullins et al. (1989). Catch and effort for the Humber River are described by river section (Figs. 1 & 2) and the standardized weeks used are described in Table 2.

Salmon catches in both the commercial and recreational fisheries are categorized into small and large size groups. The criterion for small and large salmon designation depends upon the particular fishery as follows:

Small	-	recreational	-	< 63 cm fork length
	-	commercial	-	< 2.7 kg round weight
Large	-	recreational	-	≥ 63 cm fork length
	-	commercial	-	≥ 2.7 kg round weight.

The criteria are essentially similar since salmon < 63 cm fork length are generally less than 2.7 kg round weight.

Estimation of Recreational Harvest

DFO River Guardian Statistics

Weekly salmon angling reports are completed by river guardians and fishery officers of the Dept. of Fisheries and Oceans. Data recorded on a daily basis for each river or section of river include water level, observed and estimated rod-days of effort, and observed and estimated small salmon catch. One rod-day is the fishing effort expended by one angler during all or part of one day; two or more fishing periods by the same angler on the same day are counted as one rod-day. The observed data represent actual observations by the river guardians or fisheries officers and those reported to the individual by others (mostly through conversations with anglers). Estimated data represent effort and catches for days when the river or section was not patrolled or while patrolling other areas. These estimates were based on the individual's knowledge of the migratory pattern of the salmon stock, local weather conditions, water levels, and patterns of local angling effort. Observed catches have generally accounted for 80% of the total catch reported (Mullins and Claytor 1989).

Creel Survey

A creel survey to estimate both the angling catch and effort was conducted at Big Falls, Humber River, between June 22 and Aug. 30, 1991. The Big Falls section (Fig. 2) was selected for the survey because it is accessed by anglers from two points and the angling catches from this section have averaged 38% of the total Humber River catch since 1986. A "bus route" design (Robson and Jones 1989), in combination with lattice sampling (Robson 1990), was used to obtain catch and effort data of completed angling trips at the two access points (Appendix 1).

The sampling day was divided into four time periods: 05:30 to 10:00, 10:00 to 14:00, 14:00 to 18:00, and 18:00 to 22:30. Two time periods were sampled every census day.

A stratum is a block of days treated as a unit. Weekly strata were used at Big Falls in 1991. The number of time periods sampled within a stratum was dictated by the available resources and prior information on angling catch and effort timing at Big Falls. Sampling effort consisted of 5 of 7 days between June 8 and June

28, 7 of 7 days between June 29 and Aug. 3, and 5 of 7 days between Aug. 4 and Aug. 30. The days and the time periods within the day to be sampled were randomly selected within each stratum. Among strata sorting followed when individual stratum size was equal (ex. 7 day or 5 day weekly strata).

The total catch and the total effort for each stratum (week) were obtained by weighting the observed sampling period matrix with the Horvitz-Thompson matrix which gives equal weight to the individual sampling periods within a stratum (Robson 1990). The variances of the catch and effort estimates were calculated for each stratum using the Yates-Grundy variance formulation (Robson 1990). Totals and variance estimates of totals for combined strata were obtained by summation. The 95% confidence intervals of the estimates were calculated using ± 2 standard deviations.

Estimation of Exploitation Rate

A trapnet was fished at Wild Cove, Humber Arm, across from Corner Brook between June 7 and Aug. 28, 1991 (Fig. 1). The trapnet design and installation were identical to the 1990 sampling program (Chaput and Mullins 1991).

All Atlantic salmon, captured at the trapnet, were measured (fork length cm), scale sampled and marked with individually numbered blue Carlin tags using a double stainless steel wire attachment directly under the dorsal fin. Tag recaptures from the commercial and recreational fisheries were mailed in.

Returns to the Humber River

The returns to the Humber River were estimated by dividing the estimated catch of small salmon in the recreational fishery by an estimate of the exploitation rate in the recreational fishery. The estimated returns of large salmon to the Humber River were considered to be 7% of the small salmon returns, based on the proportion of small and large salmon in the recreational catch prior to 1984, when large salmon could be retained (Chaput and Mullins 1991).

Returns to Counting Fences

The returns, by date, to counting fences on Hughes Brook and North Brook (see Fig. 1) for 1991 were provided by J. Peppar (DFO, Science Branch, Corner Brook, NFLD). Both of these counting fences are operated by private development associations.

Biological Characteristics

Biological characteristics of the Atlantic salmon were obtained from mortalities at the trapnet in 1991 (N=40) and from the commercial catches landed at the communities of Benoit's Cove, McIver's and Meadows, in Humber Arm between June 7 and July 6 1991 (N=204) (Fig. 1). The fish were sampled for fork length (0.5 cm), whole weight (0.01 kg) and the sex was determined by internal examination. A scale sample was obtained for determining the river and sea age.

Estimation of Target Spawning Requirements

Target egg deposition for the Humber River was calculated using an egg deposition of 2.4 eggs/m² of parr rearing area as described by Porter and Chadwick (1983). The amount of parr rearing area for the Humber River has been estimated at 11,530,700 m² (Porter and Chadwick 1983) resulting in a target egg deposition of 27.674 million eggs. Using average biological characteristics of Atlantic salmon for the Humber River, the target spawner requirement is calculated using the following formula:

$$\begin{aligned} \text{Required spawners} &= \text{egg requirements} / \text{eggs per spawner} \\ &= \frac{27,673,680}{(\% \text{small} \times \% \text{female} \times \text{mean wt} \times \text{fecundity}) + (\% \text{large} \times \% \text{female} \times \text{mean wt} \times \text{fecundity})} \end{aligned}$$

The fecundity value used was 1540 eggs per kg (Porter and Chadwick 1983).

Estimation of Potential Egg Depositions

The potential egg depositions for a given year were calculated using the estimated spawning escapement of small and large salmon and the corresponding biological characteristics of each (average weight, percent female, fecundity). The spawning escapement was obtained by subtracting the harvests in the recreational fishery from the estimated returns to the river (after commercial fisheries). Potential egg depositions of fish from the recreational and commercial fisheries were calculated using the respective biological characteristics of salmon in each of the fisheries.

RESULTS

Commercial Effort and Catches

There was a total of 44 licenses issued in Area L, in 1991, representing a potential effort of 176 gear units (1 unit = 50 fathoms of gillnet) (Table 4). The Atlantic salmon commercial fishery season in SFA 13 opened on June 5 and was scheduled to close on July 10 or when the 25 metric ton quota had been caught (Table 3). The 1990 quota for SFA 13 was 35 tons (Table 3). Additional regulations for SFA 13 are described in Mullins and Jones (in prep.).

The fishery closed at midnight July 6, 1991 as a result of the quota having been filled. The commercial catch, by number, of large salmon from SFA 13 was down dramatically in 1991 to 24% of the mean catch in pre-quota years 1978 to 1989 (Table 5). This contrasts with the catch of small salmon which was 89% of the mean catch in the pre-quota years (Table 5). The catches in Area L were 33% and 24%, by number, of the mean pre-quota year catches for small and large salmon, respectively (Table 5).

The catches in the coastal areas comprising Bay of Islands were, in general, down in 1991 relative to the previous 4 years (Table 6). The catches were especially reduced in the North Arm coastal area where small and large salmon numbers were 16% and 28% of pre-quota year (87-89) mean (Table 6). The North Arm coastal area between 1987-1990 accounted for between 67% and 87% of the Bay of Islands catch, by weight. In 1991, it accounted for only 51% of the catch (Table 6). The percent local sales was higher in 1991 than in the previous 4 years (Table 6).

The catches of small salmon in 1991 generally peaked one to two weeks later than in 1987 to 1990 (Table 7). Large salmon peak catches were more similar to previous years and were two to three weeks earlier than the peak small salmon catches in 1991 (Table 7).

Recreational Effort and Catches

The recreational angling season in 1991 opened June 1 and closed Sept. 2 or Sept. 8 depending on river section (Mullins and Jones, in prep.). The 1991 season limit of retained small salmon was reduced from previous years to 10 from 15.

The recreational catch of small salmon from the Bay of Islands in 1991 was 1535, about 50% of the mean catches over the previous 5 years and since 1953 (Table 8). The 1991 catch is the sixth lowest since 1953 (Table 8). The catch of small salmon in the Bay of Islands area represented the second lowest proportion of the SFA 13 catch since 1962 (Table 8). Large salmon catches are also down but since the imposition of hook and release regulations in 1984, the data series has been inconsistent and no inferences can be made regarding the abundance of large salmon.

The recreational catch from the Humber River remained the dominant proportion of the Bay of Islands catch. The 1991 catch of 1431 small salmon represented 48% of the previous 5 year and the long term mean catches (Table 9). The catch of 92 small salmon from the Goose Arm River was the highest ever recorded (Table 9).

The estimated recreational effort on the Humber River was about 75% of previous years effort (Table 10). The strongest decline in effort was from the Adies Lake section which was closed to angling on Aug. 2, 1991 (Table 10). The estimated effort was up at Deer Lake and Taylor's Brook but these increases were not sufficient to compensate for the reduced efforts at Little Falls and Big Falls (Table 10).

There were small increases in estimated catches of small salmon in the sections with increased effort although over the entire watershed, the catches were less than 50% of recent and long term historical means (Table 10).

The weeks of peak catches in 1991 were delayed by about one week, relative to those observed previously, in most sections of the Humber River (Table 11). The duration of the fisheries was longer in most sections. In some cases, for example Harriman's Steady, the catch was taken during an eight week period in contrast to the 4 to 6 week period in most other years (Table 11). The weeks of peak effort in the lower sections of the river (below Little Falls) were also delayed in 1991 relative to previous years. Effort duration, however, was similar to previous years (Table 11).

Creel Estimates for Big Falls

The creel catch estimate from Big Falls for the period June 22 to Aug. 30, was 450 small salmon (95% C.I. 354 to 546) (Table 12). The estimate by the DFO guardian for the same time period was 493 which is within the confidence limits of the creel estimate. The timing of the catches was similar between the two methods although the decrease in catch in week 7 was more sudden in the creel estimate than the guardian estimate (Table 12; Fig. 3). The timing of the estimated effort was very different between the two methods. The peak estimated effort from the creel occurred in week 4 whereas the DFO estimate of effort (rod-days) was highest in week 7 (Table 12; Fig. 3). The differences were not a consequence of the different units of measure for effort between the two methods because the maximum number of interviews (roughly equivalent to rod-days) was obtained in week 4 and the maximum mean effort expended by each angler interviewed was recorded in week 5 as shown below:

Week	Mean Effort per Interview (hours)	Number of Interviews
3	2.18	86
4	2.83	157
5	3.14	128
6	2.91	96
7	2.67	71
8	2.91	65
9	1.16	29
10	1.43	28
11	1.43	34
12	1.38	32

Estimation of Exploitation Rate

Between June 7 and Aug. 28, 1991, a total of 4 large salmon (≥ 63 cm) and 105 small salmon (< 63 cm) were captured at the trapnet (Fig. 4). This contrasts with the 274 salmon captured at the trapnet fished in the same location between June 9 and Aug. 2, 1990 (Chaput and Mullins 1991). The proportion of large salmon in 1991 was 4%, which is half the proportion calculated in 1990. The largest proportion was captured in July, similar to 1990, but the catches were dispersed over the entire season with no exceptionally large daily catch in 1991 (Fig. 4).

A total of 64 small salmon were marked and released of which 8 were recovered at the counting fence in Hughes Brook and 9 were reported from the recreational fishery (Table 13). The time at large before recapture in the recreational fishery was short for the lower sections of the river, less than two weeks, in contrast to the longer time at large before tagged fish moved through the counting fence at Hughes Brook (Table 14).

Adjustments for tag loss and reporting rate, made in the 1990 assessment (Chaput and Mullins 1991), could not be done in 1991 because of the small number of reported recaptures in the angling fishery and the absence of tagged fish at the North Brook fence. The unadjusted exploitation rate in 1991 for small salmon was 0.164 (Table 13) which is very close to the unadjusted rate of 0.134 for the 1990 angling fishery (Chaput and Mullins 1991).

Returns to Counting Fences

The return of Atlantic salmon to the counting fence at Hughes Brook in 1991 was 175, the highest return since 1984 (Table 15). The return to the fence at North Brook was 52 fish, half the 1990 return (Table 15). The timing of movements through the fences in 1991 was similar to previous years. The dates for which 50% of the run had been enumerated were Aug. 6 and 7 for Hughes Brook and North Brook respectively (Table 15). The 8 Carlin tagged fish passing through the Hughes Brook fence represented 5% of the 1991 run. In 1990, 9 tags were recovered which represented 8% of the run at Hughes Brook.

Biological Characteristics of the Bay of Islands Stock

The average weight of small salmon (<63 cm fork length) sampled from the commercial fishery was 1.66 kg and the average fork length was 53.3 cm (Table 16). The sex ratio of these fish was 54.1% female, which is similar to the sex ratio of 53% used previously (Chaput and Mullins 1991). The large salmon (\geq 63 cm fork length) from the commercial fishery had a mean weight of 4.44 kg (N=8) and a sex ratio of 68.6% female (N=35) (Table 16). This contrasts with the 90%+ female ratio used in the previous assessment (Chaput and Mullins 1991). Analysis of the scale samples indicated that 66.7% of the large male salmon were repeat spawning 1SW fish. In contrast, 95% of the large female salmon were maiden 2SW fish. This explains in large part the discrepancy in the sex ratio of the large salmon found in 1991 relative to the values tabled previously which were not based on characteristics of the Bay of Islands stock.

Small salmon sampled at the trapnet had a smaller mean size and a higher proportion female than those sampled from the commercial fishery (Table 16). Spawner requirements and egg depositions were calculated using the biological characteristics of the trapnet sampled fish. The impact of using the biological characteristics of the trapnet sampled fish rather than the commercial biological characteristics was minimal. The previous spawner requirements had been calculated at 18905 fish, 18338 small and 567 large salmon (Chaput and Mullins 1991). The new values are 18030 small and 558 large salmon for a total of 18588 fish, 98.3% of previous estimate (Table 17).

Returns and Escapements to the Humber River in 1991

Returns to the counting fence at Hughes Brook in 1991 were 81% of target (215 small salmon), the best noted since 1984. In recent years, returns to Hughes Brook were consistently less than 50% of target (Chaput and Mullins 1991). The returns to the North Brook fence in 1991 were 50% of 1990 returns, similar to the reduction in angling catch in 1991 relative to 1990.

Using the minimum exploitation rate derived for the 1991 recreational fishery (0.164), the estimated returns of small salmon to the Humber River in 1991 were 8726 fish (Table 18). The returns of large salmon in 1991, estimated to be equivalent to 7% of small salmon returns (Chaput and Mullins 1991), were 611 fish. This provided an escapement to the Humber River of 7906 small and large salmon and an estimated egg deposition 14.51 million eggs or 45% of target (Table 18).

In 1990, an exploitation rate of 0.25 was considered more realistic after having accounted for tag loss and non-reporting of recaptured tags (Chaput and Mullins 1991). The unadjusted exploitation rate in 1991 (0.164) was similar to the unadjusted rate of 1990 (0.134), therefore, the adjusted rate of 0.25 was also applied to the 1991 recreational fishery. Using this adjusted exploitation rate, the egg deposition in the Humber River in 1991 was 27% of target requirement (Table 18).

Estimated Egg Depositions under Alternate Management

If the recreational fisheries of the Humber River and the commercial fisheries of the Bay of Islands had been closed, the egg depositions in 1991 would have been between 48% (at ER = 0.25) and 66% (at ER = 0.164) of target (Table 18). The target egg depositions would have been achieved in 3 of the last 5 years under this management strategy. Even at the lowest exploitation rate of 0.134, egg depositions would have been between 22% and 13% below target in 1991 and 1989 (Table 18).

DISCUSSION

The commercial and recreational catches of the Bay of Islands/Humber River fisheries in 1991 were below short and long term mean values. The commercial catch of large salmon throughout SFA 13 was severely depressed while the catch of small salmon was only slightly lower than the pre-quota year values. Recreational catch of small salmon in 1991 was 50% of previous years. The recreational fishery effort in the Humber River was estimated at 75% of previous years. The lower angling catches in 1991 relative to previous years could, in part, have been explained by the reduced effort estimate and reduced license bag limits introduced in 1991. However, the derived exploitation rate in the recreational fishery for 1991 was similar to that for 1990, thus, the lower angling catches in 1991 were the result of a lower abundance of salmon. It is imperative that the exploitation rates be derived every year if angling catches are to serve as indicators of returns.

The estimated exploitation rate in 1991 was slightly higher than the minimum exploitation rate value for 1990. On that basis, it can be concluded that the returns in 1991, based on the angling catches, were reduced by 50% from those of 1990. The trapnet catch in 1991 was less than half that of 1990 which was another indicator of the lower returns in 1991. Returns to the North Brook counting fence were also half the return level of 1990.

The timing in the commercial and recreational fisheries was delayed by 1 to 2 weeks in 1991 relative to recent years. The catches at the trapnet were delayed by 1 to 2 weeks as well although the returns to the counting fences were not delayed. The timing of the movements at the counting fences is generally later than in the fisheries, August rather than June and July, and this may explain the similarity in timing at the fences in 1991 relative to previous years.

The egg depositions to the Humber River in 1991 were 45% of the target based on the minimum exploitation rate derived for the recreational fishery. Even with the commercial fishery of Humber Arm closed and the recreational fishery of Humber River closed, the egg depositions would only have been 58% in 1991. Additional eggs from the closure of all the Bay of Islands commercial fisheries, assuming all commercial catch would have escaped to the Humber River, would have resulted in egg depositions of 66% of target in 1991.

The estimated catch of small salmon at Big Falls in 1991 obtained by the river guardian was similar to the creel survey method. It was assumed that the catch data were collected independently, i.e. the creel clerk and the river guardian had minimal interaction and exchange of information. The timing estimates for catch were similar but the estimates related to the timing of the effort were dissimilar. This puts into question not only the estimates of effort for the Humber River but also the inferences regarding the timing of the recreational fishery. The changes in the priorities of the river guardians in recent years away from day time patrols to increased night patrols have surely affected the data series. Continued validation of both the catch and effort data is warranted and an independent creel survey such as the "bus route" survey conducted in 1991 should be undertaken in 1992.

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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
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.

prior to 1978	15 May to 31 Dec.
1978 - 1983	1 June to 10 July
1984 - 1989	5 June to 10 July
1990	5 June to 10 July or 35 metric tons
1991	5 June to 10 July or 25 metric tons

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

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	176	44
1990	176	44
1991	176	44

Table 5. Commercial catch of small and large salmon for SFA 13 and Area L, 1974 to 1991.

By Number									
Year	SFA 13			Area L			% of SFA 13		
	Small	Large	Total	Small	Large	Total	Small	Large	Total
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	24443	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	16499	4189	20688	4968	1093	6061	30.1	26.1	29.3
1990	16638	3239	19877	5325	758	6083	32.0	23.5	30.6
1991	15687	872	16559	2050	257	2304	13.1	29.5	13.9
Minimum (78-91)	10136	872	13142	2050	257	2304	13.1	18.3	13.9
Maximum (78-91)	32492	6704	36787	14651	1986	16637	49.4	45.0	45.7
Mean (78-89)	17544	3708	21252	6263	1077	7339	34.6	29.3	33.7
1991 as % of 1978 to 1989	89.4	23.5	77.9	32.7	23.9	31.4			
By Weight (kg)									
Year	SFA 13			Area L			% of SFA 13		
	Small	Large	Total	Small	Large	Total	Small	Large	Total
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	29046	13794	43009	10647	3288	13935	36.6	23.6	32.4
1991	24719	3870	28589	3895	1234	5129	15.8	31.9	17.9
Minimum (78-91)	17300	3870	28589	3895	1234	5129	15.8	18.4	17.9
Maximum (78-91)	57744	27859	79324	26808	8756	34978	52.1	46.1	45.4
Mean (78-89)	31316	16672	47988	12093	4982	17075	37.6	30.4	35.1
1991 as % of 1978 to 1989	78.9	23.2	59.6	32.2	24.8	30.0			

Table 6. Commercial catch by number and weight from Bay of Islands coastal areas and % local sales, 1987 to 1991.

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
By Number										
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
1991	2007	244	97.9	94.9	144	35	905	54	958	155
Mean										
1987-1989	7420	789			254	46	1334	188	5832	555
1991 as % of										
1990	40.3	42.1			27.6	145.8	81.7	29.2	28.6	41.9
87-89	27.0	30.9			56.6	76.6	67.8	28.7	16.4	27.9
By Weight(kg)										
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
1991	3810	1175	97.8	95.2	275	166	1718	268	1817	741
Mean										
1987-1989	14653	3580			441	202	2561	867	11651	2511
1991 as % of										
1990	38.2	47.3			26.6	190.8	77.5	32.6	27.1	47.0
87-89	26.0	32.8			62.4	82.3	67.1	30.9	15.6	29.5

% 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
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	3041	15.2	8285	4.1
1991	4985	33.0	441	34.7	1986	52.6	2558	17.4

Table 7. Timing of small and large salmon commercial catch by coastal area of the Bay of Islands, 1987 to 1991.

	Week of Maximum Catch					
	Bay of Islands South		Humber Arm		North Arm	
	Small	Large	Small	Large	Small	Large
By Number						
1987	27 & 28	27 & 28	25	25	26	26
1988	23 to 25	23 to 25	26	26	26	26
1989	25	24	25	24	25	23
1990	26	26	26	24	26	24
1991	26	25	27	24	27	25
By Weight						
1987	27 & 28	27 & 28	25	25	26	26
1988	23 to 25	23 to 25	26	26	26	26
1989	25	24	25	24	25	23
1990	26	26	26	24	26	24
1991	26	25	27	24	27	25

Table 8. Recreational catch of small and large Atlantic salmon from the Bay of Islands region, 1953 to 1991.

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
1991	1535	29.6	89.1	92.1	11	5.4	19.3	19.3
1991 as % of								
1986-1990	51.0				9.1			
1953-1990	50.2				6.5			

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 small and large Atlantic salmon from Bay of Islands rivers, 1953 to 1991.

Year	1SW				Humber	MSW				Humber
	Humber River	Hughes Brook	Cooks Brook	Goose Arm	% of Bay of Islands	Humber	Hughes	Cooks	Goose Arm	% of Bay of Islands
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
1991	1431	.	12	92	93	11	.	0	0	100
1991 as % of										
1986-1990	48.2		85.7	250.3		9.1				
1953-1990	48.1		26.5	452.2		6.6				

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

Table 10. Effort (rod-days) and recreational catch (number) of small and large salmon from sections of the Humber River, 1976 to 1991. River sections are shown in figure 2.

Year	Effort (rod-days) by location on Humber River								
	Humber River	Lower Humber	Deer Lake	Harrim. Steady	Little Falls	Big Falls	Adies Stream	Adies Lake	Taylor's Brook
1976	10489	1415	430	1454	1620	4076	369	1125	.
1977	6127	1243	494	288	778	2445	316	407	156
1978	7633	1312	883	503	1036	2390	491	598	420
1979	7961	1540	737	1010	891	2696	441	274	372
1980	8292	941	879	761	1365	3310	515	338	183
1981	8701	1355	701	708	914	3718	602	447	256
1982	8737	1240	206	816	1476	4194	318	370	117
1983	7746	1762	1224	803	945	1746	387	539	340
1984	7189	1359	322	1281	1174	2412	377	6	258
1985	7211	1196	570	282	1079	2807	479	798	.
1986	8635	1814	586	465	1082	2634	484	1570	.
1987	7250	1764	482	1005	804	2377	129	641	48
1988	8521	1247	144	923	1769	2894	512	630	402
1989	6014	749	434	713	783	1543	1200	220	372
1990	7008	805	193	1319	980	2377	300	843	191
1991	5770	1038	465	922	357	2014	411	63	500
Mean									
1986-1990	7486	1276	368	885	1084	2365	525	781	203
1976-1985	8009	1336	645	791	1128	2979	430	490	210
1991 as % of									
1986-1990	77	81	126	104	33	85	78	8	247
1976-1985	72	78	72	117	32	68	96	13	238

Year	Small salmon catch (number) by location on Humber River								
	Humber River	Lower Humber	Deer Lake	Harrim. Steady	Little Falls	Big Falls	Adies Stream	Adies Lake	Taylor's Brook
1976	5102	433	298	689	730	1891	343	718	.
1977	2158	229	82	118	359	1207	98	37	28
1978	2722	138	214	210	600	1071	171	198	120
1979	3343	641	275	415	317	1200	191	158	146
1980	3512	195	158	358	712	1817	171	63	38
1981	4132	250	260	327	368	2226	375	242	84
1982	4287	107	53	390	677	2767	154	98	41
1983	3110	218	571	401	409	726	177	446	162
1984	2872	170	101	532	633	1069	210	3	154
1985	2430	38	319	69	382	989	210	423	.
1986	3456	238	239	144	496	1367	189	783	.
1987	3074	218	209	673	313	1234	50	355	22
1988	4042	225	57	502	929	1563	228	369	169
1989	1214	31	189	187	181	316	195	57	58
1990	3054	148	44	763	372	1138	107	434	48
1991	1431	138	179	364	83	504	95	7	61
Mean									
1986-1990	2968	172	148	454	458	1124	154	400	59
1976-1985	3367	242	233	351	519	1496	210	239	77
1991 as % of									
1986-1990	48	80	121	80	18	45	62	2	103
1976-1985	43	57	77	104	16	34	45	3	79

Table 10 (cont'd).

Year	Large salmon catch (number) by location on Humber River								
	Humber River	Lower Humber	Deer Lake	Harrim. Steady	Little Falls	Big Falls	Adies Stream	Adies Lake	Taylor's Brook
1976	61	18	0	10	5	14	4	10	.
1977	45	10	1	0	6	26	2	0	0
1978	187	6	19	2	32	111	16	1	0
1979	27	10	0	4	0	13	0	0	0
1980	303	19	4	4	99	157	10	10	0
1981	153	61	2	1	6	78	4	1	0
1982	95	32	1	3	4	53	2	0	0
1983	47	13	1	1	4	24	1	2	1
1984	40	2	0	6	5	27	0	0	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	0	30	86	16	0	8
1989	8	1	0	0	0	7	0	0	0
1990	75	54	0	0	7	14	0	0	0
1991	11	11	0	0	0	0	0	0	0
Mean									
1986-1990	45	12	0	0	7	21	3	0	2
1976-1985	96	17	3	3	16	50	4	2	0
1991 as % of									
1986-1990	24	93	.	.	0	0	0	.	0
1976-1985	11	64	0	0	0	0	0	0	0

Table 12. Estimates of effort and catch of 1SW and MSW salmon by week at Big Falls, Humber River, obtained by DFO Guardian method and creel method.

Dates	Week	DFO Guardian		Creel			
		Estimate	% of Total	% of Total	Estimate	Lower C.I.	Upper C.I.
Effort Estimate; rod days for DFO, hours for creel							
	1	2	.		.		
	2	6	.		.		
June 22 to 28	3	31	1.6	13.3	3591	2226	4956
June 29 to July 5	4	229	11.7	22.2	5988	4514	7462
July 6 to 12	5	301	15.4	19.8	5328	3129	7527
July 13 to 19	6	249	12.7	13.9	3733	2692	4774
July 20 to 26	7	429	21.9	9.4	2531	1834	3228
July 27 to Aug. 2	8	349	17.8	9.7	2620	1878	3362
Aug. 3 to Aug. 9	9	153	7.8	2.5	662	243	1081
Aug. 10 to Aug. 16	10	87	4.4	2.9	768	163	1373
Aug. 17 to Aug. 23	11	78	4.0	3.2	867	502	1232
Aug. 24 to Aug. 30	12	52	2.7	3.2	849	290	1408
	13	42	.		.		
	14	6	.		.		
	Total	2014			26937	23476	30398
Small Salmon Catch Estimate							
	1	.			.	.	.
	2	.			.	.	.
June 22 to 28	3	4	0.8	0.0	0	0	0
June 29 to July 5	4	87	17.6	20.2	91	60	122
July 6 to 12	5	114	23.1	24.4	110	60	160
July 13 to 19	6	120	24.3	29.6	133	71	195
July 20 to 26	7	93	18.9	8.0	36	9	63
July 27 to Aug. 2	8	30	6.1	5.6	25	20	30
Aug. 3 to Aug. 9	9	14	2.8	4.2	19	4	34
Aug. 10 to Aug. 16	10	13	2.6	1.8	8	-2	18
Aug. 17 to Aug. 23	11	8	1.6	5.3	24	-4	52
Aug. 24 to Aug. 30	10	10	2.0	0.9	4	-3	11
	13	9			.	.	.
	14	2			.	.	.
	Total	504			450	354	546
Large Salmon Catch Estimate							
	1	.			.	.	.
	2	.			.	.	.
June 22 to 28	3	.			0	0	0
June 29 to July 5	4	.			0	0	0
July 6 to 12	5	.			0	0	0
July 13 to 19	6	.			0	0	0
July 20 to 26	7	.			0	0	0
July 27 to Aug. 2	8	.			0	0	0
Aug. 3 to Aug. 9	9	.			0	0	0
Aug. 10 to Aug. 16	10	.			0	0	0
Aug. 17 to Aug. 23	11	.			0	0	0
Aug. 24 to Aug. 30	12	.			16	-4	36
	13	.			.	.	.
	14	.			.	.	.
	Total	0			16	-4	36

Table 15. Total counts of Atlantic salmon and dates to 50% of total counts at the Hughes Brook and North Brook counting fences, 1984 to 1991. N/A means not available.

Year	Hughes Brook Fence		North Brook Fence	
	Total	Date to 50%	Total	Date to 50%
1984	93	Aug. 11		
1985	13	Sept. 8		
1986	N/A	N/A	69	Aug. 10
1987	33	Sept. 28	75	Sept. 9
1988	35	Aug. 5	178	Aug. 29
1989	56	N/A	N/A	N/A
1990	106	Aug. 2	104	Aug. 4
1991	175	Aug. 6	52	Aug. 7

Table 16. Biological characteristics of the Bay of Islands Atlantic salmon stock, 1991.

Size	Gear	Statistics	Fork Length (cm)	Whole Weight (kg)	% Female	% at Smolt Age		
						2	3	4
Small	Commercial Gillnet	Mean	53.3	1.66	54.1	1.2	95.1	3.7
		Min.	37.3	0.54				
		Max.	62.5	2.80				
		Std. Dev.	3.22	0.45				
		N	164	68	146	163		
	DFO Trapnet	Mean	50.5	1.33	69.2	5.0	95.0	-
		Min.	37.3	0.54				
		Max.	55.9	1.90				
		Std. Dev.	3.26	0.24				
		N	40	34	39	40		
Large	Commercial Gillnet	Mean	75.2	4.44	68.6	12.5	72.5	15.0
		Min.	67.2	3.80				
		Max.	92.0	6.00				
		Std. Dev.	5.09	0.77				
		N	40	8	35	40		
			Repeat Spawning 1SW Salmon					
			Male	Female				
		Percent	66.7	5.0				
		N	15	20				

Table 17. Estimation of spawning requirements for the Humber River. All parameter values are from Porter and Chadwick (1983) except where noted.

HUMBER RIVER

Rearing Units	115,307 (100 sq. m)	
Optimal Egg Deposition	240 per rearing unit	
Fecundity	1540 eggs/kg	
Small - % overall	97	
% female	69	(this document)
mean wt	1.33 kg	(this document)
Large - % overall	3	
% female	69	(this document)
mean wt	3.7 + kg	

Number of spawners to obtain sufficient females:

$$\begin{aligned}
 \text{Required spawners} &= \frac{\text{egg requirements}}{\text{eggs per spawner}} \\
 &= \frac{\text{Rearing Units} \times \text{Optimal Egg Deposition}}{(\% \text{grilse} \times \% \text{female} \times \text{mean wt} \times \text{fecundity}) + (\% \text{large} \times \% \text{female} \times \text{mean wt} \times \text{fecundity})} \\
 &= \frac{115,307 \times 240}{(.97 \times .69 \times 1.33 \times 1540) + (.03 \times .69 \times 3.7 \times 1540)} \\
 &= \frac{27,673,680}{1489} \\
 &= 18588 \text{ ---->> } \begin{array}{l} 18030 \text{ small salmon} \\ 558 \text{ large salmon} \end{array}
 \end{aligned}$$

Table 18. Estimates of returns and percent of egg target met for the Humber River, 1985 to 1991, under present management and alternate management scenario.

Year	1SW Catch	Exploitation Rate			MSW Returns Assumed 7% of 1SW		
		0.134	0.164	0.25			
1985	2430	18134	14817	9720	1269	1037	680
1986	3456	25791	21073	13824	1805	1475	968
1987	3074	22940	18744	12296	1606	1312	861
1988	4042	30164	24646	16168	2111	1725	1132
1989	1217	9082	7421	4868	636	519	341
1990	3054	22791	18622	12216	1595	1304	855
1991	1431	10679	8726	5724	748	611	401

Percent of Egg Target Met by 1SW & MSW salmon
at exploitation rates of

	0.134	0.164	0.25
1985	96.4%	76.6%	46.1%
1986	137.1%	108.9%	65.5%
1987	122.0%	96.9%	58.3%
1988	160.4%	127.4%	76.6%
1989	48.3%	38.3%	23.1%
1990	121.2%	96.2%	57.9%
1991	56.8%	45.1%	27.1%

Percent of Egg Target Met with Humber Arm Commercial and
Humber River Recreational Closed

	at exploitation rates of		
	0.134	0.164	0.25
1987	143.6%	118.5%	79.9%
1988	194.2%	161.2%	110.4%
1989	62.6%	52.7%	37.4%
1990	144.6%	119.7%	81.3%
1991	69.3%	57.6%	39.6%

Percent of Egg Target Met with Bay of Islands Commercial and
Humber River Recreational Closed

	at exploitation rates of		
	0.134	0.164	0.25
1987	188.8%	163.5%	124.8%
1988	243.2%	210.1%	159.1%
1989	87.3%	77.4%	62.0%
1990	170.3%	145.2%	106.7%
1991	77.7%	66.0%	48.0%

APPENDIX 1. Instructions for conducting the creel survey at Big Falls, Humber River, 1991.

The creel survey at Big Falls is designed similar to a bus route. The clerk travels to one location, waits a fixed interval of time, then moves on to next site and waits required interval of time at second site, etc. For Big Falls, only two sites have been designated therefore the route is very simple.

The two designated stops on the route are the stairs at the boat landing spot (designated as boat) and the stairs immediately upstream of the boat landing (designated as stair). The standard waiting period at the boat location is 4 hours (240 minutes) while the stair stop period is 1 hour (60 minutes).

The day is divided into four time periods as follows:

- A - 05:30 to 10:00
- B - 10:00 to 14:00
- C - 14:00 to 18:00
- D - 18:00 to 22:30

At each pool, the clerk will interview as many anglers departing as possible. Critical data include number of grilse kept, number of grilse released, number of large salmon released. Any grilse which are kept by the angler should be examined for the following critical features:

- 1 - presence of external Carlin tag (blue) - record number, angler name and ask angler to return tag to the address indicated on the tag.
- 2 - if no tag is present on fish, examine for tagging scar, two holes immediately below the dorsal fin.
- 3 - if no long line up of anglers, collect fork length and scales (if present) from fish
- 4 - ask angler time started fishing for that day.

It is more important to look at all fish being brought out, get accurate count of fish being caught and presence of tags or tagging scars. Length, scales and effort information are secondary.

The starting point of the creel and the time which the clerk spends at the very first stop may vary from day to day and period to period. The starting point and the duration of the initial stop are given on the schedule. The clerk is expected to work the duration of each time period and this may involve moving between the two interview locations several times.

For example, looking at the schedule, we see that for June 13, a creel is to be conducted during the 10:00 to 14:00 PM period. Looking at the schedule, the starting point is location 'boat' at time 10:00. The clerk should be ready to start intercepting anglers at that time at the boat landing site. Note also that the clerk would spend 30 minutes there (from 10:00 to 10:30) at which time, the person would move to the other location, stair. The clerk will stay at stair for 1 hour (10:45 to 11:45 assuming that the travel time from the boat landing spot to the bottom of the stair is 15 minutes) and intercept departing anglers. At 11:45, the clerk leaves and moves to the boat landing again. Assuming that the walk takes 15 minutes, then the clerk would intercept anglers at the boat landing between 12:00 and 14:00 at which time the sampling for that time period is over.

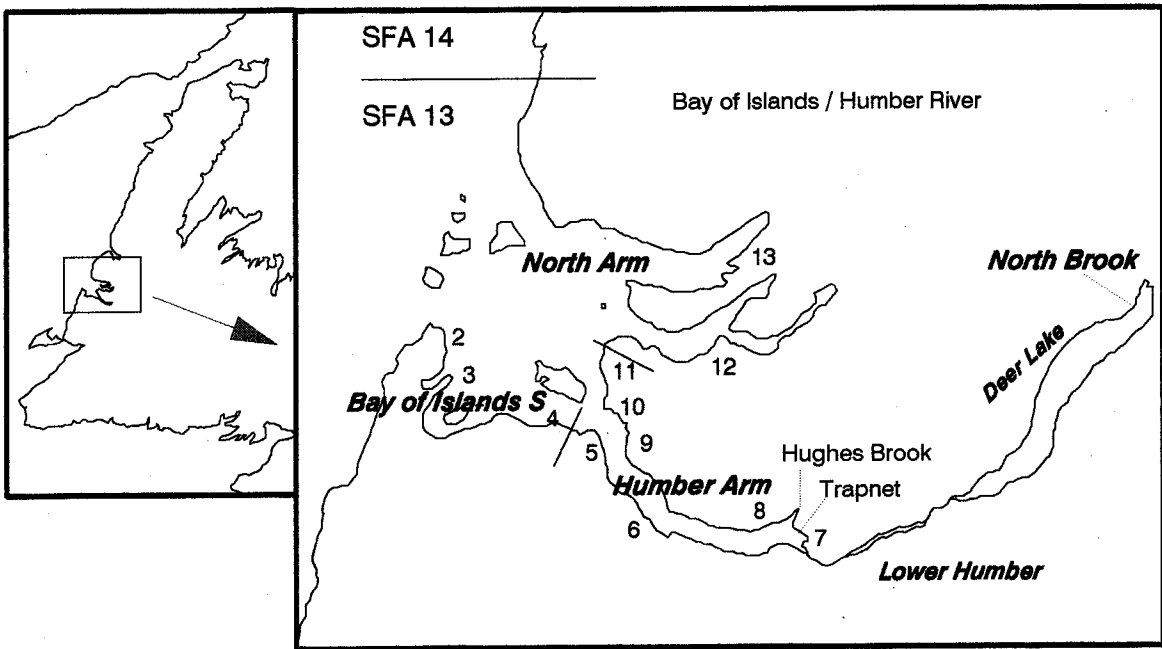


Figure 1. Coastal areas of Bay of Islands and Lower Humber River. Numbers indicate location of communities within Bay of Islands described in Table 1.

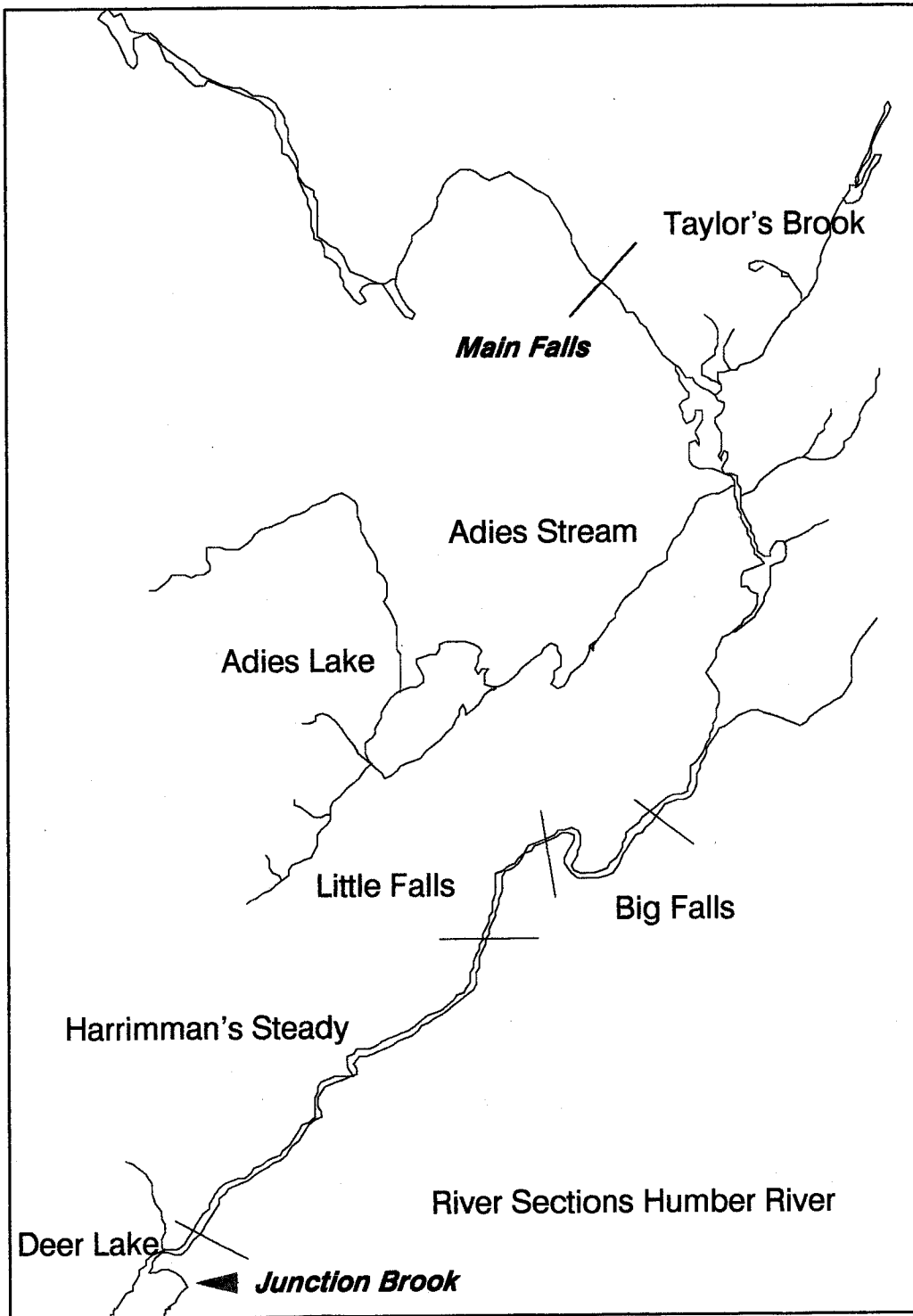


Figure 2. River sections of the Humber River, upstream of Deer Lake.

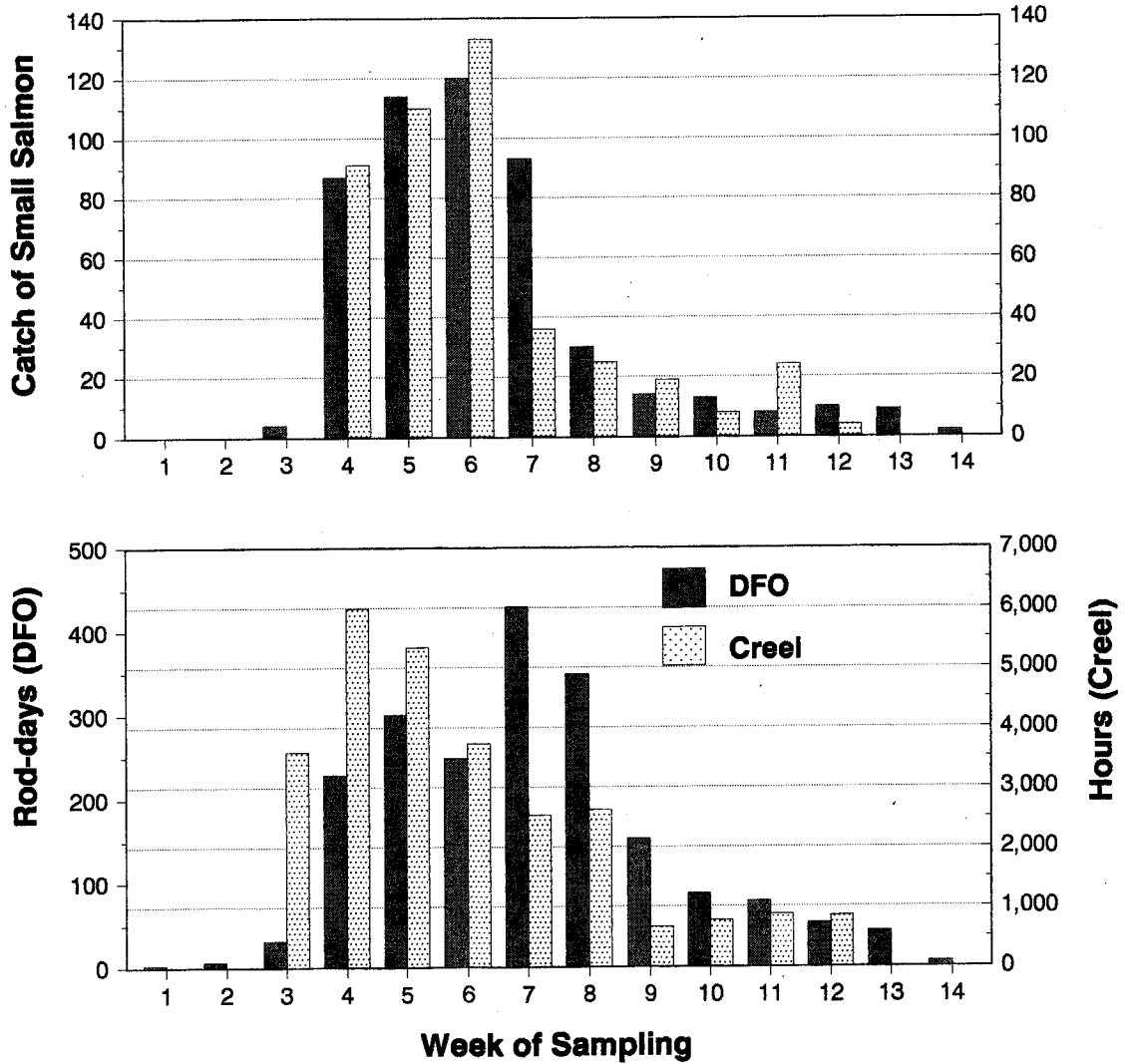
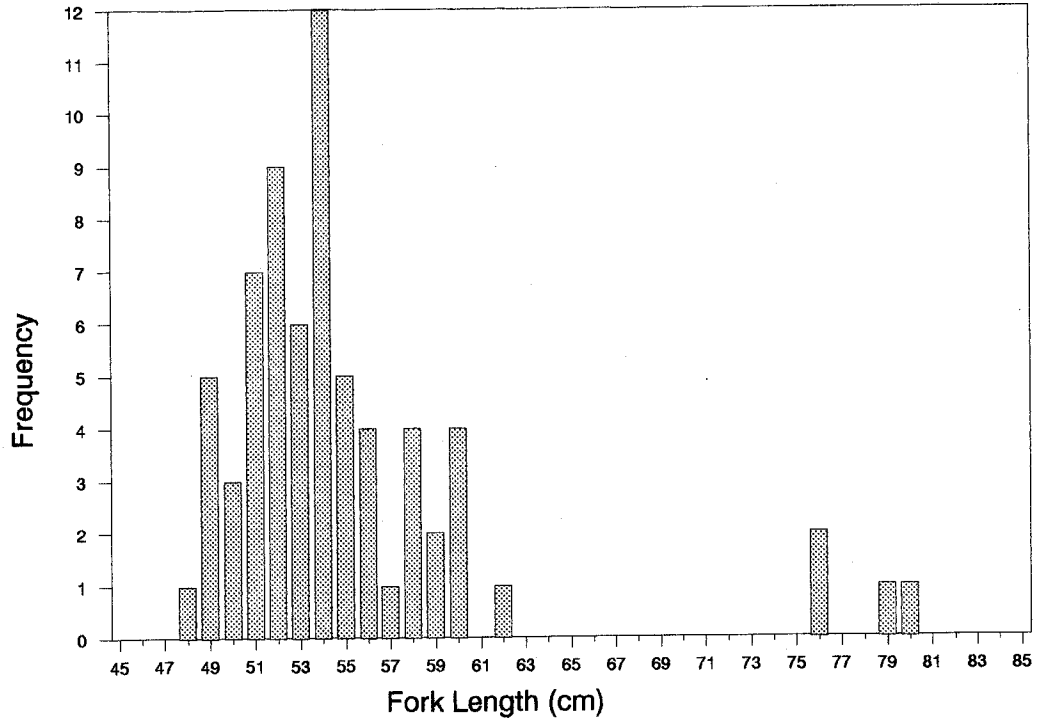


Figure 3. Comparison of effort and small salmon catch statistics obtained by DFO guardian and Science Branch creel survey at Big Falls, Humber River, 1991.

Length frequency of salmon sampled from trapnet, 1991



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

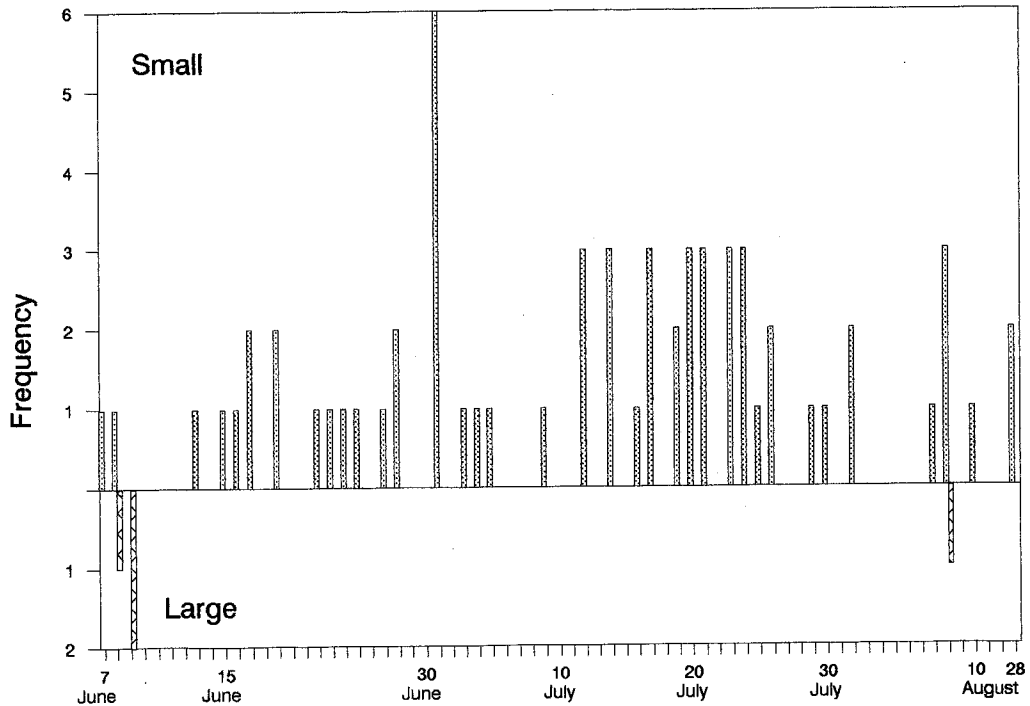


Figure 4. Length frequency and timing of catches of Atlantic salmon at the trapnet at Wild Cove, Humber River, 1991.