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THE STATUS OF THE ATLANTIC SALMON STOCK OF HUMBER RIVER/BAY OF ISLANDS, NEWFOUNDLAND, 1992

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 total recreational catch of 2,475 small salmon (both retained and released) from the Humber River was 61% greater than in 1991 but 94% of the previous 5 year mean. The recreational catch of released large salmon showed an even greater improvement than small salmon relative to 1991 and was above the previous 5 year mean. Increased river escapement of adults suggested by increased recreational catches is consistent with increased returns to counting facilities and to the tagging trapnet operated at Wild Cove. The results of the 1992 creel survey conducted at the Big Falls segment of the Humber River from June 16 to August 30 suggest that the 1992 recreational catch of retained small salmon was approximately 50% greater than the DFO river guardian estimate. The Big Falls creel survey estimated angling catches to be 3,001 fish compared to an estimate of 1,497 by the river guardian. The angling exploitation rate derived for the Humber River in 1992 was based on the recaptures of Carlin-tagged salmon from the Big Falls creel survey. Of 152 fish tagged two weeks before the recreational quota was reached, 5 recaptures were observed by the survey clerk amongst a total of 738 small salmon. The estimated potential egg deposition to the river was 44.0 million eggs, 160% of target in 1992. The large increase from 1991 is attributed to changes in biological characteristics of salmon returning to the river and an increase in the proportion of large salmon returns resulting from the closure of the commercial salmon fishery.

RÉSUMÉ

La région de la Humber et de la baie Islands se trouve dans l'ouest de Terre-Neuve, à l'extrémité nord de la zone de pêche du saumon (ZPS) 13. Les prises totales (prises gardées et prises remises à l'eau) de la pêche récréative dans la Humber, soit 2 475 petits saumons, étaient supérieures de 61 % à celles de 1991 et de 94 % à la moyenne des cinq années antérieures. Les prises récréatives de gros saumon remises à l'eau révélaient une amélioration encore plus grande par rapport à 1991 et se situaient au-dessus de la moyenne des cinq années antérieures. La hausse des prises récréatives semble refléter une augmentation du nombre d'échappées d'adultes dans la rivière, comme en témoigne la hausse des montaisons aux installations de dénombrement et au piège de marquage de l'anse Wild. D'après le relevé des prises effectué dans la Humber aux chutes Big du 16 juin au 30 août 1992, les prises récréatives de petit saumon gardées étaient supérieures de 50 % environ aux estimations du garde-rivière du MPO. Selon ce relevé, les prises des pêcheurs à la ligne étaient de 3 001 poissons, tandis que le garde-rivière les chiffrait à 1 497 poissons. Le taux d'exploitation des pêcheurs à la ligne dans la Humber en 1992 a été déterminé d'après les recaptures de saumons qui avait été munis d'une étiquette Carlin lors du relevé. Cinq des 152 poissons étiquetés deux semaines avant que le quota de pêche récréative ne soit épuisé ont été observés par le préposé au relevé parmi un total de 738 petits saumons. On estimait les possibilités de ponte dans la rivière à 44,0 millions d'oeufs en 1992, soit 160 % de la cible. La forte augmentation que cela représente par rapport à 1991 est attribuée à des changements dans les caractéristiques biologiques du saumon qui remonte la rivière et à une proportion accrue de montaisons de gros saumon due à la fermeture de la pêche commerciale.

INTRODUCTION

The Humber River / Bay of Islands area is one of four river systems within the Gulf of St. Lawrence selected for a pilot study of the River/Zone Management Strategy. The Humber River flows into the Bay of Island coastal area which is situated in western Newfoundland at the northern limit of Salmon Fishing Area (SFA) 13 (Figure 1). Atlantic salmon were exploited commercially in this coastal area until 1991 but this fishery was closed in 1992 to help rebuild declining stocks. Low stock levels in the Bay of Islands have been indicated by egg depositions which were below target requirements on the Humber River in 1990 and 1991 (Chaput and Mullins 1992, 1991). Egg depositions for the Humber River stock in 1991 were estimated at only 45% of the target spawning requirements for the Humber River system (Chaput and Mullins, 1992) which is the largest tributary of the Bay of Islands. Recreational fisheries in 1992 continued to harvest salmon in 3 of the 4 tributaries within the bay but were limited by the quota on small salmon harvests which was implemented in SFA 13.

The total drainage area of the tributaries flowing into the Bay of Islands is 8124 km^2, which is 93% of the drainage area of Statistical Area L (Table 1) and 57% of SFA 13 drainage area. The Humber River comprises 95% of the Bay of Islands drainage area and flows into Humber Arm (Figure 1) 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 migrations of anadromous Atlantic salmon within the Humber River system occur at Main Falls (Figure 2) which is 112.6 kilometres from the river mouth and at Junction Brook which was diverted for hydroelectric development in 1925. The diversion of Junction Brook which flowed into the Humber River at Deer Lake, resulted in the loss to the Humber River system of the anadromous salmon production potential of the Grand Lake system (Porter et al. 1974) (see Figure 2).

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

1) the reduction, starting in 1978, of the commercial fishing season from May 15-December 31 to June 1-July 10 from the previous May 15 to December 31,
2) the introduction in 1984 of a regulation requiring the mandatory release in the recreational fishery of all salmon $\geq$63 cm fork length,
3) the intoduction 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,
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.
6) the closure of the commercial salmon fishery in 1992, the implementation of a recreational fishery (zonal) quota of 5,000 small

salmon for SFA 13 and a quota of 100 small salmon for the Adies Lake (Figure 2) segment of the Humber River, a reduction of the seasonal bag limit to 8 small salmon and the introduction of a catch and release recreational fishery after the zonal quota was reached.

The assessment of the status of the Atlantic salmon stock is based on the analysis of annual trends in the catches from the recreational fishery and the estimation of spawning escapement. Spawning escapement is estimated using derived exploitation rates in a portion of the recreational fishery applied to actual observed recreational fishery harvests. The present document provides the catches, effort, and timing data for the recreational fisheries of Humber River / Bay of Islands for 1992. It follows the initial assessments presented for 1990 and 1991 (Chaput and Mullins, 1991; Chaput and Mullins, 1992) and addresses the following topics:

1) verification by independent creel method, of the recreational catch statistics collected by the Department of Fisheries and Oceans (DFO) river guardians for the Big Falls segment of the Humber River,
2) estimation of the exploitation rate by the recreational fishery on small salmon in 1992 by mark-recapture methods,
3) updating of the biological characteristics of the Humber River/Bay of Islands Atlantic salmon stock,
4) examination of the effect of the 1992 management regulations on the spawning escapement to the Humber River,
5) assessment of the fall migration of salmon into the Humber River.

MATERIALS AND METHODS

The recreational catch statistics were compiled from DFO river guardian and fisheries officer 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 segment (Figures 1 & 2) and the standardized weeks used are described in Table 2.

Salmon catches in the recreational fishery are categorized into small and large size groups. The criteria for small and large salmon designation are as follows:

Small (1SW) - < 63 cm fork length

Large (MSW) - ≥ 63 cm fork length

Estimation of Recreational Harvest

DFO River Guardian Statistics

Weekly salmon angling reports are completed by DFO river guardians and fishery officers. Data recorded on a daily basis for each river or river segment 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 segment 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).

In 1992, weekly salmon angling reports were also completed for the catch and release recreational fishery which was permitted after the SFA 13 zonal quota was reached. Comparisons of recreational catches of small salmon on the Humber River in 1992 with those in previous years were made by combining the 1992 retained (Kept) and released (hooked and released; H&R) catches.

Creel Survey

A creel survey to estimate the angling catch at Big Falls, Humber River, was conducted between June 16 and Aug. 30, 1992. Unfortunately, an estimate of total angling effort could not be determined from the 1992 survey as only the anglers with catch were interviewed as they left the fishing area. The angling effort estimate for 1992 is the effort expended by successful anglers. The Big Falls segment (Figure 2) was again selected for the survey because it is accessed by anglers from two points and the angling catches from this segment 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 successful 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 (7 days) were used at Big Falls in 1992. 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 within strata consisted of 5 days per strata between June 8 and June 28, 7 days between June 29 and August 3, and 5 days between August 4 and August 30. The days and the time periods within the day to be sampled were randomly selected within each stratum. Among strata sorting followed when consecutive strata were equal in size (ex. 7 day or 5 day weekly strata).

The total catch for each stratum (week) was 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 variance of the catch estimate was calculated for each stratum using the Yates-Grundy variance formulation (Robson 1990). Totals and variance estimate of totals for combined strata were obtained by summation. The confidence intervals of the estimate were calculated using $\pm$ 2 standard deviations.

Estimation of Exploitation Rate

A trapnet was fished at Wild Cove, Humber Arm, between June 7 and October 2, 1992 (Figure 1). The trapnet design and installation were identical to the 1990 and 1991 sampling program (Chaput and Mullins 1991, 1992).

All Atlantic salmon, captured at the trapnet, were measured (fork length cm), and scale sampled. Those captured prior to August 30 were marked with individually numbered blue Carlin tags using a double stainless steel wire attachment directly under the dorsal fin. Tag recaptures used to estimate the exploitation rate were collected by the DFO creel survey clerk at Big Falls. The exploitation rate used to calculate 1992 returns to the Humber River was the number of tags collected during the creel survey divided by the number of tags at large prior to the closure of the recreational fishery on August 1. The number of tags at large was adjusted for known removals at the Hughes Brook counting fence and for tagged fish that had spawned the previous year and had not acquired new scale growth at the time of tagging. For comparison, the exploitation rate of all recreational catches of small salmon is also calculated.

Returns to the Humber River

The returns of small salmon to the Humber River were estimated by dividing the catches of small salmon actually observed by the DFO creel clerk in the recreational fishery at Big Falls by an estimate of the exploitation rate in the recreational fishery at Big Falls. The returns of large salmon to the Humber River were determined by applying the ratio of large to small salmon captured in the trapnet at Wild Cove to the estimate of small salmon returns. In previous assessments, the appropriate ratio of large to small salmon returns to the river was considered to be equivalent to the ratio of large to small salmon in the recreational fishery (7%) prior to 1984 when large salmon could be retained (Chaput and Mullins 1991, 1992). However, a commercial fishery was also permitted. Because of the closure of the commercial fishery in 1992 and the potential for an increase in the river escapement of large salmon, the ratio of large to small salmon captured at the Wild Cove trapnet was considered to be more representative of returns to the river in 1992.

An index of the fall migration of salmon into the Humber River after recreational fisheries were closed was obtained from captures of salmon at the Wild Cove trapnet from September 1 to October 2. The trapnet was operated during this period by a local recreational fisheries development group with supervision from DFO, Science Branch staff.

Biological Characteristics

Biological characteristics of Atlantic salmon in 1992 were obtained from mortalities and live samples of bright salmon at the trapnet and from the recreational fishery catches landed at the Big Falls segment of the Humber River. The fish were sampled for fork length (0.5 cm) and whole weight (0.01 kg) and sex determination was by internal examination except on live fish. Scale samples were obtained for determining the river and sea age. These methods were identical to those used in 1990 and 1991.

Estimation of Target Spawning Requirements

Target egg deposition for the Humber River was calculated using an optimal egg deposition of 2.4 eggs/m^2 of parr rearing area as described by Porter and Chadwick (1983). The parr rearing area for the Humber River has been estimated at 11,530,700 m^2 (Porter and Chadwick 1983) resulting in a target egg deposition of 27.674 million eggs.

Estimation of Potential Egg Depositions

The potential egg depositions were calculated using the estimated spawning escapement and observed biological characteristics (mean weight, percent female, fecundity) of small and large salmon. The spawning escapement was obtained by subtracting the adjusted total recreational catch of small salmon retained from the estimated returns to the river. The total recreational catch for the river was adjusted upwards based on the angling exploitation rate for catches at Big Falls.

Returns to Counting Fences

The returns, by date, to counting fences on Hughes Brook and North Brook (see Figure 1) for 1992 were collected by private development associations. Supervision and instruction in data compilation were provided by DFO, Science Branch staff.

RESULTS

Recreational Effort and Catches

The recreational angling season in the Bay of Islands for retention of small salmon in 1992 opened June 6 and closed August 1 when the SFA 13 zonal quota of 5,000 small salmon was reached (Mullins and Jones, 1993). A total of 5,970 small salmon were angled including those hooked and released. The August 1 closing date was five weeks earlier than the earliest closing date in previous years. The Adies Lake quota of 100 small salmon was not reached by that date. Cook's Brook which did not open until August 1, closed the same day. Catch and release angling was permitted from August 2 to September 7.

The total recreational catch of retained and released small salmon reported from the Bay of Islands region in 1992 was 2,475, an increase of 61% from the 1991 catch (Table 3). The 1992 catch was about 94% of the mean catches over the previous 5 years and about 80% of mean catches since 1953 (Table 3). The proportion of the SFA 13 catch of small salmon taken in the Bay of Islands was 40% in 1992, approximately 12% higher than in 1991 and similar to most years since 1984 (Table 3). In 1992, released catches of large salmon in the Bay of Islands showed a larger increase compared to 1991 and the previous five years than did catches of small salmon in 1992.

Within the Bay of Islands region the total recreational catch from the Humber River remained the dominant proportion of the catch (Table 4). The 1992 catch of 2,428 small salmon was 70% higher than the catch of small salmon in 1991 and represented 95% of both the previous 5 year and the long-term mean catches. Catches of small salmon from the Goose Arm River and Cook's Brook were lower in 1992 than in the previous year.

Retained catches of small salmon from the Humber River represented 92% of the total retained and released catch of small salmon on the Humber River (Table 5).

Catches of small salmon increased relative to 1991 on four of eight segments of the Humber River (Table 6a). At Big Falls, for example, the estimated catch of small salmon was more than 200% above the 1991 catch and 163% of the previous five year mean. Big Falls was the only segment of the river where the catch was above the the previous five year mean. The Big Falls recreational catch of small salmon represented 63.7% of the Humber River total catch in 1992, compared to an average of 50% in previous years (1976-1991). The increase in the proportion of Humber River small salmon angled at Big Falls was due in part to the reduction in catches on segments of the river above Big Falls as a result of the zonal quota and the catch and release fishery. Large salmon released catches at Big Falls were 64% of the total for the river and represented a dramatic increase from the previous five year mean (Table 6b).

The total recreational effort on the Humber River was approximately 5% greater than the previous years effort (Table 6c). The angling effort on some segments of the river, however, increased by a much larger amount while the effort at other segments declined, compared to the previous year. The greatest increase in effort was at Adies Lake which was 81% above the effort in the previous year and represented 24% of the mean effort for the previous five years. The effort at Big Falls, the most productive angling location on the Humber River, was 34% above the previous year and 120% of the mean effort in the previous five years. The segments of Adies Stream and Taylor's Brook had the greatest reduction in effort compared to 1991 (Table 6c). These segments are in the uppermost part of the Humber River system and angling effort in these areas may have been curtailed because of the early closure of the fishery when the zonal quota was reached.

The weeks of peak catches in 1992 for eight of the nine segments of the Humber River were earlier than in 1991 by about one to three weeks. The weeks of peak catches in 1992 for most segments of the Humber River were also earlier, compared to most years since 1976 (Table 7a).

The total duration of the recreational fishery for on small salmon in 1992 was approximately 6 weeks in most segments of the Humber River (Table 7b). The longest duration of angling for small salmon was on the Lower Humber River segment which covered a 10 week period in 1992. The weeks of peak effort in most segments of the river (except Little Falls) were either earlier or the same as in 1991 (Table 7c). Effort duration, however, was similar to previous years (Table 7d).

Creel Estimates for Big Falls

The creel survey catch estimate (Kept) of small salmon from Big Falls for the period June 15 to August 30, was 3,001 fish (95% C.I. 2,702 to 3,301) (Table 8a). The catch of small salmon estimated by the DFO river guardian for the same time period was 1,497 which is below the 95% confidence limits of the creel estimate. The discrepancy between the two estimates was primarily in week 4 when the peak catches were estimated by the creel survey but the DFO river guardian estimate was only the third highest (Figure 3a). The DFO river guardian estimate of 239 small salmon (Kept) in week 4 (Table 8a) was only slightly higher than the 208 small salmon actually seen by the creel clerk during the same week (Table 9). The weekly creel estmates of small salmon released after week 9 were also higher than the DFO river guardian estimates (Table 8b). The weekly creel and DFO river guardian estimates of large salmon released, however, were similar (Table 8c).

The distribution of weekly catches was similar between the two methods, although, according to the creel estimate, the largest percentage of the catch was in week 4, in contrast to week 3 from the DFO river guardian estimate (Figure 3b). Week 4 is spread between the standardized weeks 25 and 26, i.e. slightly earlier than the usual peak of angling catches at Big Falls. In 1986-1991, peak catches occurred in standardized weeks 26 and 27 (Mullins et. al. 1989; Mullins and Claytor 1989; Mullins and Jones 1993).

The greatest similarity between the two methods was in the distribution of the estimated effort. The peak estimated effort from both the creel and the DFO river guardian methods occurred in week 4 (Figure 3c).

Of the 194 anglers with catch that were interviewed during the peak of the 1992 season in June, 43% had caught their daily bag limit of two fish (Table 10). This was twice the percentage of anglers that caught their daily bag limit of two fish at the peak of the 1991 season in July-1 (Table 10) suggesting that either the exploitation rate or the abundance of salmon, or both, were higher in 1992.

For released catches of large salmon in 1992, 50% of the anglers interviewed who had released large salmon had released one and 13% had released their limit of four large salmon. In the 1991 creel survey, no releases of large salmon were reported.

Humber River Fall-Run Salmon

Anecdotal information from salmon anglers describes historical catches of large salmon during the fall on the lower Humber River. This information suggests that some large salmon enter the river late in the season on their spawning migration (in 1974-1977 the recreational salmon fishery closed on September 15). In 1990, the DFO tagging trapnet at Wild Cove, in the estuary of the Humber River, was operated until mid-September as an index of the fall salmon run and catches indicated some small salmon entering the river, but no large salmon were caught (Figure 4). In 1992, with the Newfoundland commercial salmon fishery closed, the trapnet was again operated in the fall. The total catch at the trapnet from September 1 to October 2, 1992 was as follows:

Date	Small <63cm	Large >=63cm
Sept. 1	1	2
Sept. 3	1	0
Sept. 5	0	1
Sept. 9	1	0
Total	3	3

These catches represent approximately 2% of total small salmon catch and 10% of the total large salmon catch at the trapnet in 1992.

These small and large salmon catches and the catches at the trapnet in late August, 1992 (Figure 4) were noted to follow the period in which the highest water temperatures for the season were recorded at the trapnet (Figure 6). In the three years of temperature data collection in the Humber River estuary, the highest water temperatures have been recorded during the month of August (Figures 6, 7, 8). In assessing the presence or absence of a fall salmon run to the Humber River it is important to consider the possibility of water temperature effects on the timing of the summer run in some years. High temperatures may delay the entry into the river of some summer run fish.

Estimation of Exploitation Rate

Between June 7 and September 9, 1992, a total of 31 large salmon ($\geq$ 63 cm) and 212 small salmon ($<$ 63 cm) were captured at the trapnet (Figure 4). Of these, 30 large and 179 small were considered bright salmon returning to the Humber River. The ratio of 30 large to 179 small bright salmon in 1992 was four times the ratio (3/94) in 1991 and twice the ratio (18/242) in 1990. The trapnet was fished in the same location in 1992 as in 1991 and 1990.

The peak of small salmon catches occurred in June, 1992, whereas catches in 1990 and 1991 were more temporally dispersed (Figure 4). The peak of large salmon catches in early June, 1992, was similar to the previous two years.

A total of 150 small bright salmon were tagged and released between June 7 and the closing date of the recreational fishery on August 1 (week 31) (Table 11). The last salmon tagged and released prior to the closure was on July 15 (week 28). Fish tagged in week 28 had at least two weeks to disperse into the population. During the recreational fishery, 5 tags were recovered from the creel survey clerk at Big Falls and 27 were reported by anglers (Table 11). The time at large before recapture in the recreational fishery was short for the lower segments of the river, less than two weeks in most cases. In contrast, fish recaptured from the upper segments of the river had been at large from 3 to 6 weeks before recapture (Table 12).

Adjustments for tag loss, made in the 1990 assessment (Chaput and Mullins 1991), could not be made in 1992 because of the absence of tagged fish at the counting fence on North Brook. An estimate of the reporting rate was not required because only recaptures actually observed by the creel survey clerk were used to estimate the exploitation rate. The small salmon exploitation rate from the creel survey at Big Falls in 1992 was 0.033, and was unadjusted for tag loss (Table 11). In comparison, the exploitation rate derived from angling and unadjusted for tag loss and reporting rate, was 0.22, which is higher than the unadjusted rate of 0.164 in 1991 and 0.134 in 1990 (Chaput and Mullins 1992, 1991). This difference might have been accounted for by the difference in tag loss and reporting rate between years.

Biological Characteristics of the Humber River Stock

The average weight of small salmon (<63 cm fork length) sampled from the recreational fishery in 1992 was 1.96 kg (N=159) and the average fork length was 56.1 cm (N=339) (Table 13a). The mean weight in 1992 was 15% greater than the mean weight of small salmon sampled in the 1991 recreational fishery. The sex ratio of these fish was 54.2% female, which was similar to the sex ratio of 54.1% in Bay of Islands commercial samples in 1991 and similar to the 53% female small salmon reported by Porter and Chadwick (1983). The percentage female small salmon sampled at the trapnet in 1992 was 70% (N=30), similar to the value of 69.2% which was determined from mortalities (N=39) at the trapnet in 1991 (Chaput and Mullins 1992).

Spawner requirements and egg depositions were calculated using the biological characteristics of the small salmon from the recreational fishery in 1992. There was only one large salmon mortality at the trapnet in 1992. Therefore, the sex ratio of 68.6% female determined from Bay of Islands commercial samples (N=35) in 1991 and the mean weight of 3.7+ kg for large salmon, used in the 1991 assessment (Chaput and Mullins 1992), were not updated.

Small salmon sampled at the trapnet in 1992 had a larger mean size than small salmon sampled at the trapnet in 1991 (Table 13a). The mean fork length of 53.6 cm and and the mean whole weight of 1.71 kg in 1992 were similar to biological characteristics of salmon sampled in the Bay of Islands commercial fishery in 1991 (Chaput and Mullins 1992). The percentage female small salmon sampled at the trapnet in 1992 was unchanged from the percentage female small salmon at the trapnet in 1991 and in 1990 (Table 13a). The proportion of large salmon sampled at the trapnet increased to 14.6% in 1992 from 3.1% in 1991 and 6.9% in 1990 (Table 13a). The percentage of large salmon sampled in the commercial fishery in 1991 was 11% (Chaput and Mullins 1992).

There was no difference in the mean fork length of the weighed versus the unweighed salmon sampled in the recreational fishery in 1992 (Table 13b) indicating that the angled fish which were weighed were representative of the population.

Returns and Escapements to the Humber River in 1992

Using the exploitation rate derived for catches of small salmon observed in the 1992 creel survey at Big Falls (0.033), the Petersen (uncorrected) estimate of returns of small salmon to the Humber River in 1992 were 22,364 fish (Table 14). The estimate of small salmon returns determined by the Bayesian estimation method for small numbers of recaptures (Gazey and Staley 1986) was 21,700 (Figure 9) with a 95% confidence interval of 8,500 to 81,100 (Appendix 2). The estimate of returns was similar for both methods. The returns of large salmon in 1992, equivalent to 16.76% of small salmon returns, based on captures at the trapnet, were 3,748 fish (Table 14). This provided a total escapement to the Humber River of 26,112 small and large salmon.

The potential spawning escapement was determined by subtracting the number of small salmon removed by anglers from the total returns (Table 14). The number of small salmon angled was estimated based on the percentage of the total tag returns recaptured by anglers at Big Falls. Twenty-two of 32 tags returned (69%) during the recreational fishery were from Big Falls. This is consistent with the percentage of recreational catches reported for Big Falls by the DFO river guardian. The creel survey estimate of 3,001 small salmon caught at Big Falls was adjusted to give a total angling catch for the river of 4,349 small salmon.

The estimated egg deposition for 1992 is 44.0 million eggs after angling or 160% of target (Table 15). If returns had been calculated using the angling catch method (Table 14), the potential egg deposition would have 138% of target.

Returns to Counting Fences

Returns of small salmon to the counting fences at Hughes Brook and North Brook were the second highest recorded for both facilities (Table 16). The returns of small salmon to the North Brook counting fence in 1992 were 152% above 1991 returns, similar to the increase in captures at the Wild Cove trapnet but slightly higher than the increase in angling catch in 1992 relative to 1991. Returns of large salmon were the highest ever recorded at either counting fence and had increased significantly from 1991. The magnitude of the increase in large salmon returns in 1992 relative to 1991 and previous years was similar to increases at the Wild Cove trapnet and to the increase in released catches of large salmon in the recreational fishery on the Humber River.

The timing of movements through the fence at Hughes Brook was similar to previous years but was about two weeks later at North Brook. The dates when 50% of the run had been enumerated were August 1 for Hughes Brook and August 22 for North Brook (Table 16).

DISCUSSION

The total estimated recreational catches of retained and released small salmon in the Bay of Islands/Humber River fisheries in 1992 were 61% above those in 1991 and similar to the mean retained catches in the previous five years. The returns of small salmon to the counting fence on North Brook and to the trapnet, however, were more than 100% above returns to these facilities in 1991. The increase in returns at the counting facilities was approximately 40% greater than the increase in returns of small salmon suggested by DFO river guardian estimates of recreational catches on the Humber River. The creel survey of recreational catches of small salmon at Big Falls also suggested that the catch of small salmon reported by the DFO river guardian at Big Falls in 1992 was underestimated by approximately 50% (Table 8). An adjustment to the recreational catch of small salmon retained, based on the percentage of the angling catch taken at Big Falls, resulted in a catch of 4,349 fish in 1992. This is an increase of 213% (in a season five weeks longer) compared to the 1991 catch. During 1991, when stock abundance was low (45% of target), the creel survey and guardian estimates of small salmon catch at Big Falls were the same. Because of the higher catches in 1992, the number of patrols conducted by the river guardians should have been increased in order to acquire the same accuracy as in the 1991 estimate of the catch. These results indicate that traditional methods of collection of recreational catch and effort statistics cannot be assumed to provide a consistent index of abundance. It is essential that alternate methods of estimating angling catches and effort such as the 'bus-route' creel be employed on the Humber River in order to validate angling data each year for river specific assessments, especially with management measures now in place to rebuild salmon stocks.

The recreational catches of released large salmon indicated an even greater increase in abundance than that observed for small salmon relative to 1991 (178 large salmon in 1992 compared to 11 large salmon in 1991) and compared to the previous five year mean. The large increase in returns of large salmon to the counting fences on Hughes Brook and North Brook and to the trapnet at Wild Cove relative to 1991 and previous years were consistent with increased catches in the recreational fishery on the Humber River. An increase in catches of large and small salmon could be explained by an increase in salmon abundance as a result of the closure of the Bay of Islands commercial fishery.

The recreational fishing effort in the Humber River was only 5% above recreational effort in 1991 and 88% of the previous five year mean. Increased recreational catches, particularly of large salmon, therefore, are not explained by the small increase in effort. Angling effort, as well as catch, may have been underestimated in 1992.

The analysis of biological characteristics of Humber River salmon sampled at the trapnet at Wild Cove and from the recreational fishery in 1991-1992 indicates that the mean weight of small salmon in 1992 increased relative to 1991 (Table 13a; Figure 5). This change can be explained by an increase in river escapement of larger salmon which would have been selectively intercepted by commercial gillnets in the past. The mean fork length of Humber River salmon in 1992 was also above that recorded in 1991 but lower than in 1990 (Table 13a) suggesting that the effect of body weight as opposed to fork length is more influential in gillnet selectivity.

The removal of commercial gillnets from the Bay of Islands appears to have also resulted in a change in the timing of returns to the river in 1992. The timing of peak returns to the tagging trapnet at Wild Cove in 1990 and in 1991 did not occur until after the closure of the commercial fishery on July 10 but in 1992, peak returns occurred during the period previously covered by the commercial fishery (Figure 4). The answer to the question of whether or not commercial gillnets affected the timing of the run, however, is not clear because the earlier run-timing at the trapnet is not supported by an earlier timing in the recreational fishery on all segments of the Humber River. The modal week of recreational catches and effort in 1992 was earlier than in 1991 and earlier than in most previous years on most segments of the river but not on all (Table 7).

The recreational quota imposed on the 1992 recreational fishery in SFA 13 resulted in a five week earlier closing date for retention of catches of small salmon in the area and in a reduction of angling effort for the remainder of the season (Mullins and Jones 1993). A result of the early closure on the Humber River was that the middle segments of Harriman's steady, Little Falls and Big Falls produced higher catches relative to 1991 than the the lower or upper river segments. The lower river segments of Lower Humber and Deer Lake and the upper river segments of Taylor's Brook and Adies Stream produced fewer catches than in 1991 (Table 6a) because prior to 1992 these areas were commonly fished later in the season. The upper river segment of Adies Lake produced higher catches in 1992 relative to 1991 than other upper river segments because it had been closed four weeks earlier than other sements in 1991 for conservation reasons (Mullins and Jones 1992). The recreational quota, however, did not reduce the prosecution of the fishery over the entire season on all segments. The catch and release fishery on the Lower Humber River, for example, permitted angling to be spread over a 10 week period in 1992, compared to a maximum of 8 weeks in previous years (Table 7b).

The percentage of anglers at Big Falls that caught their daily bag limit of two small salmon (at the peak of the season) in 1992 increased relative to 1991. This increase is consistent with an increased abundance of small salmon relative to 1991 at Big Falls. Had the daily bag limit of small salmon been set at one fish per day in 1992 instead of two, angling catches at Big Falls during the peak of the run would have been less. The percentage of anglers (interviewed in the creel survey) who had reached their catch and release limit of large salmon also increased in 1992 relative to 1991 (Table 10). This is consistent with an increased abundance of large salmon.

The egg depositions to the Humber River in 1992, were 160% of the target requirement, based on the exploitation rate derived for the recreational fishery at Big Falls. This was a dramatic improvement relative to the 45% of the target met in 1991. In comparison, the egg depositions of salmon returns derived from the exploitation rate in the whole recreational fishery were 164% of the target. The latter method was similar to that used in the 1991 assessment, however, this method relies on an estimation of angling catch to calculate total returns, whereas, the former creel method uses fish actually observed by the survey clerk to calculate total returns. Also, angling catches this year may have been as much as three times the estimate provided by DFO river guardians and, therefore, would have underestimated the total returns to the river. It is essential that estimates of angling catch be as accurate as possible if they are to be used as anything more than indices of abundance.

If the increase in egg deposition is attributed to the change in abundance of large salmon in 1992 and the increase in the mean weight of small salmon brought about by the closure of the commercial fishery in the Bay of Islands there is reason to be optimistic about it's effectiveness in rebuilding stocks. The effect of the closure, however, can only be fully evaluated by continuing to assess changes in biological characteristics relative to previous years and assessing the impact on potential egg depositions.

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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

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

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

Table 3. Recreational catch of small (1SW) and large (MSW) Atlantic salmon from the Bay of Islands region, 1953 to 1992. Bay of Islands percentages of SFA 13, Area L and Sec. 44 small salmon in 1992 are based on the total angling catch (retained + released) of small salmon in these areas.

	Recreational Catch of 1SW				Recreational Catch of MSW			
		Bay of Islands, % of				Bay of Islands, % of		
Year	Bay of Islands	SFA 13	AREA L	Sec 44	Bay of Islands	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
1992	2475	41.5	88.0	88.6	178	18.8	64.7	66.7
1992 as % of:								
1987–1991	94.2				251.4			
1953–1991	82.0				108.2			

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

Table 4. Recreational catch of small and large Atlantic salmon from Bay of Islands rivers, 1953 to 1992.

Year	1SW				Humber % of Bay of Islands	MSW				Humber % of Bay of Islands
	Humber River	Hughes Brook	Cooks Brook	Goose Arm		Humber River	Hughes Brook	Cooks Brook	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
1991	1431	.	12	92	93	11	.	0	0	100
1992	2428	.	3	44	98	177	.	0	1	100
1991 as % of										
1987–1991	94.7		18.3	92.1		250.7				
1953–1991	82.6		6.8	189.5		109.1				

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

Table 5. Distribution by standardized week of recreational catch and effort of Atlantic salmon on the Humber River, 1992. H&R refers to hooked and released fish.

Week	Water Level	Total Effort (Rod-days)	Catch				
			Small Salmon			Large Salmon	Total Salmon Catch
			Kept	H&R	Total	H&R	
23	High	25	0	.	0	1	1
24	High	93	74	.	74	0	74
25	High	739	514	.	514	58	572
26	Med.	882	315	.	315	26	341
27	Med.	1052	377	.	377	34	411
28	Med.	895	335	.	335	11	346
29	Med.	893	355	.	355	10	365
30	Med.	640	186	.	186	5	191
31	Med.	334	78	11	89	8	97
32	High	131	.	41	41	8	49
33	Med.	165	.	50	50	4	54
34	Med.	112	.	57	57	8	65
35	Med.	44	.	8	8	1	9
36	Med.	67	.	27	27	3	30
Total	Med.	6072	2234	194	2428	177	2605

Table 6a. Recreational catch (number) of small salmon from sections of the Humber River, 1976 to 1992. River sections are shown in Figures 1 and 2.

Year	Humber River Total	Small salmon catch (number) by location on 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
1992	2428	70	144	372	177	1547	31	51	36
Mean									
1987–1991	2563	152	136	498	376	951	135	244	72
1977–1986	3202	222	227	296	495	1444	195	245	77
1992 as % of									
1987–1991	95	46	106	75	47	163	23	21	50
1977–1986	76	31	63	126	36	107	16	21	47

Table 6b. Recreational catch (number) of large salmon from sections of the Humber River, 1976 to 1992. River sections are shown in Figures 1 and 2.

Year	Humber River Total	Large salmon catch (number) by location on 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
1992	177	22	0	17	14	113	7	3	17
Mean									
1987–1991	48	14	0	0	7	21	3	0	2
1977–1986	90	15	3	2	16	49	4	1	0
1992 as % of									
1987–1991	372	157	.	.	189	528	219	.	1063
1977–1986	197	144	0	810	90	231	200	214	17000

Table 6c. Recreational effort (rod–days) on sections of the Humber River, 1976 to 1992. River sections are shown in Figures 1 and 2.

Year	Humber River Total	Effort (rod–days) by location on 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
1992	6072	1237	414	1034	360	2698	115	114	100
Mean									
1987–1991	6913	1121	344	976	939	2241	510	479	303
1977–1986	7823	1376	660	692	1074	2835	441	535	210
1992 as % of									
1987–1991	88	110	120	106	38	120	23	24	33
1977–1986	78	90	63	149	34	95	26	21	48

Table 7a. Frequency of modal week of small salmon catch on river segments within the Humber River, between 1976 and 1992. Includes temporary river closures in some years. * indicates 1991 value and ** indicates 1992 value.

Catch of Small Salmon	River Segment on the Humber River								
Modal Week	Humber River	Lower Humber	Deer Lake	Harrim. Steady	Little Falls	Big Falls	Adies Stream	Adies Lake	Taylor's Brook
25	0	0	0	0	1	1	0	0	0
26	2	**6	0	2	3	3	1	0	0
27	**8	3	1	*,**6	*6	**6	0	0	0
28	*6	4	2	6	**6	*6	0	1	0
29	0	*2	2	3	0	0	0	1	2
30	1	2	**3	0	1	1	2	0	2
31	0	0	3	0	0	0	2	*,**2	1
32	0	0	*3	0	0	0	4	2	**3
33	0	0	0	0	0	0	*,**4	3	*3
34	0	0	2	0	0	0	1	3	2
35	0	0	1	0	0	0	3	3	3
Sample Size	17	17	17	17	17	17	17	15	16

Table 7b. Frequency of weeks encompassing 10–90% of small salmon catch on river segments within the Humber River, between 1976 and 1992. Includes temporary river closures in some years. * indicates 1991 value and ** indicates 1992 value.

Weeks for 10–90% Catch	River Segment on the Humber River								
	Humber River	Lower Humber	Deer Lake	Harrim. Steady	Little Falls	Big Falls	Adies Stream	Adies Lake	Taylor's Brook
0	0	0	0	0	0	0	0	1	0
2	0	0	0	0	0	0	0	*2	0
3	0	1	2	0	2	3	1	0	2
4	0	3	4	3	3	5	2	6	*4
5	1	0	*4	6	4	*,**5	3	2	4
6	**2	3	**4	**4	**2	2	*,**8	2	**5
7	8	5	2	1	*4	1	0	**2	1
8	*5	*4	1	*2	2	0	3	0	0
9	1	0	0	0	0	1	0	0	0
10	0	**1	0	1	0	0	0	0	0
Sample Size	17	17	17	17	17	17	17	15	16

Table 7c. Frequency of modal week of recreational effort on river segments within the Humber River, between 1976 and 1992. Includes temporary river closures in some years. * indicates 1991 value and ** indicates 1992 value.

Effort (rod–days)		River Segment on the Humber River							
Modal Week	Humber River	Lower Humber	Deer Lake	Harrim. Steady	Little Falls	Big Falls	Adies Stream	Adies Lake	Taylor's Brook
25	0	2	0	1	0	0	0	0	0
26	1	1	0	2	2	3	1	0	0
27	8	6	0	**4	*7	**7	1	0	0
28	**6	**3	2	5	**5	5	0	1	1
29	0	2	**2	*4	3	0	0	1	1
30	*2	*3	3	0	0	*2	*,**5	*,**5	4
31	0	0	3	0	0	0	3	1	**3
32	0	0	*3	1	0	0	3	3	1
33	0	0	1	0	0	0	3	1	*5
34	0	0	2	0	0	0	1	2	1
35	0	0	1	0	0	0	0	1	0
Sample Size	17	17	17	17	17	17	17	15	16

Table 7d. Frequency of weeks encompassing 10–90% of the recreational effort on river segments within the Humber River, between 1976 and 1992. Includes temporary river closures in some years. * indicates 1991 value and ** indicates 1992 value.

Weeks for 10–90% Effort		River Segment on the Humber River							
	Humber River	Lower Humber	Deer Lake	Harrim. Steady	Little Falls	Big Falls	Adies Stream	Adies Lake	Taylor's Brook
0	0	0	0	0	0	0	0	1	0
2	0	0	0	0	0	0	0	1	0
3	0	0	1	0	1	0	1	*1	0
4	0	0	2	0	0	2	1	1	2
5	0	1	**4	3	4	6	4	4	6
6	1	0	*5	**5	4	**2	*,**6	**4	**3
7	**4	3	3	*4	**3	*5	1	1	2
8	*9	*8	1	4	*3	0	2	2	*3
9	3	**4	1	0	2	2	2	0	0
10	0	1	0	0	0	0	0	0	0
11	0	0	0	1	0	0	0	0	0
Sample Size	17	17	17	17	17	17	17	15	16

Table 8a. Estimate of catch of small salmon kept by week at Big Falls, Humber River, obtained by DFO River Guardian method and Creel method.

		DFO Guardian		Creel						
Dates	Week	Estimate	% of Total	% of Total	Estimate	Var.	Std.Dev.	Lower C.I.	Upper C.I.	Coef. Var.
Small Salmon Catch Estimate (Kept)										
	1	.	.	.	.	.	.	.	.	.
	2	.	.	.	.	.	.	.	.	.
June 15 to 21	3	352	23.5%	6.8%	204	3054	55.3	93.5	314.5	27.1%
June 22 to 28	4	239	16.0%	33.2%	997	17468	132.2	732.7	1261.3	13.3%
June 29 to July 5	5	289	19.3%	14.9%	446	969	31.1	383.7	508.3	7.0%
July 6 to 12	6	166	11.1%	17.0%	509	1059	32.5	443.9	574.1	6.4%
July 13 to 19	7	318	21.2%	18.8%	564	2622	51.2	461.6	666.4	9.1%
July 20 to 26	8	91	6.1%	7.2%	215	37	6.1	202.8	227.2	2.8%
July 27 to Aug. 2 *	9	42	2.8%	2.2%	66	277	16.6	32.7	99.3	25.2%
Aug. 3 to Aug. 9	10	.	.	0.0%	0	0	0.0	0.0	0.0	.
Aug. 10 to Aug. 16	11	.	.	0.0%	0	0	0.0	0.0	0.0	.
Aug. 17 to Aug. 23	12	.	.	.	.	.	.	.	.	.
Aug. 24 to Aug. 30	13	.	.	.	.	.	.	.	.	.
	14	.	.	.	.	.	.	.	.	.
	15	.	.	.	.	.	.	.	.	.
	Total	1497			3001	22432	149.8	2701.5	3300.5	5.0%

Table 8b. Estimate of catch of small salmon kept and released by week at Big Falls, Humber River, obtained by DFO River Guardian method and Creel method.

		DFO Guardian		Creel						
Dates	Week	Estimate	% of Total	% of Total	Estimate	Var.	Std.Dev.	Lower C.I.	Upper C.I.	Coef. Var.
Small Salmon Catch Estimate (Kept and Released)										
	1	.	.	.	.	.	.	.	.	.
	2	.	.	.	.	.	.	.	.	.
June 15 to 21	3	352	22.8%	8.5%	254	5121	71.6	110.9	397.1	28.2%
June 22 to 28	4	239	15.5%	37.1%	1113	26858	163.9	785.2	1440.8	14.7%
June 29 to July 5	5	289	18.7%	15.1%	454	1161	34.1	385.9	522.1	7.5%
July 6 to 12	6	166	10.8%	17.2%	517	1118	33.4	450.1	583.9	6.5%
July 13 to 19	7	318	20.6%	19.7%	591	2697	51.9	487.1	694.9	8.8%
July 20 to 26	8	91	5.9%	7.4%	223	58	7.6	207.8	238.2	3.4%
July 27 to Aug. 2 *	9	42	2.7%	2.3%	69	270	16.4	36.1	101.9	23.8%
Aug. 3 to Aug. 9	10	9	0.6%	2.2%	65	180	13.4	38.2	91.8	.
Aug. 10 to Aug. 16	11	15	1.0%	3.1%	92	1931	43.9	4.1	179.9	.
Aug. 17 to Aug. 23	12	18	1.2%	.	.	.	.	.	.	.
Aug. 24 to Aug. 30	13	4	0.3%	.	.	.	.	.	.	.
	14	.	.	.	.	.	.	.	.	.
	15	.	.	.	.	.	.	.	.	.
	Total	1543			3378	34273	185.1	3007.7	3748.3	5.5%

* Recreational quota reached August 1.

Table 8c. Estimate of catch of large salmon released by week at Big Falls, Humber River, obtained by DFO River Guardian method and Creel method.

		DFO Guardian			Creel					
Dates	Week	Estimate	% of Total	% of Total	Estimate	Var.	Std.Dev.	Lower C.I.	Upper C.I.	Coef. Var.
Large Salmon Catch Estimate (Released)										
	1	.	.	.	.	.	.	.	.	.
	2	.	.	.	.	.	.	.	.	.
June 15 to 21	3	36	31.9%	13.5%	15	110	10.5	−6.0	36.0	69.9%
June 22 to 28	4	23	20.4%	35.1%	39	596	24.4	−9.8	87.8	62.6%
June 29 to July 5	5	31	27.4%	35.1%	39	131	11.4	16.1	61.9	29.3%
July 6 to 12	6	10	8.8%	7.2%	8	17	4.1	−0.2	16.2	51.5%
July 13 to 19	7	7	6.2%	5.4%	6	11	3.3	−0.6	12.6	55.3%
July 20 to 26	8	3	2.7%	0.0%	0	0	0.0	0.0	0.0	.
July 27 to Aug. 2 *	9	2	1.8%	0.0%	0	0	0.0	0.0	0.0	.
Aug. 3 to Aug. 9	10	0	0.0%	3.6%	4	12	3.5	−2.9	10.9	86.6%
Aug. 10 to Aug. 16	11	0	0.0%	0.0%	0	0	0.0	0.0	0.0	.
Aug. 17 to Aug. 23	12	0	0.0%	.	.	.	.	.	.	.
Aug. 24 to Aug. 30	13	1	0.9%	.	.	.	.	.	.	.
	14	.	.	.	.	.	.	.	.	.
	15	.	.	.	.	.	.	.	.	.
	Total	113			111	877	29.6	51.8	170.2	26.7%

Table 8d. Estimate of recreational effort by week at Big Falls, Humber River, obtained by DFO River Guardian method and Creel method.

		DFO Guardian			Creel					
Dates	Week	Estimate	% of Total	% of Total	Estimate	Var.	Std.Dev.	Lower C.I.	Upper C.I.	Coef. Var.
Effort Estimate (rod−days for DFO Guardian; hours for Creel) Note: creel effort values for 1992 correspond to anglers with catch.										
	1	.	.	.	.	.	.	.	.	.
	2	.	.	.	.	.	.	.	.	.
June 15 to 21	3	326	12.2%	7.1%	2519	541427	735.8	1047.4	3990.6	29.2%
June 22 to 28	4	475	17.8%	30.0%	10687	1343019	1158.9	8369.2	13004.8	10.8%
June 29 to July 5	5	476	17.8%	14.9%	5303	387425	622.4	4058.1	6547.9	11.7%
July 6 to 12	6	441	16.5%	21.0%	7493	644137	802.6	5887.8	9098.2	10.7%
July 13 to 19	7	452	16.9%	16.1%	5735	289782	538.3	4658.4	6811.6	9.4%
July 20 to 26	8	274	10.3%	7.7%	2747	105006	324.0	2098.9	3395.1	11.8%
July 27 to Aug. 2 *	9	148	5.5%	2.3%	819	24871	157.7	503.6	1134.4	19.3%
Aug. 3 to Aug. 9	10	30	1.1%	0.9%	313	17841	133.6	45.9	580.1	42.7%
Aug. 10 to Aug. 16	11	23	0.9%	0.0%	0	0	0.0	0.0	0.0	.
Aug. 17 to Aug. 23	12	20	0.7%	0.0%	0	0	0.0	0.0	0.0	.
Aug. 24 to Aug. 30	13	4	0.1%	.	.	.	.	.	.	.
	14	.	.	.	.	.	.	.	.	.
	15	.	.	.	.	.	.	.	.	.
	Total	2669			35616	3353508	1831.3	31953.5	39278.5	5.1%

* Recreational quota reached August 1.

Table 9. Summary of Big Falls creel survey observations, 1992.

Week	Number Anglers Interviewed	Total Effort (hours)	Mean Effort per Interview (hours)	Number Small		Number Large Salmon Released	Number Carlin Tags Observed
				Kept	Released		
3	34	142.43	4.19	47	10	4	.
4	142	620.19	4.37	208	18	7	3
5	111	438.97	3.95	126	3	8	1
6	137	607.53	4.43	161	3	3	.
7	109	544.12	4.99	127	7	2	1
8	46	229.57	4.99	54	3	.	.
9	16	76.09	4.76	15	1	.	.
10	7	23.75	3.39	.	8	1	.
11	5	26.17	5.23	.	6	.	.
12	0		.	.	.	.	.
Total	607	2708.82	4.46	738	59	25	5

Table 10. Comparison by half month period of the proportion of anglers who had caught their daily bag limit in the recreational fishery at Big Falls, Humber River, 1991–1992.

1992 Analysis

	Number Anglers				Proportion			
	June	July–1	July–2	Aug–1	June	July–1	July–2	Aug–1
Small Kept								
0	0	0	0	0				
1	110	222	90	4	0.57	0.82	0.80	1.00
2	84	49	23	0	0.43	0.18	0.20	0.00
Total	194	271	113	4				
Small Kept/Released								
0	0	0	0	0				
1	100	225	89	12	0.51	0.81	0.77	0.80
2	89	51	26	3	0.45	0.18	0.23	0.20
3	5	1	0	0	0.03	0.00	0.00	0.00
4	2	0	0	0	0.01	0.00	0.00	0.00
5	0	0	0	0	0.00	0.00	0.00	0.00
6	0	0	0	0	0.00	0.00	0.00	0.00
7	1	0	0	0	0.01	0.00	0.00	0.00
Total	197	277	115	15				
Large Released								
0	0	0	0	0				
1	4	9	0	1	0.50	1.00	0.00	1.00
2	2	0	0	0	0.25	0.00	0.00	0.00
3	1	0	0	0	0.13	0.00	0.00	0.00
4	1	0	0	0	0.13	0.00	0.00	0.00
Total	8	9	0	1				

1991 Analysis

	Number Anglers				Proportion			
	June	July–1	July–2	Aug–1	June	July–1	July–2	Aug–1
Small Kept								
0	133	203	148	127				
1	6	52	31	5	0.86	0.79	0.86	0.83
2	1	14	5	1	0.14	0.21	0.14	0.17
3	0	0	0	0	0.00	0.00	0.00	0.00
4	0	0	0	0	0.00	0.00	0.00	0.00
5	0	0	0	0	0.00	0.00	0.00	0.00
Total	7	66	36	6				
Small Kept/Released								
0	133	202	148	123				
1	5	51	31	9	0.71	0.76	0.86	0.90
2	2	15	5	1	0.29	0.22	0.14	0.10
3	0	1	0	0	0.00	0.01	0.00	0.00
4	0	0	0	0	0.00	0.00	0.00	0.00
5	0	0	0	0	0.00	0.00	0.00	0.00
Total	7	67	36	10				
Large Released								
0	140	269	182	132				
1	0	0	2	1	0.00	0.00	1.00	1.00
2	0	0	0	0	0.00	0.00	0.00	0.00
3	0	0	0	0	0.00	0.00	0.00	0.00
4	0	0	0	0	0.00	0.00	0.00	0.00
5	0	0	0	0	0.00	0.00	0.00	0.00
Total	0	0	2	1				

Table 11. Weekly distribution of tagged and recaptured salmon on the Humber River, 1992. The cumulative number of tags available in the population was adjusted by subtracting the number recaptured at the Hughes Brook counting fence.

Standardized Week	Number Brights Tagged	Cumulative Number Tagged	Recaptures *			Exploitation Rate	
			From Creel	From Anglers	From Hughes	in angling after adjustment	in creel after adjustment
Small Salmon							
23	11	11	1	2	.	0.30	0.091
24	66	77	2	14	.	0.26	0.039
25	31	108	1	5	.	0.24	0.037
26	10	118	1	2	.	0.25	0.042
27	21	139	.	3	.	0.23	0.036
28	11	150	.	1	.	0.22	0.033
29	0	150	.	.	.	0.22	0.033
30	0	150	.	.	.	0.22	0.033
31 **	2	152	.	.	.	0.22	0.033
32	4	156	.	.	.	0.21	0.032
33	0	156	.	.	.	0.21	0.032
34	1	157	.	1	2	0.22	0.032
35	0	157	.	.	.	0.22	0.032
Total	157	157	5	28	2	0.22	0.032
Large salmon							
23	6	6	.	.	.	0.00	0.000
24	17	23	.	1	.	0.04	0.000
25	3	26	.	.	.	0.04	0.000
26	0	26	.	.	.	0.04	0.000
27	1	27	.	.	.	0.04	0.000
28	1	28	.	.	.	0.04	0.000
29	0	28	.	.	.	0.04	0.000
30	0	28	.	.	.	0.04	0.000
31 **	1	29	.	.	.	0.03	0.000
32	0	29	.	.	.	0.03	0.000
33	0	29	.	.	.	0.03	0.000
34	0	29	.	.	.	0.03	0.000
35	0	29	.	.	.	0.03	0.000
Total	29	29	0	1	0	0.03	0.000

* Two small salmon were also recaptured at the Wild Cove trapnet and released.
** Recreational fishery closed August 1.

Table 12. Distribution of small salmon recaptures by location and week of recapture.

Week of Tagging	Week of Recapture by Location																	
	Hughes Brook Counting Fence	Wild Cove		Humber	Steady Brook	Harrimans Steady				Little Falls	Big Falls*						Whites River	Taylors Brook
	34	24	28	26	34	25	26	27	29	26	25	26	27	28	29	30	29	30
23	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	.	.
24	.	2	.	.	.	.	1	.	1	.	5	3	2	1	.	.	1	1
25	.	.	1	1	.	1	.	.	.	2	1	.	1	.	.	.	.	.
26	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.
27	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	1	.	.
28	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
29	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
30	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
31	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
32	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
35	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

* Five of the recaptures at Big Falls were observed by DFO creel survey clerk.

Table 13a. Biological characteristics of Humber River Atlantic salmon stock, 1990–1992. Trapnet data is from bright salmon only.

Gear	Statistics	1992 Fork Lt. (cm)	1992 Whole Wt. (kg)	1992 % Female	1992 Percent at Smolt Age (yr) 2	3	4	1991 Fork Lt. (cm)	1991 Whole Wt. (kg)	1991 % Female	1991 Percent at Smolt Age (yr) 2	3	4	1990 Fork Lt. (cm)	1990 Whole Wt. (kg)	1990 % Female	1990 Percent at Smolt Age (yr) 2	3	4
Small Salmon																			
Angling	Mean	56.1	1.96	54.2	2.3	83.9	13.9	54.0	1.70	50.8	7.6	75.8	16.7	56.3	.	73.1	5.3	68.4	26.3
Big Falls	Min.	48.5	1.25	.	.	.	.	48.0	1.10	.	.	.	.	50.8	.	.	.	.	.
	Max.	62.0	2.75	.	.	.	.	62.0	2.80	.	.	.	.	62.0	.	.	.	.	.
	Std. Dev.	2.62	0.31	.	.	.	.	2.52	0.23	.	.	.	.	2.99	.	.	.	.	.
	N	339	159	253	310	.	.	136	135	130	132	.	.	37	.	26	38	.	.
DFO	Mean	53.6	1.71	70.0	3.5	74.7	21.8	51.8	1.33	69.2	2.1	93.7	4.2	54.3	.	72.4	3.3	87.1	9.5
Trapnet	Min.	34.7	0.90	.	.	.	.	37.3	0.54	.	.	.	.	31.4	.	.	.	.	.
	Max.	61.8	2.75	.	.	.	.	59.6	1.90	.	.	.	.	62.3	.	.	.	.	.
	Std. Dev.	3.20	0.49	.	.	.	.	8.38	0.24	.	.	.	.	3.76	.	.	.	.	.
	N	175	19	30	174	.	.	94	34	39	95	.	.	242	.	29	241	.	.
Large Salmon																			
DFO	Mean	75.6	.	.	6.7	83.3	10.0	76.6	.	.	0.0	100.0	0.0	72.8	.	.	5.9	70.6	23.5
Trapnet	Min.	63.6	.	.	.	.	.	75.5	.	.	.	.	.	62.5	.	.	.	.	.
	Max.	91.0	.	.	.	.	.	78.4	.	.	.	.	.	92.0	.	.	.	.	.
	Std. Dev.	5.51	.	.	.	.	.	1.57	.	.	.	.	.	8.29	.	.	.	.	.
	N	30	.	.	30	.	.	3	.	.	3	.	.	18	.	.	17	.	.

Table 13b. Comparison of mean fork length of weighed and unweighed small salmon at Big Falls, 1992.

Statistics	Fork Lt. (cm) Weighed	Fork Lt. (cm) Unweighed
Mean	56.5	56
Min.	51.0	49
Max.	62.0	62
Std. Dev.	2.5	2.6
N	159	180

Table 14. Estimate of returns for Humber River, 1992.

Creel Survey Method:	
Catch of Small Salmon (Creel)	738
Proportion Tagged	0.033
Small Salmon Returns	22,364
Adjusted Recreational Catch of Small Salmon Retained	4,349
Small Salmon Returns Less Angling Catch Retained	18,015
Ratio of Large to Small Salmon in Total Returns	0.1676
Large Salmon Returns	3,748
Angling Catch Method:	
Adjusted Recreational Catch of Small Salmon Retained	4,349
Proportion Tagged	0.22
Small Salmon Returns	19,768
Small Salmon Returns Less Angling Catch Retained	15,419
Ratio of Large to Small Salmon in Total Returns	0.1676
Large Salmon Returns	3,313

Table 15. Estimation of egg deposition and percent egg target met in Humber River. All parameter values are from Porter and Chadwick (1983) except where noted.

HUMBER RIVER

Rearing Units (100 sq. m)		115,307	
Optimal Egg Deposition		240 per rearing unit	
Fecundity		1,540 eggs / kg	
Small –	% overall	85.7	(trapnet, 1992)
	% female	54.2	(recreational, 1992)
	mean wt	1.96 kg	(recreational, 1992)
Large –	% overall	14.4	(trapnet, 1992)
	% female	69.2	(trapnet, 1991)
	mean wt	3.7 + kg	

Percent Egg Target Met:

= potential egg depositions / egg requirements x 100

$$= \frac{(\text{grilse returns} * \%\text{female} * \text{mean wt} * \text{fecundity}) + (\text{msw returns} * \%\text{female} * \text{mean wt} * \text{fecundity})}{\text{Rearing Units} * \text{Optimal Egg Deposition}} \times 100$$

$$= \frac{(18{,}015 * .542 * 1.96 * 1{,}540) + (3{,}748 * .692 * 3.7 * 1{,}540)}{115{,}307 * 240} \times 100$$

$$= \frac{44{,}250{,}453}{27{,}673{,}680} \times 100$$

= 160%

Table 16. Counts of Atlantic salmon and date on which 50% of cumulative catches were enumerated at the Hughes Brook and North Brook counting fences, 1984–1992.

Year	Hughes Brook Fence				North Brook Fence			
	Small <63cm	Large >63cm	Total	Date to 50%	Small <63cm	Large >63cm	Total	Date to 50%
1984	90	3	93	Aug. 11	.	.	.	
1985	13	0	13	Sept. 8	.	.	.	
1986	63	2	65	N/A	66	3	69	Aug. 10
1987	37	6	43	Sept. 28	74	1	75	Sept. 9
1988	65	0	65	Aug. 5	166	9	175	Aug. 29
1989	54	1	55	N/A	46	2	48	N/A
1990	106	1	107	Aug. 2	49	0	49	Aug. 4
1991	175	0	175	Aug. 6	52	1	53	Aug. 7
1992	146	7	153	Aug. 1	131	12	143	Aug. 22

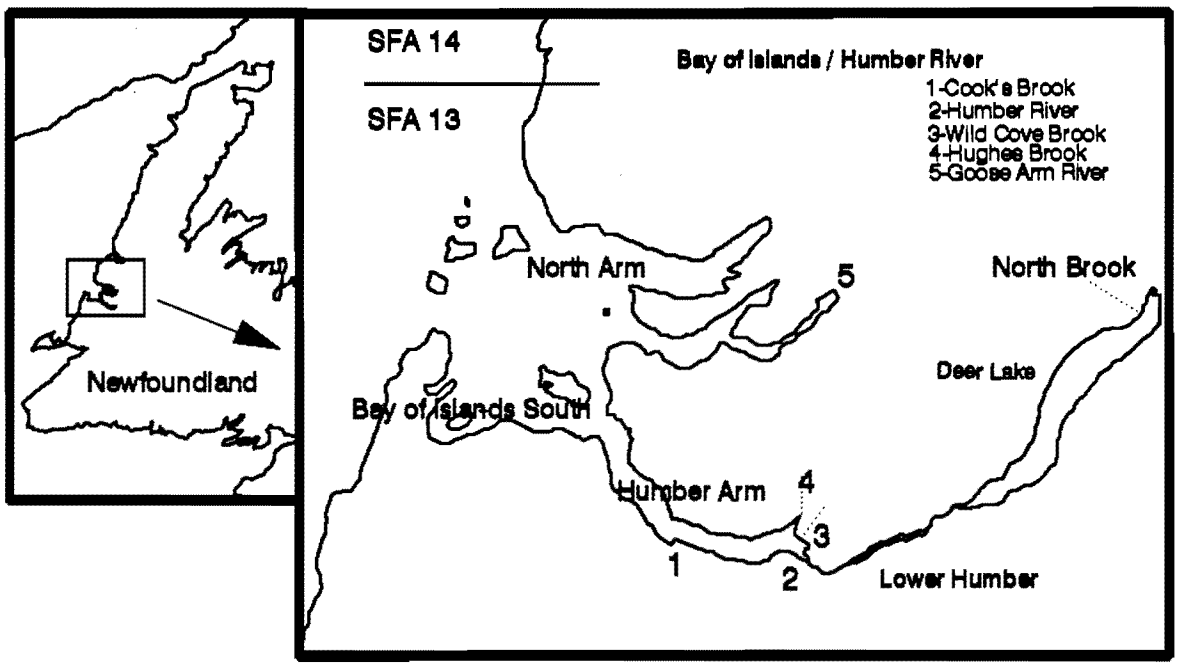

Figure 1. Location of rivers flowing into Bay of Islands, Newfoundland.

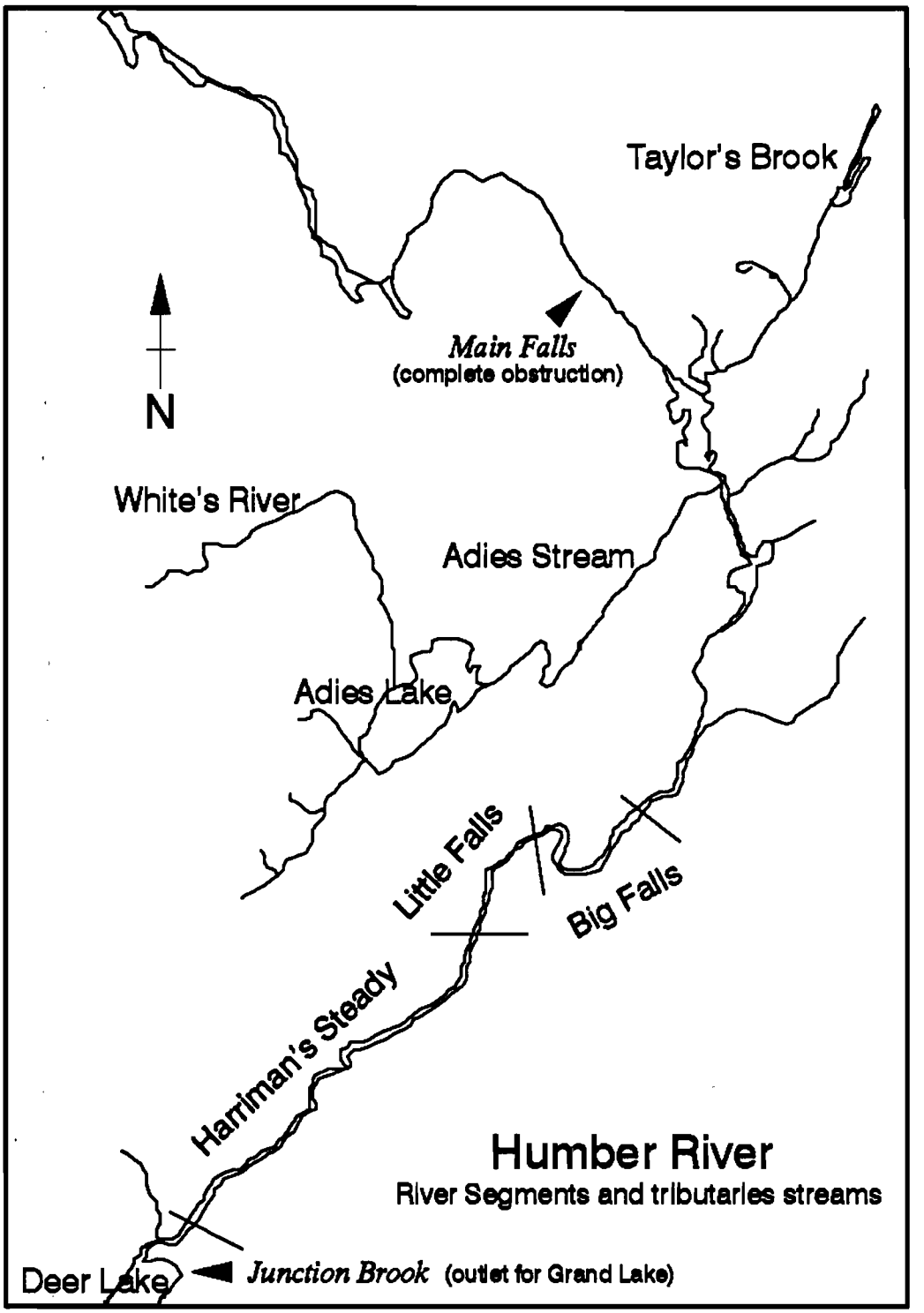

Figure 2. River segments of the Humber River, upstream of Deer Lake.

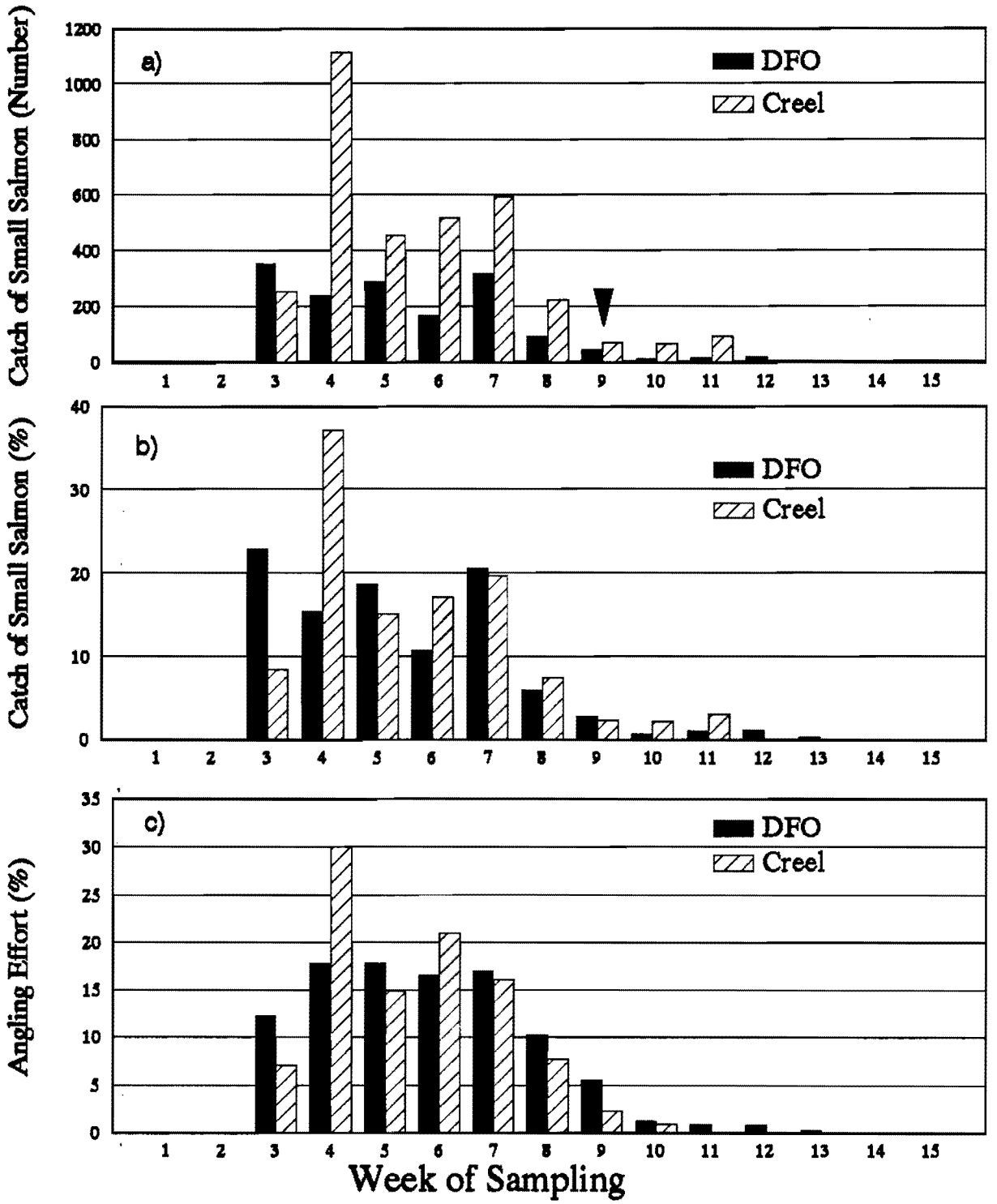

Figure 3. Comparison of catches of small salmon and the percent frequency distribution of catch and effort obtained by DFO guardian and creel survey at Big Falls, 1992. Arrow indicates week in which zonal quota was reached.

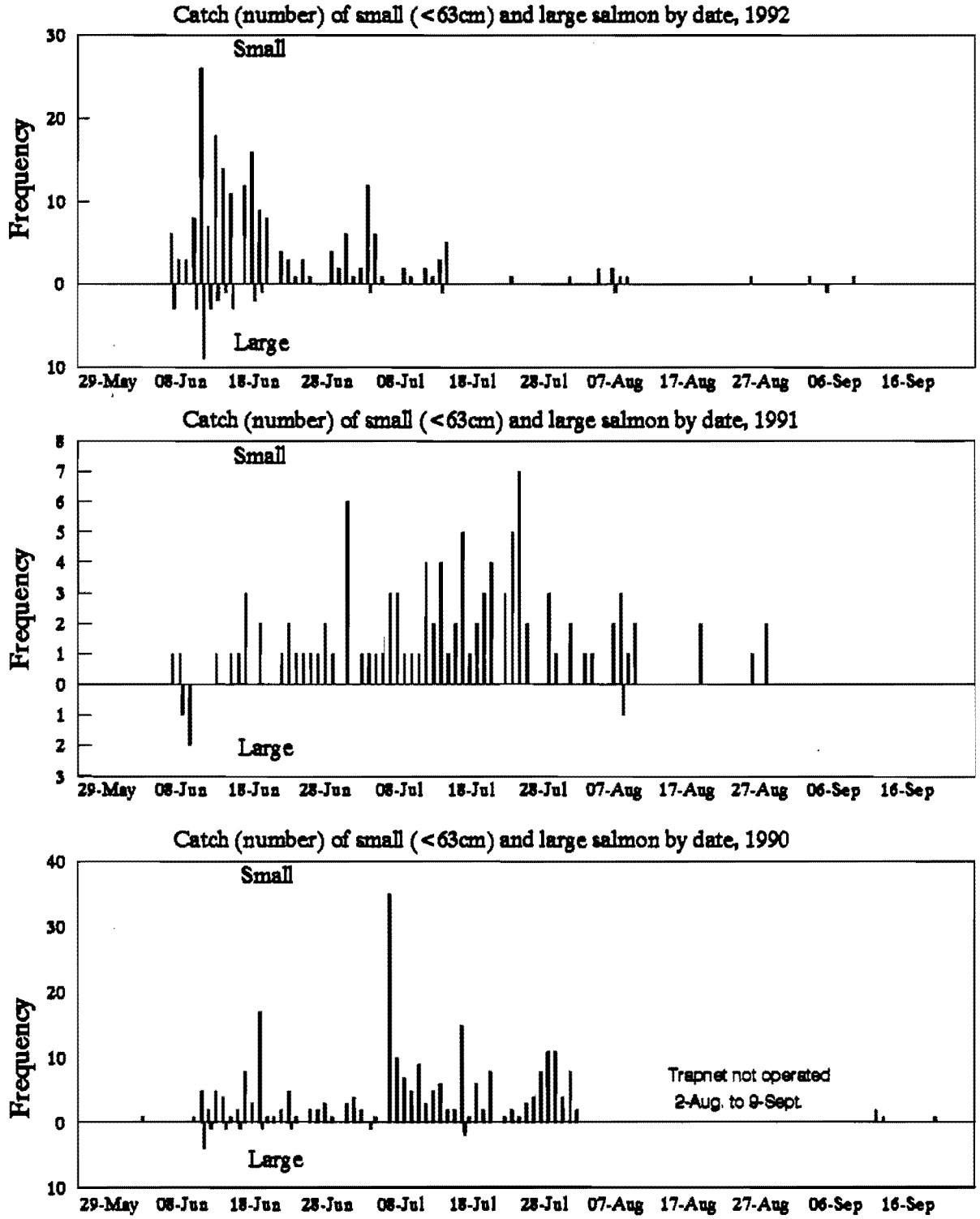

Figure 4. Distribution of small and large salmon at the Wild Cove trapnet in 1990-1992.

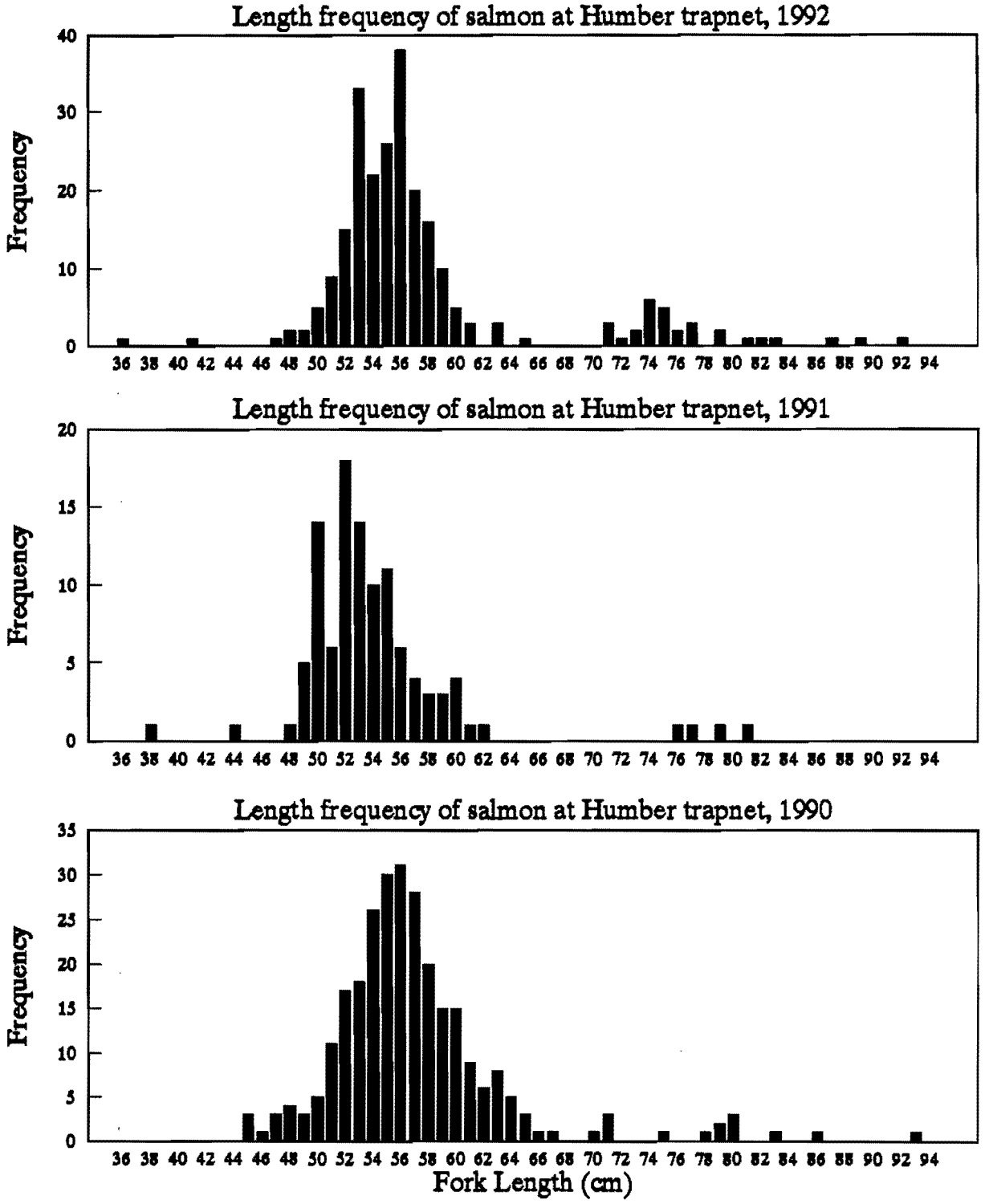

Figure 5. Length frequency distribution of Atlantic salmon at the Wild Cove trapnet in 1990-1992.

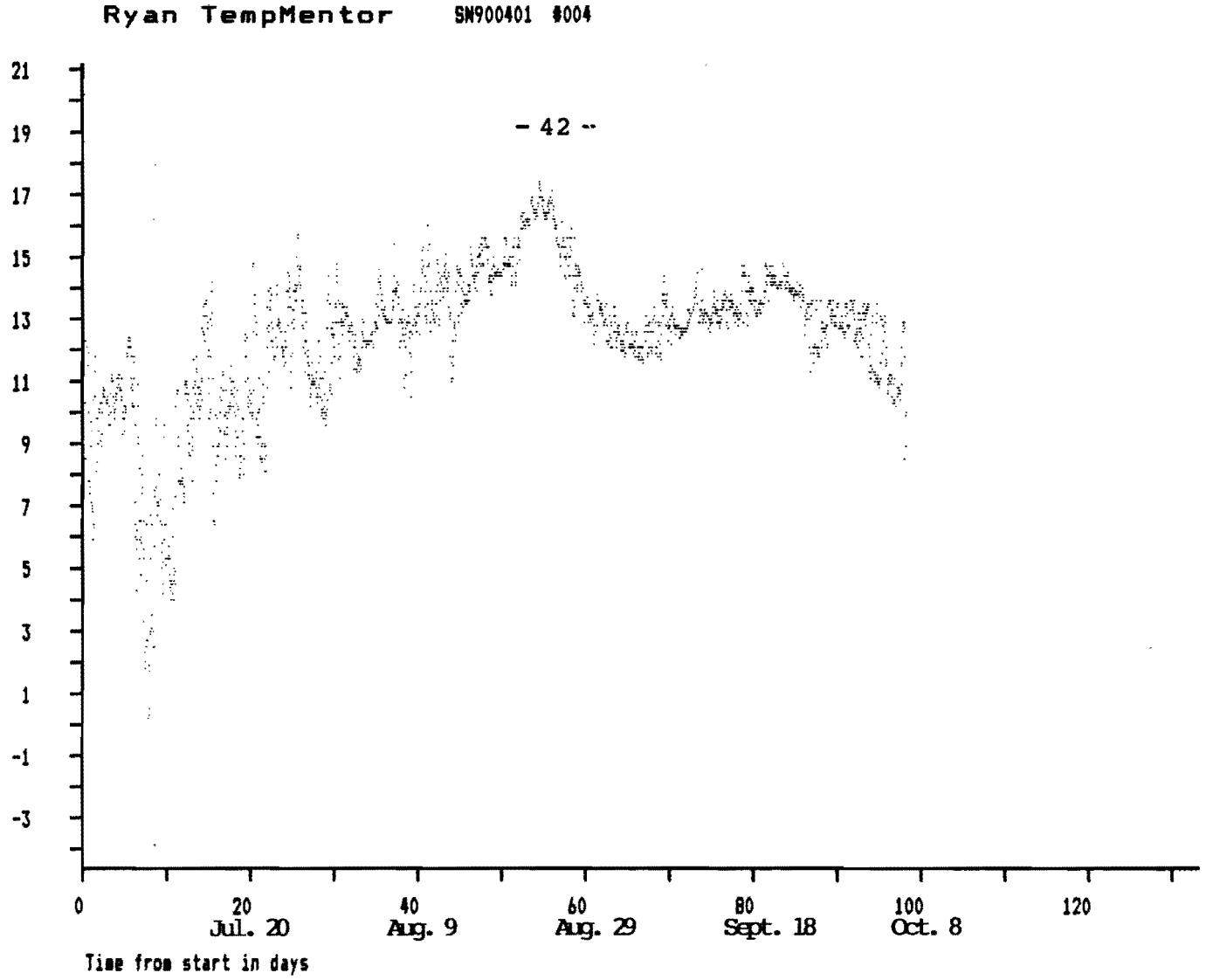

Fig. 6.
HUMBER TRAPNET, 1992
Water temperature (C) at Wild Cove trapnet during period of operation in 1992.

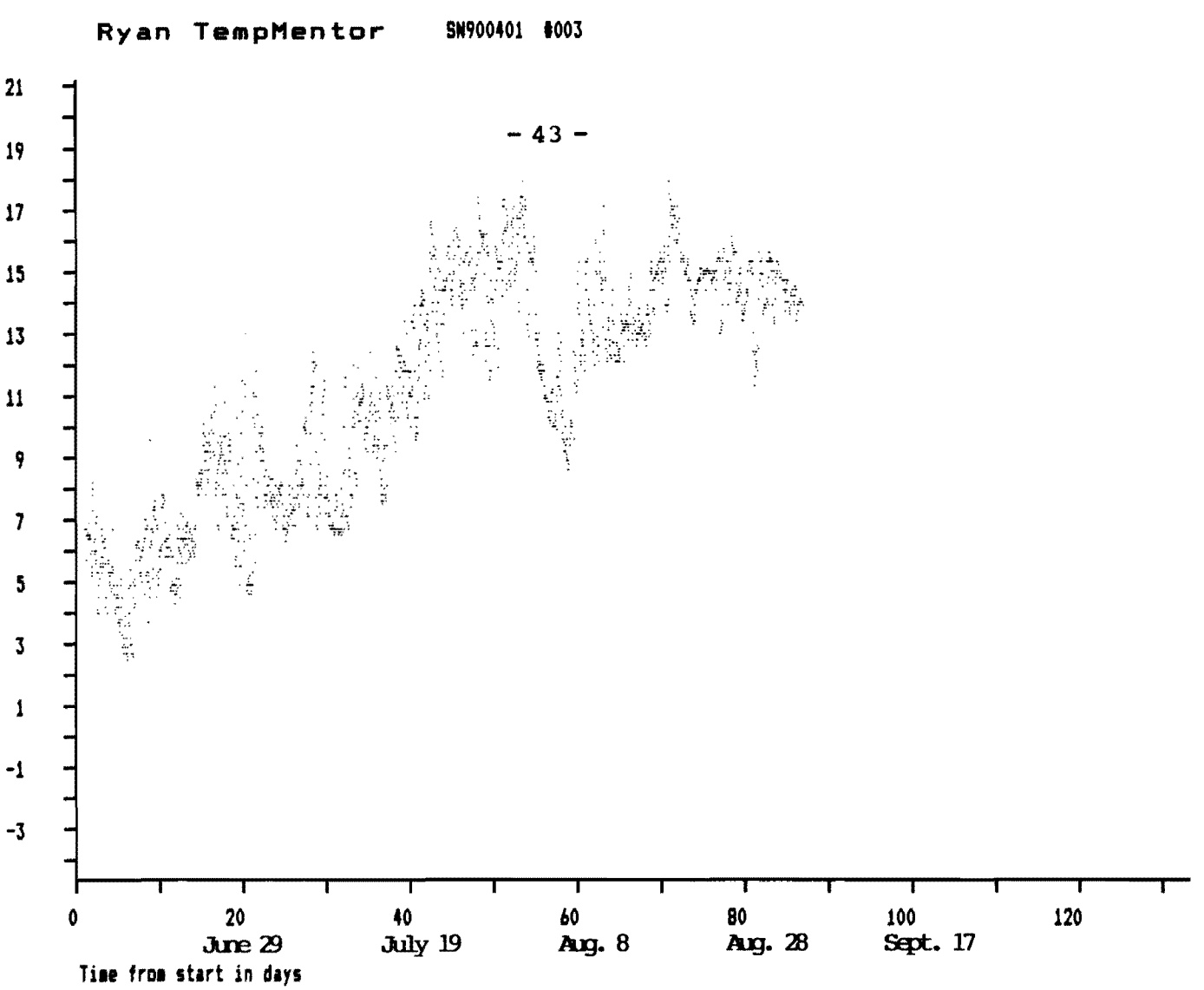

Fig. 7.
HUMBER RIVER TRAPNET 1991
Water temperature (C) at Wild Cove trapnet during period of operation, 1991.

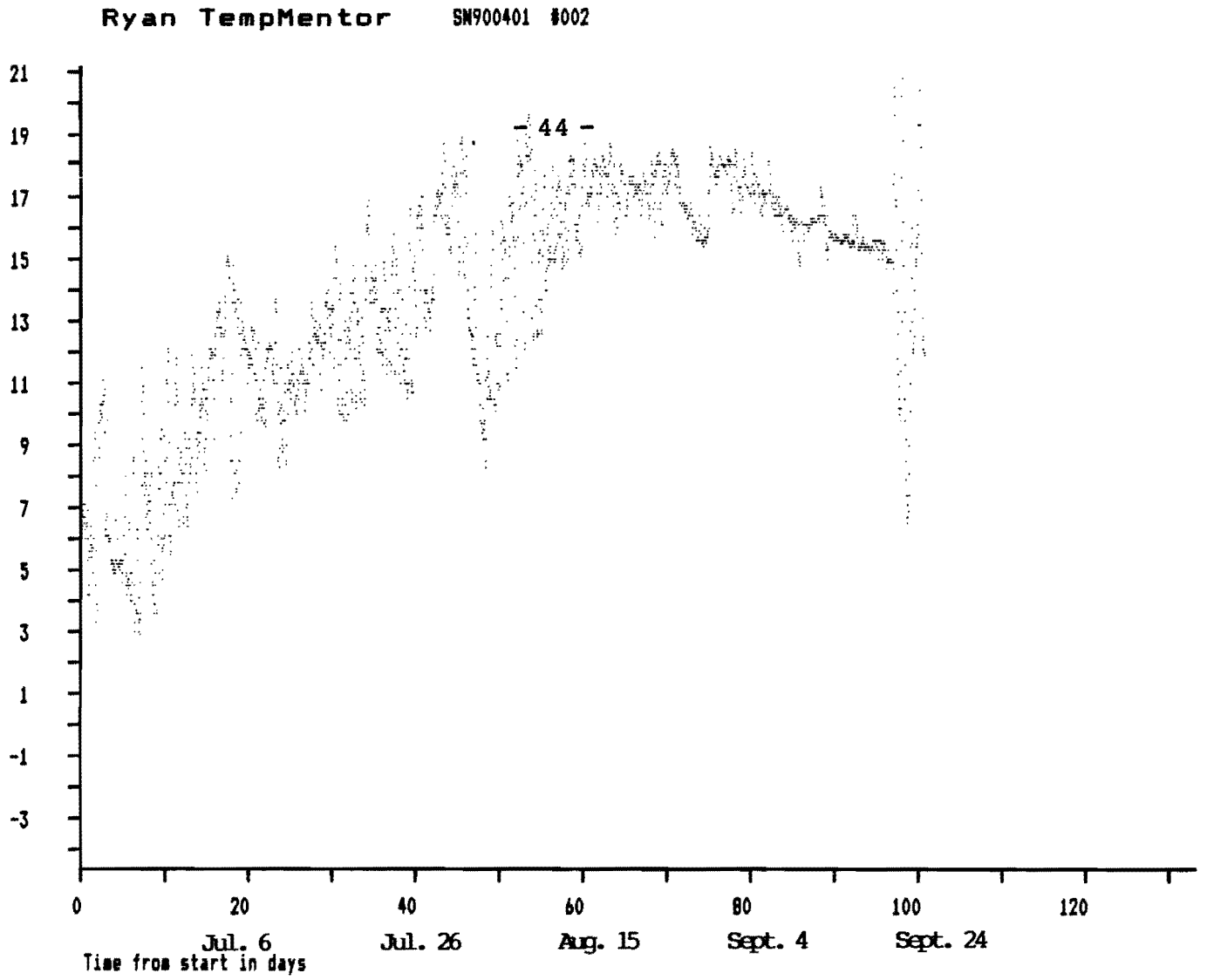

Fig. 8.
HUMBER RIVER 1990
Water temperature at Wild Cove trapnet during period of operation in 1990.

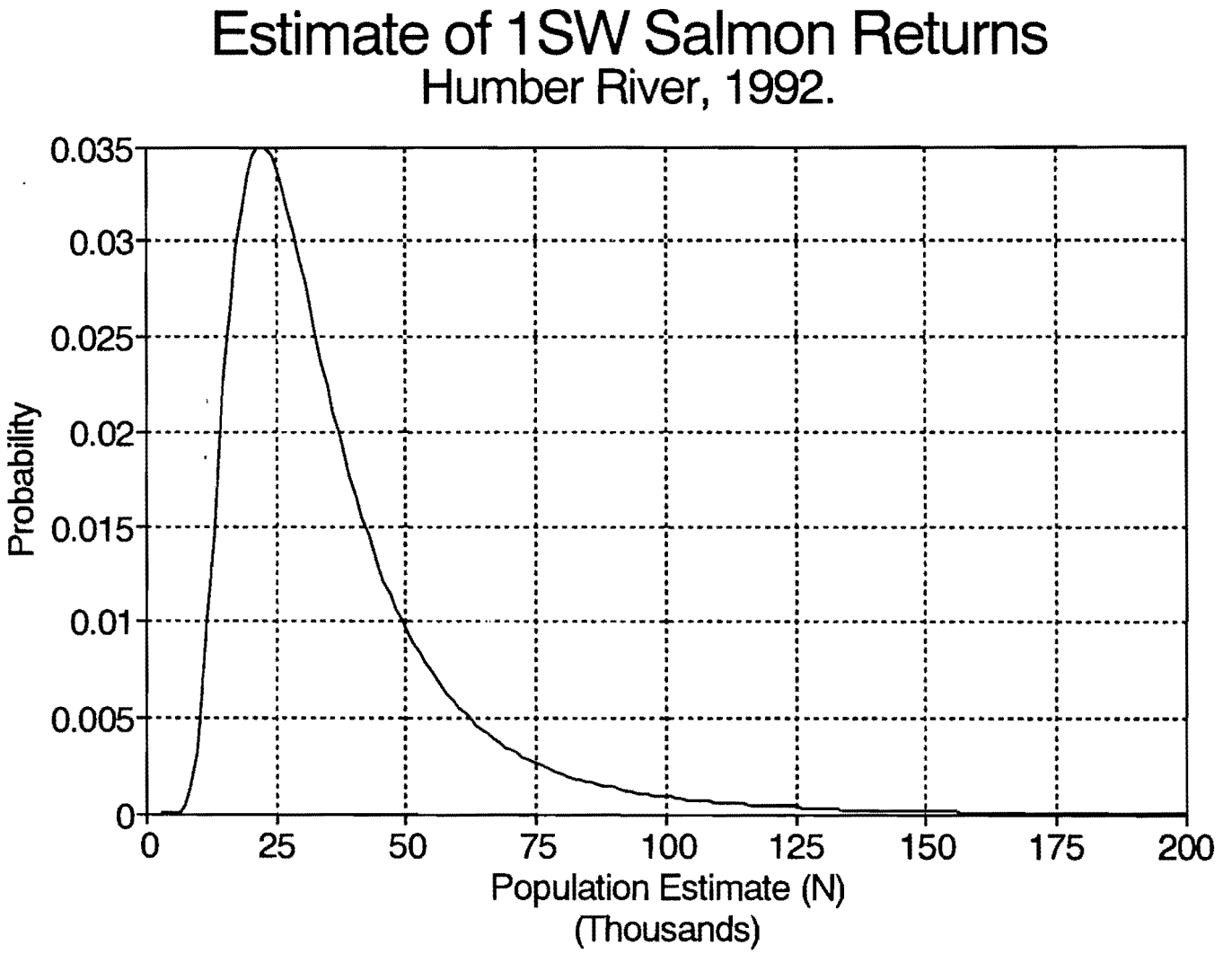

Fig. 9. Estimate of small salmon returns to the Humber River in 1992 based on the Bayesian estimation method.

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 nuumber 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.

APPENDIX 1 (cont'd). Big Falls, Humber River creel survey design after selection of dates, time periods and starting locations.

A = 530 - 1000
B = 1000 - 1400
C = 1400 - 1800
D = 1800 - 2030

Loc. - boat = boat landing path
stair = up river stairs
Time - = time clerk should be at river to start interviews
Dur. = duration (minutes) clerk spends at the first site before moving on to next site
Normally duration of creel is 4 hours (240 minutes) at boat location and 1 hour (60 minutes) at stair location. Travel between locations is estimated at 15 minutes one-way.

			A	B	C	D	TOTAL		Creel A			Creel B			Creel C			Creel D		
			4.5	4	4	4.5	HOURS		Loc.	Time	Dur.	Loc.	Time	Dur.	Loc.	Time	Dur.	Loc.	Time	Dur.
Sat.	June	8	1	0	1	0	8.5		boat	530	225				boat	1400	105			
		9	0	0	1	1	8.5								boat	1400	30	boat	1800	60
Mon.		10	0	0	0	0	0													
		11	1	1	0	0	8.5		boat	530	165	stair	1015	60						
		12	0	0	0	0	0													
		13	0	1	1	0	8					boat	1000	30	stair	1400	60			
Fri.		14	0	1	0	1	8.5	42				boat	1000	75				stair	1815	60
Sat.		15	0	0	1	1	8.5								boat	1400	150	boat	1800	90
		16	0	0	0	0	0													
Mon.		17	0	1	0	1	8.5					boat	1000	240				stair	1800	60
		18	1	0	0	1	9		boat	530	120							boat	1800	195
		19	1	0	1	0	8.5		boat	530	15				stair	1415	60			
		20	0	1	1	0	8					boat	1015	240	boat	1400	180			
Fri.		21	0	0	0	0	0	42.5												
Sat.		22	0	0	1	1	8.5								boat	1415	240	stair	1800	30
		23	1	1	0	0	8.5		stair	530	15	stair	1000	60						
Mon.		24	1	0	0	1	9		stair	530	45							boat	1800	45
		25	0	0	0	0	0													
		26	0	1	0	1	8.5					boat	1000	90				boat	1800	225
		27	0	0	0	0	0													
Fri.		28	1	0	1	0	8.5	43	boat	530	75				boat	1400	45			
Sat.		29	1	0	0	1	9		boat	530	45							boat	1800	45
		30	0	1	0	1	8.5					boat	1000	45				boat	1800	225
Mon.	July	1	1	0	1	0	8.5		boat	530	210				boat	1400	120			
		2	0	0	1	1	8.5								stair	1400	60	boat	1800	180
		3	1	1	0	0	8.5		boat	530	195	boat	1000	180						
		4	0	1	1	0	8					boat	1000	210	stair	1415	60			
Fri.		5	1	1	0	0	8.5	59.5	boat	530	180	stair	1000	45						

APPENDIX 2

FILE: BAY-HUMB.WQ! Using both 1SW and MSW salmon combined .
Uses Catch as the total catch for the year.

Gazey and Staley Bayesian Population Estimation
Assumes sampling is performed with replacement (binomial distribution of recaptures)
Population level minimum should not be less than Marks+Recaps

		Population Levels to test (301 in total):	
Marks =	150	Minimum =	3000
Recaps =	5	Increment=	1100
Catch =	738		

	Estimate	95% C.I.		Upp-Low
Peterson (corrected) =	**18597**	8786	42918	34132
lower limit	11.7			
upper limit	1.6			

Bayesian Results

Mean =	36691			
Median =	29400	11800	99800	88000
Mode =	**21700**	8500	81100	72600

Scaled	Logged		Population	Probabilitie Standardized	Cumulative	Use macros alt-c then alt-x.			
3.32E-08	-33.7142	1.57E-08	3000	0.00000	0.00000	3000	3000	0.00000	1
0.000203	-29.9288	0.000131	4100	0.00000	0.00000	4100	4100	0.00000	1
0.021747	-27.8979	0.017874	5200	0.00000	0.00000	5200	5200	0.00000	1
0.369341	-26.6679	0.36777	6300	0.00006	0.00006	6300	333000	0.00000	0.999997
2.344461	-25.8653	2.742099	7400	0.00037	0.00043	7400	331900	0.00000	0.999992
8.323628	-25.315	11.18253	8500	0.00132	0.00175	8500	330800	0.00000	0.999987
20.44744	-24.9247	31.02549	9600	0.00323	0.00498	9600	329700	0.00000	0.999982
39.27519	-24.6412	66.42179	10700	0.00621	0.01119	10700	328600	0.00001	0.999977
63.57337	-24.432	118.5675	11800	0.01005	0.02124	11800	327500	0.00001	0.999972
91.00234	-24.2762	185.5456	12900	0.01438	0.03562	12900	326400	0.00001	0.999967
118.9835	-24.1598	263.2834	14000	0.01881	0.05442	14000	325300	0.00001	0.999962
145.3117	-24.073	346.8054	15100	0.02297	0.07739	15100	324200	0.00001	0.999956
168.4281	-24.0089	431.2589	16200	0.02662	0.10401	16200	323100	0.00001	0.999951