

**Status of Atlantic Salmon (*Salmo salar* L.) Populations
in Crabbes and Robyns Rivers, and Middle Barachois, Fischells,
and Flat Bay Brooks Bay St. George, Newfoundland, 1997**

by

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ABSTRACT

Adult Atlantic salmon were visually counted in Crabbes and Robinsons rivers, and Middle Barachois and Flat Bay brooks, in 1997, for the second consecutive year. A visual count of salmon was conducted for the first time in Fischells Brook. The surveys were conducted between August 19 and 26 by swimmers snorkeling down each river. Almost all of the salmon were found in pools, generally with water depths greater than 1 m. An adjustment factor, ranging from 1.0 to 2.0, was applied to the counts in each river section surveyed to account for fish not observed in the larger pools. There were no known removals after the survey, therefore the adjusted count is considered to be the spawning escapement for the river. An estimate of the numbers of salmon hooked and released and numbers retained in the recreational fishery were available from the license stub return system. A hook-and-release mortality of 10% was assumed. The estimated total returns to the rivers are: Crabbes, 1,154 small and 358 large salmon; Middle Barachois Brook, 1,104 small and 188 large salmon; Robinsons River, 1,075 small and 190 large salmon; Fischells Brook, 800 small and 85 large salmon; Flat Bay Brook 1,308 small and 173 large salmon. The percentage of the egg deposition conservation requirements achieved by each river are: Crabbes River - 95%, Middle Barachois Brook - 148%, Robinsons River - 91%, Fischells Brook - 44%, and Flat Bay Brook - 89%. The percent of the conservation requirements achieved is the highest estimated for the past 15 years for all rivers other than Fischells Brook. The spawning stock on Fischells Brook is at a very low level and fishing mortality should be reduced. The information available did not lend itself to forecasting the abundance of salmon in 1998; however, the increased abundance of small salmon in rivers other than Fischells Brook, in 1997 compared to 1996, would suggest that there may be a slight increase in large salmon in 1998. The abundance on small salmon in 1998 may be lower due to the severe flooding in February 1996, which may have caused an increase in mortality of juvenile salmon.

RÉSUMÉ

En 1997, on a procédé, pour la deuxième année consécutive, à un dénombrement visuel des saumons adultes dans les rivières Crabbes et Robinsons et les ruisseaux Middle Barachois et Flat Bay. Un comptage visuel a aussi été effectué, pour la première fois, dans le ruisseau Fischells. Les relevés ont été effectués entre les 19 et 26 août par des plongeurs équipés de tuba qui ont descendu les rivières. Pratiquement tous les saumons ont été aperçus dans des fosses dont la profondeur était généralement supérieure à 1 m. Un facteur de correction, variant entre 1,0 et 2,0, a été appliqué au dénombrement de chaque partie de cours d'eau afin de tenir compte des poissons non aperçus dans les fosses les plus importantes. Il n'y a pas eu de prélèvement connu après le relevé et les dénombrements corrigés sont jugés être représentatifs de l'échappée de géniteurs. Une estimation des nombres de saumons capturés et relâchés ou conservés par les pêcheurs récréatifs a été obtenue à partir des talons des permis retournés. Un taux de mortalité de 10 % a été supposé pour les poissons capturés et remis à l'eau. Les remontées totales estimées sont : Crabbes - 1 154 petits et 358 grands saumons; Middle Barachois - 1 104 petits et 188 grands saumons; Robinsons - 1 075 petits et 190 grands saumons; Fischells - 800 petits et 85 grands saumons; Flat Bay - 1 308 petits et 173 grands saumons. Les pourcentages de la ponte nécessaire à la conservation, atteints pour chaque rivière, ont été: Crabbes - 95 %; Middle Barachois - 148 %; Robinsons - 91 %; Fischells - 44 % et Flat Bay - 89 %. À l'exception du ruisseau Fischells, les pourcentages estimés ont été les plus élevés au cours des 15 dernières années. Le stock de géniteurs du ruisseau Brook est à un niveau très faible et la mortalité par pêche devrait être réduite. Les renseignements disponibles ne permettent pas de prévoir l'abondance du saumon en 1998, mais l'abondance accrue des petits saumons dans les rivières autres que le ruisseau Fischells en 1997, comparativement à 1996, indique que l'on pourrait observer une légère augmentation des gros saumons en 1998. L'abondance des petits saumons pourrait être inférieure en 1998 à cause de l'importante inondation survenue en février 1996 qui pourrait avoir occasionné un accroissement de la mortalité des juvéniles.

INTRODUCTION

Atlantic salmon populations in Bay St. George rivers declined in the 1970's (Porter and Chadwick 1983) and have been below conservation levels for most of the past 30 years (Reddin and Mullins 1996). The total returns to rivers appear to have only marginally increased with the closure of the commercial fisheries in 1992. Unfed salmon fry were stocked into Flat Bay Brook in 1995, 1996, and 1997.

Direct measurements of salmon population sizes in most rivers are difficult to obtain using conventional fish counting facilities due to the large size of the rivers and their extreme range in discharge. Salmon stocks in Highlands River have been assessed using a fish counting fence in 1980, 1981, and 1993 to 1997 (Reddin and Whalen 1998). A fish counting fence was operated on Flat Bay Brook from 1994 to 1996 (Bourgeois et al. 1997). However it was difficult to maintain the counting fence on Flat Bay Brook during periods of high discharge. In 1996, more salmon were counted in a visual survey than had passed through the fish counting fence (Bourgeois et al. 1997).

Reddin and Mullins (1996) conducted assessments of the salmon populations in rivers in Bay St. George, used angling catch statistics and estimates of angling exploitation rates to estimate population sizes. Visual counts of salmon were successfully used in 1996, as a means to estimate the numbers of large and small salmon spawners in Crabbes River, Middle Barachois Brook, and Robinsons River (Porter 1997) and in Flat Bay Brook (Bourgeois et al. 1997).

In 1997, visual spawner surveys were conducted on the same rivers as in 1996, and on Fischells Brook (Figs. 1 to 5). The surveys were part of a joint salmon stock assessment project between the Bay St. George South Area Development Association and the Department of Fisheries and Oceans. This document documents the results of the spawner survey and provides an assessment of the status of the salmon populations in these rivers. The physical characteristics of the five rivers surveyed are in Table 1.

METHODS

Recreational Fisheries data

There were hook-and-release angling fisheries on Crabbes River, Middle Barachois Brook, Robinsons River and Flat Bay Brook from June 1 to September 1 in 1997; and, on Fishchells Brook, a hook-and-release angling fishery occurred from June 1 to June 20, and a retention angling fishery from June 21 to September 1. Angling catch data were available from the salmon angler license stub in 1997.

Unrecorded mortalities

An estimate of all fish killed or naturally died before spawning is important for any stock assessment. Illegal activities do occur on the five rivers being assessed; however, no quantitative estimates of salmon mortality are available. The percentage of the hooked-and-released salmon

that will die will vary with handling techniques and water temperature (Wilkie et al. 1996; and Brobbel et al. 1996). Mortality of hooked-and-released salmon at water temperatures below 20° C is believed to be less than 10%. This value was applied to the estimated number of salmon hooked and released for the five rivers assessed.

Biological characteristics

The biological characteristics that are most important for assessing the status of an Atlantic salmon population are: proportion of large (≥ 63 cm) and small (<63) salmon, mean weight or length, percent female of each size group, and relative fecundity. The values of these parameters were used to determine the reproductive potential of the stock.

For Crabbes River, Middle Barachois Brook, Robinsons River, and Fischells Brook, the mean weights (1.63 kg for small, 5.06 kg for large) and percentage female (71.9% for small, 86.8% for large salmon) used in this assessment are values for years 1992-94 from Table 6a,b in Reddin and Mullins (1996) (Table 2). The estimated mean fecundity of 1540 eggs/kg of body weight used by Porter and Chadwick (1983) was also used for Crabbes and Robinsons rivers and Middle Barachois and Fischells and brooks. The proportion of large and small salmon in each population, in 1997, was that which was observed during the visual surveys.

For Flat Bay Brook, biological characteristics data were available from fish taken as broodstock in 1994, 1995 and 1996, and from the angling fishery in 1994 (Bourgeois et al. 1997). These values were used in this assessment (Table 2) except for the percent female for small salmon, which was taken from Reddin and Mullins (1996). A length-fecundity relationship, for Flat Bay Brook, was developed from samples taken as broodstock in 1995 and 1996.

Conservation spawning requirements

Spawning requirements for Atlantic salmon represent an estimate of the number of eggs (or spawners) required for conservation of the stock (O'Connell and Dempson 1995). Juvenile salmon rear in both stream and lake habitat and thus spawning requirements are based on both types (O'Connell and Dempson 1995). The available habitat in Crabbes and Robinsons rivers and Middle Barachois, Fischells and Flat Bay brooks, is mostly fluvial with little pond habitat (Table 1). Those lakes that are present are mostly found in the upper part of the watershed and are inaccessible to migrating salmon. Therefore, in relation to the river habitat, the contribution of parr produced in lakes to the total production would be small but still important.

Conservation egg deposition requirements for the five rivers being assessed are those

calculated by Reddin and Mullins (1996) as target eggs. These numbers are:

Crabbes River	4,600,000 eggs
Middle Barachois Brook	2,100,000 eggs
Robinsons River	3,300,000 eggs
Fischells Brook	3,600,000 eggs
Flat Bay Brook	3,800,000 eggs

The conservation requirements in terms of numbers of spawners requires knowledge of the portion of the eggs which should come from large salmon and from small salmon. Since these rivers (other than Flat Bay Brook) are believed to historically have had a significant component of virgin 2SW salmon, it is uncertain how to determine the number of large salmon that should be in the spawning population to meet its conservation requirements. Since the populations are currently at low levels the observed proportions may not be the appropriate composition for conservation of the large salmon component. However, if it is assumed that the proportion of large salmon required for conservation is the average of the proportions estimated in the total population in each river, 1996 and 1997, based on the visual surveys, then the conservation requirements in terms of small (CS_S) and large salmon spawners (CS_L) can be calculated for Crabbes and Robinsons rivers, and Middle Barachois and Fischells brooks as follows:

$$(1) \quad CS_{S \text{ or } L} = \frac{CED * P_{S \text{ or } L}}{(P_S * PF_S * MW_S * RF_S) + (P_L * PF_L * MW_L * RF_L)}$$

where:

CED	= egg deposition required for Conservation
$P_{S \text{ or } L}$	= proportion small or large salmon for conservation
$PF_{S \text{ or } L}$	= percent female small or large salmon
$MW_{S \text{ or } L}$	= mean weight for small or large salmon
$RF_{S \text{ or } L}$	= relative fecundity for small or large salmon (1540 eggs/kg)

The conservation requirements in terms of small (CS_S) and large salmon spawners (CS_L) were calculated for Flat Bay Brook from the following equation:

$$(2) \quad CS_{S \text{ or } L} = \frac{CED * P_{S \text{ or } L}}{(P_S * PF_S * F_{FS}) + (P_L * PF_L * F_{FL})}$$

Where: $F_{FS \text{ or } FL}$ = fecundity of small or large salmon for Flat Bay Brook based on length-fecundity relationship.

The proportion small and large salmon used to determine the number of spawners required to achieve the egg deposition levels required for conservation for each river is the average of the estimated total returns to the river for 1996 and 1997. These proportions should approximate the

entire population. Biological characteristics, other than the proportion of large and small salmon, are those referenced above in the Biological Characteristics Section.

Total Returns to the Rivers and Number of Spawners

Atlantic salmon were visually counted in Crabbes and Robinsons rivers, and Middle Barachois, Fischells, and Flat Bay brooks, 19-26 August 1997, by surveyors snorkeling or, where the water was not deep enough, walking down each river. Two tributaries were also surveyed on Flat Bay Brook and one on each of the other four rivers. It was deemed that salmon were unlikely to have ascended the other tributaries since these tributaries were small and had very low water levels. The main stem of each river which is accessible to sea-run Atlantic salmon was divided into four or five sections with each section being generally less than 10 km in length (Figs. 1 to 5). The method of survey was a modification of that reported by Porter (1997). Generally crew sizes were increased and, in large pools a rope was used to hold surveyors in a straight line as they floated or were pulled downstream.

A crew, consisting of two to six people, was assigned to each section. For most sections, two or three surveyors would passively float or swim the river and count salmon, and one person would walk the riverbank and record the information. Water depths in most riffle areas were too shallow for swimming, particularly in the upper sections (Sections 1 and 2) of each river. Information collected included: numbers of large and small salmon, number of salmon with net marks or other injuries and a description of the pools where salmon were observed. Pools were numbered on a map and crossed referenced to a field notebook.

The procedure for the snorkel team was to float through a pool, preferably to one side, with as little movement as possible, and count the salmon. If the surveyors were unsure of the count, they would float through the pool a second or third time. In some pools, the river conditions and location of fish were such that it was possible for the snorkel team to hold position and count salmon. Some pools were surveyed a second time with more surveyors.

In large pools, a rope was strung across the upper end of the pool, each end was held by a team member on the bank. Surveyors spaced themselves along the rope and floated, or were towed (by team members on the bank), down river through the pool. All surveyors would look in one direction, either left or right, and count salmon that passed between himself/herself and the adjacent surveyor. This technique proved to be very effective and greatly increased the confidence in the estimates of the number of fish in the larger pools.

No attempt was made to calibrate differences between teams or individuals since there are many factors that affect accuracy of the counts. These factors include water depth and width of pools, turbidity and colour of water, angle of sun, and light conditions in general.

The water levels in the rivers were very low and almost all of the salmon were found in pools; however, even with large number of surveyors, some of pools were too deep and/or too wide to obtain a complete count of salmon. Therefore, an adjustment factor was applied to the count in

each section to obtain an estimate that would include unobserved salmon. This factor was subjectively determined in consultation with the surveyors, taking into consideration the number and size of the pools in which complete counts could not be ascertained, and the number of salmon counted in adjacent pools.

No adjustments were made for the possibility of salmon being present in tributaries not surveyed because the tributaries are small and water levels were so low that it was unlikely that salmon would be in them. Due to the low water levels it is unlikely that salmon moved between sections during the period of the survey. The sizing of the salmon by the various survey teams were examined for possible differences or bias by comparing whether or not a particular team consistently recorded a higher or lower number of large salmon than other teams. No bias was found, so no adjustments were made to the proportion of large and small salmon recorded by each team.

The adjusted numbers are believed to represent the total number of salmon in each river at the time of the survey. It is assumed that the results of the survey approximate the spawning escapement, since no information is available on unrecorded mortalities after the survey and it is believed that the majority of the spawners have entered the river by the time of the survey.

The total returns to each river was obtained by adding the retained catch (if any) and 10% of the hooked-and-released salmon.

Egg deposition

The unadjusted and adjusted egg deposition (ED_{ua} & ED_a) for Crabbes River, Middle Barachois Brook, Robinsons River, and Fischells Brook, in 1997, were calculated for small and large salmon separately then summed as follows:

$$(3) \quad ED_{ua} = (UN_s * PF_s * RF_s * MW_s) + (UN_L * PF_L * RF_L * MW_L)$$

$$(4) \quad ED_a = (AN_s * PF_s * RF_s * MW_s) + (AN_L * PF_L * RF_L * MW_L)$$

where,

$UN_{s \text{ or } L}$ = unadjusted numbers of small or large salmon counted in the survey

$AN_{s \text{ or } L}$ = adjusted number of small or large salmon counted in the survey

The unadjusted and adjusted egg deposition (ED_{ua} & ED_a) for Flat Bay Brook, in 1997, were calculated for small and large salmon separately then summed as follows:

$$(5) \quad ED_{ua} = (UN_s * PF_s * F_{FS}) + (UN_L * PF_L * F_{FL})$$

$$(6) \quad ED_a = (AN_s * PF_s * RF_s * MW_s) + (AN_L * PF_L * RF_L * MW_L)$$

Percentage of Conservation Level Achieved

The adjusted and unadjusted percentage of the conservation egg deposition levels which were achieved in each river were calculated as follows:

$$(7) \quad \text{Percentage of conservation level achieved} = (ED_{\text{ua or a}} / \text{CED}) * 100$$

RESULTS

Recreational Fisheries Data

Preliminary angling catch data for 1997 for the five rivers assessed, as compiled from the angling license stub returns, are provided in Table 3 and Appendices 1-5. The catch statistics from 1974 to 1996 are also provided in Appendices 1-5; however, these were derived from River Monitors or Fisheries Guardians and may not be directly comparable to the data derived from the license stub returns.

An estimate of the angling effort is not available for 1997, since many anglers did not record this information properly on their license return. Some anglers reported retaining small salmon on Crabbes and Robinsons rivers and Middle Barachois Brook even though these rivers were only open to hook-and-release angling. The estimate total numbers of small salmon retained, and hooked and released in 1997 was higher than in recent years for all rivers. The estimated number of large salmon hooked and released in each of the five rivers were either the highest or among the highest recorded 1974-97.

Unrecorded Mortalities

The estimates of unreported hook-and-release mortality ranged from 16 small salmon on Middle Barachois Brook and Fischells Brook to 54 small salmon on Robinsons River, and from three (3) large salmon on Middle Barachois Brook to 18 large salmon on Robinsons River (Table 3).

Biological Characteristics

The parameter values for mean weights, mean lengths, percent female, and percentage small and large salmon used to calculate a conservation requirement in terms of numbers of spawners is provided in Table 2. The percentage of large salmon in each population, in 1997, is shown in Tables 4-8. The length-fecundity relationship developed for Flat Bay Brook is $y = 173.02x - 6266.8$ (Fig 6).

Conservation Spawning Requirements

The following text table shows the number of eggs and the equivalent number of spawners required for conservation in each river, assuming that the proportion of large and small salmon required for conservation is the same as the average of the proportions observed in 1996 and 1997.

River	Eggs Required	Spawners Required	
		Small	Large
Crabbes	4.6*10 ⁶	1,203	359
Middle Barachois	2.1*10 ⁶	808	95
Robinsons	3.3*10 ⁶	1,121	189
Fischells	3.6*10 ⁶	1,427	152
Flat Bay	3.8*10 ⁶	1,467	179

The differences in the proportions of small and large salmon required for spawning across rivers is related to differences in biological characteristics.

Total Returns to Rivers and Number of Spawners

The unadjusted and the adjusted numbers of small and large salmon counted in Crabbes River, Middle Barachois Brook, Robinsons River, Fischells Brook, and Flat Bay Brook are provided in Tables 4 to 8 respectively. Salmon were highly concentrated in a small number of pools in each river. Very few salmon were found in riffles or in pools less than one meter in depth. Densities greater than 10 salmon were found in 20 pools in Crabbes River, 13 pools on Middle Barachois Brook, 18 pools in Robinsons River, nine (9) pools in Fischells Brook, and 15 pools on Flat Bay Brook. The adjustment applied to the actual counts ranged from 1.00 to 2.00 depending on the Section of river. The overall adjustment factor for the counts in each river ranged from 1.07 for Middle Barachois Brook to 1.24 for Crabbes River.

In Crabbes River, the greatest number of small salmon were found in Section 2 although pools with relatively high numbers were found Sections 1-4; whereas the large salmon were primarily found in Sections 1 and 2. In Middle Barachois Brook, both small and large salmon were concentrated in the upper two Sections of the river. In Robinsons River, small and large salmon were found primarily in Section 2. In Fischells Brook, both small and large salmon were

primarily found in Section 1; although Section 1 was a long section. In Flat Bay Brook, small and large salmon were distributed throughout river Sections 2 to 5. No salmon were found in any of the tributaries surveyed.

The adjusted numbers of salmon counted are assumed to be the same as the number of salmon that spawned, since there were no known removals subsequent to the survey. The numbers of small salmon spawners ranged from 599 in Fischells Brook to 1,282 in Flat Bay Brook (Table 9). The numbers of large salmon spawners ranged from 73 in Fischells Brook to 346 in Crabbes River (Table 9). A summary of the estimated historical spawning escapements to these five rivers is provided in Table 10.

The total returns to each river was estimated by adding an estimate of mortalities due to angling (retained and 10% of hooked and released fish) (Table 3) to the estimated numbers of spawners (Table 9). The total returns of small salmon ranged from 800 for Fischells Brook to 1,308 for Flat Bay Brook (Table 11). The total returns of large salmon ranged from 85 for Fischells Brook to 358 for Crabbes River (Table 11)

Egg Deposition

The estimated egg deposition and percentage of conservation level achieved are provide in Table 9, and summarized below:

River	Egg Deposition	% Conservation achieved
Crabbes River	$4.4 \cdot 10^6$	95
Middle Barachois Brook	$3.1 \cdot 10^6$	148
Robinsons River	$3.0 \cdot 10^6$	91
Fischells Brook	$1.6 \cdot 10^6$	44
Flat Bay Brook	$3.4 \cdot 10^6$	89

The percentage of the egg deposition required for conservation that was achieved in each of the five rivers, 1953-97 is provided in Table 12 and Figures 7 and 8.

The number of salmon with external marks, including net marks and other injuries are:

Crabbes River	13
Middle Barachois Brook	9
Robinsons River	22
Fischells River	10
Flat Bay Brook	17

DISCUSSION

The status of the salmon stocks in Crabbes River, Middle Barachois Brook, Robinsons River, and Flat Bay Brook in 1997 improved over that estimated for 1996 by Porter (1997), and is the highest egg deposition achieved for more than 15 years (Table 12, Fig. 7 and 8). The salmon population in Middle Barachois Brook achieved 148% of its egg deposition requirements in 1997 up from 81% in 1996. Crabbes River, Robinsons River, and Flat Bay Brook achieved 95%, 91% and 89% of its egg deposition respectively. The increases observed in these rivers continues an increasing trend that began in the early 1990's. An increase in total returns of small salmon in 1997 compared to returns in 1996, was also observed on Highlands River (Reddin and Whalen, 1998), and on Harrys River (Anon, 1998), suggesting that the returns were generally higher for all rivers in Bay St. George. The sea survival of smolts that went to sea in 1996 and returned as 1SW salmon in Highlands River in 1997 had increased by about 100% over that recorded for the previous three years. This increase may be one of the contributing factors to the increase in returns in Crabbes River, Middle Barachois Brook, Robinsons River, and Flat Bay Brook. One difference between returns to these rivers and Highlands River is that the numbers of large salmon increased from 1996 to 1997 by 31% to 422% in 1997 compared to 1996 (Table 10); whereas, the large salmon in Highlands Rivers increased by about 10% (Reddin and Whalen 1998).

The estimated number of spawners required for conservation, as calculated in Table 2, are not being recommended to be used for management purposes, at the present time. Greater consideration needs to be given to the biological and management implications of using these values.

Unfed Atlantic salmon fry were stocked in Flat Bay Brook in 1995, 1996 and 1997. The fry were incorporated, as egg equivalents, into the percentage conservation egg deposition achieved in 1994, 1995 and 1996 (Table 11) (Bourgeois et al. 1997). There was no broodstock collection in 1997; thus, there will be no fry stocked in 1998.

This year (1997) was the first time that a visual spawner survey had been conducted, on Fischells Brook. The river was relatively easy to survey due to the small number of large pools. Most salmon were found in Section 1, upstream from the large steady. There was 599 small salmon spawners estimated to be in the river at the time of the survey which is 29% less than the 844 small salmon in 1994 (Table 10) as estimated by Reddin and Mullins (1996). It is estimated that there were 73 large salmon spawners in the river in 1997 which is 54% lower than the 158

large salmon in 1994 (Table 10) as estimated by Reddin and Mullins (1996). Reddin and Mullins (1996) used angling catch statistics to obtain their estimates of spawning escapement. They also point out the problems associated with this technique, which could at least partially explain the observed differences. The results of the assessment indicate that there is a serious conservation problem on Fischells Brook, having achieved only 44% of its egg deposition required for conservation (Table 9). Fishing mortality should be reduced on this river. About 56% of the river's conservation egg deposition would have been achieved if there was no angling fishery in 1997.

The proportion of large salmon estimated from the visual surveys in 1997 were similar to those estimated in Crabbes River and Robinsons River in 1996 (Porter 1997), and in Flat Bay Brook (Bourgeois et al., 1997). However, the observed proportion of large salmon in Middle Barachois Brook increased from by 247%. The comparison of the percentage of large salmon observed in 1996 and 1997 is provided below:

	<u>Percent large salmon</u>	
	1996	1997
Crabbes River	22.1	23.6
Middle Barachois Brook	4.3	14.9
Robinsons River	13.5	14.5
Fischells Brook	N/A	10.8
Flat Bay Brook	9.7	11.5

The angling catch statistics in 1997 (Appendices 1-5) were compiled from information provide on license stubs (logbooks) returned by anglers and adjusted for non-respondents (O'Connell, 1998). The number salmon hooked and released appears to be high compared to the estimated numbers of salmon in the rivers (Table 3). Of particular interest is the hook-and-release rates on Robinsons River, where 50% and 95% of the returns of small and large salmon respectively were estimated to have been caught and released; and on Fischells Brook, where 43% of the small salmon were either retained or released, and 115% of the large salmon were hooked and released. These data suggest one or more of the following: 1) the visual surveys significantly underestimate the returns to the river; 2) the catch statistics significantly overestimate the numbers of salmon caught; or 3) a large number of unrecorded removals occurred prior to the visual surveys. Although there is a possibility that the visual surveys underestimated the number of fish in the rivers, it is unlikely that the numbers were underestimated by as large an amount as implied by the angling data. As indicated by the small adjustment factors (Table 4-8), the surveyors felt that they observed a high proportion of the small salmon in the rivers. O'Connell et al. (1998) discusses some of the problems with estimating the numbers of salmon caught using the license stub return information. One of the most serious problems is estimating the catch and effort of anglers that do not return their license. The 'estimating error' is greatest on rivers with less than 200 anglers, which is the situation for the rivers covered by this assessment. Another factor that may have contributed to an over-estimate of angling catch, is that some anglers caught kelt and recorded these along with their catches of bright salmon on their angling log.

The biological characteristics (Table 2) used in this assessment are default values from Reddin and Mullins (1996). Thus, calculations of egg deposition have an associated error related to possible use of inappropriate parameter values. River specific data on weights and sex ratio are required to improve the stock assessment on these rivers.

The use of more surveyors in the larger pools and the application of a rope to keep the surveyors in a straight line across the river, vastly improved the technique for counting fish. There is still a problem of counting fish in pools that are too deep to see the bottom. A further refinement is required.

There were only a small number of salmon observed with net marks, for the second consecutive year. This implies that the marine by-catch and illegal netting in rivers of salmon is low. There appeared to be evidence of illegal activity in the upper sections of Fischells and Flat Bay brooks.

There should be an increase in the returns of 2SW salmon in 1998, if the improved sea survival observed in Highlands River in 1997 also occurred in the five rivers assessed in this document. However, the smolt production in Highlands River in 1997 was less than one-half that counted in 1996 (Reddin and Whalen, 1998). This low production was attributed to the severe flowing that occurred in February 1996, which also affected Crabbes River, Middle Barachois Brook, Robinsons River, Fischells Brook, and Flat Bay Brook. Thus, it is expected that the returns of 1SW salmon would be lower in 1998 than in 1997 in these rivers.

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Table 1. Drainage area, fluvial habitat, and egg deposition levels required for conservation in five rivers in Bay St. George.

RIVER NAME	DRAINAGE AREA (sq. km)	FLUVIAL REARING UNITS (100 sq. m)	STANDING WATER (ha)	Conservation Requirement EGGS (x 10**6)
CrabbesRiver	551	18,429	381	4.6
Middle Barachois Brook	241	8,395	362	2.1
Robinsons River	439	13,491	124	3.3
Fischells River	360	13,661	948	3.6
Flat Bay Brook	635	16,012		3.8
Total	2,226	40,315	42,541	17.4

Table 2. Biological characteristics and conservation spawner requirements for five Bay St. George river
 The spawner requirements assumes that the proportion of large salmon is the same as the
 average of the proportion in the total returns to each river in 1996 and 1997.

River	Small Salmon				Large salmon				Conservation Spawners	
	% of Total	% Female	Mean Wt(kg)	Mean Lth(cm)	% of Total	% Female	Mean Wt(kg)	Mean Lgth(cm)	Small	Large
	Crabbes	77.1	71.9	1.63	N/A	22.9	86.8	5.06	N/A	1207	358
Middle Barachois	90.58	71.9	1.63	N/A	9.4	86.8	5.06	N/A	837	87
Robinsons	85.73	71.9	1.63	N/A	14.3	86.8	5.06	N/A	1126	187
Fischells	90.4	71.9	1.63	N/A	9.6	86.8	5.06	N/A	1427	152
Flat Bay	89.32	71.9	1.34	53.4	10.7	66.7	3.31	69.1	1467	175
Total									6064	959

Table 3. Retained and released salmon in the angling fishery on five Bay St. George rivers, in 1997, as derived from the salmon angler licence stub return system. Estimated mortality is the sum of the retained salmon and 10% of the hooked and released salmon. Percent(%) returns is the percent of total returns to the river.

Small salmon

	Crabbes		M. Barachois		Robinsons		Fischells		Flat Bay	
	Fish	% of returns	Fish	% of returns	Fish	% of returns	Fish	% of returns	Fish	% of returns
Retained	4	<1	44	4	4	<1	185	23	0	
Released	286	25	155	14	542	50	162	20	258	20
Estimated Mortality	33	3	60	5	58	5	201	25	26	2

Large salmon

	Crabbes		M. Barachois		Robinsons		Fischells		Flat Bay	
	Fish	% of returns	Fish	% of returns	Fish	% of returns	Fish	% of returns	Fish	% of returns
Retained	0	0	0	0	0	0	0	0	0	0
Released	122	34	58	31	180	95	115	135	58	34
Estimated Mortality	12	3	6	3	18	10	12	14	6	4

Table 4. Number of small and large salmon counted in Crabbes River, 20-21 August 1997.

River Section	# pools > 10 fish	Unadjusted Count		Adjustment Factor	Adjusted Count			Percent Large
		Small	Large		Small	Large	Total	
1	5	124	109	1.10	136	120	256	46.8
2	6	300	103	1.30	390	134	524	25.6
3	5	172	21	1.30	224	27	251	10.9
4	3	254	44	1.10	279	48	328	14.8
5	1	46	8	2.00	92	16	108	14.8
L Crabbes	0	0	0	1.00	0	0	0	
TOTAL	20	896	285	1.24	1121	346	1467	23.6

Table 5. Number of small and large salmon counted in Middle Barchois Brook, 22 -26 August 1997.

River Section	# pools > 10 fish	Unadjusted Count		Adjustment Factor	Adjusted Count			Percent Large
		Small	Large		Small	Large	Total	
1	8	742	131	1.05	779	138	917	15.0
2	4	201	34	1.05	211	36	247	14.5
3	1	36	6	1.50	54	9	63	14.3
4	0	0	0	1.00	0	0	0	0.0
Big Dribble	0	0	0	1.00	0	0	0	0.0
TOTAL	13	979	171	1.07	1044	182	1226	14.9

Table 6. Number of small and large salmon counted in Robinsons River, 22-24 August 1997

River Section	# pools > 10 fish	Unadjusted Count		Adjustment Factor	Adjusted Count			Percent Large
		Small	Large		Small	Large	Total	
1	1	74	4	1.50	111	6	117	5.1
2	11	640	131	1.10	704	144	848	17.0
3	3	66	7	1.10	73	8	80	9.6
4	3	118	13	1.10	130	14	144	9.9
N. Feeder	0	0	0	1.00	0	0	0	0.0
TOTAL	18	898	155	1.13	1017	172	1190	14.5

Table 7. Number of small and large salmon counted in Fishells Brook, 19-20 August 1997

River Section	# pools > 10 fish	Unadjusted Count		Adjustment Factor	Adjusted Count			Percent Large
		Small	Large		Small	Large	Total	
1	4	389	48	1.10	428	53	481	11.0
2	0	0	0	1.00	0	0	0	0.0
3	5	131	16	1.25	164	20	184	10.9
4	0	7	0	1.10	8	0	8	0.0
TOTAL	9	527	64	1.14	599	73	672	10.8

Table 8. Number of small and large salmon counted in Flat Bay Brook, 19 & 23 August 1997

River Section	# pools > 10 fish	Unadjusted Count		Adjustment Factor	Adjusted Count			Percent Large
		Small	Large		Small	Large	Total	
1	0	26	1	1.20	31	1	32	3.7
2	3	231	23	1.10	254	25	279	9.1
3	2	356	47	1.10	392	52	443	11.7
4	5	361	62	1.15	415	71	486	14.7
5	5	173	16	1.10	190	18	208	8.5
Coal Brook	0	0	0	1.00	0	0	0	0.0
TOTAL	15	1147	149	1.12	1282	167	1449	11.5

Table 9. Adjusted and unadjusted numbers of small and large spawners, estimated egg deposition, and percentage of egg deposition required for conservation attained in 1997 in five bay St. George Bay rivers.

River	Small salmon		Large salmon		Egg deposition		% Conservation level	
	unadjust	adjusted	unadjust	adjusted	unadjust	adjusted	unadjust	adjusted
Crabbes River	896	1121	285	346	3544815	4363495	77	95
Middle Barachois Bk	979	1044	171	182	2923543	3115259	139	148
Robinsons River	898	1017	155	172	2669130	2998890	81	91
Fischells River	527	599	64	73	1384031	1574853	38	44
Flat Bay Brook	1147	1282	149	167	3016780	3373607	79	89

Table 10. Spawning escapement of Atlantic salmon in five Bay St. George rivers, 1953-97. Estimates for 1953-94 are from Reddin and Mullins (1996), except for Flat Bay Brook in 1994. Estimates for 1994, 1995 and 1996 for Flat Bay Brook are updated from Bourgeois et al (1997). Estimates for other rivers in 1996 are from Porter (1997)

Year	Crabbes		M. Barachois		Robinsons		Fishells		Flat Bay	
	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
1953	166	51	54	6	1141	228	226	57	1554	179
1954	271	77	77	21	863	305	79	65	768	69
1955	177	149	63	23	847	159	75	68	1006	50
1956	420	329	532	105	1372	299	343	104	1321	44
1957	772	467	390	102	1857	267	425	117	1675	29
1958	313	411	254	131	840	447	364	149	1447	59
1959	551	276	138	24	1139	147	336	47	779	27
1960	343	75	201	23	1773	176	222	57	2357	98
1961	756	168	502	38	1708	249	450	108	1783	53
1962	1328	294	551	71	2345	176	658	86	3215	111
1963	1092	450	632	218	2814	585	992	180	4263	138
1964	1909	437	798	149	2182	423	712	204	4324	146
1965	1003	363	1265	167	2382	300	471	126	1815	263
1966	293	127	229	74	616	116	64	45	704	27
1967	593	164	667	130	1035	136	434	33	1098	52
1968	552	186	749	101	984	120	339	36	1162	33
1969	1018	191	936	126	693	60	508	63	1047	78
1970	370	123	455	56	634	65	369	110	1828	94
1971	379	70	672	44	456	47	292	22	1245	65
1972	486	124	425	151	351	34	163	52	1074	58
1973	407	87	694	63	1002	70	490	66	851	69
1974	359	80	314	57	433	14	269	22	623	48
1975	330	74	623	96	747	34	225	17	499	34
1976	233	47	643	38	680	46	226	13	744	39
1977	265	103	653	46	493	151	299	54	255	21
1978	333	270	234	1057	592	318	397	321	208	4
1979	553	30	568	0	1248	108	173	0	107	1
1980	877	193	1329	249	1724	529	585	415	662	8
1981	940	244	962	31	2170	604	701	114	680	12
1982	1355	159	628	21	2281	192	919	73	635	10
1983	254	97	385	10	592	42	330	79	458	2
1984	952	30	724	0	1265	108	551	83	483	2
1985	129	30	160	40	507	67	216	20	390	22
1986	472	108	326	82	463	61	274	26	224	13
1987	114	26	83	21	313	41	88	8	282	16
1988	386	89	329	83	394	52	556	53	321	18
1989	64	15	129	33	158	21	25	2	167	10
1990	152	35	225	57	315	42	173	16	357	20
1991	140	32	111	28	239	32	234	22	323	18
1992	393	126	362	72	557	130	210	21	287	25
1993	204	34	435	36	306	31	234	65	223	21
1994	600	113	578	81	750	115	844	158	243	67
1995	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	567	44
1996	844	239	805	36	768	120	N/A	N/A	1051	112
1997	1121	346	1044	182	1017	172	599	73	1282	167
Mean 53-65	700	273	420	83	1636	289	412	105	2024	97
Mean 66-77	441	115	588	82	677	74	306	44	928	52
Mean 78-84	752	146	690	195	1410	272	522	155	462	6
Mean 85-91	208	48	195	49	341	45	224	21	295	17
Mean 92-94	399	91	459	63	538	92	429	82	289	39
Mean 96-97	983	293	925	109	893	146	599	37	1282	167

Table 11. Estimated total returns to five Bay St. George rivers, 1953-97. Estimates for 1953-94 are from Reddin and Mullins (1996), except for Flat Bay Brook, 1994. Estimates for 1994, 1995 and 1996 are updated from Bourgeois et al (1997). Estimates for other rivers for 1996 are from Porter (1997).

Year	Crabbes		Middle Barachois		Robinsons		Fishells		Flat Bay	
	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
1953	237	85	77	10	1630	380	323	95	2220	298
1954	387	128	110	35	1233	508	113	108	1097	115
1955	253	248	90	38	1210	265	107	113	1437	83
1956	600	548	760	175	1960	498	490	173	1887	73
1957	1103	778	557	170	2653	445	607	195	2393	48
1958	447	685	363	218	1200	745	520	248	2067	98
1959	787	460	197	40	1627	245	480	78	1113	45
1960	490	125	287	38	2533	293	317	95	3367	163
1961	1080	280	717	63	2440	415	643	180	2547	88
1962	1897	490	787	118	3350	293	940	143	4593	185
1963	1560	750	903	363	4020	975	1417	300	6090	230
1964	2727	728	1140	248	3117	705	1017	340	6177	243
1965	1433	605	1807	278	3403	500	673	210	2593	438
1966	533	282	416	164	1120	258	116	100	1280	60
1967	1078	365	1213	289	1882	302	789	73	1996	115
1968	1004	413	1362	225	1789	267	616	80	2113	73
1969	1851	425	1702	280	1260	133	924	140	1904	173
1970	673	273	827	125	1153	145	671	245	3324	209
1971	689	155	1222	98	829	104	531	49	2264	145
1972	884	276	773	335	638	75	296	115	1953	129
1973	740	193	1262	140	1822	155	891	147	1547	153
1974	653	178	571	127	787	31	489	49	1133	107
1975	600	164	1133	213	1358	76	409	38	907	76
1976	424	105	1169	84	1236	102	411	29	1353	87
1977	482	229	1187	102	896	335	544	120	464	47
1978	471	397	285	1159	827	386	551	352	348	16
1979	782	44	692	0	1743	131	240	0	179	5
1980	1240	284	1619	273	2408	642	812	455	1107	34
1981	1329	359	1172	34	3031	733	973	125	1137	51
1982	1916	234	765	23	3186	233	1276	80	1062	43
1983	359	119	469	11	827	51	458	80	766	9
1984	1346	44	882	0	1767	131	765	91	808	9
1985	224	30	258	40	880	67	361	20	693	22
1986	819	108	526	82	804	61	458	26	398	13
1987	198	26	134	21	543	41	147	8	501	16
1988	670	89	531	83	684	52	930	53	570	18
1989	111	15	208	33	274	21	42	2	297	10
1990	264	35	363	57	547	42	289	16	634	20
1991	243	32	179	28	415	32	391	22	574	18
1992	682	126	584	72	967	130	351	21	510	25
1993	354	34	665	36	531	31	391	65	396	21
1994	774	113	732	81	910	115	1060	158	420	70
1995	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	650	48
1996	844	239	805	36	768	120	N/A	N/A	1233	132
1997	1154	358	1104	188	1075	190	800	85	1308	173
Mean 53-65	1000	454	599	138	2337	482	588	175	2891	162
Mean 66-77	801	255	1070	182	1231	165	557	99	1687	115
Mean 78-84	1063	212	840	214	1970	330	725	169	772	24
Mean 85-91	361	48	314	49	592	45	374	21	524	17
Mean 92-94	603	91	661	63	803	92	600	82	463	39
Mean 96-97	999	299	955	112	922	155	800	85	1271	153

Table 12. Percentage of the egg deposition level required for conservation achieved on five rivers in Bay St. George, 1953-97. Estimates for 1953-94 are from Reddin and Mullins (1996). Estimates for Flat Bay Brook 1994-96 are from Bourgeois et al (1997). Estimates for all other rivers for 1996 are from Porter (1997).

Year	Crabbes	M. Barachois	Robinsons	Fishells	Flat Bay
1953	10	4	73	18	79
1954	15	9	75	15	36
1955	20	8	53	15	40
1956	46	52	92	30	48
1957	69	44	104	35	57
1958	52	43	95	39	55
1959	43	13	61	20	29
1960	17	16	87	18	90
1961	37	35	96	35	64
1962	64	45	107	37	118
1963	75	83	184	66	155
1964	94	76	138	61	19
1965	64	105	127	39	102
1966	19	25	32	10	27
1967	28	54	45	21	44
1968	30	51	42	18	43
1969	38	63	26	29	47
1970	20	30	25	33	75
1971	14	35	18	14	51
1972	22	50	14	15	44
1973	16	40	35	29	39
1974	15	25	13	13	28
1975	14	45	23	11	22
1976	9	32	23	10	31
1977	16	35	34	20	12
1978	38	254	70	72	7
1979	19	34	65	6	4
1980	45	136	146	96	22
1981	52	64	174	44	23
1982	55	42	117	43	21
1983	17	25	29	25	14
1984	30	43	65	33	15
1985	6	18	28	10	15
1986	24	36	25	13	8
1987	6	9	17	4	11
1988	19	37	22	26	12
1989	3	14	9	1	6
1990	8	25	17	8	13
1991	7	12	13	11	12
1992	34	53	57	14	18
1993	13	48	23	24	14
1994	41	74	65	71	19
1995	N/A	N/A	N/A	N/A	45
1996	68	81	67	N/A	85
1997	95	148	91	44	89
Mean 53-65	47	41	99	33	79
Mean 66-77	20	40	28	19	39
Mean 78-84	37	86	95	46	15
Mean 85-91	10	22	19	10	11
Mean 92-94	29	58	49	36	17
Mean 96-97	82	115	79	44	87

Figure 1. Sections of Crabbes River and Little Crabbes Brook in which visual surveys were conducted, 1997.

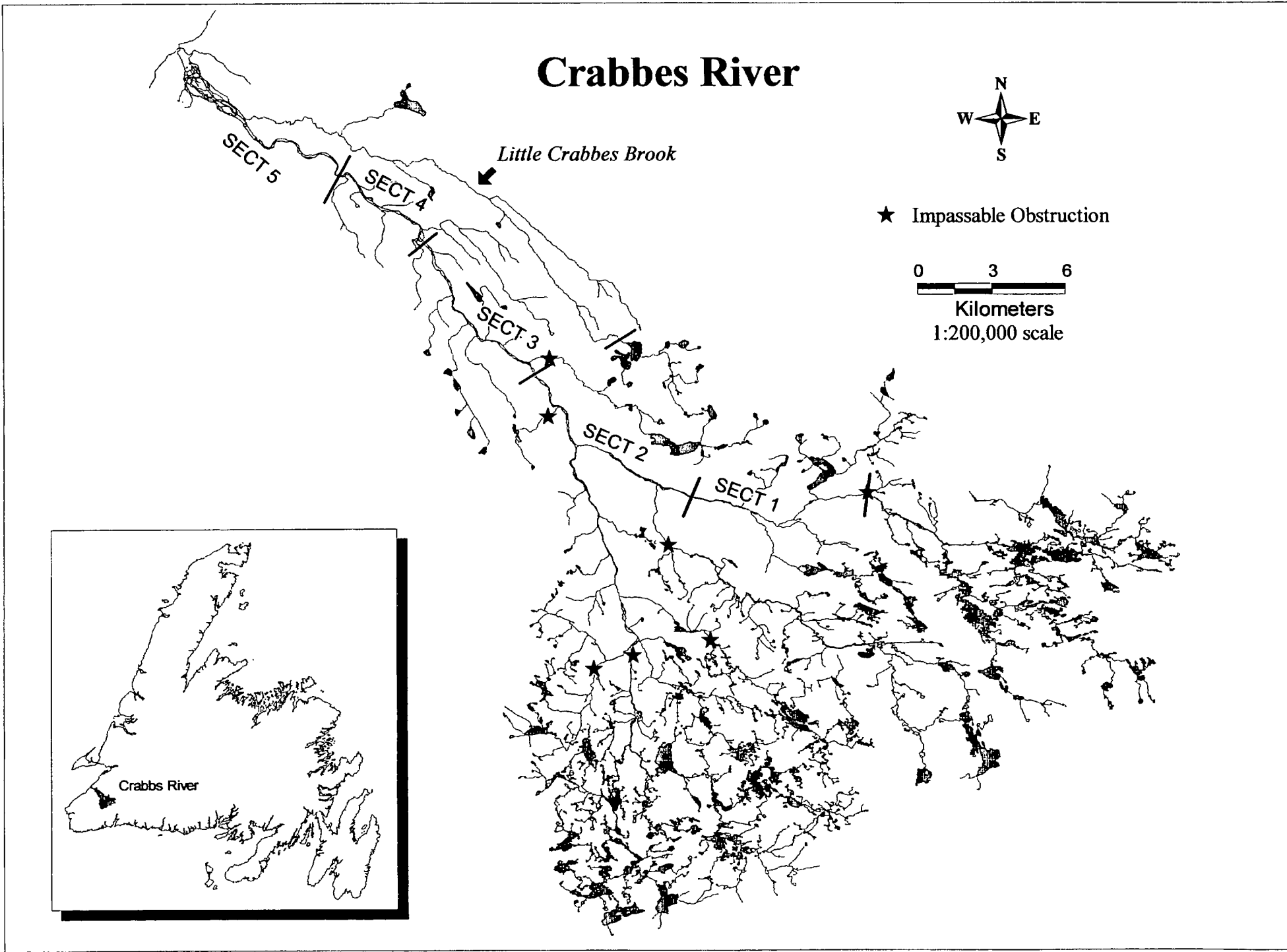


Figure 2. Sections of Middle Barchois Brook and Big Dribble Brook in which visual surveys were conducted, 1997.

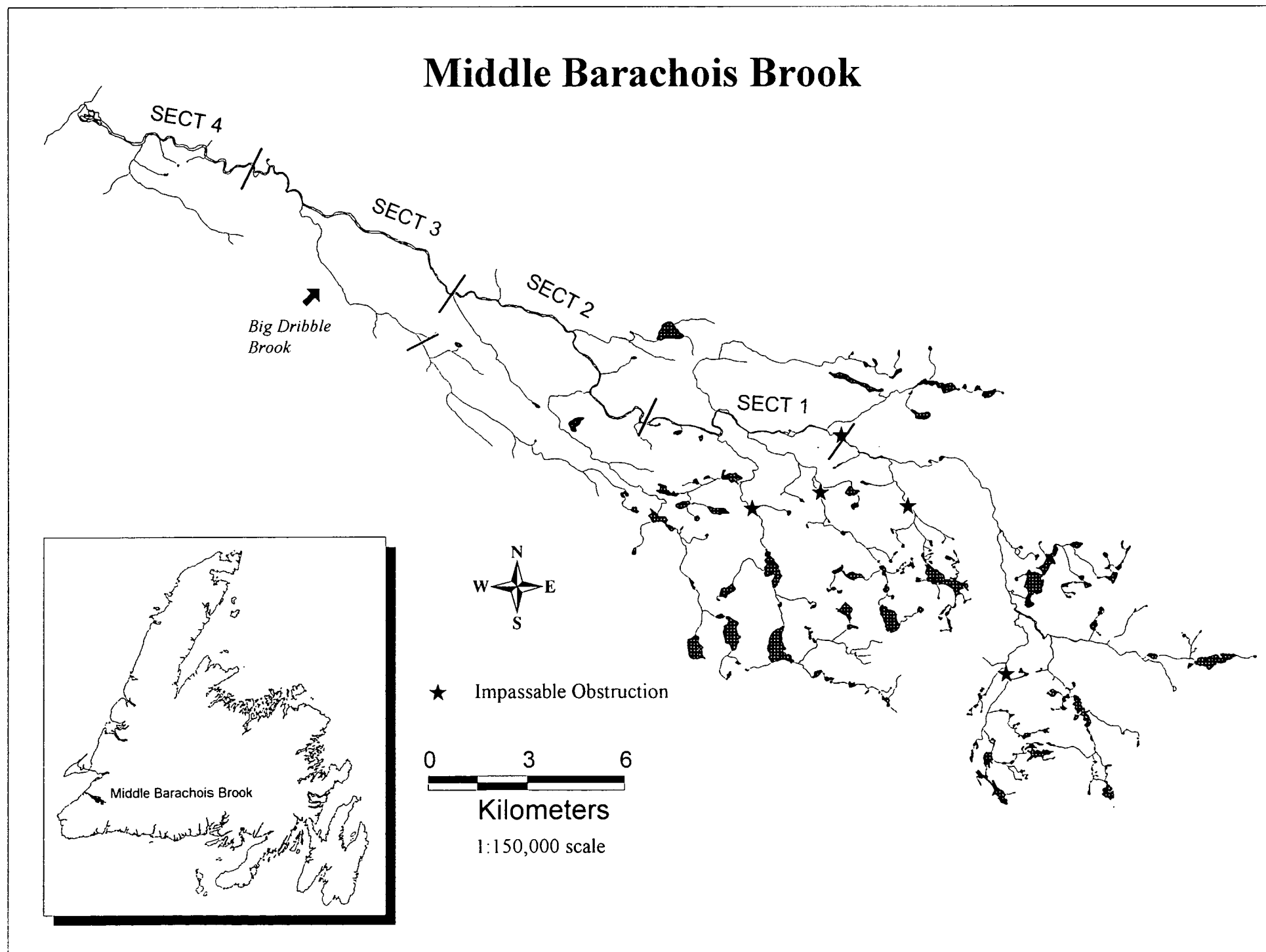


Figure 3. Sections of Robinsons River and Northern Feeder in which visual surveys were conducted, 1997.

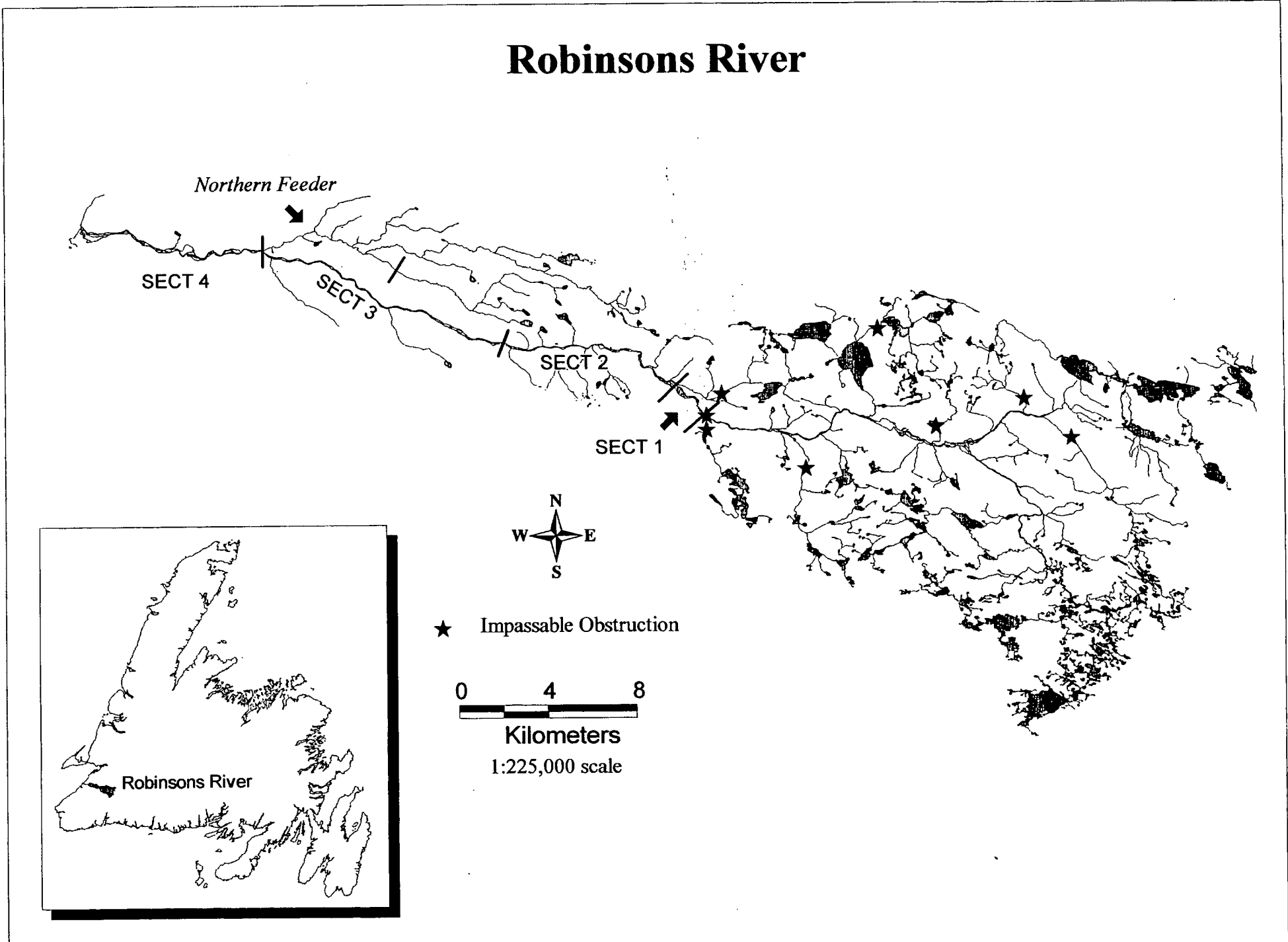


Figure 4. Sections of Fischells Brook in which visual surveys were conducted, 1997.

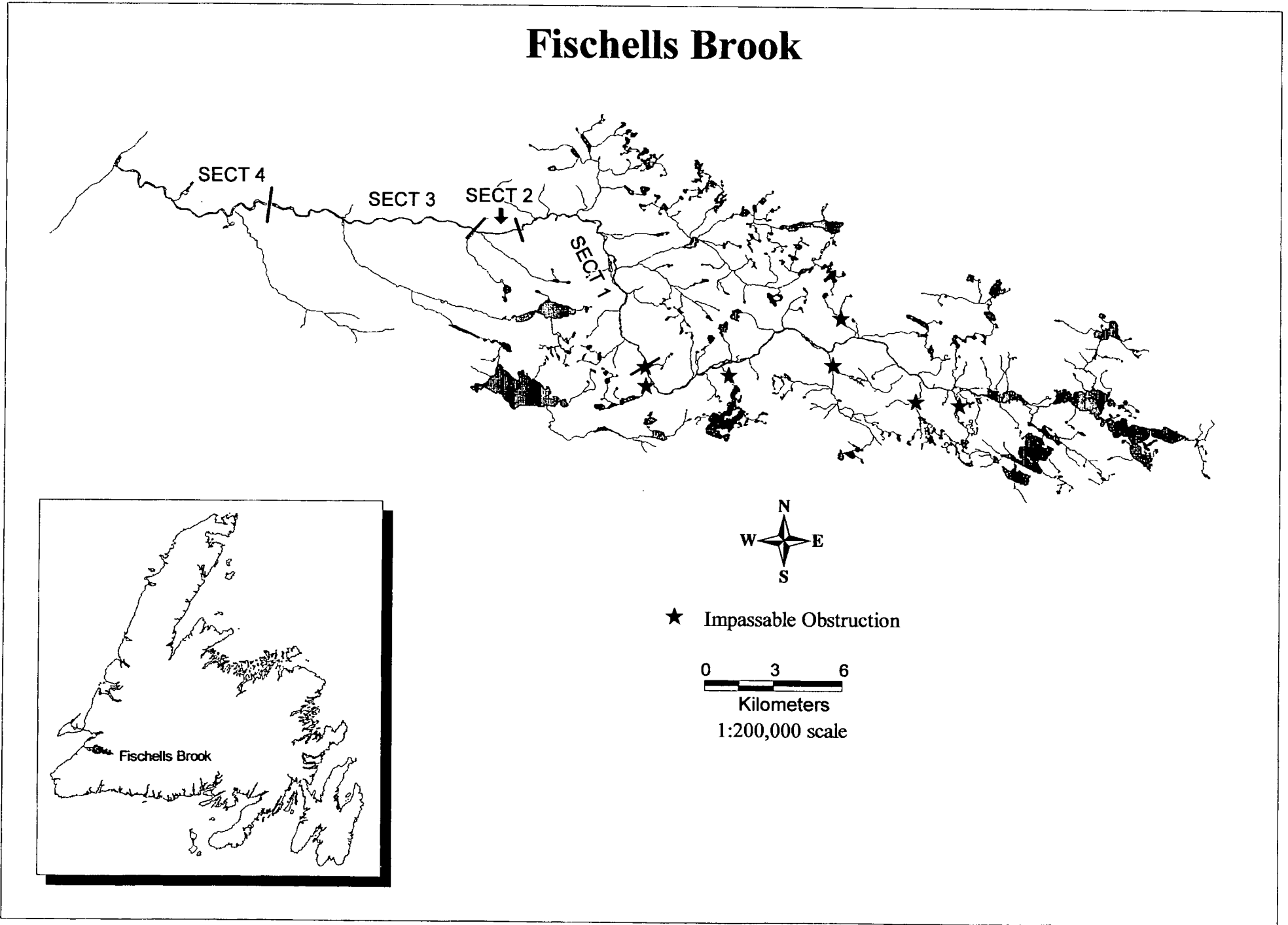
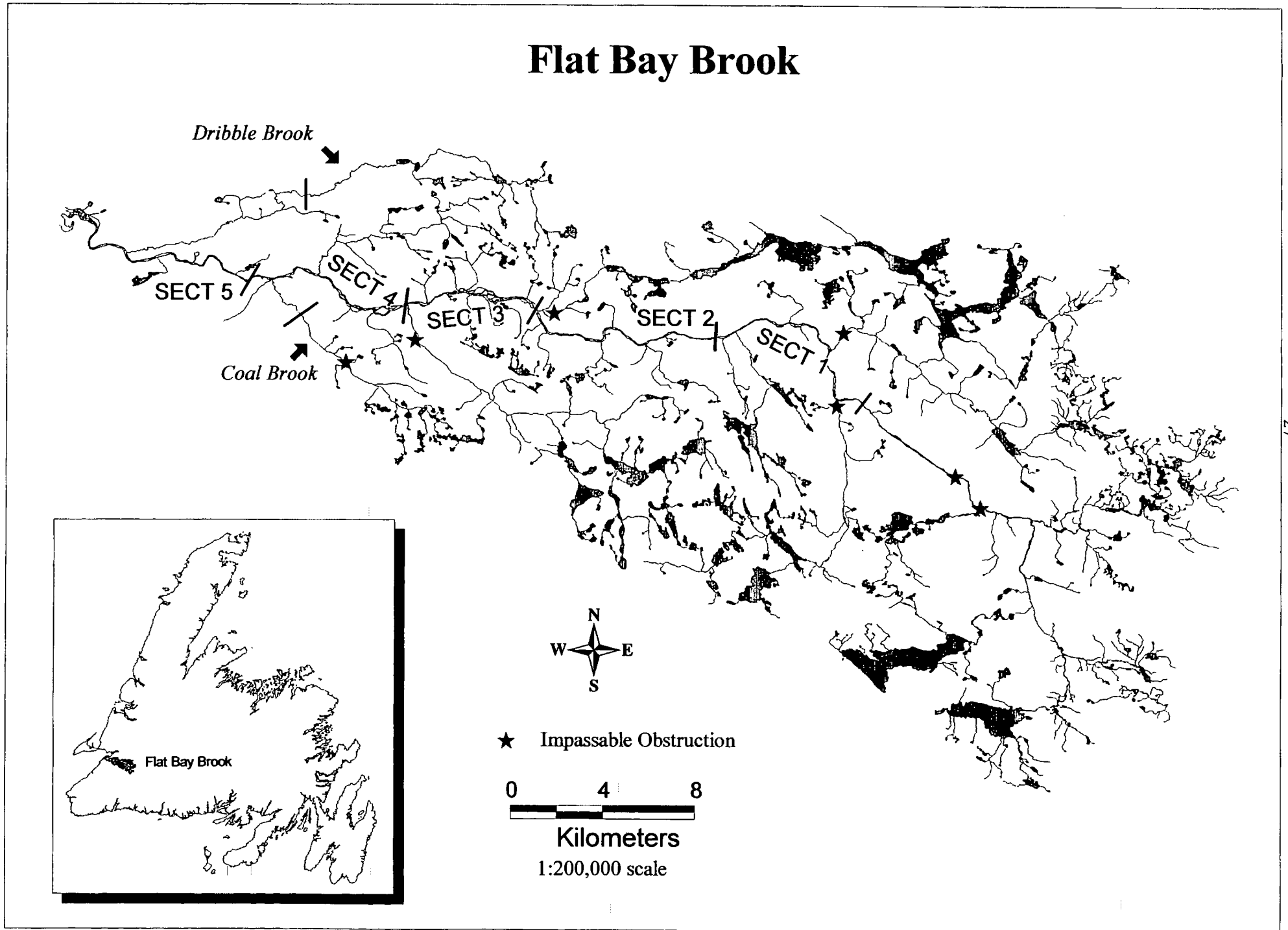


Figure 5. Sections of Flat Bay Brook, Dribble Brook and Coal Brook in which visual surveys were conducted, 1997.



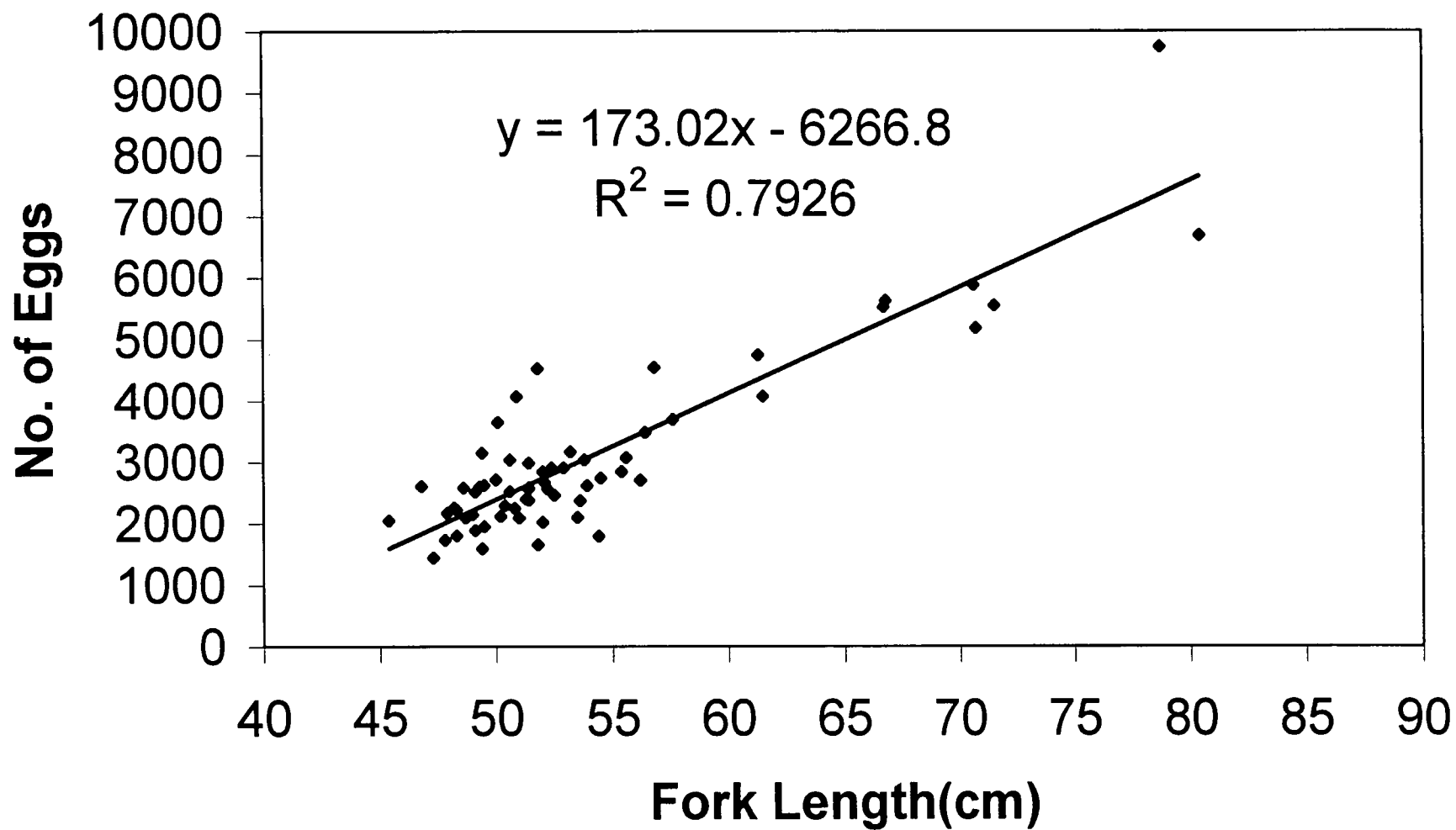


Fig. 6. Length-fecundity relationship derived from 63 female salmon for Flat Bay Brook 1995 and 1996. Eggs were removed at time of spawning.

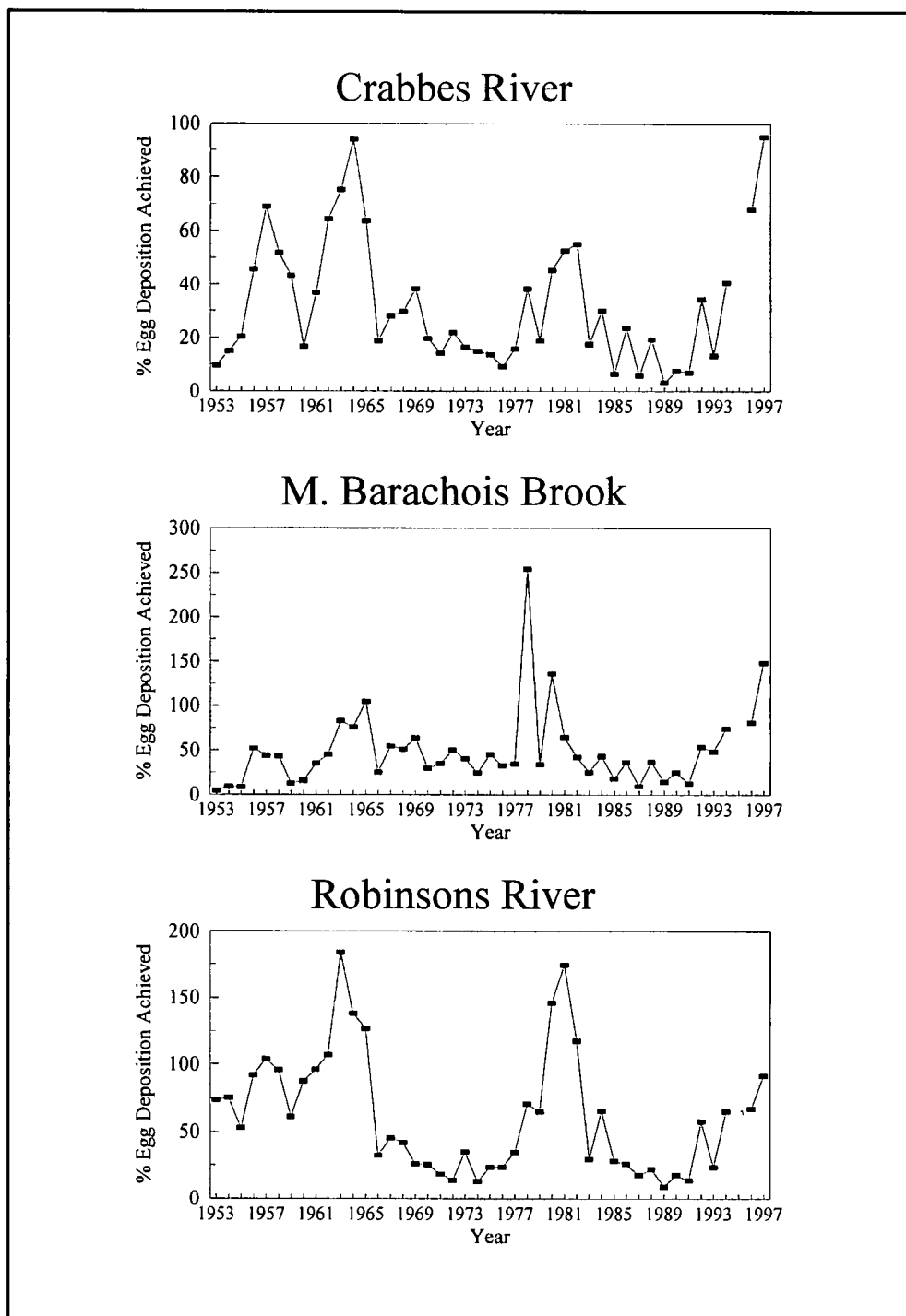


Fig. 7. Percentages of the egg deposition levels required for conservation which were achieved on Crabbes, Middle Barchois and Robinsons rivers 1953-97. Values for 1953-94 are from Reddin and Mullins (1996); values for 1996-97 are from visual surveys.

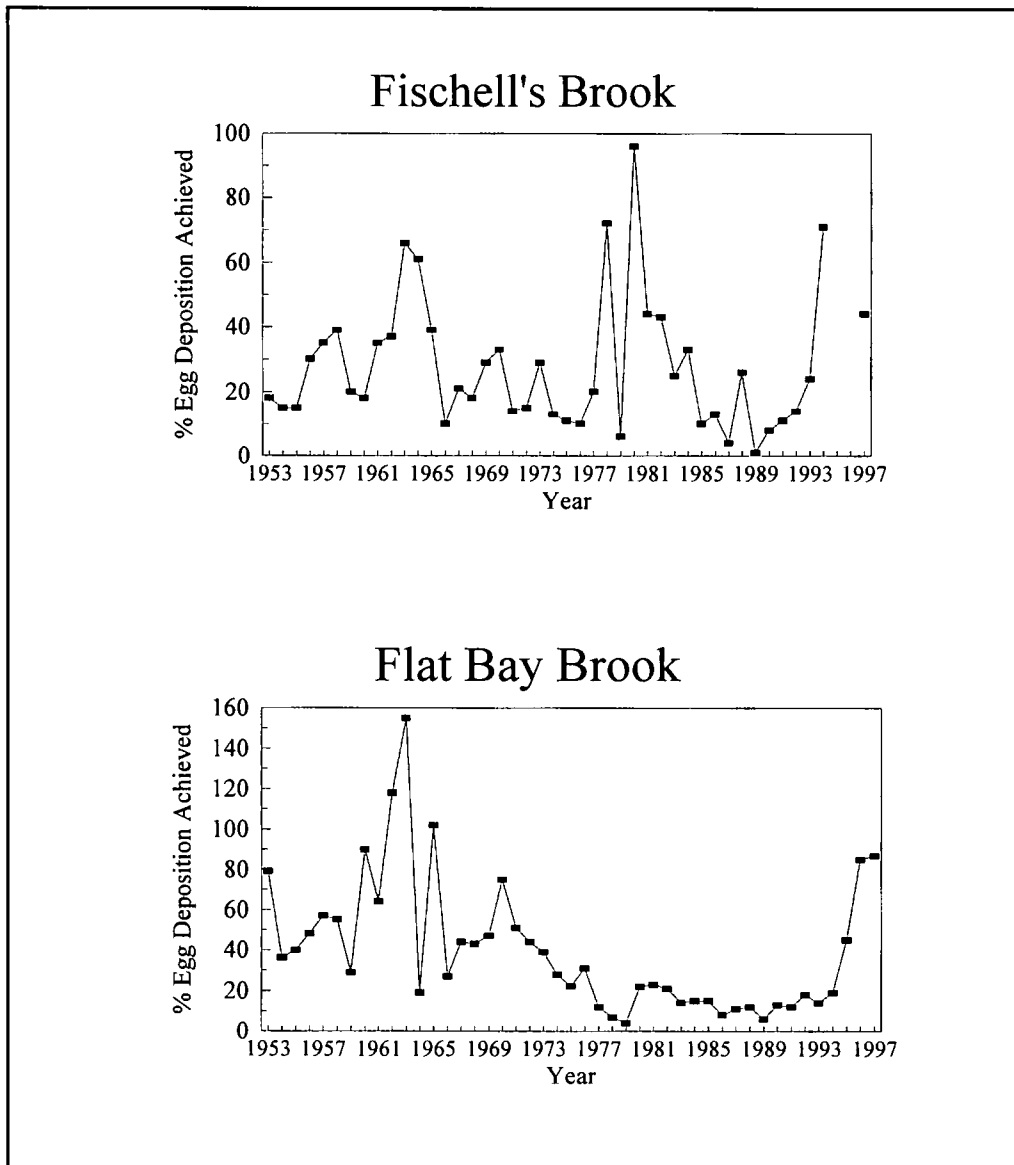


Fig. 8. Percentages of the egg deposition levels required for conservation which were achieved on Fischell's and Flat Bay brooks 1953-97. Values for 1953-94 are from Reddin and Mullins (1996); except for Flat Bay Brook where values for 1994 and 1995 are from Bourgeois et al (1997); values for 1996-97 are from visual surveys.

Appendix 1. Angling catch statistics for Crabbes River. Data for 1974-1996 were collected by DFO River Guardians. Data for 1997 are from the license stub return and are preliminary.

River: Crabbes River

Code: 4000860

Year	Effort Rod Days	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			CPUE
		Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	
1974	1010	294	.	294	98	.	98	392	.	392	0.39
1975	1641	270	.	270	90	.	90	360	.	360	0.22
1976	859	191	.	191	58	.	58	249	.	249	0.29
1977	859	217	.	217	126	.	126	343	.	343	0.40
1978	907	138	.	138	127	.	127	265	.	265	0.29
1979	501	229	.	229	14	.	14	243	.	243	0.49
1980	902	363	.	363	91	.	91	454	.	454	0.50
1981	905	389	.	389	115	.	115	504	.	504	0.56
1982	1135	561	.	561	75	.	75	636	.	636	0.56
1983	758	105	.	105	38	.	38	143	.	143	0.19
1984	848	394	.	394	14	.	14	408	.	408	0.48
1985	602	95	.	95	*	3	3	95	3	98	0.16
1986	997	347	.	347	*	0	0	347	0	347	0.35
1987	377	84	.	84	*	4	4	84	4	88	0.23
1988	773	284	.	284	*	17	17	284	17	301	0.39
1989	419	47	.	47	*	5	5	47	5	52	0.12
1990	457	112	.	112	*	25	25	112	25	137	0.30
1991	385	103	.	103	*	9	9	103	9	112	0.29
1992	822	263	26	289	*	88	88	263	114	377	0.46
1993	737	150	0	150	*	24	24	150	24	174	0.24
1994	906	174	37	211	*	45	45	174	82	256	0.28
1995	268	26	5	31	*	32	32	26	37	63	0.24
1996**	.	.	.	.	*	.	.	.	.	.	.
1997	.	4	286	290	*	122	122	4	408	412	.
84-89 \bar{X}	669.3	208.5	.	208.5	.	5.8	7.2	210.8	5.8	215.7	0.32
95% CL	258.3	158.3	.	158.3	.	8.1	7.1	162.0	8.1	161.6	0.14
N	6	6	0	6	0	5	6	6	5	6	6
86-91 \bar{X}	568.0	162.8	.	162.8	.	10.0	10.0	162.8	10.0	172.8	0.30
95% CL	269.9	128.0	.	128.0	.	9.8	9.8	128.0	9.8	127.3	0.09
N	6	6	0	6	0	6	6	6	6	6	6
92-96 \bar{X}	683.3	153.3	17.0	170.3	.	47.3	47.3	153.3	64.3	217.5	0.32
95% CL	453.9	155.6	27.8	173.2	.	45.4	45.4	155.6	65.9	210.8	0.18
N	4	4	4	4	0	4	4	4	4	4	4

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985-1997 AND ON RETAINED FISH ONLY PRIOR TO 1985.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

**DATA UNAVAILABLE

Appendix 2. Angling catch statistics for Barachois Brook. Data for 1974-1996 were collected by DFO River Guardians. Data for 1997 are from the license stub return and are preliminary.

River: Barachois Brook

Code: 4000900

Year	Effort Rod Days	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			CPUE
		Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	
1974	894	257	.	257	70	.	70	327	.	327	0.37
1975	1129	510	.	510	117	.	117	627	.	627	0.56
1976	1572	526	.	526	46	.	46	572	.	572	0.36
1977	1218	534	.	534	56	.	56	590	.	590	0.48
1978	273	51	.	51	102	.	102	153	.	153	0.56
1979	342	124	.	124	0	.	0	124	.	124	0.36
1980	622	290	.	290	24	.	24	314	.	314	0.50
1981	487	210	.	210	3	.	3	213	.	213	0.44
1982	313	137	.	137	2	.	2	139	.	139	0.44
1983	292	84	.	84	1	.	1	85	.	85	0.29
1984	320	158	.	158	0	.	0	158	.	158	0.49
1985	422	98	.	98	*	1	1	98	1	99	0.23
1986	683	200	.	200	*	23	23	200	23	223	0.33
1987	208	51	.	51	*	0	0	51	0	51	0.25
1988	565	202	.	202	*	11	11	202	11	213	0.38
1989	395	79	.	79	*	1	1	79	1	80	0.20
1990	547	138	.	138	*	7	7	138	7	145	0.27
1991	293	68	.	68	*	6	6	68	6	74	0.25
1992	535	222	0	222	*	22	22	222	22	244	0.46
1993	916	230	23	253	*	11	11	230	34	264	0.29
1994	785	154	25	179	*	14	14	154	39	193	0.25
1995	341	53	2	55	*	24	24	53	26	79	0.23
1996**	.	.	.	.	.	.	.	.	.	.	.
1997	.	44	155	199	*	58	58	44	213	257	.
84-89 \bar{X}	432.2	131.3	.	131.3	.	7.2	6.0	131.3	7.2	137.3	0.32
95% CL	178.7	67.6	.	67.6	.	12.3	9.8	67.6	12.3	75.3	0.10
N	6	6	0	6	0	5	6	6	5	6	6
86-91 \bar{X}	448.5	123.0	.	123.0	.	8.0	8.0	123.0	8.0	131.0	0.29
95% CL	189.6	70.5	.	70.5	.	8.8	8.8	70.5	8.8	78.0	0.07
N	6	6	0	6	0	6	6	6	6	6	6
92-96 \bar{X}	644.3	164.8	12.5	177.3	.	17.8	17.8	164.8	30.3	195.0	0.30
95% CL	408.3	130.4	21.2	138.4	.	9.9	9.9	130.4	12.2	131.9	0.14
N	4	4	4	4	0	4	4	4	4	4	4

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985-1997 AND ON RETAINED FISH ONLY PRIOR TO 1985.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

**DATA UNAVAILABLE

Appendix 3. Angling catch statistics for Robinsons River. Data for 1974-1996 were collected by DFO River Guardians. Data for 1997 are from the license stub return and are preliminary.

River: Robinsons River

Code: 4000920

Year	Effort Rod Days	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			CPUE
		Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	
1974	1134	354	.	354	17	.	17	371	.	371	0.33
1975	1556	611	.	611	42	.	42	653	.	653	0.42
1976	1842	556	.	556	56	.	56	612	.	612	0.33
1977	1184	403	.	403	184	.	184	587	.	587	0.50
1978	671	235	.	235	68	.	68	303	.	303	0.45
1979	989	495	.	495	23	.	23	518	.	518	0.52
1980	1352	684	.	684	113	.	113	797	.	797	0.59
1981	1527	861	.	861	129	.	129	990	.	990	0.65
1982	1648	905	.	905	41	.	41	946	.	946	0.57
1983	2580	278	.	278	210	.	210	488	.	488	0.19
1984	1884	502	.	502	23	.	23	525	.	525	0.28
1985	1905	373	.	373	*	7	7	373	7	380	0.20
1986	2344	341	.	341	*	37	37	341	37	378	0.16
1987	1276	230	.	230	*	15	15	230	15	245	0.19
1988	1528	290	.	290	*	9	9	290	9	299	0.20
1989	971	116	.	116	*	11	11	116	11	127	0.13
1990	1182	232	.	232	*	22	22	232	22	254	0.21
1991	818	176	.	176	*	10	10	176	10	186	0.23
1992	1552	386	24	410	*	75	75	386	99	485	0.31
1993	1284	225	0	225	*	18	18	225	18	243	0.19
1994	1051	160	88	248	*	38	38	160	126	286	0.27
1995	719	73	38	111	*	23	23	73	61	134	0.19
1996**	.	.	.	.	.	.	.	.	.	.	.
1997	.	4	542	546	*	180	180	4	722	726	.
84-89 \bar{X}	1651.3	308.7	.	308.7	.	15.8	17.0	312.5	15.8	325.7	0.20
95% CL	517.9	137.8	.	137.8	.	15.2	11.9	145.1	15.2	142.5	0.05
N	6	6	0	6	0	5	6	6	5	6	6
86-91 \bar{X}	1353.2	230.8	.	230.8	.	17.3	17.3	230.8	17.3	248.2	0.18
95% CL	571.1	83.7	.	83.7	.	11.3	11.3	83.7	11.3	91.5	0.03
N	6	6	0	6	0	6	6	6	6	6	6
92-96 \bar{X}	1151.5	211.0	37.5	248.5	.	38.5	38.5	211.0	76.0	287.0	0.25
95% CL	562.6	210.4	59.1	196.0	.	41.0	41.0	210.4	74.7	233.4	0.11
N	4	4	4	4	0	4	4	4	4	4	4

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985-1997 AND ON RETAINED FISH ONLY PRIOR TO 1985.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

**DATA UNAVAILABLE

Appendix 4. Angling catch statistics for Fishells Brook. Data for 1974-1996 were collected by DFO River Guardians. Data for 1997 are from the license stub return and are preliminary.

River: Fishells Brook

Code: 4000960

Year	Effort Rod Days	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			CPUE
		Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	
1974	753	220	.	220	27	.	27	247	.	247	0.33
1975	522	184	.	184	21	.	21	205	.	205	0.39
1976	418	185	.	185	16	.	16	201	.	201	0.48
1977	468	245	.	245	66	.	66	311	.	311	0.66
1978	292	154	.	154	31	.	31	185	.	185	0.63
1979	168	67	.	67	0	.	0	67	.	67	0.40
1980	386	227	.	227	40	.	40	267	.	267	0.69
1981	463	272	.	272	11	.	11	283	.	283	0.61
1982	651	357	.	357	7	.	7	364	.	364	0.56
1983	377	128	.	128	7	.	7	135	.	135	0.36
1984	411	214	.	214	8	.	8	222	.	222	0.54
1985	373	145	.	145	*	3	3	145	3	148	0.40
1986	427	184	.	184	*	4	4	184	4	188	0.44
1987	266	59	.	59	*	2	2	59	2	61	0.23
1988	840	374	.	374	*	7	7	374	7	381	0.45
1989	110	17	.	17	*	0	0	17	0	17	0.15
1990	256	116	.	116	*	12	12	116	12	128	0.50
1991	414	157	.	157	*	16	16	157	16	173	0.42
1992	384	133	8	141	*	11	11	133	19	152	0.40
1993	819	157	0	157	*	34	34	157	34	191	0.23
1994	702	216	58	274	*	47	47	216	105	321	0.46
1995	555	80	112	192	*	43	43	80	155	235	0.42
1996**	.	.	.	.	.	.	.	.	.	.	.
1997	.	185	162	347	*	115	115	185	277	462	.
84-89 \bar{X}	404.5	165.5	.	165.5	.	3.2	4.0	166.8	3.2	169.5	0.42
95% CL	255.9	132.8	.	132.8	.	3.2	3.2	133.4	3.2	135.5	0.10
N	6	6	0	6	0	5	6	6	5	6	6
86-91 \bar{X}	385.5	151.2	.	151.2	.	6.8	6.8	151.2	6.8	158.0	0.41
95% CL	263.9	131.5	.	131.5	.	6.5	6.5	131.5	6.5	133.6	0.09
N	6	6	0	6	0	6	6	6	6	6	6
92-96 \bar{X}	615.0	146.5	44.5	191.0	.	33.8	33.8	146.5	78.3	224.8	0.37
95% CL	299.3	89.7	82.4	94.3	.	25.6	25.6	89.7	100.9	115.5	0.20
N	4	4	4	4	0	4	4	4	4	4	4

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985-1997 AND ON RETAINED FISH ONLY PRIOR TO 1985.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

**DATA UNAVAILABLE

Appendix 5. Angling catch statistics for Flat Bay Brook. Data for 1974-1996 were collected by DFO River Guardians. During 1995 and 1996 this river was closed to angling. Data for 1997 are from the license stub return and are preliminary.

River: Flat Bay Brook

Code: 4101080

Year	Effort Rod Days	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			CPUE
		Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	
1974	2156	510	.	510	59	.	59	569	.	569	0.26
1975	2625	408	.	408	42	.	42	450	.	450	0.17
1976	1705	609	.	609	48	.	48	657	.	657	0.39
1977	1045	209	.	209	26	.	26	235	.	235	0.22
1978	537	140	.	140	12	.	12	152	.	152	0.28
1979	263	72	.	72	4	.	4	76	.	76	0.29
1980	932	445	.	445	26	.	26	471	.	471	0.51
1981	1299	457	.	457	39	.	39	496	.	496	0.38
1982	1357	427	.	427	33	.	33	460	.	460	0.34
1983	1123	308	.	308	7	.	7	315	.	315	0.28
1984	602	325	.	325	7	.	7	332	.	332	0.55
1985	1060	303	.	303	*	6	6	303	6	309	0.29
1986	684	174	.	174	*	2	2	174	2	176	0.26
1987	816	219	.	219	*	0	0	219	0	219	0.27
1988	871	249	.	249	*	5	5	249	5	254	0.29
1989	612	130	.	130	*	1	1	130	1	131	0.21
1990	939	277	.	277	*	6	6	277	6	283	0.30
1991	977	251	.	251	*	2	2	251	2	253	0.26
1992	666	211	12	223	*	20	20	211	32	243	0.36
1993	678	173	0	173	*	17	17	173	17	190	0.28
1994	615	128	8	136	*	32	32	128	40	168	0.27
1995	.	.	.	.	*	.	.	.	.	.	.
1996	.	.	.	.	*	.	.	.	.	.	.
1997	.	0	258	258	*	58	58	0	316	316	.
84-89 \bar{X}	774.2	233.3	.	233.3	.	2.8	3.5	234.5	2.8	236.8	0.31
95% CL	185.9	78.4	.	78.4	.	3.2	3.0	80.3	3.2	81.0	0.10
N	6	6	0	6	0	5	6	6	5	6	6
86-91 \bar{X}	816.5	216.7	.	216.7	.	13.0	2.7	216.7	16.3	219.3	0.27
95% CL	150.7	57.9	.	57.9	.	12.8	2.5	57.9	17.3	59.5	0.03
N	6	6	0	6	0	6	6	6	6	6	6
92-96 \bar{X}	653.0	170.7	6.7	177.3	.	23.0	23.0	170.7	29.7	200.3	0.31
95% CL	83.1	103.2	15.2	108.5	.	19.7	19.7	103.2	29.0	95.8	0.13
N	3	3	3	3	0	3	3	3	3	3	3

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985-1997 AND ON RETAINED FISH ONLY PRIOR TO 1985.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.