Relative abundance of juvenile Atlantic salmon (*Salmo salar*) and other fishes in rivers of southeastern New Brunswick, from electrofishing surveys 1974 to 2003

Gary Atkinson

Fisheries and Oceans Canada
Gulf Region
Oceans and Science Branch
Diadromous Fish Section
P.O. Box 5030, Moncton, NB
E1C 9B6

2004

Canadian Technical Report of Fisheries and Aquatic Sciences 2537

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Cat. No. Fs. 97-6/2537E ISSN 0706-6457

Correct citation for this publication:

Atkinson, G. 2004. Relative abundance of juvenile Atlantic salmon (*Salmo salar*) and other fishes in rivers of southeastern New Brunswick, from electrofishing surveys 1974 to 2003. Can. Tech. Rep. Fish. Aquat. Sci. 2537: viii + 57 p.

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In southeastern New Brunswick, from the Miramichi River to the Nova Scotia border, numerous short, shallow, low gradient streams provide limited areas of less-than-ideal spawning and rearing habitat for Atlantic salmon. In 1974 a spot-check electrofishing survey of 22 rivers in the region produced catches of juvenile salmon in 14. Among these, the Kouchibouguac, Kouchibouguacis, Richibucto, Coal Branch, Buctouche and Cocagne rivers were considered to have the greatest production potential, and were sampled quantitatively in various subsequent years up to 2003. Fry densities generally were found to be well below Elson's (1967) 'normal' value of 29 per sq. m, except in the Kouchibouguac River where higher quality substrate probably contributes to higher abundance. Percent habitat saturation (PHS) values for the six largest rivers were consistently well below the reference level of 27%. In the Buctouche River, egg-to-fry survival was found to be low (~9%) and appears to constrain juvenile production. This is likely the case for most other rivers; however, survival to subsequent stages in all rivers was good (~45%), with parr densities commensurate with initial fry levels despite several factors which may negatively impact survival. Judged from fry abundance generally, and adult assessments on the Buctouche (used as a regional index river) in particular, spawning success in southeastern New Brunswick rivers varies considerably spatially and temporally, with egg depositions in most rivers infrequently meeting the present conservation requirement for Maritime rivers. That notwithstanding, juvenile densities in the past three decades have been at least stable, if erratic, demonstrating no significant trend. Higher densities in recent years, particularly on the Richibucto and Buctouche, may be influenced by the closure in 1998 of all salmon harvesting in Northumberland Strait rivers south of the Miramichi. The abundance of species other than salmon, as determined from catch per unit area, was essentially unchanged over the period sampled, excepting sea lamprey (ammocoetes), which have become apparent in electrofishing samples in southeastern New Brunswick rivers since the mid 1990's.

Key words: Atlantic salmon, electrofishing, juvenile abundance, survival, New Brunswick

Résumé

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Dans le sud-est du Nouveau-Brunswick, depuis la rivière Miramichi jusqu'à la frontière de la Nouvelle-Écosse, de nombreux petits cours d'eau peu profonds et à faible pente offrent des habitats de fraie et d'alevinage du saumon atlantique dont la superficie est restreinte et dont la qualité n'est pas idéale. En 1974, lors d'un relevé ponctuel de pêche électrique dans 22 rivières de la région, des saumons juvéniles ont été capturés dans 14 d'entre elles. Parmi celles-ci, les rivières Kouchibouguac, Kouchibouguacis, Richibouctou, Coal Branch, Buctouche et Cocagne, considérées comme présentant le plus grand potentiel de production, ont fait l'objet d'un échantillonnage quantitatif à plusieurs années par la suite. En général, les densités d'alevins étaient inférieures à la valeur « normale » de 29 individus par mètre carré établie par Elson (1967), sauf dans la rivière Kouchibouguac, où la haute qualité du substrat contribue sans doute à l'abondance plus élevée. Les valeurs de pourcentage de saturation de l'habitat pour les six plus grandes rivières étaient toujours inférieures au niveau référence de 27 %. Dans la rivière Buctouche, le taux de survie des œufs de saumons jusqu'au stade d'alevin était faible (~ 9 %), et il semble restreindre la production de juvéniles. Cela est sans doute le cas dans la plupart des autres rivières. Par contre, la survie des alevins jusqu'aux stades ultérieurs était bonne (~45 %) dans toutes les rivières, les densités de tacons étant proportionnelles aux abondances initiales d'alevins malgré plusieurs facteurs qui peuvent nuire à la survie. Jugé selon l'abondance des alevins en général et celle des adultes dans la rivière Buctouche (qui sert de rivière indicatrice régionale) en particulier, le succès de la fraie dans les rivières du sud-est du Nouveau-Brunswick varie considérablement dans l'espace et dans le temps, et la ponte dans la plupart des rivières atteint rarement l'impératif de conservation actuel pour les rivières des Maritimes. Malgré cela, depuis trois décennies, les densités de juvéniles sont au moins stables, même si elles sont erratiques, et elles ne présentent aucune tendance significative. Décrétée en 1998, l'interdiction de toute pêche au saumon dans les rivières se jetant dans le détroit de Northumberland au sud de la rivière Miramichi pourrait avoir entraîner une hausse des densités depuis quelques années, en particulier dans les rivières Richibouctou et Buctouche. L'abondance d'espèces autres que le saumon, telle que déterminée par les captures par unité de superficie, n'a pratiquement pas varié durant la période d'échantillonnage, à l'exception des ammocètes de lamproie marine, qui sont apparus dans les échantillons de pêche électrique dans les rivières du sud-est du Nouveau-Brunswick depuis le milieu des années 1990.

Mots clés : saumon atlantique, pêche électrique, abondance des juvéniles, survie, Nouveau-Brunswick

Introduction

From the mouth of the Miramichi River south to the Nova Scotia border, New Brunswick has many small, north-east flowing rivers which drain the low coastal forest bordering Northumberland Strait. These are all typically short, shallow, low gradient streams flowing into large, shallow estuaries that extend well inland. Despite the lack of slope, the majority have extensive areas of hard coarse substrate which provides habitat of widely varying quality for spawning and rearing of Atlantic salmon (*Salmo salar* L.), which ascend most of these rivers from late September through early November.

In 1974 the Department of Environment - Fisheries and Marine Service, currently the Department of Fisheries and Oceans (DFO) conducted a non-quantitative spot-check electrofishing survey to determine the extent of juvenile Atlantic salmon populations in southeastern New Brunswick rivers. Of approximately 200 sites on 32 rivers which were visually assessed as potential salmon habitat, a total of 92 sites on 22 rivers were ultimately selected and fished. Salmon were found in 14 of these rivers. Subsequent electrofishing, conducted quantitatively in varying years up to 2003, was focused on the Kouchibouguac, Kouchibougacis, Richibucto, Coal Branch, Buctouche and Cocagne rivers. These were assessed as having the greatest potential for salmon production in the southeastern region of the province.

Additionally, the Buctouche served as an index river for the status of Atlantic salmon stocks in southeastern New Brunswick from 1993 to 2002 (DFO 2003). As such, the number of returning spawners was assessed up to 2000, and more electrofishing sites have been located there than on any other river. This has provided valuable information on survival from egg to succeeding juvenile stages.

This report presents abundance indices and other relevant data for all species collected in these surveys. For juvenile Atlantic salmon in particular, the results are discussed with respect to ecological factors and currently used assessment reference points. While some of the data collected from 1996 onward have been presented in some of the stock assessment documents listed elsewhere in this report, it has not been collected under one cover, and the results of surveys prior to that year have not been previously published.

Materials and Methods

Site characteristics

Location of rivers and sites, years sampled, stream orders and map references, are indicated in Table 1. Rivers are listed in north-to-south order: names and co-ordinates are as given in the Gazetteer of Canada, New Brunswick (Anon.1972). Co-ordinates for individual sites were calculated from national topographic series maps, scale 1:50,000. The general location of rivers within the province is shown in Fig. 1; individual sites on all rivers are located in Figures 2 through 5. For the 22 rivers sampled, Table 2 shows average percentages of habitat and substrate type encountered, as estimated subjectively at individual sampling sites. The habitat and substrate definitions given in the table are as used from 1996 on. Prior to that, the definition of these categories is not precisely known, consequently there may be some slight overlap.

Electrofishing and other sampling methods

In 1974, spot-check sites were conducted with a single upstream sweep using an unidentified electrofishing unit, of a length and/or duration (not recorded) deemed sufficient to determine the presence or absence of salmon juveniles. Area fished at most sites was small, averaging 96 square meters, as calculated from individual sites. The fish, collected with a dip net and hand-held seine of unspecified width, were counted but in most cases only salmon and trout were measured, after being anaesthetized with tricaine methanesulfonate (MS-222). All fish were released after recovery from the anaesthetic.

Sites fished from 1977 through 1984 were closed across the stream above and below with barrier nets, and fished with three to five downstream sweeps using a Dirigo model 500 electrofishing unit. Site area averaged 321 square meters. Fish were collected and processed as above, except that lengths were recorded for most species other than salmon, in most years. Juvenile salmon density was calculated by the Zippin (1956) removal method.

From 1996 onward, electrofishing activities in southeastern New Brunswick rivers were conducted essentially to provide an index of salmon stock status in the area, in conjunction with assessments of returning adult spawners to the Buctouche River. A Smith-Root type 11 or 12 unit was used to cover an average site area of 359 square meters. Fish were collected with a one meter wide hand-held seine and a dip net. Following anaesthetization with sodium citrate (Eno powder), all were counted and measured to the nearest millimeter (abundant species such as dace were sub-sampled in most years), and released after recovery.

In all years, a varying number of other parameters were measured at electrofishing locations, such as site dimensions, habitat and substrate composition, depth, temperature, vegetation, gradient, sweep time, *etc*. All nets used to collect fish were constructed of 3/16 inch (4.8 mm) woven nylon mesh. Prior to 1996 this was designated as Delta mesh; from 1996 on as Ace mesh.

To maximize the number of rivers/sites surveyed with minimal time and resources (1996 on), the following approach was adopted. From one to four closed sites were fished annually between 1996 and 2001 on the Buctouche River, in which an initial upstream sweep was followed by three or more downstream sweeps. A population size was calculated (Zippin method) on the downstream sweeps, and then the upsweep count was added to derive total population and subsequently density at the site. A linear regression equation (1a, b, below) for each of fry and total parr was later calculated, describing the relationship between density calculated for the site, and the catch-per-unit-effort (cpue) from the upstream sweep. This then permitted predicting approximate density from a single upstream sweep of a site, saving considerable time and allowing broader coverage. An appropriate unit of effort for these rivers, where juvenile salmon populations were typically low, was found to be 15 minutes (900 seconds) of electrofisher 'on' time. On average, this covered about 300 square meters of stream habitat. While time and area covered are obviously correlated, in conducting such a method in the field, it is clearly more convenient to fish for a predetermined amount of time, than to measure out a minimum area.

These data were also used to provide equations (2a, b, below) for density versus catch-per-unit-area (cpua), which is here used to convert catch to density where sweep time was not recorded, such as the spot-checks in 1974, and infrequent cases where catch sequences at closed sites could not be used in Zippin calculations. For cpua, it is convenient to express results per 100 square meters, the convention for expressing density (also referred to as a 'unit' of habitat).

A total of thirteen sites were used in these calculations: more had been anticipated, but water conditions during the available sampling time in years subsequent to 2001 precluded this. Only nine of the thirteen sites were used to obtain regression equations for parr. The excluded sites were done in discoloured water conditions, which was observed to significantly affect the catchability of parr, but not of fry. The later, on being shocked, normally tumble straight downstream into the large seine. Parr frequently flee the shock and are captured individually by a dipnetter; lowered visibility in turbid water results in the loss of many parr that would otherwise be caught.

These equations are as follows:

Based on cpue:

1a: Fry density (# per 100 sq. m) = 900 sec catch x 0.9605 + 0.135
(r^2=0.94, p<0.0001, n=13)

1b: Parr density (# per 100 sq. m) = 900 sec catch x 0.5878 + 6.616
(r^2=0.68, p=0.0061, n=9)

Based on cpua:

2a: Fry density (# per 100 sq. m) = 100 sq. m catch x 2.6401 + 0.0477
(r^2=0.98, p<0.0001, n=13)

2b: Parr density (# per 100 sq. m) = 100 sq. m catch x 1.2005 + 8.3852
(r^2=0.60, p=0.0139, n=9)

Although highly significant, the relationships for parr are less reliable predictors of density than those for fry. Also, intercept values imply that when no fish were caught, there were nonetheless 7 (cpue) or 8 (cpua) parr present, per 100 square meters. Since it can never be presumed that all fish on a site will be captured, it is therefore to be expected that some fish would be present even if none were caught. The higher intercept values for parr than fry derive from the lower catchability of parr, and low abundance generally in the rivers sampled, where 'escapees' may represent a higher proportion of the population than at high density sites. Where catches of parr at cpue sites (1996-2003) were zero and no fish were observed to have escaped, this was felt to be an overestimate. Consequently in such rare instances (3 only), the equations have not been applied and parr densities have been considered '0' at these sites. It is cautioned that the application of the above regressions is appropriate only where the electrofishing technique is identical to that used here to generate them, and as used on the cpue sites. Those wishing to employ the method should conduct similar calibrations.

A measure of habitat utilization by salmonids, known as percent habitat saturation (PHS), was developed by Grant and Kramer (1990) and is a function of the density of fish and their average size. A total (fry + parr) PHS value around 27 is considered a useful reference point, since above this there is a greater than 50% chance that density dependant responses will occur in the population. These values have been calculated for the Kouchibouguac, Kouchibouguacis, Richibucto, Coal Branch, Buctouche and Cocagne rivers.

Estimates of returning spawners and the resultant egg depositions used to obtain egg-to-fry survival rates for the Buctouche River are based on assessments

carried out in 1993-2000, methods for which are detailed in: Atkinson and Claytor (1994), Atkinson *et al*. (1995), Atkinson and Chaput (1996), Atkinson *et al.* (1997, 1998, 1999, 2000), and Atkinson and Peters (2001).

Continuous temperature recordings were made in the Buctouche River in 2000 and 2001 using Vemco Minilog-12T recorders (Vemco Ltd., Shad Bay, Nova Scotia).

Data presentation

Since the focus of electrofishing surveys has been on Atlantic salmon, other species have typically been recorded as general categories such as “dace”, “stickleback”, etc. Table 3 indicates these designations as used in this report, and lists the species, in order of frequency of occurrence, which have been included in each. Identifications were made with the aid of Scott and Crossman (various editions, 1998 most recent). With the exception of rare occurrences of brown bullhead (*Ictalurus nebulosus*) and mummichog (*Fundulus diaphanous*), all other fish listed were generally widespread and frequently caught.

The varying methodologies used in these surveys render the presentation of results in a single, concise, comparable format rather difficult. Density estimates for Atlantic salmon juveniles are given at all sites and years. For 1974 spot-check sites, these are predicted from cpua as described above, using formulas 2a and b. For the years 1977 through 1982, density has been calculated by the Zippin (1956) removal method for most sites. In rare instances where catch sequences would not function in the Zippin equations, density was predicted from cpua**.** From 1996 onward, estimates have been obtained from cpue using formulas 1a and b, except for the closed sites which were derived as per Zippin. In all cases for parr, a total value was initially computed, and then partitioned into large and small parr based on proportion in the catch. Where density values differ between this report and those presented in previous documents, this is due to minor length differences used for juvenile category definitions and/or the use here of fixed regression equations for predicting density from cpue. Formerly, equations were adjusted annually as new data points were accumulated. Thus, the information presented here is meant to correct and update all previously published data: such changes, however, have been few and minor.

Since site areas were measured in almost all instances (for several in 1974 an average of site areas was used as an approximation), catch per 100 square meters (cpua) is given for all species at all sites and years. Additionally, for sites done from 1996 on, catch per 900 seconds (cpue) is presented, since this was the basis for the generation of equations to convert catch to density for salmon. These two abundance indices also provide a simple and convenient way to compare results with other surveys which may not lend themselves to estimating density. In all cases, catch per unit area/effort values have been obtained from

the initial sweep over the site. As well, cpua and cpue have been totalled for all years sampled to provide an overall index of relative abundance among species.

Contrary to convention, all density and catch values have been rounded to the nearest whole number, since fractions of fish are seldom encountered swimming around in rivers: this also allows values to be more easily compared. For this reason, the total parr value for a given site in the density tables may not exactly equal the sum of respective small plus large parr values. Where a site listed in Table 1 does not appear in density and catch tables for a given river, there were no fish caught. This was the case at Black R. site 4, and Kouchibouguac R. site 11.

Mean lengths of all measured fish are tabled, representing forklength in millimeters for all species except sculpin, catfish and mummichog, where total length is measured, since these species have rounded caudal fins. Where sample size was sufficient, length frequency histograms for juvenile salmon have been prepared, which, in combination with the available aged scale samples, provide a rationale for the selection of size/age groups (*i.*e. fry, large and small parr, see below). Since sites on a given river were very similar in gradient, habitat type, substrate composition, and generally had low abundance of juveniles, all sites for each year sampled have been combined to obtain mean length, and length frequency plots. For the Black and Kouchibouguacis rivers, all sites in all years have been combined due to small individual sample sizes.

Herein, juvenile salmon have been designated as follows, based on length, and supported by length frequency and ageing data (see below), which were found to be similar among rivers at a given time of year. Surveys were usually conducted in August to early September, occasionally in late September to early October.

Fry (age 0+): up to and including 71 mm (75 mm in years fished late)

Small Parr (age 1+): 72-113 mm (76-120 in years fished late)

Large Parr (age 2+): 114 mm and larger (121+ in years fished late)

For juvenile Atlantic salmon, the density, catch and length data presented in this report refer to wild fish only, except in the instance noted below regarding stocking of hatchery-reared unmarked fry in 1998. Stocking of hatchery-reared marked (adipose-clipped) fall fingerlings occurred in the Buctouche River in 1978-79 and 1996-97 as an attempt to enhance adult stocks, the details and results of which are contained in the assessment documents referred to above.

Results

River, habitat, substrate and temperature characteristics

The Kouchibouguac, Kouchibouguacis, Richibucto system, Buctouche, and Cocagne rivers have been considered the most significant salmon producing rivers in the southeast (see accessible rearing area, Table 2), and electrofishing surveys have been concentrated there. All southeastern New Brunswick rivers are relatively small systems, the largest having lower main stem stream orders of only 4 (Table 1), compared with 6 or 7 for rivers such as the Miramichi (Dave Moore, DFO Moncton, pers. com). They typically extend about 30 km inland, have low gradients of around 0.25%, shallow summer depths averaging about 20 cm at the sites sampled, and very few deep pools in the stretches observed.

Since the stretches actually electrofished were generally selected by eye as optimum for juvenile salmon, it is no surprise that at these sites riffle (48%) and run (27%) habitat dominate, together accounting for 75% of the average total. Pools (19%) were more significant on the smaller, brushy streams than on the larger ones, while flats (7%) were the least prominent habitat type, occurring mainly in the longer stretches fished on larger rivers. Cobble was the single outstanding dominant substrate type, accounting for 17%-73% of individual rivers and making up 51% of the total average. Of 22 rivers, 13 had cobble composing 50% or more of the substrate. Fine sediment, rock and pebble were about equal at 14%, 11% and 12% respectively, while sand (9%), gravel (2%), bedrock (2%) and boulder (0%) were progressively less important components (Table 2).

Summer water temperature, recorded only in the Buctouche River in 2000 and 2001, routinely exceeded 22^0C, frequently exceeded 28^0C, and occasionally reached 31^0C (Fig. 6).

Density, catch and length data

<u>Rivers surveyed in 1974 only</u>

Juvenile salmon density, cpua and mean length of measured fish for 11 rivers surveyed only in 1974 are shown in Tables 4, 5 and 6, respectively. Results from other rivers in the 1974 spot-check survey which were sampled in subsequent years (Black, Kouchibouguac, Kouchibouguacis, Richibucto system, Buctouche, Cocagne), are presented with data from all years in the individual river sections following. Atlantic salmon were caught in 14 (64%) of the total 22 rivers electrofished in 1974, but among the 11 rivers sampled exclusively in 1974 (Table 5), salmon were caught in only four: Aldouane (also called St. Charles, one of seven rivers in the Richibucto system), Chockpish, Scoudouc and Kouchibouguac (Westmorland Co.). No fry were found in these four, and total parr density ranged from 9 to 23 per unit. Mean length of small parr ranged from

95 to 118 mm, and large parr from 123 to 133 mm. Salmon were not caught in Rankin Brook, Gaspereau Creek, Little Buctouche R., Howard Brook, Shediac R., Tedish R., or Rayworth Brook. Trout, sculpin and dace were the most numerous other species caught. Brook trout was also the most consistently caught species, occurring in 14 (56%) of 25 sites and all rivers except Little Buctouche and Scoudouc. These are small, brushy rivers (stream order 1-3), with better cover and probably more favourable temperatures for trout than the main stems of the larger rivers. Lamprey (ammocoetes) and shiner were not reported from any of the 11 rivers.

Black River

The Black River was sampled in only two years, 1974 when only trout were caught in the spot-check survey, and again in 1984. Salmon density, cpua and cpue for all species, and mean length are given in Table 7, salmon length frequency in Fig. 7. In 1984 mean density of fry and parr was 20 and 12 respectively. Mean length of fry and small parr (no large parr were caught) was 50 and 86 mm, respectively. Trout was the only other numerous species caught, while mummichog were caught in this river only. Chub, dace, lamprey, sculpin, shiner and sucker were not caught in either of the two years sampled, though most occur commonly in other rivers.

Kouchibouguac River

Salmon density (Table 8) and length frequency (Fig. 8), cpua (Table 9) and cpue (Table 10) for all species, and mean length for all species (Table 11) are presented for the eight years sampled between 1974 and 2002. Overall annual mean fry density was 40 (range 0-116), and total parr 20 (6-36) per unit. Mean length (N=2 or more) range for fry and small and large parr was 52-72, 92-104, and 118-128 mm, respectively. Salmon, dace and sculpin had the highest total cpua values. Catches of trout were consistent through the years (66% of all samplings), but were highest in the smaller tributary brooks. Chub and shiner were not caught in any year, and lamprey were not recorded prior to 1999.

Kouchibouguacis River

Salmon density (Table 12) and length frequency (Fig. 9), cpua (Table 13) and cpue (Table 14) for all species, and mean length for all species (Table 15) are presented for the five years sampled between 1974 and 2003. This was the only river in southeastern New Brunswick that was electrofished in 2003. Overall annual mean fry density was 7 (range 2-14), and total parr 11 (9-13) per unit. Mean length (n=2 or more) range for fry and small and large parr was 52-58, 88-104, and 118-129 mm. Dace and salmon had the highest total cpua values, trout were noticeable by their absence after 1974, and sculpin and stickleback were not captured in any year.

Richibucto River system

Salmon density (Table 16) and length frequency (Figs. 10, 11), cpua (Table 17) and cpue (Table 18) for all species, and mean length for all species (Table 19) are presented for the nine years sampled between 1974 and 2002. The Richibucto River proper is only one of seven individual rivers which empty into a common estuary bearing that name (Fig. 4). The following rivers in this system have been sampled, designated in the tables with a letter prefix to site numbers (here in brackets): (A) Aldouane (St. Charles) R., considered above; (B) Bass R.; (C) Coal Branch; (H) Hudson Brook; (M) Molus R.; (N) St. Nicholas R.; (R) Richibucto R.; and (T) Trout Brook. Hudson Brook is a tributary to the Richibucto River; the others all have their own estuaries. While salmon were found in all rivers except the Molus in the 1974 survey, Richibucto and Coal Branch are the two largest rivers in the system and the only ones that consistently had populations of juvenile salmon: they were the only rivers electrofished from 1997-2002. For Coal Branch, overall annual mean fry density was 9 (range 1-33), and total parr 13 (4-22) per unit. Mean length range for fry and small and large parr was 47-69, 89-101, and 118-127 mm. For Richibucto, overall annual mean fry density was 23 (range 1-58), and total parr 14 (6-20) per unit. Although mean fry density in Coal Branch was less than half that in Richibucto, parr density was nearly the same. Mean length range for fry and small and large parr was 51-70, 94-106, and 115-135 mm. Highest total cpua values were for dace, salmon and sculpin; lamprey were not encountered before 1997. The St. Nicholas River sites were notable for having the largest catches of sculpin and trout, both of which prefer colder water than other the species, which were less numerous at these sites. Trout were rarely caught in Coal Branch or the Richibucto.

Buctouche River

Salmon density (Table 20) and length frequency (Fig. 12), cpua (Table 21) and cpue (Table 22) for all species, and mean length for all species (Table 23) are presented for the fifteen years sampled between 1974 and 2002. South Branch is the most significant tributary of the Buctouche, itself having nearly half the habitat area of the main stem, and worthy of separate consideration. Other tributaries are small brushy brooks, frequently dammed by beavers, and not consistently sampled for that reason. Trout Brook and Mill Creek are not tributary to the Buctouche proper, but drain into the common estuary (Fig. 5). For South Branch, overall annual mean fry density was 19 (range 0-80), and total parr 15 (5-34) per unit. For the main Buctouche including minor tributaries, overall annual mean fry density was 8 (range 0-28), and total parr 9 (3-24) per unit. These values are respectively 42% and 60% of South Branch densities. All sites combined had an annual mean fry density of 11 (0-43), and for total parr 11 (6-27). Average values for fry (1998), small parr (1999) and large parr (2000) have been adjusted for the stocking of unmarked hatchery fry at a density of 14.6 per unit in the main stem in June 1988, assuming a 50% survival rate until sampling in September of that

year, and similarly for survival to small parr in 1999 and then to large parr in 2000 (see Atkinson *et al.* 1999). Mean length range (main plus South Branch) for fry and small and large parr was 47-60, 87-101, and 121-131 mm. Highest total cpua values were for dace, salmon and chub. Before 1996, lamprey were recorded only in 1978, at a single site. Trout were rarely found in the Buctouche, the largest catch occurring in the single sampling of Trout Brook (1996). Sculpin, as elsewhere, were most common in the smaller, cooler brooks (Trout, Yankee, Mill Creek). This was the only river fished in southeastern New Brunswick where brown bullhead (catfish) were caught.

Cocagne River

Salmon density (Table 24) and length frequency (Fig. 13), cpua (Table 25) and cpue (Table 26) for all species, and mean length for all species (Table 27) are presented for the five years sampled between 1974 and 2002. Overall annual mean fry density was 20 (range 0-68), and total parr 20 (13-27) per unit. Mean length range for fry and small and large parr was 50-62, 85-103, and 120-131 mm. Dace, salmon and sucker had the highest total cpua values, and trout were found in low numbers at all three sites. No lamprey were captured in any year.

Age Data

All age determinations made for juvenile salmon from southeastern New Brunswick rivers are detailed in Table 28. Though these data are scant, the length/age similarity among them is notable, and supports the juvenile salmon definitions presented above.

Discussion

The preferred substrate composition of spawning Atlantic salmon does not appear to be well defined, and probably depends to some extent on what is available in a given river. For example, Belding (1934) stated that 2-8 inches (51-203 mm) was the most suitable substrate in Canadian rivers, and Peterson (1978) indicates that in southwestern New Brunswick rivers, typical spawning gravel was composed of 40-60% cobble (22.2-256 mm); 40-50% pebble (2.2-22.2 mm); 10-15% coarse sand (0.5-2.2 mm); and 0-3% fine sand (0.06-0.5 mm). Crisp and Carling (1989) give a finer preferred range of 20-30 mm, from various rivers in Britain. These values essentially span the gravel, pebble and cobble categories used here (Table 2), with the inference that the upper end of the latter is probably somewhat too coarse for spawning. As observed at southeastern New Brunswick electrofishing sites, cobble is consistently at the coarse end of the spectrum, gravel is scarce (2%), and pebble content is quite variable but generally low (12%). Symons and Heland (1978) stated that in the Northwest Miramichi, fry (age 0+) prefer substrate sizes between 16 and 64 mm, and parr (age 1+ and older) prefer particles 260 mm and up. These ranges correspond respectively to the pebble and rock designations in the present report, both of which constitute low average percentages (12% and 11%) of the substrate at sampled sites. Additionally, if the Buctouche can be taken as representative of this group of rivers, the proportion of total habitat rated as “fair” to “good” riffle and run (excludes pool, flats, “poor” riffle, bedrock), is only 63% (New Brunswick Department of Natural Resources and Energy database). The conclusion drawn from the above is that in general, the rivers in southeastern New Brunswick are somewhat marginal for Atlantic salmon, containing limited amounts of inferior spawning substrate and rearing habitat that is too coarse for fry, but reasonably well suited to parr.

The densities of juveniles in the rivers sampled tend to confirm this. Reference values commonly used in salmon assessment work were derived by Elson (1967) as “normal” densities for fry and total parr at Miramichi River sites which were unaffected by DDT spraying to control spruce budworm. These densities were 29 fry and 38 total parr per 100 square meters of habitat. However, results from more recent (1994-2003) work on the Miramichi give mean fry and parr densities of 84 and 36 per unit, respectively (Dave Moore, DFO Moncton, pers. com.). While the parr values are similar, Elson’s fry value is believed to be low due to loss through his barrier nets which were constructed of much coarser mesh than is currently used. Annual mean fry and parr densities for the six principal rivers considered here clearly show that, excepting the Kouchibouguac and Richibucto, the Elson norms were rarely achieved for fry, and never have been for parr (Figs. 14, 15, upper panels). None of the sampled southeastern New Brunswick rivers has had juvenile densities even approaching average Miramichi values. Kouchibouguac and Richibucto had consistently higher fry densities than other rivers, achieving Elson,s norm about a third of the time, and

more frequently in recent years. As expected, they also sustained consistently higher parr densities. It is worth noting that of all rivers, the Kouchibouguac has the highest proportion of pebble substrate (33%, Table 2), the preferred habitat of fry, and which provides a more ideal blend for spawning, as per Peterson (1978). The other rivers show quite variable juvenile densities, consistently well below the reference levels. Fry densities compared among rivers for individual years seldom showed similar trends: some had good years while others experienced poor ones (Fig. 14, lower panel). Parr densities mimicked this pattern, but were not quite as variable (Fig. 15, lower panel). Synchrony nearly occurred in 2000, when all rivers except Kouchibouguacis had mean fry levels in excess of the Elson norm, presumably reflecting improved spawning success the previous fall. This was confirmed for the Buctouche at least, where egg deposition in 1999 was triple the previous year and the only one of eight assessed years when the egg conservation requirement was estimated to have been achieved (Atkinson *et al*. 2000). The high fry levels in 2000 translated into the highest overall parr levels in 2001, of any year in the series. By contrast, 2001 was one of the poorest fry years for all but Kouchibouguac and Richibucto. This was noteworthy for the Buctouche, since although egg deposition in 2000 was the third lowest among assessed years, 25% of the eggs (and fry in 2001) were directly attributable to returns from previous stocking: without these fish, it would have been the worst year on record (Atkinson and Peters 2001). Fry abundance was much improved in 2002 over 2001, but not up to the unprecedented level seen in 2000, and parr were high in 2002 due to survival of large numbers of small parr from the year before. In all rivers, fry densities suggested a weak upward trend with time, but none was found to be significant at the 0.05 level. The closest to significance was the Richibucto (r^2=0.41, p=0.09, n=8). Similarly, parr densities were positively correlated with year, but showed no significant trend. Juvenile Atlantic salmon abundance in southeastern New Brunswick rivers, while quite volatile both spatially and temporally, has thus remained at least stable over the period sampled. Apparent improvement in juvenile abundance in recent years may in part be due to the closure in 1998 of all Northumberland Strait rivers from Miramichi south to the Nova Scotia border to harvesting of adult Atlantic salmon, as a conservation measure (see assessment documents referred to above). This may be especially significant for the Richibucto and Buctouche rivers, which up to then had been subject to a First Nation fishery in addition to recreational angling.

Total PHS values for individual sites in six southeastern NB rivers sometimes achieved the reference value of 27 (most frequently in Kouchibouguac), but rarely exceeded it (Table 29). Annual mean values were significantly below 27 for all rivers and overall means ranged from a high of 20 for Kouchibouguac to a low of 10 for Kouchibouguacis and Buctouche. For comparison, the average of annual mean PHS values on the Miramichi system from 1994-2003, was 28 (Dave Moore, DFO Moncton, pers. com.). Paralleling densities, the highest PHS levels were observed in all rivers in more recent years. Thus, competition

resulting from overcrowding would seldom appear to be a consideration in these rivers.

Survival rates from egg through the various juvenile stages significantly affect abundance. For the Buctouche River, assessments of returning adults and resultant egg depositions (Table 30) permit estimating survival rates from egg to fry. Annual survival rates from 1996 through 2001 vary from 4-18%, with a mean of 9% (Table 31). This survival rate is probably an overestimate, since it assumes all habitat to be of equal rearing value. If, as indicated above, only 63% of the total is suitable, survival may in fact be as low as 6%. Symons (1979) considered 9% to be a low, and 13% a medium, survival rate. For comparison, the mean fry density of 84 per unit from recent Miramichi investigations represents a relatively high survival rate of 35% (Dave Moore, DFO Moncton, pers. com.). It is interesting to note that the highest survival rate (18% in 2000) observed for the Buctouche followed the only year (1999) that the egg conservation requirement was estimated to have been met (Table 30). This may not have been entirely fortuitous, since a significant positive relationship was found between egg deposition rate in one year and survival rate to fry in the next (r^2=0.67, p=0.046, n=6). However, the data are too scant to draw meaningful conclusions. For comparison, mean egg to fry survival rates in the Miramichi range from 18-65% with a mean around 35%, within an egg deposition range of about 2-3 per unit (Dave Moore, DFO Moncton, pers. com.). Low egg-to-fry survival in the Buctouche is thought to result from the physical characteristics of the river combined with the probable effects of land use practices. Extensive cutting in the watershed appears to have resulted in erratic and extreme flows, with notably low winter and summer levels, and violent spates following less than unusual rainfall amounts. The general shallowness of the Buctouche combined with low winter flows promotes the formation of anchor ice and complete ice cover, the two possibly becoming continuous in many places by late winter. The former lowers water temperature and circulation within the gravel, and both, powered by rapid spring runoff, must result in some scouring of redds. In Catamaran Brook, a small tributary (stream order 3) of the Little Southwest Miramichi, ice scouring of redds in a high water spring runoff event resulted in the lowest egg to fry survival rate (9.2%) observed in the period from 1990 to 1995 (Cunjak *et al*. 1998). How typical low egg survival is of the other rivers under consideration is not known, but physical characteristics are at least very similar in all, and extensive timber harvesting is manifest in the entire area, more so in recent years.

Calculation of survival rates from fry to small parr generally produced spurious results (*i.e*. >100%) when initial fry densities were 10 per unit or less. Excluding these data, mean rates among rivers varied from 37-65% with an overall mean of 53% (Table 32). Deriving small to large parr survival requires adjusting large parr densities for the fish that left in a given year as smolts. On average, 44% of Buctouche parr leave as age 2+ smolts (Atkinson 2001), the remainder representing 56% of the population. Accounting for this gives survival estimates from small to large parr ranging from 32-48% with an overall mean of 41%,

assuming similar biological characteristics among rivers. Such rates were considered by Symons (1979) to be high (fry-small parr) and medium (small-large parr). For the Miramichi (1994-2003), fry to small parr and small to large parr survivals were about 32% and 67% respectively, assuming that on average, 50% of large parr leave in a given year as smolts (Dave Moore, DFO Moncton, in prep.). Survival rates on the Buctouche appear reasonable considering the elevated temperatures, exacerbated by low summer flows, to which these rivers may often be subjected, if the Buctouche is typical (Fig. 6). Lund *et al*. (2002) researched physiological heat shock responses in young salmon, and reviewed other temperature reference points which have been published in the literature. Juvenile Atlantic salmon have a preferred temperature range of 6 to 19^0C and demonstrate maximum growth between 16^0 and 19^0. At 22^0 they cease feeding, and between this and 25^0 they show physiological heat shock responses and behavioural changes such as seeking refuge. Trout mortality becomes significant within this latter range. Salmon can tolerate 27-28^0 but begin dying above this, and 32^0 C is almost invariably lethal. On the Buctouche at least, 22^0C is routinely exceeded (50 days in 2000, 82 in 2001, on the main stem), and 28^0+ is not uncommon (23 days in 2000, Fig. 6). Maximum temperatures have reached 31^0C. This may explain why brook trout were rarely encountered in the main stems of these rivers, and although extensive fish kills have not been reported at such times, some otherwise unaccountable mortality of young salmon was occasionally noted by electrofishing crews and others. As well, Cunjak (1996) has noted the displacement of salmonids and other stream fishes from preferred habitats due to sedimentation resulting from land use practices and the extensive formation of ice in winter, which could negatively impact on survival. However, it is worth noting that age 2+ parr in all these rivers are uniformly large (125 mm mean length, maximum 173 mm) and apparently well-conditioned fish. Good parr survival is most likely related to the fact that, as noted earlier, the coarseness of the substrate appears most amenable to this juvenile stage.

It would thus appear that low egg-to-fry survival may be constraining juvenile salmon abundance in southeastern New Brunswick rivers, but survival to parr stages does not seem to be a problem. Elson's (1967) 'normal' fry density of 29 per unit is a useful reference point, in that it represents a medium survival (12%) of 240 eggs per unit (2.4 per sq. m), the current egg conservation requirement used for Maritime rivers (Anon. 1991). When compared with annual mean fry densities taken over an adequate number of sites (suggested, 5-10), it provides a means to quickly assess whether the egg requirement was likely met in the previous year, in small rivers where adult assessments are not routinely conducted. By this standard (although Buctouche is the only river that meets the criterion for number of sites), the conservation requirement may have been met 38% of the time in Kouchibouguac (n=8), 0% in Kouchibouguacis (n=5), 38% in Richibucto (n=8), 12% in Coal Branch (n=8), 8% in Buctouche (n=12), and 20% in Cocagne (n=5). Considering all river/year combinations together, conservation may have been met in only 20% of the instances.

If one assumes a relatively high annual mean survival rate of 50% (Symons, 1979) to each parr stage succeeding fry, and that 50% of large parr leave in any year as age 2+ smolts (typical of Northumberland Strait rivers), then the expected fry to total parr ratio is 1:0.6, which is very close to that observed in this study (mean, all sites 1:0.7). The ratio calculated from recent Miramichi studies, as related above, is 1:0.4. However, Elson's ratio of 'normal' fry to parr density is considerably higher at 1:1.4, which assumes exceptionally high survival rates and low emigration of age 2+ parr as smolts. It is therefore suggested that relative to 29 fry, 38 parr is not a realistic number (17 would be more nearly 'normal'), and that the parr densities observed in southeastern New Brunswick rivers are in fact quite good with respect to the initial fry densities which generated them.

Considering species other than salmon, which tend to be overlooked when the focus of a study concentrates on a single species, annual mean catch per unit area for all rivers (Table 33) showed no systematic increase or decrease over time. Catches have varied somewhat, as might be expected in natural systems sampled under differing yearly conditions, but exhibited no significant (0.05 level) trends. Blacknose dace were the most abundant fish in all rivers, followed by juvenile salmon, except in the Kouchibouguac where the reverse was true. Overall mean annual cpua for dace apparently increases in a north-south cline, the Cocagne catch being three times that in the Kouchibouguac. Lampreys, encountered almost exclusively as ammocoetes in electrofishing surveys, were very rare in all rivers prior to the mid 1990's, and while trout and sculpin may appear to have been more numerous in the earlier years sampled, particularly in the Kouchibouguac and Buctouche, this was probably due to more sites fished in smaller, colder tributaries (stream orders 1-3) than in more recent years. Reduced sampling in small tributaries in recent years was the result of extensive beaver activity, where numerous dams rendered small brooks largely impracticable to electrofish. It is well known that under appropriate water conditions both juvenile and adult salmon can surmount, circumvent or penetrate beaver dams, and that generally the benefits of the latter outweigh the negative effects (Collen and Gibson 2001). However, in the small streams in this study, it has frequently been observed that for varying periods of time, flooding by beavers occludes spawning habitat which is at a premium on these rivers.

In summary, the small rivers of southeastern New Brunswick provide marginal habitat for Atlantic salmon, having limited quantities of less-than-ideal spawning and rearing habitat, and summer temperature regimes that appear to threaten juvenile survival. Salmon were found in varying abundance in 64% of rivers initially sampled, but only six were subsequently considered to have the potential for significant production. In these, fry densities were generally below the reference level and it is inferred that spawning success does not normally meet currently defined conservation requirements in most rivers. Egg to fry survival is apparently low and probably a constraint to production, but subsequent survival is good. Despite this, juvenile salmon density as well as other species'

abundance has remained essentially stable over the period sampled. In the shadow of increased habitat degradation and the predictions that the effects of global warming will result in loss of juvenile Atlantic salmon habitat in Canada (Minns *et al*. 1995), these already stressed rivers of southeastern New Brunswick, though apparently resilient, seem to face an uncertain future as producers of *Salmo salar*.

Acknowledgements

We thank the Southeastern Anglers Association, the Richibucto River Association, and Friends of the Kouchibouguacis for providing assistance with electrofishing at various times, and the numerous DFO staff, students and interns who were also involved. Buctouche First Nation and Southeastern Anglers Association operated assessment trapnets and a counting fence, respectively, providing data on returning spawners and stock characteristics in the Buctouche River. Thanks are also extended to the following co-workers at DFO Moncton: Robert Nowlan for providing resources to computerize data, Brad Firth for preparing the site maps, and Dave Moore, Gérald Chaput, and David Cairns for their reviews of the manuscript.

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Table 1. Location of rivers and sites sampled during electrofishing surveys in southeastern New Brunswick, 1974-2003. Rivers are listed in north-to-south order; river co-ordinates as per Gazetteer of Canada, New Brunswick (Anon.1972); site co-ordinates from National Topographic Map series, scale 1:50,000. Black R. south to Cocagne R. are in Kent Co., and Shediac R. to Rayworth Brook are in Westmorland Co. New Brunswick atlas (Anon. 1998)

River	Years Sampled	Site No.	Stream Order	Stream and Descriptive Location	N Lat. Degrees	W Long. Degrees	Topographic Map	NB Atlas Page
Black River	1974,'84				46.85	64.95	21-I-14	43
		1	3	Main river	46.84	65.01		
		2	3	Main river	46.84	65.02		
		3	2	Main river	46.85	65.06		
		4	1	Main river below Rte. 11	46.85	65.12		
Rankin Brook	1974				46.83	64.98	21-I-14	43
		1	1	Main river at northern Rte. 11 crossing	46.81	65.08		
		2	2	Main river at southern Rte. 11 crossing	46.80	65.06		
Kouchibouguac River	1974,'77,'78,'82,'99-'02				46.83	64.93	21-I-14, 21-I-11	43, 50
		1	4	Main river 300m below Rte. 480	46.74	65.20		
		2	3	Main river 400m below Desherbiers Rd., near Pineau	46.70	65.32		
		3	4	Main river 150 m below mouth of Tweedie Brook	46.79	65.11		
		4	3	Tweedie Brook above confluence with main river	46.78	65.11		
		5	3	Main river below Rte. 126	46.68	65.38		
		6	4	Main river 3.2 km below mouth of McInnis Brook	46.75	65.18		
		7	4	Main river 1.6 km above Rte. 480	46.75	65.21		
		8	3	Main river below Desherbiers Rd., near Pineau	46.70	65.32		
		9	2	North Branch McInnis Brook above road	46.76	65.20		
		10	3	Tweedie Brook above road at Tweedie Brook Settlement	46.78	65.14		
		11	1	Ferris Brook above road	46.68	65.34		
		12	2	East Branch Russell Brook at Rte. 480 crossing	46.70	65.35		
		13	3	South Branch McInnis Brook above Rte. 480, N of Vautour	46.75	65.22		
		14	3	South Branch McInnis Brook below Rte. 480, in Acadieville	46.73	65.27		
		15	2	North Branch McInnis Brook below road crossing, NE of Vautour	46.76	65.24		
Kouchibouguacis River	1974,2000-'03				46.78	64.90	21-I-11	50
		1	3	Main river below Cameron's Mill crossroad	46.67	65.14		
		2	3	Main river 150 m below Rte. 126	46.60	65.34		
		3	3	Main river midway between sites 1 & 2	46.65	65.25		
		4	3	Main river 2.1 km above St-Ignace bridge, above old quarry	46.69	65.10		

Table 1. Continued.

River	Years Sampled	Site No.	Stream Order	Stream and Descriptive Location	N Lat. Degrees	W Long. Degrees	Topographic Map	NB Atlas Page
Richibucto System (7 rivers, see text)	1974,'82,'97-'02				46.70	64.85	21-I-11, 21-I-10, 21-I-06	50, 51, 57
Aldouane (St.Charles) River		A1	3	Aldouane (St. Charles) River below road	46.66	65.00		
		A2	3	Aldouane (St. Charles) River below road	46.65	65.04		
		A3	3	Aldouane (St. Charles) River below road	46.65	65.06		
		A4	2	Aldouane (St. Charles) River at road	46.64	65.05		
		A5	2	Aldouane (St. Charles) River below road	46.63	65.07		
		A6	2	Big Brook above Bretagneville road	46.68	65.02		
Bass River		B1	3	Bass River below Rte. 116	46.55	65.10		
Coal Branch River		C1	4	Coal Branch head of tide above Fords Mills	46.48	65.09		
		C2	4	Coal Branch 100 m below Beersville crossroad	46.44	65.06		
		C3	4	Coal Branch 250 m below Rte. 465	46.42	65.07		
		C5	3	Coal Branch, South Forks, below Rte. 465	46.36	65.15		
		C6	3	Coal Branch, South Forks, below Rte. 126	46.35	65.15		
Richibucto River		R1	4	Richibucto River 75 m above Rte. 116	46.51	65.16		
		R2	4	Richibucto River 200 m below Rte. 126	46.49	65.26		
		R3	4	Richibucto River east of Mortimer below washed out bridge	46.49	65.29		
		R4	3	Richibucto River east of Mortimer below washed out bridge	46.50	65.35		
		H1	3	Hudson Brook above gravel road	46.50	65.19		
		H2	3	Hudson Brook below Rte.116	46.47	65.21		
Molus River		M1	3	Molus River below Rte. 116	46.58	65.08		
		M2	3	Molus River above road from Molus River (settlement)	46.59	65.09		
St. Nicholas River		N1	3	St. Nicholas River, East Branch, above road	46.55	64.89		
		N2	2	St. Nicholas River, East Branch, below road	46.52	64.86		
		N3	2	St. Nicholas River, Black Brook, above and below road	46.57	64.85		
		N5	3	St. Nicholas River, South Branch, below road	46.52	64.92		
		N7	2	St. Nicholas River, South Branch, below road	46.50	65.93		
		N9	3	St. Nicholas River, West Branch, below road	46.54	64.96		
		N10	3	St. Nicholas River, West Branch, below road from Ford Bank	46.49	64.99		
Trout Brook		T1	3	Trout Brook above Emmerson Rd.	46.46	65.14		
		T2	2	Trout Brook below Rte. 126	46.43	65.21		
Gaspereau Creek	1974				46.68	64.78	21-I-10	51
		1	2	Main river below road at Bells Mills	46.63	64.80		
Chockpish River	1974				46.58	64.72	21-I-10	51
		1	3	Main river at Rte. 11	46.55	64.78		

Table 1. Continued.

River System	Years Sampled	Site No.	Stream Order	Stream and Descriptive Location	N Lat. Degrees	W Long. Degrees	Topographic Map	NB Atlas Page
Buctouche River	1974,'77-'80,'82,'96-'02				46.47	64.70	21-I-06, 21-I-07	58, 57
		1	4	Main river above South Branch confluence	46.36	64.90		
		2	4	Main river 100 m below Rte. 490	46.37	64.94		
		3	3	South Branch below Rte. 490	46.32	64.90		
		4	4	Main river 600 m below St. Paul crossroad	46.32	65.01		
		5	3	Upper N. Branch below Rte. 515	46.28	65.06		
		6	4	Main river 300 m below Johnson (Luke) Brook	46.35	64.98		
		7	4	Main river 500 m above Coates Mill bridge	46.37	64.88		
		8	3	South Branch 200 m above confluence with main river	46.36	64.90		
		9	2	Trout Brook below Rte. 515	46.39	64.87		
		10	3	Mill Creek below McNairn crossroad	46.45	64.83		
		11	3	South Branch 3.5 km below Rte. 490	46.34	64.87		
		12	3	Main river below Rte. 485	46.28	65.03		
		13	3	Johnson Brook above Rte. 515	46.35	64.99		
		14	3	Yankee Brook below Rte. 490	46.35	64.93		
		15	4	Main river 1 km above South Branch confluence	46.36	64.90		
		16	2	Bailey Brook below New Scotland Road	46.25	64.93		
		17	4	Main river below St. Paul crossroad	46.32	65.01		
		18	3	Mill Creek 3.5 km above site 10, below road	46.46	64.85		
Little Buctouche River	1974				46.45	64.68	21-I-07	58
		1	3	Main river below Rte. 525	46.37	64.77		
Howard Brook	1974				46.38	64.62	21-I-07	58
		1	1	Main river below road, W of Rte. 11	46.37	63.67		
Cocagne River	1974,'99-'02				46.33	64.62	21-I-07, 21-I-02	58, 65
		1	4	Main river below Poirier Rd.	46.31	64.80		
		2	3	Main river 200m below Victoria Rd.	46.24	64.89		
		3	2	Northwest Branch below St. Damien crossroad	46.31	64.80		
		4	2	Shaw Brook below Victoria Rd.	46.22	64.87		
Shediac River	1974				46.27	64.57	21-I-02	65
		1	4	Main river below Shediac River-Irishtown road, SW of Shediac River	46.25	64.66		
		2	3	Main river at junct. of Scotch Sett. and Shediac River-Irishtown roads	46.21	64.74		
		3	3	Main river below Rte. 490	46.19	64.82		
		4	3	Weisner Brook below upper road crossing	46.21	65.67		
		5	2	Calhoun Brook below upper road crossing	46.21	64.69		
Scoudouc River	1974				46.22	64.55	21-I-02, 21-I-01	65, 66
		1	1	Tributary, below road	46.18	64.51		
		2	3	Main river below road	46.18	64.51		
		3	3	Main river at gravel road contact N of Malakoff	46.15	64.52		
		4	2	Tributary, above road	46.16	64.48		
Kouchibouguac River	1974				46.23	64.40	21-I-01	66
(Westmorland Co.)		1	2	Main river below Rte. 945	46.17	64.35		
		2	2	Main river below road	46.14	64.30		
Tedish River	1974				46.22	64.30	21-I-01	66
		1	2	Main river below road	46.18	64.29		
Rayworth Brook	1974				46.05	63.93	11-L-04	67
		1	1	Main river below Rte. 16	46.09	63.95		

Table 2. Accessible rearing area and average percentage of habitat and substrate types in southeastern New Brunswick rivers, sampled from 1974-2003. Rearing area (total wetted area) for Buctouche from New Brunswick Department of Natural Resources and Energy database, others from Anonymous (1978); areas not available probably less than Scoudouc (146). Habitat and substrate type were determined subjectively at sampling sites only; definitions are as used from 1996 on, prior designations may overlap these categories.

	Rearing Area	Habitat Type (%)					Substrate Type (%)								
River	$x10^3$ sq. m	# Sites	Riffle	Run	Flat	Pool	# Sites	Fines	Sand	Gravel	Pebble	Cobble	Rock	Boulder	Bedrock
Black	-	4	29	44	0	28	4	0	3	28	3	46	19	0	3
Rankin Brook	-	1	25	0	0	75	2	43	18	0	20	17	2	0	2
Kouchibouguac	588	11	53	29	8	10	13	4	4	1	33	46	5	2	5
Kouchibouguacis	549	4	63	3	16	18	4	1	3	2	17	41	23	0	14
Richibucto system (7 rivers)	1226	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aldouane (St. Charles)	-	6	8	75	13	3	6	14	19	0	0	51	16	0	0
Bass	-	2	88	8	5	0	2	0	1	0	25	68	4	0	3
Coal Branch	-	19	60	11	28	1	19	0	5	4	13	73	5	0	0
Molus	-	2	5	35	0	60	2	40	10	0	0	45	5	0	0
Richibucto	-	18	66	11	16	7	18	3	9	4	20	60	4	0	0
St. Nicholas	-	9	39	42	2	17	9	13	15	2	19	45	3	1	2
Trout Brook	-	2	10	45	0	45	2	8	25	0	5	63	0	0	0
Gaspereau Creek	-	1	0	90	0	10	1	65	0	0	0	35	0	0	0
Chockpish	-	1	55	45	0	0	1	30	10	0	0	40	20	0	0
Buctouche	661	18	41	23	29	6	17	3	6	11	15	51	10	2	3
Little Buctouche	-	1	60	30	0	10	1	0	10	0	0	70	20	0	0
Howard Brook	-	1	100	0	0	0	1	0	0	0	20	50	30	0	0
Cocagne	283	4	36	28	31	5	4	0	5	1	18	66	10	0	0
Shediac	216	5	76	14	0	10	5	3	8	0	22	64	0	0	3
Scoudouc	146	4	51	13	0	36	4	11	24	0	25	20	20	0	0
Kouchibouguac (West. Co.)	-	2	75	0	0	25	2	35	8	0	8	50	0	0	0
Tedish	-	1	10	40	0	50	1	30	10	0	5	55	0	0	0
Rayworth Brook	-	1	100	0	0	0	1	0	0	0	0	60	40	0	0
Average all rivers			48	27	7	19		14	9	2	12	51	11	0	2

Habitat definitions

Riffle: fast current, shallow depth <23 cm, turbulent usually broken flow
Run: fast current, depth >23 cm, turbulent and sometimes broken flow
Flat: slow current, depth <46 cm, smooth surface
Pool: slow current, depth >46 cm, smooth surface

Substrate definitions

Fines: silt or clay
Sand: < 2 mm
Gravel: 2 to 6 mm
Pebble: 16 to 60 mm
Cobble: 60 to 250 mm
Rock: 250 to 500 mm
Boulder: >500 mm
Bedrock: solid rock, not loose

Table 3. Fish species collected during electrofishing surveys in southeastern New Brunswick rivers, 1974-2003. Common and species names as per Scott and Crossman (1998).

Name Used	Common Name(s)	Species	Family
Catfish	Brown bullhead	*Ictalurus nebulosus* L.	Ictaluridae
Chub	Creek chub	*Semotilus atromaculatus* M.	Cyprinidae
	Lake chub	*Couesius plumbeus* A.	Cyprinidae
Dace	Blacknose dace	*Rhinichthys atratulus* H.	Cyprinidae
	Northern redbelly dace	*Chrosomos eos* C.	Cyprinidae
Eel	American eel	*Anguilla rostrata* L.	Anguillidae
Lamprey	Sea lamprey	*Petromyzon marinus* L.	Petromyzontidae
Mummichog	Mummichog	*Fundulus heteroclitus* L.	Cyprinodontidae
Salmon	Atlantic salmon	*Salmo salar* L.	Salmonidae
Sculpin	Slimy sculpin	*Cottus cognatus* R.	Cottidae
Shiner	Common shiner	*Notropis cornutus* M.	Cyprinidae
	Golden shiner	*Notemigonus crysoleucas* M.	Cyprinidae
Stickleback	Threespine stickleback	*Gasterosteus aculeatus* L.	Gasterostiidae
	Nine-spined stickleback	*Pungitius pungitius* L.	Gasterostiidae
Sucker	White sucker	*Catostomus commersoni* L.	Catostomidae
Trout	Brook trout	*Salvelinus fontinalis* M.	Salmonidae

Table 4. Density (fish per 100 sq. m) of juvenile Atlantic salmon in rivers surveyed in 1974 only. Values predicted from cpua. Rivers listed are only those where salmon were caught. A dash (-) indicates none caught.

River	Site	Fry	Small Parr	Large Parr	Total Parr
Aldouane (St. Charles)	**A1**	-	9	-	9
Chockpish	**1**	-	-	9	9
Scoudouc	**2**	-	-	10	10
	3	-	23	-	23
Kouchibouguac (Westmorland Co.)	**1**	-	9	3	12

Table 5. Catch per 100 sq. m of all species from rivers surveyed in 1974 only. A dash (-) indicates none caught.

					Salmon				Stickle-		
River	**Site**	**Chub**	**Dace**	**Eel**	**Fry**	**Sm Parr**	**Lg Parr**	**Sculpin**	**back**	**Sucker**	**Trout**
Rankin Brook	**1**	-	-	-	-	-	-	-	-	-	23
	2	-	-	-	-	-	-	-	-	-	25
Aldouane (St. Charles)	**A1**	-	-	-	-	1	-	16	-	-	1
	A2	-	-	-	-	-	-	19	-	17	-
	A3	-	-	-	-	-	-	-	-	4	7
	A4	-	-	-	-	-	-	8	-	-	6
	A5	-	-	-	-	-	-	19	-	-	5
	A6	-	-	-	-	-	-	-	-	-	-
Gaspereau Creek	**1**	-	-	-	-	-	-	-	-	-	8
Chockpish	**1**	-	-	-	-	-	1	3	-	-	7
Little Buctouche	**1**	-	2	-	-	-	-	16	-	-	-
Howard Brook	**1**	-	-	-	-	-	-	27	-	-	3
Shediac	**1**	-	25	-	-	-	-	-	-	1	1
	2	2	10	-	-	-	-	-	-	-	-
	3	-	8	-	-	-	-	-	-	1	-
	4	-	4	-	-	-	-	-	-	1	-
	5	-	10	-	-	-	-	-	-	-	2
Scoudouc	**1**	-	-	-	-	-	-	-	-	-	-
	2	-	17	-	-	-	2	-	-	-	-
	3	-	11	1	-	12	-	-	1	4	-
	4	-	-	-	-	-	-	-	-	-	-
Kouchibouguac	**1**	-	4	-	-	2	1	-	-	-	13
(Westmorland Co.)	**2**	-	-	-	-	-	-	-	-	-	-
Tedish	**1**	-	-	-	-	-	-	-	-	-	22
Rayworth Brook	**1**	-	-	-	-	-	-	-	-	-	11
	Total	2	91	1	0	16	3	107	1	29	136

Table 6. Mean length (mm) of measured salmonids from rivers sampled in 1974 only.

River	Data	Small Parr	Large Parr	Trout
Aldouane (St. Charles)	Mean length	118	-	-
	SD	-	-	-
	N	1	-	-
Chockpish	Mean length	-	133	-
	SD	-	-	-
	N	-	1	-
Howard Brook	Mean length	-	-	80
	SD	-	-	16
	N	-	-	4
Shediac	Mean length	-	-	75
	SD	-	-	-
	N	-	-	2
Scoudouc	Mean length	95	123	-
	SD	10	-	-
	N	9	1	-
Kouchibouguac (Westmorland Co.)	Mean length	108	128	90
	SD	5	-	35
	N	3	1	16
Rayworth Brook	Mean length	-	-	97
	SD	-	-	45
	N	-	-	9

Table 7. Density of juvenile Atlantic salmon, catch per 100 sq. m of all species, and mean length (mm) of measured fish from the Black R., 1974 and 1984. A dash (-) indicates none caught, '0' a catch <0.5.

Salmon density

Year	Site	Fry	Small Parr	Large Parr	Total Parr
1984	1	33	-	-	-
	2	9	28	-	28
	3	19	8	-	8
	Mean	20	12	-	12

All species cpua

Year	Site	Eel	Mummichog	Salmon Fry	Salmon Sm Parr	Salmon Lg Parr	Stickleback	Trout
1974	1	-	-	-	-	-	-	14
1984	1	1	1	17	-	-	2	1
	2	-	-	1	13	-	0	3
	3	-	-	14	7	-	1	4
	Total	1	1	31	20	0	3	22

Mean length

Year	Data	Fry	Small Parr
1984	Mean length	50	86
	SD	15	10
	N	69	100

Table 8. Density of juvenile Atlantic salmon in the Kouchibouguac R., 1974-2002. Bold underlined values from Zippin method, others predicted from **cpua** (1974, '82) or **cpue** (1999-2002). A dash (-) indicates site not fished, '0' a density <0.5 or none caught.

Salmon stage	Site	1974	1977	1978	1982	1999	2000	2001	2002	Mean
	1	-	-	-	-	67	75	24	26	48
	2	-	-	-	-	48	49	13	32	36
	3	-	-	-	-	-	45	39	80	55
	4	-	-	-	-	-	76	-	-	76
	5	0	**4**	**187**	3	-	1	-	-	39
	6	-	**9**	-	-	-	-	-	-	9
Fry	**7**	0	**0**	-	-	-	-	-	-	0
	8	0	**10**	**148**	-	-	-	-	-	53
	9	0	**6**	**29**	**1**	-	-	-	-	9
	10	0	**45**	**102**	**28**	-	-	-	-	44
	12	0	-	-	-	-	-	-	-	0
	13	0	-	-	-	-	-	-	-	0
	14	0	-	-	-	-	-	-	-	0
	15	2	-	-	-	-	-	-	-	2
	Mean	0	12	116	11	57	49	25	46	40
	1	-	-	-	-	29	27	33	11	25
	2	-	-	-	-	34	19	23	21	24
	3	-	-	-	-	-	19	25	16	20
	4	-	-	-	-	-	15	-	-	15
	5	17	**2**	**1**	**3**	-	24	-	-	9
	6	-	**13**	-	-	-	-	-	-	13
Small Parr	**7**	15	**8**	-	-	-	-	-	-	12
	8	20	**8**	**3**	-	-	-	-	-	10
	9	12	**6**	**4**	**4**	-	-	-	-	7
	10	17	**17**	**25**	**9**	-	-	-	-	17
	12	6	-	-	-	-	-	-	-	6
	13	14	-	-	-	-	-	-	-	14
	14	8	-	-	-	-	-	-	-	8
	15	18	-	-	-	-	-	-	-	18
	Mean	14	9	8	5	31	21	27	16	16
	1	-	-	-	-	4	5	1	8	5
	2	-	-	-	-	6	7	1	2	4
	3	-	-	-	-	-	1	3	7	4
	4	-	-	-	-	-	0	-	-	0
	5	0	**2**	**2**	**1**	-	2	-	-	2
	6	-	**8**	-	-	-	-	-	-	8
Large Parr	**7**	9	**1**	-	-	-	-	-	-	5
	8	2	**4**	**6**	-	-	-	-	-	4
	9	0	**0**	**1**	**1**	-	-	-	-	0
	10	2	**5**	**2**	**2**	-	-	-	-	3
	12	6	-	-	-	-	-	-	-	6
	13	0	-	-	-	-	-	-	-	0
	14	4	-	-	-	-	-	-	-	4
	15	0	-	-	-	-	-	-	-	0
	Mean	2	3	3	1	5	3	2	6	3
	1	-	-	-	-	33	32	34	19	30
	2	-	-	-	-	39	27	23	23	28
	3	-	-	-	-	-	20	28	24	24
	4		-	-	-	-	15	-	-	15
	5	17	**5**	**3**	**4**	-	26	-	-	11
	6	-	**21**	-	-	-	-	-	-	21
Total Parr	**7**	24	**9**	-	-	-	-	-	-	16
	8	23	**13**	**9**	-	-	-	-	-	15
	9	12	**6**	**6**	**4**	-	-	-	-	7
	10	18	**22**	**27**	**11**	-	-	-	-	20
	12	11	-	-	-	-	-	-	-	11
	13	14	-	-	-	-	-	-	-	14
	14	12	-	-	-	-	-	-	-	12
	15	18	-	-	-	-	-	-	-	18
	Mean	17	13	11	6	36	24	29	22	20

Table 9. Catch per 100 sq. m of all species from the Kouchibouguac R., 1974-2002. A dash (-) indicates none caught, '0' a catch <0.5.

					Salmon				Stickle-		
Year	Site	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Sculpin	back	Sucker	Trout
1974	**5**	13	-	-	-	7	-	2	-	-	-
	7	10	1	-	-	8	5	-	-	-	-
	8	7	-	-	-	11	1	-	-	-	-
	9	-	-	-	-	3	-	9	-	-	1
	10	-	-	-	-	8	1	5	-	-	3
	12	8	-	-	-	1	1	-	-	-	-
	13	-	-	-	-	5	-	1	-	-	-
	14	3	-	-	-	2	1	-	-	1	2
	15	-	-	-	1	8	-	14	-	-	5
1977	**5**	39	2	-	2	2	2	-	-	3	-
	6	7	2	-	3	7	4	0	-	-	1
	7	14	1	-	0	6	0	-	0	2	0
	8	24	5	-	3	5	2	-	1	1	1
	9	7	-	-	4	0	-	5	4	0	20
	10	7	1	-	25	11	4	25	-	0	10
1978	**5**	58	1	-	98	1	1	-	2	12	-
	8	47	4	-	73	1	5	-	2	9	2
	9	3	-	-	22	3	1	27	4	1	16
	10	8	-	-	71	20	2	43	2	1	5
1982	**5**	9	-	-	1	1	1	0	-	0	0
	9	-	-	-	-	2	0	2	0	-	2
	10	2	1	-	7	4	2	3	-	0	0
1999	**1**	10	0	1	25	14	2	1	0	-	3
	2	45	-	-	13	12	2	-	-	2	1
2000	**1**	1	-	1	19	9	2	1	0	-	1
	2	7	-	0	11	6	2	-	-	0	0
	3	0	0	-	7	3	0	0	-	-	-
	4	-	-	-	19	3	-	8	-	-	1
	5	38	-	0	0	9	1	-	-	0	-
2001	**1**	3	-	0	4	8	0	0	-	-	1
	2	6	-	-	3	5	0	-	-	1	-
	3	1	-	-	7	6	1	0	-	-	-
2002	**1**	9	-	0	10	4	3	1	0	-	1
	2	11	-	0	11	9	1	-	-	-	1
	3	0	-	-	20	5	2	0	0	0	-
	Total catch	398	19	3	462	210	49	149	16	37	78

Table 10. Catch per 900 seconds of all species from the Kouchibouguac R., 1999-2002. A dash (-) indicates none caught.

					Salmon				Stickle-		
Year	Site	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Sculpin	back	Sucker	Trout
1999	**1**	26	1	3	69	39	6	2	1	-	8
	2	173	-	-	50	48	8	-	-	8	4
2000	**1**	5	-	3	78	37	7	4	1	-	4
	2	30	-	2	51	25	10	-	-	1	2
	3	3	1	-	47	22	2	1	-	-	-
	4	-	-	-	79	14	-	33	-	-	5
	5	133	-	1	1	30	3	-	-	1	-
2001	**1**	16	-	1	24	45	2	1	-	-	5
	2	33	-	-	14	28	1	-	-	7	-
	3	4	-	-	41	32	4	1	-	-	-
2002	**1**	24	-	1	27	12	9	3	1	-	4
	2	31	-	1	33	26	2	-	-	-	2
	3	2	-	-	83	20	9	1	1	1	-
	Total catch	479	2	11	597	377	60	45	4	18	33

Table 11. Mean length (mm) of fish measured from the Kouchibouguac R., 1974-2002.

Year	Data	Dace	Eel	Lamprey	Salmon			Sculpin	Shiner	Stickle-back	Sucker	Trout
					Fry	Sm Parr	Lg Parr					
1974	Mean length	-	-	-	73	101	128	-	-	-	-	-
	SD	-	-	-	-	10	7	-	-	-	-	-
	N	-	-	-	1	50	8	-	-	-	-	-
1977	Mean length	-	-	-	56	104	125	-	-	-	-	-
	SD	-	-	-	6	7	8	-	-	-	-	-
	N	-	-	-	176	151	58	-	-	-	-	-
1978	Mean length	-	-	-	58	95	126	-	-	-	-	-
	SD	-	-	-	5	9	9	-	-	-	-	-
	N	-	-	-	1204	81	31	-	-	-	-	-
1982	Mean length	-	-	-	72	100	121	-	-	-	-	-
	SD	-	-	-	3	11	5	-	-	-	-	-
	N	-	-	-	60	42	12	-	-	-	-	-
1999	Mean length	51	140	133	53	93	119	84	-	27	44	112
	SD	14	-	31	4	12	5	2	-	-	21	66
	N	88	1	3	125	91	14	2	-	1	8	13
2000	Mean length	58	350	174	52	89	122	62	-	50	83	177
	SD	9	-	52	4	8	8	16	-	-	46	76
	N	72	1	6	273	136	22	38	-	1	2	11
2001	Mean length	54	-	110	56	92	118	79	-	-	90	106
	SD	13	-	-	3	9	4	4	-	-	19	43
	N	54	-	1	83	110	7	2	-	-	7	5
2002	Mean length	54	-	115	55	94	122	60	-	38	33	175
	SD	10	-	7	4	8	7	24	-	1	-	55
	N	60	-	2	155	62	21	4	-	2	1	6

Table 12. Density of juvenile Atlantic salmon in the Kouchibouguacis R., 1974-2003. Values are predicted from **cpua** (1974) or **cpue** (2000-2003). A dash (-) indicates site not fished, '0' a density <0.5 or none caught.

Salmon stage	Site	1974	2000	2001	2002	2003	Mean
Fry	1	-	7	3	23	12	11
	2	2	4	6	8	6	5
	3	-	-	4	11	13	9
	Mean	2	6	4	14	11	7
Small Parr	1	-	9	8	2	8	6
	2	13	12	11	6	11	11
	3	-	-	11	2	11	8
	Mean	13	11	10	3	10	9
Large Parr	1	-	2	3	6	0	3
	2	0	1	3	2	0	1
	3	-	-	2	7	1	4
	Mean	0	2	3	5	0	2
Total Parr	1	-	11	11	9	8	9
	2	13	13	14	9	11	12
	3	-	-	13	9	12	11
	Mean	13	12	13	9	10	11

Table 13. Catch per 100 sq. m of all species from the Kouchibouguacis R., 1974-2003. A dash (-) indicates none caught, '0' a catch <0.5.

						Salmon					
Year	Site	Chub	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Shiner	Sucker	Trout
1974	1	-	-	-	-	-	-	-	-	3	-
	2	-	6	1	-	1	4	-	-	1	1
	3	-	7	2	-	-	-	-	-	6	4
	4	-	31	5	-	-	-	-	-	3	3
2000	1	-	5	-	-	2	1	0	2	1	-
	2	-	28	-	-	1	3	0	1	2	-
2001	1	2	13	-	0	1	1	0	-	1	-
	2	2	31	-	1	2	4	1	-	2	-
	3	-	11	-	-	1	2	0	1	-	-
2002	1	1	11	0	-	5	0	0	1	-	-
	2	2	8	-	-	2	1	0	2	3	-
	3	3	11	-	-	3	0	1	2	1	-
2003	1	0	10	0	-	3	0	-	1	0	-
	2	-	9	-	0	2	2	-	-	-	-
	3	1	5	-	-	3	1	0	-	-	0
	Total catch	10	187	8	2	25	19	4	8	24	8

Table 14. Catch per 900 seconds of all species from the Kouchibouguacis R., 2000-2003. A dash (-) indicates none caught.

						Salmon					
Year	Site	Chub	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Shiner	Sucker	Trout
2000	1	-	22	-	-	7	6	2	8	3	-
	2	-	91	-	-	4	11	1	3	7	-
2001	1	9	68	-	1	3	5	2	-	7	-
	2	6	85	-	4	6	10	3	-	6	-
	3	-	59	-	-	4	9	2	3	-	-
2002	1	5	60	1	-	24	1	2	3	-	-
	2	7	28	-	-	8	2	1	6	12	-
	3	11	41	-	-	11	1	4	6	3	-
2003	1	1	43	1	-	13	2	-	3	1	-
	2	-	35	-	1	7	7	-	-	-	-
	3	3	28	-	-	14	8	1	-	-	1
	Total catch	41	561	2	6	101	61	17	32	39	1

Table 15. Mean length (mm) of fish measured from the Kouchibouguacis R., 1974-2003.

						Salmon					
Year	Data	Chub	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Shiner	Sucker	Trout
1974	Mean length	-	-	181	-	75	96	-	-	94	86
	SD	-	-	75	-	-	16	-	-	54	20
	N	-	-	7	-	1	4	-	-	10	7
2000	Mean length	-	51	-	-	52	88	118	47	78	-
	SD	-	11	-	-	2	6	3	9	22	-
	N	-	65	-	-	14	19	3	13	12	-
2001	Mean length	40	51	-	116	53	97	126	65	91	-
	SD	21	13	-	15	6	7	9	6	46	-
	N	16	102	-	5	13	25	7	3	13	-
2002	Mean length	30	44	320	-	54	104	129	53	47	-
	SD	11	11	-	-	5	6	10	12	29	-
	N	26	117	1	-	53	5	8	18	18	-
2003	Mean length	39	47	130	75	58	99	170	68	42	167
	SD	18	13	-	-	5	9	-	4	-	-
	N	4	113	1	1	35	17	1	3	1	1

Table 16. Density of juvenile Atlantic salmon in rivers of the Richibucto system, sampled subsequent to 1974 and up to 2002. Bold underlined values from Zippin method, others predicted from **cpua** (1974, '82) or **cpue** (1997-2002). Letter prefix to site code indicates rivers as follows: (B) Bass R.; (C) Coal Branch; (H) Hudson Brook; (M) Molus R.; (N) St. Nicholas R.; (R) Richibucto R.; (T) Trout Brook. A dash (-) indicates site not fished, '0' a density <0.5 or none caught.

Salmon stage	Site	1974	1982	1997	1998	1999	2000	2001	2002	Mean
	B1	0	**0**	0	-	-	-	-	-	0
	C1	6	-	6	-	-	-	-	-	6
	C2	-	**0**	7	4	2	45	3	28	13
	C3	5	1	-	-	6	21	1	23	9
	C5	0	1	-	0	-	-	4	0	1
	C6	3	-	-	-	-	-	-	-	3
Fry	**H1**	0	0	-	-	-	-	-	-	0
	M1	0	1	-	-	-	-	-	-	1
	N9	6	-	0	-	-	-	-	-	3
	R1	3	**1**	11	15	13	32	8	21	13
	R2	3	**46**	10	12	51	84	41	41	36
	R3	0	2	-	-	-	-	-	-	1
	T1	0	**0**	-	-	-	-	-	-	0
	Mean-Coal Branch	3	1	6	2	4	33	3	17	9
	Mean-Richibucto	1	12	10	14	32	58	25	31	23
	B1	0	**2**	8	-	-	-	-	-	3
	C1	15	-	9	-	-	-	-	-	12
	C2	-	**0**	8	7	10	8	23	0	8
	C3	14	**1**	-	-	11	8	22	5	10
	C5	13	**6**	-	10	-	-	19	11	12
	C6	18	-	-	-	-	-	-	-	18
Small Parr	**H1**	6	**0**	-	-	-	-	-	-	3
	M1	-	**1**	-	-	-	-	-	-	1
	N9	10	-	0	-	-	-	-	-	5
	R1	8	**4**	9	9	9	0	11	7	7
	R2	13	**16**	24	12	10	12	25	24	17
	R3	11	**0**	-	-	-	-	-	-	5
	T1	8	**0**	-	-	-	-	-	-	4
	Mean-Coal Branch	15	2	9	9	10	8	21	6	10
	Mean-Richibucto	11	6	17	11	10	6	18	16	12
	B1	10	**4**	2	-	-	-	-	-	5
	C1	0	-	6	-	-	-	-	-	3
	C2	-	**0**	6	3	1	0	0	8	3
	C3	2	**4**	-	-	1	0	1	10	3
	C5	0	**2**	-	6	-	-	2	0	2
	C6	2	-	-	-	-	-	-	-	2
Large Parr	**H1**	6	**0**	-	-	-	-	-	-	3
	M1	-	**0**	-	-	-	-	-	-	0
	N9	0	-	0	-	-	-	-	-	0
	R1	4	**2**	4	4	0	7	3	6	4
	R2	3	**2**	2	1	4	2	1	0	2
	R3	0	**1**	-	-	-	-	-	-	0
	T1	4	**0**	-	-	-	-	-	-	2
	Mean-Coal Branch	1	2	6	5	1	0	1	6	3
	Mean-Richibucto	2	2	3	2	2	5	2	3	3
	B1	10	**6**	9	-	-	-	-	-	8
	C1	15	-	15	-	-	-	-	-	15
	C2	-	**0**	14	10	11	8	23	8	11
	C3	17	**4**	-	-	12	8	23	15	13
	C5	13	**7**	-	17	-	-	21	11	14
	C6	20	-	-	-	-	-	-	-	20
Total Parr	**H1**	11	**0**	-	-	-	-	-	-	6
	M1	-	**1**	-	-	-	-	-	-	1
	N9	10	-	0	-	-	-	-	-	5
	R1	12	**6**	13	13	9	7	13	12	11
	R2	16	**18**	26	13	14	14	26	24	19
	R3	11	**1**	-	-	-	-	-	-	6
	T1	13	**0**	-	-	-	-	-	-	6
	Mean-Coal Branch	16	4	15	14	12	8	22	11	13
	Mean-Richibucto	13	6	20	13	12	11	20	18	14

Table 17. Catch per 100 sq. m of all species from the Richibucto River system, 1974-2002. Letter prefix to site code indicates rivers as follows: (B) Bass R.; (C) Coal Branch; (H) Hudson Brook; (M) Molus R.; (N) St. Nicholas R.; (R) Richibucto R.; (T) Trout Brook. A dash (-) indicates none caught, '0' a catch <0.5.

						Salmon					Stickle-		
Year	Site	Chub	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Sculpin	Shiner	back	Sucker	Trout
1974	**B1**	-	8	-	-	-	-	1	1	-	-	-	-
	C1	-	10	-	-	2	5	-	-	-	-	-	-
	C3	-	4	-	-	2	6	1	-	-	-	-	-
	C5	1	1	-	-	-	4	-	-	-	-	1	-
	C6	-	-	-	-	1	9	1	-	-	-	2	-
	H1	-	-	-	-	-	1	1	-	2	-	4	-
	H2	-	4	-	-	-	-	-	7	-	-	2	4
	M2	7	-	-	-	-	-	-	-	-	-	15	-
	N1	-	-	-	-	-	-	-	7	-	-	-	1
	N2	5	-	-	-	-	-	-	2	-	-	2	6
	N3	-	-	-	-	-	-	-	3	-	-	-	15
	N5	-	-	-	-	-	-	-	5	-	-	-	6
	N7	-	-	-	-	-	-	-	4	-	-	-	3
	N9	2	-	-	-	2	1	-	8	-	-	-	3
	N10	5	-	-	-	-	-	-	1	-	-	-	17
	R1	1	2	-	-	1	2	1	-	1	-	7	-
	R2	1	-	-	-	1	5	1	-	-	-	1	-
	R3	3	-	-	-	-	2	-	-	-	-	-	-
	R4	3	-	-	-	-	-	-	3	-	-	-	3
	T1	-	5	-	-	-	2	1	-	-	-	1	1
	T2	-	9	9	-	-	-	-	-	-	26	5	-
1982	**B1**	-	3	-	-	-	0	3	-	3	0	0	-
	C2	-	8	0	-	-	-	-	-	2	1	2	-
	C3	-	9	-	-	-	1	2	-	-	-	1	-
	C5	5	5	-	-	-	2	1	-	-	1	2	-
	H1	-	2	-	-	-	-	-	-	-	1	1	-
	M1	1	0	3	-	0	1	-	6	-	-	1	-
	R1	-	1	-	-	0	1	-	-	-	-	0	-
	R2	-	3	-	-	1	4	-	0	-	-	-	-
	R3	-	4	0	-	-	-	0	0	-	-	-	-
	T1	-	15	-	-	-	-	-	1	1	1	0	1
1997	**B1**	12	9	-	2	-	1	0	8	2	0	8	2
	C1	1	15	-	1	2	3	2	0	2	-	1	-
	C2	5	26	-	1	3	3	2	7	2	1	4	-
	N7	1	-	-	2	-	-	-	40	-	1	-	13
	N9	1	-	-	4	-	-	-	32	1	-	2	12
	R1	2	9	0	1	4	3	1	-	-	-	0	-
	R2	1	39	-	0	5	14	1	4	-	-	-	-
1998	**C2**	1	29	-	-	1	1	0	0	1	-	1	-
	C5	6	5	-	2	-	5	3	-	-	2	2	-
	R1	2	8	0	0	5	2	1	-	3	0	1	-
	R2	1	28	0	-	4	3	0	4	-	-	0	-
1999	**C2**	2	34	-	-	0	2	0	-	3	-	1	0
	C3	6	42	-	-	1	2	0	-	-	-	0	-
	R1	1	17	0	1	4	1	-	-	1	2	2	-
	R2	4	70	-	0	15	3	1	-	-	1	8	-
2000	**C2**	1	11	-	0	8	0	-	1	2	1	0	0
	C3	0	24	-	-	6	0	-	-	1	-	0	-
	R1	0	4	0	0	6	-	0	-	-	1	-	-
	R2	0	5	0	0	21	3	0	0	-	-	-	-
2001	**C2**	1	10	-	-	1	8	-	-	1	-	1	-
	C3	0	24	0	0	0	9	0	-	1	-	1	-
	C5	8	7	1	2	2	12	1	-	-	1	1	-
	R1	1	7	0	0	2	2	1	-	-	-	0	-
	R2	-	24	-	-	15	12	1	-	-	-	-	-
2002	**C2**	0	8	0	-	7	-	1	0	-	-	1	-
	C3	-	11	-	-	7	2	3	-	-	-	1	-
	C5	4	5	0	0	-	3	-	-	-	1	3	-
	R1	1	15	1	0	7	2	1	-	-	-	-	-
	R2	1	9	-	1	13	9	-	-	0	0	-	-
	Total catch	96	586	17	19	150	151	35	144	28	40	84	86

Table 18. Catch per 900 seconds of all species from the Richibucto River system, 1999-2002. Letter prefix to site code indicates rivers as follows: (B) Bass R.; (C) Coal Branch; (H) Hudson Brook; (M) Molus R.; (N) St. Nicholas R.; (R) Richibucto R.; (T) Trout Brook. A dash (-) indicates none caught.

Arranged by						Salmon					Stickle-		
Year	Site	Chub	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Sculpin	Shiner	back	Sucker	Trout
1997	**B1**	35	26	-	7	-	4	1	25	6	1	24	5
	C1	2	46	-	2	6	9	6	1	5	-	2	-
	C2	13	65	-	1	7	7	6	17	6	3	10	-
	N7	1	-	-	3	-	-	-	68	-	1	-	22
	N9	1	-	-	6	-	-	-	45	2	-	2	17
	R1	7	27	1	2	11	8	4	-	-	-	1	-
	R2	2	89	-	1	11	31	2	8	-	-	-	-
1998	**C2**	5	109	-	-	4	4	2	1	4	-	4	-
	C5	12	10	-	4	-	11	7	-	-	3	3	-
	R1	7	28	2	2	16	8	3	-	11	2	2	-
	R2	3	95	1	-	13	11	1	13	-	-	1	-
1999	**C2**	7	145	-	-	2	7	1	-	12	-	5	1
	C3	27	185	-	-	6	9	1	-	-	-	2	-
	R1	3	63	1	5	13	4	-	-	3	6	7	-
	R2	13	253	-	1	53	9	4	-	-	4	29	-
2000	**C2**	6	62	-	1	47	2	-	3	11	4	2	1
	C3	2	86	-	-	22	2	-	-	3	-	1	-
	R1	2	19	1	1	33	-	1	-	-	4	-	-
	R2	2	20	1	1	88	11	2	1	-	-	-	-
2001	**C2**	3	33	-	-	3	28	-	-	2	-	4	-
	C3	2	73	2	1	1	27	1	-	2	-	2	-
	C5	14	12	1	4	4	22	2	-	-	2	2	-
	R1	4	28	1	2	8	9	2	-	-	-	1	-
	R2	-	66	-	-	43	32	2	-	-	-	-	-
2002	**C2**	1	34	1	-	29	-	2	1	-	-	2	-
	C3	-	36	-	-	24	5	9	-	-	-	3	-
	C5	9	12	1	1	-	8	-	-	-	2	6	-
	R1	4	49	2	1	21	5	4	-	-	-	-	-
	R2	2	28	-	3	43	30	-	-	1	1	-	-
	Total catch	187	1698	13	47	506	303	62	183	67	31	115	46

Table 19. Mean length (mm) of fish measured from the Richibucto River system, 1974-2002. No fish were measured from the Molus R.

							Salmon					Stickle-		
River	Year	Data	Chub	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Sculpin	Shiner	back	Sucker	Trout
Bass	**1974**	**Mean length**	-	-	-	-	-	-	125	-	-	-	-	-
		SD	-	-	-	-	-	-	-	-	-	-	-	-
		N	-	-	-	-	-	-	1	-	-	-	-	-
	1982	**Mean length**	-	-	-	-	-	112	127	-	-	-	-	-
		SD	-	-	-	-	-	2	6	-	-	-	-	-
		N	-	-	-	-	-	7	12	-	-	-	-	-
	1997	**Mean length**	40	58	-	116	-	105	115	59	38	25	41	94
		SD	6	10	-	23	-	7	-	18	3	-	4	33
		N	43	32	-	9	-	5	1	31	7	1	30	6
Coal Branch	**1974**	**Mean length**	-	-	-	-	69	95	126	-	-	-	-	-
		SD	-	-	-	-	4	12	2	-	-	-	-	-
		N	-	-	-	-	5	23	2	-	-	-	-	-
	1982	**Mean length**	-	-	-	-	-	101	127	-	-	-	-	-
		SD	-	-	-	-	-	10	15	-	-	-	-	-
		N	-	-	-	-	-	20	18	-	-	-	-	-
	1997	**Mean length**	68	56	-	111	55	101	126	68	44	47	55	-
		SD	23	10	-	13	3	9	9	11	12	7	21	-
		N	20	144	-	4	17	21	15	24	14	4	16	-
	1998	**Mean length**	60	78	-	131	58	95	127	70	30	38	57	-
		SD	7	363	-	13	6	7	13	-	4	6	27	-
		N	20	134	-	5	4	18	10	1	4	4	8	-
	1999	**Mean length**	38	43	-	-	47	92	118	-	29	-	49	112
		SD	20	12	-	-	4	10	6	-	3	-	16	-
		N	34	169	-	-	8	16	2	-	13	-	7	1
	2000	**Mean length**	59	54	-	125	57	98	-	60	63	34	56	105
		SD	25	10	-	-	4	6	-	7	6	4	19	-
		N	8	64	-	1	72	4	-	3	14	4	3	1
	2001	**Mean length**	68	53	395	110	60	89	120	-	44	33	58	-
		SD	15	12	187	23	5	9	6	-	12	1	31	-
		N	20	82	3	5	8	86	3	-	5	2	9	-
	2002	**Mean length**	64	49	380	180	53	101	121	65	-	41	69	-
		SD	8	12	170	-	4	9	6	-	-	13	45	-
		N	11	80	2	1	60	14	12	1	-	2	13	-

Table 19. Continued

River	Year	Data	Chub	Dace	Eel	Lamprey	Salmon			Sculpin	Shiner	Stickle-back	Sucker	Trout
							Fry	Sm Parr	Lg Parr					
Hudson Brook	**1974**	**Mean length**	-	-	-	-	-	94	123	-	-	-	-	-
		SD	-	-	-	-	-	-	-	-	-	-	-	-
		N	-	-	-	-	-	1	1	-	-	-	-	-
	1982	**Mean length**	-	-	-	-	71	93	-	-	-	-	-	-
		SD	-	-	-	-	4	0	-	-	-	-	-	-
		N	-	-	-	-	2	4	-	-	-	-	-	-
Richibucto	**1974**	**Mean length**	-	-	-	-	68	106	132	-	-	-	-	-
		SD	-	-	-	-	8	11	5	-	-	-	-	-
		N	-	-	-	-	2	10	2	-	-	-	-	-
	1982	**Mean length**	-	-	-	-	70	104	135	-	-	-	-	-
		SD	-	-	-	-	4	10	19	-	-	-	-	-
		N	-	-	-	-	24	45	13	-	-	-	-	-
	1997	**Mean length**	57	57	178	125	53	94	119	62	-	-	25	-
		SD	30	9	18	10	4	9	6	25	-	-	-	-
		N	15	155	2	4	31	51	9	10	-	-	1	-
	1998	**Mean length**	63	56	168	132	58	102	120	61	58	40	71	-
		SD	14	11	31	16	4	7	7	19	7	4	3	-
		N	12	133	3	2	33	21	5	13	14	2	4	-
	1999	**Mean length**	46	43	300	116	51	98	121	-	43	28	39	-
		SD	23	16	-	25	4	9	1	-	15	5	23	-
		N	18	154	1	8	75	16	4	-	4	12	40	-
	2000	**Mean length**	58	52	190	105	56	95	120	47	-	53	-	-
		SD	29	11	14	35	3	9	5	-	-	21	-	-
		N	4	44	2	2	136	12	3	1	-	4	-	-
	2001	**Mean length**	51	52	175	140	55	94	115	-	-	-	29	-
		SD	19	14	-	42	4	9	1	-	-	-	-	-
		N	5	65	1	2	59	48	5	-	-	-	1	-
	2002	**Mean length**	45	54	175	119	56	95	132	-	80	34	-	-
		SD	22	10	35	4	4	10	11	-	-	-	-	-
		N	6	62	2	4	71	39	5	-	1	1	-	-
St. Nicholas	**1974**	**Mean length**	-	-	-	-	65	93	-	-	-	-	-	86
		SD	-	-	-	-	5	-	-	-	-	-	-	17
		N	3	-	-	-	2	1	-	-	-	-	-	12
	1997	**Mean length**	78	-	-	118	-	-	-	61	40	48	30	78
		SD	19	-	-	41	-	-	-	13	1	-	3	25
		N	2	-	-	10	-	-	-	129	2	1	3	45
Trout Brook	**1974**	**Mean length**	-	-	-	-	-	111	125	-	-	-	-	-
		SD	-	-	-	-	-	10	-	-	-	-	-	-
		N	-	-	-	-	-	2	1	-	-	-	-	-

Table 20. Density of juvenile Atlantic salmon in the Buctouche R., 1974-2002. Bold underlined values from Zippin method, others predicted from cpua (1974-'82) or cpue (1996-2002). Mean values exclude Mill Creek and Trout Brook sites (9,10,18). Mean fry and parr values in brackets are adjusted for stocking of unmarked fry in 1988 (see text). A dash (-) indicates site not fished, '0' a density <0.5 or none caught.

Salmon Stage	Site	1974	1977	1978	1979	1980	1982	1996	1997	1998	1999	2000	2001	2002	Mean
	1	-	-	-	-	-	-	**5**	**12**	**4**	1	**66**	3	28	17
	2	-	**0**	**1**	**0**	**2**	**0**	**5**	4	**13**	1	18	4	22	6
	3	-	**0**	**69**	**30**	**6**	**4**	**7**	**16**	**47**	**38**	**150**	9	18	33
	4	-	-	-	-	-	-	0	6	18	14	49	7	2	14
	5	-	-	-	-	-	-	1	7	69	1	0	0	-	13
	6	-	-	-	-	-	-	3	3	20	3	24	12	42	15
	7	-	-	-	-	-	-	19	7	18	2	36	2	34	17
	8	-	**1**	**12**	1	-	**0**	2	1	2	0	50	1	13	7
Fry	9	-	-	-	-	-	-	1	-	-	-	-	-	-	1
	10	0	-	-	-	-	-	0	-	-	-	-	-	-	0
	11	-	-	-	-	-	-	17	8	10	1	39	10	39	18
	12	-	-	-	-	-	-	0	1	0	0	4	-	-	1
	13	-	**0**	**3**		-	-	-	-	-	-	-	-	-	1
	14	0	**0**	**7**	**0**	-	**2**	-	-	-	-	-	-	-	2
	15	-	3	**19**	2	-	-	-	-	-	-	-	-	-	8
	16	0	-	-	-	-	-	-	-	-	-	-	-	-	0
	17	0	**0**	**8**	**6**	**6**	2	-	-	-	-	-	-	-	4
Mean-South Branch		-	0	41	15	6	2	9	9	20	13	80	7	23	19
Mean-Main Buctouche		0	1	7	2	4	1	5	6	20(13)	3	28	5	26	8
Mean-All Buctouche		0	1	17	7	5	1	5	7	20(17)	6	43	5	25	11
	1	-	-	-	-	-	-	**6**	**9**	**13**	**8**	**1**	30	7	11
	2	-	**1**	9	**10**	**1**	0	**3**	8	**20**	11	7	25	4	8
	3	-	**18**	**7**	**24**	**9**	**12**	**22**	**10**	**20**	**23**	**23**	38	16	18
	4	-	-	-	-	-	-	4	10	9	12	7	17	13	10
	5	-	-	-	-	-	-	4	7	4	18	4	8	-	8
	6	-	-	-	-	-	-	**6**	8	7	16	11	24	5	11
	7	-	-	-	-	-	-	18	20	15	12	5	31	8	16
	8	-	**2**	**1**	**6**	-	**7**	10	8	7	8	3	38	9	9
Small Parr	9	-	-	-	-	-	-	13	-	-	-	-	-	-	13
	10	0	-	-	-	-	-	7	-	-	-	-	-	-	4
	11	-	-	-	-	-	-	13	13	9	13	4	25	11	13
	12	-	-	-	-	-	-	0	7	0	14	6	-	-	5
	13	-	0	9	-	-	-	-	-	-	-	-	-	-	4
	14	9	**1**	**0**	**4**	-	**4**	-	-	-	-	-	-	-	4
	15	-	9	**2**	**12**	-	-	-	-	-	-	-	-	-	8
	16	13	-	-	-	-	-	-	-	-	-	-	-	-	13
	17	0	**2**	7	**3**	**2**	**5**	-	-	-	-	-	-	-	3
Mean-South Branch		-	10	4	15	9	9	15	10	12	15	10	34	12	13
Mean-Main Buctouche		7	2	5	7	2	3	6	10	10	13(9)	6	23	8	8
Mean-All Buctouche		6	5	5	10	4	6	9	10	10	14(11)	7	26	9	9
	1	-	-	-	-	-	-	**0**	**6**	**3**	**2**	**2**	3	10	4
	2	-	**0**	0	**0**	**3**	9	**2**	0	**3**	1	0	0	9	2
	3	-	**5**	**3**	**2**	**2**	**0**	**5**	**1**	**1**	**1**	**7**	0	1	2
	4	-	-	-	-	-	-	4	1	0	0	2	0	1	1
	5	-	-	-	-	-	-	4	0	4	0	7	3	-	3
	6	-	-	-	-	-	-	**3**	1	4	0	3	2	6	3
	7	-	-	-	-	-	-	2	7	11	3	7	1	5	5
	8	-	**1**	**0**	**0**	-	**2**	1	7	4	3	5	1	9	3
Large Parr	9	-	-	-	-	-	-	0	-	-	-	-	-	-	0
	10	0	-	-	-	-	-	0	-	-	-	-	-	-	0
	11	-	-	-	-	-	-	2	1	5	4	4	0	2	3
	12	-	-	-	-	-	-	0	0	0	0	3	-	-	1
	13	-	9	0	-	-	-	-	-	-	-	-	-	-	4
	14	0	**0**	**0**	**0**	-	**0**	-	-	-	-	-	-	-	0
	15	-	0	**0**	**0**	-	-	-	-	-	-	-	-	-	0
	16	0	-	-	-	-	-	-	-	-	-	-	-	-	0
	17	0	**3**	3	**0**	**0**	**1**	-	-	-	-	-	-	-	1
Mean-South Branch		-	3	2	1	2	1	3	3	3	2	5	0	4	2
Mean-Main Buctouche		0	2	1	0	2	3	2	2	4	1	3(1)	1	6	2
Mean-All Buctouche		0	3	1	0	2	2	2	2	4	1	4(3)	1	5	2
	1	-	-	-	-	-	-	**6**	**15**	**16**	**10**	**3**	33	17	14
	2	-	**1**	9	**11**	**4**	9	**5**	8	**23**	12	7	25	13	11
	3	-	**23**	**9**	**26**	**12**	**12**	**26**	**11**	**21**	**23**	**29**	38	17	21
	4	-	-	-	-	-	-	8	11	9	12	9	17	14	11
	5	-	-	-	-	-	-	8	7	8	18	11	11	-	10
	6	-	-	-	-	-	-	**9**	9	11	16	13	26	12	14
	7	-	-	-	-	-	-	20	27	26	15	13	32	13	21
	8	-	**3**	**2**	**6**	-	**9**	11	15	11	11	8	39	18	12
Total Parr	9	-	-	-	-	-	-	13	-	-	-	-	-	-	13
	10	0	-	-	-	-	-	7	-	-	-	-	-	-	4
	11	-	-	-	-	-	-	15	14	13	17	9	25	13	15
	12	-	-	-	-	-	-	0	7	0	14	8	-	-	6
	13	-	9	9	-	-	-	-	-	-	-	-	-	-	9
	14	9	**1**	**0**	**4**	-	**5**	-	-	-	-	-	-	-	4
	15	-	9	**2**	**12**	-	-	-	-	-	-	-	-	-	8
	16	13	-	-	-	-	-	-	-	-	-	-	-	-	13
	17	0	**5**	9	**3**	**3**	**6**	-	-	-	-	-	-	-	4
Mean-South Branch		-	13	5	16	12	10	18	13	15	17	15	34	16	15
Mean-Main Buctouche		7	5	6	8	3	6	8	12	13	14(10)	9(7)	24	14	9
Mean-All Buctouche		6	7	6	10	6	8	11	12	14	15(12)	11(10)	27	15	11

Table 21. Catch per 100 sq. m of all species from the Buctouche R., 1974-2002. A dash (-) indicates none caught, '0' a catch <0.5.

							Salmon					Stickle-		
Year	Site	Catfish	Chub	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Sculpin	Shiner	back	Sucker	Trout
1974	**10**	-	-	-	-	-	-	-	-	6	-	-	-	-
	14	-	1	3	-	-	-	1	-	3	-	-	-	1
	16	-	-	-	-	-	-	4	-	-	-	-	-	5
	17	-	-	8	-	-	-	-	-	-	-	-	4	1
	18	-	-	1	-	-	-	-	-	3	-	-	1	-
1977	**2**	-	1	32	0	-	-	1	-	0	-	0	-	-
	3	-	2	12	0	-	-	3	1	0	-	-	-	-
	8	-	7	18	1	-	0	1	1	-	-	0	3	-
	13	-	17	38	-	-	-	-	0	-	-	-	5	-
	14	-	2	9	-	-	-	0	-	12	-	-	1	1
	15	-	3	12	1	-	1	0	-	-	-	-	1	-
	17	0	4	24	1	0	-	1	2	0	-	0	2	-
1978	**2**	-	-	22	0	-	0	0	-	0	1	1	0	-
	3	-	-	67	0	-	39	4	3	-	26	2	2	-
	8	-	-	23	0	-	6	1	0	-	5	-	4	-
	13	-	-	25	-	-	1	-	-	-	10	3	-	-
	14	-	-	12	-	-	3	-	-	8	3	-	1	3
	15	-	-	71	-	-	11	1	-	-	6	2	6	-
	17	-	-	26	1	-	6	0	0	-	12	5	5	-
1979	**2**	-	-	41	1	-	-	5	0	1	2	0	3	-
	3	-	-	39	1	-	19	16	2	0	4	-	5	-
	8	-	-	17	1	-	-	1	-	-	1	-	2	-
	14	-	2	24	-	-	-	2	-	9	-	-	-	1
	15	-	-	23	-	-	-	5	-	-	3	-	2	-
	17	-	2	12	0	-	3	3	-	-	1	1	3	-
1980	**2**	-	-	26	-	-	1	0	2	3	0	-	1	-
	3	-	1	8	0	-	6	8	2	0	-	-	2	-
	17	-	2	12	0	-	3	1	-	1	0	0	2	-
1982	**2**	-	1	2	-	-	-	-	-	0	-	-	1	-
	3	-	1	7	1	-	2	6	0	-	-	-	-	-
	8	-	-	10	-	-	-	1	0	-	-	-	1	-
	14	-	1	16	-	-	1	3	0	10	-	-	-	1
	17	-	0	5	-	-	1	2	0	2	-	1	1	-
1996	**1**	-	-	19	0	-	2	3	-	-	-	-	2	-
	2	-	4	27	-	0	2	1	-	2	-	1	2	-
	3	-	2	26	-	2	3	3	1	0	-	0	2	-
	4	-	10	18	-	2	-	0	0	-	-	1	-	-
	5	-	34	7	-	1	1	1	1	-	-	2	13	1
	6	-	5	28	-	0	1	2	1	-	-	-	2	-
	7	-	3	20	-	-	9	10	1	0	1	0	9	-
	8	-	5	45	0	-	1	4	0	-	1	1	6	-
	9	-	2	1	-	-	1	12	-	122	-	-	-	16
	10	-	6	8	-	1	-	0	-	13	-	-	6	2
	11	-	3	39	-	-	6	5	1	0	2	1	2	-
	12	-	21	23	-	2	-	-	-	-	1	5	16	-
1997	**1**	-	1	27	-	0	3	2	2	-	-	-	0	-
	2	-	5	25	-	0	2	1	-	1	-	-	1	-
	3	-	-	14	-	1	7	4	1	1	-	-	-	-
	4	-	3	21	-	2	3	3	0	-	-	-	-	-
	5	-	30	5	-	-	7	1	-	-	-	-	1	-
	6	-	3	18	-	1	1	2	0	-	-	-	0	-
	7	-	3	16	-	0	2	9	3	0	2	-	7	-
	8	-	2	37	-	5	0	4	3	-	-	-	8	-
	11	-	3	24	-	1	3	4	0	-	0	0	0	-
	12	-	9	15	-	-	1	1	-	-	-	6	2	-
1998	**1**	-	0	23	-	-	2	4	2	-	-	-	1	-
	2	-	22	134	-	1	2	9	4	-	-	-	10	-
	3	-	4	61	-	1	24	14	2	-	-	3	3	1
	4	-	1	24	-	-	6	2	-	-	-	-	1	-
	5	-	23	1	-	1	55	1	1	-	1	2	5	1
	6	-	4	44	-	0	6	1	1	-	-	-	2	-
	7	-	0	11	-	1	7	7	5	-	-	0	3	-
	8	-	3	39	0	-	1	2	1	-	-	-	7	-
	11	-	5	35	-	4	4	3	2	-	0	0	2	-
	12	-	1	3	-	-	-	-	-	-	-	5	1	-

Table 21. Continued.

Year	Site	Catfish	Chub	Dace	Eel	Lamprey	Salmon			Sculpin	Shiner	Stickle-back	Sucker	Trout
							Fry	Sm Parr	Lg Parr					
1999	**1**	-	4	28	-	1	1	4	1	-	-	-	1	-
	2	-	4	33	-	-	0	2	0	0	5	0	2	-
	3	-	6	25	-	-	15	9	0	-	-	1	1	-
	4	-	10	44	-	2	5	3	-	-	-	2	6	-
	5	-	11	4	-	1	0	11	-	-	1	10	4	0
	6	-	14	30	-	-	1	5	-	-	2	0	3	-
	7	-	6	8	-	0	0	2	0	0	-	-	4	-
	8	-	7	36	0	0	-	2	1	0	-	0	6	-
	11	-	5	47	0	0	0	5	1	-	2	0	0	-
	12	-	8	21	-	1	-	4	-	-	7	11	4	-
2000	**1**	-	2	21	0	-	24	0	1	-	-	0	-	-
	2	-	3	43	-	-	8	0	-	0	2	1	1	-
	3	-	-	15	-	0	54	8	3	-	-	-	-	-
	4	-	1	17	0	0	16	1	0	-	-	0	0	-
	5	0	9	7	-	1	-	1	2	-	-	12	2	1
	6	-	1	19	-	0	7	3	1	-	-	0	-	-
	7	-	2	7	0	-	8	1	1	1	-	0	1	-
	8	-	8	17	-	0	17	0	1	-	-	1	2	-
	11	-	1	14	0	-	14	1	1	-	-	0	-	1
	12	-	5	26	-	0	2	1	0	-	2	4	5	-
2001	**1**	-	2	21	-	1	1	16	2	0	1	-	1	-
	2	-	6	25	-	0	2	12	-	0	-	-	2	-
	3	-	3	27	-	-	6	33	-	0	0	1	2	-
	4	-	-	32	-	0	3	9	-	-	-	2	13	-
	5	-	35	9	-	3	-	3	1	-	-	10	6	1
	6	-	3	38	-	-	5	12	1	-	-	-	-	-
	7	-	0	4	0	-	0	8	0	-	-	-	3	-
	8	-	5	24	-	-	0	18	1	0	1	1	6	-
	11	-	0	29	-	1	3	10	-	-	-	-	-	1
2002	**1**	-	5	32	-	0	12	3	5	-	2	-	1	0
	2	-	3	16	0	-	8	1	3	-	-	-	1	-
	3	-	2	23	-	-	6	6	0	-	1	1	1	-
	4	-	1	27	-	-	1	5	0	-	0	1	1	-
	6	-	1	34	-	-	22	2	2	-	-	-	0	-
	7	-	9	25	0	-	15	3	2	-	1	-	9	-
	8	-	3	28	-	0	6	5	5	-	-	-	3	-
	11	-	1	19	-	-	12	3	1	-	-	-	-	-
	Total catch	1	446	2361	13	41	541	396	78	202	109	103	260	39

Table 22. Catch per 900 seconds of all species from the Buctouche R., 1996-2002. A dash (-) indicates none caught.

							Salmon					Stickle-		
Year	Site	Catfish	Chub	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Sculpin	Shiner	back	Sucker	Trout
1996	**1**	-	-	97	2	-	10	14	-	-	-	-	8	-
	2	-	10	63	-	1	4	2	-	4	-	1	5	-
	3	-	5	56	-	4	6	7	3	1	-	1	3	-
	4	-	25	44	-	4	-	1	1	-	-	2	-	-
	5	-	38	8	-	1	1	1	1	-	-	3	14	1
	6	-	14	82	-	1	2	5	3	-	-	-	5	-
	7	-	6	41	-	-	20	21	2	1	2	1	18	-
	8	-	8	74	1	-	2	7	1	-	2	2	9	-
	9	-	2	1	-	-	1	11	-	108	-	-	-	14
	10	-	12	16	-	2	-	1	-	26	-	-	12	3
	11	-	7	111	-	-	17	13	2	1	6	2	5	-
	12	-	39	43	-	3	-	-	-	-	2	10	29	-
1997	**1**	-	3	63	-	1	8	4	4	-	-	-	1	-
	2	-	13	67	-	1	4	2	-	3	-	-	3	-
	3	-	-	30	-	2	15	9	1	1	-	-	-	-
	4	-	6	48	-	4	6	6	1	-	-	-	-	-
	5	-	30	5	-	-	7	1	-	-	-	-	1	-
	6	-	8	44	-	3	3	4	1	-	-	-	1	-
	7	-	9	49	-	1	7	26	9	1	5	-	20	-
	8	-	5	75	-	10	1	7	6	-	-	-	17	-
	11	-	9	69	-	4	9	12	1	-	1	1	1	-
	12	-	13	23	-	-	1	1	-	-	-	9	3	-
1998	**1**	-	1	62	-	-	4	12	4	-	-	-	3	-
	2	-	44	269	-	2	5	17	7	-	-	-	21	-
	3	-	7	122	-	2	48	27	4	-	-	5	5	2
	4	-	2	78	-	-	18	5	-	-	-	-	3	-
	5	-	29	2	-	1	72	1	1	-	1	3	7	2
	6	-	13	158	-	1	20	4	3	-	-	-	8	-
	7	-	1	32	-	4	18	18	14	-	-	1	7	-
	8	-	6	85	1	-	2	5	2	-	-	-	15	-
	11	-	12	88	-	9	11	7	4	-	1	1	4	-
	12	-	3	6	-	-	-	-	-	-	-	11	2	-
1999	**1**	-	12	86	-	3	2	11	2	-	-	-	2	-
	2	-	14	131	-	-	1	8	1	1	20	2	7	-
	3	-	21	81	-	-	48	31	1	-	-	2	2	-
	4	-	31	143	-	6	15	9	-	-	-	6	20	-
	5	-	19	6	-	2	1	19	-	-	2	17	8	1
	6	-	40	89	-	-	3	16	-	-	6	1	8	-
	7	-	35	51	-	2	2	12	3	3	-	-	24	-
	8	-	21	101	1	1	-	6	2	1	-	1	17	-
	11	-	14	135	1	1	1	14	4	-	6	1	1	-
	12	-	24	64	-	3	-	13	-	-	21	32	13	-
2000	**1**	-	6	83	1	-	96	1	4	-	-	1	-	-
	2	-	7	102	-	-	19	1	-	1	4	3	3	-
	3	-	-	38	-	1	134	20	6	-	-	-	-	-
	4	-	2	52	1	1	50	3	1	-	-	1	1	-
	5	1	20	15	-	3	-	3	5	-	-	26	4	2
	6	-	2	66	-	2	25	9	2	-	-	1	-	-
	7	-	9	36	2	-	37	4	6	3	-	1	6	-
	8	-	24	53	-	1	52	1	2	-	-	2	5	-
	11	-	3	40	1	-	40	2	2	-	-	1	-	2
	12	-	12	55	-	1	4	2	1	-	4	8	10	-
2001	**1**	-	6	55	-	1	3	41	4	1	1	-	1	-
	2	-	15	64	-	1	4	31	-	1	-	-	6	-
	3	-	6	43	-	-	10	53	-	1	1	2	4	-
	4	-	-	66	-	1	7	18	-	-	-	4	26	-
	5	-	63	16	-	5	-	5	2	-	-	18	11	3
	6	-	8	96	-	-	12	31	2	-	-	-	-	-
	7	-	2	20	1	-	2	42	1	-	-	-	14	-
	8	-	13	71	-	-	1	54	2	1	3	2	19	-
	11	-	1	89	-	2	10	31	-	-	-	-	-	2
2002	**1**	-	11	74	-	1	29	7	11	-	4	-	3	1
	2	-	8	46	1	-	23	4	8	-	-	-	3	-
	3	-	6	69	-	-	19	17	1	-	3	2	3	-
	4	-	3	74	-	-	2	12	1	-	1	3	2	-
	6	-	3	66	-	-	44	4	5	-	-	-	1	-
	7	-	22	60	1	-	36	7	4	-	2	-	21	-
	8	-	6	59	-	1	13	9	9	-	-	-	7	-
	11	-	4	66	-	-	41	9	2	-	-	-	-	-
	Total catch	1	871	4471	12	96	1104	810	166	158	97	187	481	31

Table 23. Mean length (mm) of fish measured from the Buctouche R., 1974-2002. Fry measurements in 1998 included an unknown number of unmarked hatchery fry, released in June.

							Salmon							
Year	Data	Catfish	Chub	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Sculpin	Shiner	Stickle-back	Sucker	Trout
1974	Mean length	-	-	-	-	-	-	96	-	-	-	-	-	-
	SD	-	-	-	-	-	-	11	-	-	-	-	-	-
	N	-	-	-	-	-	-	4	-	-	-	-	-	-
1977	Mean length	-	-	-	-	-	48	101	126	-	-	-	-	-
	SD	-	-	-	-	-	0	10	10	-	-	-	-	-
	N	-	-	-	-	-	5	47	25	-	-	-	-	-
1978	Mean length	-	-	-	-	-	48	95	126	-	-	-	-	-
	SD	-	-	-	-	-	4	9	8	-	-	-	-	-
	N	-	-	-	-	-	323	31	9	-	-	-	-	-
1979	Mean length	-	-	-	-	-	52	89	123	-	-	-	-	-
	SD	-	-	-	-	-	3	10	6	-	-	-	-	-
	N	-	-	-	-	-	102	160	6	-	-	-	-	-
1980	Mean length	-	-	-	-	-	58	100	126	-	-	-	-	-
	SD	-	-	-	-	-	4	9	9	-	-	-	-	-
	N	-	-	-	-	-	47	34	15	-	-	-	-	-
1982	Mean length	-	-	-	-	-	58	97	123	-	-	-	-	-
	SD	-	-	-	-	-	3	12	5	-	-	-	-	-
	N	-	-	-	-	-	20	83	12	-	-	-	-	-
1996	Mean length	-	53	50	212	134	54	95	121	47	47	39	52	93
	SD	-	22	12	73	19	5	10	7	17	11	10	26	41
	N	-	289	1672	6	72	126	175	31	214	30	35	174	26
1997	Mean length	-	62	55	-	126	49	97	131	62	39	50	69	-
	SD	-	19	9	-	15	5	9	9	21	6	10	32	-
	N	-	137	932	-	65	127	133	40	10	9	13	64	-
1998	Mean length	-	60	47	159	132	50	98	127	79	72	37	49	69
	SD	-	23	15	25	18	5	10	10	12	5	8	30	17
	N	-	195	1508	8	53	303	149	54	3	3	32	124	6
1999	Mean length	-	46	47	290	133	47	90	124	50	40	36	59	105
	SD	-	22	15	127	29	3	10	10	11	14	9	28	81
	N	-	287	703	2	73	170	230	18	7	58	65	112	3
2000	Mean length	85	57	53	232	129	53	94	127	62	56	38	79	94
	SD	-	23	12	88	19	4	11	11	18	4	11	29	69
	N	1	140	367	6	23	934	80	41	9	8	59	34	6
2001	Mean length	-	60	52	200	121	60	87	121	67	55	42	76	69
	SD	-	24	12	-	36	6	9	6	13	11	12	32	23
	N	-	86	264	1	12	56	349	13	4	6	32	91	5
2002	Mean length	-	55	52	218	120	53	99	124	-	57	34	68	165
	SD	-	17	10	25	21	4	9	7	-	11	3	38	-
	N	-	65	266	2	2	220	73	43	-	10	5	41	1

Table 24. Density of juvenile Atlantic salmon in the Cocagne R., 1974-2002. Values are predicted from cpua (1974) or cpue (1999-2002). A dash (-) indicates site not fished, '0' a density <0.5 or none caught.

Salmon Stage	Site	1974	1999	2000	2001	2002	Mean
	1	-	6	109	19	60	48
	2	-	1	27	5	1	8
Fry	**3**	-	-	-	1	1	1
	4	0	-	-	-	-	0
	Mean	0	3	68	8	21	20
	1	-	32	8	34	16	22
	2	-	17	5	15	10	12
Small Parr	**3**	-	-	-	27	10	18
	4	13	-	-	-	-	13
	Mean	13	25	6	25	12	16
	1	-	1	9	4	10	6
	2	-	2	6	0	3	3
Large Parr	**3**	-	-	-	0	8	4
	4	0	-	-	-	-	0
	Mean	0	1	8	1	7	3
	1	-	33	17	38	26	28
	2	-	19	11	15	13	15
Total Parr	**3**	-	-	-	27	18	22
	4	13	-	-	-	-	13
	Mean	13	26	14	27	19	20

Table 25. Catch per 100 sq. m of all species from the Cocagne R., 1974-2002. A dash (-) indicates none caught, '0' a catch <0.5.

Arranged by					Salmon					Stickle-		
Year	Site	Chub	Dace	Eel	Fry	Sm Parr	Lg Parr	Sculpin	Shiner	back	Sucker	Trout
1974	**4**	-	2	-	-	4	-	-	-	-	-	2
1999	**1**	4	68	0	1	9	0	-	1	0	15	0
	2	12	30	1	0	5	1	-	5	2	19	-
2000	**1**	0	20	-	33	2	3	-	-	-	4	0
	2	7	31	0	13	1	2	-	-	0	5	1
2001	**1**	3	27	-	10	25	3	-	-	-	6	1
	2	10	33	-	2	6	-	-	1	-	5	1
	3	2	30	-	0	16	-	3	-	1	3	3
2002	**1**	2	25	-	27	9	6	-	-	0	0	-
	2	1	43	0	0	3	1	-	-	-	2	-
	3	1	75	-	0	5	4	2	-	-	4	2
	Total catch	42	383	1	89	85	19	5	7	4	63	11

Table 26. Catch per 900 seconds of all species from the Cocagne R., 1999-2002. A dash (-) indicates none caught.

Arranged by					Salmon					Stickle-		
Year	Site	Chub	Dace	Eel	Fry	Sm Parr	Lg Parr	Sculpin	Shiner	back	Sucker	Trout
1999	**1**	17	316	1	6	44	1	-	3	1	70	1
	2	46	114	2	1	19	2	-	20	8	74	-
2000	**1**	2	70	-	113	8	9	-	-	-	13	1
	2	15	65	1	28	3	4	-	-	1	10	3
2001	**1**	6	52	-	20	48	6	-	-	-	12	3
	2	24	81	-	5	15	-	-	2	-	13	2
	3	5	64	-	1	34	-	6	-	2	6	7
2002	**1**	5	57	-	62	20	13	-	-	1	1	-
	2	2	113	1	1	9	3	-	-	-	4	-
	3	2	158	-	1	10	8	5	-	-	7	4
	Total catch	122	1090	5	237	209	46	11	26	12	211	20

Table 27. Mean length (mm) of fish measured from the Cocagne R., 1974-2002.

Year	Data	Chub	Dace	Eel	Salmon			Sculpin	Shiner	Stickle-back	Sucker	Trout
					Fry	Sm Parr	Lg Parr					
1974	**Mean length**	-	-	-	-	94	-	-	-	-	-	-
	SD	-	-	-	-	3	-	-	-	-	-	-
	N	-	-	-	-	3	-	-	-	-	-	-
1999	**Mean length**	64	42	333	62	87	131	-	47	31	58	147
	SD	19	14	115	10	10	15	-	15	3	24	-
	N	67	133	3	8	71	3	-	25	9	91	1
2000	**Mean length**	71	54	600	53	103	124	-	-	35	55	58
	SD	17	10	-	4	10	7	-	-	-	17	4
	N	18	60	1	174	13	16	-	-	1	28	4
2001	**Mean length**	64	49	-	57	85	125	71	30	55	73	83
	SD	19	12	-	6	8	7	13	2	1	34	42
	N	40	98	-	28	107	6	7	3	2	36	13
2002	**Mean length**	59	49	460	50	97	120	70	-	33	74	94
	SD	11	9	-	4	11	6	19	-	-	27	17
	N	9	93	1	68	42	26	5	-	1	14	4

Table 28. Age at length for juvenile Atlantic salmon collected from southeastern New Brunswick rivers, 1974-2001.

River	Site	Year	Month	Day	Forklength mm	Age	River	Site	Year	Month	Day	Forklength mm	Age
Black	2	1984	9	11	75	1	Buctouche	8	1998	8	5	49	0
Black	2	1984	9	11	83	1	Buctouche	11	1998	8	10	53	0
Black	2	1984	9	11	97	1	Buctouche	8	1998	8	5	54	0
Black	2	1984	9	11	102	1	Buctouche	4	1998	8	14	56	0
Black	2	1984	9	11	118	2	Buctouche	7	1998	8	5	57	0
Kouchibouguac	3	2001	8	22	47	0	Buctouche	3	1998	8	13	58	0
Kouchibouguac	3	2001	8	22	52	0	Buctouche	11	1998	8	10	60	0
Kouchibouguac	3	2001	8	22	58	0	Buctouche	3	2001	9	12	60	0
Kouchibouguac	3	2001	8	22	60	0	Buctouche	2	1998	8	11	61	0
Kouchibouguac	3	2001	8	22	61	0	Buctouche	3	2001	9	12	61	0
Kouchibouguac	3	2001	8	22	79	1	Buctouche	3	2001	9	12	66	0
Kouchibouguac	3	2001	8	22	82	1	Buctouche	4	2001	9	13	67	0
Kouchibouguac	3	2001	8	22	85	1	Buctouche	3	2001	9	12	69	0
Kouchibouguac	9	1974	10	10	87	1	Buctouche	3	2001	9	12	71	0
Kouchibouguac	9	1974	10	10	89	1	Buctouche	3	2001	9	12	71	0
Kouchibouguac	3	2001	8	22	92	1	Buctouche	3	2001	9	12	72	1
Kouchibouguac	3	2001	8	22	93	1	Buctouche	4	1998	8	14	73	1
Kouchibouguac	9	1974	10	10	98	1	Buctouche	4	1998	8	14	74	1
Kouchibouguac	3	2001	8	22	101	1	Buctouche	3	2001	9	12	74	1
Kouchibouguac	14	1974	10	10	104	1	Buctouche	3	2001	9	12	75	1
Kouchibouguac	3	2001	8	22	112	2	Buctouche	3	2001	9	12	78	1
Kouchibouguac	3	2001	8	22	113	2	Buctouche	3	1998	8	13	80	1
Kouchibouguac	14	1974	10	10	114	1	Buctouche	3	1998	8	13	80	1
Kouchibouguac	3	2001	8	22	114	1	Buctouche	3	2001	9	12	80	1
Kouchibouguac	3	2001	8	22	114	2	Buctouche	3	2001	9	12	80	1
Kouchibouguac	11	1974	10	10	120	1	Buctouche	3	1998	8	13	82	1
Kouchibouguac	14	1974	10	10	121	1	Buctouche	6	1998	8	14	85	1
Kouchibouguac	3	2001	8	22	121	2	Buctouche	2	1998	8	11	85	1
Kouchibouguac	3	2001	8	22	121	2	Buctouche	3	1998	8	13	89	1
Kouchibouguac	11	1974	10	10	124	1	Buctouche	14	1974	10	15	93	1
Kouchibouguacis	2	1974	10	10	75	1	Buctouche	8	1998	8	5	95	1
Kouchibouguacis	2	1974	10	10	85	1	Buctouche	8	1998	8	5	95	1
Kouchibouguacis	2	1974	10	10	88	1	Buctouche	7	1998	8	5	97	1
Kouchibouguacis	2	1974	10	10	91	1	Buctouche	8	1998	8	5	100	1
Kouchibouguacis	2	1974	10	10	119	2	Buctouche	8	1998	8	5	102	1
Richibucto	C3	2001	9	13	64	0	Buctouche	8	1998	8	5	106	1
Richibucto	C2	2001	9	14	66	0	Buctouche	14	1974	10	15	111	1
Richibucto	C3	1974	10	11	67	0	Buctouche	7	1998	8	5	112	1
Richibucto	C2	2001	9	14	67	0	Buctouche	8	1998	8	5	114	1
Richibucto	C5	1974	10	11	80	1	Buctouche	7	1998	8	5	130	2
Richibucto	C5	1974	10	11	81	1	Buctouche	8	1998	8	5	136	2
Richibucto	C5	1974	10	11	85	1	Buctouche	7	1998	8	5	136	2
Richibucto	C5	1974	10	11	89	1	Buctouche	7	1998	8	5	145	2
Richibucto	C3	1974	10	11	90	1	Buctouche	1	1998	8	7	151	2
Richibucto	C3	1974	10	11	105	1	Buctouche	1	1998	8	7	153	2
Richibucto	C3	1974	10	11	110	1	Buctouche	2	1998	8	11	155	2
Richibucto	C3	1974	10	11	112	2	Cocagne	4	1974	10	9	91	1
Richibucto	C3	1974	10	11	114	1	Cocagne	4	1974	10	9	94	1
Richibucto	C3	1974	10	11	120	2	Cocagne	4	1974	10	9	96	1
Richibucto	C3	1974	10	11	124	2	Cocagne	4	1974	10	9	97	1

Table 29. Total (fry+parr) percent habitat saturation (PHS) values for the Kouchibouguac, Kouchibouguacis, Richibucto, Coal Branch, Buctouche and Cocagne rivers, 1974-2003.

River		Site	1974	1977	1978	1979	1980	1982	1996	1997	1998	1999	2000	2001	2002	2003	Mean
Kouchibouguac		**1**	-	-	-	-	-	-	-	-	-	27	31	25	21	-	26
		2	-	-	-	-	-	-	-	-	-	34	23	14	19	-	23
		3	-	-	-	-	-	-	-	-	-	-	17	23	29	-	23
		4	-	-	-	-	-	-	-	-	-	-	18	-	-	-	18
		5	-	6	34	-	-	4	-	-	-	-	14	-	-	-	14
		6	-	22	-	-	-	-	-	-	-	-	-	-	-	-	22
		7	-	7	-	-	-	-	-	-	-	-	-	-	-	-	7
		8	-	15	38	-	-	-	-	-	-	-	-	-	-	-	26
		9	-	4	8	-	-	4	-	-	-	-	-	-	-	-	5
		10	-	24	33	-	-	18	-	-	-	-	-	-	-	-	25
		15	12	-	-	-	-	-	-	-	-	-	-	-	-	-	12
		Min	12	4	8	-	-	4	-	-	-	27	14	14	19	-	
		Max	12	24	38	-	-	18	-	-	-	34	31	25	29	-	
		Mean	12	13	28	-	-	8	-	-	-	31	20	21	23	-	**20**
Kouchibouguacis		**1**	-	-	-	-	-	-	-	-	-	-	8	9	13	8	9
		2	9	-	-	-	-	-	-	-	-	-	8	11	10	8	9
		3	-	-	-	-	-	-	-	-	-	-	-	11	12	12	11
		Min	9	-	-	-	-	-	-	-	-	-	8	9	10	8	
		Max	9	-	-	-	-	-	-	-	-	-	8	11	13	12	
		Mean	9	-	-	-	-	-	-	-	-	-	8	10	12	9	**10**
Richibucto		**C1**	12	-	-	-	-	-	-	15	-	-	-	-	-	-	13
		C2	-	-	-	-	-	-	-	15	10	8	13	13	14	-	12
		C3	16	-	-	-	-	-	-	-	-	7	8	12	17	-	12
		C5	-	-	-	-	-	-	-	-	-	-	-	12	-	-	12
		C6	12	-	-	-	-	-	-	-	-	-	-	-	-	-	12
		M1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
		N9	7	-	-	-	-	-	-	-	-	-	-	-	-	-	7
		R1	15	-	-	-	-	7	-	13	14	8	14	11	17	-	12
		R2	15	-	-	-	-	27	-	17	13	17	22	22	20	-	19
		R3	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2
	Richibucto	**Min**	15	-	-	-	-	2	-	13	13	8	14	11	17	-	
		Max	15	-	-	-	-	27	-	17	14	17	22	22	20	-	
		Mean	15	-	-	-	-	12	-	15	13	13	18	16	19	-	**15**
	Coal Branch	**Min**	12	-	-	-	-	-	-	15	10	7	8	12	14	-	
		Max	16	-	-	-	-	-	-	15	10	8	13	13	17	-	
		Mean	14	-	-	-	-	-	-	15	10	8	11	12	16	-	**12**
Buctouche		**1**	-	-	-	-	-	-	4	17	15	7	14	23	22	-	15
		2	-	1	8	7	5	13	4	5	21	8	8	13	17	-	9
		3	-	18	14	17	10	8	20	8	18	15	38	18	15	-	17
		4	-	-	-	-	-	-	5	8	7	8	14	9	10	-	9
		5	-	-	-	-	-	-	5	7	13	7	12	8	-	-	9
		6	-	-	-	-	-	-	7	6	11	10	13	17	15	-	11
		7	-	-	-	-	-	-	16	24	28	11	18	17	17	-	19
		8	-	3	2	3	-	8	7	14	10	8	14	19	19	-	10
		9	-	-	-	-	-	-	7	-	-	-	-	-	-	-	7
		10	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3
		11	-	-	-	-	-	-	13	11	13	11	13	13	15	-	12
		12	-	-	-	-	-	-	-	6	-	8	8	-	-	-	7
		13	-	17	7	-	-	-	-	-	-	-	-	-	-	-	12
		14	7	0	1	2	-	3	-	-	-	-	-	-	-	-	3
		15	-	9	4	7	-	-	-	-	-	-	-	-	-	-	7
		16	7	-	-	-	-	-	-	-	-	-	-	-	-	-	7
		17	-	5	8	2	3	5	-	-	-	-	-	-	-	-	5
	South Branch	**Min**	-	3	2	3	10	8	7	8	10	8	13	13	15	-	
		Max	-	18	14	17	10	8	20	14	18	15	38	19	19	-	
		Mean	-	11	8	10	10	8	14	11	14	11	22	17	16	-	12
	Main stem	**Min**	7	0	1	2	3	3	4	5	7	7	8	8	10	-	
		Max	7	17	8	7	5	13	16	24	28	11	18	23	22	-	
		Mean	7	7	5	5	4	7	7	10	16	9	12	14	16	-	9
	All Buctouche	**Min**	7	0	1	2	3	3	3	5	7	7	8	8	10	-	
		Max	7	18	14	17	10	13	20	24	28	15	38	23	22	-	
		Mean	7	8	6	6	6	7	8	11	15	9	15	15	16	-	**10**
Cocagne		**1**	-	-	-	-	-	-	-	-	-	17	32	22	27	-	25
		2	-	-	-	-	-	-	-	-	-	12	13	7	10	-	10
		3	-	-	-	-	-	-	-	-	-	-	-	14	17	-	15
		4	8	-	-	-	-	-	-	-	-	-	-	-	-	-	8
		Min	8	-	-	-	-	-	-	-	-	12	13	7	10	-	
		Max	8	-	-	-	-	-	-	-	-	17	32	22	27	-	
		Mean	8	-	-	-	-	-	-	-	-	14	23	15	18	-	**15**

Table 30. Summary of adult salmon spawning returns, spawning escapement, and egg deposition in the Buctouche R. The conservation requirement for the Buctouche River is 1.586 million eggs, based on an egg deposition rate of 240 eggs per 100 sq. m of habitat (CAFSAC 1991) and a habitat area estimate of 661,200 sq. m (Atkinson and Peters 2001). Large salmon are 63 cm or more, small salmon <63 cm.

	Spawning Returns		Spawning Escapement		% Egg Requirement met		Egg Deposition Rate
Year	Large	Small	Large	Small	Returns	Escapement	per 100 sq. m
1993	95	78	94	21	38%	35%	84
1994	225	77	212	59	77%	72%	173
1995	154	98	147	67	61%	58%	139
1996	134	127	124	78	49%	46%	110
1997	200	97	191	67	74%	70%	168
1998	102	92	101	91	33%	33%	79
1999	244	115	244	111	103%	102%	245
2000	100	38	100	28	37%	36%	86

Table 31. Percent egg to fry survival estimates for the Buctouche R., 1996-2001.

	Mean fry density (# / 100 sq. m)				
Year	Main river	South Branch	Buctouche[1]	Egg deposition rate (eggs / 100 sq. m) in year-1	Egg to fry Survival (%)
1996	4.8	8.5	6.0	139	4%
1997	5.8	8.5	6.7	110	6%
1998	13.0	20.1	15.3	168	9%
1999	3.2	13.2	6.4	79	8%
2000	28.0	79.5	44.5	245	18%
2001	4.6	6.8	5.3	86	6%
Mean	9.9	22.8	14.0	138	9%

[1] Buctouche density derived from Main river and South branch densities weighted by Proportion of total habitat represented by Main river (0.68) and South Branch (0.32).

Table 32. Percent survival estimates between stages of juvenile Atlantic salmon for Kouchibouguac, Richibucto, Coal Branch, Buctouche and Cocagne rivers.

		Mean density (# / 100 sq. m)			Survival rates (Year+1 / year, %)		
			Parr		Fry to	Small to	Small to
River	Year	Fry	Small	Large	Small	Large	Large (Adj.)[1]
Kouchibouguac	**1977**	12.3	9.2		68%	32%	56%
	1978		8.4	2.9			
	1999	57.3	31.3		36%	10%	18%
	2000	49.3	20.8	3.2	54%	8%	15%
	2001	25.4	26.8	1.7	64%	21%	37%
	2002		16.2	5.6			
	Mean				56%	18%	32%
Richibucto	**1997**	10.4	16.7		(105%)	14%	26%
	1998	13.8	10.9	2.4	70%	18%	33%
	1999	31.9	9.7	2.0	19%	47%	85%
	2000	58.1	6.0	4.6	31%	33%	60%
	2001	24.6	17.9	2.0	63%	16%	28%
	2002		15.6	2.8			
	Mean[2]				46%	26%	46%
Coal Branch	**1997**	6.4	8.7		(139%)	54%	96%
	1998	1.9	8.9	4.7	(574%)	15%	26%
	1999	3.9	10.4	1.3	(197%)	0%	0%
	2000	32.9	7.7	0.0	65%	10%	19%
	2001	2.5	21.4	0.8	(224%)	28%	49%
	2002		5.6	5.9			
	Mean[2]				65%	21%	38%
Buctouche	**1977**		4.6			17%	31%
	1978	16.9	5.0	0.8	59%	8%	14%
	1979	6.6	9.9	0.4	61%	19%	34%
	1980		4.0	1.9			
	1996	5.0	8.8		(202%)	27%	49%
	1997	6.7	10.1	2.4	(152%)	35%	62%
	1998	16.7	10.2	3.5	66%	13%	23%
	1999	6.2	11.0	1.3	(115%)	24%	42%
	2000	43.4	7.1	2.6	61%	15%	28%
	2001	5.3	26.3	1.1	(174%)	21%	37%
	2002		9.2	5.4			
	Mean[2]				63%	22%	40%
Cocagne	**1999**	3.5	24.8		(174%)	31%	55%
	2000	67.9	6.1	7.6	37%	21%	38%
	2001	8.3	25.4	1.3	(142%)	28%	50%
	2002		11.8	7.1			
	Mean[2]				37%	27%	48%
Mean[2] of Means					53%	23%	41%

[1] Small to large survival adjusted to account for on average, 56% of adults returning to the Buctouche River being three or four year old smolts, 44% two year old smolts.

[2] Values in brackets (>100%) are excluded from the calculation of means.

Table 33. Mean annual catch per 100 sq. m for Kouchibouguac, Kouchibouguacis, Richibucto, Coal Branch, Buctouche and Cocagne rivers, 1974-2003. A dash (-) indicates no catch, '0' a catch <0.5.

							Salmon					Stickle-		
River	Year	No. of Sites/(Yrs)	Chub	Dace	Eel	Lamprey	Fry	Sm Parr	Lg Parr	Sculpin	Shiner	back	Sucker	Trout
Kouchibouguac	1974	9	-	8	1	-	1	6	2	6	-	-	1	3
	1977	6	-	16	2	-	6	5	3	10	-	1	2	7
	1978	4	-	29	3	-	66	6	2	35	-	3	6	7
	1982	3	-	5	1	-	4	2	1	2	-	0	0	1
	1999	2	-	20	1	-	14	10	2	1	-	0	1	2
	2000	5	-	12	0	0	11	6	1	3	-	0	0	1
	2001	3	-	3	-	0	5	6	0	0	-	-	1	1
	2002	3	-	7	-	0	14	6	2	1	-	0	0	1
	Mean-all years	(8)	-	13	1	0	15	6	2	7	-	1	1	3
Kouchibouguacis	1974	4	-	15	3	-	1	4	-	-	-	-	3	3
	2000	2	-	16	-	-	1	2	0	-	1	-	1	-
	2001	3	2	19	-	1	1	2	1	-	1	-	2	-
	2002	3	2	10	0	-	3	0	1	-	1	-	2	-
	2003	3	0	8	0	0	2	1	0	-	1	-	0	0
	Mean-all years	(5)	1	14	1	1	2	2	0	-	1	-	2	1
Richibucto	1974	4	2	2	-	-	1	3	1	3	1	-	4	3
	1982	3	-	3	0	-	0	2	0	0	-	-	0	-
	1997	2	2	24	0	0	4	8	1	4	-	-	0	-
	1998	2	1	18	0	0	4	3	1	4	3	0	0	-
	1999	2	2	43	0	1	9	2	1	-	1	1	5	-
	2000	2	0	4	0	0	14	3	0	0	-	1	-	-
	2001	2	1	15	0	0	9	7	1	-	-	-	0	-
	2002	2	1	12	1	1	10	6	1	-	0	0	-	-
	Mean-all years	(8)	1	15	0	0	6	4	1	2	1	1	2	3
Coal Branch	1974	4	1	5	-	-	2	6	1	-	-	-	2	-
	1982	3	5	7	0	-	-	1	1	-	2	1	2	-
	1997	2	3	20	-	1	2	3	2	4	2	1	2	-
	1998	2	4	17	-	2	1	3	2	0	1	2	1	-
	1999	2	4	38	-	-	1	2	0	-	3	-	1	0
	2000	2	1	18	-	0	7	0	-	1	1	1	0	0
	2001	3	3	13	1	1	1	10	1	-	1	1	1	-
	2002	3	2	8	0	0	7	2	2	0	-	1	1	-
	Mean-all years	(8)	3	16	0	1	3	3	1	1	2	1	1	0
Buctouche	1974	3	1	6	-	-	-	2	-	3	-	-	4	3
	1977	7	5	21	1	0	1	1	1	3	-	0	2	1
	1978	7	-	35	0	-	10	2	1	4	9	2	3	3
	1979	6	2	26	1	-	11	5	1	4	2	1	3	1
	1980	3	1	15	0	-	3	3	2	1	0	0	2	-
	1982	5	1	8	1	-	1	3	0	4	-	1	1	1
	1996	10	10	25	0	1	3	3	1	1	1	1	6	1
	1997	10	7	20	-	1	3	3	1	1	1	3	3	-
	1998	10	6	38	0	1	12	5	2	-	1	2	3	1
	1999	10	7	28	0	1	3	5	1	0	3	3	3	0
	2000	10	3	19	0	1	17	2	1	1	2	2	2	1
	2001	9	7	23	0	1	3	13	1	0	1	4	5	1
	2002	8	3	26	0	0	10	3	2	-	1	1	2	0
	Mean-all years	(13)	4	22	0	1	6	4	1	2	2	2	3	1
Cocagne	1999	2	8	49	0	-	1	7	0	0	3	1	17	0
	2000	2	4	26	0	-	23	2	2	0	0	0	4	1
	2001	3	5	30	0	-	4	16	1	1	0	0	5	2
	2002	3	1	48	0	-	9	6	4	1	0	0	2	1
	Mean-all years	(4)	4	38	0	-	9	8	2	0	1	0	7	1

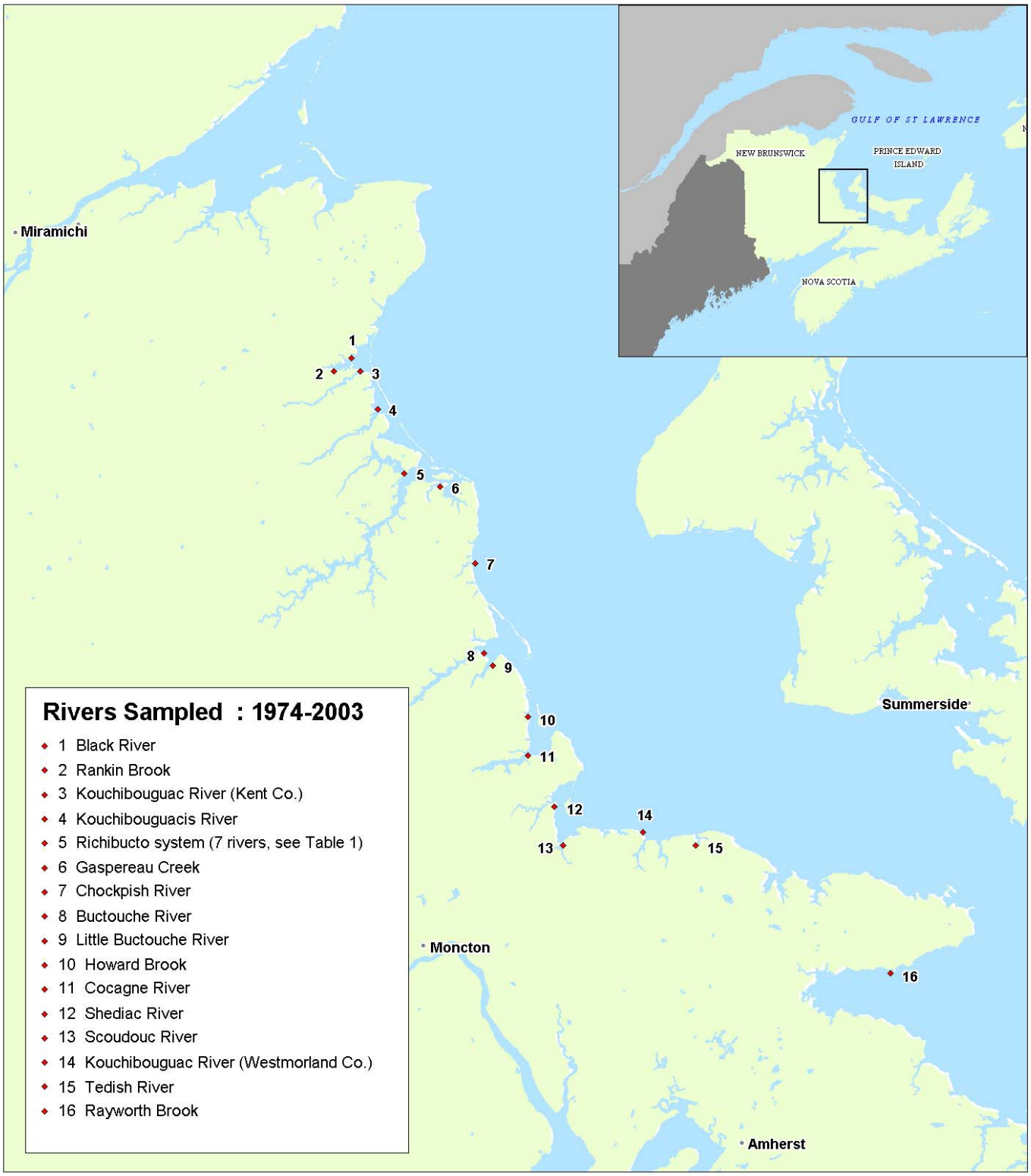

Figure 1. General location of rivers electrofished in southeastern New Brunswick, 1974-2003.

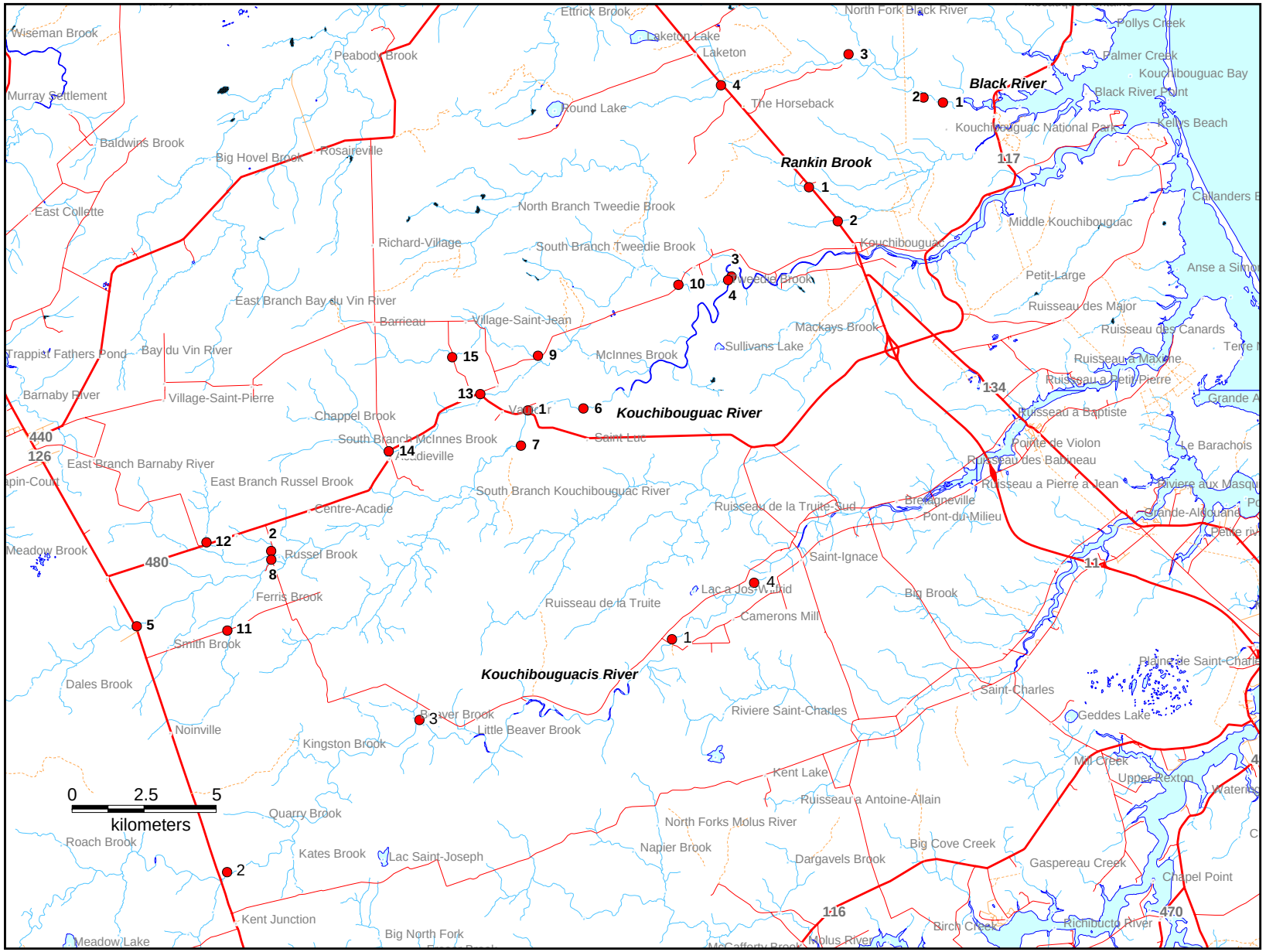

Figure 2. Site locations on Rankin Brook, Black, Kouchibouguac (Kent Co.) and Kouchibouguacis rivers.

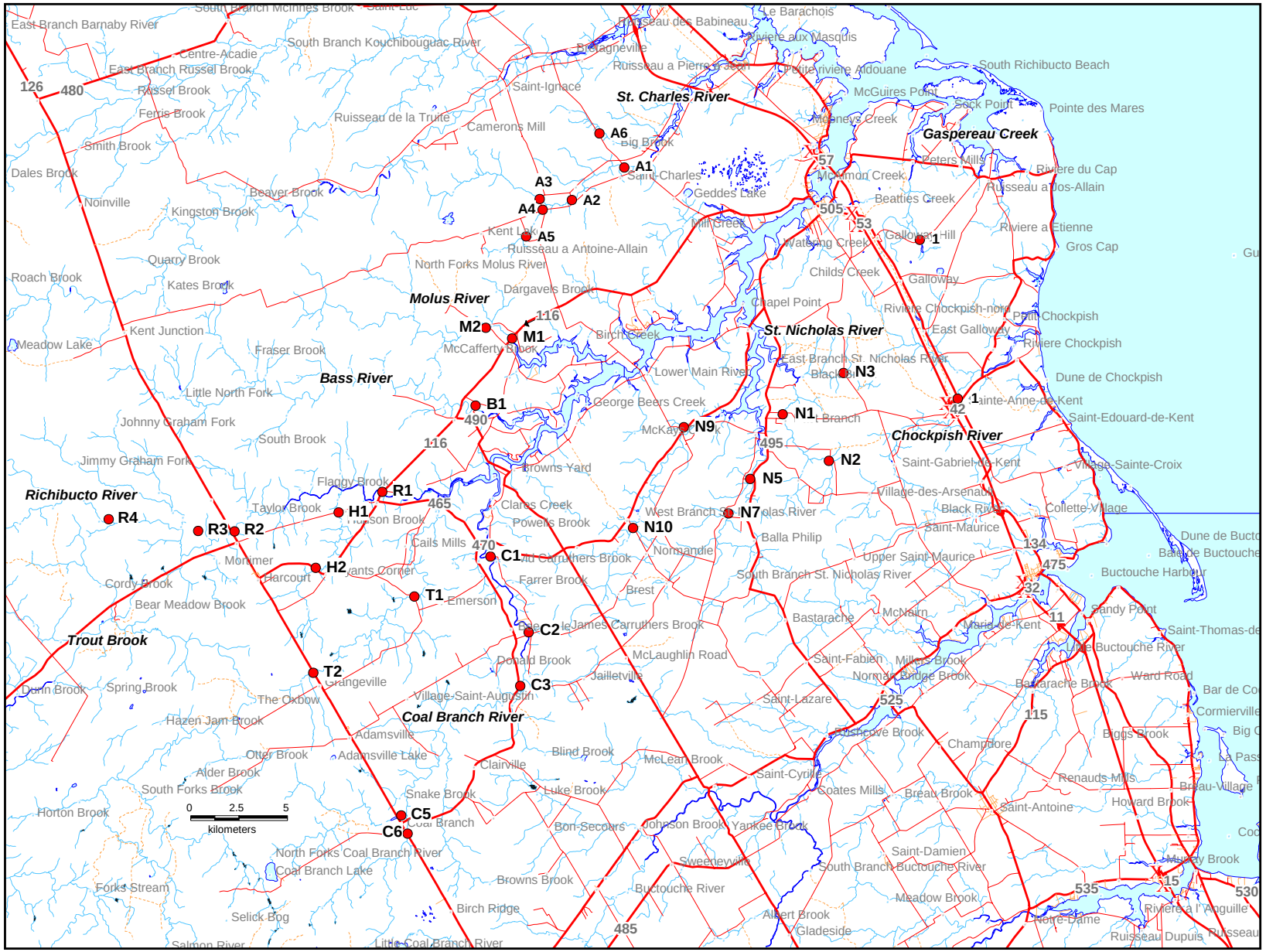

Figure 3. Site locations on the Richibucto system, Gaspereau Creek and Chockpish River.

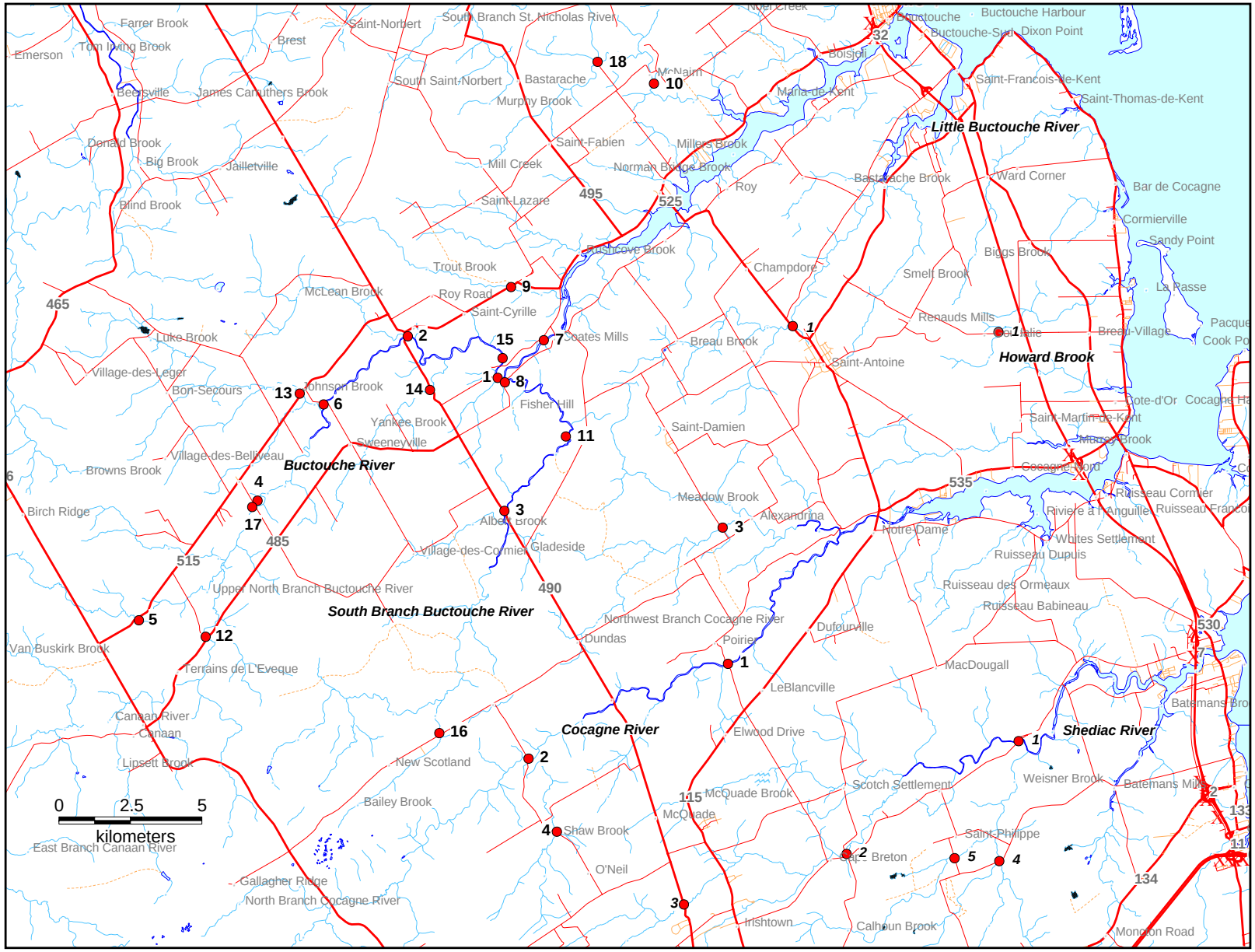

Figure 4. Site locations on the Buctouche, Little Buctouche, Howard Brook, Cocagne and Shediac rivers.

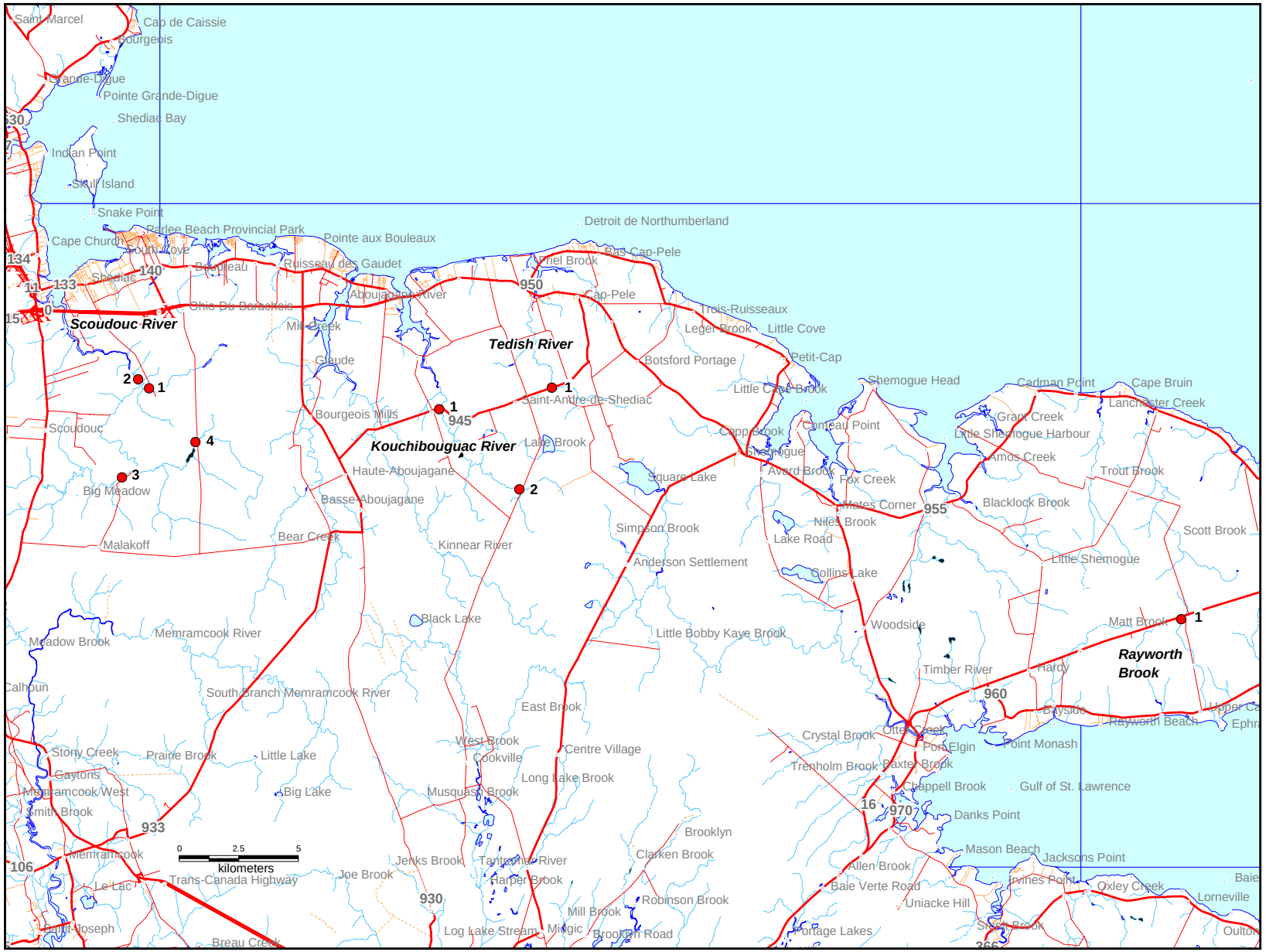

Figure 5. Site locations on the Scoudouc, Kouchibouguac (Westmorland Co.) and Tedish rivers, and Rayworth Brook.

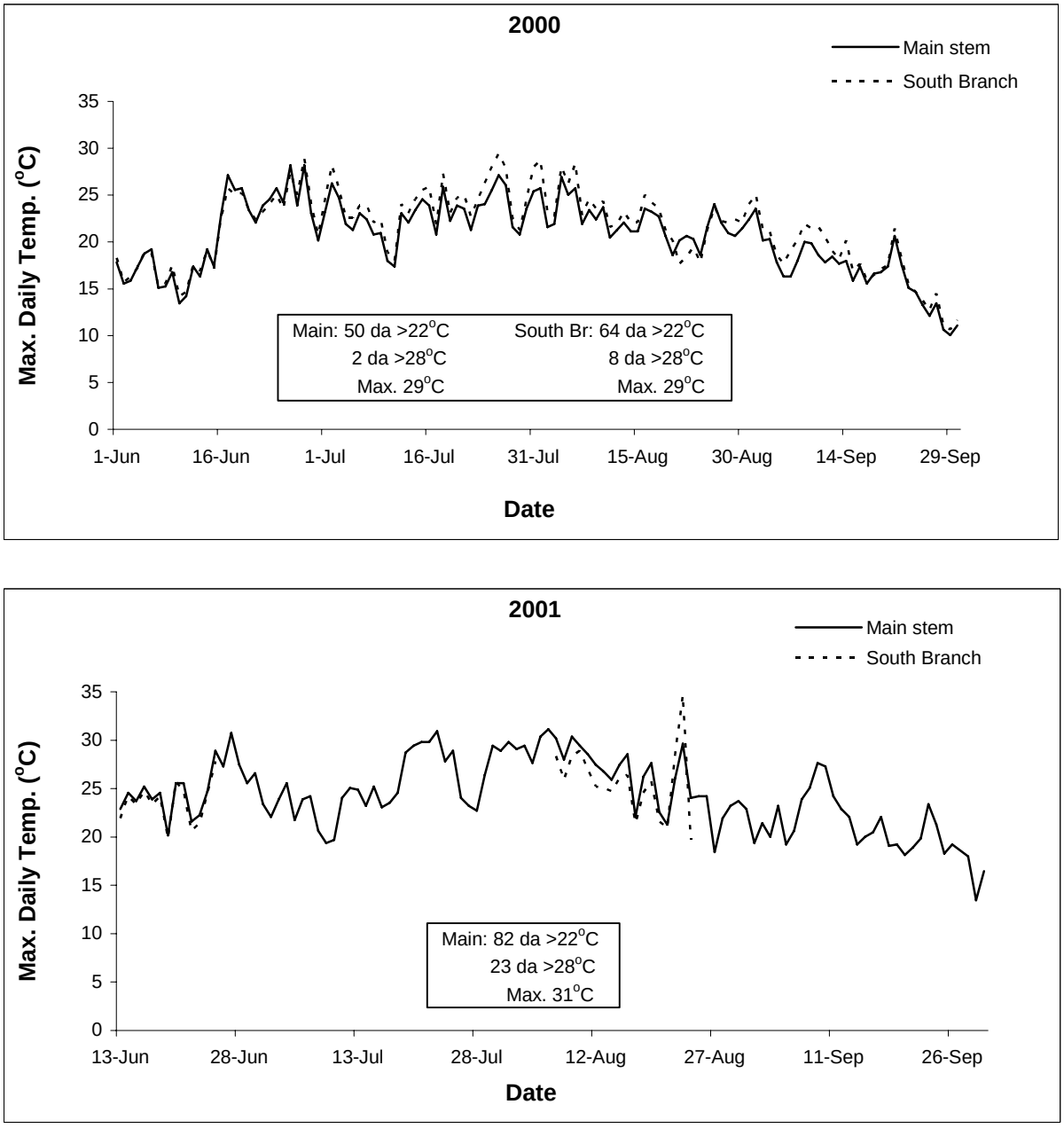

Figure 6. Maximum daily water temperature (°C) in the main stem and South Branch, Buctouche R., 2000 (upper panel) and 2001 (lower panel). South Branch recordings were discontinuous in 2001 due to tampering with the recorder.

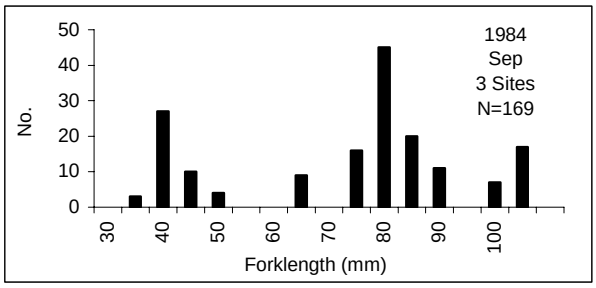

Figure 7. Length frequency of juvenile Atlantic salmon from the Black R., 1984. All sites combined.

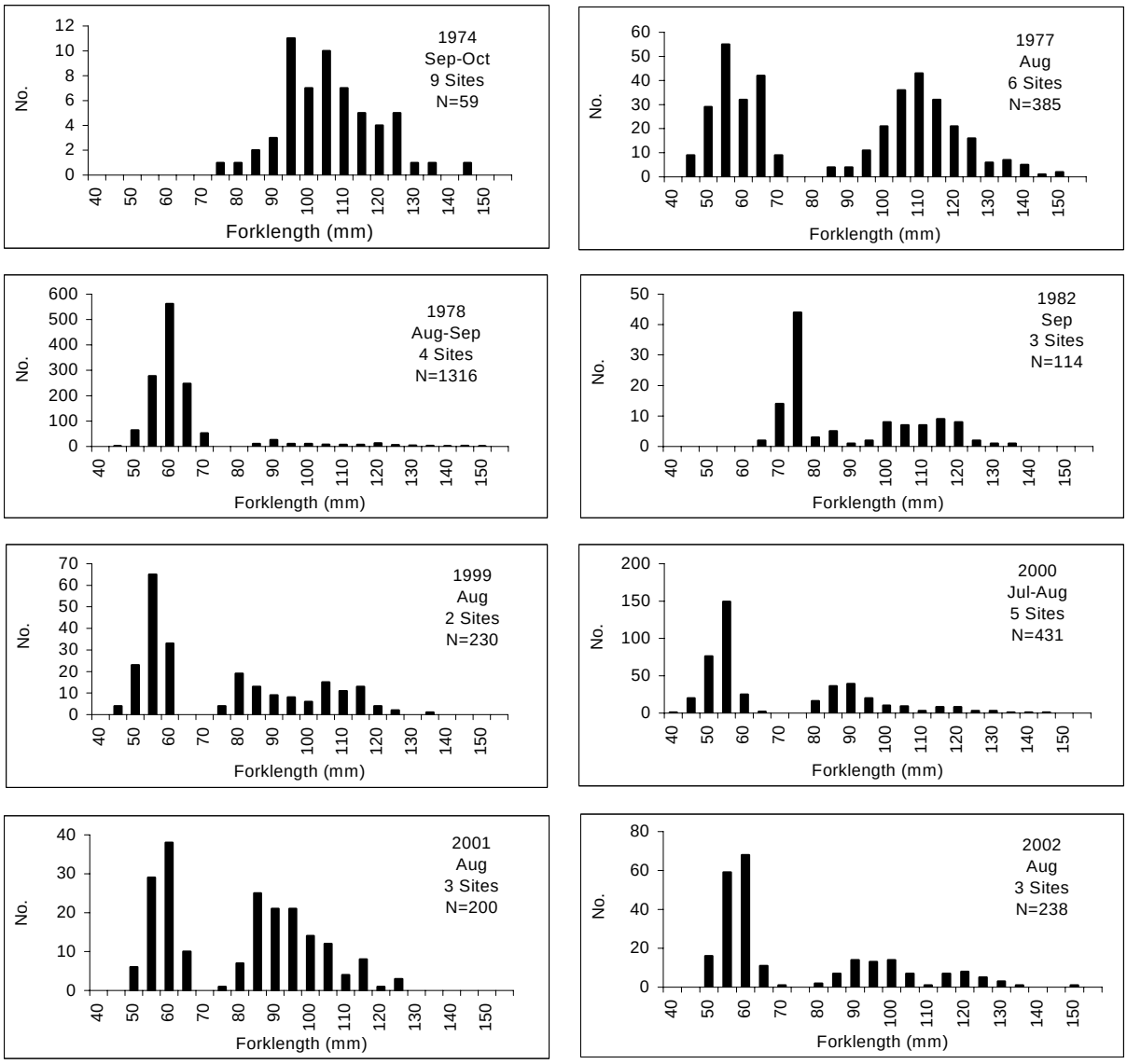

Figure 8. Length frequency of juvenile Atlantic salmon from the Kouchibouguac R., 1974-2002. All sites combined in a given year.

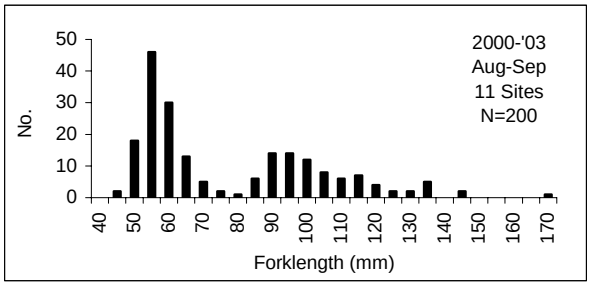

Figure 9. Length frequency of juvenile Atlantic salmon from the Kouchibouguacis R., 2000-2003. All sites combined.

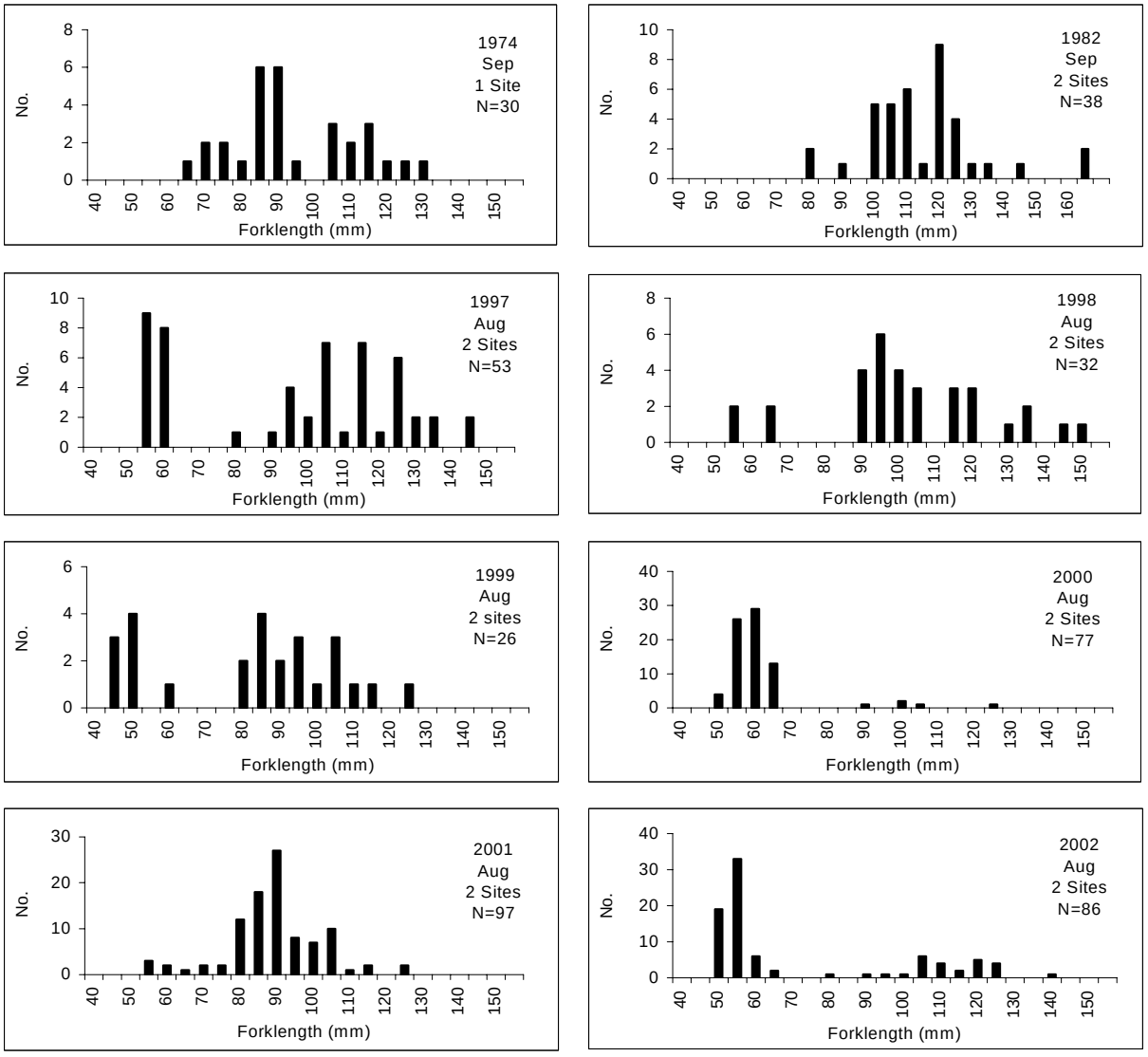

Figure 10. Length frequency of juvenile Atlantic salmon from Coal Branch, 1974-2002. All sites combined in a given year.

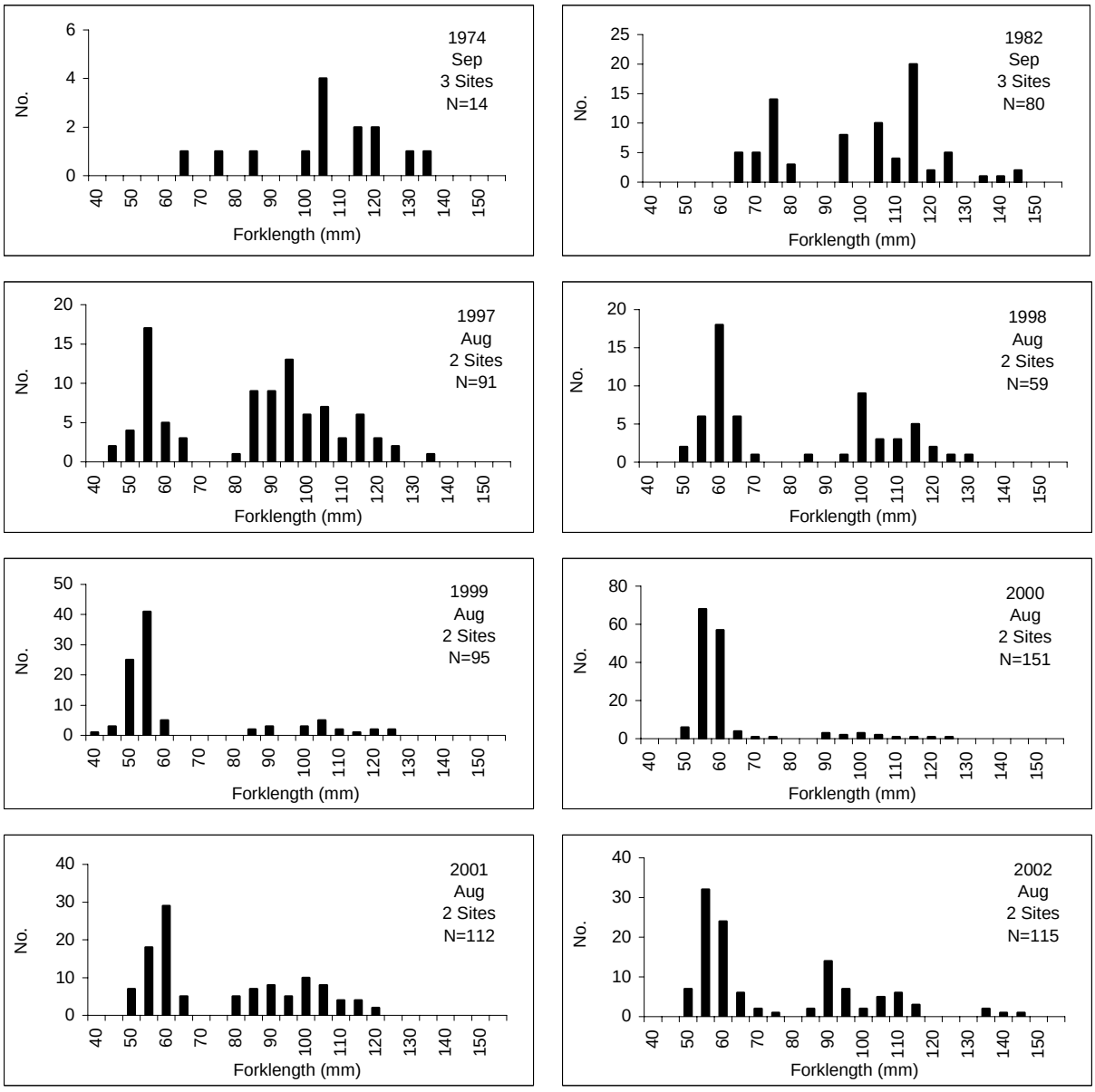

Figure 11. Length frequency of juvenile Atlantic salmon from the Richibucto R., 1974-2002. All sites combined in a given year.

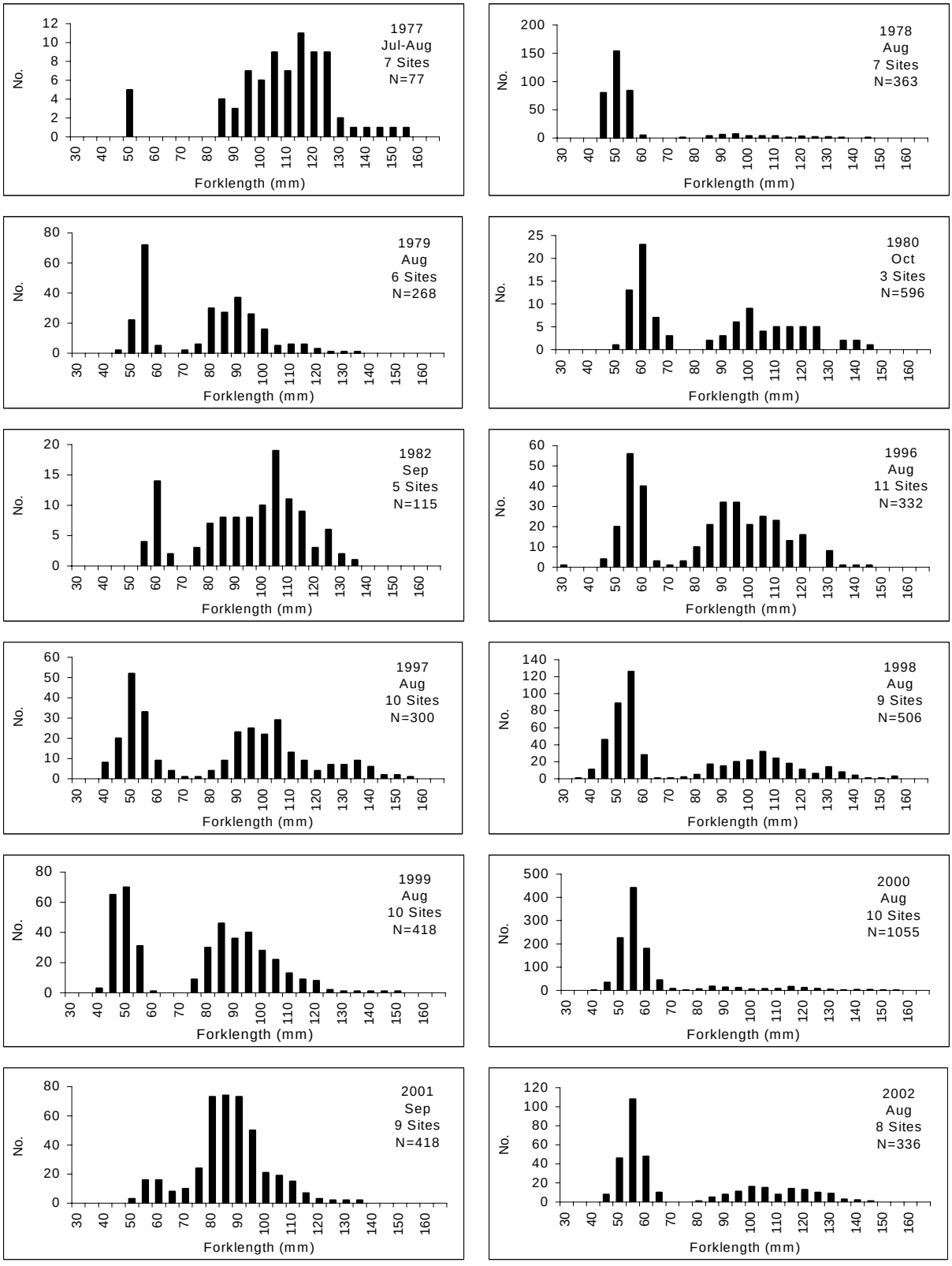

Figure 12. Length frequency of juvenile Atlantic salmon from the Buctouche R., 1974-2002. All sites combined in a given year.

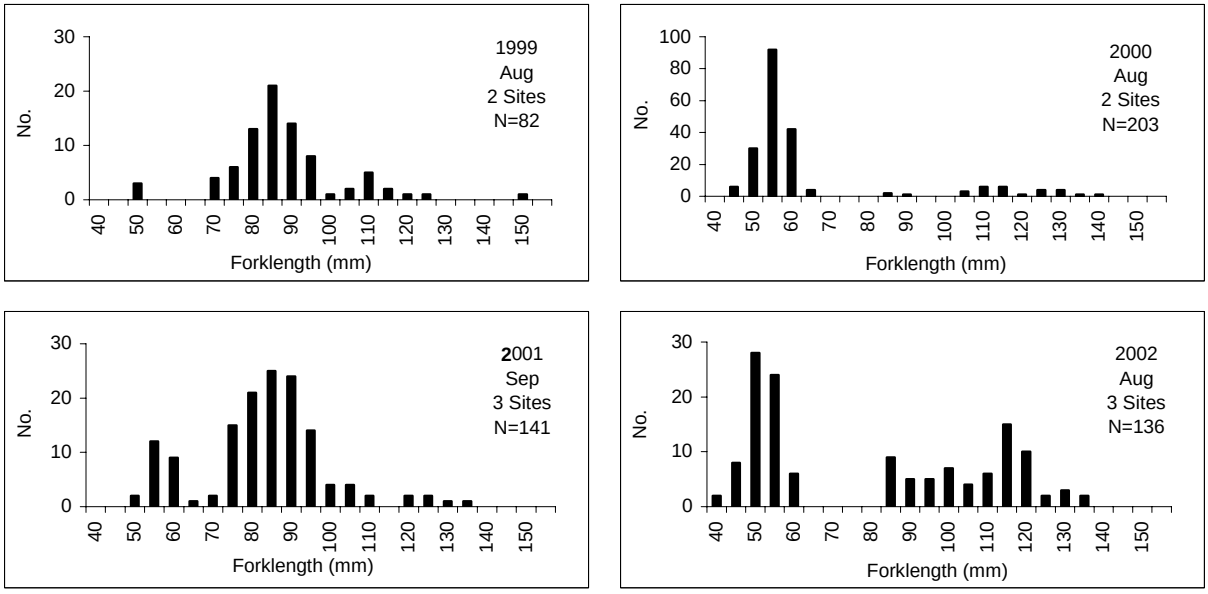

Figure 13. Length frequency of juvenile Atlantic salmon from the Cocagne R., 1974-2002. All sites combined in a given year.

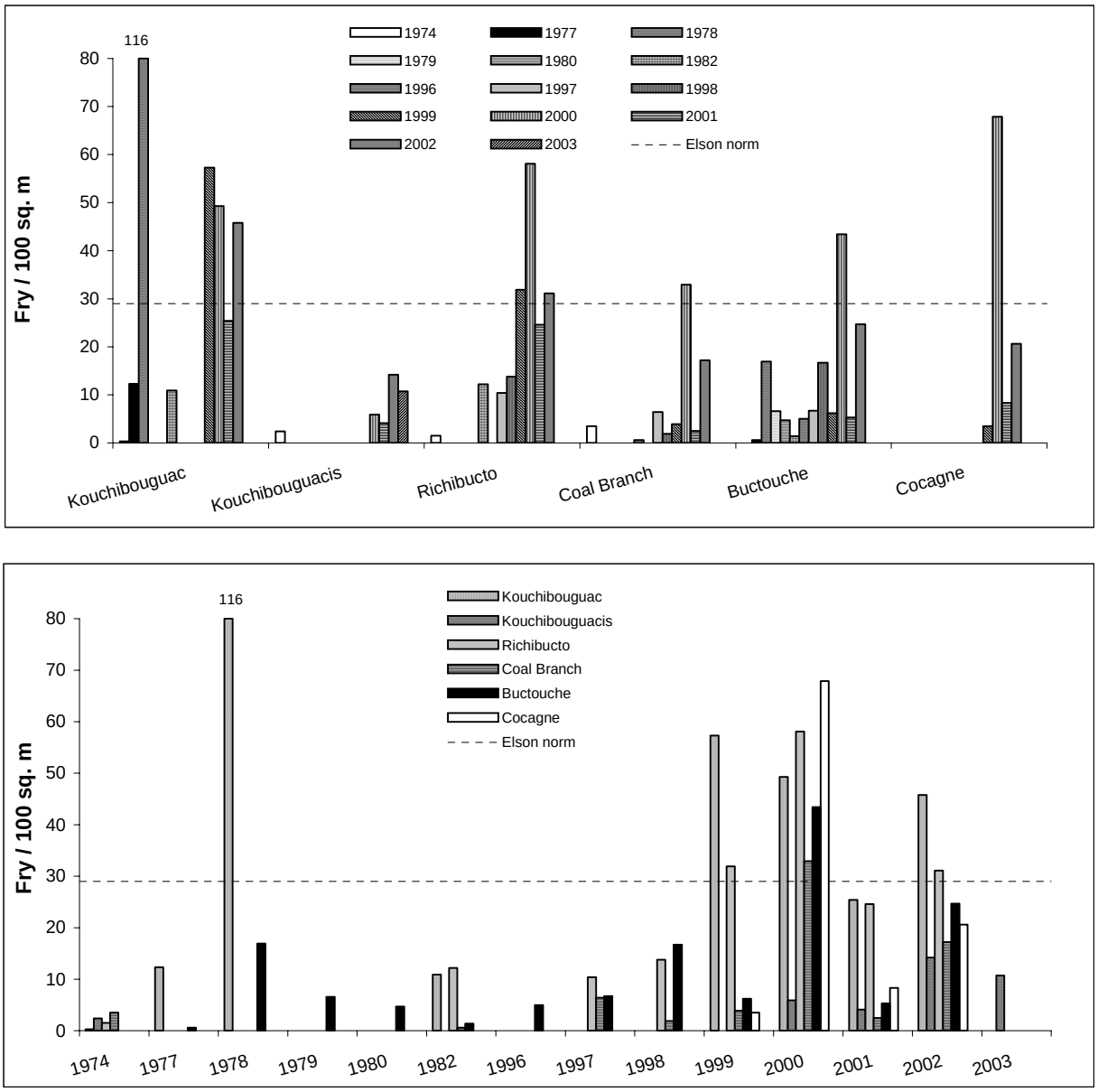

Figure 14. Annual mean fry density in the Kouchibouguac, Kouchibouguacis, Richibucto, Coal Branch, Buctouche and Cocagne rivers, 1974-2003, arranged by river (upper panel) and by year (lower panel). Kouchibouguac density for 1978 is 116 (shortened bar).

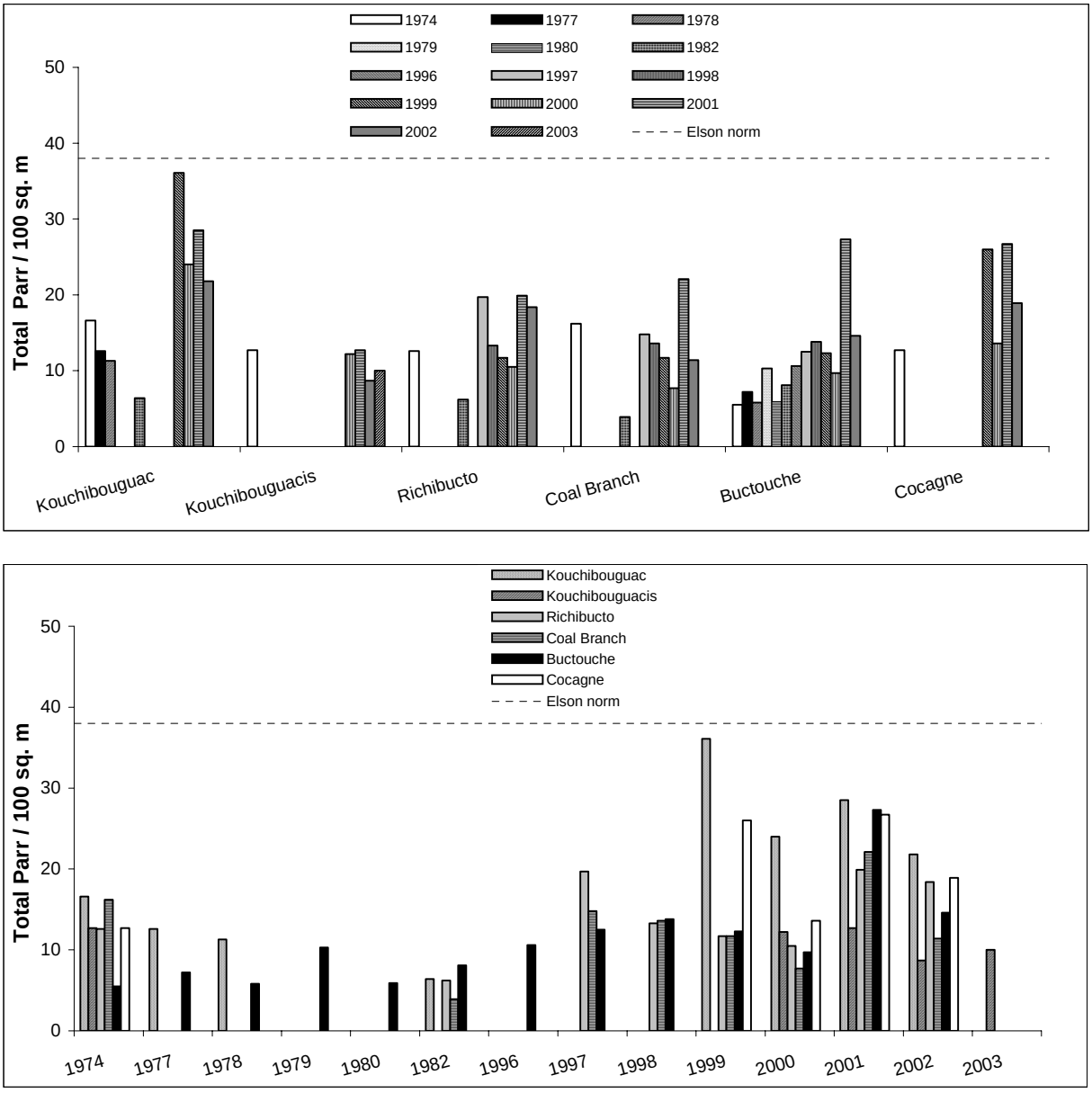

Figure 15. Annual mean total parr density in the Kouchibouguac, Kouchibouguacis, Richibucto, Coal Branch, Buctouche and Cocagne rivers, 1974-2003, arranged by river (upper panel) and by year (lower panel).