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The status of Atlantic salmon (*Salmo salar*) on Prince Edward Island (SFA 17) in 2011

L'état du saumon de l'Atlantique (*Salmo salar*) à l'Île-du-Prince-Édouard (ZPS 17) en 2011

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ABSTRACT

Prince Edward Island, Salmon Fishing Area 17, is part of the southern Gulf - Gaspé Designatable Unit which COSEWIC assessed as Special Concern in 2010. Atlantic salmon probably occupied about 71 PEI rivers at the time of European contact. Rivers containing salmon fell to 28 in 2000-2002 and to 22 in 2007-2008, with salmon presence detected in one additional river in 2011. Original salmon populations were largely late-run and multi-sea-winter, but stocking fish of mainland origin has led to early run components in seven PEI rivers. Reported harvest in aboriginal Food, Social, and Ceremonial fisheries were 0-1 fish per year in 2009-2011 (only one of two licenced groups provided harvest information in 2011). Recreational salmon angling is permitted in all PEI rivers, but salmon in small rivers receive de facto protection from angling because seasons close on 15 September, before fish return to these rivers. Salmon fishing is permitted up to 31 October in parts of larger rivers which have early-run components. Recreational angling has been catch-and-release since 2009. Estimated mortalities in the angling fishery due to catch-and-release mortality (assumed to be 3%) were 1-4 fish per year in 2009-2011. Angler card surveys indicate that fishing effort, small salmon kept, and small and large salmon released have followed declining trends since the mid-1990s. Total conservation requirements for current salmon rivers (4,668,586 eggs) are based on all habitat types in these rivers, including habitat blocked by dams. Egg deposition was estimated from historic biological characteristics and redd counts, using a redd:female spawner ratio (3.357) measured in a single year in the West River, PEI. Total estimated egg deposition in current salmon rivers is 67.7% of requirements for these rivers. Estimated deposition exceeds requirements in six rivers. Total conservation requirements for all 71 probable current and historic salmon rivers on PEI are 10,565,273 eggs. Estimated total egg deposition is 29.9% of this total. Atlantic salmon on PEI are negatively affected by sedimentation, blockages to upstream passage due to artificial and beaver dams, excessive water temperatures and low dissolved oxygen levels caused by some dams, pesticide inputs, and competition with rainbow trout. Fishing mortality from aboriginal fishery harvests and from angling is currently low and probably has little impact on salmon populations. Major sources of uncertainty in this assessment include low sample sizes in angler card surveys, use of historic rather than current data on biological characteristics, and use of a redd:spawner ratio measured at only one site in one year.

RÉSUMÉ

L'Île-du-Prince-Édouard, zone de pêche du saumon n° 17, fait partie de l'unité désignable Gaspésie-sud du golfe du Saint-Laurent, évaluée comme préoccupante par le COSEPAC en 2010. Le saumon de l'Atlantique occupait probablement environ 71 rivières de l'Î.-P.-É. avant les premiers contacts avec les Européens. Le nombre de rivières contenant du saumon a chuté à 28 en 2000-2002, puis à 22 en 2007-2008, auxquelles s'est ajoutée une nouvelle rivière dans laquelle la présence du saumon a été constatée en 2011. À l'origine, les populations étaient largement composées de saumons de montaison tardive et de saumons pluribermarins, mais du poisson d'empoissonnement originaire du continent a entraîné la présence de saumons de montaison hâtive dans sept rivières de l'Î.-P.-É. Le nombre déclaré de poissons pêchés par des autochtones dans le cadre de la pêche à des fins alimentaires, sociales et rituelles s'élevait à 0-1 poisson par an en 2009-2011 (seul un des deux groupes détenteurs d'un permis a fourni des renseignements sur sa pêche en 2011). La pêche à la ligne récréative du saumon est autorisée dans toutes les rivières de l'Î.-P.-É., mais le saumon des petites rivières est protégé de facto de la pêche à la ligne, car la saison ferme le 15 septembre, avant le retour du saumon dans ces rivières. La pêche au saumon est autorisée jusqu'au 31 octobre dans certaines parties des grandes rivières qui contiennent des populations de montaison hâtive. La pêche à la ligne récréative est une pêche avec remise à l'eau depuis 2009. La mortalité due à la pêche à la ligne pratiquée avec remise à l'eau (estimée à 3 %) est estimée à 1-4 poissons par an en 2009-2011. Les enquêtes réalisées à partir des cartes des pêcheurs indiquent que l'effort de pêche, le nombre de petits saumons conservés et le nombre de petits et grands saumons remis à l'eau suivent des courbes à la baisse depuis le milieu des années 1990. Les exigences de conservation totales pour les rivières contenant actuellement du saumon (4 668 586 œufs) se fondent sur tous les types d'habitats de ces rivières, y compris l'habitat bloqué par des barrages. La ponte est estimée à partir de caractéristiques biologiques antérieures et de décomptes de frayères de salmonidés, au moyen d'un rapport frayère/femelle reproductrice (3,357) mesuré une seule année dans la rivière West (Î.-P.-É.). La ponte totale estimée dans les rivières actuellement occupées par le saumon équivaut à 67,7 % des exigences pour ces rivières. La ponte estimée est supérieure aux exigences dans six rivières. Les exigences totales en matière de conservation pour les 71 rivières à saumon probables, passées et actuelles, de l'Î.-P.-É. s'élèvent à 10 565 273 œufs. La ponte totale estimée est égale à 29,9 % de ce total. Le saumon de l'Atlantique de l'Î.-P.-É. souffre de la sédimentation, du blocage des déplacements vers l'amont dû aux barrages artificiels et aux barrages de castor, de températures de l'eau excessives et de faibles niveaux d'oxygène dissous causés par certains barrages, des apports de pesticides et de la compétition avec la truite arc-en-ciel. La mortalité par pêche causée par les pêches autochtone et récréative est faible à l'heure actuelle et a probablement peu d'incidence sur les populations de saumon. Les principales sources d'incertitude de la présente évaluation sont notamment le faible nombre d'échantillons des enquêtes sur les cartes de pêcheurs, l'utilisation de données antérieures plutôt que de données actuelles sur les caractéristiques biologiques et l'utilisation d'un rapport frayère/femelle reproductrice mesuré uniquement à un endroit une seule année.

INTRODUCTION

The status of Atlantic salmon populations on Prince Edward Island (PEI; Salmon Fishing Area 17) is of high interest to anglers and conservationists. PEI salmon status and biology has previously been reviewed by Ducharme (1977), Bielak et al. (1991), Davidson and Bielak (1992), Davidson and Angus (1994), Cairns et al. (1995, 1996, 2000, 2010), Cairns (1997), Marshall et al. (1999), Guignion et al. (2002, 2010), Chaput et al. (2006), Guignion (2009), and MacFarlane et al. (2009).

A recent COSEWIC review (COSEWIC 2010) included Prince Edward Island in a Designatable Unit that includes the southern Gulf of St. Lawrence and the Gaspé Peninsula. Atlantic salmon within this area were assessed as Special Concern. However, COSEWIC (2010) recognized that conservation status of Atlantic salmon varied within this Designatable Unit, and noted particular conservation issues on PEI that arise from poor habitat quality.

This paper updates Atlantic salmon status on Prince Edward Island. Salmon <63 cm fork length are classified as small, and those with $\geq$ 63 cm fork length are classified as large. These size categories approximately correspond to returning adults which have passed one winter at sea (one sea winter, 1SW), and those which have passed two or more winters at sea (multi-sea winter, MSW).

HISTORY AND BIOLOGICAL CHARACTERISTICS

Accounts in the early historical period indicate that salmon were present throughout PEI. At least 71 PEI rivers probably offered sufficient habitat to support salmon populations (Cairns et al. 2010) (Fig. 1). Of these, salmon occupancy has been confirmed in 55 rivers by historic or modern records. Salmon abundance and distribution have diminished greatly from historical times. Juvenile surveys conducted in 2000-2002 and in 2007-2008 found salmon in 28 and 22 rivers, respectively. Electrofishing surveys in 2011 located salmon in an additional river, the Clyde (Fig. 2). These 23 rivers are referred to in this paper as current salmon rivers. However, given the lack of comprehensive electrofishing surveys in 2009-2011, it is possible that some other rivers either gained or lost salmon populations in the several years prior to 2011.

Original salmon populations of PEI were dominated by late-run and multi-sea winter fish. Beginning in the late 19th century, many PEI rivers were stocked with hatchery-reared fry or parr. In the 1970s and subsequently, stocking efforts aimed to increase angling opportunities by establishing or maintaining early salmon runs. This was accomplished by using reproductive material from the mainland, primarily the Miramichi River which has a strong early-run component. Subsequently, broodstock was sourced from PEI rivers which had earlier been stocked with fish of Miramichi origin. In general, late runs tend to have a high proportion of female multi-sea-winter fish, and early runs tend to have a high proportion of small male fish.

Davidson and Bielak (1992) measured fecundity of 68 small salmon as 3,143 eggs and fecundity of 24 large salmon as 4,963 eggs. Large salmon comprised 50.8%, 8.2%, 6.0%, 16.0%, and 0.0% of salmon counted in the Mill (Carruthers and Cains), Morell, Valleyfield, West, and Dunk Rivers, respectively (Table 1). On the Morell River, small salmon are 19.3% female and large salmon are 72.6% female (Table 2).

Stocking efforts have tended to be greater in larger rivers. Consequently, large rivers are more likely to have a substantial early run component (Table 3). The Morell and Cardigan Rivers have mixed early and late run fish. In the Morell this can be attributed to extensive stocking over

many years, and in the Cardigan this can be attributed to fish escaping from the salmon hatchery which is adjacent to the river (R. Angus, pers. comm.). Cains and Carruthers Brooks (which together form Mill River), Trout River (Coleman), the West River, and the Dunk River have mostly late runs with some early component. All other PEI salmon rivers are late run (Table 3).

Guignion (2009) classified PEI salmon rivers as Class I, "wilderness rivers" with habitat suitable for ongoing populations; Class II, rivers with good habitat that can sustain salmon populations provided that beaver obstructions are managed; and Class III, in which salmon populations are at immediate risk of extirpation. Guignion (2009) classed 10 rivers as Class I, five as Class II, and seven as Class III (Table 3, Fig. 2). The Clyde River is here classed as Class III because only seven juveniles were found at the two electrofishing sites, and no redds were found, in 2011. There are a variety of run timing patterns in Class I and II rivers. All Class III rivers except the Cardigan are late run.

All current salmon rivers on the south shore of PEI contain rainbow trout (Table 3). No current salmon rivers on the north shore of PEI contain rainbow trout.

MANAGEMENT REGIMES AND FISHERY HARVESTS

Salmon fisheries on PEI are authorized for aboriginal Food, Social, and Ceremonial (FSC) harvests, and for public recreational angling. Two aboriginal groups had FSC licences in 2011. The Native Council of PEI had an allocation of 250 grilse (small salmon). The season was between 1 April and 30 November and there were no geographical restrictions. The Abegweit First Nation had an allocation of 200 grilse in the Mill, Trout (Coleman), Morell, and West Rivers. There were no seasonal restrictions.

Recreational angling is governed by regulations pursuant to the federal Fisheries Act, and by Variation Orders which alter the provisions of these regulations. Recreational salmon licencing is administered by the Province of Prince Edward Island, which may impose additional restrictions on salmon angling. Recreational salmon anglers on PEI must first obtain a trout angling licence, and then purchase a salmon licence. The salmon season in most rivers is 1 June to 15 September (Table 3). In parts of the Cains, Carruthers, Trout (Coleman), Morell, West, and Dunk, salmon angling is extended to 31 October. Salmon angling, and all angling after 15 September, is restricted to artificial barbless fly. Seasonal retention limits for small salmon were seven in 1997-2004, four in 2005-2006, two in 2007-2008, and zero in 2009 and subsequently. Hence beginning in 2009, all salmon angling on PEI has been catch-and-release only. The PEI Angling Summary (http://www.gov.pe.ca/photos/original/FWanglesum2011.pdf) provides further details on fishing restrictions.

FSC fisheries were reported to have harvested two small salmon in the West River and five small salmon in the Pisquid River in 2008 (Table 4). All other reported FSC harvests have been in the Morell. Twenty small salmon were reported harvested in that river in 2008. Reported harvests were <= 5 in all other years between 2004 and 2011 (Table 4). The Native Council of PEI reported zero catch in 2011. The Abegweit First Nation did not report its harvest for 2011.

From 1995 to 2006, salmon angling licences had a tear-off stub with space to record daily and seasonal catches. The stub had an address and Business Reply insignia on the reverse side. Salmon licence-holders who did not return the stub were sent a reminder card requesting their catch information. In 2007-2011, no stub was attached to salmon licences, and the angling survey was administered by mailing questionnaire cards to licence-holders.

Mailing and return statistics for the card survey are shown in Table 5. In 2011, additional questions were added to the survey card to obtain information on salmon angling effort up to 15 September vs. after 15 September, and the number of trout caught during the extended salmon angling season which ran from 16 September to 31 October. Among respondents, mean number of days spent salmon angling was 18.8 up to 15 September, and 6.3 between 16 September and 31 October (Table 6).

Table 4 and Figure 3 show salmon angling effort, catch rate, small salmon kept, small salmon released, and large salmon released, based on card survey results. The Morell is the major salmon angling stream on PEI (Table 7). For the period 1995-2011, total salmon rod-days for the Morell were 59.5% of total salmon rod-days for all PEI rivers. Nearly all other salmon angling effort took place in the Mill (Cains and Carruthers), Trout (Coleman), Montague/Valleyfield, West, and Dunk Rivers. The scarcity of reported salmon angling effort in all other rivers is due to the fact that these rivers are late-run, and salmon do not enter the rivers until after the season closes on 15 September (Table 3).

For all PEI and for the Morell, salmon fishing activity, as indicated by licences sold, estimated rod-days, and number of active anglers, followed a declining trend from the mid 1990s to the present (Fig. 3). Small salmon kept declined until the retention fishery was ended in 2009, and the number of large and small salmon caught and released declined from the mid-1990s to the present. Estimated catch per rod day fluctuated without a consistent trend in the 1990s and early 2000s, but has been lower than the long-term mean since the mid 2000s. Estimated catch per rod-day in most other major PEI streams (Mill, Trout (Coleman), Dunk, and Montague; but not the West) has also been lower than the long-term mean since the mid 2000s (Fig. 4).

RETURNS AND CONSERVATION REQUIREMENTS

The conservation limit reference point for Atlantic salmon in PEI rivers is an egg deposition rate of 2.4 eggs per m^2. PEI salmon were assessed from the late 1980s to the early 2000s by adult mark-recapture experiments, fishway counts, and juvenile surveys, particularly in the Morell River (Cairns et al. 2000). Between 1987 and 1993, estimated potential egg deposition above Leards Pond on the Morell River exceeded conservation requirements (Table 8). Estimated egg deposition was below target in 1981-1986, 1994-1995, 1997, 1999, and 2002. Most of the fish contributing to estimated egg depositions in the Morell during this period were of hatchery origin. Estimated egg depositions in the Mill, Valleyfield, West, and Dunk Rivers in 1989-1996 ranged from 1% to 70% of conservation requirements (Cairns 1997).

Egg conservation requirements for PEI rivers which currently contain salmon, or which probably contained them in the past, were calculated from stream areas. Stream areas were estimated from a regression based on measurements of stream area and watershed area in larger rivers (Cairns et al. 2010). This process estimates total stream area, including habitat which is inaccessible to salmon due to human- and beaver-made dams. The proportion of stream habitat that is inaccessible to salmon is unmeasured but possibly substantial. This means that estimates of egg conservation requirements are greater than those which would be produced if only accessible habitat were considered.

The number of female spawners needed to meet egg conservation requirements was calculated from data on size-specific sex ratio and size-specific fecundity (Table 2). There are no current data on the proportion of spawners that are large. For the purposes of calculating spawner requirements, it is assumed that large fish comprise 50% and 90% of spawners in rivers with and without an early run component, respectively (Table 3).

Total conservation requirements for the 23 current PEI salmon rivers are 4,668,586 eggs, 1,055 female spawners, and 1,773 total spawners (Table 9). Total conservation requirements for the 71 rivers which currently have salmon, or probably had salmon in the past, are 10,565,273 eggs, equivalent to 2,288 female spawners, and 3,557 total spawners.

A single female salmon may produce several spawning redds, and redds are often superimposed on each other (Beland 1996, Cunjak and Therrien 1998). Despite the variability imposed by these circumstances, ratios of redd counts to spawners are commonly used in New England to estimate spawning escapement (Anon. 2011). They are also commonly used in assessments of Pacific salmon (Gallagher et al. 2007). Redd surveys were used in salmon assessments of the Restigouche River in the 1990s (Locke et al. 1998). DFO (2001) reported a mean ratio of 2.5 redds per large returning female in the Nepisiguit River. In 1990-1996, redd counts above Leards Pond on the Morell River were significantly correlated with the number of salmon counted and released at Leards Dam ($r=0.85$, $n=6$, $P=0.03$). However, this series cannot be used to calculate a relation between redd counts and spawners because an unknown, but possibly substantial, number of salmon entered the waters upstream of Leards Dam in 1990-1996 without being counted (Cairns 1997).

No early run salmon were stocked in the West River prior to 1991. In 1990, 48 salmon were counted through a fence on the river's tidal estuary. These included 14 females, of which 13 were large and 1 was small. Forty-seven redds were counted in the river in fall 1990. The ratio of redds to escaping females is thus 47/14=3.357.

Salmon redds have been counted in all current PEI salmon rivers at least once since 1990 (Tables 9 and 10). In the rivers with the best temporal survey coverage, there is no consistent trend in counts, although high counts occurred in 2011 in two rivers in northeastern PEI (Fig. 5).

Egg deposition in current salmon rivers, estimated using the most recent redd counts for these rivers and a ratio of 3.357 redds per female spawner, is 3,159,930 eggs (Table 9). This is 67.7% of conservation requirement. Egg conservation requirements were exceeded in six rivers (Cains, Carruthers, Morell, Naufrage, Cross, North Lake). In six rivers classed as current salmon rivers on the basis of juvenile electrofishing surveys (Cardigan, Vernon, Clarks, Head of Hillsborough, Clyde, Wilmot), the most recent redd counts were zero; hence estimated egg depositions were 0% of requirements. Figure 6 shows trends in percent of conservation requirements for rivers which have the best temporal coverage.

Approximately 71 PEI rivers probably contained salmon at the time of European contact (Cairns et al. 2010). Estimated total egg deposition on PEI (2,962,556 eggs) is 29.9% of requirements for these 71 rivers (Table 9).

A total of 78 estimtes of egg deposition are available for the 23 current salmon rivers in the period 1990-2011. Of these estimates, 18 (23.1%) exceeded conservation requirements (Table 10).

Estimated spawners in 2011, based on the most recent redd counts, are 662 females and a total of 1,177 spawners (Table 9). Given an estimated three mortalities due to fisheries in 2011, estimated total returns are 1,180 adult salmon (1,177 spawners plus 3 mortalities).

Percent egg conservation on the Morell River above Leards Pond, derived from fishway counts and mark-recapture experiments (Table 8) were not significantly correlated with percent egg conservation for the entire Morell River based on redd counts (Table 10) ($r = 0.488$, $P = 0.40$,

n = 5) (Fig. 7). This suggests that one or both series contains substantial error. However, the lack of a close relation may also be due to the fact that one series treats only part of the river while the other series treats the entire river.

Most electrofishing conducted on PEI since 2000 has been directed at determining the presence of salmon and helping identify habitat problems (Guignion 2009). The river with the most extensive electrofishing data is the Morell (Table 11, Fig. 8). However, only three electrofishing sessions have been conducted since 2003, all at sites which were not used in previous surveys. For these reasons the electrofishing data series is poorly suited to indicate recent trends in freshwater production in the Morell River.

Long term trends of PEI salmon abundance are not consistent among data series. Declines in salmon caught and kept in the angling fishery, and low recent angler CPUEs, suggest declining abundance (Fig. 3). The decrease in the number of rivers with salmon from 28 in 2000-2002 to 22 in 2007-2008 likewise suggests a declining trend. However, redd count series do not provide evidence for a generalized or consistent decline (Table 10, Fig. 6).

There are no recent estimates of marine survival of PEI salmon. In the late 1980s and early 1990s, return rates of hatchery smolts to adult salmon ranged from under 0.2% to 9.0% (Cairns et al. 1996).

FACTORS IMPACTING SALMON

Threats to Atlantic salmon on PEI are discussed in detail by Guignion (2009) and Cairns et al. (2010). The chief limitation to Atlantic salmon production in PEI is stream sedimentation caused by agriculture and other land use activities (Cairns 2002). Unsurfaced roads and site preparation for commercial developments contribute sediments to streams in some areas. Cultivation techniques which reduce erosion and pesticide run-off have become more widespread in recent years. However, acreage devoted to row-crops, notably potatoes, continues to be high. These crops are commonly grown with intensive fertilizer and pesticide applications, and with cultivation techniques that leave fields bare and erosion-prone during part of the year. These sediment impacts are a barrier to the re-establishment of widespread and substantial self-sustaining salmon runs. The trend of progressive extirpation of salmon populations from smaller streams, witnessed in the first decade of the 2000s, will probably not be reversed until sediment impact problems are resolved.

Beavers are common in many PEI watercourses, and their dams may flood suitable spawning habitat and prevent upstream movements by returning adults. Guignion (2009) recommended that beaver management be a central consideration in salmon conservation efforts in PEI streams. Sobey (2007) conducted a detailed examination of mammalian references in historical documentation from the French and British colonial periods. These records contained no references to beaver presence, and an account of PEI mammals prepared in 1721 specifically stated that beavers were absent. On this basis Sobey (2007) classified beavers as non-indigenous to PEI. It nevertheless remains possible that beavers were trapped to extirpation prior to the first European settlement in 1720 (Sobey 2007). Current beaver populations are descendents of introduced animals (Cameron 1958, Dibblee 1994). Whether beaver impact on PEI Atlantic salmon is viewed as an anthropogenic effect depends on whether the beaver is considered to be an indigenous or non-indigenous species.

Artificial dams that lack salmonid fishways also impede access to spawning habitat in many present or former salmon rivers on PEI. Notably, dams prevent salmon from reaching

substantial parts of the Morell, Midgell, and St. Peters Rivers. Artificial and beaver dams lead to excessive temperatures and low dissolved oxygen in some systems (MacFarlane 1999, Guignion 2009). This may prevent salmon from occupying both pond habitat and waters downstream from ponds.

PEI streams are crossed by a large number of public and private roads. Some of these crossings are barriers to upstream salmon movement.

PEI rivers are subject to fish kills caused by chemical pesticides. Fish kills in the Montrose River in 2010 and the Big Pierre Jacques River in 2011 did not affect salmon, because salmon do not occupy these rivers (Table 3). In 2011, five juvenile salmon were retrieved dead after a kill in Carruthers Brook, and 10 juvenile salmon were retrieved dead after a kill in Trout River (Coleman).

Resource requirements of juvenile rainbow trout overlap with those of Atlantic salmon and rainbow trout competition may negatively affect salmon (Cairns 2006). Rainbow trout are widely distributed in rivers on the south side of PEI (Table 9). This introduced species is absent from most north side rivers, but has recently been reported from the Hunter and Wheatley Rivers on PEI's central north shore. All current PEI salmon rivers that exceed egg conservation requirements are on the north side of PEI and none of these rivers have rainbow trout (Tables 8 and 9). All current PEI salmon rivers on the south side of PEI are below conservation requirements, and all of these rivers have rainbow trout.

Mortality due to fishing probably has low impact on PEI salmon populations. Reported aboriginal FSC harvests have been nil or very low in most recent years (0 in 2009, 1 fish in 2010, 0 in 2011) (2011 data are from only one of two aboriginal groups). Recreational salmon fishing on PEI has been subject to mandatory catch-and-release since 2009. Under the assumption that catch-and-release mortality is 3%, total PEI salmon mortality due to recreational fishing is estimated at one fish in 2009, four fish in 2010, and four fish in 2011 (Table 3). Fishing regulations permit salmon angling in all rivers, including small rivers with low populations. However, salmon in these rivers have de facto protection from angling because they enter rivers in fall, after seasonal closures come into effect (Table 3).

Anecdotal reports indicate that bycatch of Atlantic salmon in the mackerel fishery off the north shore of PEI in 2011 was higher than in previous years (DFO 2012). The destination of these fish is unknown, but it is likely that the majority were heading for non-PEI rivers.

Brook trout occur in all PEI streams where Atlantic salmon occur. Angling under a brook trout licence may therefore result in salmon catches, even if the angler is targeting trout under a trout licence. These catches are not accounted for in the salmon card survey, which covers only anglers who have purchased a salmon licence. Anglers targeting brook trout who instead catch salmon are required to release the salmon, but released salmon are subject to catch-and-release mortality.

It is also possible for an angler who is nominally targeting salmon to catch brook trout instead. Up until 15 September, any catches of brook trout while targeting salmon fall under the provisions of the brook trout licence which all salmon anglers are required to have. Angling for brook trout is closed after 15 September. In the extended salmon season, from 16 September to 31 October, anglers are obliged to release any trout they catch. Responses to the 2011 card survey indicated that responding anglers caught and released a mean of 5.7 trout per angler during the extended salmon season (N=7).

Large Atlantic salmon from PEI may migrate to West Greenland waters, where they are subject to a fishery.

KNOWLEDGE GAPS AND UNCERTAINTIES

Recreational fisheries statistics on PEI are estimated from a card survey. This survey has a small and decreasing sample size (N = 15 in 2011, Table 5), which leads to a high level of uncertainty in estimates of angling effort, CPUE, and catch. FSC harvests are not reliably known, because only one of two groups with FSC licences provided harvest information for 2011.

The estimate of egg conservation requirements is based on estimates of total habitat in each stream. However, a portion of many streams is unavailable to salmon due to artificial and beaver dams and to culverts that do not pass returning adult salmon. Hence the conservation requirements used in this paper may overestimate the requirements of habitat that the fish have access to.

Most data inputs used in the evaluation of compliance with egg conservation requirements are poorly known. The calculations use fecundities, sex-ratios, size distributions, and run timings which are primarily based on measurements from the 1990s or earlier.

For two current salmon rivers (Trout River (Coleman) and Dunk), the most recent redd counts were conducted in the 1990s. These counts may not reflect current conditions in these rivers. Egg deposition is estimated using a ratio of redd counts to female spawners that is derived from a single year's data in the West River. Redd:spawner ratios are likely to vary among years and among sites. Redd:spawner ratios may vary non-linearly with density, because redd superimposition is likely to occur with increasing frequency when density is high, notably in those rivers in northeastern PEI where salmon have been abundant in recent years. More years of data at more sites are needed to properly characterize redd:spawner ratios on PEI. There is an opportunity to measure redd:spawner ratios in the Naufrage River. This river has not been stocked with early-run salmon. Returning spawners could be counted at the fishway in Larkins Pond, and these counts could be compared with redd counts in waters upstream from the dam.

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Table 1. Counts of small and large salmon on PEI. Fish fence counts include only salmon moving upstream.

Year	Method	Small		Large		Total
		Number	Percent	Number	Percent	
Mill River (Cains and Carruthers)						
1993	Fish fence	17	77.3	5	22.7	22
1994	Fish fence	11	100.0	0	0.0	11
1995	Fish fence	3	10.0	27	90.0	30
Total		31	49.2	32	50.8	63
Morell River						
1981	Fish trap, Leards Pond	39	86.7	6	13.3	45
1982	Fish trap, Leards Pond	33	91.7	3	8.3	36
1983	Fish trap, Leards Pond	2	50.0	2	50.0	4
1984	Fish trap, Leards Pond	5	55.6	4	44.4	9
1985	Fish trap, Leards Pond	14	93.3	1	6.7	15
1986	Fish trap, Leards Pond	620	99.0	6	1.0	626
1987	Fish trap, Leards Pond	1,168	94.5	68	5.5	1,236
1988	Fish trap, Leards Pond	1,394	94.0	89	6.0	1,483
1989	Fish trap, Leards Pond	335	72.8	125	27.2	460
1990	Fish trap, Leards Pond	409	86.7	63	13.3	472
1991	Fish trap, Leards Pond	327	89.3	39	10.7	366
1992	Fish trap, Leards Pond	907	95.2	46	4.8	953
1993	Fish trap, Leards Pond	628	98.3	11	1.7	639
1994	Fish trap, Leards Pond	36	55.4	29	44.6	65
1995	Fish trap, Leards Pond	186	92.5	15	7.5	201
1996	Fish trap, Leards Pond	548	88.0	75	12.0	623
1997	Fish trap, Leards Pond	217	94.3	13	5.7	230
1999	Fish trap, Leards Pond	81	94.2	5	5.8	86
1998	Visual counts (mostly by snorkel)	214	88.4	28	11.6	242
1999	Visual counts (mostly by snorkel)	48	81.4	11	18.6	59
2002	Fish trap, Leards Pond	61	87.1	9	12.9	70
Total		7,272	91.8	648	8.2	7,920
Valleyfield River						
1990	Fish fence	36	100.0	0	0.0	36
1991	Fish fence	30	100.0	0	0.0	30
1993	Fish fence	84	100.0	0	0.0	84
1994	Fish fence	15	68.2	7	31.8	22
1995	Fish fence	58	93.5	4	6.5	62
1996	Fish fence	75	90.4	8	9.6	83
Total		298	94.0	19	6.0	317
West River						
1989	Fish fence	31	62.0	19	38.0	50
1990	Fish fence	25	52.1	23	47.9	48
1993	Fish fence	250	95.4	12	4.6	262
1994	Fish fence	8	57.1	6	42.9	14
Total		314	84.0	60	16.0	374
Dunk River						
1995	Fish fence	40	100.0	0	0.0	40

Table 2. Sex ratios of small and large salmon measured on the Morell River.

Year	Method	Small					Large				
		Male		Female		Total	Male		Female		Total
		Number	Percent	Number	Percent		Number	Percent	Number	Percent	
1986	Fish trap, Leards Pond	520	84.8	93	15.2	613					
1987	Fish trap, Leards Pond	471	82.3	101	17.7	572	5	12.8	34	87.2	39
1988	Fish trap, Leards Pond	547	76.0	173	24.0	720	11	37.9	18	62.1	29
1989	Fish trap, Leards Pond	196	87.5	28	12.5	224	15	37.5	25	62.5	40
1990	Fish trap, Leards Pond	131	72.8	49	27.2	180	29	37.7	48	62.3	77
1994	Fish trap, Leards Pond	33	91.7	3	8.3	36	4	13.8	25	86.2	29
2000	Seining, below Mooneys Pond	47	72.3	18	27.7	65	0	0.0	12	100.0	12
2001	Seining, below Mooneys Pond	49	81.7	11	18.3	60	0	0.0	8	100.0	8
Total		1,994	80.7	476	19.3	2,470	64	27.4	170	72.6	234

Table 3. Stocking history, run timing, fishing season, and rainbow trout presence in PEI rivers which contain Atlantic salmon. Atlantic salmon presence in the Clyde River is from surveys in 2011. Alantic salmon presence in other rivers is from surveys in 2007 and 2008.

River name	River class (Guignion 2009)[a]	Stocked with Atlantic salmon In 1880-1899	In 1900-1949	In 1950-2011	Run timing	Atlantic salmon angling season in 2011	Rainbow trout present
Cains Brook, Mill River	I				Some early, but mostly late	1 Jun - 31 Oct[b]	N
Carruthers Brook, Mill River	I		Y	Y	Some early, but mostly late	1 Jun - 31 Oct[b]	N
Trout River (Coleman)	I	Y	Y	Y	Some early, but mostly late	1 Jun - 31 Oct[c]	N
Trout River, Tyne Valley	III	Y	Y		Late	1 Jun - 15 Sep	N
Little Trout River	III				Late	1 Jun - 15 Sep	N
Bristol (Berrigans) Creek	III				Late	1 Jun - 15 Sep	N
Morell River	II	Y	Y	Y	Mixed early and late	1 Jun - 31 Oct[d]	N
Midgell River	II		Y	Y	Late	1 Jun - 15 Sep	N
St. Peters River	I		Y	Y	Late	1 Jun - 15 Sep	N
Naufrage River	I		Y	Y	Late	1 Jun - 15 Sep	N
Cross Creek	I		Y		Late	1 Jun - 15 Sep	N
Priest Pond Creek	I				Late	1 Jun - 15 Sep	N
North Lake Creek	I	Y	Y		Late	1 Jun - 15 Sep	N
Cardigan River	III		Y		Mixed early and late	1 Jun - 15 Sep	Y
Vernon River	II	Y			Late	1 Jun - 15 Sep	Y
Clarks Creek	II				Late	1 Jun - 15 Sep	Y
Pisquid River	I				Late	1 Jun - 15 Sep	Y
Head of Hillsborough R.	III		Y		Late	1 Jun - 15 Sep	Y
North River	III		Y		Late	1 Jun - 15 Sep	Y
Clyde River	III				Late	1 Jun - 15 Sep	Y
West River	I	Y	Y	Y	Some early, but mostly late	1 Jun - 31 Oct[e]	Y
Dunk River	II	Y	Y	Y	Some early, but mostly late	1 Jun - 31 Oct[f]	Y
Wilmot River	III	Y	Y		Late	1 Jun - 15 Sep	Y

[a]Class I: wilderness rivers; Class II, rivers requiring beaver management; Class III, rivers where salmon are at immediate risk of extirpation. The Class III designation of Clyde River is based on low electrofishing numbers (7 juveniles at 2 sites) and 0 redd counts in 2011.

[b]The 1 Jun - 31 Oct season applies to areas downstream of Route 148. Eslewhere the season is 1 Jun - 15 Sep.

[c]The 1 Jun - 31 Oct season applies to areas between Routes 140 and 2. Eslewhere the season is 1 Jun - 15 Sep.

[d]The 1 Jun - 31 Oct season applies to Leards Pond and to the Morell River mainstem from the Forks to MacKays. A 1 Jun - 15 Oct season applies to the West Branch below Leards Pond and to the East Branch below Route 329. Elsewhere the season is 1 Jun - 15 Sep.

[e]The 1 Jun - 31 Oct season applies to areas downstream of Route 249. Eslewhere the season is 1 Jun - 15 Sep.

[f]The 1 Jun - 31 Oct season applies to areas downstream of Route 109. Eslewhere the season is 1 Jun - 15 Sep.

Table 4. Salmon fishing effort and harvest in Prince Edward Island rivers, 1994-2011. Data for 1994 and for 2007-2011 are from mail-out surveys. Data for 1995-2006 are from licence stub surveys.

Year	No. licences issued	Percent of respondents who fished river	Estimated total number of anglers who fished river	Mean number of rod-days per angler who fished river	Estimated total rod-days	Mean catch per rod-day				Estimated recreational catch				Estimated total harvest, including hook and release mortality*						
						Small salmon kept	Small salmon released	Large salmon released	All salmon	Small salmon kept	Small salmon released	Large salmon released	All salmon	Small, recreational	Large, recreational	Aboriginal small	Aboriginal large	Total, small	Total, large	Total, small and large
Mill (Cairns and Carruthers)																				
1994										11	NA	0	NA	11	0			11	0	11
1995		2	9	9.0	85	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
1996		7	52	4.2	218	0.119	0.075	0.030	0.224	26	16	7	49	27	0			27	0	27
1997		6	36	5.1	181	0.049	0.000	0.016	0.066	9	0	3	12	9	0			9	0	9
1998		7	38	8.4	317	0.017	0.034	0.026	0.077	5	11	8	24	6	0			6	0	6
1999		5	25	3.9	97	0.194	0.097	0.000	0.290	19	9	0	28	19	0			19	0	19
2000		8	30	8.3	251	0.072	0.012	0.000	0.084	18	3	0	21	18	0			18	0	18
2001		7	25	6.3	156	0.020	0.040	0.000	0.060	3	6	0	9	3	0			3	0	3
2002		6	20	6.8	133	0.029	0.000	0.000	0.029	4	0	0	4	4	0			4	0	4
2003		4	20	3.0	60	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2004		2	11	2.7	30	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2005		1	6	1.0	6	0.500	0.000	0.000	0.500	3	0	0	3	3	0			3	0	3
2006		1	4	3.0	12	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2007		5	13	57.5	742	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2008		12	26	17.0	437	0.020	0.000	0.000	0.020	9	0	0	9	9	0			9	0	9
2009		14	18	9.0	166	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2010		11	16	11.0	175	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2011		7	14	1.0	14	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
Trout (Coleman)																				
1994										5	6	0	11	5	0			5	0	5
1995		3	19	13.5	256	0.025	0.012	0.012	0.049	6	3	3	13	6	0			6	0	7
1996		7	46	6.1	277	0.024	0.000	0.024	0.047	7	0	7	13	7	0			7	0	7
1997		11	65	7.6	498	0.048	0.042	0.006	0.095	24	21	3	47	24	0			24	0	24
1998		8	41	3.9	157	0.000	0.121	0.017	0.138	0	19	3	22	1	0			1	0	1
1999		7	31	4.1	128	0.073	0.049	0.049	0.171	9	6	6	22	10	0			10	0	10
2000		13	48	9.6	463	0.059	0.033	0.020	0.111	27	15	9	51	28	0			28	0	28
2001		14	47	8.8	411	0.038	0.008	0.008	0.053	16	3	3	22	16	0			16	0	16
2002		9	31	3.9	122	0.000	0.097	0.000	0.097	0	12	0	12	0	0			0	0	0
2003		8	40	5.5	220	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2004		8	37	5.4	199	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2005		4	19	3.2	59	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2006		5	16	7.8	128	0.000	0.032	0.000	0.032	0	4	0	4	0	0			0	0	0
2007		8	19	18.3	355	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2008		12	26	11.0	283	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2009		24	31	8.2	252	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2010		6	8	10.0	79	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2011		7	14	2.0	27	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0

Table 4 (continued).

Year	No. licences issued	Percent of respondents who fished river	Estimated total number of anglers who fished river	Mean number of rod-days per angler who fished river	Estimated total rod-days	Mean catch per rod-day				Estimated recreational catch				Estimated total harvest, including hook and release mortality						
						Small salmon kept	Small salmon released	Large salmon released	All salmon	Small salmon kept	Small salmon released	Large salmon released	All salmon	Small, recreational	Large, recreational	Aboriginal small	Aboriginal large	Total, small	Total, large	Total, small and large
Morell																				
1994										89	111	99	299	92	3			92	3	95
1995		72	453	11.2	5,073	0.089	0.029	0.019	0.136	449	146	95	690	454	3	19	1	473	4	477
1996		66	462	9.0	4,156	0.096	0.065	0.036	0.197	397	270	150	818	405	4	17	0	422	4	427
1997		59	361	7.7	2,796	0.071	0.033	0.013	0.117	198	92	36	326	201	1	1	0	202	1	203
1998		63	325	8.6	2,809	0.083	0.047	0.024	0.154	233	133	68	433	237	2	28	0	265	2	267
1999		65	307	8.3	2,556	0.060	0.058	0.048	0.165	153	147	122	423	158	4	0	0	158	4	162
2000		61	230	7.6	1,745	0.055	0.036	0.021	0.113	97	64	36	197	99	1	28	0	127	1	128
2001		61	208	8.6	1,791	0.082	0.087	0.047	0.215	146	156	84	386	151	3	28	0	179	3	181
2002		56	196	7.8	1,521	0.077	0.085	0.021	0.183	118	129	31	278	122	1	29	0	151	1	151
2003		66	333	8.1	2,708	0.098	0.098	0.049	0.246	266	266	133	666	274	4	16	0	290	4	294
2004		56	255	8.2	2,093	0.041	0.062	0.016	0.118	85	129	33	247	89	1	0	0	89	1	90
2005		66	284	6.3	1,795	0.063	0.049	0.042	0.153	112	87	75	274	115	2	0	0	115	2	117
2006		68	214	10.2	2,190	0.043	0.081	0.019	0.143	95	177	41	313	100	1	5	0	105	1	106
2007		73	187	12.4	2,328	0.011	0.055	0.036	0.102	26	129	84	239	30	3	4	0	34	3	36
2008		54	120	9.4	1,132	0.023	0.000	0.000	0.023	26	0	0	26	26	0	20	0	46	0	46
2009		62	80	8.4	670	0.000	0.000	0.037	0.037	0	0	25	25	0	1	0	0	0	1	1
2010		67	95	5.3	501	0.000	0.095	0.000	0.095	0	48	0	48	1	0	1	0	2	0	2
2011		27	54	28.0	1,523	0.000	0.000	0.027	0.027	0	0	41	41	0	1	0	0	0	1	1
Montague[u]																				
1994																				
1995		1	6	1.5	9	0.000	0.333	0.000	0.333	0	3	0	3	0	0			0	0	0
1996		0	0	NA	0	NA	NA	NA	NA	0	0	0	0	0	0			0	0	0
1997		3	21	6.0	124	0.095	0.000	0.000	0.095	12	0	0	12	12	0			12	0	12
1998		6	30	7.6	228	0.071	0.071	0.000	0.143	16	16	0	33	17	0			17	0	17
1999		4	19	6.2	116	0.054	0.081	0.189	0.324	6	9	22	38	7	1			7	1	7
2000		2	6	2.5	15	0.000	0.200	0.000	0.200	0	3	0	3	0	0			0	0	0
2001		4	12	20.0	249	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2002		2	8	5.0	39	0.100	0.100	0.000	0.200	4	4	0	8	4	0			4	0	4
2003		3	13	7.3	97	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2004		3	15	2.5	37	0.100	0.000	0.000	0.100	4	0	0	4	4	0			4	0	4
2005		3	12	7.3	90	0.000	0.069	0.000	0.069	0	6	0	6	0	0			0	0	0
2006		5	16	1.3	21	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2007		3	6	1.0	6	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2008		0	0	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0			0	0	0
2009		0	0	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0			0	0	0
2010		0	0	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0			0	0	0
2011		0	0	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0			0	0	0

Table 4 (continued)

Year	No. licences issued	Percent of respondents who fished river	Estimated total number of anglers who fished river	Mean number of rod-days per angler who fished river	Estimated total rod-days	Mean catch per rod-day				Estimated recreational catch				Estimated total harvest, including hook and release mortality						
						Small salmon kept	Small salmon released	Large salmon released	All salmon	Small salmon kept	Small salmon released	Large salmon released	All salmon	Small, recreational	Large, recreational	Aboriginal small	Aboriginal large	Total, small	Total, large	Total, small and large
Valleyfield																				
1994										5	28	5	38	5	0			5	0	5
1995		4	22	28.1	624	0.025	0.015	0.025	0.066	16	9	16	41	16	0			16	0	17
1996		12	85	5.5	466	0.077	0.049	0.042	0.168	36	23	20	78	37	1			37	1	37
1997		7	41	11.2	465	0.032	0.038	0.019	0.089	15	18	9	41	15	0			15	0	16
1998		8	41	8.1	330	0.000	0.074	0.000	0.074	0	24	0	24	1	0			1	0	1
1999		7	31	4.0	125	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2000		8	30	2.1	64	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2001		6	19	3.7	68	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2002		3	12	4.0	47	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2003		5	23	2.4	57	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2004		5	22	2.3	52	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2005		4	16	6.4	100	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2006		3	8	16.0	132	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2007		5	13	7.5	97	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2008		0	0	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0			0	0	0
2009		5	6	8.0	49	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2010		0	0	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0			0	0	0
2011		0	0	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0			0	0	0
Pisquid																				
2008														0	0	5	0	5	0	5
West																				
1994										20	38	NA	NA	21				21	0	21
1995		16	101	12.7	1,282	0.010	0.030	0.017	0.057	13	38	22	73	14	1			14	1	14
1996		24	166	6.1	1,006	0.061	0.055	0.042	0.159	62	55	42	160	64	1			64	1	65
1997		21	130	6.0	779	0.068	0.030	0.015	0.114	53	24	12	89	54	0			54	0	54
1998		18	95	6.9	653	0.017	0.004	0.017	0.037	11	3	11	24	11	0			11	0	11
1999		16	75	7.4	558	0.000	0.022	0.006	0.028	0	13	3	16	0	0			0	0	0
2000		15	57	3.9	224	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2001		15	50	9.1	451	0.000	0.048	0.034	0.083	0	22	16	37	1	0			1	0	1
2002		15	51	7.2	369	0.000	0.064	0.011	0.074	0	24	4	27	1	0			1	0	1
2003		15	73	6.0	436	0.015	0.015	0.008	0.038	7	7	3	17	7	0			7	0	7
2004		11	48	7.9	380	0.010	0.107	0.136	0.252	4	41	52	96	5	2			5	2	6
2005		12	53	6.7	355	0.000	0.018	0.079	0.096	0	6	28	34	0	1			0	1	1
2006		17	54	9.8	523	0.000	0.031	0.024	0.055	0	16	12	29	0	0			0	0	1
2007		20	52	7.9	406	0.000	0.048	0.032	0.079	0	19	13	32	1	0			1	0	1
2008		19	43	11.6	497	0.000	0.017	0.052	0.069	0	9	26	34	0	1	2		2	1	3
2009		29	37	6.5	240	0.000	0.026	0.000	0.026	0	6	0	6	0	0			0	0	0
2010		28	40	7.8	310	0.000	0.077	0.103	0.179	0	24	32	56	1	1			1	1	2
2011		27	54	9.0	490	0.000	0.139	0.056	0.194	0	68	27	95	2	1			2	1	3

Table 4 (continued)

Year	No. licences issued	Percent of respondents who fished river	Estimated total number of anglers who fished river	Mean number of rod-days per angler who fished river	Estimated total rod-days	Mean catch per rod-day				Estimated recreational catch				Estimated total harvest, including hook and release mortality						
						Small salmon kept	Small salmon released	Large salmon released	All salmon	Small salmon kept	Small salmon released	Large salmon released	All salmon	Small, recreational	Large, recreational	Aboriginal small	Aboriginal large	Total, small	Total, large	Total, small and large
Dunk																				
1994										11	38	5	54	12	0			12	0	12
1995		4	25	12.9	326	0.000	0.010	0.000	0.010	0	3	0	3	0	0			0	0	0
1996		7	52	6.8	352	0.009	0.306	0.037	0.352	3	107	13	124	6	0			6	0	7
1997		9	56	6.4	358	0.017	0.041	0.041	0.099	6	15	15	36	6	0			6	0	7
1998		13	65	11.2	729	0.019	0.007	0.015	0.041	14	5	11	30	14	0			14	0	14
1999		14	66	10.8	711	0.009	0.018	0.004	0.031	6	13	3	22	7	0			7	0	7
2000		14	51	10.4	537	0.012	0.042	0.000	0.054	6	22	0	29	7	0			7	0	7
2001		16	53	6.1	323	0.019	0.048	0.000	0.067	6	16	0	22	7	0			7	0	7
2002		18	63	7.1	447	0.009	0.149	0.000	0.158	4	67	0	71	6	0			6	0	6
2003		17	87	6.3	543	0.067	0.025	0.018	0.110	37	13	10	60	37	0			37	0	37
2004		11	48	9.5	454	0.016	0.016	0.008	0.041	7	7	4	18	8	0			8	0	8
2005		10	44	7.4	324	0.010	0.010	0.000	0.019	3	3	0	6	3	0			3	0	3
2006		12	37	3.6	132	0.000	0.063	0.000	0.063	0	8	0	8	0	0			0	0	0
2007		5	13	1.5	19	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2008		0	0	NA	0	NA	NA	NA	NA	0	0	0	0	0	0			0	0	0
2009		10	12	6.5	80	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
2010		0	0	NA	0	NA	NA	NA	NA	0	0	0	0	0	0			0	0	0
2011		7	14	1.000	14	0.000	0.000	0.000	0.000	0	0	0	0	0	0			0	0	0
All rivers																				
1994										142				142						
1995	633	80	506	15.1	7,669	0.063	0.027	0.018	0.109	484	209	139	832	491	4	19	1	510	5	515
1996	697	81	563	11.5	6,478	0.082	0.073	0.037	0.192	534	472	238	1,244	548	7	17	0	565	7	572
1997	616	76	468	11.2	5,254	0.061	0.034	0.015	0.109	320	178	77	575	325	2	1	0	326	2	328
1998	520	78	404	13.5	5,457	0.052	0.043	0.021	0.115	282	233	114	628	289	3	28	0	317	3	320
1999	473	75	357	12.0	4,291	0.045	0.046	0.036	0.128	194	197	157	548	200	5	0	0	200	5	205
2000	378	78	296	11.0	3,257	0.045	0.032	0.014	0.092	148	106	45	299	151	1	28	0	179	1	181
2001	339	80	271	12.7	3,449	0.050	0.059	0.030	0.138	171	202	103	476	177	3	28	0	205	3	208
2002	349	78	271	10.7	2,888	0.048	0.088	0.013	0.149	140	254	38	431	147	1	29	0	176	1	177
2003	503	81	406	10.1	4,121	0.075	0.070	0.036	0.180	310	286	147	743	318	4	16	0	334	4	339
2004	454	68	310	10.5	3,244	0.031	0.055	0.027	0.113	100	177	89	365	105	3	0	0	105	3	108
2005	430	73	315	8.7	2,730	0.043	0.038	0.038	0.119	118	103	103	324	121	3	0	0	121	3	125
2006	317	77	243	12.9	3,137	0.030	0.066	0.017	0.113	95	206	54	354	101	2	5	0	106	2	107
2007	258	75	194	20.3	3,935	0.007	0.038	0.025	0.069	26	148	97	271	30	3	4	0	34	3	37
2008	223	73	163	14.4	2,350	0.015	0.004	0.011	0.029	34	9	26	69	35	1	27	0	62	1	62
2009	129	81	104	13.9	1,456	0.000	0.004	0.017	0.021	0	6	25	31	0	1	0	0	0	1	1
2010	143	78	111	9.6	1,065	0.000	0.067	0.030	0.097	0	72	32	103	2	1	1	0	3	1	4
2011	204	47	95	21.7	2,067	0.000	0.033	0.033	0.066	0	68	68	136	2	2	0	0	2	2	4

[a]Assumed to be 3%.

[u]1994 Montague data are included with those of the Valleyfield.

Table 5. Mailing and return statistics for the PEI salmon licence stub survey, 1995-2011. Licence stubs were not issued after 2006.

Year	Number of licences issued	Number of stubs returned	Percent of stubs returned	Number of reminder cards mailed	Number of reminder cards returned as undeliverable	Number of reminder cards returned by anglers	Percent of reminder cards returned by anglers	Total number of anglers who returned either stubs or cards	Number of anglers returning stubs/cards as a percent of licences issued	Number of anglers whose stubs/cards have full catch and effort data. This includes respondents who did not fish.	Stubs/cards with full catch and effort data as a percent of licences issued	Stubs/cards with full data which reported fishing	Percent fishing	Scale-up factor (Licences sold/non-redundant cards with full data)
1995	633	59	9.3	589	35	168	28.5	221	34.9	200	31.6	161	80.5	3.17
1996	697	63	9.0	596	28	175	29.4	237	34.0	214	30.7	172	80.4	3.26
1997	616	51	8.3	570	33	174	30.5	222	36.0	208	33.8	158	76.0	2.96
1998	520	47	9.0	453	35	171	37.7	212	40.8	192	36.9	149	77.6	2.71
1999	473	46	9.7	416	23	112	26.9	158	33.4	151	31.9	116	76.8	3.13
2000	378	33	8.7	364	27	103	28.3	136	36.0	125	33.1	99	79.2	3.02
2001	339	26	7.7	326	18	94	28.8	120	35.4	109	32.2	88	80.7	3.11
2002	349	32	9.2	322	7	69	21.4	101	28.9	89	25.5	69	77.5	3.92
2003	503	48	9.5	491	22	114	23.2	162	32.2	151	30.0	122	80.8	3.33
2004	454	52	11.5	388	19	108	27.8	160	35.2	123	27.1	85	69.1	3.69
2005	430	27	6.3	408	18	118	28.9	145	33.7	138	32.1	104	75.4	3.12
2006	317	22	6.9	303	8	60	19.8	82	25.9	77	24.3	60	77.9	4.12
2007	258			254	6	42	16.5	42	16.3	40	15.5	32	80.0	6.45
2008	223			214	6	30	14.0	30	13.5	26	11.7	19	73.1	8.58
2009	129			128	0	21	16.4	21	16.3	21	16.3	17	81.0	6.14
2010	143			139	7	21	15.1	21	14.7	18	12.6	14	77.8	7.94
2011	204			127	3	14	11.0	14	6.9	15	7.4	7	46.7	13.60

Table 6. Salmon angling effort up to and after 15 September, and trout catches after 15 September, in 2011, from survey cards which reported salmon fishing.

	N[a]	Total	Mean
Number of days spent salmon angling, 15 Apr - 15 Sep	6	113	18.8
Number of days spent salmon angling, 16 Sep - 31 Oct	6	38	6.3
Number of trout caught and released, 16 Sep - 31 Oct	7	40	5.7

[a]Number of anglers supplying data

Table 7. Atlantic salmon recreational catches on the Morell River, 1955-2011. Figures for 1955-1990 are estimates by DFO fisheries officers (Smith 1981; O'Neil and Swetnam 1984, 1991; Swetnam and O'Neil 1985; Bielak et al. 1991). Figures for 1991, 1992, and 1994 are from angler mail-out surveys (MacFarlane and Guignion 1992, 1993; Cairns 1996). Figures for 1995-2011 are angler harvest from licence stub or mail-in surveys. Salmon caught and retained include estimated mortality from catch-and-release fisheries. Blank cells mean that data are unavailable.

Year	Salmon caught and retained			Salmon caught and released			Fishing effort	Salmon caught
	Small	Large	Total	Small	Large	Total	(rod-days)	per rod-day
1955			21				18	1.17
1956			29				87	0.33
1957			3				52	0.06
1958			9				52	0.17
1959			4				34	0.12
1960			4				44	0.09
1961			15				45	0.33
1962			13				50	0.26
1963			51				280	0.18
1964			12				46	0.26
1965			12				115	0.10
1966			10					
1967			26				206	0.13
1968			10				192	0.05
1969			12				214	0.06
1970	0	13	13				204	0.06
1971	0	0	0				83	0.00
1972	0	7	7				138	0.05
1973	2	0	2				168	0.01
1974	0	2	2				78	0.03
1975	0	0	0				0	
1976	6	1	7				250	0.03
1977	0	0	0				105	0.00
1978	0	0	0				60	0.00
1979	1	2	3				54	0.06
1980	5	1	6				119	0.05
1981	108	4	112				914	0.12
1982	73	8	81				2,088	0.04
1983	7	2	9				686	0.01
1984	7	0	7				675	0.01
1985	47		47				1,007	0.05
1986	236		236				2,725	0.09
1987	476		476					
1988	643		643				4,994	0.13
1989	167		167				4,506	0.04
1990	768		768				9,000	0.09
1991	657		657	1,033	164	1,197	11,552	0.06
1992	781		781			1,044	11,700	0.07
1993	N/A							
1994	92	3	95	111	99	210	4,911	0.02
1995	454	3	457	146	95	241	5,073	0.14
1996	405	4	410	270	150	420	4,156	0.20
1997	201	1	202	92	36	127	2,796	0.12
1998	237	2	239	133	68	200	2,809	0.15
1999	158	4	162	147	122	269	2,556	0.17
2000	99	1	100	64	36	100	1,745	0.11
2001	151	3	153	156	84	239	1,791	0.22
2002	122	1	122	129	31	161	1,521	0.18
2003	274	4	278	266	133	400	2,708	0.25
2004	89	1	90	129	33	162	2,093	0.12
2005	115	2	117	87	75	162	1,795	0.15
2006	100	1	101	177	41	218	2,190	0.14
2007	30	3	32	129	84	213	2,328	0.10
2008	26	0	26	0	0	0	1,132	0.02
2009	0	1	1	0	25	25	670	0.04
2010	1	0	1	48	0	48	501	0.10
2011	0	1	1	0	41	41	1,523	0.03

Table 8. Atlantic salmon available to spawn above Leards Dam and their potential egg depositions, 1981-2002. Potential spawners are adjusted for broodstock removals at both Leards and Mooneys, but not for fishery removals. From Cairns et al. (2000), with updates.

Year	Potential spawners		Egg deposition above Leard's Pond[a]			
	Small salmon	Large salmon	Small salmon	Large salmon	Total	Percent of target
1981	39	6	21,451	21,470	42,921	24
1982	33	3	18,151	10,735	28,886	16
1983	2	2	1,100	7,157	8,257	5
1984	5	4	2,750	14,313	17,063	10
1985	14	1	7,700	3,578	11,279	6
1986	278	3	152,907	10,735	163,642	91
1987	658	54	361,916	193,229	555,146	310
1988	1,290	20	709,532	71,566	781,099	436
1989	330	48	181,508	171,760	353,268	197
1990	368	44	202,409	157,446	359,855	201
1991	280	14	154,007	50,097	204,104	114
1992	824	14	453,221	50,097	503,317	281
1993	461	0	253,562	0	253,562	141
1994	2 [b]	3 [c]	3,143	14,889	18,032	10
1995	130	2	71,503	4,963	76,466	43
1996 [d]	498	65	273,912	161,298	435,210	243
1997	158	10	86,904	24,815	111,719	62
1999	30	0	16,501	0	16,501	9
2002	61	8	33,552	19,852	53,404	30

[a]Based on fecundities from Davidson and Bielak 1992 and sex ratios from Davidson and Bielak 1992 and Cairns et al. 1995

[b]1 male, 1 female

[c]All females

[d]Adjusted for trap efficiency measured in 1996 (40%)

Table 9. Atlantic salmon conservation requirements and estimated egg deposition in 71 PEI rivers.

River name	Water-shed area (km^2)	Stream area (m^2)[a]	Egg conservation requirements[b]	Current salmon river[c]	Assumed proportion large	Required spawners		Most recent redd count[f]	Estimated spawners[g]		Estimated eggs deposited[h]	Estimated eggs deposited as a percent of requirement	Rain-bow trout present
						Female[d]	Total[e]		Female	Total			
Tignish River	44.5	58,241	139,778	N	0.9	29.2	42.3		0	0	0	0.0	
Montrose (Kildare) River	29.0	37,911	90,986	N	0.9	19.0	27.5		0	0	0	0.0	
Huntley River	28.9	37,767	90,641	N	0.9	19.0	27.4		0	0	0	0.0	
Long Creek (Mill R. East)	19.2	25,069	60,165	N	0.9	12.6	18.2		0	0	0	0.0	
Cains Brook, Mill River	30.9	22,845	54,828	Y	0.5	13.5	26.0	56	17	36	76,426	139.4	
Carruthers Brook, Mill River	47.9	35,455	85,092	Y	0.5	21.0	40.4	294	88	191	401,234	471.5	
Trout River (Coleman)	107.1	140,202	336,486	Y	0.5	83.0	159.8	42	13	27	57,319	17.0	
Ellerslie (Bideford) River	34.1	44,653	107,167	N	0.9	22.4	32.4		0	0	0	0.0	
Trout River, Tyne Valley	48.3	63,281	151,874	Y	0.9	31.8	45.9	14	4	6	20,480	13.5	
Little Trout River	21.3	27,883	66,920	Y	0.9	14.0	20.2	28	8	12	40,961	61.2	
Indian River	23.9	31,326	75,183	N	0.9	15.7	22.7		0	0	0	0.0	
Granville Creek	26.0	34,036	81,687	N	0.9	17.1	24.7		0	0	0	0.0	
Trout River (Millvale)	53.3	69,787	167,489	N	0.9	35.0	50.7		0	0	0	0.0	
Hunter River	88.8	116,259	279,023	N	0.9	58.4	84.4		0	0	0	0.0	Y
Wheatley River	58.0	75,914	182,193	N	0.9	38.1	55.1		0	0	0	0.0	Y[i]
Black River	20.9	27,307	65,538	N	0.9	13.7	19.8		0	0	0	0.0	
Bells Creek	28.9	37,819	90,766	N	0.9	19.0	27.5		0	0	0	0.0	
Auld Creek	14.4	18,785	45,085	N	0.9	9.4	13.6		0	0	0	0.0	
Winter River	69.6	91,112	218,669	N	0.9	45.7	66.2		0	0	0	0.0	
Bristol (Berrigans) Creek	41.4	54,183	130,039	Y	0.9	27.2	39.3	7	2	3	10,240	7.9	
Morell River	170.6	237,176	569,222	Y	0.5	140.4	270.3	450	134	292	614,134	107.9	
Marie River	29.3	38,408	92,180	N	0.9	19.3	27.9		0	0	0	0.0	
Midgell River	63.8	83,532	200,478	Y	0.9	41.9	60.6	110	33	49	160,917	80.3	
St. Peters River	44.6	58,333	139,998	Y	0.9	29.3	42.4	53	16	23	77,533	55.4	
McAskill Crk. (Goose R.)	10.6	13,876	33,303	N	0.9	7.0	10.1		0	0	0	0.0	
Cow River	22.8	29,886	71,727	N	0.9	15.0	21.7		0	0	0	0.0	
Naufrage River	43.6	57,037	136,888	Y	0.9	28.6	41.4	429	128	190	627,576	458.5	
Bear River	17.2	22,477	53,945	N	0.9	11.3	16.3		0	0	0	0.0	
Hay River	25.7	33,696	80,870	N	0.9	16.9	24.5		0	0	0	0.0	
Cross Creek	44.3	57,992	139,181	Y	0.9	29.1	42.1	190	57	84	277,948	199.7	
Priest Pond Creek	24.9	32,557	78,136	Y	0.9	16.3	23.6	20	6	9	29,258	37.4	
North Lake Creek	47.7	62,495	149,989	Y	0.9	31.4	45.4	355	106	157	519,323	346.2	
Black Pond Creek	14.3	18,759	45,022	N	0.9	9.4	13.6		0	0	0	0.0	
Souris River	53.2	69,578	166,986	N	0.9	34.9	50.5		0	0	0	0.0	Y
Fortune River	75.4	98,652	236,765	N	0.9	49.5	71.6		0	0	0	0.0	
Boughton River	51.2	67,025	160,860	N	0.9	33.6	48.7		0	0	0	0.0	
Cardigan River	44.6	58,411	140,187	Y	0.5	34.6	66.6	0	0	0	0	0.0	Y
Brudenell River	55.3	72,379	173,710	N	0.9	36.3	52.5		0	0	0	0.0	Y
Montague River	76.3	99,883	239,719	N	0.9	50.1	72.5		0	0	0	0.0	Y
Valleyfield River	87.7	127,500	306,000	N	0.9	64.0	92.6		0	0	0	0.0	Y
Sturgeon River	60.4	79,068	189,764	N	0.9	39.7	57.4		0	0	0	0.0	
Murray River	71.0	92,905	222,973	N	0.9	46.6	67.5		0	0	0	0.0	Y
Belle River	35.9	47,022	112,853	N	0.9	23.6	34.1		0	0	0	0.0	
Flat River	30.1	39,390	94,537	N	0.9	19.8	28.6		0	0	0	0.0	
South Pinette River	18.3	23,891	57,338	N	0.9	12.0	17.3		0	0	0	0.0	
Middle Pinette River	8.8	11,530	27,673	N	0.9	5.8	8.4		0	0	0	0.0	
North Pinette River	27.5	35,987	86,368	N	0.9	18.1	26.1		0	0	0	0.0	
Orwell River	29.5	38,657	92,777	N	0.9	19.4	28.1		0	0	0	0.0	Y
Vernon River	69.2	90,536	217,286	Y	0.9	45.4	65.7	0	0	0	0	0.0	Y
Seal River (Vernon)	23.4	30,646	73,549	N	0.9	15.4	22.2		0	0	0	0.0	

Table 9 (continued).

River name	Water-shed area (km^2)	Stream area (m^2)[a]	Egg conservation requirements[b]	Current salmon river[c]	Assumed proportion large	Required spawners		Most recent redd count[f]	Estimated spawners[g]		Estimated eggs deposited[h]	Estimated eggs deposited as a percent of requirement	Rain-bow trout present
						Female[d]	Total[e]		Female	Total			
Johnstons River	39.3	51,421	123,410	N	0.9	25.8	37.3		0	0	0	0.0	
Glenfinnan River	33.3	43,553	104,527	N	0.9	21.9	31.6		0	0	0	0.0	Y
Clarks Creek	46.3	60,610	145,465	Y	0.9	30.4	44.0	0	0	0	0	0.0	Y
Pisquid River	47.6	62,247	149,392	Y	0.9	31.2	45.2	68	20	30	99,476	66.6	Y
Head of Hillsborough R.	53.1	69,512	166,829	Y	0.9	34.9	50.5	0	0	0	0	0.0	Y
North River	99.0	129,651	311,163	Y	0.9	65.1	94.1	11	3	5	16,092	5.2	Y
Clyde River	41.7	54,549	130,918	Y	0.9	27.4	39.6	0	0	0	0	0.0	Y
West River	114.1	184,500	442,800	Y	0.5	109.3	210.3	90	27	58	122,827	27.7	Y
Desable River	43.7	57,246	137,391	N	0.9	28.7	41.6		0	0	0	0.0	Y
Westmoreland River	43.2	56,500	135,600	N	0.9	28.4	41.0		0	0	0	0.0	Y
Tryon River	56.4	73,767	177,040	N	0.9	37.0	53.6		0	0	0	0.0	Y
Bradshaw River	46.1	60,362	144,868	N	0.9	30.3	43.8		0	0	0	0.0	Y
Dunk River	165.7	193,078	463,387	Y	0.5	114.3	220.1	6	2	4	8,188	1.8	Y
Wilmot River	83.4	109,177	262,025	Y	0.9	54.8	79.3	0	0	0	0	0.0	Y
Sheep River	30.7	40,202	96,484	N	0.9	20.2	29.2		0	0	0	0.0	
Enmore River	42.6	55,767	133,840	N	0.9	28.0	40.5		0	0	0	0.0	
Brae River	19.5	25,553	61,328	N	0.9	12.8	18.6		0	0	0	0.0	
Little Pierre Jacques	21.8	28,472	68,334	N	0.9	14.3	20.7		0	0	0	0.0	
Big Pierre Jacques River	40.6	53,122	127,494	N	0.9	26.7	38.6		0	0	0	0.0	
Little Mininigash River	60.2	78,846	189,230	N	0.9	39.6	57.2		0	0	0	0.0	
Miminigash River	26.7	34,939	83,854	N	0.9	17.5	25.4		0	0	0	0.0	
Total, current salmon rivers	1,501.0	1,945,244	4,668,586			1,055.1	1,773.0	2,223	662	1,177	3,159,930	67.7	
Total, all rivers	3,368.2	4,402,197	10,565,273			2,288.4	3,556.8	2,223	662	1,177	3,159,930	29.9	

[a]For the Mill, Morell, Valleyfield, West, and Dunk Rivers, from field measurements of stream area. For other rivers, estimated from a linear regression based on stream area measurements and watershed areas for the Mill, Morell, Valleyfield, West and Dunk Rivers. For the Mill River, the breakdown between Cains and Carruthers Brooks is assumed to follow the relative proportions of the watershed areas of the two streams.

[b]Based on 2.4 eggs/m^2

[c]For the Clyde River, based on juvenile electrofishing surveys in 2011. For all other rivers, based on juvenile electrofishing surveys conducted in 2007-2008 and reviews of recent records (Guignion 2009).

[d]Number of female spawners required to meet egg conservation requirements, based on the formula
Required female spawners = eggs required / ((Prop. of salmon that are large x Fecundity of large females) + ((1-prop. of salmon that are large) x Fecundity of small females)).

[e]Total number of spawners required to meet egg conservation requirements, based on the formula
Required spawners = eggs required / ((Prop. of salmon that are large x Prop. of large salmon that are female x Fecundity of large females) + ((1-prop. of salmon that are large) x Prop. of small salmon that are female x Fecundity of small females)). See Table 2 for sex ratios.

[f]Redd counts are given only if the river is listed as a current salmon river. The count for Trout River (Coleman) is from 1996 and the count for the Dunk River is from 1993. All other counts are from 2008 or 2011.

[g]Based on most recent redd count, and 3.357 redds per female spawner. Total spawners calculated from proportion large, and the size-specific sex ratios in Table 2. Where proportion large is 0.5, overall proportion female is 0.460. Where proportion large is 0.9, overall proportion female is 0.673.

[h]Based on estimated female spawners, proportion large among females, and size-specific fecundities given in the text. Where overall proportion large is 0.5, the proportion of females that are large is 0.790. Where overall proportion large is 0.9, the proportion of females that are large is 0.971

[i]From unconfirmed angler reports

Table 10. Redd counts, estimated number of female spawners, estimated number of eggs deposited, and estimated number of eggs deposited as a percent of egg conservation requirements in current PEI salmon rivers, 1990-2008. Redd counts for 1990-2008 are from Cairns 1997 and Guignion 2009. Blank cells mean that data are unavailable.

River	1990	1991	1992	1993	1994	1995	1996	2004	2005	2008	2009	2010	2011
Number of redds counted (brackets indicate incomplete counts)													
Cains Brook										(58)			56
Carruthers Brook				311						(152)			294
Trout River, Coleman			33	58	33		42			(2)			
Trout River, Tyne Valley										14			
Little Trout River								5	12	11	19	(9)	28
Bristol (Berrigans) Creek				41			49	15	11	7			
Morell River	656	637	917	377	(162)	(309)	438	(71)		328			450
Midgell River				77			73	64		69	116		110
St. Peters River				93			30			53			53
Naufrage River				32			88	53		100	32	33	429
Cross Creek										120	70	113	190
Priest Pond Creek										(11)	8	14	20
North Lake Creek		29	200	36				84	68	200	213	205	355
Cardigan River										0			
Vernon River										0			
Clarks Creek										0			
Pisquid River								14	17	38		(37)	68
Head of Hillsborough R.										0			
North River										18			11
Clyde River													0
West River	47	(33)	(274)	(165)	(59)	(57)		(18)		141	47	88	90
Dunk River				6						(17)			
Wilmot River										0			
Number of female spawners													
Cains Brook													16.7
Carruthers Brook				92.6									87.6
Trout River, Coleman			9.8	17.3	9.8		12.5						
Trout River, Tyne Valley										4.2			
Little Trout River								1.5	3.6	3.3	5.7		8.3
Bristol (Berrigans) Creek				12.2			14.6	4.5	3.3	2.1			
Morell River	195.4	189.8	273.2	112.3		92.0	130.5			97.7			134.0
Midgell River				22.9			21.7	19.1		20.6	34.6		32.8
St. Peters River				27.7			8.9			15.8			15.8
Naufrage River				9.5			26.2	15.8		29.8	9.5	9.8	127.8
Cross Creek										35.7	20.9	33.7	56.6
Priest Pond Creek											2.4	4.2	6.0
North Lake Creek		8.6	59.6	10.7				25.0	20.3	59.6	63.4	61.1	105.7
Cardigan River										0.0			
Vernon River										0.0			
Clarks Creek										0.0			
Pisquid River								4.2	5.1	11.3			20.3
Head of Hillsborough R.										0.0			
North River										5.4			3.3
Clyde River													0.0
West River	14.0					17.0				42.0	14.0	26.2	26.8
Dunk River				1.8									
Wilmot River										0.0			

Table 10 (continued).

River	1990	1991	1992	1993	1994	1995	1996	2004	2005	2008	2009	2010	2011
Number of eggs deposited													
Cains Brook													76424
Carruthers Brook				424426									401226
Trout River, Coleman			45035.57	79153.4	45036		57318						
Trout River, Tyne Valley										20480.6			
Little Trout River								7314.5	17555	16091.9	27795.1		40961.1
Bristol (Berrigans) Creek				59978.8			71682	21943	16092	10240.3			
Morell River	895253	869323	1251443	514497		421697	597745			447626			614121
Midgell River				112643			106792	93625		100940	169696		160919
St. Peters River				136049			43886.9			77533.6			77533.6
Naufrage River				46812.7			128735	77534		146290	46812.7	48275.6	627583
Cross Creek										175548	102403	165307	277951
Priest Pond Creek											11703.2	20480.6	29258
North Lake Creek		42424	292579.6	52664.3				122883	99477	292580	311597	299894	519329
Cardigan River										0			
Vernon River										0			
Clarks Creek										0			
Pisquid River								20481	24869	55590.1			99477.1
Head of Hillsborough R.										0			
North River										26332.2			16091.9
Clyde River													0
West River	64141.6					77788.7				192425	64141.6	120095	122824
Dunk River				8188.29									
Wilmot River										0			
Deposited eggs as a percent of conservation requirement													
Cains Brook													139.4
Carruthers Brook				498.8									471.5
Trout River, Coleman			13.4	23.5	13.4		17.0						
Trout River, Tyne Valley										13.5			
Little Trout River								10.9	26.2	24.0	41.5		61.2
Bristol (Berrigans) Creek				46.1			55.1	16.9	12.4	7.9			
Morell River	157.3	152.7	219.9	90.4		74.1	105.0			78.6			107.9
Midgell River				56.2			53.3	46.7		50.3	84.6		80.3
St. Peters River				97.2			31.3			55.4			55.4
Naufrage River				34.2			94.0	56.6		106.9	34.2	35.3	458.5
Cross Creek										126.1	73.6	118.8	199.7
Priest Pond Creek											15.0	26.2	37.4
North Lake Creek		28.3	195.1	35.1				81.9	66.3	195.1	207.7	199.9	346.2
Cardigan River										0.0			
Vernon River										0.0			
Clarks Creek										0.0			
Pisquid River								13.7	16.6	37.2			66.6
Head of Hillsborough R.										0.0			
North River										8.5			5.2
Clyde River													0.0
West River	14.5					17.6				43.5	14.5	27.1	27.7
Dunk River				1.8									
Wilmot River										0.0			

Table 11. Mean densities of juvenile Atlantic salmon on the Morell River, from electrofishing surveys.

Year	Mean densities of Atlantic salmon (fish 100 m^{-2})				Source
	N	Age 0+	Age 1+	Total	
1975	5	0.00	3.38	3.38	Ducharme 1977
1984	4	8.46	3.49	11.95	Cairns et al. 1995
1985	6	6.75	4.34	11.09	Cairns et al. 1995
1994	12	20.43	5.71	26.14	Cairns et al. 1995
1995	30	8.60	6.49	15.09	Cairns et al. 2000
1996	15	11.72	0.29	12.02	Cairns et al. 2000
1997	13	9.09	4.68	13.77	Cairns et al. 2000
1998	6	12.07	6.84	18.92	Cairns et al. 2000
1999	6	10.11	10.86	20.97	Cairns et al. 2000
2000	6	18.50	12.76	31.26	Cairns et al. 2000
2001	8			35.30	Guignion et al. 2002, DFO files
2002	6			12.98	Guignion 2009, DFO files
2007	1			62.40	Guignion 2009
2008	2			11.90	Guignion 2009

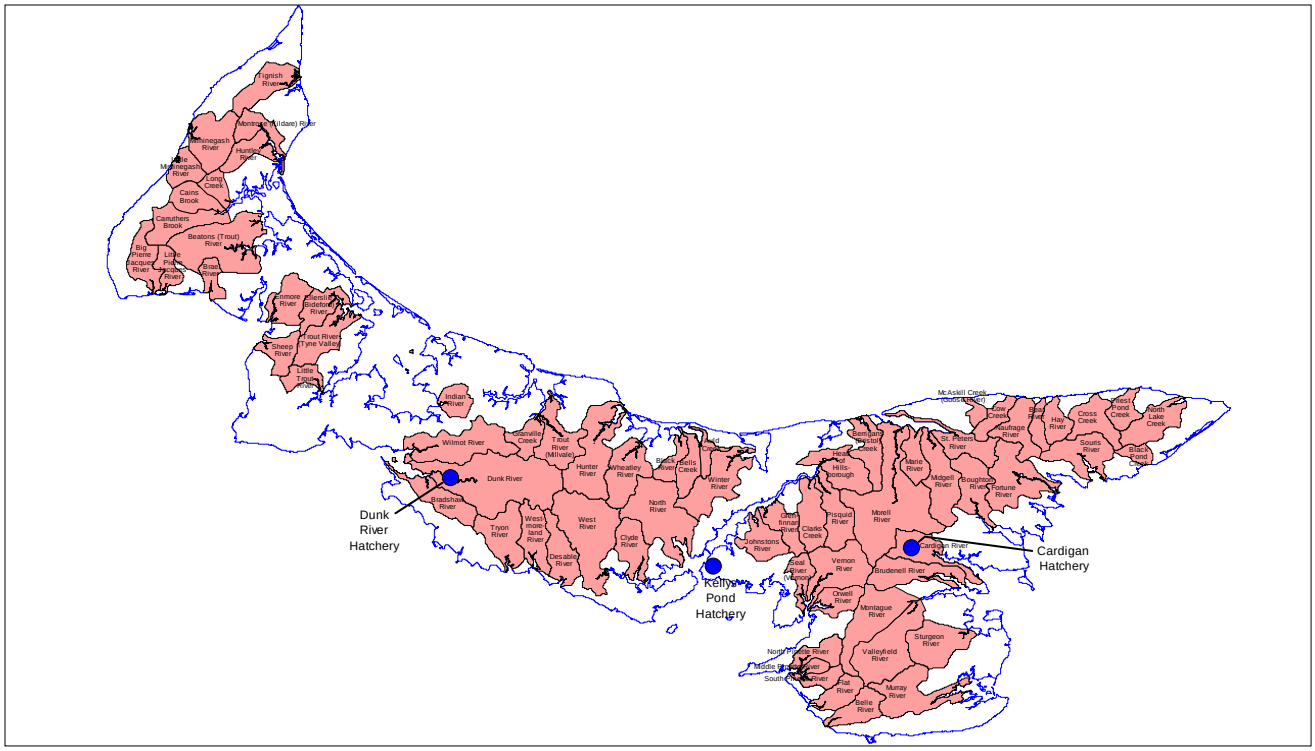

Figure 1. Watersheds of rivers in Prince Edward Island which likely contained salmon at the beginning of European settlement. Data from Cairns et al. (2010).

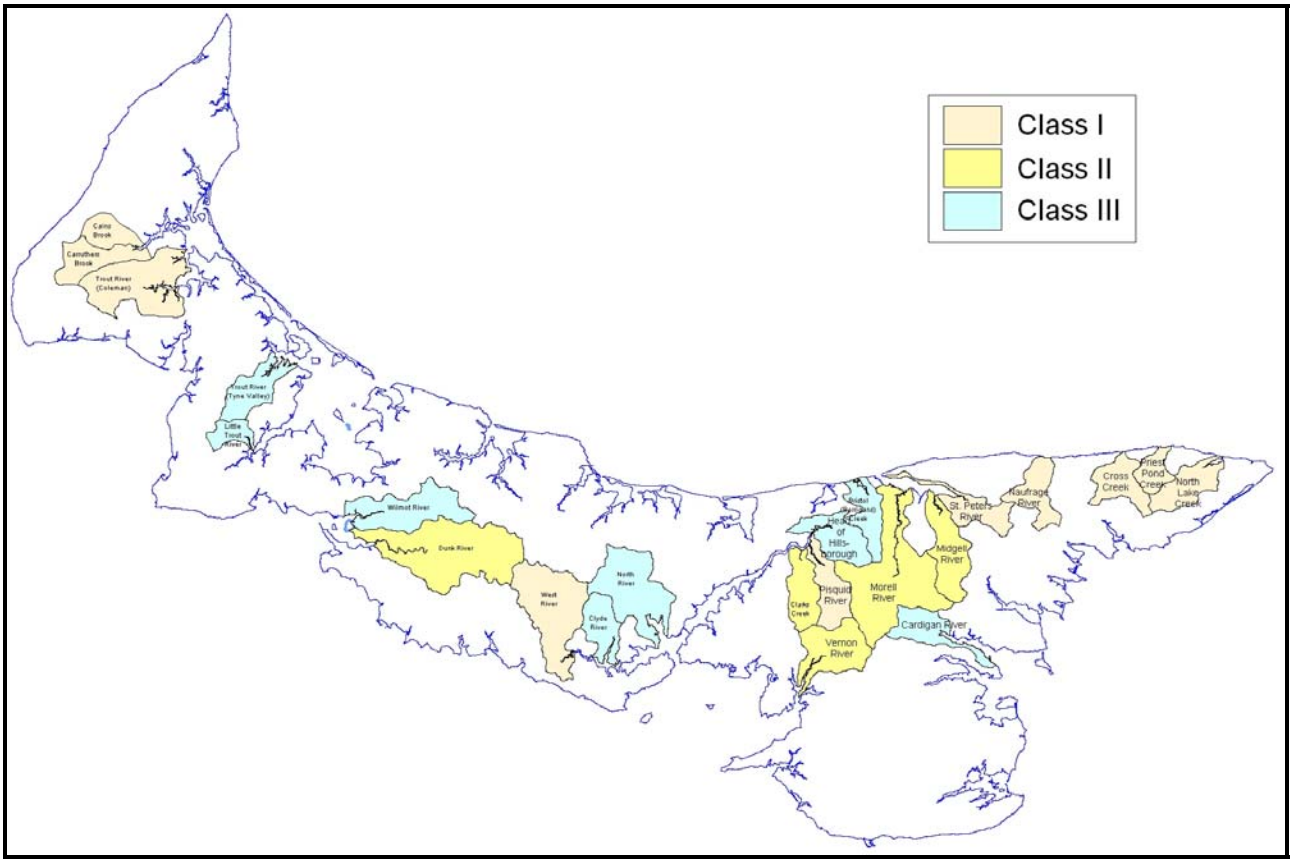

Figure 2. Watersheds of Prince Edward Island with confirmed contemporary presence of Atlantic salmon. Presence of salmon is based on surveys in 2011 (Clyde River) and 2007/2008 (all other rivers). Classes are from Guignion (2009).

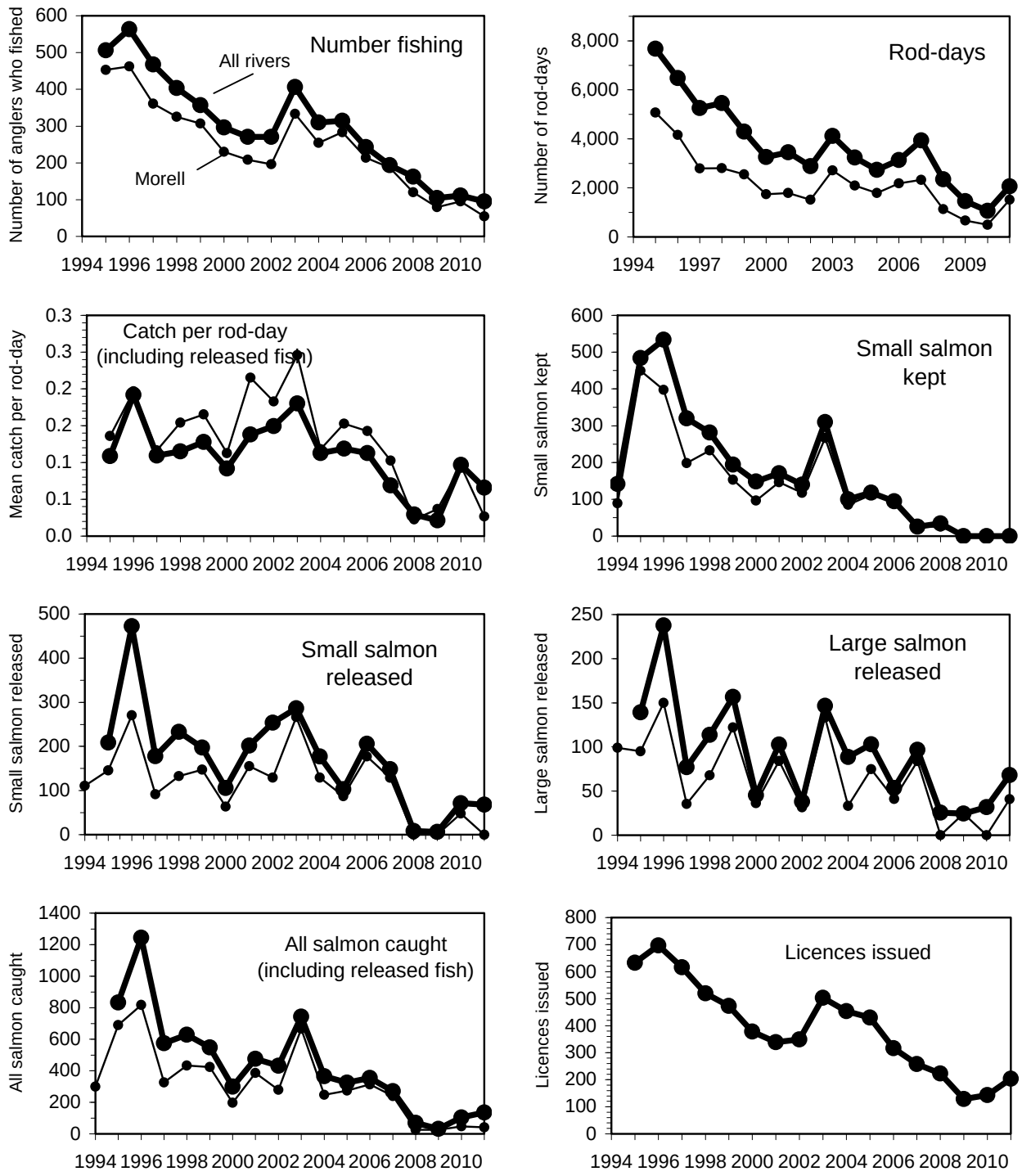

Figure 3. Salmon fishing effort and catch on the Morell River (light lines) and in all PEI rivers (heavy lines), 1994-2011. The number of salmon licences issued on PEI is also shown.

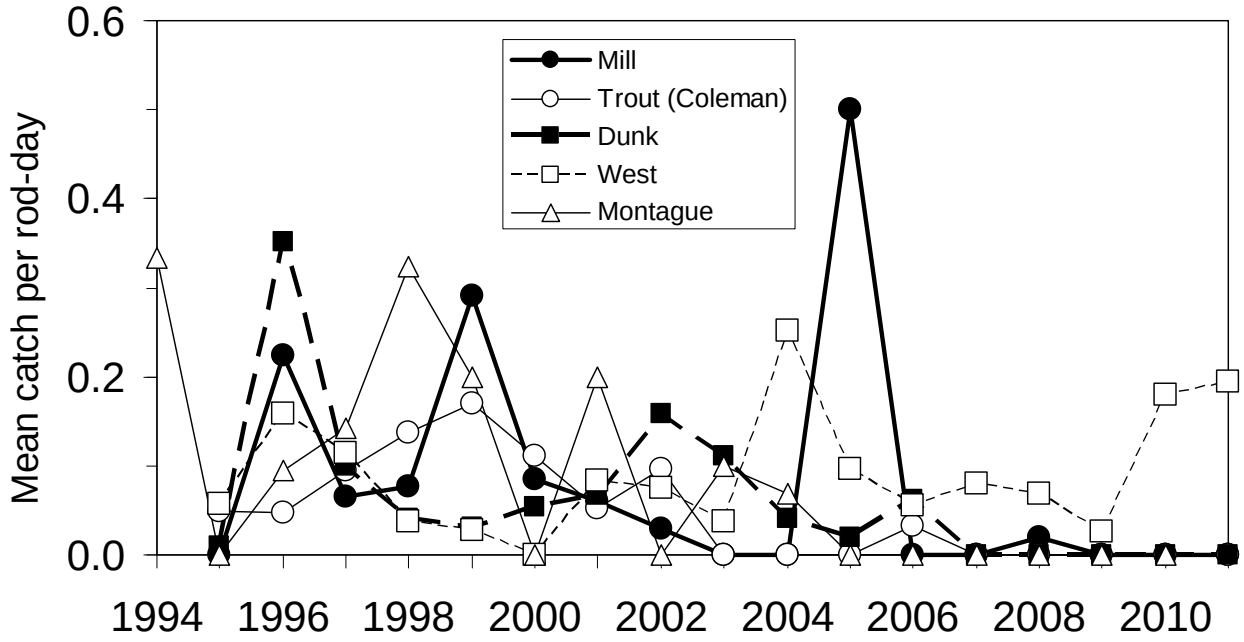

Figure 4. Mean catch of Atlantic salmon (including those released) per rod-day in five Prince Edward Island rivers.

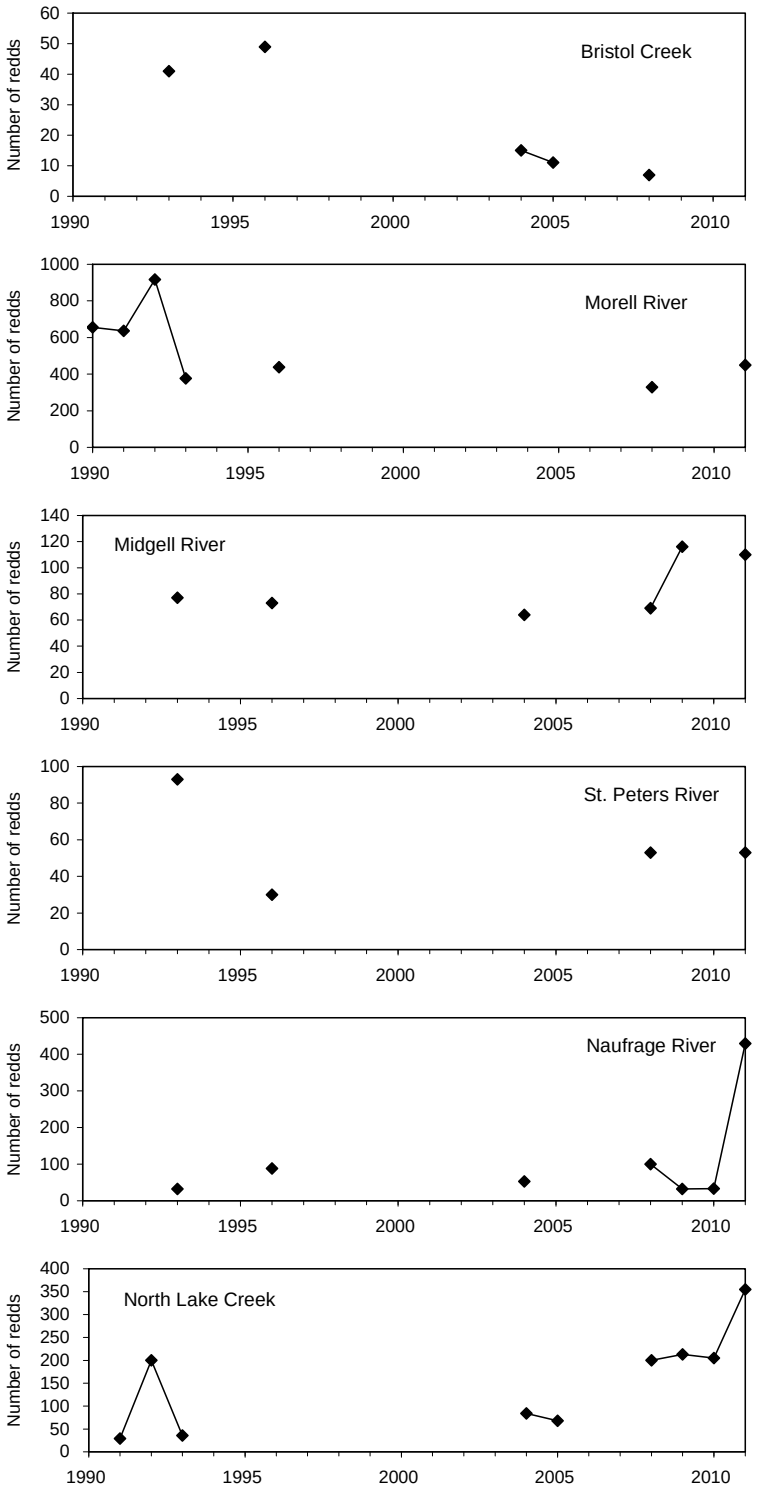

Figure 5. Counts of Atlantic salmon redds in six Prince Edward Island rivers, 1990-2011.

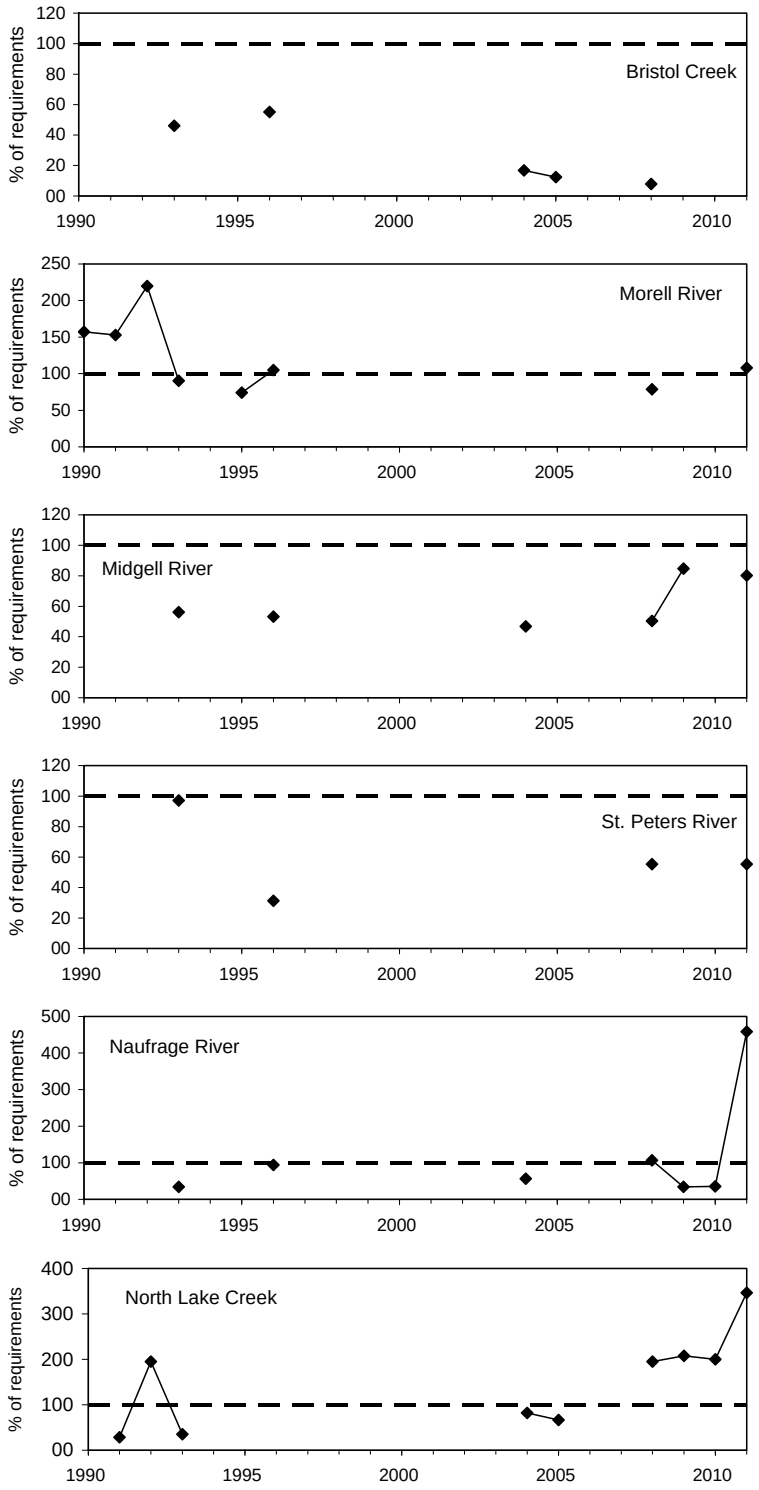

Figure 6. Estimated egg deposition as a percent of egg conservation requirements in six Prince Edward Island rivers, 1990-2011. The dashed horizontal line indicates 100% requirements.

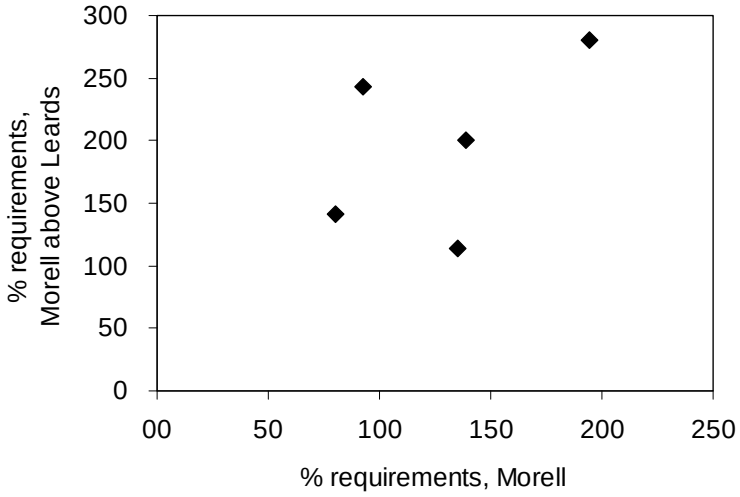

Figure 7. Percent of egg conservation requirements in the Morell River above Leards Dam (Table 7) vs. percent of egg conservation requirements in the Morell River (Table 10).

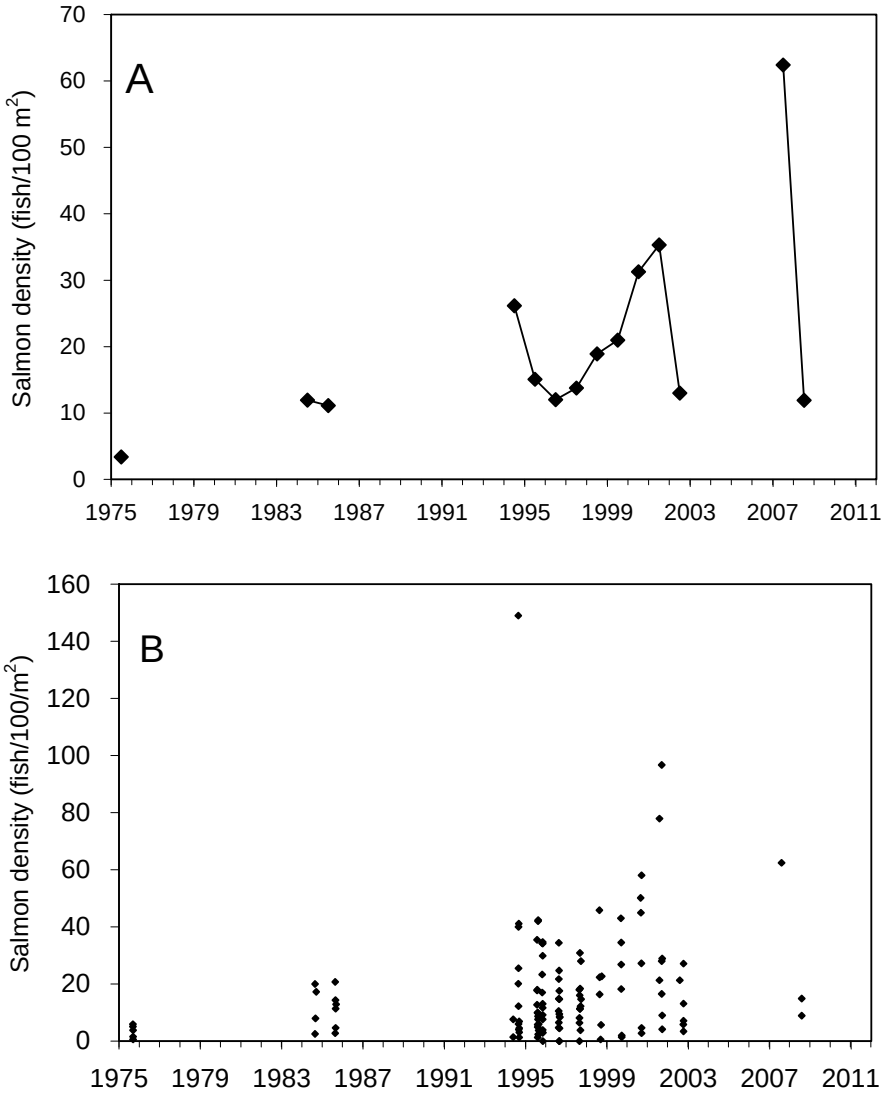

Figure. 8. Mean (A) and by-site (B) densities of juvenile Atlantic salmon on the Morell River, estimated by electrofishing.