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**Gulf Region**

**Status of Atlantic salmon (*Salmo salar* L.) stocks in rivers of Nova Scotia flowing into the Gulf of St. Lawrence (SFA 18), 2012-2013**

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## Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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## ABSTRACT

This document provides an assessment of the Atlantic salmon (*Salmo salar* L.) stocks of Salmon Fishing Area 18 (SFA 18) of Gulf Nova Scotia. The information includes estimates of fisheries catches and harvests of salmon, estimates of returns and spawning escapements and indices of juvenile abundance. The annual trends in abundance of Atlantic salmon populations in SFA 18 are assessed in relation to past years and to conservation requirements. Returns of Atlantic salmon to SFA 18 in 2012 and 2013 were among the lowest of the time series. The estimated return of large salmon to the Margaree River was 1,276 fish with 95% probability that 1,001 fish returned in 2012, the lowest value for the assessment series beginning in 1987, and 1,715 fish with 95% probability that 1,345 fish returned in 2013. The estimated return of small salmon to the Margaree River was 269 with 95% probability that 183 small salmon returned in 2012, and 363 with 95% probability that 263 small salmon returned in 2013. After accounting for removals, conservation requirements for the Margaree River, the largest river of SFA 18, have been met every year since 1987. There were no adult salmon counts in rivers of mainland Nova Scotia (SFA 18A). Catch per unit effort from the recreational fishery is used as an index of adult returns. Following the peak values observed in 2011, catches of large salmon and small salmon per rod day decreased in 2012 and 2013 in River Philip, East River (Pictou) and West River (Antigonish) compared to the previous 5-year average.

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**État des populations de saumon atlantique (*Salmo salar* L.) dans les rivières de la Nouvelle-Écosse qui déversent dans le golfe du Saint-Laurent (ZPS 18), 2012-2013**

**RESUME**

L'évaluation de l'état des populations de saumon atlantique (*Salmo salar* L.) de la zone de pêche à saumon 18 (ZPS 18) pour la région de Golfe Nouvelle-Ecosse est présentée. Les informations comprennent des estimations de captures et de prélèvements de saumon dans les pêcheries, des estimations de montaisons et de reproducteurs, et des indices d'abondance des juvéniles. Les tendances temporelles de l'abondance des populations de saumon atlantique pour la ZPS 18 sont évaluées par rapport aux années antérieures et aux besoins de conservation. Les montaisons de saumon atlantique dans la ZPS 18 en 2012 et 2013 étaient parmi les plus basses de la série temporelle. Les estimées de grands saumons pour la rivière Margaree étaient de 1276 poissons avec 95% de chance que la montaison était d'au moins 1001 poissons en 2012, la plus basse valeur de la série temporelle datant de 1987, et de 1715 poissons avec 95% de chance que la montaison était d'au moins 1345 poissons en 2013. La montaison de petits saumons pour la rivière Margaree était de 269 poissons avec 95% de chance que la montaison était au moins 183 petits saumons en 2012, et de 363 poissons avec 95% de chance que la montaison était au moins 263 petits saumons en 2013. Après avoir tenu compte des pertes de saumon dans les pêches, les besoins de conservation pour la rivière Margaree ont été dépassés chaque année depuis 1987. Aucun décompte de saumons adultes est disponible pour les rivières de la partie continentale de la Nouvelle-Ecosse (ZPS 18A). Les taux de captures par unité d'effort dans la pêche récréative servent d'indices d'abondance des montaisons de saumons adultes. Suivant les valeurs maximales observées en 2011, les prises de grands et petits saumons par canne à pêche/jour a diminué en 2012 et 2013 dans la rivière Philip, l'East River (Pictou) et West River (Antigonish.) par rapport à la moyenne des 5 années précédentes.



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## INTRODUCTION

Atlantic salmon (*Salmo salar* L.) in eastern Canada are managed with area-specific harvesting regulations in 34 management areas known as Salmon Fishing Areas (SFA 1 to 23 and Q1 to Q11; Fig. 1). Rivers in Nova Scotia that flow into the Gulf of St. Lawrence are part of SFA 18 and are managed by the Department of Fisheries and Oceans (DFO) Gulf Region, Canada. Currently, two user groups have access to Atlantic salmon in SFA 18: Aboriginal peoples and recreational anglers. Aboriginal peoples have first access, after conservation requirements are met, based on communal needs for food, social, and ceremonial purposes (FSC allocations).

Atlantic salmon are known to be present in 55 rivers of SFA 18; 29 of these rivers are located from the New Brunswick/Nova Scotia border to the Canso causeway (SFA 18A; Fig. 2) and the remaining 26 rivers are located in Western Cape Breton (SFA 18B; Fig. 2). The Margaree River is the largest river in SFA 18 with a drainage area of 1,100 km<sup>2</sup>.

Adult salmon return to rivers in SFA 18 during May to November and spawning occurs from October to December. Spawning adults consist of small salmon (fork length < 63 cm) and large salmon (fork length ≥ 63cm) with varying proportions of small and large salmon in the returns depending on the geographic area and river (Chaput et al. 2006). Small salmon, also known as grilse or one-sea-winter (1SW), are mostly maiden fish (first time spawners) that have spent one year at sea. The large salmon consists of maiden fish that return to rivers as two-sea-winter (2SW) or older (e.g. 3SW) and repeat spawners (fish that have spawned previously); collectively large salmon are often referred to as multi-sea-winter salmon (MSW).

The Margaree River has the largest Atlantic salmon population in SFA 18. The Atlantic salmon population in the Margaree River and other rivers in SFA 18 return mostly as large salmon and consist mainly of 2SW maiden fish (LeBlanc et al. 2005).

Formal stock assessments of Atlantic salmon have been conducted in the Margaree River since 1985 (Claytor and Chadwick 1985), and since 1991 in selected rivers of mainland Gulf Nova Scotia (Chaput and Jones 1991). Since 1996, there has been no annual adult monitoring program in rivers of SFA 18. In 2010, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identified the rivers in the southern Gulf of St. Lawrence including rivers of Gulf Nova Scotia, and the Gaspé Peninsula, as a Designatable Unit (DU) and this DU was assessed as “Special Concern” (COSEWIC 2010).

This document provides estimates of adult returns and spawning escapement of Atlantic salmon to rivers of SFA 18 and assesses salmon returns and spawners in relation to past years and conservation requirements. Catches and harvest levels of adult salmon and juvenile abundances are also presented.

## ATLANTIC SALMON FISHERIES

Aboriginal food, social and ceremonial (FSC) fisheries and recreational fisheries occur in several rivers of SFA 18. The details of the fisheries are included in the Integrated Fisheries Management Plan (IFMP) 2008 to 2012 (DFO 2008).

## FIRST NATIONS FISHERIES

For western Cape Breton (SFA 18B), Chapel Island, Eskasoni, Indian Brook, Membertou, Millbrook, Pictou Landing, Wagmatcook and Waycobah First Nations had combined FSC allocations to harvest 135 small salmon, 335 large salmon and 10 to 20 small or large salmon in the Margaree River in 2012 and 2013 (Tables 1 and 2). The salmon could be harvested using

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angling, spearing and snaring. Trapnets could be used in the estuary. Eskasoni was also permitted to fish for kelt (salmon that have just spawned) in the Margaree River.

In rivers of mainland Nova Scotia (SFA 18A), Indian Brook, Millbrook and Pictou Landing had combined FCS allocations to harvest 85 small, 127 large salmon and 30 small or large salmon in 2012 (Table 1). In 2013, Indian Brook, Millbrook, Paq'tnkek and Pictou Landing had combined FCS allocations to harvest 295 small, 317 large salmon and 30 small or large salmon in rivers of mainland Nova Scotia (Table 2). The FSC fisheries were permitted in the entire watersheds of River Philip, Pugwash, Wallace, Waugh, French, West (Pictou), West (Antigonish), Shinimicas rivers and River John. FSC gillnet fisheries with allocations of 10 small and 30 large salmon were permitted in the Merigomish Harbour, Pictou County area. The FSC harvest dates for bright salmon (arrived from the ocean) varied by river but in general, were scheduled for the summer and fall season. The communities had scheduled dates to harvest kelts during the spring in River Philip, Wallace and Waugh rivers.

The Native Council of Nova Scotia (off-reserve aboriginal peoples) had allocations to fish Atlantic salmon in rivers of SFA 18 in 2012 and 2013 totalling 1,820 salmon per year (small and large salmon combined) that could be taken from a large number of rivers in Nova Scotia. The fishing season was from January 1 to May 14th for male small salmon and large salmon, May 15th to 31st for male and female small salmon and June 1st to November 5th for small salmon only (DFO 2008).

### **First Nations harvests**

The reported FSC harvest for mainland Nova Scotia was 122 small and large salmon (undifferentiated) and 98 kelts in 2012/2013, and 61 small and large salmon (undifferentiated) in 2013/2014. The reported FSC harvest for Margaree River was 35 small and large salmon (undifferentiated) in 2012/2013, and 24 small and large salmon (undifferentiated) in 2013/2014. The harvest information from these fisheries are preliminary and incomplete.

## **RECREATIONAL FISHERY**

The recreational fishery in rivers of SFA 18 is regulated by season, gear, daily and seasonal bag limits. There is a retention fishery for small salmon and a mandatory catch and release for large salmon. The season and daily bag limits in all rivers of SFA 18 were 4 and 2 small salmon in 2008 to 2013, respectively, which was down from 8 and 2 small salmon prior to 2008 (DFO 2008). Only barbless or pinched barb artificial flies are permitted from October 1 to October 31. Barbed artificial flies are permitted prior to October 1. Four tags are issued with the purchase of every license. Small salmon that are retained must be tagged by inserting the tag through the mouth and gill cavity. It is mandatory that the stub return on the salmon license be properly filled out and mailed within seven days of the close of the season or fishing privileges may be suspended. License stubs should be returned even if the person did not fish or if no fish were caught or retained. The catch and effort information recorded on the license stubs are used to determine exploitation rates to give science advice for the proper management of Atlantic salmon stocks.

The angling season in rivers of SFA18 extends from September 1 to October 31 in most rivers, the exceptions being the Margaree River and the Cheticamp River. The angling season in Margaree River is from June 1st until October 15th except for upstream from the highway bridges at East Margaree to the Big Intervale bridge on the Northeast Margaree River and upstream to the Scottsville highway bridge on the Southwest Margaree River which is from June 1st to October 31st. The Northeast Margaree River and tributaries upstream from the Big Intervale bridge are closed all year.

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The angling fishery in the Cheticamp River is managed by Parks Canada and the season extends from May 19 to September 30 for the section upstream from the lower end of the Terre Rouge Pool and the season extends from May 19 to October 31 for the lower end of Terre Rouge Pool up to and including the Fence Pool. There is no retention of any salmon allowed in the Cheticamp River.

### **Angling statistics from licence stubs**

The sale of recreational Atlantic salmon fishing licences is managed by the province of Nova Scotia. Licence sales from 1987 to 1990 varied between 7,191 and 8,615 licences annually (Fig. 3). Since 1998, annual sales have ranged from 1,938 to 2,600 licences (Fig. 3). In 2012 and 2013, 2,314 and 2,491 Atlantic salmon licenses were purchased in Nova Scotia. To date (February 2013), 886 licence stubs were returned by anglers for the 2012 season, a 38% stub return rate, and 513 licenses for 2013, a 21% return rate. The licence stub information is compiled in a recreational catch database. The observed data (not corrected for total licence sales) was used to estimate adult salmon returns to the Margaree River, and to SFA 18 overall. Total catch and total effort had to be estimated for the total licence sale because not all licence stubs were returned. In the software used, the catch and effort data from voluntary returns were used to build a regression analysis that estimated catch and effort for non-returned licence stubs.

Angling statistics for 2013 are preliminary because licence stubs will likely be received until September 2014. Anglers reported catch and effort from 17 rivers in 2012, and 16 rivers in 2013. The angling efforts in mainland Nova Scotia was estimated to be 4,354 rod-days in 2012 and 5,150 rod-days in 2013, and were above the 5-year average for SFA 18A (Table 3). The angling efforts for western Cape Breton was estimated to be 4,931 rod-days in 2012 and 6,500 rod-days in 2013, and were below the 5-year average for SFA 18B (Table 3). Although the data are preliminary for 2013, the estimated catch of small and large salmon in 2012 and 2013 were below the 5-year average in SFA 18A, and well below in SFA 18B (less than 50%). The large salmon caught and released in 2012 and 2013 were estimated to be 691 and 661 fish in SFA 18A and 397 and 630 fish in SFA 18B, respectively (Table 3). It was estimated that 260 small salmon were caught in SFA 18A during 2012, and 257 in 2013, of which 21% and 20% were retained, respectively. The small salmon catch in SFA 18B was estimated at 87 fish in 2012 and 157 in 2013, of which 20% and 44% were retained, respectively. All persons purchasing a salmon licence received 4 tags to retain small salmon. Considering that 2,314 licenses were sold in 2012, and 2,491 licences in 2013, this represented a total of 9,256 tags in 2012 and 9,964 tags in 2013 available for the potential retention of small salmon. It was estimated that 71 small salmon were harvested in SFA 18 in the 2012 recreational fisheries, and 120 small salmon in 2013 (Table 3).

The angling data obtained from the licence stubs are presented by river in Appendices 1 to 5. Salmon catch and the catch per unit of effort (rod days) in three index rivers of SFA 18A (West River (Antigonish), East River (Pictou) and River Philip) have decreased to values near or below the 5-year average following the historical peak values observed in 2011 (Figs. 4, 5 and 6; Appendices 2, 3, 5). The catch of large salmon in the Margaree River for 2012 and 2013 were estimated to be 2 to 3 fold lower than the 5-year average, and 4 to 6 times lower than the values observed in 2011 (Figs. 4 and 7; Appendix 1). The total catch per unit of effort of small and large salmon in 2012 and 2013 were amongst the lowest of the time series following the highest record values observed in 2011 (Fig. 7).

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## CONSERVATION REQUIREMENTS

Breau (2012) gave a detailed review of conservation requirements that were in place for all rivers of SFA 18 prior to 2013 (Table 4). The conservation requirement for Atlantic salmon in the Gulf Region was defined as an egg deposition rate of 2.4 eggs per m<sup>2</sup> of juvenile rearing habitat (CAFSAC 1991a). The objective was to obtain the egg requirements from large salmon (CAFSAC 1991b) because the majority of salmon returning to rivers of SFA 18 consisted of large salmon and these were, on average, 75% female (Marshall 1982). CAFSAC (1991b) also provided an objective for small salmon for ensuring a 1:1 male to female ratio at spawning time, corresponding to the conservation requirements for large salmon. This objective has in the past been used to manage access for fisheries on small salmon in cases where the large salmon returns were below conservation requirement; however a firm biological basis for this objective has yet to be documented (Breau 2012; Breau and Chaput 2012).

### SFA 18A

In SFA 18A, a total of 2,257 large salmon are needed to meet conservation requirements in the 17 rivers for which egg requirements have been calculated (Breau 2012). River Philip and West River (Antigonish) have the highest conservation requirements with 358 and 353 large salmon, respectively, while requirements in other rivers of SFA 18A are less than 300 large salmon per river (Breau 2012).

No fish count has been conducted in any of the three index rivers (West River (Antigonish), East River (Pictou) and River Philip) to generate a formal adult salmon population estimate since the late 1990's (Breau 2012). Catch per unit effort from the recreational fishery was used as an index of adult abundance but there are no population estimates to determine if conservation requirement was met.

Angling catches and the catch per unit of effort (rod days) in West River (Antigonish), East River (Pictou) and River Philip have decreased to values near or below the 5-yr average following the historical peak values observed in 2011 (Figs. 4, 5 and 6; Appendices 2, 3, 5).

### SFA 18B

The egg requirement for Margaree River was estimated to be approximately 6.71 million eggs which would be obtained from 1,036 large salmon (Breau 2012). The estimates of salmon returns to the Margaree River were derived from a Bayesian model that incorporates data from mark and recapture experiments (1988 to 1996), catch and effort from license stubs (1987 to 2013) and catch and effort from voluntary anglers logbooks (1987 to 2013) (Breau and Chaput 2012). During 1988 to 1996, returns of Atlantic salmon to the Margaree River were estimated using mark and recapture techniques. For 1987 to 2013, angling catch and effort data from voluntary angler logbooks and provincial license stubs were used in conjunction with the mark and recapture data to derive a catchability coefficient for the recreational fisheries (Breau and Chaput 2012). The catchability coefficient per rod day was estimated from angling catch and effort data for the years 1988 to 1996 when a mark and recapture program was used to estimate returns, independently from angling catch (Breau and Chaput 2012). Since 1997, angling catch and effort data was used to estimate returns of salmon to Margaree River since no adult salmon were counted or marked to estimate returns to the river. The catchability coefficient generated during 1988 to 1996 was applied to the other years assuming it to be the same for those years.

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## **Estimates of salmon returns to Margaree River**

The median estimate of small salmon returns to Margaree River in 2012 was 269 with a 95% probability that at least 183 small salmon returned (5th to 95th percentile range: 183 to 397), and 363 small salmon returned in 2013 with a 95% probability that at least 263 small salmon returned (5th to 95th percentile range: 263 to 559) (Table 5; Figs. 8 and 9). A median estimate of 1,276 large salmon (5th to 95th percentile range: 1,001 to 1,627) returned to Margaree River in 2012, and 1,715 large salmon (5th to 95th percentile range: 1,345 to 2,186) returned in 2013 (Table 5; Figs. 8 and 10). The estimated return of large salmon for 2012 was the lowest since 1987 (Table 5; Figs. 8 and 10).

## **Estimates of salmon returns to SFA 18**

Estimates of salmon returns to SFA 18 were derived from estimates for the Margaree River. The estimates of returns to Margaree River were adjusted by the ratio of angling catch in the SFA relative to the Margaree catch (Breau et al. 2009).

A median estimate of 2,900 large salmon (5th to 95th percentile range: 1,100 to 4,700) returned to SFA 18 in 2012, and 3,900 large salmon (5th to 95th percentile range: 1,450 to 6,350) returned to SFA 18 in 2013; a major drop from the highest median estimate of the time series reported in 2011 (Fig. 11). The median estimate of small salmon returns in 2012 was 650 with a 95% probability that at least 200 small salmon returned (5th to 95th percentile range: 200 to 1,100), and 910 small salmon returned in 2013 with a 95% probability that at least 300 small salmon returned (5th to 95th percentile range: 300 to 1,500) (Fig. 11).

## **Estimates of spawners in Margaree River**

Spawners are the salmon remaining in the river to spawn after fisheries removals (harvest, catch and release mortality). Fisheries removals are subtracted from the yearly estimated returns to estimate spawning escapements.

In the calculations of conservation requirement for the Margaree River, the eggs required to meet conservation requirements are calculated based on large salmon only because the majority of the returns consist of large salmon. However, females composed, on average, 16% (range: 7% to 43%) of the small salmon returns during 1987 to 1996 (LeBlanc et al. 2005). Even though there are fewer eggs per female small salmon, the genetic composition of these fish may play a role in the maintenance of the small salmon component of the returns.

In the Margaree River, removals for 1987 to 2013 consisted of the retained angling catch for small salmon and a hook and release mortality estimate of 5% for small salmon and large salmon angled and released. The removals from the aboriginal fisheries were incomplete and not always differentiated between small and large salmon, and therefore not included in the calculations of spawner escapements. However, it is important to acknowledge that large and small salmon are harvested from the aboriginal fisheries.

The preliminary estimate of spawning escapement for large salmon in the Margaree River was 1,258 (5th to 95th percentile range: 982 to 1,608) in 2012 and 1,686 (5th to 95th percentile range: 1,316 to 2,158) in 2013 (Figs. 8 and 10) indicating that the conservation requirement of 1,036 large salmon was met both years. The returns and spawning escapements of large salmon in the Margaree River have exceeded the conservation requirement every year since 1987 (Fig. 10).

The estimate of the small salmon spawning escapement was 253 (5th to 95th percentile range: 168 to 381) in 2012 and 310 (5th to 95th percentile range: 190 to 484) in 2013 (Figs. 8 and 9). The median estimate of small salmon spawner did not exceed the secondary objective of 518 small salmon both years (Fig. 9).

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## Estimates of spawners in SFA 18

The estimates of spawners in SFA 18 were derived from estimates of spawners to the Margaree River, adjusted by the ratio of angling catch in the SFA relative to the Margaree catch (Breau et al. 2009).

The preliminary estimate of spawning escapement for large salmon in SFA 18 in 2012 was 2,850 large salmon (5th to 95th percentile range: 1,050 to 4,700) and 3,850 large salmon (5th to 95th percentile range: 1,400 to 6,300) in 2013 (Fig. 11). The median estimate of spawning escapement for small salmon was 450 with a 95% probability that at least 120 small salmon made it to the spawning grounds (5th to 95th percentile range: 120 to 860), and 625 small salmon in 2013 with a 95% probability that at least 135 small salmon escaped (5th to 95th percentile range: 135 to 1,100) (Fig. 11).

## JUVENILE ATLANTIC SALMON ABUNDANCE

Relative abundance of wild juvenile salmon in freshwater was determined by electrofishing surveys. Juvenile surveys have been conducted in the Margaree River since 1957 (Chaput and Claytor 1989; LeBlanc and Chaput 2003) and since 1987 in a number of rivers of SFA 18A (mostly West River (Antigonish), East River (Pictou) and River Philip) (see Breau et al. 2009). Prior to 1993, sites were closed with barrier nets, the total depletion method was used and abundance estimates were generated by the algorithm developed by Zippin (1956).

Since 1993, sites in SFA 18 have been surveyed using the catch per unit effort (CPUE), a method that was introduced to increase the spatial coverage of sampling (Chaput et al. 2005). In 2001 and 2002, sites in the Margaree River were electrofished using the depletion method to calibrate the CPUE sites. The CPUE data collected each year was converted to fish density using the regression line obtained from the total removal method (see Chaput et al. 2005 for description of method).

Herein, fry refers to young-of-the-year (or 0+ parr) Atlantic salmon and parr refers to all juvenile salmon of age-1 and older. Juvenile salmon having a clipped adipose fin were identified as fish of hatchery-origin. Densities of fry and parr are assessed relative to a “normal index of abundance” (Elson norm) of 29 fry per 100 m<sup>2</sup> and 38 parr per 100 m<sup>2</sup> (DFO 2002).

## SFA 18A

A change in strategy for the juvenile sampling coverage was implemented for the rivers of mainland Gulf-Nova in 2012. Prior to 2012 in SFA 18A, three sites were electrofished in West River (Antigonish), two sites in Barney’s River, three sites in East River (Pictou), two sites in Wallace River and two sites in River Philip. In 2012 and 2013, the number of sites electrofished increased to six sites per river in West River (Antigonish), East River (Pictou) and River Philip, while the coverage of Barney’s River and Wallace River was eliminated.

Fry density exceeded 29 fish per 100m<sup>2</sup> in all 3 index river in 2012 and 2013 (Fig. 12). However, in the cases of East River (Pictou) and West River (Antigonish), fry densities have been lower in recent years compared to the 90’s and 00’s. Parr densities were lower than 38 fish per 100 m<sup>2</sup> in all 3 index river but were still comparable to earlier recent estimates with more than 20 parr per 100 m<sup>2</sup> (Fig. 12). Large yearly variations in fry and parr densities likely resulted from the low number of sampling sites, specifically within rivers on mainland, and changes in physical characteristics of some sites (Breau 2012).

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## **MARGAREE RIVER (SFA 18B)**

Surveys for juvenile salmon have been conducted annually at 5 to 13 sites in the Margaree River since 1990 (Fig. 13). Juvenile densities in the Margaree River have been generally high but with important annual variation. A 100-year flood occurred in the Margaree River in December 2010 and subsequently fry were absent at the three mainstem sites and present in only four of eight sampled tributary sites in the Margaree in 2011 (Fig. 14). By contrast, fry densities were high in fall 2012 confirming that spawners abundance was high in fall 2011 (Fig. 14). Fry and parr were found at each site covered in 2012 and 2013 (Fig. 15).

Fry densities have declined from the peak abundances in 2004 and 2005 and were at the lowest abundance in 2011 (Fig. 16). An increase in densities in 2012 following the good adult returns of 2011 was followed by another low density in 2013 relative to the recent time series (Fig. 16). And except for 2012, four of the lowest five values in fry densities occurred during the last 5 years compared to the 1990 to 2008 trend (Fig. 16).

Parr abundances have also declined from the peak value in 2005 (Fig. 16). Parr densities in 2011 were slightly higher than in 2009 and 2010, but densities for years 2009 to 2013 were half the densities observed in the 1990 to 2008 long-term average (Fig. 16).

Values in fry and parr densities observed in recent years are reminiscent to the values observed during the 70's and early 80's (Breau et al. 2009).

### **Juvenile salmon densities and growth in the Margaree River**

Breau (2012) demonstrated that for the Margaree river, parr density in year (t+1) was positively correlated to fry density in year (t), and that the average fork length decreased with increased density. It inferred that growth was presumably better at low fish densities because of greater food availability and less competition for food and space. In 2012 and 2013, the juvenile densities were low but the average fork lengths of fry, 1 year old and 2 year old parr were larger than past years which indicated that growth was better (Fig. 17).

## **ATLANTIC SALMON OF HATCHERY-ORIGIN**

Juvenile salmon and smolts released from the Margaree fish culture station in 2012 and 2013 can be recognized by a clipped adipose fin. Unclipped salmon of hatchery-origin were released in the Margaree River during 2009 and 2010 which made the distinction of wild and hatchery-reared salmon not possible. In 2012 and 2013, salmon of hatchery-origin were released in the Margaree River (SFA 18B). A total of 137,602 juvenile salmon (31,769 1+ smolts, 6,000 1+ parr, 99,833 0+ parr) were released in the Margaree River in 2012 and 34,308 juveniles salmon (31,204 1+ smolts, 3,104 1+ parr) in 2013. Broodstock for the Margaree River system were collected from the early run of the Northeast Branch of the Margaree.

Since 1987, a group of anglers have volunteered to participate in a logbook program by recording all of their fishing activities in Nova Scotia. The total number of participants has decreased from 70 anglers in 2000 to 28 anglers in 2012 and 20 in 2013. One of the observations recorded by anglers was whether the small and large salmon captured had a clipped adipose fin. The data were summarized to show the number and percentage of small and large salmon angled in the Margaree River that were of wild and hatchery-origin over the years 2000 to 2013.

During 2000 to 2013, the number of small salmon (wild and adipose-fin clipped) caught by anglers participating in the logbook program varied from 0 small salmon in 2012 to 42 small salmon in 2002 and 2011 (Table 6). The number of large salmon (wild and adipose-fin clipped) caught by anglers varied between 7 large salmon caught in 2012 to 115 fish in 2011 (Table 6).

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In any given year, anglers always caught a greater number of large salmon than small salmon. In 2004, 2007, 2009 and 2012, no small salmon with a clipped adipose fin were reported caught by anglers (Table 6) and in 2001, 2003, 2006 and 2013, 10%, 15%, 16% and 40% of the small salmon caught had a clipped adipose fin. There were no large salmon with a clipped adipose fin reported angled in 2000, 2007, 2010 and 2012. In all, the percentage of large salmon caught with a clipped adipose fin varied between 0 to 3% except in 2003 and 2013 when 35% and 8% of large salmon caught were reported as clipped, respectively. The high percentage values of adipose clip observed in 2013 are due to low catch of wild salmon compared to normal capture of adipose clip fish. The value in 2003 is anomalously high. The majority of salmon caught by these anglers were wild fish. These data indicate that the majority of the returns of salmon to rivers in Gulf Nova Scotia including the Margaree River are from natural spawning. It is imperative that any fish which are stocked from the hatchery be marked for identification before release.

### **ABUNDANCE INDICATORS**

Adult returns and adult return rates were found to be the most informative indicators of Atlantic salmon stock abundance (ICES 2007). Small salmon abundance in the Margaree River is used as an indicator of abundance in the ICES framework of indicators used for the assessment of the validity of multi-year advice for the West Greenland fishery (ICES 2011).

During years with no formal assessment of salmon stock status, the estimate of adult returns to the Margaree River is used by DFO Science Branch to infer abundance in all rivers of SFA 18. The catch and effort in the recreational fishery is also used as indices of abundance. The angling statistics in rivers of SFA 18A follow the same trends as in the Margaree River. As currently done, adult returns to the Margaree River and angling statistics could still inform on adult salmon abundance in rivers of SFA 18.

The DFO Science Branch has been conducting juvenile surveys in the fall of each year for a number of years. According to Breau (2012), the abundance of young-of-the-year salmon in a river is a good indicator of the spatial extent and the level of spawning. However, juvenile abundance is not a good indicator of current adult abundance because surveys are done the year after the adult returned to spawn. The young-of-the-year abundance does not provide the information to determine if conservation requirements were met.

### **SOURCES OF UNCERTAINTIES**

Harvest levels and catches of salmon from aboriginal fisheries and recreational fisheries have been incomplete or undocumented. The aboriginal fisheries include large salmon harvests in the FSC allocations; information important to determine if conservation requirements have been met because the egg requirements are calculated for large salmon. Recreational anglers receive a report stub with their salmon license. It is mandatory that the anglers return their license stubs even if they did not fish. However, return rate of license stubs by recreational anglers have always been less than 50% even with a reminder letter. Because recreational data file is continuously updated with the arrival of new stubs, results from previous stock assessment will change accordingly once data files for estimation models are also updated. In the current document, changes in angling data had to be done up to the year 2008 for some rivers.

In SFA 18, there were no counts of adult salmon or recent mark-recapture experiments to determine population sizes and status. The assessments conducted for the Margaree River were based on a mark-recapture experiment conducted during 1988 to 1996 in conjunction with recreational catch and effort data. Since 1997, only the recreational angling statistics have been



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used in the model with the catchability coefficient developed during 1988 to 1996 assumed to still be appropriate. In rivers of SFA 18A, there are no estimate of adult salmon returns to compare with the conservation requirements in those rivers. Recreational angling statistics were used as indices of abundance. Juvenile surveys are conducted on these rivers but the data only provides an indication of the spawning escapement from the previous year.

Median values are presented in this document, however it is important to note that large uncertainties are associated with the estimates (included as credibility intervals). The median values do not represent the exact number of fish that returned. The assumed catch rate used to estimate adult returns to the Margaree River, and SFA 18, is high and should be verified to confirm the values (Breau 2012). It is in this optic that DFO Science Branch (Gulf Region) proposed a collaborative project with Unama'ki First Nations that involves an assessment procedure based on mark-recapture experiment for the Margaree. The approach does not require a trapnet as was the case for the Margaree in the late 1980s to mid-1990s but rather we propose to capture and mark fish by seining in the fall and recapturing fish by angling in the spring. The main objective of the mark-recapture program in Margaree River that was initiated in 2013 is to recalculate the catchability coefficient in the angling fishery to determine if the current values differ from that estimated during 1987 to 1996. The program should preferably be conducted for three to five years. More current biological characteristics of salmon during marking and recapture activities would also be collected (sex, age, length) since the last year of collection of biological characteristics dates to 1996.

## **ACKNOWLEDGMENTS**

The results presented in this document were based on data collected over many years. The successful collection of the data involved many individuals. We would like to thank the following individuals for their help with the juvenile surveys during the years of 2012 and 2013: Renelle Doucette, Peter Hardie, Sophie Leblanc, Claude Léger, Dave Moore, Samuel Ouellette, and Réjean Vienneau. We also thank Sean Neary, manager of the Margaree Fish Culture Station for providing stocking data for 2012 and 2013. And finally, some of this work would not have been possible without the cooperation of Shelley Denny, Angie Denny, Tyson Paul and Keith Christmas from the Unama'ki Institute of Natural Resources in Cape Breton, NS.

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Table 1. Atlantic salmon harvest allocations to aboriginal communities in rivers of Nova Scotia flowing into the Gulf of St. Lawrence in 2012.

Aboriginal community	River	Allocation			Kelt
		1SW	MSW	1SW or MSW	
Indian Brook	Phillip, Wallace, Waugh	-	-	-	100 (total among 3 rivers)
Millbrook	Margaree	-	-	10	-
	West (Pictou)	-	-	20	-
	West (Antigonish)	10	10	-	-
	Shiminicas	-	-	10	-
Pictou Landing	Margaree	-	-	10	-
	East (Pictou)	30	70	-	-
	West (Pictou)	25	37	-	-
	River John	20	10	-	-
	Merigomish and Pictou Hbrs	10 <sup>1</sup>	30 <sup>1</sup>	-	-
	Margaree	5	10	-	-
Chapel Island	Pictou and Inverness Counties	-	-	-	as required
Eskasoni	Margaree	26	65	-	-
Membertou	Margaree	26	65	-	as required
Wagmatcook	Margaree	26	65	-	-
Waycobah	Margaree	26	65	-	-
Native Council of Nova Scotia	Open rivers in Nova Scotia	-	-	1,820	-
All groups	All rivers	240	522	1,860	-

<sup>1</sup> allocation for both harbours

Table 2. Atlantic salmon harvest allocations to aboriginal communities in rivers of Nova Scotia flowing into the Gulf of St. Lawrence in 2013.

Aboriginal community	River	Allocation			Kelt	
		1SW	MSW	1SW or MSW		
Indian Brook	Phillip, Wallace, Waugh	-	-	-	100 (total among 3 rivers)	
Millbrook	Margaree	-	-	10	-	
	Philip	50	90	-	as required	
	Pugwash	10	10	-	-	
	Wallace	20	-	-	as required	
	Waugh	20	-	-	as required	
	West (Pictou)	-	-	20	-	
	West (Antigonish)	10	10	-	-	
	Shiminicas	-	-	10	-	
Pictou Landing	Margaree	-	-	10	-	
	East (Pictou)	30	70	-	-	
	West (Pictou)	25	37	-	-	
	River John	20	10	-	-	
	Merigomish and Pictou Hbrs	10 <sup>1</sup>	30 <sup>1</sup>	-	-	
	Margaree	5	10	-	-	
Chapel Island	Pictou and Inverness Counties	-	-	-	2 per day/person	
	Margaree	26	65	-	-	
	Eskasoni	26	65	-	as required	
	Membertou	26	65	-	-	
	Wagmatcook	26	65	-	-	
	Waycobah	26	65	-	-	
	Paq'tnkek	Barney's	15	10	-	-
		French	15	10	-	-
		Pomquet, Afton, Monastery	30	15 <sup>2</sup>	-	-
		West (Antigonish)	45	45	-	-
		South (Antigonish)	5	10	-	-
		Pictou and Antigonish Counties	-	-	-	2 per day/person
Native Council of Nova Scotia	Open rivers in Nova Scotia	-	-	1,820	-	
All groups	All rivers	440	682	1,870	-	

<sup>1</sup> allocation for both harbours

<sup>2</sup> no more than 10 MSW from any single river to a total of 15

Table 3. Recreational effort (rod days) and catch of Atlantic salmon by size group in Gulf Nova Scotia rivers, 1984 to 2013. SFA 18A refers to rivers on mainland Nova Scotia and SFA 18B to rivers in Cape Breton.

Year	SFA 18A			SFA 18B				
	Effort rod days	Small salmon kept	Small salmon catch	Large salmon released	Effort rod days	Small salmon kept	Small salmon catch	Large salmon released
1984	943	54	60	104	6,553	197	248	334
1985	1,122	67	96	434	7,955	408	523	1,259
1986	2,822	299	389	1,727	10,298	657	790	2,702
1987	3,998	238	304	1,091	12,904	827	979	1,907
1988	4,003	374	487	1,160	14,269	772	902	2,024
1989	4,556	255	363	1,514	13,537	450	582	1,753
1990	4,201	417	562	830	14,217	502	655	1,579
1991	5,332	333	494	1,586	13,696	585	784	1,919
1992	4,240	390	560	1,344	15,242	589	731	2,103
1993	5,685	271	424	1,232	15,783	562	790	1,135
1994	3,783	141	219	549	13,657	293	437	1,488
1995	4,092	247	365	541	12,436	207	353	1,115
1996	5,834	480	857	2,117	9,373	290	1,259	1,989
1997	2,415	137	215	452	9,910	195	330	2,133
1998	4,384	268	455	781	10,209	212	359	1,371
1999	4,145	282	523	1,058	7,956	200	321	819
2000	3,263	134	275	382	7,383	137	276	705
2001	1,009	15	46	59	7,570	146	373	862
2002	3,226	128	337	282	7,418	163	370	626
2003	2,413	82	193	391	7,485	187	347	1,171
2004	2,933	180	408	565	7,920	253	523	1,412
2005	3,268	133	434	705	9,475	215	439	1,374
2006	3,705	102	281	620	9,158	258	458	1,285
2007	3,048	78	291	273	8,723	200	342	786
2008	3,356	132	485	542	8,658	331	684	1,391
2009	4,506	23	280	968	8,357	52	179	1,040
2010	4,003	122	416	706	7,372	183	442	1,264
2011	4,047	134	606	1,556	7,634	207	616	2,224
2012	4,354	54	260	691	4,931	17	87	397
2013	5,150	51	257	661	6,500	69	157	630
5-yr average (2008-2012)	4,053	93	409	893	7,390	158	402	1,263

Table 4. The conservation egg requirements and spawner requirements for the Gulf Nova Scotia rivers of SFA 18 (from Breau 2012).

River	Egg requirements	
	(X 1,000)	Large salmon
<b>Mainland Nova Scotia (SFA 18A)</b>		
Afton	45	14
Barney's	511	79
East (Pictou)	1,750	271
French (Colchester)	673	104
French (Pictou)	417	65
Middle (Pictou)	709	110
Pomquet	185	57
Pugwash	593	92
River John	954	148
River Philip	2,309	358
South	228	70
Sutherlands	160	25
Tracadie (Monastery)	126	39
Wallace	1,495	232
Waugh	752	116
West (Antigonish)	1,153	353
West (Pictou)	798	124
<b>Cape Breton (SFA 18B)</b>		
Margaree	6,714	1,036
<b>Total</b>	<b>19,572</b>	<b>3,293</b>

Table 5. Small and large salmon return estimates to the Margaree River, 1984 to 2013.

Year	Small salmon			Large salmon		
	median	2.5th	97.5th	median	2.5th	97.5 <sup>th</sup>
1987	1,718	1,432	2,130	3,429	2,943	4,037
1988	1,465	1,208	1,828	3,316	2,840	3,915
1989	957	782	1,212	2,777	2,366	3,285
1990	1,056	870	1,331	2,505	2,132	2,957
1991	1,244	1,014	1,574	3,093	2,618	3,686
1992	1,065	876	1,334	3,126	2,673	3,699
1993	1,189	1,003	1,465	1,759	1,519	2,050
1994	718	585	909	2,642	2,245	3,139
1995	591	477	750	1,986	1,678	2,365
1996	2,653	2,135	3,384	4,186	3,519	5,016
1997	616	489	796	4,561	3,811	5,485
1998	705	557	919	2,766	2,308	3,342
1999	778	614	1,010	2,107	1,744	2,557
2000	692	539	909	2,000	1,646	2,443
2001	917	716	1,205	2,298	1,897	2,803
2002	952	742	1,249	1,693	1,388	2,071
2003	873	678	1,163	3,138	2,580	3,844
2004	1,229	950	1,631	3,582	2,919	4,417
2005	876	693	1,137	2,970	2,472	3,616
2006	972	754	1,286	2,849	2,368	3,483
2007	805	623	1,063	1,980	1,629	2,419
2008	1,402	1,082	1,865	2,986	2,432	3,697
2009	368	264	522	2,295	1,835	2,865
2010	999	762	1,353	3,050	2,468	3,783
2011	1,418	1,084	1,888	5,383	4,375	6,610
2012	269	183	397	1,276	1,001	1,627
2013	383	263	559	1,715	1,345	2,186



Table 6. The numbers and percentages of small and large salmon of wild-origin and hatchery-origin (clipped adipose fin) that were reported caught by recreational anglers in the Margaree River during 2000 to 2013. The data were collected by anglers who volunteered to participate in a logbook program in Nova Scotia.

Year	Small salmon			Large salmon		
	Wild origin	Adipose-fin clipped	Percentage with clipped fin	Wild origin	Adipose-fin clipped	Percentage with clipped fin
2000	26	1	4	85	0	0
2001	27	3	10	74	2	3
2002	41	1	2	59	1	2
2003	22	4	15	59	32	35
2004	33	0	0	92	3	3
2005	23	2	8	89	1	1
2006	26	5	16	61	1	2
2007	13	0	0	30	0	0
2008	37	1	3	51	1	2
2009	3	0	0	34	1	3
2010	15	1	6	33	0	0
2011	41	1	2	113	2	2
2012	0	0	0	7	0	0
2013	3	2	40	33	3	8

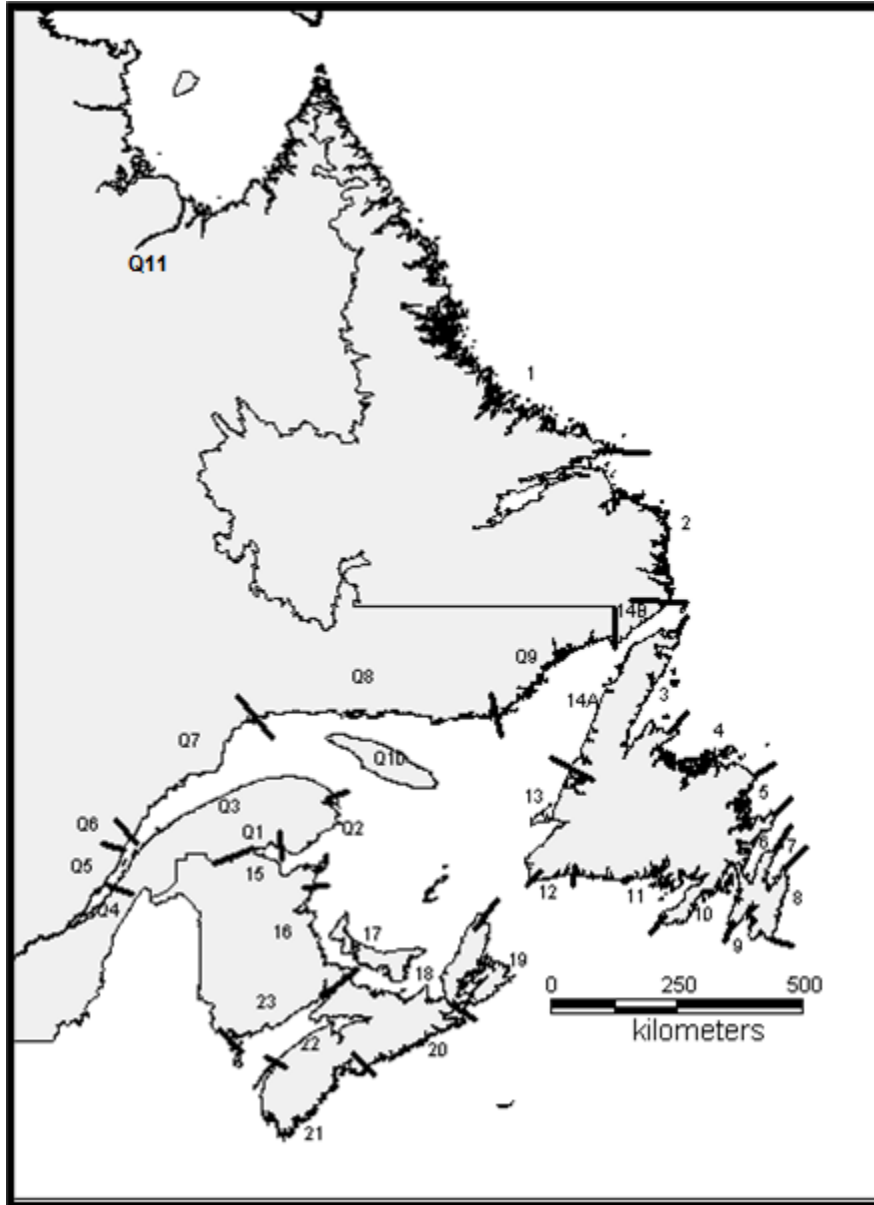


Figure 1. Salmon Fishing Areas (SFA) in eastern Canada. SFA 18 refers to rivers in Nova Scotia that flow into the Gulf of St. Lawrence.

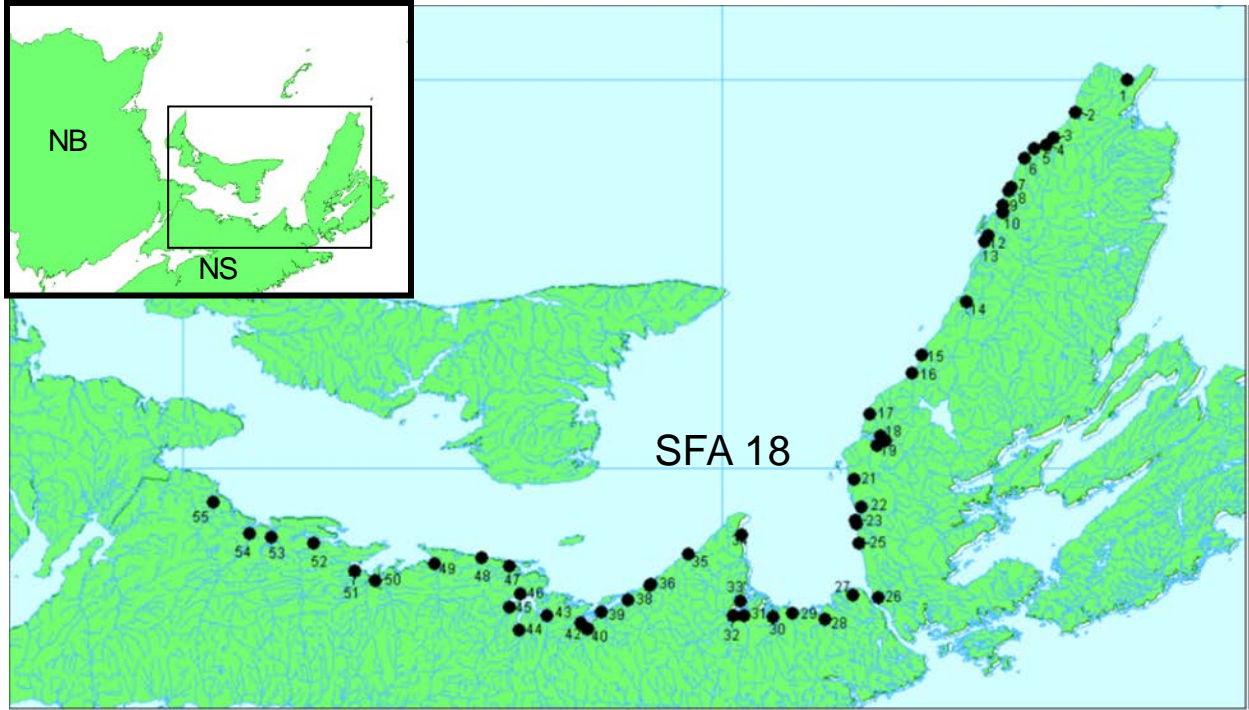


Figure 2. Rivers in Gulf Nova Scotia (SFA 18) that flow into the southern Gulf of St.Lawrence. Index numbers refers to river names as presented in Breau et al. (2009).

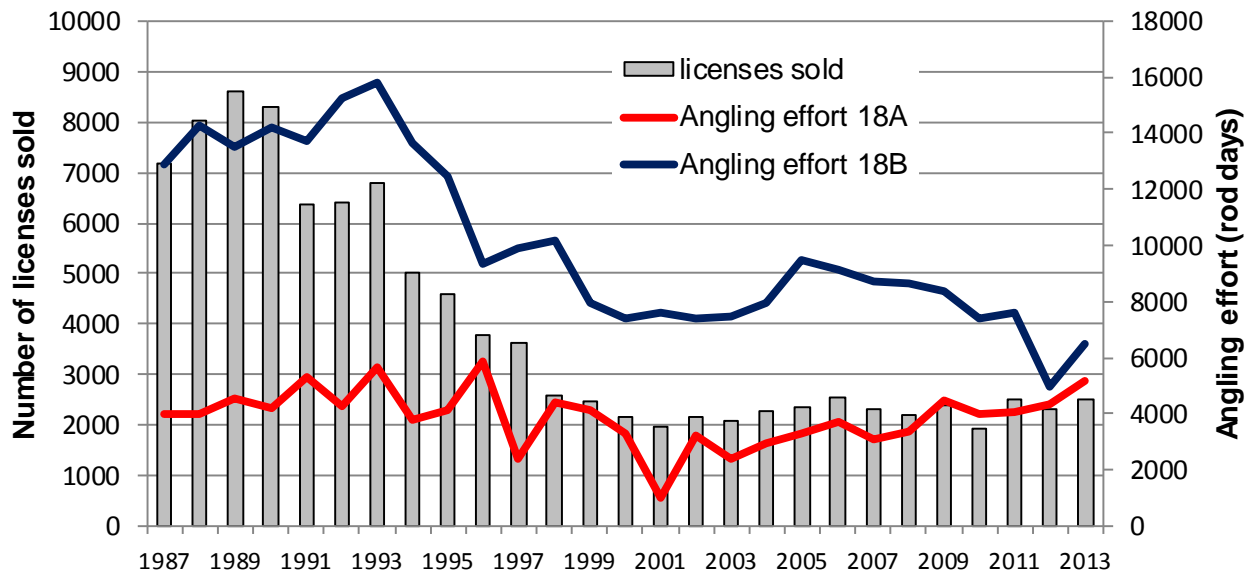


Figure 3. The number of recreational Atlantic salmon licenses sold in Nova Scotia and the annual estimated angling effort in mainland Gulf-Nova Scotia (SFA 18A) and western Cape Breton (SFA 18B).

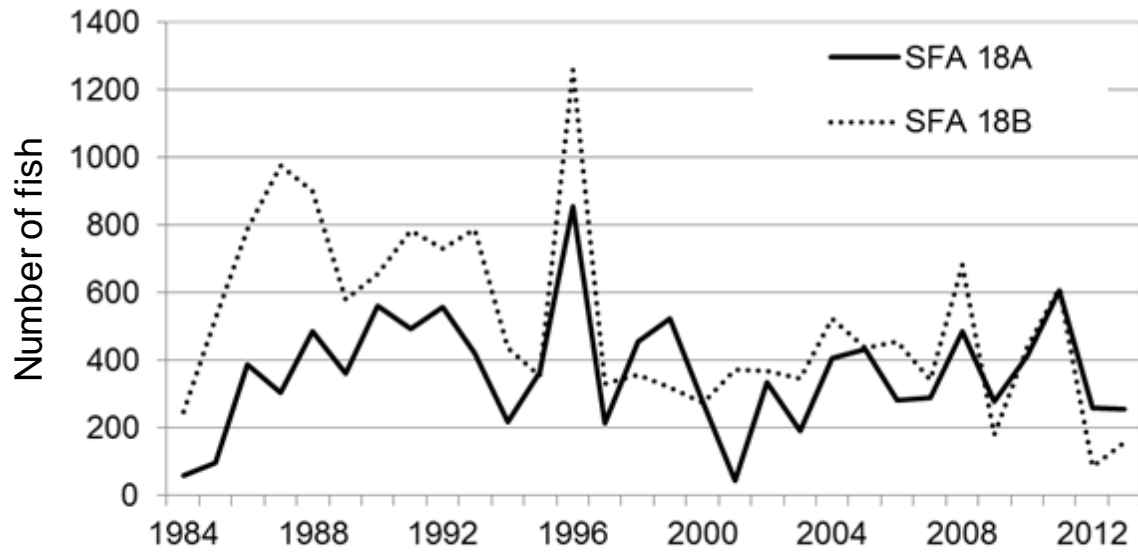


Figure 4. Angling catch of small salmon (upper panel) and large salmon (lower panel) for mainland Gulf-Nova Scotia (SFA 18A) and western Cape Breton (SFA 18B), 1984 to 2013.

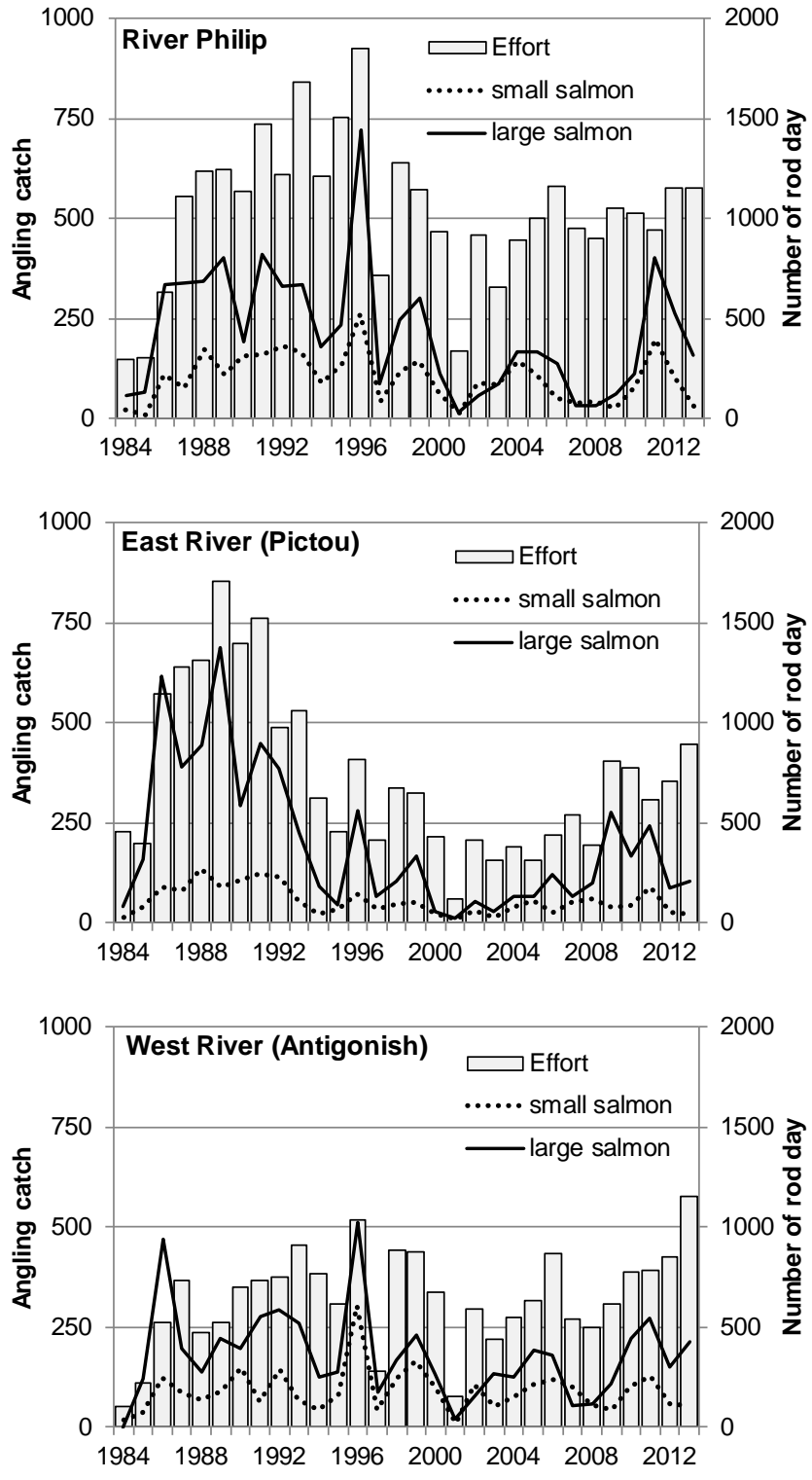


Figure 5. Angling catches of small and large salmon with effort for the three index rivers of mainland Nova Scotia (SFA 18A), 1984 to 2013.

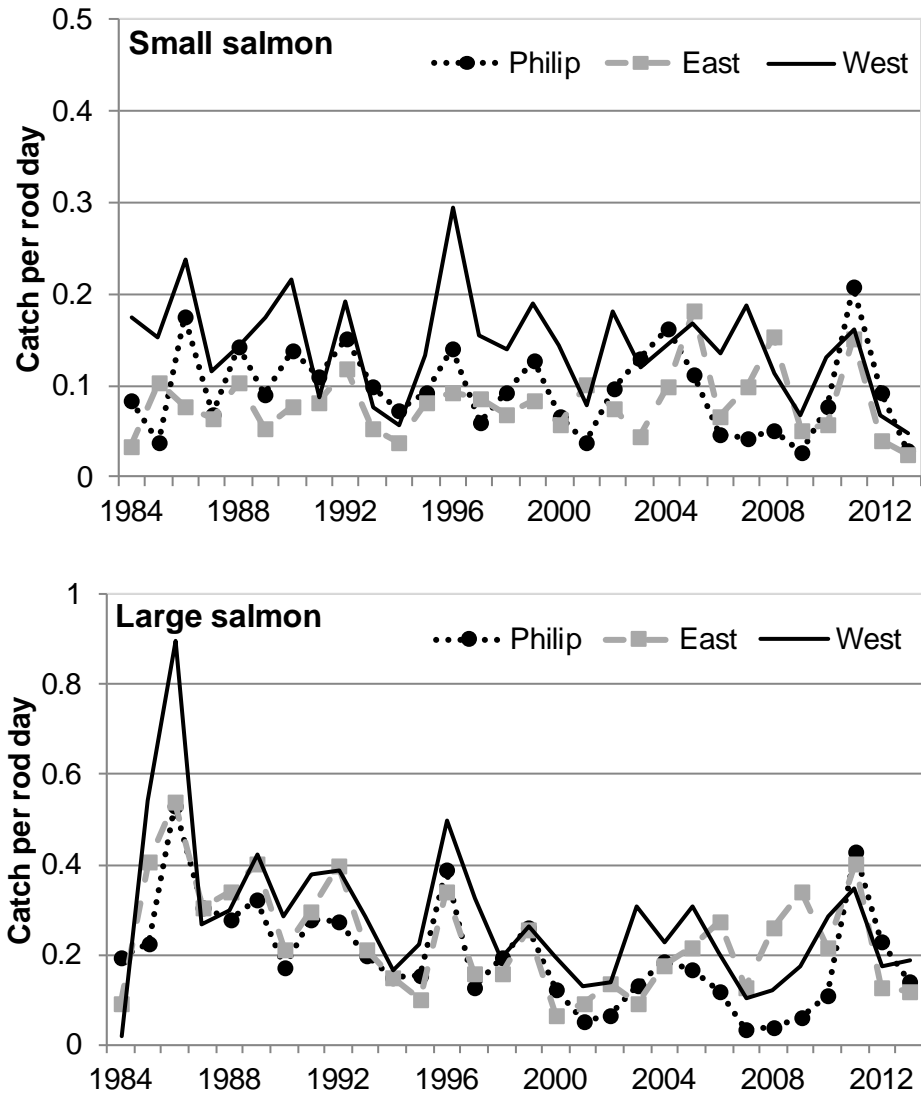


Figure 6. Catch per rod day for small salmon (upper panel) and large salmon (lower panel) for the three index rivers of mainland Nova Scotia (SFA 18A), 1984 to 2013.

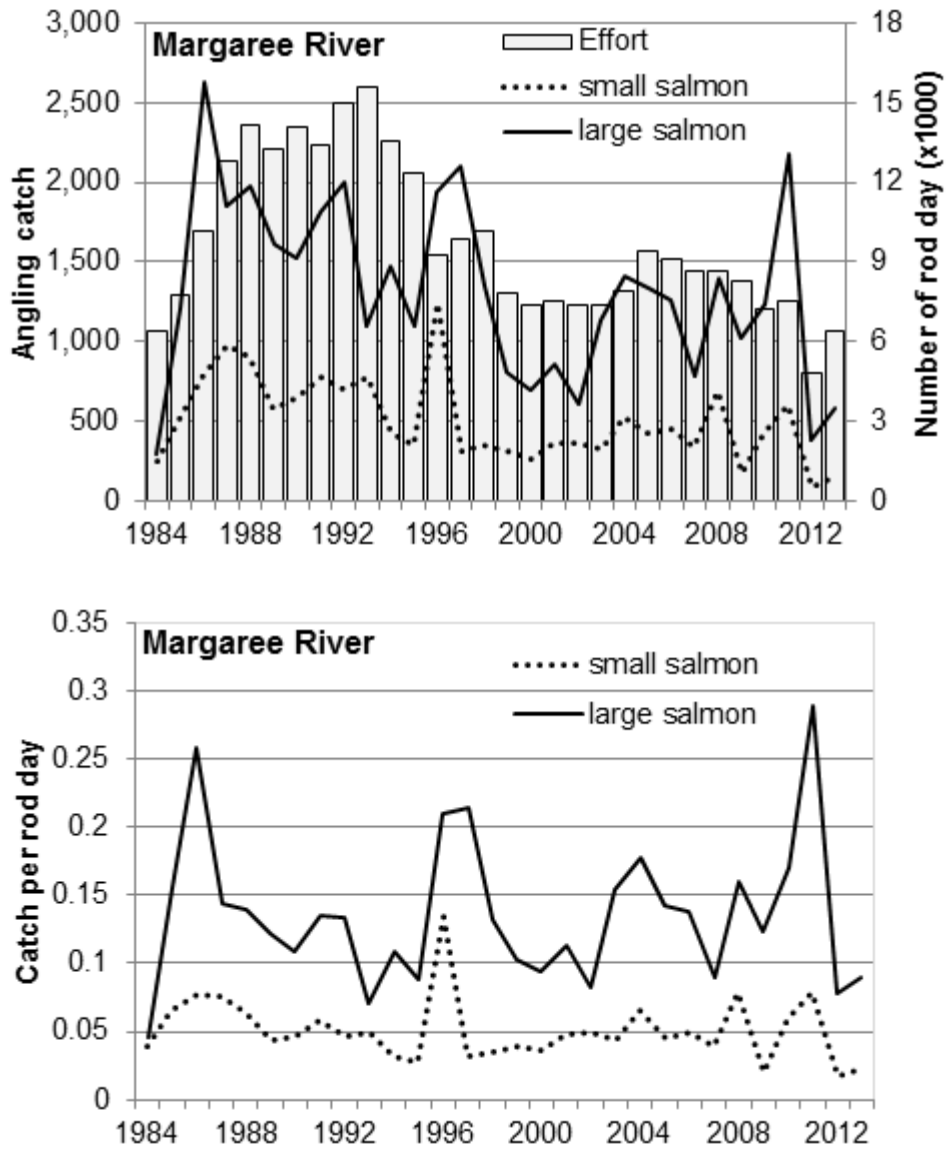


Figure 7. Angling catch and effort (upper panel) and catch per rod day (lower panel) of small and large Atlantic salmon in the Margaree River (SFA 18B), 1984 to 2013.

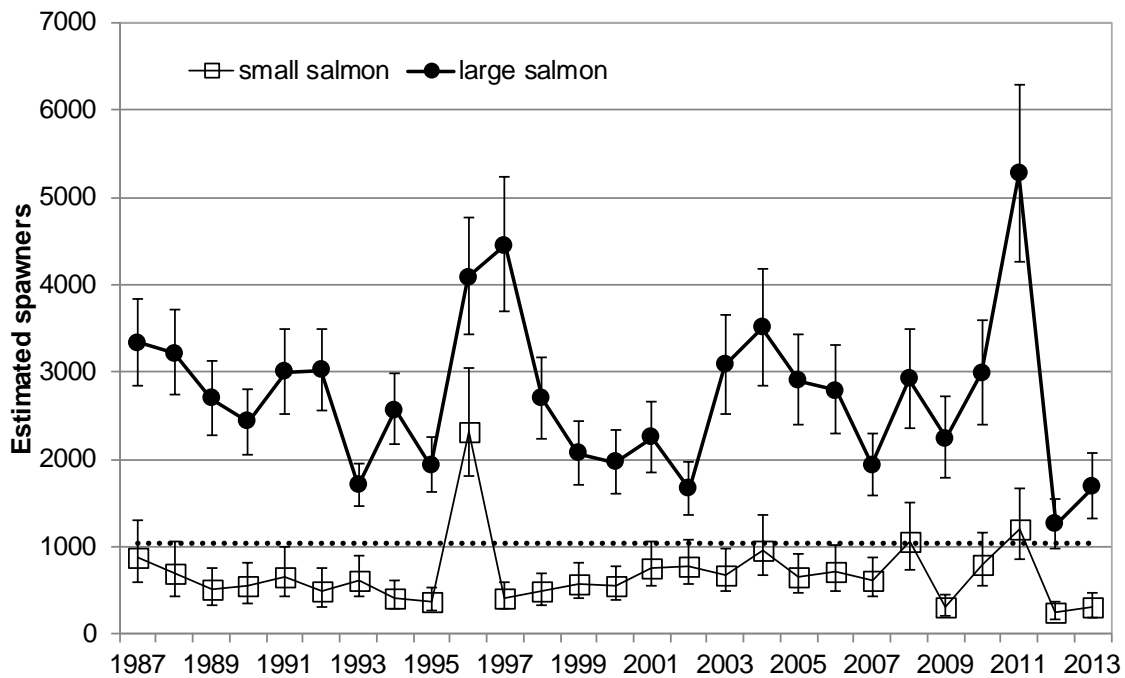
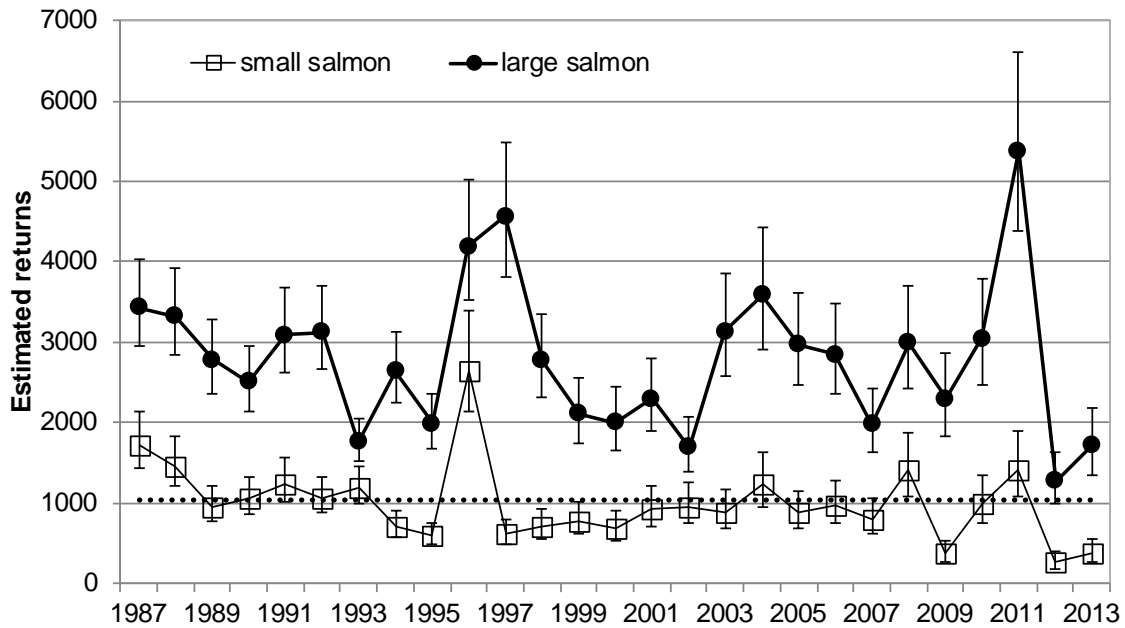


Figure 8. Estimates of returns (upper panel) and spawners (lower panel) for small and large salmon in the Margaree River during 1987 to 2013. The conservation requirement based on large salmon is depicted by the dashed line (1,036 large salmon). Vertical bars represent the 2.5% and 97.5% credibility intervals.



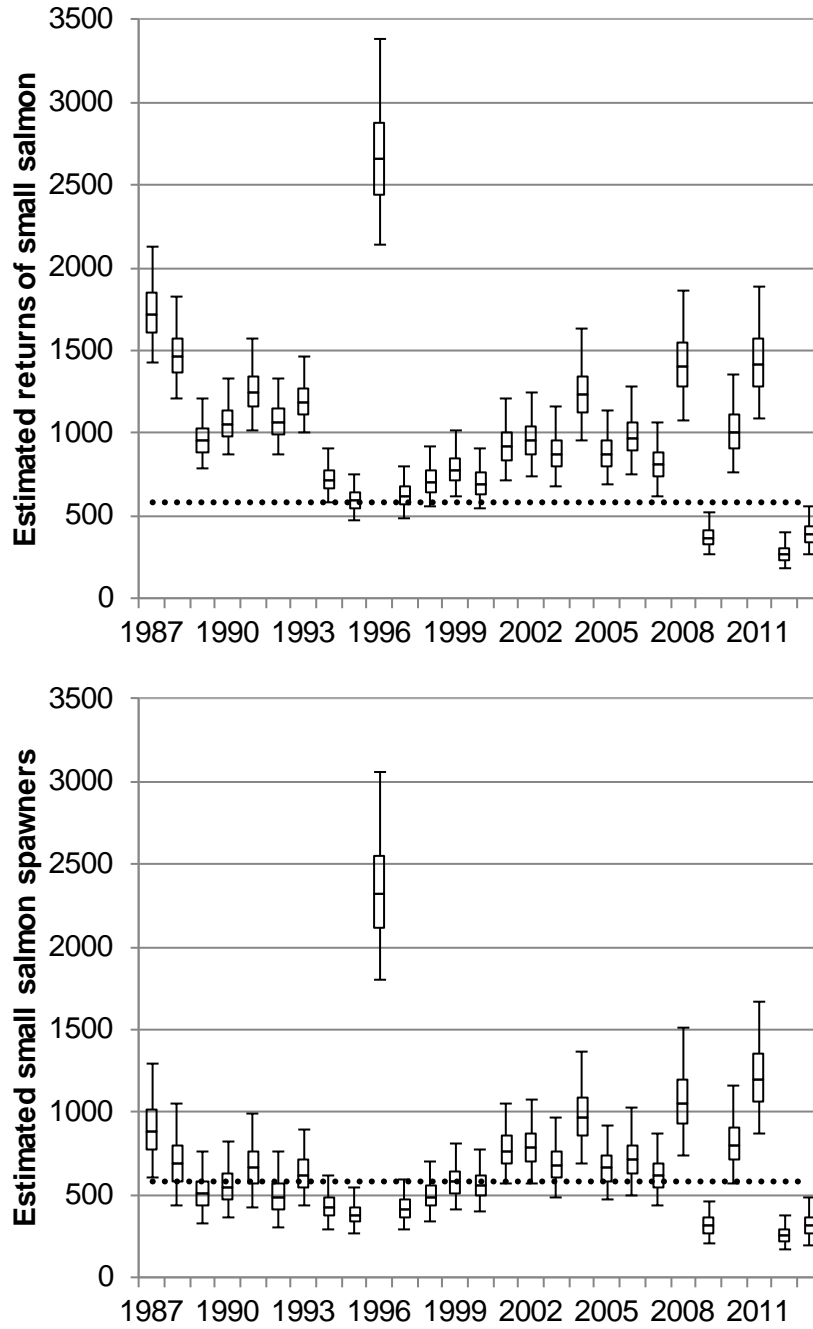


Figure 9. Estimates of returns (upper panel) and spawners (lower panel) for small salmon in the Margaree River during 1987 to 2013. The conservation requirement based on sex ratio of 1:1 is depicted by the dashed line (582 small salmon). Vertical bars represent the 2.5% and 97.5% credibility intervals.

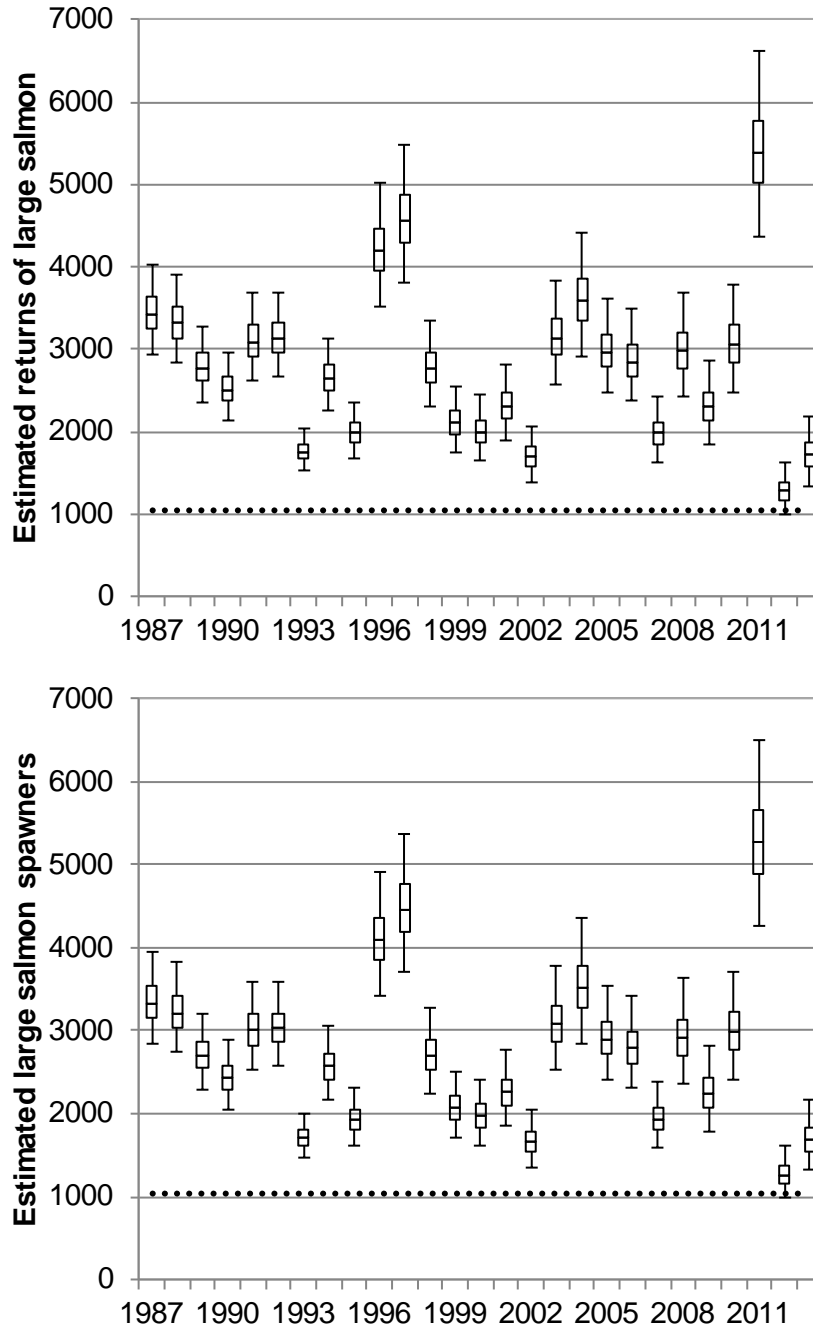


Figure 10. Estimates of returns (upper panel) and spawners (lower panel) for large salmon in the Margaree River during 1987 to 2013. The conservation requirement based on large salmon is depicted by the dashed line (1036 large salmon). Vertical bars represent the 2.5% and 97.5% credibility intervals.

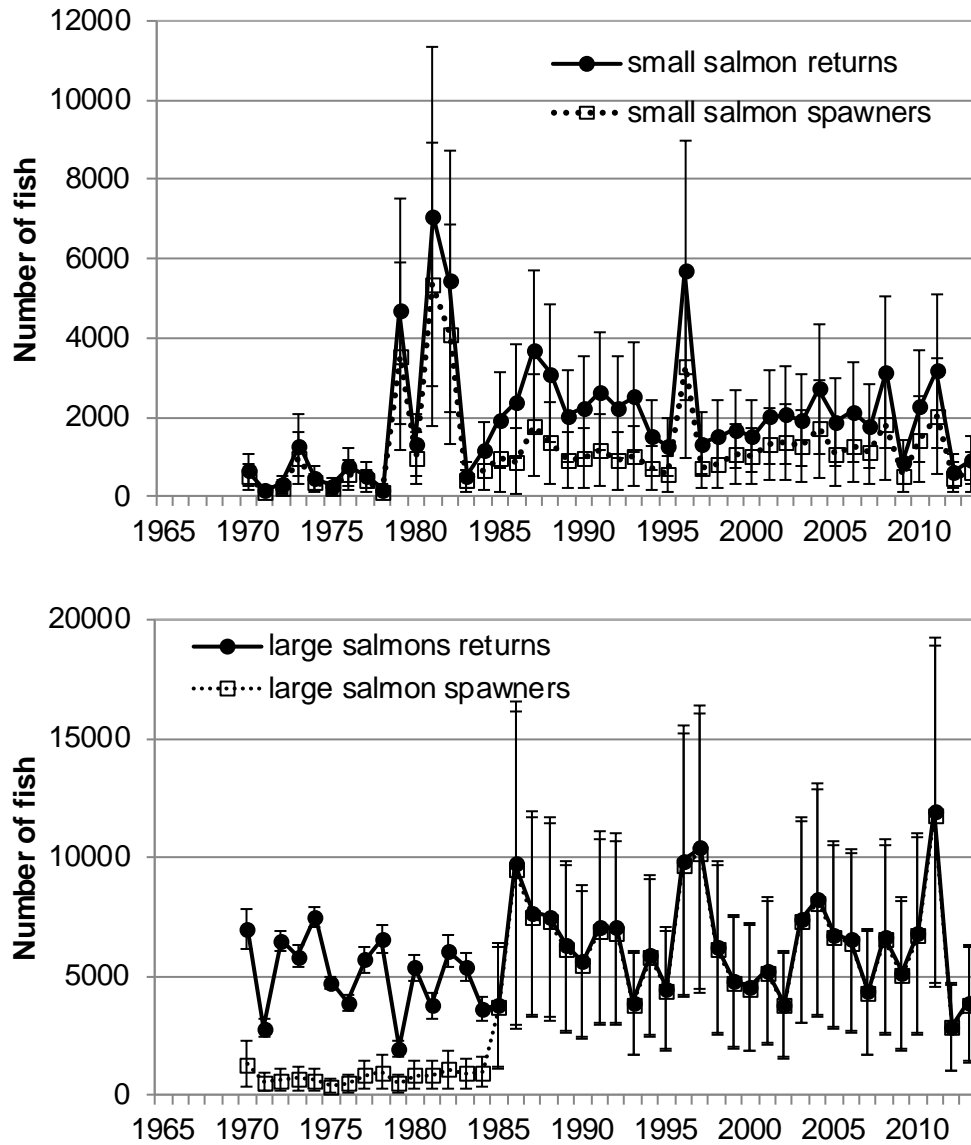


Figure 11. Estimates of returns and spawners for small (upper panel) and large (lower panel) Atlantic salmon in SFA 18 during 1970 to 2013. Vertical bars represent the 2.5% and 97.5% credibility intervals.

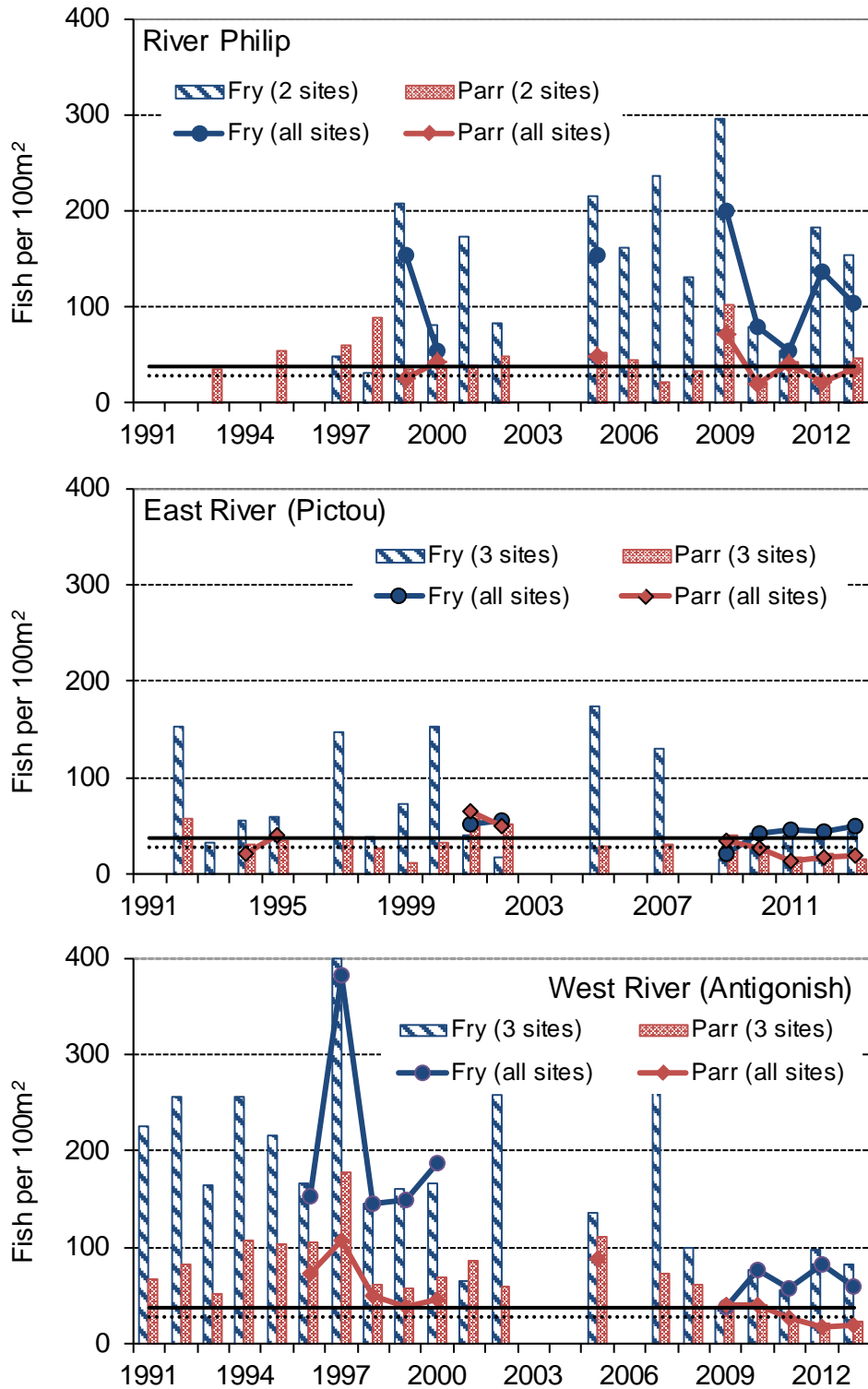


Figure 12. Density of fry and parr per 100 m<sup>2</sup> in River Philip, East River (Pictou) and West River (Antigonish), 1991 – 2013. Elson norms of 29 fry/100m<sup>2</sup> (dashed) and 38 parr/100m<sup>2</sup> (solid) are depicted by the lines.

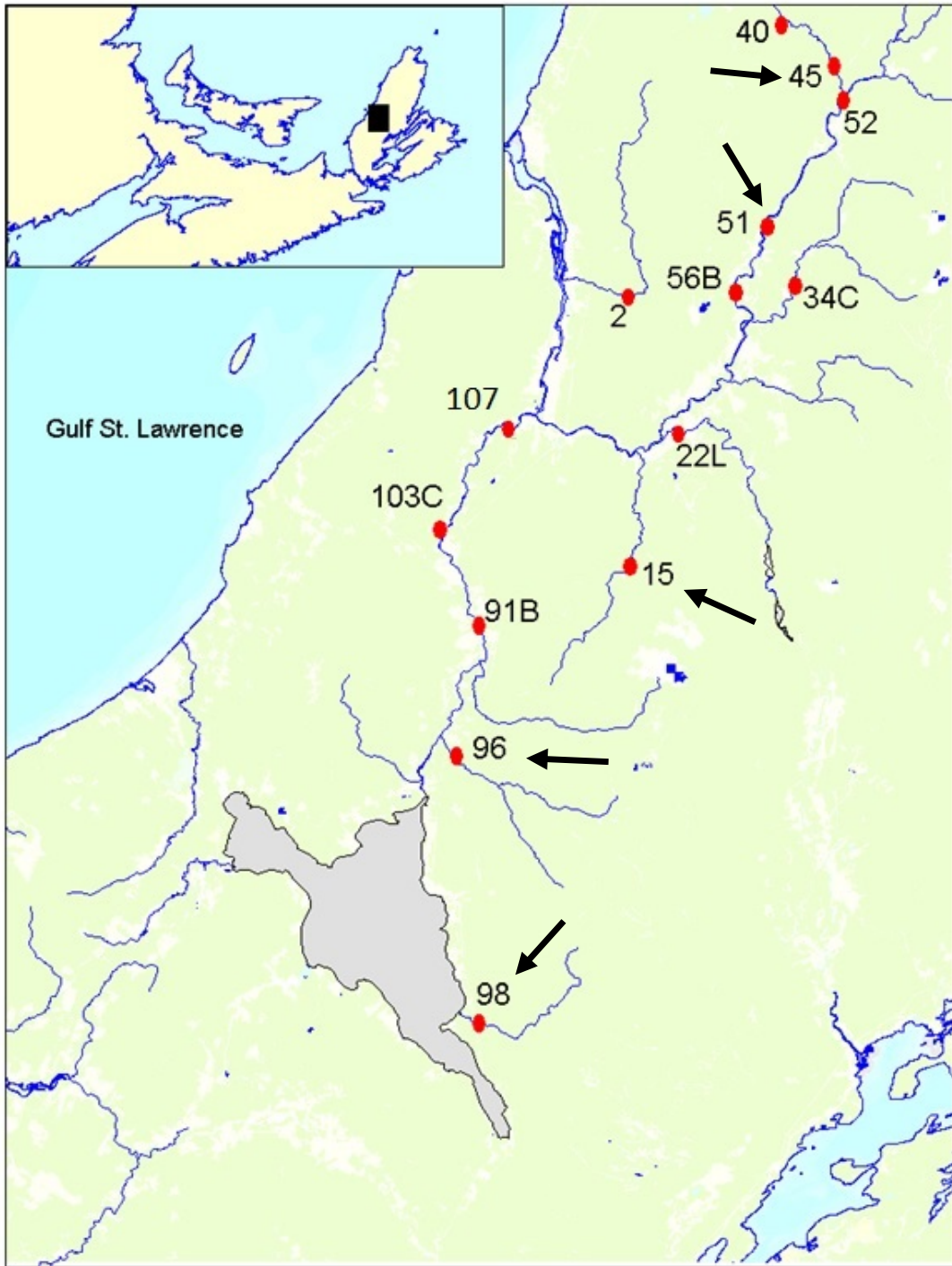


Figure 13. Location of electrofishing sites covered in 2012 and/or 2013 on the Northwest and Southwest Branches of the Margaree River. The arrows indicate the 5 index sites used for juvenile densities comparison.

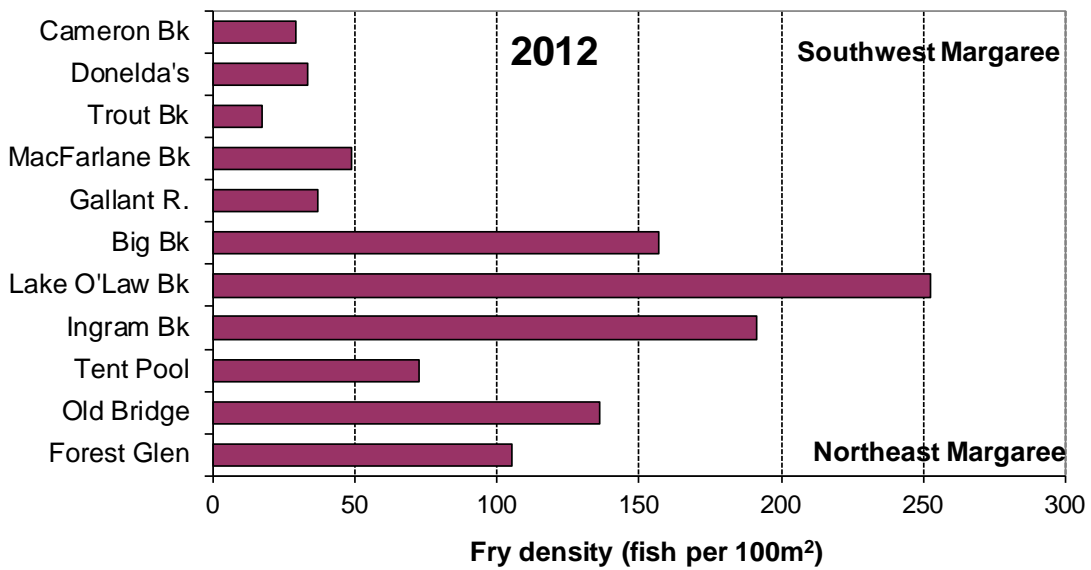
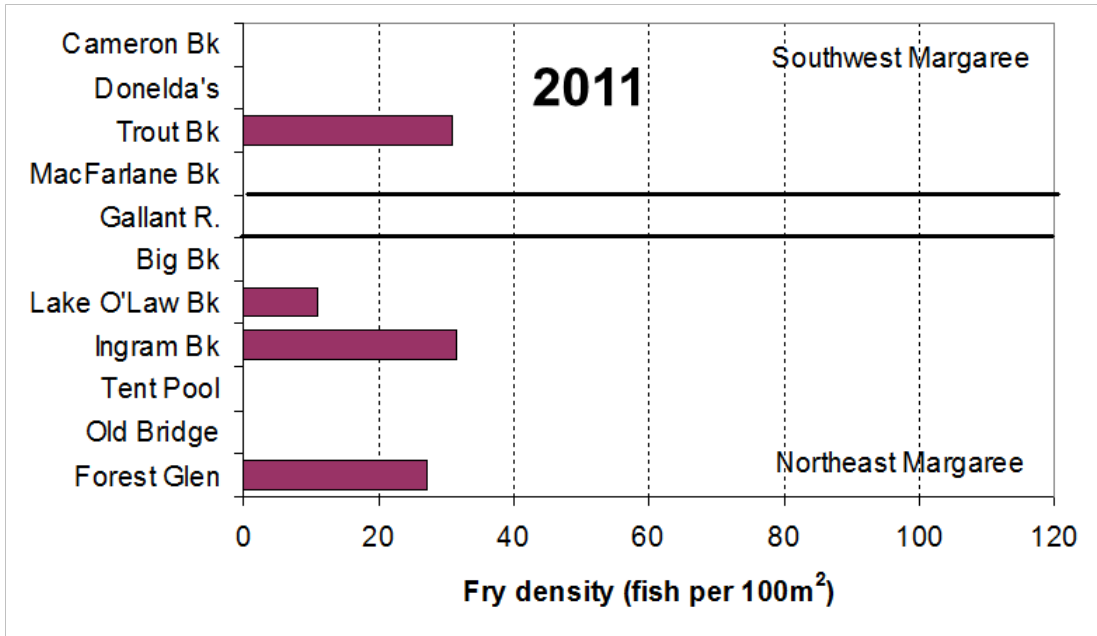


Figure 14. Densities (fish per 100m<sup>2</sup>) of fry for all the electrofishing sites sampled in 2011 (upper panel) and 2012 (lower panel) in Margaree River.

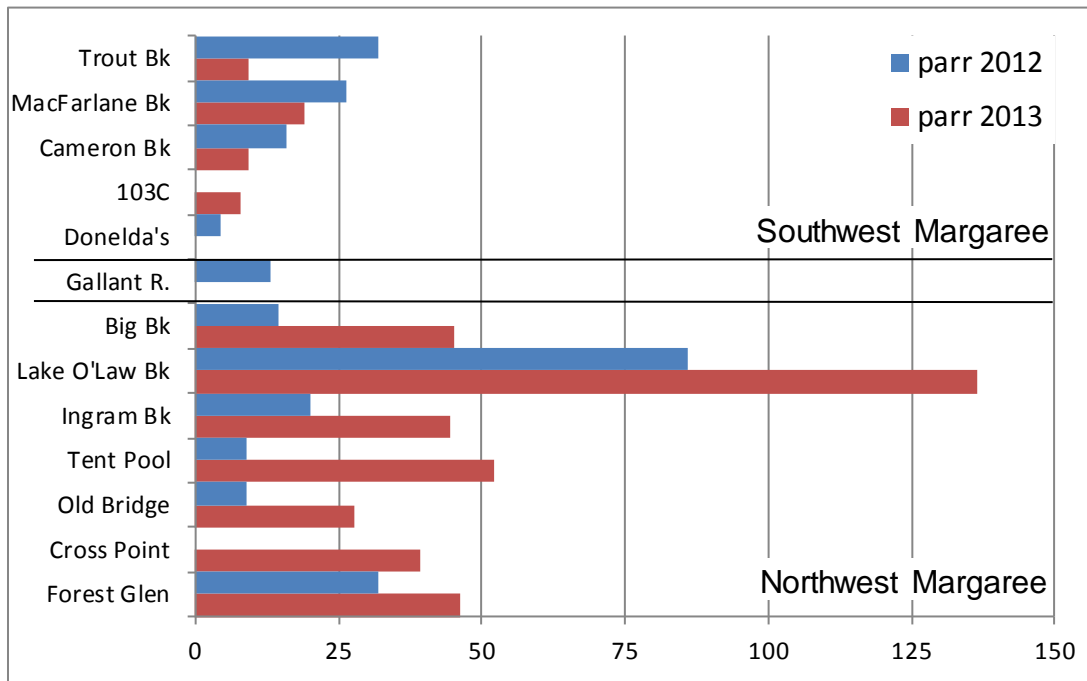
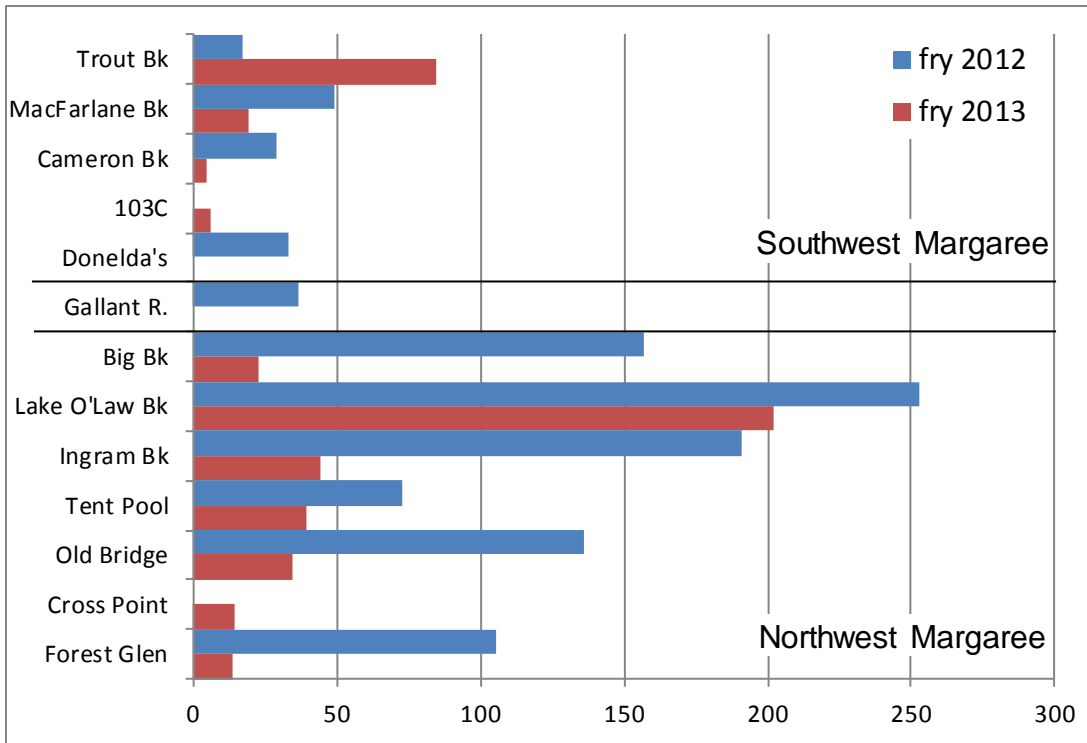


Figure 15. Densities (fish per 100m<sup>2</sup>) of fry (upper panel) and parr (lower panel) for all the electrofishing sites covered in 2012 and 2013 in Margaree River.

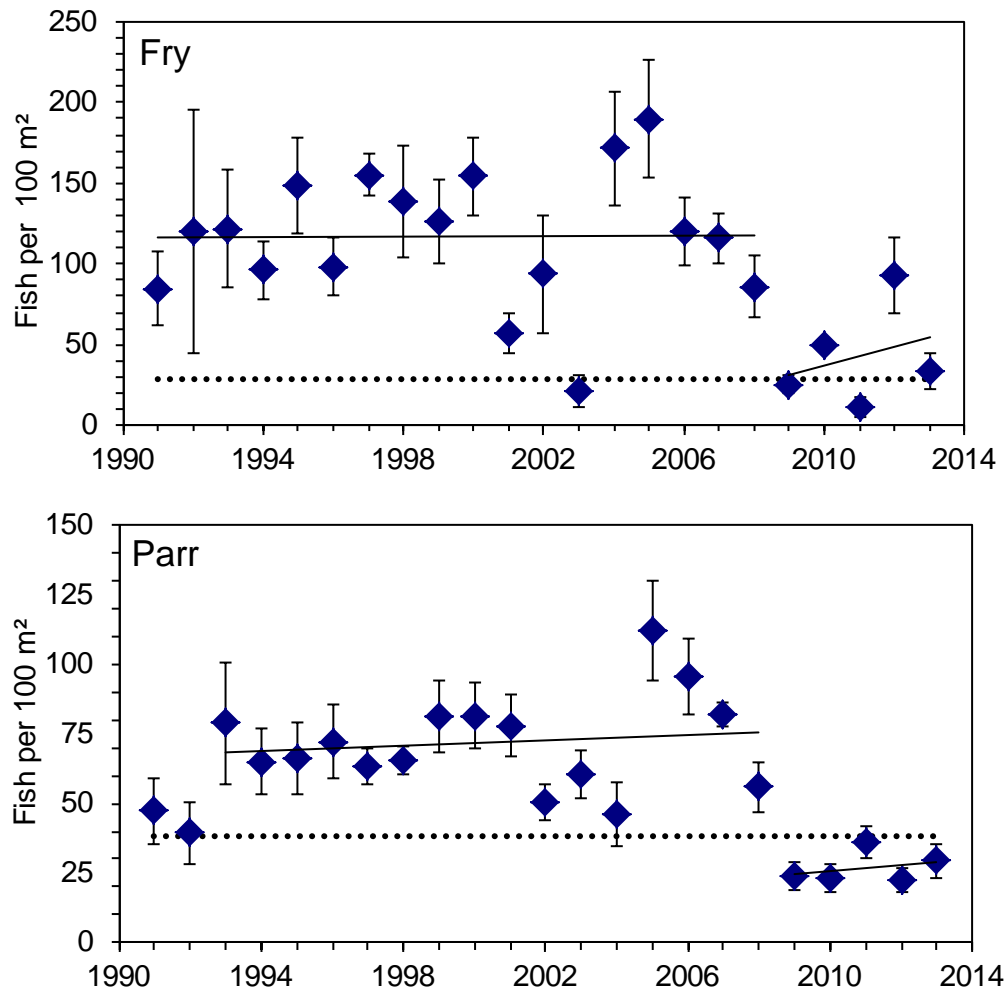


Figure 16. Densities (fish per 100m<sup>2</sup>) of fry (upper panel) and parr (lower panel) in the Margaree River from 1991 to 2013. Solid line indicates mean values. Elson norms of 29 fry/100m<sup>2</sup> and 38 parr/100m<sup>2</sup> are depicted by the dashed lines.



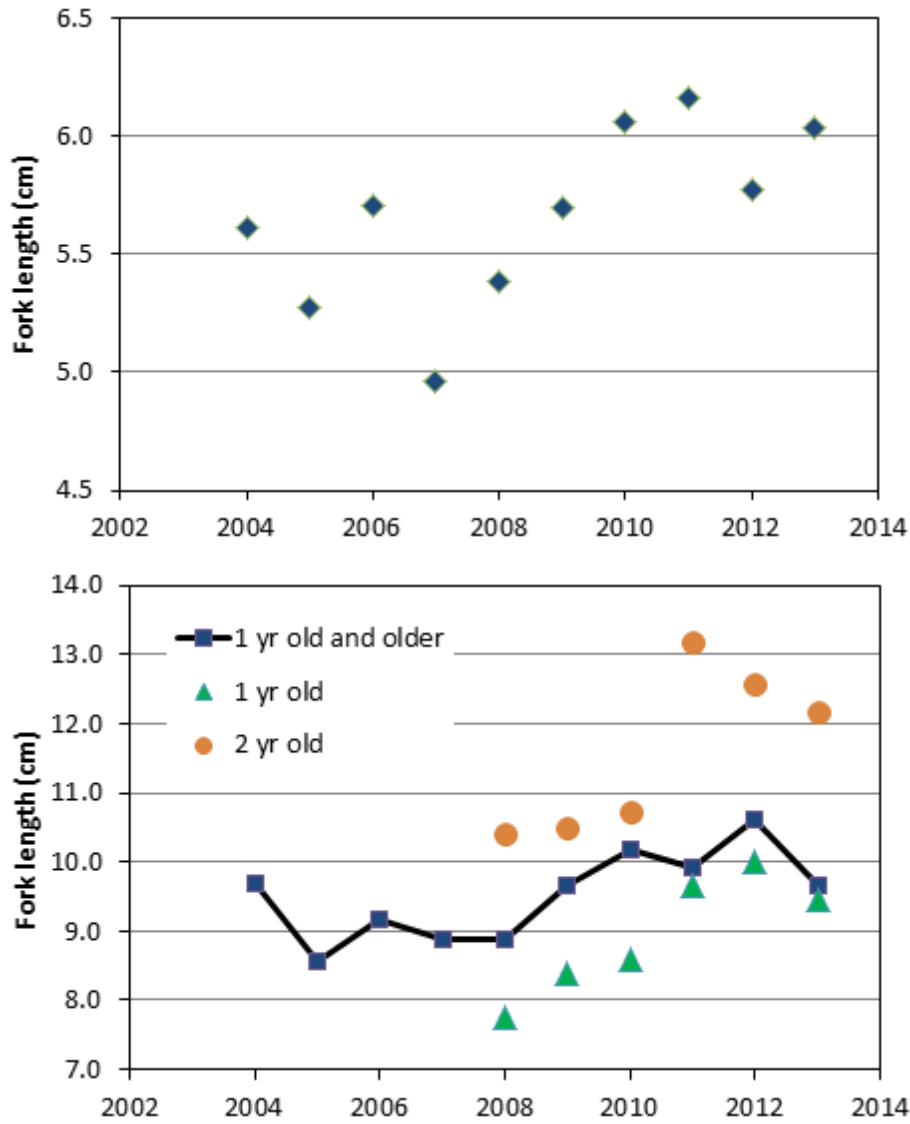


Figure 17. Fork length (cm) of fry (upper panel) and parr (lower panel) in the Margaree River during 2004 to 2013.

## APPENDICES

*Appendix 1. Angling catch data for the Margaree and Mabou rivers (Inverness County) of SFA 18B, 1984 to 2013. Small salmon catch includes small salmon kept and released. Data for 2013 are preliminary. Data are adjusted for incomplete reporting.*

Year	Mabou River			Margaree River				
	Effort (rod days)	Grilse kept	Grilse catch	Salmon released	Effort (rod days)	Grilse kept	Grilse catch	Salmon released
1984	1	0	0	0	6,410	196	246	296
1985	0	0	0	0	7,775	399	508	1,206
1986	13	3	3	19	10,172	651	783	2,632
1987	1	0	0	0	12,773	822	972	1,847
1988	5	0	0	0	14,136	771	901	1,979
1989	0	0	0	0	13,241	444	574	1,607
1990	16	0	0	0	14,062	502	655	1,520
1991	9	3	3	3	13,407	575	773	1,808
1992	26	3	10	23	15,016	568	699	1,999
1993	12	2	2	3	15,575	556	769	1,090
1994	31	3	3	1	13,534	290	427	1,478
1995	8	2	3	1	12,336	205	343	1,091
1996	21	6	7	6	9,224	284	1,239	1,938
1997	11	0	0	2	9,827	195	311	2,105
1998	20	3	3	5	10,129	209	352	1,341
1999	16	3	3	4	7,843	197	311	808
2000	16	4	8	6	7,351	133	262	696
2001	20	4	4	3	7,521	142	364	854
2002	13	2	2	6	7,359	161	363	611
2003	18	3	3	4	7,398	184	327	1,138
2004	11	2	3	2	7,896	251	518	1,408
2005	26	9	12	16	9,382	206	418	1,340
2006	27	5	10	9	9,088	253	444	1,256
2007	39	1	2	1	8,675	186	341	784
2008	14	0	2	0	8,658	331	684	1,391
2009	58	3	3	10	8,274	50	171	1,023
2010	110	0	7	23	7,218	183	426	1,231
2011	78	10	12	30	7,521	197	596	2,170
2012	68	5	7	17	4,836	12	80	374
2013	36	0	7	4	6,413	69	146	579
5-yr average (2008-2012)	66	4	6	16	7,301	155	391	1,238

Appendix 2. Angling catch data for the South and West rivers (Antigonish County) of SFA 18A, 1984 to 2013. Small salmon catch includes small salmon kept and released. Data for 2013 are preliminary. Data are adjusted for incomplete reporting.

Year	South River				West River			
	Effort (rod days)	Grilse kept	Grilse catch	Salmon released	Effort (rod days)	Grilse kept	Grilse catch	Salmon released
1984	103	16	18	2	103	16	18	2
1985	224	25	34	121	224	25	34	121
1986	521	84	124	468	521	84	124	468
1987	734	58	84	197	734	58	84	197
1988	472	36	68	140	472	36	68	140
1989	525	67	91	222	525	67	91	222
1990	698	88	150	198	698	88	150	198
1991	731	38	63	277	731	38	63	277
1992	753	80	144	293	753	80	144	293
1993	911	40	69	261	911	40	69	261
1994	769	29	43	127	769	29	43	127
1995	612	48	81	137	612	48	81	137
1996	1034	118	305	513	1034	118	305	513
1997	277	22	43	90	277	22	43	90
1998	885	58	123	168	885	58	123	168
1999	879	78	167	232	879	78	167	232
2000	678	32	97	134	678	32	97	134
2001	153	0	12	20	153	0	12	20
2002	591	32	107	81	591	32	107	81
2003	444	16	53	136	444	16	53	136
2004	549	26	79	125	549	26	79	125
2005	629	17	105	194	629	17	105	194
2006	870	22	118	179	870	22	118	179
2007	549	19	88	43	542	19	102	55
2008	51	2	22	7	497	9	56	60
2009	52	0	3	6	619	0	42	107
2010	91	7	19	9	775	9	101	222
2011	109	2	30	40	780	12	126	271
2012	102	0	6	1	854	4	58	149
2013	91	0	11	4	1151	7	55	215
5-yr average (2008-2012)	81	2	16	13	705	7	77	162

Appendix 2 (con't). Angling catch data for the Pomquet, Tracadie and Wright rivers (Antigonish County) of SFA 18A, 1984 to 2013. Small salmon catch includes small salmon kept and released. Data for 2013 are preliminary. Data are adjusted for incomplete reporting. Dash (-) indicates no reported angling or river closures.

Year	Pomquet River				Tracadie River				Wright River			
	Effort (rod days)	Grilse kept	Grilse catch	Salmon released	Effort (rod days)	Grilse kept	Grilse catch	Salmon released	Effort (rod days)	Grilse kept	Grilse catch	Salmon released
1984	2	0	0	0	-	-	-	-	-	-	-	-
1985	1	0	0	0	-	-	-	-	-	-	-	-
1986	6	1	1	2	1	1	1	0	1	0	0	0
1987	38	3	5	3	4	1	1	1	1	0	0	0
1988	1	0	0	0	0	0	0	0	0	0	0	0
1989	5	1	1	1	0	0	0	0	0	0	0	0
1990	0	0	0	0	10	2	2	0	0	0	0	0
1991	3	0	0	0	3	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	1	0	0	0
1993	4	0	0	0	0	0	0	0	1	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0
1997	15	0	0	0	0	0	0	0	0	0	0	0
1998	45	0	1	4	0	0	0	0	11	1	3	0
1999	27	1	5	6	0	0	0	0	3	0	0	1
2000	24	0	1	5	0	0	0	0	25	1	1	0
2001	4	0	0	0	0	0	0	0	12	0	0	0
2002	41	0	16	8	0	0	0	0	20	1	1	1
2003	51	0	2	4	0	0	0	0	19	0	0	0
2004	13	0	0	5	0	0	0	0	20	0	0	9
2005	109	4	25	12	0	0	0	0	13	0	1	5
2006	35	1	2	9	0	0	0	0	24	0	1	6
2007	23	0	9	3	0	0	0	0	21	0	4	3
2008	7	0	7	7	0	0	0	0	11	0	0	0
2009	36	0	0	3	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	7	0	0	0
2011	64	4	9	22	5	0	0	0	36	0	0	0
2012	25	0	5	9	0	0	0	0	16	0	6	7
2013	7	0	4	0	0	0	0	0	11	0	0	0
5-yr average (2008-2012)	26	1	4	8	1	0	0	0	14	0	1	1

Appendix 3. Angling catch data for the East, Middle and West rivers (Pictou County) of SFA 18A, 1984 to 2013. Small salmon catch includes small salmon kept and released. Data for 2013 are preliminary. Data are adjusted for incomplete reporting.

Year	East River				Middle River				West River			
	Effort (rod days)	Grilse kept	Grilse catch	Salmon released	Effort (rod days)	Grilse kept	Grilse catch	Salmon released	Effort(rod days)	Grilse kept	Grilse catch	Salmon released
1984	455	13	15	41	0	0	0	0	1	0	0	0
1985	396	25	41	161	1	0	0	0	31	2	2	4
1986	1144	71	89	616	0	0	0	0	38	3	4	4
1987	1275	63	82	388	2	0	0	3	245	15	15	26
1988	1309	100	135	443	0	0	0	0	314	23	25	43
1989	1706	42	89	687	0	0	0	0	425	13	15	61
1990	1393	81	106	292	0	0	0	0	251	32	38	42
1991	1522	77	123	448	4	0	0	1	640	35	45	152
1992	974	64	115	386	0	0	0	0	415	25	32	129
1993	1063	35	57	227	2	0	1	0	608	32	42	168
1994	627	15	24	93	0	0	0	0	249	3	5	17
1995	460	21	37	47	0	0	0	0	466	27	37	39
1996	819	34	75	280	0	0	0	0	767	57	87	193
1997	417	24	36	67	0	0	0	0	205	5	9	27
1998	678	25	47	106	5	0	0	0	518	30	36	102
1999	652	24	54	168	3	0	0	0	591	28	64	168
2000	433	11	25	29	0	0	0	0	398	16	26	32
2001	119	8	12	11	0	0	0	0	122	0	0	7
2002	414	5	31	56	3	0	2	0	558	19	40	37
2003	312	4	14	29	6	0	0	0	280	5	15	48
2004	384	17	38	67	0	0	0	0	342	24	50	31
2005	313	24	57	67	1	0	0	0	427	13	34	69
2006	443	10	29	121	5	0	0	0	400	22	34	56
2007	542	18	54	68	0	0	0	0	295	16	24	22
2008	389	13	60	101	2	0	0	0	300	16	36	25
2009	811	6	41	276	0	0	0	0	477	8	28	105
2010	772	5	45	166	0	0	0	0	410	23	56	82
2011	612	30	92	245	13	0	0	3	501	11	38	95
2012	707	5	29	89	7	0	0	2	562	0	13	71
2013	896	7	22	106	0	0	0	0	517	18	40	33
5-yr average (2008-2012)	658	12	53	175	4	0	0	1	450	12	34	76

Appendix 3 (con't). Angling catch data for the River John, Barney's and Sutherland rivers (Pictou County) of SFA 18A, 1984 to 2013. Small salmon catch includes small salmon kept and released. Data for 2013 are preliminary. Data are adjusted for incomplete reporting. Dash (-) indicates no reported angling or river closures.

Year	River John				Barney's River				Sutherland River			
	Effort (rod days)	Grilse kept	Grilse catch	Salmon released	Effort (rod days)	Grilse kept	Grilse catch	Salmon released	Effort (rod days)	Grilse kept	Grilse catch	Salmon released
1984	22	1	1	0	0	0	0	0	-	-	-	-
1985	58	1	2	58	0	0	0	0	3	0	0	4
1986	187	29	30	152	0	0	0	0	2	0	0	0
1987	235	21	24	70	0	0	0	0	6	2	4	7
1988	258	40	53	121	6	1	1	8	0	0	0	0
1989	267	17	18	99	11	1	6	1	0	0	0	0
1990	302	52	66	44	23	7	7	5	0	0	0	0
1991	200	28	34	81	18	1	1	4	3	0	0	0
1992	167	11	17	77	102	7	11	11	9	2	2	1
1993	234	14	22	73	26	1	1	1	25	0	0	0
1994	185	11	13	34	53	0	0	3	0	0	0	0
1995	122	10	12	17	5	1	1	0	3	1	1	0
1996	276	21	33	118	30	11	14	10	3	0	0	0
1997	210	23	24	52	9	0	0	0	0	0	0	0
1998	209	19	44	37	21	0	0	1	9	0	1	0
1999	231	17	23	56	11	0	0	4	0	0	0	0
2000	169	6	8	10	4	0	0	0	6	0	0	0
2001	25	0	0	0	0	0	0	0	0	0	0	0
2002	104	5	8	5	3	0	0	0	4	0	0	0
2003	70	0	0	0	3	0	0	0	1	0	0	0
2004	151	19	26	34	0	0	0	0	2	0	0	0
2005	126	11	21	87	13	0	1	4	9	1	3	1
2006	95	5	8	18	8	0	0	2	3	0	2	0
2007	112	7	19	23	7	1	1	1	7	0	1	1
2008	98	9	27	18	9	0	0	0	0	0	0	0
2009	105	0	25	69	52	0	3	6	10	0	0	0
2010	115	9	16	21	61	0	5	7	14	2	4	2
2011	149	5	27	87	129	0	17	43	11	0	2	7
2012	113	4	4	26	102	0	7	21	9	0	6	0
2013	142	0	33	44	91	0	4	22	22	0	0	7
5-yr average (2008-2012)	116	5	20	44	71	0	6	15	9	0	2	2

Appendix 4. Angling catch data for the French and Waugh rivers (Colchester County) of SFA 18A, 1984 to 2013. Small salmon catch includes small salmon kept and released. Data for 2013 are preliminary. Data are adjusted for incomplete reporting.

Year	French				Waugh			
	Effort (rod days)	Grilse kept	Grilse catch	Salmon released	Effort (rod days)	Grilse kept	Grilse catch	Salmon released
1984	0	0	0	0	8	0	0	0
1985	0	0	0	0	5	0	0	1
1986	7	0	0	0	33	6	9	28
1987	2	0	0	0	47	0	0	7
1988	6	0	0	2	74	5	11	26
1989	1	0	0	0	92	5	5	5
1990	13	0	1	1	98	14	15	15
1991	26	7	8	7	270	14	19	108
1992	17	0	0	0	123	10	13	18
1993	23	0	0	7	201	13	19	42
1994	22	0	0	0	102	6	15	30
1995	17	1	1	1	218	13	21	36
1996	39	1	1	14	450	25	29	141
1997	21	3	6	6	127	7	13	11
1998	20	1	1	1	254	15	28	45
1999	6	2	2	2	153	10	16	26
2000	4	0	0	0	163	11	13	8
2001	0	0	0	0	76	0	2	0
2002	3	0	0	0	146	7	10	7
2003	4	0	0	0	152	2	2	20
2004	9	0	2	2	149	3	15	41
2005	5	0	0	1	160	3	7	30
2006	8	0	0	8	112	1	2	7
2007	27	0	3	3	141	2	11	25
2008	20	2	4	7	150	0	11	29
2009	55	0	0	0	175	0	6	19
2010	35	2	4	0	131	2	7	23
2011	29	2	7	10	202	6	19	123
2012	90	0	0	0	213	0	5	7
2013	80	0	0	4	259	0	4	0
5-yr average (2008-2012)	46	1	3	3	174	2	10	40

Appendix 5. Angling catch data for the River Philip and Wallace rivers (Cumberland County) of SFA 18A, 1984 to 2013. Small salmon catch includes small salmon kept and released. Data for 2013 are preliminary. Data are adjusted for incomplete reporting.

Year	River Philip				Wallace			
	Effort rod days	Grilse kept	Grilse catch	Salmon released	Effort rod days	Grilse kept	Grilse catch	Salmon released
1984	297	23	25	57	52	1	1	4
1985	309	11	12	69	85	3	5	16
1986	636	87	111	337	232	15	16	115
1987	1,108	66	76	338	282	9	11	49
1988	1,235	154	176	342	297	14	17	35
1989	1,249	93	113	403	239	10	13	34
1990	1,137	126	157	193	258	11	16	33
1991	1,469	107	161	412	399	25	39	88
1992	1,221	169	184	332	428	19	31	91
1993	1,677	107	166	336	847	20	33	109
1994	1,210	62	88	179	487	11	22	56
1995	1,506	105	138	234	617	19	32	30
1996	1,845	181	260	722	453	21	27	93
1997	713	38	43	90	389	13	39	105
1998	1,282	86	119	248	358	29	41	60
1999	1,142	101	146	300	343	11	23	67
2000	936	41	63	115	297	12	22	22
2001	340	4	13	17	141	3	7	4
2002	922	42	89	59	336	15	29	25
2003	661	45	86	88	340	10	15	31
2004	896	62	145	166	345	26	46	63
2005	998	45	111	167	300	5	36	47
2006	1,164	29	54	138	468	11	29	70
2007	948	12	40	33	380	8	13	24
2008	901	14	45	34	313	11	2	25
2009	1,050	0	29	62	489	13	88	101
2010	1,030	21	80	115	562	42	79	59
2011	944	54	197	404	463	12	42	206
2012	1,151	28	106	265	403	9	15	44
2013	1,151	4	33	160	732	15	51	66
5-yr average (2008-2012)	1,015	23	91	176	446	17	45	87