STATUS OF ATLANTIC SALMON IN SALMON FISHING AREAS (SFAS) 19-21 AND 23

Context

Abundance of Atlantic salmon in the Maritimes Region has been in decline for more than two decades. Atlantic salmon commercial fisheries were closed by 1985. In addition, increasingly restrictive management measures for recreational fisheries have been implemented, including their complete closure in inner Bay of Fundy rivers in 1991, outer Bay of Fundy rivers in 1998, and eastern and southern shore Nova Scotia rivers in 2010. Recreational fisheries in eastern Cape Breton are currently closed in all but four rivers (Appendix 1). In addition, Aboriginal communities have either reduced or ceased their salmon fishing activity.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identified four large groupings of salmon in the Maritimes Region: the outer Bay of Fundy (corresponding to the western part of Salmon Fishing Area, SFA, 23), the Nova Scotia Southern Upland (SFAs 20, 21 and part of 22), the inner Bay of Fundy (part of SFAs 22 and 23), and eastern Cape Breton (SFA 19) areas (Appendix 2). Populations in many rivers are extirpated, and inner Bay of Fundy salmon are listed as Endangered under the Species at Risk Act (SARA). In November 2010, COSEWIC assessed the outer Bay of Fundy, Nova Scotia Southern Upland, and eastern Cape Breton populations as Endangered. DFO Science held Recovery Potential Assessments (RPAs) for Southern Upland Atlantic salmon in May 2012, eastern Cape Breton salmon in late January/early February 2013, and outer Bay of Fundy Salmon in February 2013. Peer-reviewed scientific information from these RPAs is used in SARA processes, including listing decisions and recovery planning. Final RPA Research Documents and Science Advisory Reports will be posted to the Canadian Science Advisory Secretariat (CSAS) website when complete (http://www.isdm-gdsi.gc.ca/csas-sccs/applications/publications/index-eng.asp).

Science advice on the status of salmon in SFAs 19-21 and 23 in 2012 was requested by Fisheries and Aquaculture Management (FAM) on February 8, 2013. This advice is used to inform Aboriginal communities, clients and the provinces of Nova Scotia and New Brunswick, of the status of the salmon resource in advance of developing harvest agreements and recreational fishing plans for 2013. Given that this request was for an update of previous advice using established methods (e.g., DFO 2012a), it was decided to use the Science Special Response Process. This Science Response Report results from the Science Special Response Process of March 1, 2013, on the Assessment of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23.

DFO Science is moving toward providing multi-year advice on the status of fish stocks, including Atlantic salmon. Currently a formal review of scientific methods is planned on a 5-year basis, with interim reports planned on an annual basis.

Analyses and Responses

Methods

Evaluation of the status of Atlantic salmon in the Maritime Region is based on abundance monitoring for a number of index populations. For most index populations, status is evaluated using a comparison of estimated egg deposition (calculated from the estimated abundance and biological characteristics of salmon) relative to a reference point known as the conservation (egg) requirement. The river-specific conservation (egg) requirement is based on an egg deposition of 2.4 eggs/m^2 multiplied by the amount of fluvial rearing (of suitable gradient) habitat. An egg deposition of 2.4 eggs/m^2 is considered to be a limit reference point in the context of DFO's Precautionary Approach Framework (DFO 2009, DFO 2012b, Gibson and Claytor 2012). Conservation requirements for many of the rivers in the Maritimes Region are reported in O'Connell et al. (1997).

An assumed 4% catch-and-release mortality rate is applied to estimate spawning escapement for rivers where recreational salmon fisheries are open. Aboriginal Food, Social and Ceremonial (FSC) allocations are not subtracted from salmon return estimates when estimating spawning escapement, although the reported FSC catch was subtracted from salmon return estimates in 2012 when estimating spawning escapement in North River as FSC reporting for eastern Cape Breton is thought to be complete.

Eastern Cape Breton (SFA 19)

Salmon population monitoring by DFO in eastern Cape Breton is currently focused on three river systems: Middle, Baddeck, and North rivers (Appendix 2). Grand River was assessed annually in the past, but this assessment has been discontinued because neither fish counts nor recreational catch data are available for this river. Dive survey counts were conducted in the past on North River; however, a dive survey was not conducted in 2012 and the assessment of status is based on the preliminary recreational catch data. A dive survey count, including a mark-recapture experiment, was attempted in the North Aspy River in 2012 but could not be completed due to high water levels and poor water clarity. Parks Canada monitors adult salmon abundance on Clyburn Brook using dive surveys similar to those conducted by DFO.

In 2010, 2011 and 2012, all rivers within SFA 19 with the exception of Middle, Baddeck, North, and North Aspy rivers were closed to salmon fishing all year. In 2012, Middle and Baddeck rivers were open to catch-and-release angling from October 1st to October 31st; North River (downstream from the area known as the "Benches") was open to catch-and-release angling from June 8th to October 31st; and North Aspy River was open to catch-and-release angling from June 8th to July 15th and from September 1st to October 31st (Table 1, Appendix 1). The recreational salmon fishery on North Aspy River was closed during mid-July to September due to concerns with high temperatures and related catch-and-release mortalities.

Further details on the assessment of eastern Cape Breton salmon populations are provided in Gibson and Bowlby (2009) and Robichaud-LeBlanc and Amiro (2004).

Table1. Salmon angling seasons, assessment information, percent conservation (egg) requirements attained, collections, and releases of salmon for index rivers in SFA 19 during 2012. Recreational salmon angling catch is estimated using license stub returns. Note: NA=not applicable.

	MIDDLE RIVER	BADDECK RIVER	NORTH RIVER
Angling Season	October 1 – 31	October 1 – 31	June 8 – October 31
Assessment Information	- Recreational Catch Estimates	-Recreational Catch Estimates	-Recreational Catch Estimates
	-Dive Counts	-Dive Counts	-Dive Counts
	-Available Electrofishing Data	-Available Electrofishing Data	-Available Mark Recapture Data
	-Available Mark Recapture Data	-Available Mark Recapture Data	
% Conservation	79 %	73 %	Above Conservation Requirement
Collections	5 large salmon (October)	0 salmon (small or large)	NA
Releases	1 large and 18 small mature adults (October)	1 large and 14 small mature adults (October) 11,990 parr (October)	NA

Status

Data available for assessing the status of salmon in **Middle River** include annual recreational catch estimates from license stub returns, counts of adult salmon made during dive surveys, as well as available electrofishing data (Table 1). An abundance time series for Atlantic salmon in Middle River was derived using a model that uses these data to estimate abundance using maximum likelihood (Gibson and Bowlby 2009).

The conservation (egg) requirement for Middle River is 2.07 million eggs (O'Connell et al. 1997), calculated based on an estimated 864,600 m^2 of habitat and a target egg deposition density of 2.4 eggs/m^2.

In 2012, one large male salmon and four large female salmon were removed from the population by the province of Nova Scotia for use as broodstock in a stocking program. The stocking program was designed to offset anticipated future losses to the population from catch-and-release mortality. A total of 5,340 fry resulting from 2011's broodstock collection were released into Middle River on August 1, 2012, and an additional 13,986 fin clipped parr were released on October 19, 2012, as part of this program. Adult returns associated with these releases are expected in three to seven years. In addition, DFO released 11 male and 8 female mature adult salmon into Middle River on October 24, 2012. This was the last release of adult salmon from parr collections that occurred in 2009. This adult stocking program was intended to offset the Aboriginal FSC allocation from Middle River.

Data from the recreational fishery have been collected from salmon license stub returns since 1983, with values for large salmon (63 cm or larger) and small salmon (less than 63 cm) being recorded separately. The data include the number of salmon caught and released, the number harvested, and fishing effort in each year. Effort is estimated in rod days where any portion of a day fished by one angler is recorded as one rod day. Values are adjusted for non-returned stubs using a relationship based on the reported catch as a function of the number of reminder letters sent to licensed anglers (O'Neil et al. 1987). The preliminary estimates of the recreational catch for Middle River in 2012 were 39 small and 281 large salmon with an estimated effort of 971 rod days (Appendix 3). In comparison to 2011, the estimated fishing effort increased by 112% from the 2011 estimate (459), the estimated large salmon catch increased by 136% from the 2011 estimate (119) and the estimated small salmon catch decreased by 62% from the 2011 estimate (102). Analysis of the recreational fishing data series indicates that fishing effort on this river has shown an increasing trend over the last ten years.

The numbers of large and small salmon counted during dive surveys in Middle River from 1989 to 2012 provide indices of the spawning escapements for each size category for this population. These surveys typically take place during the last week of October, just prior to the end of the fishing season. During the dive survey (Oct. 29, 2012) 24 small and 324 large salmon were counted. The dive survey count in 2012 includes captive reared adult salmon that were released into Middle River by DFO, as the dive count occurred after the release. The number of small salmon counted in 2012 was lower compared to the 2011 mean count of 100 small (i.e., mean of surveys with and without “new pools” surveyed in 2011; refer to Sources of Uncertainty) whereas the number of large salmon counted in 2012 was greater than the mean count of large in 2011 (221).

The 2012 spawning escapement in Middle River is estimated to be 39 small and 457 large salmon. The large salmon escapement estimate is higher than the 2011 large salmon estimate (314), whereas the small salmon escapement estimate is lower than the small salmon estimate in 2011 (160). Total estimated spawning escapement (496, including captive reared adults) increased for the third consecutive year in 2012 to the second highest value estimated during the 30 year time-series. Since 1983, the spawning escapement (large and small salmon combined) in Middle River has increased from the previous year on 15 occasions and decreased on 14 occasions to varying degrees with no obvious trend (Figure 1).

Estimates of the percent of the conservation (egg) requirement met annually show a similar pattern to the total escapement estimates with little chance that the population has met its conservation (egg) requirement at any time since the time series began in 1983 (Figure 1). An assumption of 4% catch-and-release mortality is used in the assessment model; however, the majority of salmon are currently caught during October when water temperatures are low, and 4% is considered to be precautionary in this case. Based on the preliminary recreational catch estimates, the number of mortalities resulting from the recreational fishery is estimated to be 12-13 salmon (see Sources of Uncertainty). The percent of the conservation (egg) requirement attained is estimated to be 79% in 2012, and has ranged between 31 and 79% during the last 10 years.

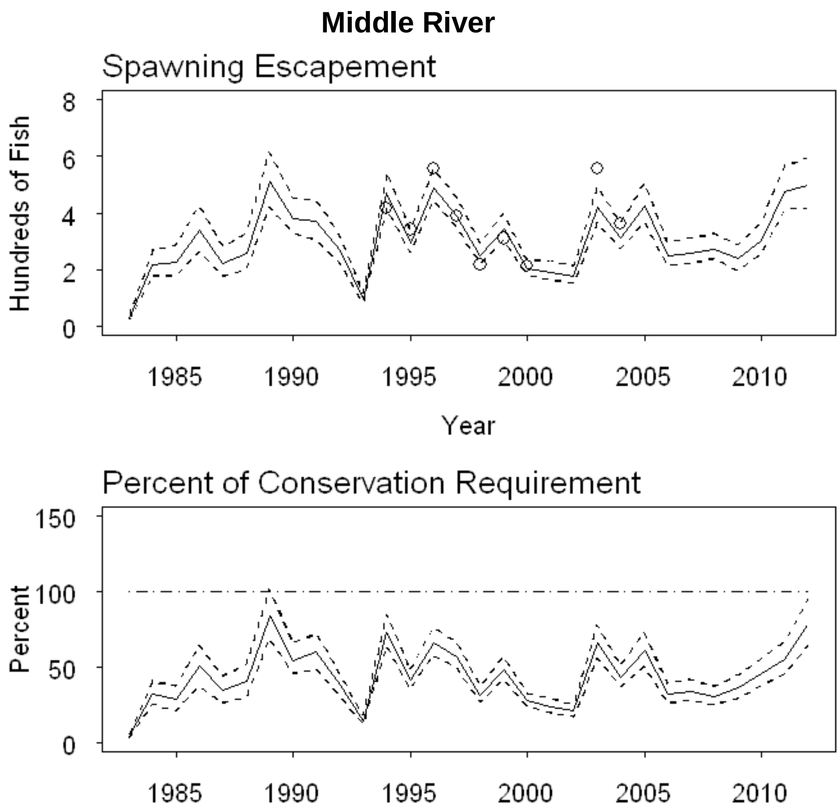


Figure 1. Estimated total number of spawners (top graph) and the percent of the conservation (egg) requirement attained (bottom graph) in Middle River, NS, from 1983 to 2012. The solid lines are the estimated values and the dashed lines are the 10th and 90th percentiles of the posterior probability densities for the estimates (indicative of the uncertainty of the estimates). The points in the upper panel are the population estimates obtained by mark recapture during the dive surveys. The horizontal dashed line in the bottom panel indicates 100% of the conservation (egg) requirement.

The assessment methods and data available for Atlantic salmon in **Baddeck River** are similar to those for Middle River. The conservation (egg) requirement for the Baddeck River is 2.01 million eggs (O'Connell et al. 1997), calculated based on an estimated 836,300 m^2 of habitat and a target egg deposition density of 2.4 eggs/m^2.

A provincial stocking program also exists on the Baddeck River to offset anticipated future losses to the population from catch-and-release mortality. In 2012, there were no broodstock removals from the Baddeck River due to high water conditions; however, 11,990 fin clipped parr were released on October 18, 2012, as part of this program. Adult returns associated with these releases are expected in three to seven years. In addition, DFO released 11 male and 4 female mature adult salmon into Baddeck River on October 24, 2012. This was the last release of adult salmon from parr collections that occurred in 2009. This adult stocking program was intended to offset the Aboriginal FSC allocation from Baddeck River.

In 2012, the preliminary estimate of the recreational catch was 11 small and 225 large salmon with an estimated effort of 711 rod days (Appendix 3). Although the fishing effort increased by 47% from 2011 (483), small salmon catch decreased by 87% from 2011 (86), and the number of large salmon caught increased by 6% from 2011 (213). Analysis of the recreational fishing data series indicates that fishing effort has shown an increasing trend over the last ten years.

The numbers of large and small salmon counted during dive surveys in Baddeck River from 1994 to 2012 provide indices of the spawning escapement for each size category for this population. These surveys typically take place during the last week of October, just prior to the end of the fishing season. During the dive survey (October 28, 2012) 22 small and 158 large salmon were counted. The dive survey count in 2012 includes captive reared adult salmon that were released into Baddeck River by DFO, because the dive count occurred after the release. The count of small salmon was lower than that in 2011 (39), while the count of large salmon was higher than the dive survey count in 2011 (121).

The 2012 spawning escapement in Baddeck River is estimated to be 22 small and 282 large salmon (including captive reared adults). The large salmon escapement estimate is higher than the 2011 large salmon estimate (258), whereas the small salmon escapement estimate is lower than the small salmon estimate in 2011 (86). Since 1983, the spawning escapement (large and small salmon combined) in Baddeck River has increased from the previous year on 12 occasions and decreased on 17 occasions to varying degrees (Figure 2). In general, annual estimates of salmon escapement show an increasing trend until 1996 (including a sharp decline and “recovery” period between 1991 and 1996), followed by a gradual decrease to 2010 and an increase to 2012 (Figure 2).

Estimates of the percent of the conservation (egg) requirement met annually show a similar pattern with little chance that the population has met its conservation (egg) requirement since the time series began in 1983 (Figure 2). An assumption of 4% catch-and-release mortality is used in the assessment model; however, the majority of salmon are currently caught during October when water temperatures are low, and 4% is considered to be precautionary in this case. Based on the preliminary recreational catch estimates, the number of mortalities resulting from the recreational fishery in the Baddeck River is estimated to be 9-10 salmon (see Sources of Uncertainty). The percent of the conservation (egg) requirement attained is estimated to be 73% in 2012, and has ranged between 27 and 73% during the past 10 years.

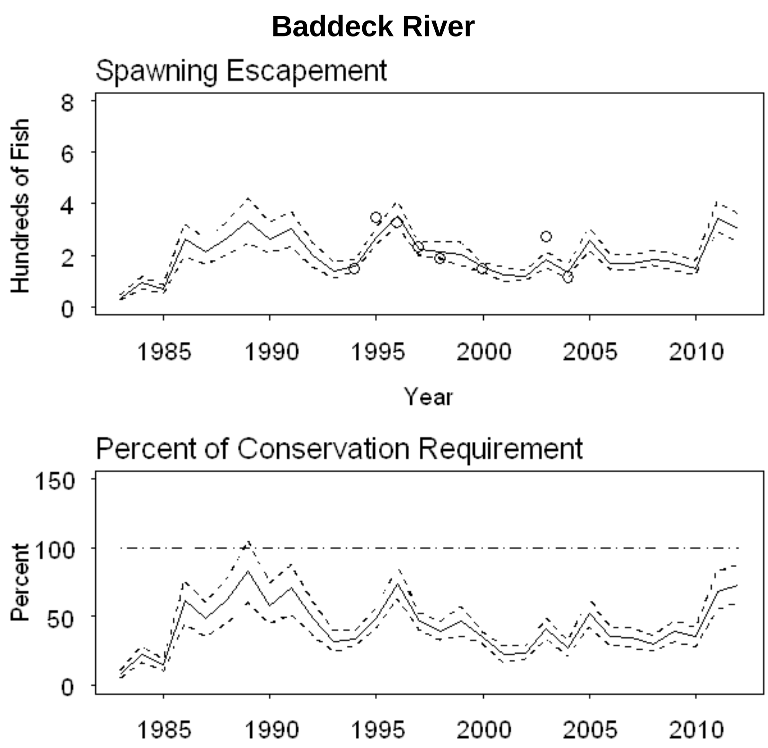


Figure 2. Estimated total number of spawners (top panel) and the percent of the conservation (egg) requirement attained (bottom panel) in Baddeck River, NS, from 1983 to 2012. The solid lines are the estimated values and the dashed lines are the 10th and 90th percentiles of the posterior probability densities for the estimates (indicative of the uncertainty of the estimates). The points in the upper panel are the population estimates obtained by mark recapture during the dive surveys. The horizontal dashed line in the bottom panel indicates 100% of the conservation (egg) requirement.

Recreational catch estimates from license stub returns and counts of adult salmon made by divers, similar to the Middle and Baddeck rivers, were available for assessing the status of salmon in **North River** in previous years. The conservation (egg) requirement for North River is 0.92 million eggs (O'Connell et al. 1997), based on a target egg deposition density of 2.4 eggs/m^2 and an estimated 382,700 m^2 of rearing habitat. Although there is an alternative estimate of the number of large and small spawners expected to meet this egg requirement (Marshall et al. 1999), the estimated number of large and small salmon reported by O'Connell et al. (1997) of 215 large and 32 small salmon is used in this assessment. An alternative rearing area estimate of 355,900 m^2 has also been reported (Amiro and Marshall 1990) and used to establish a conservation (egg) requirement of 0.85 million eggs, which has been used in past assessments (the most recent being DFO 2012a). However, the conservation (egg) requirement reported in O'Connell et al. (1997) is being used in this assessment because it has been calculated using methods consistent with other conservation requirements within the Maritimes Region and is consistent with the estimated rearing area for North River most recently reported in Robichaud-LeBlanc and Amiro (2004).

In 2012, the preliminary estimate of the recreational catch was 25 small salmon and 99 large salmon, with an estimated effort of 468 rod days (Appendix 3). In 2012, the effort was 16% lower than in 2011 (559 days), the estimated catch of small salmon was 66% lower than in 2011 (74), and the estimated catch of large salmon was 43% lower than in 2011 (175). Based on the preliminary estimates of recreational catch and an assumed 4% catch-and-release mortality rate, which is considered less precautionary on North River because of the higher temperatures expected in a summer fishery, the number of mortalities as a result of the recreational fishery is estimated to be 4 to 5 salmon.

A dive survey was not attempted in 2012; therefore, salmon returns to North River were estimated using the preliminary recreational catch data and mean catch rates (ratio of the recreational catch to the estimated returns) for this river. Based on these rates (0.41 for large and 0.69 for small salmon), the estimated returns were 242 large and 36 small salmon. The 2012 large and small salmon return estimates are lower than those for 2011 (428 large and 107 small). Since 1984, the total returns (large and small salmon combined) in North River has increased from the previous year on 11 occasions and decreased on 17 occasions to varying degrees. This population has shown a declining abundance trend since the 1980s, although trends in returns are less evident since 2003 (Figure 3). Estimated spawning escapement for small and large salmon in 2012 was calculated by subtracting the estimated catch-and-release mortality and reported FSC harvest from the estimated returns. The estimated escapement in 2012 was 35 small and 235 large salmon. Based on the preliminary recreational catch estimates, North River is estimated to be slightly above its conservation requirement (Figure 3).

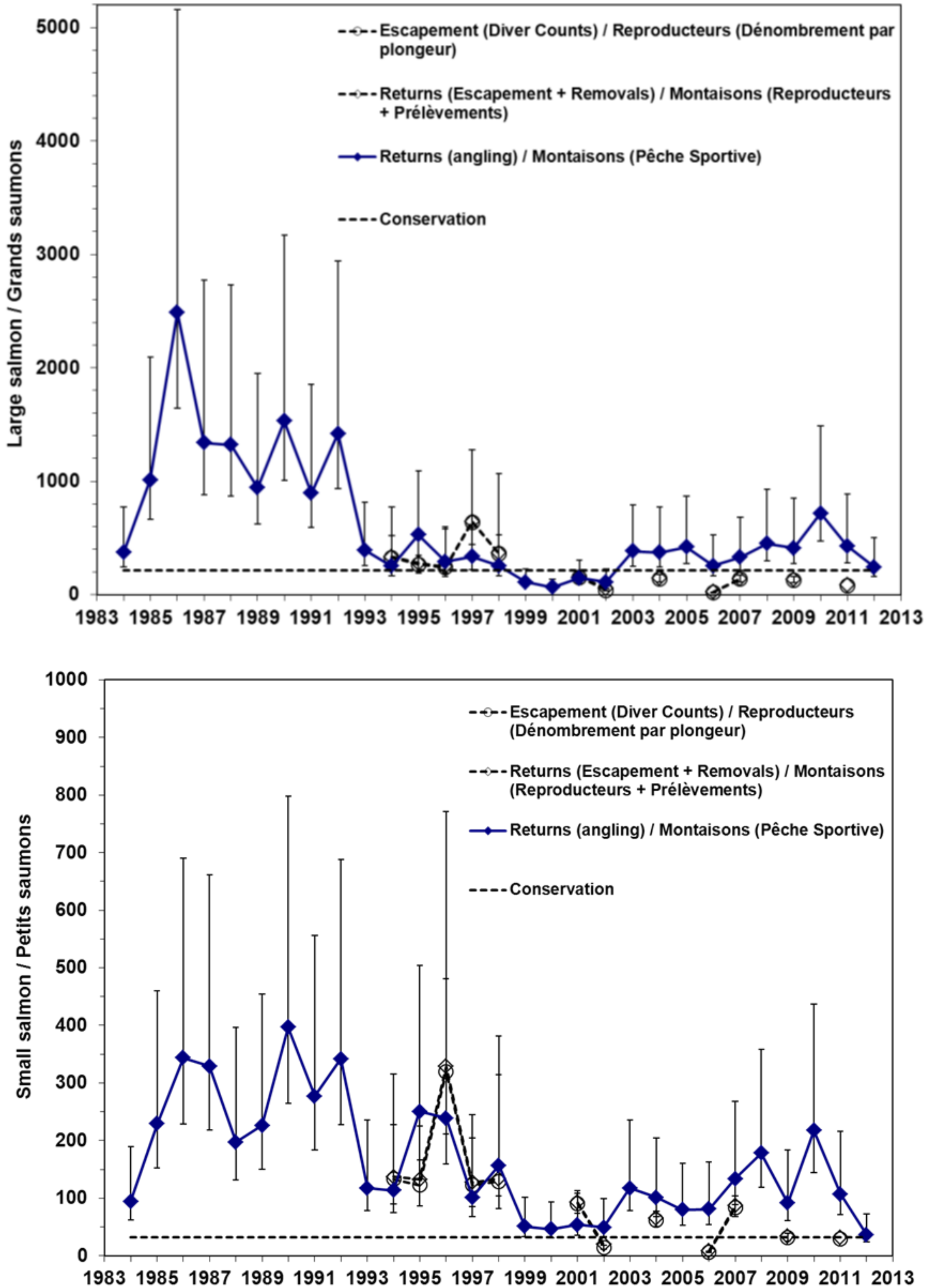


Figure 3. Estimates of the number of salmon returning to spawn and the spawning escapement for large and small salmon in the North River, NS, as derived from dive survey counts and from recreational catch data. The expected number of large or small salmon necessary to meet the conservation requirement is shown by the horizontal dashed line. Error bars are 90% confidence intervals.

Clyburn Brook is found on the eastern side of Cape Breton Highlands National Park near Ingonish. The river runs over a length of 19.4 km and is estimated to contain 116,500 m^2 of salmon rearing habitat (O'Connell et al. 1997). The conservation (egg) requirement for Clyburn Brook is 0.28 million eggs and this egg deposition is expected from about 65 large and 10 small salmon (O'Connell et al. 1997). Parks Canada has conducted annual dive surveys on Clyburn Brook from 1985 to 2012, with the exception of three years (1991, 1993, and 1996). Dive counts are conducted toward the end/after the fishing season and counts of large and small salmon are recorded separately. The observation efficiency is not known; however, the time series provides a relatively consistent index of abundance for this river. In some years, less area is covered during the survey than in others. Counts in this river were highest in 1987, at 175 salmon, and have only exceeded 20 salmon twice since 1999 (Figure 4). Only six large salmon were counted in 2012.

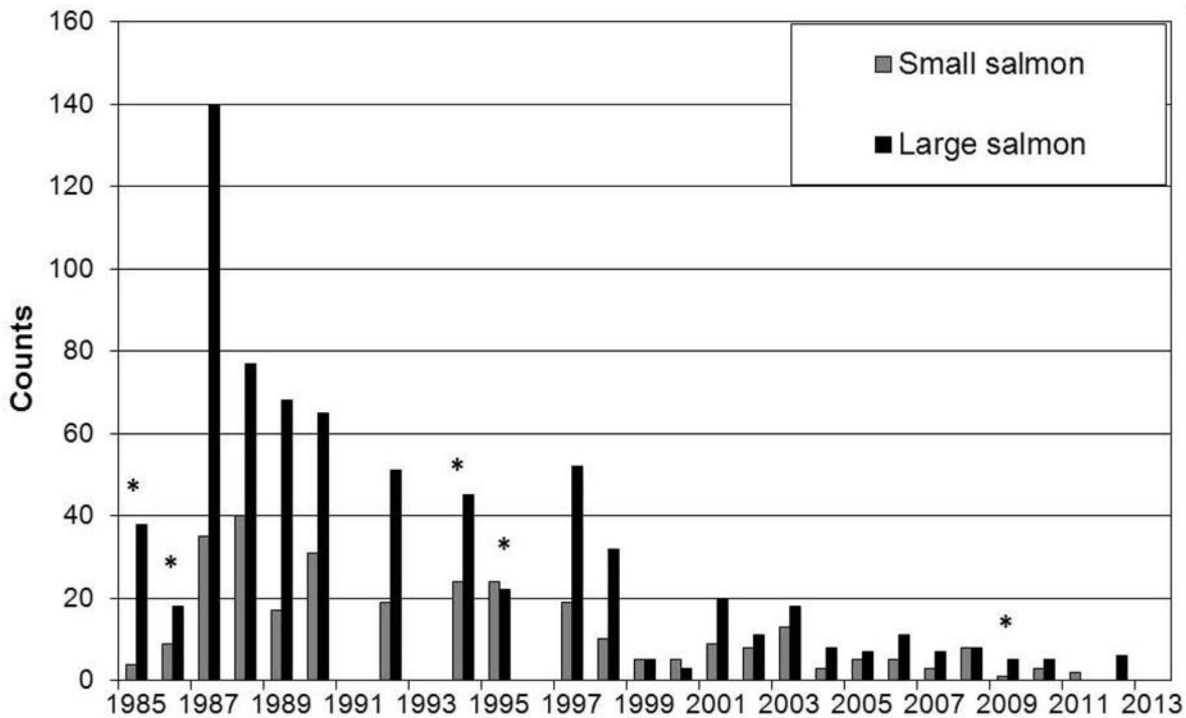


Figure 4. Counts of large and small salmon in Clyburn Brook, NS, from 1985 to 2012. Years in which only the lower section of the river was surveyed (partial counts) are identified with an asterisk (*).

The conservation (egg) requirement for the **North Aspy River** is 0.67 million eggs (O'Connell et al. 1997), calculated based on an estimated 280,700 m^2 of salmon rearing habitat and a target egg deposition density of 2.4 eggs/m^2. This egg deposition is expected from about 24 small and 158 large salmon (O'Connell et al. 1997). The status of salmon in the North Aspy River was assessed on a single occasion (2009) by a dive survey, where 28 small and 126 large salmon were observed. No dive survey was conducted in 2010 due to high water. A dive survey was conducted in 2011, but the results were deemed unsuitable for abundance estimation due to high flow and poor visibility (DFO 2012a). An attempt was made to conduct a dive survey and mark-recapture experiment in 2012; however, the dive survey was not conducted due to high flows and poor water clarity. The preliminary estimates of the recreational catch in 2012 were 4 small and 4 large salmon with an estimated effort of 53 rod days (Appendix 3). The catch of small salmon was the same as in 2011, although the catch of large salmon was lower in 2012 than 2011 (29). The recreational catch estimates for North Aspy River have been based on a small number of anglers who have submitted stub returns in recent years (e.g., estimated catch and effort based on 8 observed anglers and a total of 2 salmon caught in 2012). Based on the preliminary recreational catch estimate, the number of mortalities as a result of the recreational fishery in North Aspy River (4% mortality rate assumed) is estimated to be 0 to 1 salmon.

Southern Upland of Nova Scotia (SFAs 20 and 21)

Southern Upland (SU) Atlantic salmon populations occupy Nova Scotia rivers on the Eastern Shore and in Southwest Nova Scotia. The area has been divided into three SFAs for management purposes (Appendix 1): SFA 20 (Eastern Shore), SFA 21 (Southwest Nova Scotia) and part of SFA 22 (upper Bay of Fundy). At least 72 rivers in the Southern Upland have historically contained Atlantic salmon populations (DFO 2013). Based on pH samples collected in the early 1980s, at least 14 of these rivers were heavily acidified (pH < 4.7) and were no longer able to support salmon (DFO 2000). A further 20 rivers were partially acidified (pH ranges from 4.7 to 5.0) and were thought to support only remnant populations. A region-wide electrofishing survey conducted in 2000 found salmon in 28 of 52 rivers surveyed (54%; Gibson et al. 2011). A similar survey conducted in 2008 and 2009 found salmon in only 21 of 54 rivers surveyed (39%; Gibson et al. 2011).

Atlantic salmon assessment activities in the SU region are focused primarily on two populations: the St. Mary’s River, the index population for SFA 20, and the LaHave River, the index population for SFA 21 (Appendix 2). All rivers within SFA 20 and SFA 21 were closed to recreational fishing for Atlantic salmon (Appendix 1) beginning in 2010. Details on the assessment of SU populations are provided in Gibson et al. (2009).

Status

The **St. Mary’s River** is one of the major river systems in SFA 20 and consists of two main branches: the West and East. In the past, adult escapement estimates have been based either on the recreational catches (1996 and earlier), on adult mark-recapture experiments (1997 to 2001, 2006 to 2008 and 2010), and/or on the ratio of escapement estimates for the West Branch of the St. Mary’s relative to the LaHave River above Morgan Falls (2009, 2010 and 2011). Results of these assessments are provided in previous assessment documents (most recently DFO 2012a).

Adult assessments were not conducted in 2012 and are not expected to be continued in the future. Monitoring activities in 2012 focused on juvenile salmon via electrofishing surveys on the West and East branches of the river. Juvenile abundance trends have been shown to be indicative of adult abundance trends in the West Branch of the St. Mary’s River (Bowlby and Gibson 2012). A total of ten sites were electrofished on the St. Mary’s river in 2012; five sites on the East Branch and five sites on the West Branch. All juvenile salmon density estimates were calculated using the mean age-1 capture efficiency for years 2008-2012, which is derived from mark-recapture experiments. Fry densities were notably higher on the East Branch than on the West Branch of the river in 2012. The average densities (fish per 100 m^2) of age-0 (fry), age-1 parr, and age-2 and older parr were 45.4, 6.7, and 0.6, respectively, on the East Branch, and 9.3, 5.0 and 1.3, respectively, on the West Branch. When results from the two branches are combined, estimated densities (fish per 100 m^2) of fry, age-1 parr, and age-2 and older parr were 27.4, 5.8 and 1.0 respectively for the entire St. Mary’s River. The densities for the entire St. Mary’s (i.e., East and West branches combined) are higher than in 2011 for fry (12.9), age-1 parr (5.1), and age-2 and older parr (0.3) and also higher than the previous 5-year mean values for fry (9.7), age-1 parr (4.2) and age-2 and older parr (0.3). However, none of these differences are statistically significant (Welch two-sample t-tests: p=0.148, p=0.51, p=0.256, p=0.080, p=0.275, p=0.158, respectively).

In 2012, all indices of juvenile abundance for the St. Mary’s river were below Elson’s norm values of 29 fry/100m^2 and 38 parr/100m^2 (Elson 1967), reference values used for assessing the status of juvenile salmon populations, with the exception of the mean fry density in the East Branch of the St. Mary's River.

In 2012, assessment activities on the **LaHave River**, the index population for SFA 21, included counts of adult salmon ascending a fish ladder at Morgan Falls and electrofishing surveys to determine juvenile densities. The conservation (egg) requirement for the entire LaHave River (12.2 million eggs) is based on 2.4 eggs/m^2 and an estimated rearing area of 5,084,800 m^2 (O'Connell et al. 1997). In past assessments, the LaHave conservation (egg) requirement was estimated from a different estimate of rearing area (2,046,228 m^2; Cutting and Grey 1984), which in turn was reduced in an attempt to account for the expected reduction in productivity associated with acidification. However, discussions of the Precautionary Approach that has since been adopted by DFO suggest that reference points should not be modified relative to the expected impact of existing threats. Therefore, the conservation (egg) requirement reported by O'Connell et al. (1997) has been scaled according to the proportion of habitat area above Morgan Falls (i.e., 51%) to yield a conservation (egg) requirement of 6.22 million eggs, which is used in this assessment to be consistent with the Precautionary Approach Framework and Recovery Targets proposed for Southern Upland Atlantic salmon (DFO 2013). Both conservation (egg) requirements (i.e., 1.96 million eggs used in past assessments and the 6.22 million eggs used in this assessment) are presented here to allow for comparison.

The total count of adult salmon at the Morgan Falls fishway on the LaHave River in 2012 was 67 (28 small and 39 large salmon) (Figure 5). Excluding the initial years after construction of the fishway, this was the lowest count on record, and it represents a substantial decline in total returns from 2011 (370). The count of small salmon ascending the Morgan Falls fishway in 2012 was an order of magnitude lower (28) than in 2011 (294), and the large salmon count (39) was approximately half the count in 2011 (76). The estimated egg deposition above Morgan Falls in 2012 was 290,155 eggs, which is 5% of the conservation (egg) requirement (Figure 6). This is the lowest estimated wild egg deposition since 1976. For comparison, this estimated egg deposition is 15% of the acid-reduced conservation (egg) requirement used in past assessments (Figure 6).

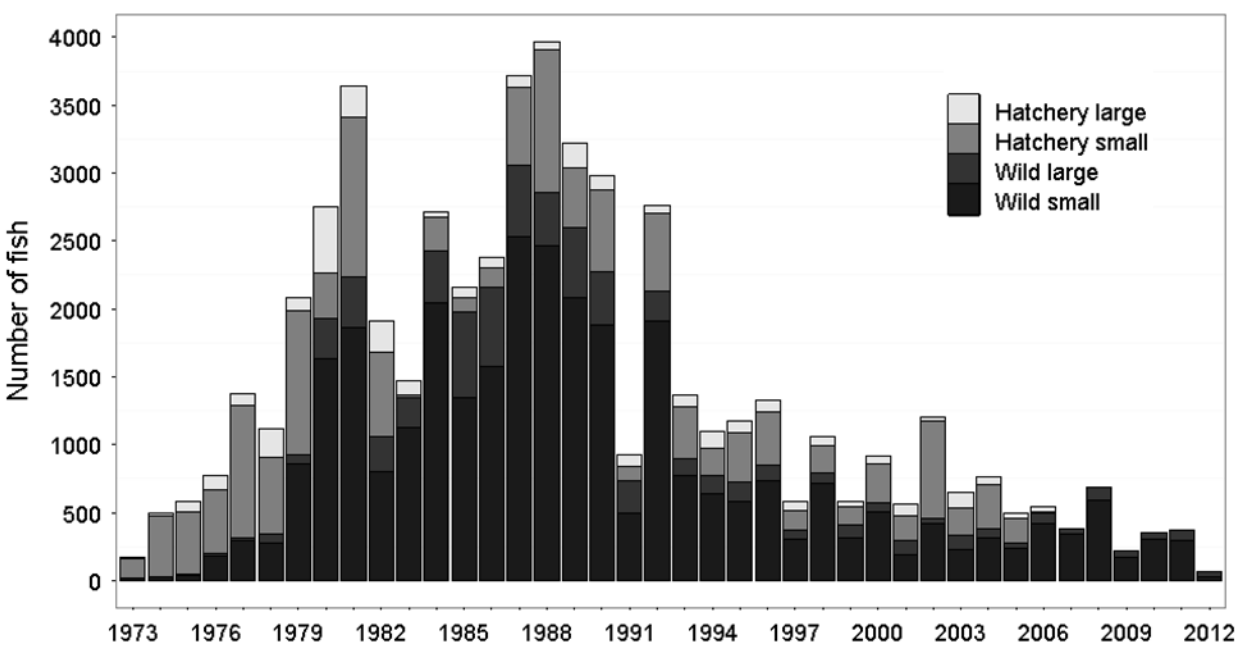


Figure 5. Counts of Atlantic salmon at Morgan Falls fishway on the LaHave River, NS, from 1973 to 2012 by wild-origin and hatchery-origin small and large adults.

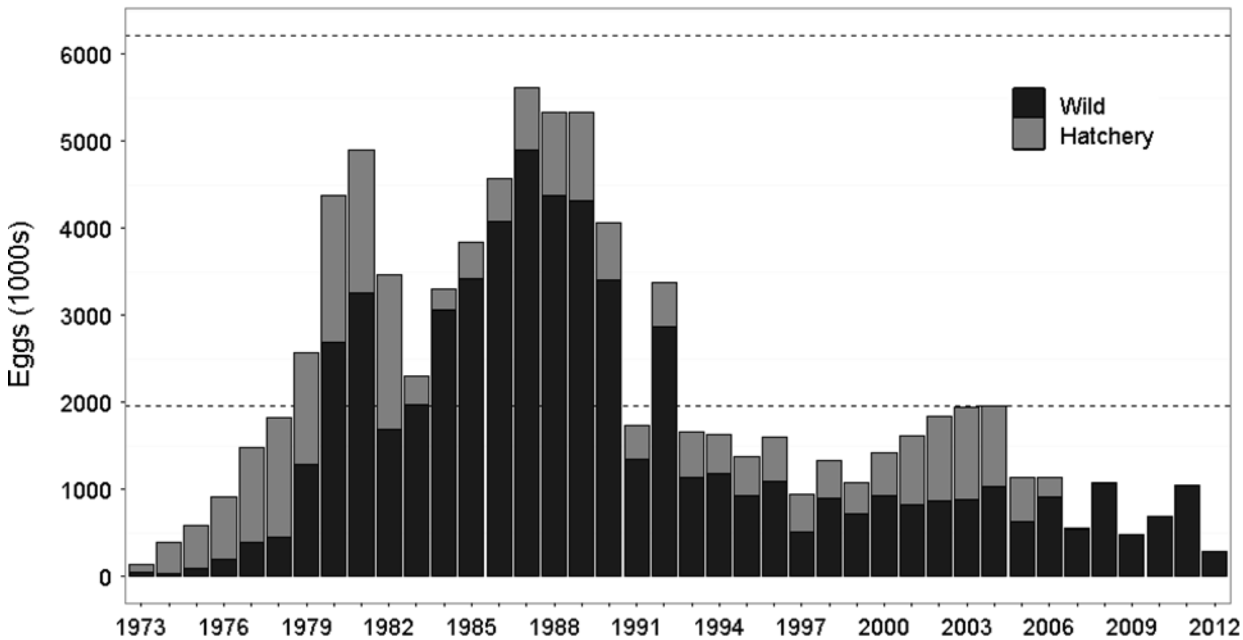


Figure 6. Estimated egg deposition (1000's) relative to the conservation (egg) requirement by wild and hatchery-origin Atlantic salmon above Morgan Falls from 1973 to 2012. 6.22 X 106 eggs represents conservation (egg) requirement reported in O'Connell et al. (1997) scaled to the proportion of habitat area above Morgan Falls. 1.96 X 106 eggs represents the acid-reduced conservation (egg) requirement reported in past assessments.

Smolt abundance monitoring was not conducted in 2012 due to mechanical problems at the smolt assessment facility.

Based on electrofishing data from nine sites in 2012 (three sites above Morgan Falls and six sites below Morgan Falls), estimated densities (fish per 100 m^2) of age-0 (fry), age-1 parr, and age-2 and older parr were 15.1, 5.0, and 0.5 respectively for the entire LaHave River. These values are higher than 2011 for fry (3.0) and age-1 parr (3.3), but lower than 2011 for age-2 and older parr (0.9), although these differences are not statistically significant (Welch two-sample t-tests: p=0.218, p=0.480, p=0.275). Following poor fry densities observed in 2011 (DFO 2012a), the mean fry density above Morgan Falls in 2012 was significantly lower than the previous 5-year mean fry density above Morgan Falls (2.9 versus 11.0; Welch two-sample t-test: p=0.037) and represents only 26% of the previous 5-year mean density. The mean fry density below Morgan Falls in 2012 (21.1) was comparable to the previous 5-year mean fry density below Morgan Falls (23.6; Welch two-sample t-test: p=0.865). Similarly, the densities of age-1 parr in 2012 (0.0) were significantly lower than the previous 5-year mean density above Morgan Falls (5.4; Welch two-sample t-test: p=0.023), while there was no significant difference between the 2012 and previous 5-year mean densities of age-1 parr below Morgan Falls (7.5 versus 10.5; Welch two-sample t-test: p=0.386). There were no significant differences in the densities of age-2 and older parr in 2012 compared to the previous 5-year mean either above (0.5 versus 0.9, respectively; Welch two-sample t-test: p=0.327) or below Morgan Falls (0.5 versus 0.5; Welch two-sample t-test: p=0.997). Mean juvenile densities on the LaHave River were below Elson's norm values of 29 fry/100m^2 and 38 parr/100m^2 in 2012.

Outer Bay of Fundy (SFA 23)

The outer Bay of Fundy rivers in SFA 23 include those between the Saint John River and its tributaries and the St. Croix River, inclusively, and are bounded on the east by the endangered inner Bay of Fundy populations and on the west by salmon populations in Maine that are listed as endangered under United States legislation.

All commercial fisheries for Atlantic salmon in SFA 23 have been closed since 1984. Low abundance of salmon has resulted in the complete closures of the Aboriginal fisheries for FSC purposes, and the recreational fisheries, since 1998. Assessment data in SFA 23 are collected for three index populations: the Saint John River upriver of Mactaquac Dam, the Nashwaak River (an index of populations in the Saint John River downriver of Mactaquac Dam) and the Magaguadavic River. The Magaguadavic River data is provided by the Atlantic Salmon Federation. In the past, the St. Croix River was assessed annually, but the fishway has not been monitored since 2006. About 38% of the total accessible salmon habitat (wetted area) within SFA 23 is upriver of Mactaquac Dam. Further detail about these assessments is provided in Jones et al. (2010).

The Mactaquac Biodiversity Facility has been involved in the mitigation of the effects of hydroelectric development on salmon in the Saint John River, primarily via smolt production. Historically, hatchery broodstock for the program has consisted of 200-300 wild sea-run adults each year. The program at the Mactaquac Biodiversity Facility has been re-focused to the objective of conserving and restoring a declining resource (Jones et al. 2004). Thus, discussion among DFO, the Saint John River Management Advisory Committee and the Saint John Basin Board resulted in a program change in 2004. The new program replaces a large portion of the traditional smolt production with production of age-0 fall parr. Additionally, the program utilizes captive-reared adults, originally collected from the wild as juveniles, for both broodstock and adult releases for natural spawning upriver of Mactaquac.

Status

The conservation (egg) requirement for salmon populations in the **Saint John River upriver of Mactaquac Dam** is based on an accessible rearing area of 13,472,200 m^2. This does not include the Aroostook River, headponds, or the 21 million square meters of river with gradient <0.12%. Based on a required egg deposition of 2.4 eggs/m^2, the conservation (egg) requirement is 32.3 million eggs. Using only eggs deposited by multi-sea-winter (MSW) salmon (including maiden two sea-winter (2SW), maiden three sea-winter (3SW) and repeat spawning salmon), Marshall et al. (1997) estimated that the conservation (egg) requirement would be met by 4,900 MSW salmon. The number of salmon required to meet the conservation (egg) requirement is expected to differ from year-to-year, depending on the biological characteristics (sex ratios and fork length) of the stock and will also differ if one sea-winter (1SW) salmon are included in the calculation. For example, 5,200 MSW and 3,510 1SW salmon would be sufficient to meet the conservation (egg) requirement using the biological characteristics of the wild origin returns observed in 2012.

Adult salmon counts consist of fish captured at the fish collection facilities at the Mactaquac Dam and at an adult trap operated in the migration channel at the Mactaquac Biodiversity Facility. During 2012, these facilities were operated from May 17th to October 25th.

Returns of 81 1SW and 132 MSW salmon, destined for upriver of Mactaquac Dam on the Saint John River in 2012, were both well below returns observed in all years since 1970 (Figure 7). Returns of 1SW salmon decreased by 92% from those of 2011, and were the lowest annual estimate since 1970. Returns of MSW salmon decreased by 81% and were also the lowest in 43 years. Wild-origin fish (which could include progeny from captive-reared adults released for natural spawning in 2006, 2007 and 2008) comprised 59% of 1SW and 54% of MSW fish.

For the second consecutive year, no suspected aquaculture escapes were captured at the Mactaquac fish collection facilities in 2012, which was encouraging considering 26 suspected escapes were captured at Mactaquac in 2010.

Removals from the returns destined for production areas upriver of Mactaquac include: 1) the estimate of 1SW and MSW salmon ascribed to by-catch in the estuary (Marshall and Jones 1996), 2) salmon passed or trucked upriver of Tinker Dam on the Aroostook River, 3) salmon retained at Mactaquac as broodstock for conserving the Serpentine strain, 4) salmon estimated to have been lost to poaching activities, in particular those taken by illegal nets just below the Tobique and Mactaquac dams, and 5) known mortalities due to handling operations at Mactaquac, at fishways (Beechwood, Tobique and Tinker Dam), and at the Tobique Half Mile Barrier (Table 2).

The resulting spawning escapement is estimated to be 70 1SW and 97 MSW salmon, which resulted in an egg deposition estimate equivalent to 2% of the conservation (egg) requirement, an 87% decrease of the value estimated in 2011 and the lowest estimate since 1970 (Figure 8). Estimated eggs from wild and hatchery 1SW fish comprised about 3% of the total deposition. Eggs from hatchery origin 1SW and MSW salmon potentially contributed 35% of the total deposition. The seven Serpentine 2SW returns were originally retained for broodstock but were later released upriver of Mactaquac due to the fact that there were too few to be used for an effective breeding program in 2012. Therefore, no sea-run 1SW or MSW salmon were retained for the Serpentine conservation initiative in 2012. Captive-reared adults (1,450 fish), with the potential to produce 5.49 million eggs (or an additional 14% of the conservation (egg) requirement), were released upriver of Mactaquac (majority in the Tobique River) in 2012 (Figure 8).

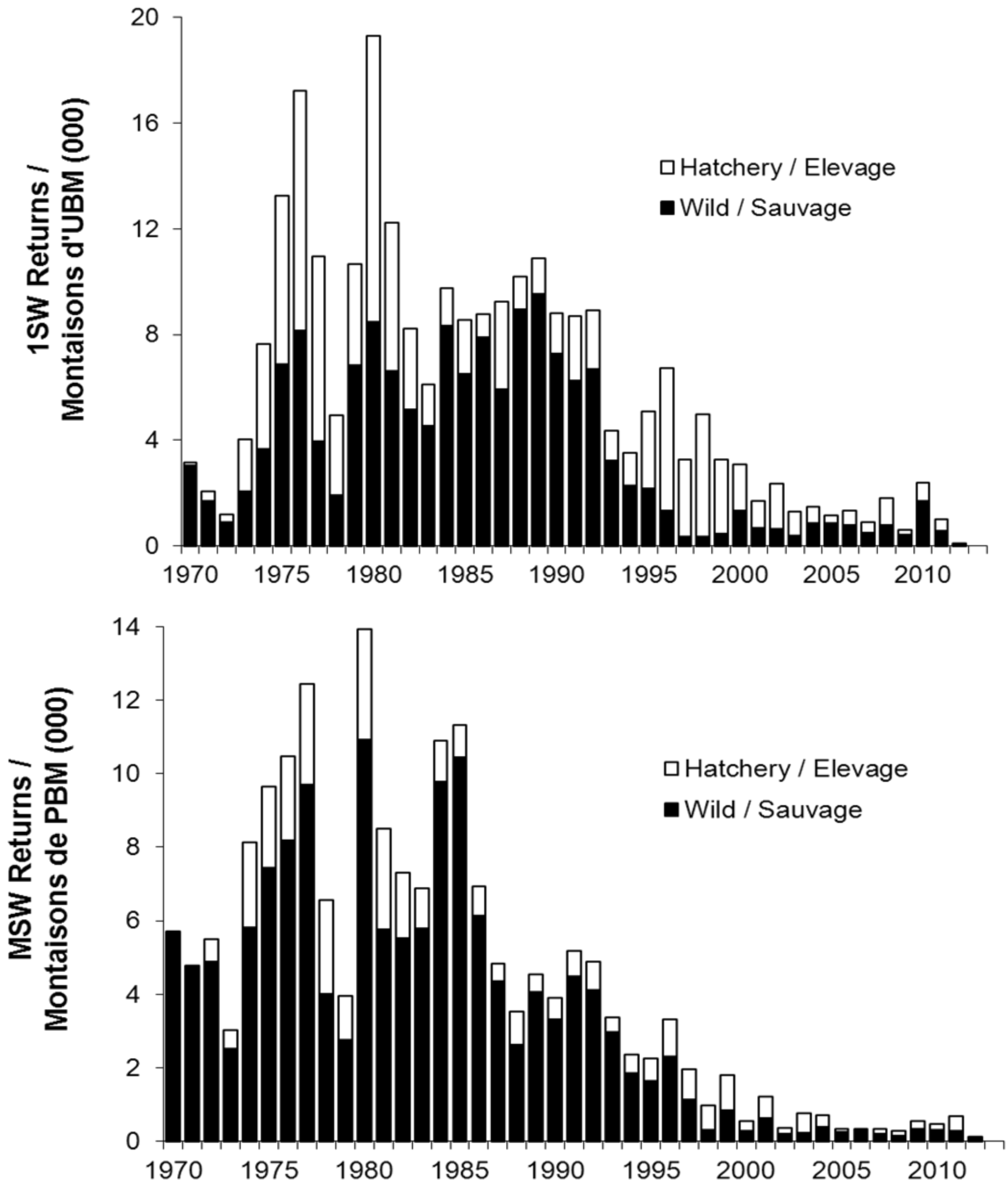


Figure 7. Estimated total returns of wild and hatchery-origin 1SW and MSW salmon destined for upriver of Mactaquac Dam, Saint John River, 1970 - 2012.

Table 2. Estimated removals of 1SW and MSW salmon destined for upriver of Mactaquac Dam on the Saint John River, NB, 2012.

	Estimated Removals		Percent of Total Returns	
Component	1SW	MSW	1SW	MSW
By-catch Estimates	0	4	0.0	3.0
Passed above Tinker Dam	6	16	7.4	12.1
Hatchery Broodstock	0	0	0.0	0.0
Poaching Estimates	5	7	6.2	5.3
Mortality at Mactaquac	0	4	0.0	3.0
Mortality at Beechwood	0	4	0.0	3.0
Mortality at Tobique	0	0	0.0	0.0
Mortality at Tinker	0	0	0.0	0.0
Mortality at Tobique Barrier	0	0	0.0	0.0
Total	11	35	13.6	26.5

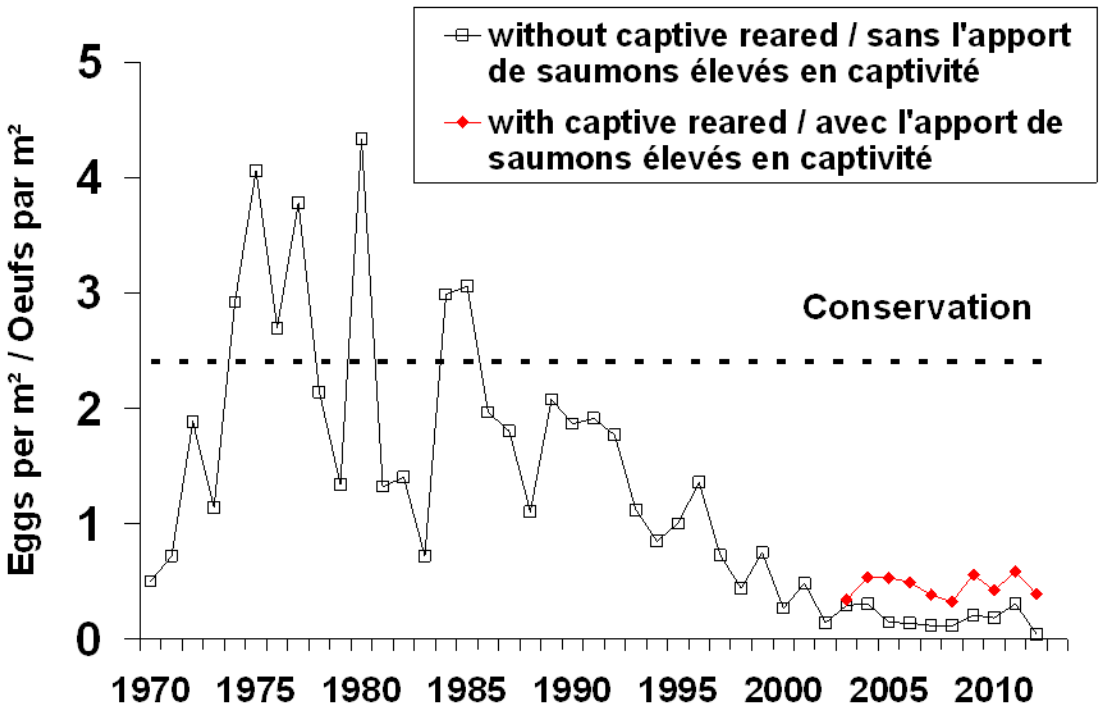
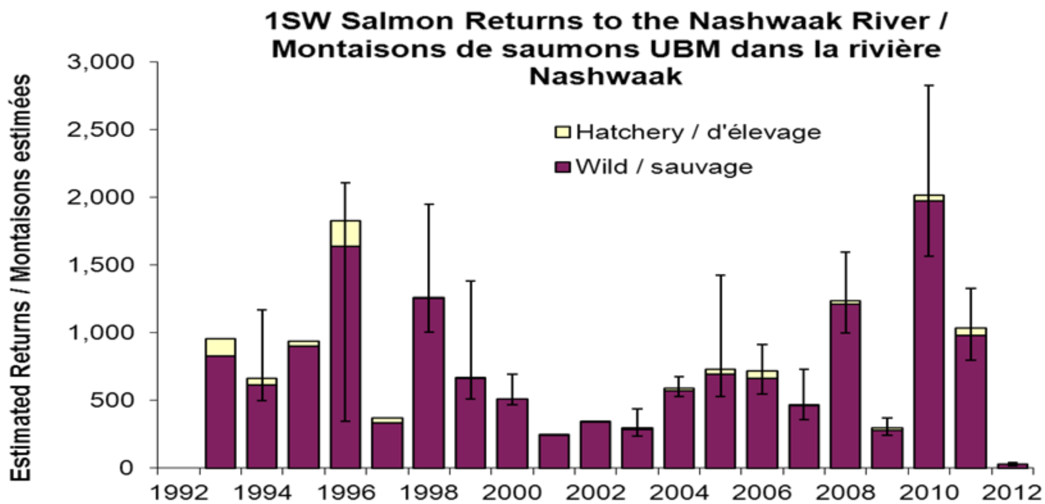


Figure 8. Estimated egg deposition (wild and hatchery combined, and captive-reared) upriver of Mactaquac Dam, Saint John River, 1970 - 2012.The dashed line is the conservation (egg) requirement.

The **Nashwaak River** is the largest salmon-producing tributary of the Saint John River downriver of Mactaquac Dam; it contains 28.5% of the total salmon production area in the Saint John River downriver of Mactaquac Dam. A salmon counting fence, located 23 km upriver from the confluence with the Saint John River, was operated by DFO in 1972, 1973 and 1975, and by DFO in cooperation with Kingsclear, Oromocto, St. Mary's, and Woodstock First Nations from 1993 to 2012. In 2012, the fence was jointly operated by Kingsclear and Oromocto First Nations and DFO. The salmon production area upriver of the fence is estimated to be 5.35 million square meters (90% of the total river estimate), and the conservation (egg) requirement is 12.8 million eggs. Using only eggs deposited by MSW salmon (including maiden 2SW, maiden 3SW and repeat spawning salmon), Marshall et al. (1997) estimated that the conservation (egg) requirement would be met by 2,040 MSW salmon. The number of salmon required to meet the conservation (egg) requirement is expected to differ from year-to-year, depending on the biological characteristics (sex ratios and fork length) of the stock and will also differ if 1SW salmon are included in the calculation. For example, 2,420 MSW and 1,150 1SW salmon would be sufficient to meet the conservation (egg) requirement using the biological characteristics of the wild origin returns observed in 2012.

Counts of 16 1SW and 39 MSW salmon at the Nashwaak River fence, combined with mean fence efficiencies of 0.54 (1SW) and 0.64 (MSW), resulted in estimates of 29 1SW and 61 MSW salmon returning to this river (Figure 9). Estimated 1SW returns decreased by 97% from those in 2011 and decreased by 96% compared to the ten year mean. Multi-sea-winter returns decreased by 89% from the 2011 returns and 71% from the ten year mean. There were no hatchery-origin fish counted at the fence, so wild-origin fish comprised all of the 1SW and MSW returns in 2012. No suspected aquaculture escapes were captured at the counting fence in 2012.



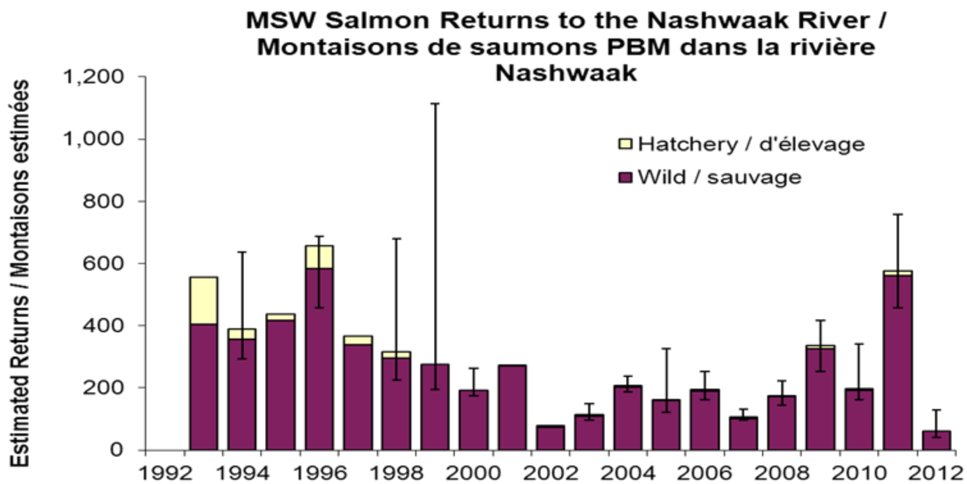


Figure 9. Estimated wild and hatchery 1SW and MSW salmon returns (and 2.5 and 97.5 percentiles) to the Nashwaak River, 1993-2012.

The return rate of the 2011 wild smolt class as maiden 1SW salmon in 2012 was 0.33%, the lowest return rate since wild smolt assessments were initiated in 1998 (Figure 10). The return rate of the 2010 wild smolt class as maiden 2SW salmon in 2012 was equally poor at 0.35%, the second lowest return rate observed and only 11% of the rate from the previous year.

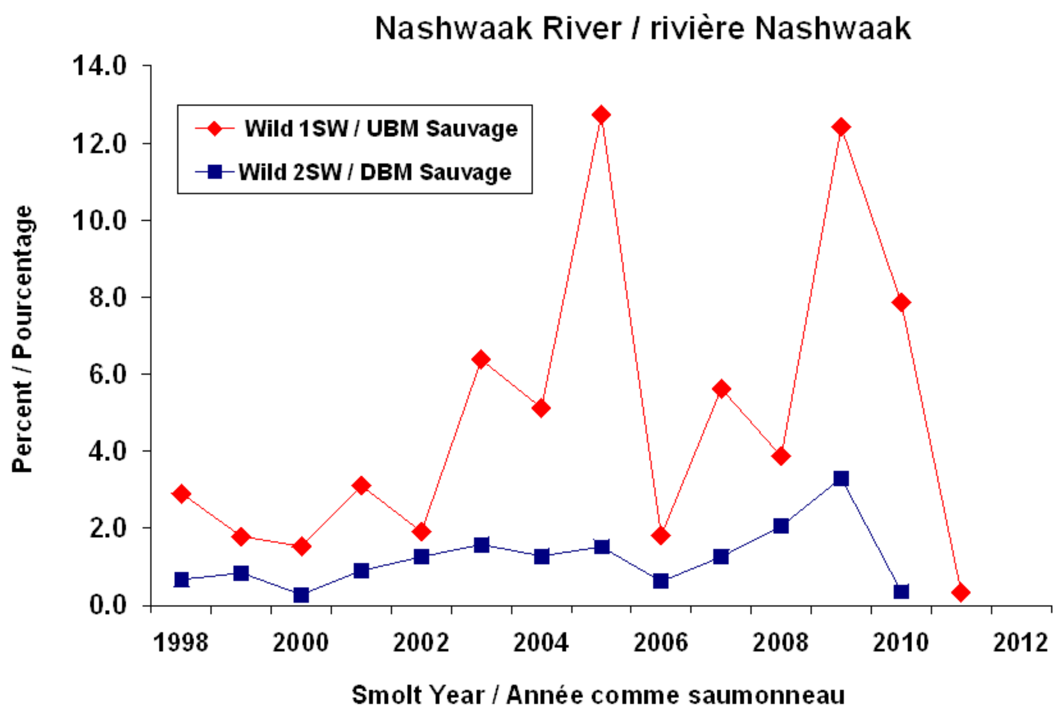


Figure 10. Return rates of wild-origin smolts to maiden 1SW and maiden 2SW salmon to the Nashwaak River (upriver of the counting fence), 1998 - 2011.

Spawning escapement is estimated by subtracting the known removals from the estimated returns. There were no salmon mortalities observed while the counting fence was in operation in 2012. DFO fishery officers reported that no salmon were known to have been removed by illegal fishing activities within the Nashwaak watershed. For the third consecutive season, there were no 1SW or MSW salmon removed from the fence trap in 2012 for conservation initiatives by the Nashwaak Watershed Association Inc. Total escapement upriver of the fence was estimated to be 29 1SW and 61 MSW salmon. Using the biological data collected on the few fish sampled at the counting fence in 2012, the egg deposition was estimated to be about 322,000 eggs (0.07 eggs/m^2 or 3% of the egg requirement). This value is the lowest estimate in the time series and followed two years of improved egg deposition estimates (Figure 11). 1SW females contributed 13% of the total estimated egg deposition.

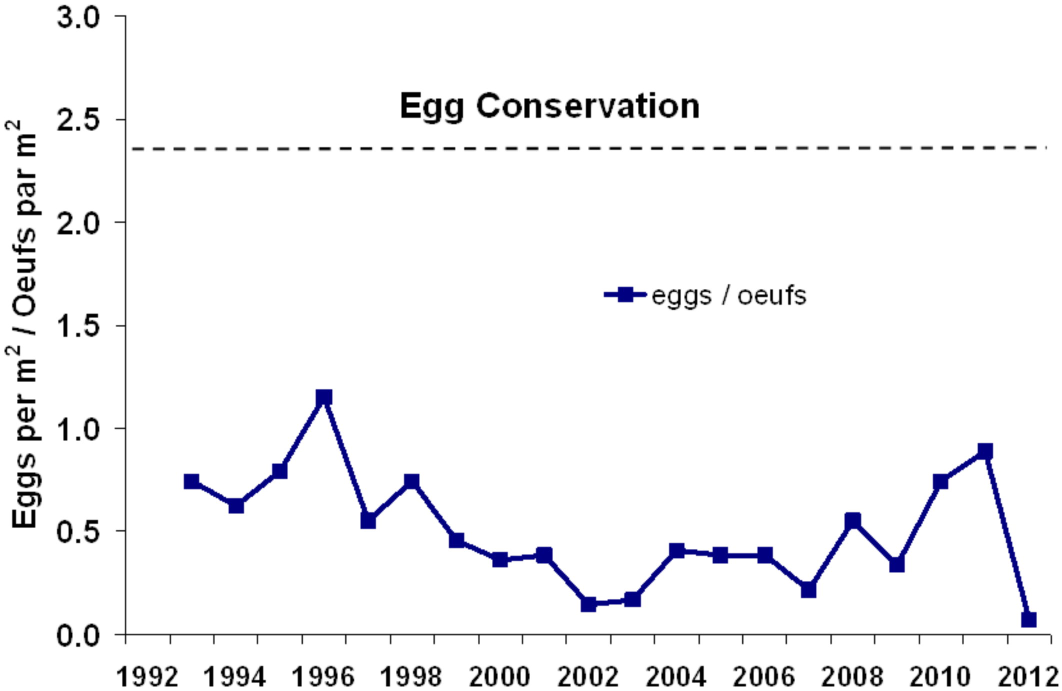


Figure 11. Estimated egg deposition upriver of the counting fence operated just below Durham Bridge, Nashwaak River, 1993 - 2012. The dashed line is the conservation (egg) requirement.

Wild smolt production in the Nashwaak River has been monitored since 1998. The number of wild smolts emigrating from upriver of the adult counting fence in 2012 was estimated to be 11,060 (95% C.I. = 8,030 to 17,745). This is an increase of 26% from 2011, but is below the five-year mean and the sixth lowest estimated total since smolt assessments commenced in 1998. The 2012 estimate is considered to be biased low since the second highest catch of the season was observed on the first of day of monitoring and trap was not operated for 3 days during the peak migration period.

Returns to the St. George fishway and trap located near the head of tide on the **Magaguadavic River** in 2012 were one female MSW salmon and one re-conditioned male captive-reared broodstock. Both were released upriver of the fishway trap and potentially deposited an estimated 7,160 eggs. The conservation (egg) requirement is estimated to be 1.35 million eggs from 140 1SW and 230 MSW salmon (Anon 1978). Unlike 2011, there were no captive-reared adults from conservation initiatives of the Atlantic Salmon Federation released in 2012 to augment the potential eggs from the one sea-run return. There were 18 suspected aquaculture-origin escapes (1SW salmon) captured at this facility in 2012. All aquaculture salmon were sacrificed for disease testing, and none of these fish tested positive for the ISA virus.

Returns to the three SFA 23 index rivers in 2012 were all estimated to contribute less than 5% of their conservation (egg) requirements (2% of the Saint John River upriver of Mactaquac requirement, 3% of the Nashwaak River requirement, and < 1% of the Magaguadavic River requirement).

Sources of Uncertainty

There are anecdotal reports of poaching, but its contribution to the depressed status of populations in the Maritimes Region is not known.

Spawning escapement for Middle and Baddeck rivers is derived using a model that combines the recreational catch, dive survey, adult mark-recapture and electrofishing data to estimate abundance using maximum likelihood (Gibson and Bowlby 2009). The models find a compromise between the abundance as estimated from the recreational catch and dive counts. If either data set is weighted differently (e.g., to improve fits to one data series or the other, as has been done starting in 2010), the abundance estimates will differ. For example, for 2012, the estimated percent conservation requirement attained for Middle and Baddeck rivers would be 79 versus 92%, and 73 versus 74%, respectively, when using the model formulation used in this assessment versus the original formulation used when the model was developed by Gibson and Bowlby (2009).

During the 2011 dive survey in Middle River, the main survey was conducted along the reach of the river and known holding pools that had been surveyed in previous years. However after completing the survey, new pools (i.e., holding pools not known to exist before) were identified. Divers swam these pools on the following day and counted additional adults; however, it was unknown if these new pools contained salmon that had already been counted on the previous day (DFO 2012a). For the Middle River assessment model used in this report, the mean dive count for small and large salmon in 2011 (i.e., mean of surveys with and without new pools) was used as model inputs for 2011.

Although studies suggest that mortality rates associated with catch-and-release angling at temperatures <12°C are thought to be <3% (ICES 2009), the more precautionary value of 4% is used for Middle and Baddeck rivers to account for other potential effects of catch-and-release salmon fishing (e.g., potential effects on migration, reproduction, habitat impacts, transfer of pathogens, and other delayed effects). The use of a more precautionary value for Middle and Baddeck rivers also reflects the fact that current water temperatures in rivers open to angling is not well known during the angling seasons in eastern Cape Breton. The use of a 4% assumption for catch-and-release mortality versus an assumption of 3% only results in an additional 3-4 and 2-3 fish estimated to be lost due to catch-and-release mortality from Middle and Baddeck rivers, respectively. The assumption of 4% catch-and-release mortality is less precautionary for North River, as there was a summer catch-and-release fishery on North River in 2012.

The number of salmon caught and released within SFA 19 is estimated based on salmon license stub returns. The estimated fishing effort and the estimated numbers of large and small salmon caught and released from the recreational fishery is considered to be preliminary at the time of this assessment as license sale information and license stubs are still being returned. Under- or over-reporting of numbers of salmon caught would impact assessments based on angling data.

Conclusions

Overall, this assessment indicates that the abundance of both outer Bay of Fundy and Southern Upland salmon are critically low. Adult salmon returns to the LaHave River (Southern Upland), the Saint John River upriver of Mactaquac Dam and the Nashwaak River, an index of populations in the Saint John River downriver of Mactaquac Dam (outer Bay of Fundy), were close to/the lowest on record, respectively, and were below 5% of their conservation (egg) requirements in 2012.

The overall salmon population assemblage in eastern Cape Breton (SFA 19) is thought to be healthier than in the outer Bay of Fundy or Southern Upland regions, although substantial declines in some populations are evident (e.g., Grand and Clyburn rivers) and there is uncertainty of the status in other (non-index) rivers, which is inferred from recreational catch and electrofishing data. Although estimates of small and large salmon on North River declined from 2011, the estimated returns remained slightly above the conservation requirement in 2012.

Estimated egg depositions in Baddeck and Middle rivers increased in 2012 for the second and fourth consecutive years, respectively; however, both of these populations still remain below their conservation (egg) requirements.

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Date: March 25, 2013

Sources of Information

This Science Response Report results from the Science Special Response Process of March 1, 2013, on the Assessment of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23.

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Appendices

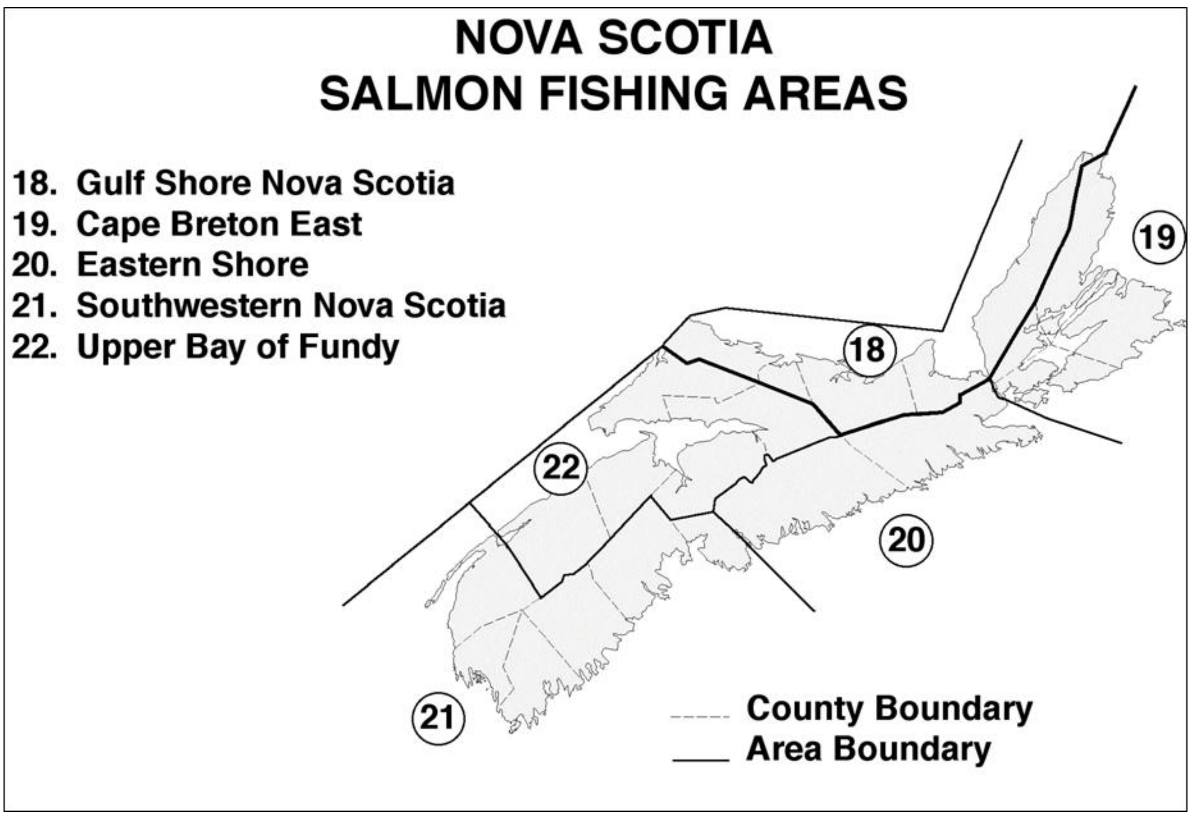
Appendix 1. Fisheries and Oceans Canada Notice: 2012 Salmon Angling Seasons for Nova Scotia.

Fisheries and Oceans Canada Pêches et Océans Canada

Canada

2012 SALMON ANGLING SEASONS

The Regional Director-General, Maritimes Region, Department of Fisheries and Oceans wishes to advise the public of the following changes to seasons and bag limits for Atlantic salmon in Nova Scotia.



1. (a) SALMON FISHING AREA 18 (Gulf Shore of Nova Scotia) and all waters of the Province flowing into that Area, except the waters referred to in paragraphs **(b)** to **(j)** .... Sept. 1 to Oct. 31

(b) East River, Pictou County .... Sept. 1 to Oct. 31

(c) West River, Pictou County .... Sept. 1 to Oct. 31

(d) River Phillip .... Sept. 1 to Oct. 31

(e) Wallace River .... Sept. 1 to Oct. 31

(f) West River, Antigonish County .... Sept. 1 to Oct. 31

(g) South River, Antigonish County .... Sept. 1 to Oct. 31

(h) Margaree River, Northeast Margaree River, Southwest Margaree River and tributaries, except the waters referred to in paragraphs (i) and (j).. June 8 to Oct. 15

(i) Margaree River upstream from the highway bridges at East Margaree to the Big Intervale bridges on the Northeast Margaree River and upstream to the Scotsville highway bridge on the Southwest Margaree River, not including tributaries ....June 8 to Oct. 31

(j) Northeast Margaree River and tributaries upstream from the Big Intervale Bridges...**Closed all year**

NOTES FOR SALMON FISHING AREA 18

- **THE DAILY CATCH AND RETAIN LIMIT IS TWO GRILSE (SALMON LESS THAN 63 CM IN LENGTH).**
- **THE DAILY CATCH AND RELEASE LIMIT IS ANY COMBINATION OF GRILSE OR SALMON TOTALING FOUR.**
- **THE YEARLY CATCH AND RETAIN LIMIT IS FOUR GRILSE (SALMON LESS THAN 63 CM IN LENGTH).**
- **WHEN FISHING FOR SALMON, ONLY BARBLESS OR PINCHED BARB ARTIFICIAL FLIES ARE PERMITTED FROM OCTOBER 1 TO OCTOBER 31, INCLUSIVE.**

2. (a) SALMON FISHING AREA 19 (Cape Breton East) and all waters of the Province flowing into that Area, except the waters referred to in paragraphs **(b)** to **(f)**...**Closed all year**

(b) Baddeck River.. (catch and release only) Oct. 1 to Oct. 31

(c) Middle River .... (catch and release only) Oct. 1 to Oct. 31

(d) North River downstream from the area known as “The Benches” as marked by a Fishery Officer .... (catch and release only) June 8 to Oct. 31

(e) North River upstream from the area known as “The Benches” ....**Closed all year**

(f) North Aspy River.. (catch and release only) June 8 to July 15 .... and Sept. 1 to Oct. 31

NOTES FOR SALMON FISHING AREA 19

- **THE ANGLING SEASONS IN ITEMS (b), (c), (d) and (f) ARE OPEN TO CATCH AND RELEASE FISHING ONLY ON THE ABOVE SPECIFIED DATES AND ARE SUBJECT TO IN-SEASON ADJUSTMENTS.**
- **THE DAILY CATCH AND RELEASE LIMIT IS ANY COMBINATION OF GRILSE OR SALMON TOTALING TWO.**
- **WHEN FISHING FOR SALMON, ONLY BARBLESS OR PINCHED BARB ARTIFICIAL FLIES ARE PERMITTED.**

3. **SALMON FISHING AREA 20 (Eastern Shore)** and all waters of the Province flowing into that Area...**Closed all year**

4. SALMON FISHING AREA 21 (Southwestern Nova Scotia) and all waters of the Province flowing into that Area ....**Closed all year**

5. SALMON FISHING AREA 22 (Upper Bay of Fundy) and all waters of the Province flowing into that Area ....**Closed all year**

REMINDERS

FOR 2012 ANGLERS ARE REMINDED THAT

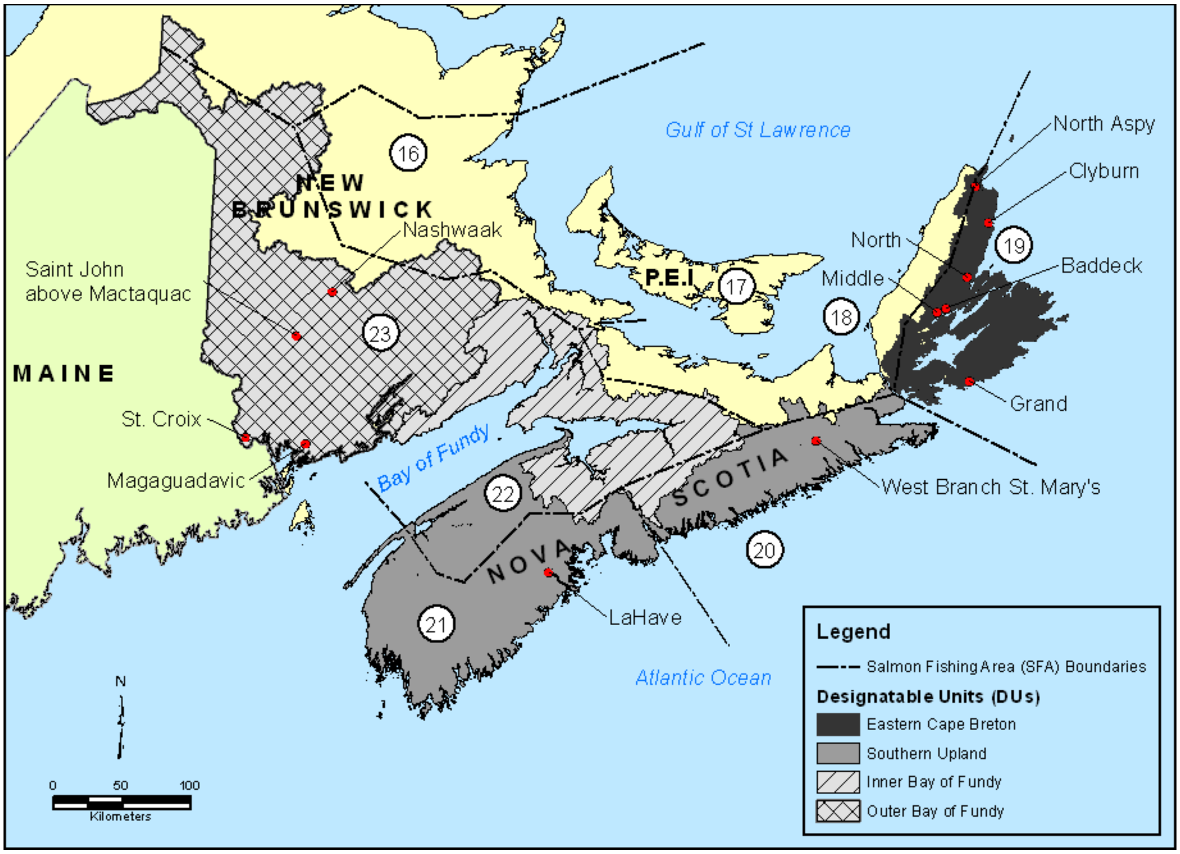
- **FOR THOSE RIVERS ON WHICH RETENTION IS PERMITTED, THE YEARLY BAG LIMIT FOR ATLANTIC SALMON IS (4) GRILSE THAT MEASURE LESS THAN 63 CM FROM THE TIP OF THE NOSE TO THE FORK OF THE TAIL.**
- **SALMON FISHING IS ONLY PERMITTED USING ARTIFICIAL FLIES AND, IN CERTAIN LOCATIONS AT CERTAIN TIMES, ONLY WITH BARBLESS OR PINCHED BARB HOOKS.**
- **ALL SALMON 63 CM OR LONGER MUST BE RETURNED TO THE WATER IN A MANNER THAT CAUSES THE LEAST POSSIBLE HARM TO THAT FISH.**

SEASONS AND BAG LIMITS MAY CHANGE AT ANY TIME FOR CONSERVATION REASONS AND SUBJECT TO ABORIGINAL HARVEST AGREEMENTS.

FOR FURTHER INFORMATION CONTACT THE LOCAL FISHERY OFFICER AND REFER TO MARITIMES REGION VARIATION ORDERS 2012-058, 2012-059 AND 2012-060.

FAITH SCATTOLON
REGIONAL DIRECTOR-GENERAL
MARITIMES REGION

Appendix 2. Map showing the locations of Atlantic salmon rivers, Salmon Fishing Areas (SFAs), and COSEWIC Designatable Units (DUs) mentioned in this Science Response. Note: SFA numbers are labeled insider the white circles.



Data Source: Designatable Units (DUs) derived from NS Secondary Watershed Layer (Nova Scotia Department of Environment) and NB Watershed Level 1 Layer (New Brunswick Department of Natural Resources).

Appendix 3. Estimated recreational catch in SFA 19 for 2012 (preliminary: February 15, 2013, database query), 2011, and the average catches for 2007-2011 time period. All salmon fisheries in SFA 20 to 23 were closed during this time period.

	2012 Preliminary				2011				5 Year Means (2007-2011)							
SFA 19: EASTERN	Small		Large	Effort	Small		Large	Effort	Small				Large		Mean Effort	
CAPE BRETON ISLAND	Retained	Released	Released	Rod days	Retained	Released	Released	Rod days	Retained	95% CI	Released	95% CI	Released	95% CI	Rod days	95% CI
ACONI BROOK									0	0	0	0	0	0	0	0
BADDECK	0	11	225	711	2	84	213	483	0.7	1.2	39.8	37.8	123.2	86.2	377.5	135.7
BARACHOIS*					0	3	0	13	0	0	2.6	5.4	0.8	1.8	12	17.2
CATALONE									0	0	0	0	0.6	1.9	3.5	11.2
CLYBURNE									0	0	0	0	0	0	0	0
FRAMBOISE (GIANT LAKE)									0	0	1	4.3	0.3	1.4	6.3	22.1
FRENCHVALE BROOK									0	0	0	0	0	0	0	0
GASPEREAUX: C. BRETON CO.*	0	0	4	7					0	0	0	0	0	0	0	0
GERRATT									0	0	0	0	0	0	0	0
GRAND									0	0	5.2	5.6	1.6	3.5	30.9	8.6
GRANT MIRE BROOK*					0	0	0	5	0	0	0	0	2	2.2	8	9.1
INDIAN BROOK*					0	0	2	13	0	0	1.2	3.8	0.4	1.4	9.3	12.8
INGONISH*					0	0	0	2	0	0	0	0	0	0	0.5	1.4
INHABITANTS									0	0	2.9	8.1	6.7	23.8	11.6	31.9
LITTLE LORRAINE									0	0	0	0	0	0	0	0
LORRAINE BROOK									0	0	0	0	0	0	0	0
MACASKILL'S BROOK									0	0	0	0	0	0	0	0
MARIE JOSEPH									0	0	0	0	0	0	1.3	3
MIDDLE: VICTORIA CO.	0	35	281	971	2	100	119	459	0.3	0.9	53.6	43.1	132.8	79.6	568	176.5
MIRA									0	0	0	0	0	0	0	0
NORTH ASPY	0	4	4	53	0	4	29	27	0	0	6.5	9.2	13.2	12.7	37.6	44.9
NORTH: VICTORIA CO.	0	25	99	468	0	74	175	559	0	0	100.6	44.3	190.4	74.6	581.5	85.7
NORTHWEST BROOK (RIVER RYAN)									0	0	0	0	0	0	0	0
RIVER BENNETT									0	0	0	0	0	0	0	0
RIVER DENY'S									0	0	0.5	2.1	0	0	1.5	6.4
RIVER TILLARD									0	0	0	0	0	0	0	0
SAINT ESPRIT									0	0	0	0	0	0	0	0
SALMON: CAPE BRETON CO.									0	0	0.5	2.1	0.5	2.1	9	20.8
SKYE									0	0	0	0	0	0	0	0
SYDNEY									0	0	0	0	0	0	0	0
SFA TOTALS	0	74	612	2210	3	266	538	1562	1	1.9	209.6	99.2	468.2	195.1	1627.4	279.2

Note: Blank rows under the 2012 (Preliminary) and 2011 headers, and those rivers marked with an asterisk (*) indicated that rivers were closed to fishing in those years.

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