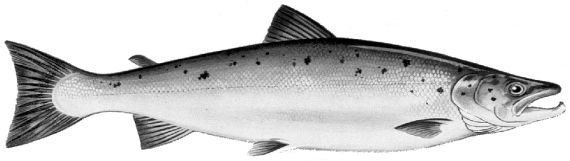
Fisheries and Oceans / Pêches et Océans

Gulf Fisheries Management and Maritimes Regions

DFO Science

Stock Status Report D3-14(2001) (revised)



Atlantic Salmon Maritime Provinces Overview for 2000

Background

Harvest regulations for Atlantic salmon (Salmo salar) are derived and applied on a river-specific basis within nine management areas known as Salmon Fishing Areas (SFA) in the Maritime provinces of eastern Canada. Within these three provinces, there are more than 150 rivers with reported Atlantic salmon populations characterized by differences in life history traits including freshwater residence time, age at maturity, and the extent of ocean migrations.

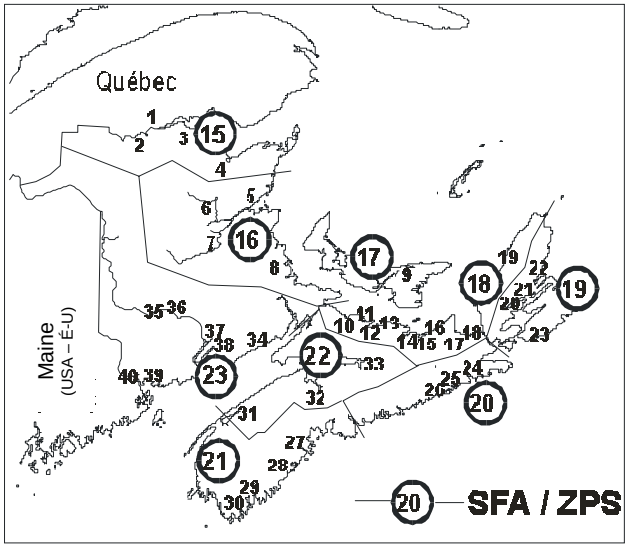
Spawning populations consist of varying proportions of small salmon (fork length <63 cm) and large salmon (fork length >= 63 cm). In the majority of rivers, small salmon (frequently referred to as grilse) are predominantly maiden fish (never spawned before) which have spent one year at sea before returning to spawn (one-sea-winter salmon, 1SW). The large salmon component (frequently referred to as salmon) contains a mixture of maiden fish which have spent two (2SW) or more years (MSW) before spawning and previous spawners which are returning for a second or subsequent spawning.

The term conservation for Atlantic salmon is a threshold reference point. The consequences of egg depositions below the reference point to the long-term sustainability of the stock are unknown but the likelihood of deleterious effects are greater when egg depositions are below the conservation requirements. The conservation requirements are established for individual rivers based on 2.4 eggs per m^2 of river habitat. In rivers impacted by airborne acid depositions, the conservation requirements are under review.

The status of the stocks is assessed on the basis of the proportion of the conservation egg deposition achieved in a given year and the trends in abundance of various life stages. In the absence of river-specific salmon escapement information and where quantitative electrofishing for juvenile salmon has been conducted, the status of stocks was assessed a "normal index of abundance" (Elson norm) of 29 fry per 100 m^2 and 38 older parr per 100 m^2. Fry refers to juvenile salmon less than one year old whereas parr refers to juveniles of age 1 year and older.

Previous summaries of stock status described a geographically defined pattern of returns of small salmon and large salmon in the Maritimes:

- *Bay of Fundy and Atlantic coast of Nova Scotia stocks are characterized by a strong decline in abundance,*
- *Trends in the southern Gulf of St. Lawrence rivers range from declining through stable through slight increased abundance.*



Index of Rivers

1&2 Restigouche System	13. River John	27. LaHave
1. Matapedia	14. West (Pictou)	28. Mersey
2. Restigouche (NB)	15. East (Pictou)	29. Jordan
3. Jacquet	16. Sutherlands	30. Clyde
4. Nepisiguit	17. West (Ant.)	31. Annapolis
5. Tabusintac	18. South	32. Gaspereau
6&7 Miramichi	19. Margaree	33. Stewiacke
6. NW Miramichi	20. Middle	34. Big Salmon
7. SW Miramichi	21. Baddeck	35. Mactaquac
8. Buctouche	22. North	36. Nashwaak
9. Morell	23. Grand	37. Kennebecasis
10. River Philip	24. St. Mary's	38. Hammond
11. Wallace	25. Liscomb	39. Magaguadavic
12. Waugh	26. East Sheet Hbr.	40. St. Croix

Summary

- Despite restrictive fisheries management measures on salmon in distant and home-water areas over an extended period, returns have fallen short of expectations. These low returns have been associated with low marine survival.

- **In Chaleur Bay (SFA 15)**, the Restigouche River (in New Brunswick) appears to have fallen short of the conservation requirement in 1999 and 2000 but spawning escapements have oscillated around the conservation level since 1986. Returns should be similar to the last five years, approximately at

Canada

conservation. Nepisiguit River returns have been around conservation in the last five years and will likely be again in 2001. Small salmon in SFA 15 rivers are predominantly male and their current harvest generally is not limiting stock conservation.

- **In SFA 16, the Miramichi River** and its Southwest branch failed to meet the conservation requirements in 2000 for the fourth consecutive year. The Northwest Miramichi did not meet conservation in 2000, for the third consecutive year. The outlook for 2001 is for a return of large salmon equal to 2000 with a 54% chance of meeting the conservation requirement in the Miramichi River overall, 39% for the Southwest Miramichi and 34% for the Northwest Miramichi River. The Tabusintac River was not assessed for adult returns in 2000 but juvenile abundance in 2000 was generally close to or above norms and similar to 1999. The Buctouche River is used as an index river for New Brunswick Northumberland Strait rivers. It did not achieve the conservation requirement in 2000 and is unlikely to do so in 2001.

- Because the majority of salmon returning to the Morell (86% in 2000) and to other PEI rivers **(SFA 17)** are of hatchery origin, current fisheries have little impact on future runs. Wild salmon production on PEI is limited by sedimentation and pesticide kills and substantial self-sustaining salmon runs cannot be re-established until these impacts are severely reduced. It is recommended that protection for wild-reared salmon be provided.

- In **Northumberland Strait**, mainland Nova Scotia rivers **(part of SFA 18)**, conservation requirements were probably not met in 2000. Recent average returns indicate the number of spawners should meet requirements in 2001. Egg depositions in these rivers are expected to come from large salmon.

- **On Cape Breton Island (part of SFA 18 and SFA 19)**, the Margaree and probably other west coast Cape Breton rivers (SFA 18) again met conservation requirements but at reduced levels from previous years. Large salmon returning to the Margaree have been declining since 1997 but are expected to be adequate to meet egg conservation requirements in 2001. No assessed rivers in SFA 19 (eastern Cape Breton) were likely to have met adult conservation requirements in 2000. With the exception of the North River, conservation requirements are unlikely to be met in 2001. Current levels of exploitation and allocation should be reviewed.

- Salmon returns to rivers along **the Atlantic Coast of mainland Nova Scotia (SFAs 20 and 21)** were insufficient to meet conservation requirements in 2000. Rivers are generally of low productivity and are negatively impacted by acid precipitation. Small salmon contribute about half of the egg depositions in these rivers. Returns in 2001 are not expected to be sufficient to meet requirements for any of the rivers, including those receiving hatchery stocking. A comprehensive review of appropriate management actions for rivers in these SFAs is required.

- **Inner Bay of Fundy (SFA 22 and part of SFA 23)** salmon stocks are critically low, should not be harvested, and are undergoing actions to prevent their extirpation.

- Most **Outer Bay of Fundy (western part of SFA 23)** assessed stocks did not meet conservation requirements in 2000 and probabilities of most stocks achieving requirements in 2001 are virtually zero. Egg depositions for the Saint John River stock upriver of Mactaquac declined to 11% of the conservation requirement, the lowest level of record. The Nashwaak River stock achieved only 15% of its requirement. The Kennebecasis River stock is unlikely to have met conservation requirement. The status of the Hammond River stock with respect to conservation is uncertain but juvenile levels are higher than in the neighboring Nashwaak and Kennebecasis rivers. Stocks of outer Bay of Fundy rivers west of the Saint John River system (e.g., Magaguadavic River) have declined markedly in the last decade and action is required to prevent their extirpation.

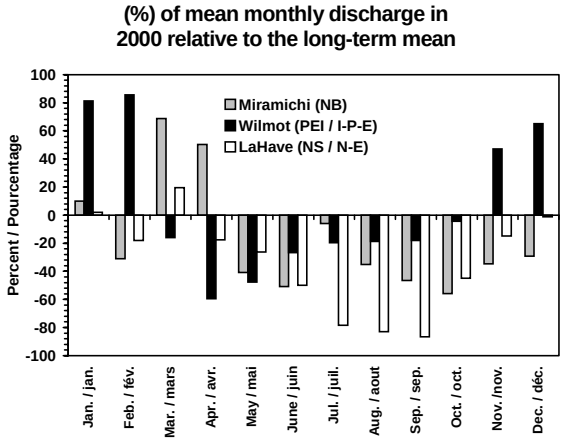
Environmental Conditions

Streamflows

Freshwater conditions can affect Atlantic salmon at different life stages and also during different seasons of the year.

Conditions in the Maritime Provinces in 2000 were characterized by higher than normal winter precipitation and streamflow, especially in January. Peak flows for many rivers occurred in January to early April this year, which is early. Peaks flows were also observed late in the year (December) in Nova Scotia. The daily peak runoff in 2000 was characterized as mild in most rivers with peak flows close to or less than the 2-year flood. Wilmot River (PEI) experienced its highest spring peak flows with a recurrence interval exceeding the 5-year flood.

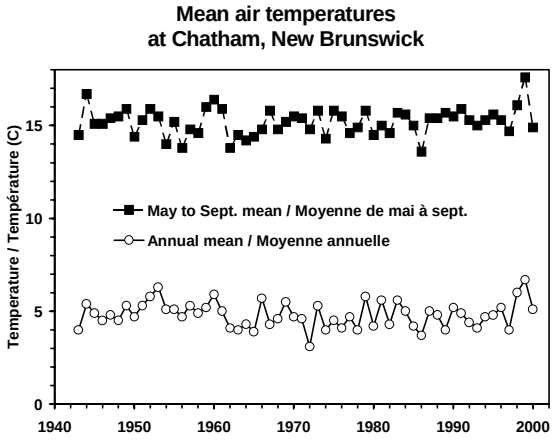
Lower than normal precipitation in May and June coupled with earlier spring peaks resulted in low monthly flow conditions earlier than normal in 2000. By April, streamflow conditions became lower than normal in PEI with Wilmot River (PEI) experiencing its lowest April monthly flow on record. By May and June, many rivers were showing lower than normal flow conditions. Normal precipitation levels in July and August resulted in normal water condition in most rivers during these months. In September, all rivers in the Maritime Provinces showed below normal water condition, and this low flow condition persisted in October in NB. In late autumn, normal flow conditions were observed in most rivers, except for Wilmot River (PEI) and St. Marys River (NS), which showed above normal flows. A record high monthly precipitation (351 mm) was recorded in Cape Breton in November 2000.



Despite lower monthly flows in September and October, daily low flows were not severe in the Maritime Provinces in 2000 where discharges were generally close to the 2-year low flow. Lower flows were observed in NB than in PEI and NS, with the exception of LaHave River which showed flows similar to those in NB.

Air and river temperatures

Data on air temperature were analysed for 6 stations across the Maritime Provinces. Mean annual and mean summer air temperatures in 2000 were near average compared to 1999 when both were the highest of the time series, dating back to the 1940s for most stations.



These normal air temperatures in 2000 resulted in normal water temperatures for many rivers. Maximum recorded water temperatures in summer of 2000 were close to 26°C. These temperatures are lower that those observed at 29-30 °C in 1999. As an indicator of water temperature stress on fish, the number of days on which temperatures exceeded 23 °C was counted as in previous years. Rivers exceeded 23 °C from approximately 11 to 25 days in 2000 depending on the location.

Number of days when maximum water temperature exceeded 23ºC

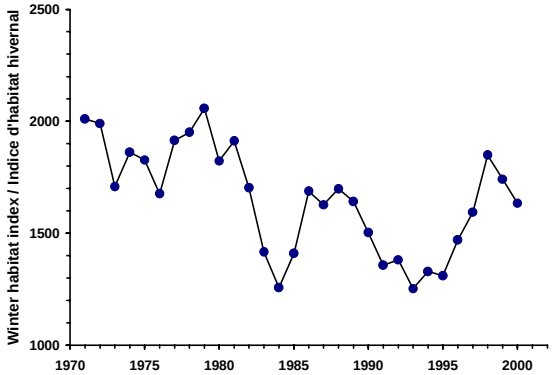
Year	Nashwaak River	Little Southwest Miramichi	Southwest Miramichi estuary
1995	55		
1996	6	10	
1997	24	14	
1998	30	15	21
1999	67	62	59
2000	25	19	11

Marine Environment

Atlantic salmon generally inhabit the near-surface water and thus, surface or near-surface temperatures are suspected of being important in determining their survival rate.

Environmental conditions and sea surface temperatures during 2000 were generally warmer-than-normal. This continues the warming trend of the past several years. Based upon previous studies, such conditions are usually conducive to improved marine survival of salmon during their second winter at sea. During 1999 and 2000, these warm conditions have been in spite of a high North Atlantic Oscillation (NAO) index (a measure of the strength of the large-scale atmospheric circulation and defined by the winter sea surface pressure at the Azores minus that at Iceland). In the Labrador Sea area, a high NAO index usually is accompanied by increased northwest winds, colder-than-normal winter air temperatures, earlier and more extensive ice along the Labrador and Newfoundland shelves, colder ocean temperatures and increased deep convection in the Labrador Sea.

The January-March habitat index, defined by the area within 4-8 °C, at the southern extent of the Labrador Sea reached its lowest value on record in 1993 and remained low until 1995. It then rose rapidly, reaching above normal values by 1998.



Although the index declined in 1999, it remained above normal. In 2000, it again declined, this time to near normal values. It explains less variability than previously in the forecast numbers of salmon returning to Atlantic Canadian rivers, i.e., the high index had been associated with better than average recruitment.

The southern extent of winter ice cover off the Newfoundland and Labrador coasts is strongly related to winter air temperatures and winds, and is believed to influence the return timing of salmon for some stocks. Increased air temperatures and reduced sea ice coverage are suspected of advancing the timing of smolt runs and affecting the ecology of coastal waters.

The areal coverage of sea-ice off southern Labrador and northern Newfoundland was less-than-normal in 2000 but slightly greater than in 1999. The light ice year was primarily due to an early retreat of ice in the spring. Over the Newfoundland Shelf, the first appearance of ice was slightly later-than-normal. Ice-cover in the Gulf of St. Lawrence in 2000 was less-than-usual and again principally a result of an earlier-than-usual break up in the spring, by upwards of 2 weeks in the central Gulf and 5 weeks in the northeast. For the third year in succession, very little ice was transported onto the Scotian Shelf from the Gulf, and indeed the ice coverage seaward of Cabot Strait was the fourth lowest in the 38-yr record. The small amount of ice on the Scotian Shelf in recent years is in contrast to the general trend of increasing sea-ice coverage from 1963 to 1990.

Satellite-derived near surface temperature from the Labrador Sea to the Gulf of Maine, including the Gulf of St. Lawrence, were above normal in most months of 2000, but were not quite as warm as in 1999. However, the satellite-derived temperatures in 1999 were some of the highest on record (which began in 1981), especially for the region from the Grand Banks to the Gulf of Maine. These high ocean temperature anomalies were consistent with the high air temperatures over the region. All time historic high air temperature records were established from southern Labrador to the Gulf of Maine in 1999 and although they declined in 2000, they still remained well above normal.

The near-surface temperatures at Station 27, located approximately 10 km off St. Johns' Newfoundland, were warmer-than-normal in all months except July in 2000. (Station 27 is generally considered to be representative of temperatures over the shelf from southern Labrador to the Grand Banks). This continues the general warm conditions that have persisted in this region and throughout the Newfoundland Shelf since 1995.

Coastal surface temperature anomalies for the Gulf of Maine (Booth Bay, Maine) and the Scotian Shelf (Halifax Harbour) may be indicative of conditions affecting smolts and post-smolts originating in rivers of the Gulf of Maine/Bay of Fundy and along the Atlantic Coast of Nova Scotia, respectively. Temperature records began in 1908 at Boothbay and 1925 at Halifax. The available data for 2000 indicate a continuation of the warm conditions in 1999.

Data from the northeastern Scotian Shelf and off southwestern Nova Scotia indicate that the subsurface temperatures of these waters are above normal. This contrasts with the period from the mid-1980s to the late 1990s when conditions were colder-than-normal. In the central Shelf and in the deep basins of the Gulf of Maine, lower layer temperatures (depth >100 m) in 1998 dropped sharply as cold Labrador type Slope water was

transported onto the shelf from offshore. By 1999, however, these deep temperatures returned to above normal as the Labrador Slope Water was replaced by Warm Slope Water and continued warm during 2000.

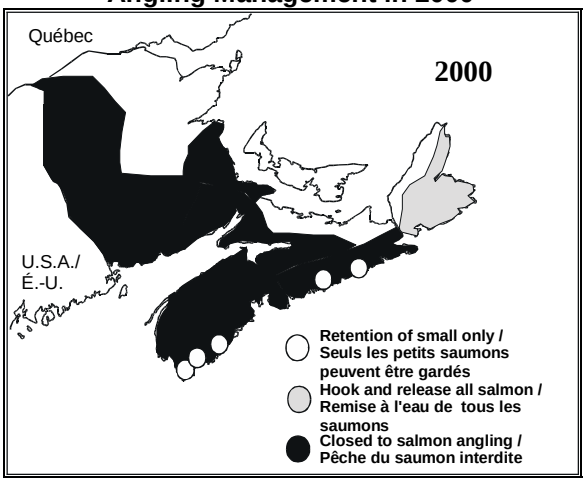
In summary, conditions in 2000 indicate the general continuance of warm ocean temperatures both at surface and subsurface layers in the areas frequented by Atlantic salmon.

The Fishery

Atlantic salmon were harvested by two user groups in 2000: Aboriginal peoples and recreational fishers. Aboriginal peoples were given first access to salmon (after conservation requirements) based on communal needs for food, social and ceremonial purposes. Aboriginal fisheries in 2000 occurred exclusively in the southern Gulf of St. Lawrence rivers generally in accordance with agreements and communal fishing licenses. Some Aboriginal communities in Nova Scotia chose not to exercise their right to the communal allocations because of conservation considerations.

The persistent failure of stocks in some areas of the Maritimes to achieve conservation requirements resulted in the progressive closures of Atlantic salmon in-river fisheries. Salmon fishery closures began in 1990 in the inner Bay of Fundy rivers. By 1998, the most restrictive measures to date were enacted. Retention angling fisheries for small salmon during 1998 to 2000 were allowed only in most of the southern Gulf of St. Lawrence, and in four acid-toxic rivers of the Atlantic coast. These measures were generally carried forward into 2000 with the addition of a fishery permitted in Liscomb River (SFA 20).

Angling Management in 2000



In the Miramichi River (SFA 16) and the Nepisiguit River (SFA 15), the daily small salmon retention limit was one fish. In all other areas of New Brunswick, daily retention limit of small salmon was two fish. The maximum daily catch-and-release limit was four fish of any size. Season bag limits of 8 in New Brunswick and Nova Scotia and 7 in PEI, remained unchanged from previous years in those areas with angling fisheries.

Other management measures in effect in 2000, which potentially affected the salmon stocks from the Maritime provinces, include: the ninth year of the commercial salmon moratorium for insular Newfoundland, the third year of closure of the entire Labrador commercial fishery, and the first year of the complete closure of the commercial fishery along the Québec north shore (Zone Q9).

A subsistence fishery (19 t) at west Greenland between August 18 and October 14 1999 intercepted an estimated 5,700 salmon destined to return as large salmon to North America in 2000.

Relative to recent years, there were increases in small salmon but decreases in

large salmon reported harvests in 2000 in the aboriginal fisheries of Gulf New Brunswick. In Gulf of St. Lawrence Nova Scotia, aboriginal harvests in 2000 were low but higher for small salmon and lower for large salmon than in 1999 (Table 1).

Removals (kept plus mortalities from hook and release angling) of small and large salmon in the recreational fisheries of the Restigouche River were up 16% and down 5%, respectively, from the previous five years (Table 1). For the Miramichi River, the catches from the crown reserve waters of small salmon were up 11% whereas catches of large salmon were down 11% from the previous five-year mean. Removals of small salmon in Gulf of St. Lawrence Nova Scotia rivers in 2000 were generally the lowest of the last five years.

Resource Description

Information in this document represents either an update or a fully reviewed assessment of 40 rivers for 2000 (Table 2). The previous assessment or update for these stocks was made available in 2000. (DFO 2000a). In an update, there are no important changes in methods or data inputs and the current year values are added to the previous year's document. The updates are tabled at a review meeting. For a fully reviewed assessment, the methods, data inputs and interpretations were presented and discussed at a peer review meeting and the summary in this document is the consensus view of the meeting.

The status of the resource is determined from the annual returns and spawning escapements relative to the conservation requirements, the abundance of juveniles and smolts, corresponding trends in the juvenile stages, measures of sea survival, and the extent of habitat constraints on production (Table 2). The returns represent the size of the population returning to the river before any in-river removals. Spawning escapement is determined by subtracting all the known removals (including food fisheries, recreational harvests, broodstock collections, and scientific samples) from the total returns. Uncertainties in estimates are characterized by 90% confidence intervals and when available are shown in brackets as a range after the point estimate.

Estimates of returns are based on various techniques ranging from entire counts (such as fishways) to indices of abundance based on catch rates. In the absence of river-specific salmon escapement information and where quantitative electrofishing for juvenile salmon has been conducted, the status of stocks was assessed relative to P.F. Elson's "normal index of abundance" (Elson norm) for Maritime streams of 29 fry per 100 m^2 and 38 older parr per 100 m^2. Fry refers to juvenile salmon less than one year old (i.e. young-of-the-year, 0+parr) whereas parr refers to juveniles of age 1 year and older.

Chaleur Bay (SFA 15)

Updates are provided for three SFA 15 rivers in northern New Brunswick: Restigouche, Jacquet and Nepisiguit rivers. The Restigouche River has the second most abundant run of large salmon in eastern Canada.

The Restigouche River is assessed as two components. The Matapédia River (PQ) empties into the Restigouche River just above the head-of-tide and is managed by the province of Québec. Most of the remaining watershed, referred to as Restigouche (NB) is in New Brunswick or borders the two provinces. The conservation requirement for

the Matapédia River was revised downward to 7.64 million eggs (equivalent to 1,139 large salmon) by the province of Québec in 1999. The revised value stems from a stock and recruitment analysis of six rivers in Québec and a revised measure of habitat. The previously used value, 11.44 million eggs, was based on standard habitat measurements and an egg requirement of 1.68 eggs per m^2. For the Restigouche (NB) portion, the conservation requirement is based on the default 2.4 egg per m^2 and equates to a requirement of 55 million eggs.

Resource Status

Returns to the **Matapédia River** are determined from visual spawner counts in early October. The returns in 2000 were estimated at 2,583 large salmon and 1,586 small salmon; similar to 1999 but below the returns of large salmon in 1996 and 1995. The end-of-year escapements to the Matapédia River were estimated at 1,893 large salmon and 733 small salmon. Spawning escapement in 2000 exceeded the conservation requirement for the seventh consecutive year.

Matapédia River

	Small salmon		Large salmon	
	Returns	Spawners	Returns	Spawners
1994	1206	384	2293	1341
1995	1006	689	3319	2460
1996	2012	1291	3749	2807
1997	1201	751	2682	1993
1998	1473	823	2084	1643
1999	1600	890	2591	1983
2000	1586	733	2583	1893

Escapement to the **Restigouche (NB)** was estimated from visual spawner counts of adult salmon in early October in the four main tributaries and the main stem. This is the first year a complete survey of the river was conducted. Additionally, the catch rates in the angling fishery during 1971 to 1999 were estimated from a model relating fry abundance as estimated from electrofishing surveys to escapement of large salmon which would have likely produced the observed fry levels. The average catch rate of 1995 to 1999 was applied to the 2000 catches of large salmon to estimate returns. The estimation of spawners and catch rates from the model were constrained by assuming that at a minimum, 500 large salmon spawners were present annually in the Restigouche (NB) waters over the time series and additionally that the visual estimates of salmon between 1985 and 1999 were also a minimum. Small salmon returns were estimated from an adjusted catch rate which historically has been about 1.68 times that of large salmon.

Visual counts in October provided minimum escapement estimates of 5,700 large salmon and about 4,600 small salmon in 2000. Escapement estimates from the catch rate model were 8,500 large salmon. Removals of less than 250 large salmon in 2000 are encompassed by the uncertainty in the escapement estimates from the catch rate model. Small salmon returns would have been 11,000 fish, considering the harvest of 2,300 small salmon in the river fisheries.

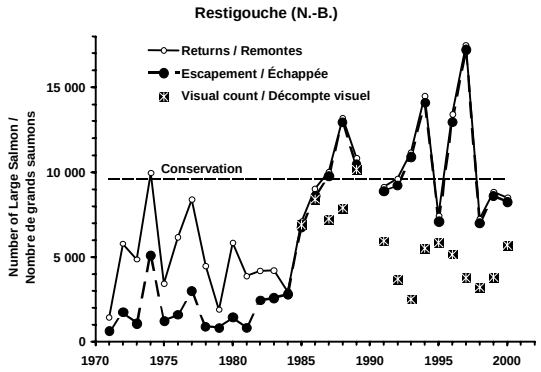
Restigouche (NB) Escapement

	Small salmon		Large salmon		
	Visual	by CR[1]	Visual	by CR[1]	CR[1]
1994	8100	10800	5500	14200	0.21
1995	3300	3100	5800	7000	0.26
1996	5000	5000	5100	13000	0.22
1997	4100	13000	3800	17500	0.10
1998	5700	8600	3200	7000	0.16
1999	4900	7000	3900	8600	0.15
2000	4600	9000	5700	8500	0.18[2]

[1] CR means catch rate as modelled from fry abundance
[2] mean of 1995-99

Catch rates in the Restigouche (NB) portion of the river have declined to less than 0.20 in recent years. The estimated catch rate in 1997, based on fry abundance in 1998, was among the lowest of record at 0.10. The catch rate in 2000 is expected to be higher than in 1999 based on better angling conditions as indicated by the user groups. Angling

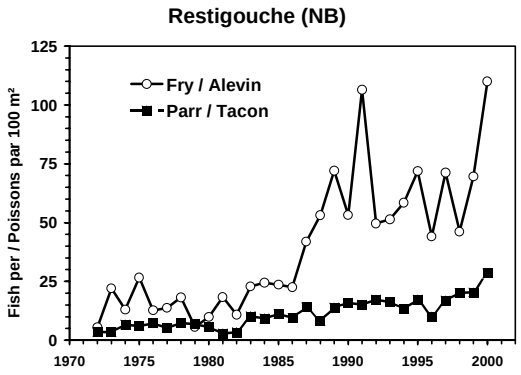
conditions in July were exceptionally good compared to historical conditions for the same month.



Conservation requirements for the Restigouche (NB) of 55 million eggs are based on 2.4 eggs per m^2 and would on average be obtained from 9,600 large salmon. The estimated escapement of 8,500 spawners in 2000 represents greater than 85% of the requirement. Point estimates of the escapements since 1984 indicate conservation requirements were met in 7 of the last 16 years. Visual estimates of escapement are considered to be minimum, have been lower than those from other methods, and are not correlated with the observed juvenile densities in subsequent years.

Use of either the historical and/or the updated Matapédia egg deposition requirements for the Restigouche (NB) would indicate that the conservation requirement was met or exceeded every year since 1986.

Densities of fry and parr (age 1 and older) from index sites sampled annually since 1972 remain at greatly improved levels relative to the 1970s and early 1980s. Densities of fry and parr in 2000 were the highest of the time series. Annual variations in densities represent variations in egg depositions, survival rates, and water conditions at time of sampling.



Densities of juvenile salmon in the Matapédia River in 1998 to 2000 are as high as those observed in the tributaries of Restigouche (NB).

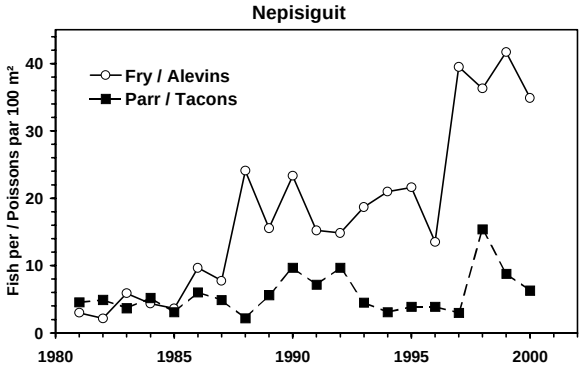
Counts of returning salmon to the **Jacquet River** barrier in 2000 are incomplete because of fence washouts on October 19th (for one day) and 29th (which ended counting for the year). Counts to the latter date were 209 small salmon and 252 large salmon, which represents about 45% of the conservation requirement. An estimate of returns for 1999 is unavailable due to a major fence washout and a fence washout in October 1998 may also have resulted in an underestimation of the returns in that year. Conservation requirements of 3.8 million eggs would be obtained from 571 large salmon. Conservation requirements were achieved in 1994 and 1995 but not in the subsequent three years.

Jacquet River

	Salmon returns		Egg depositions	
Year	Small	Large	% of conservation	% by large
1994	613	595	109	95
1995	344	589	106	98
1996	634	359	67	92
1997	372	384	70	96
1998[1]	402	298	55	95
1999[2]	-	-	-	-
2000[1]	209	252	45	97

[1] Partial count due to washout
[2] Unavailable due to washout

The conservation requirement for the **Nepisiguit River** of 9.5 million eggs could be attained from 1,600 large salmon. The escapement and returns of large salmon to the Nepisiguit River are based on redd counts conducted in late October (by the Nepisiguit Salmon Association). A general conversion rate of 2.5 redds per large female salmon derived from the years when complete counts of salmon were obtained at a counting fence was used to estimate escapement. Large salmon were assumed to average 71% female. The 3,200 redds observed in 2000 were estimated to have resulted from an escapement of 1,800 large salmon. Adjustments to account for water levels and visibility in 2000 and for the portions of the habitat not surveyed suggest that spawning escapement in 2000 probably approached 2,200 large salmon. Since 1994, egg depositions, as estimated from redd counts, have been around the conservation requirement. Juvenile abundance has increased during the 1990s and supports the interpretation of improved spawning escapements in recent years.



There is an enhancement program on the Nepisiguit River. In 2000, one small and 107 large salmon were removed for broodstock purposes. The contribution of hatchery-stocked fish is difficult to determine since all the fish are stocked at early, unmarked stages.

Outlook

For the **Matapédia River**, returns of small and large salmon have approximated or exceeded 4,000 fish annually since 1995. There is no reason to expect the total returns and the egg depositions to be less than the conservation requirements for the river in 2001.

The relatively high juvenile abundance levels observed for **Restigouche (NB)** since 1990 suggest that returns will be similar to those of the last five years, at about conservation level.

Incomplete counts for the last three years on the **Jacquet River** preclude any outlook statement for this river.

No changes in returns from the previous five years are expected for the **Nepisiguit River**.

Management Considerations

Large salmon returning to the **Restigouche River (NB)** in 1999 and 2000 were estimated to have fallen short of the conservation requirement. The in-river fisheries losses of large salmon in Restigouche (NB) are not significant, primarily catch and release associated mortality and represent less than 5% of the eggs in the returns.

Management approaches on the **Matapédia River** in recent years have provided escapement levels at or above the conservation requirement.

The impact of the aboriginal fisheries prosecuted in the estuary remains unknown because the reported harvests are incomplete. The assessments of the Restigouche (NB) and Matapédia River stocks are after the estuary fisheries and since 1985, the spawning escapement to the Restigouche (NB) and

Matapédia River have varied close to or above the conservation requirement.

Small salmon returning to SFA 15 rivers are predominantly male and contribute minimally to egg depositions. Harvests of small salmon in recent years have not jeopardized achievement of a 1:1 male to female sex ratio.

Miramichi and Southeast Gulf New Brunswick (SFA 16)

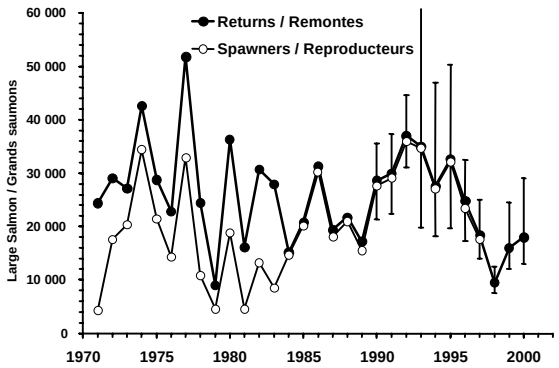
The last assessment of rivers in SFA 16 was for 1999 (DFO 2000a). The information for the Buctouche and other Northumberland Strait New Brunswick rivers and the Tabusintac River is updated for 2000. The information for the Miramichi River is based on a full assessment for 2000.

SFA 16 includes the Miramichi River, the largest salmon producing river of eastern Canada, and numerous small coastal rivers along the Northumberland Strait shore of New Brunswick. The Northwest and Southwest branches of the Miramichi River are assessed separately. The Buctouche River is used as an index river for New Brunswick Northumberland Strait rivers. Juvenile abundance was monitored on the Tabusintac River and five other rivers of Northumberland Strait New Brunswick.

Resource Status

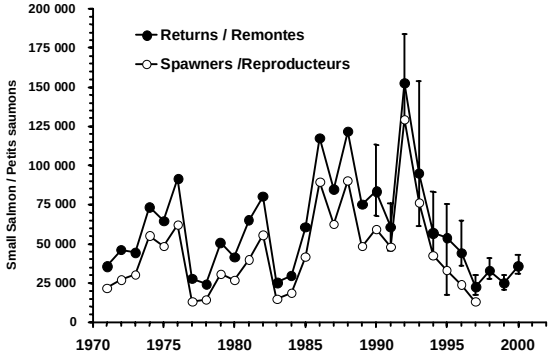
The estimated return of 18,200 large salmon (13,300 - 29,300) to the **Miramichi River** in 2000 was 25% below the previous five-year average. About 13,100 large salmon (7,400 – 31,000) returned to the **Southwest Miramichi** and 4,700 large salmon (0 - 9,400) returned to the **Northwest Miramichi**, which is up slightly from 1999 for the Southwest Miramichi and similar to 1999 for the Northwest Miramichi. The continued low abundance of large salmon in 2000, relative to the previous decade was consistent with the continued low returns of small salmon in 1997 to 1999. The low abundance of large salmon in 1998 to 2000 was primarily the result of a lower than historical proportion of fish returning in the late run (after Sept. 1).

Miramichi



Small salmon returns in 2000 were 35,600 fish (31,000 - 42,100), up 39% from 1999 but down 28% from the previous five-year average. A total of 22,600 small salmon (17,200 - 28,900) returned to the Southwest Miramichi and 12,900 small salmon (10,600 - 15,500) returned to the Northwest Miramichi.

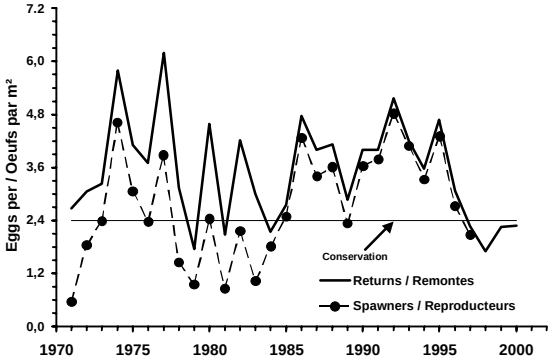
Miramichi



Conservation requirement for the Miramichi River of 132 million eggs would be contributed on average by 23,600 large salmon. Removal data for 1998 to 2000 are incomplete. In 2000, egg depositions by all

salmon returning to the Miramichi River (before any removals) would have equaled 95% of the conservation requirement (41% chance of having met requirement). Egg depositions by large salmon alone would have equaled 76% of requirement. Egg depositions after accounting for removals would be less than these values.

Miramichi



In the Southwest Miramichi, eggs in the returns would have equaled 97% (47% chance of having met requirement) of the conservation requirement of 88 million eggs. In the Northwest Miramichi, eggs in the returns would have been 87% (36% chance of having met requirement) of the 41 million egg conservation requirement. Egg depositions after accounting for removals would be less than these values.

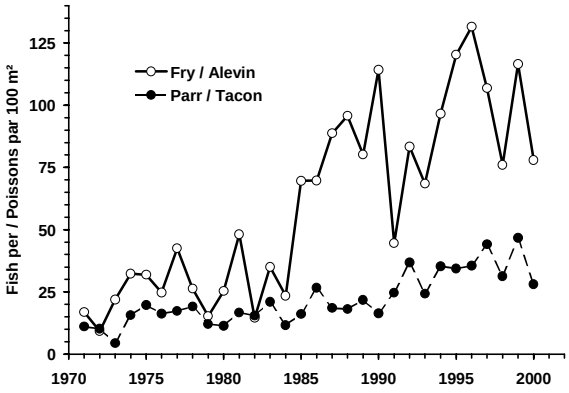
Percent of conservation requirement (eggs) achieved in returns (Ret.) and escapement (Esc.)

	Northwest		Southwest	
Year	Ret.	Esc.	Ret.	Esc.
1992	141	120	247	238
1993	184	177	154	149
1994	216	200	115	108
1995	288	269	152	139
1996	151	134	124	114
1997	121	105	82	78
1998	58		67	
1999	98		88	
2000	87		97	

Small salmon could potentially have contributed 30% of the total eggs in the Northwest Miramichi and 16% of the total in the Southwest Miramichi. Egg depositions in 2000, even before accounting for removals, were among the lowest since 1984.

Juvenile densities of fry and parr (age 1 and older) in the Miramichi River remain at higher levels than those of the 1970s and early 1980s. Annual variations in densities represent variations in egg depositions, survival rates, and water conditions at the time of sampling.

Miramichi



Smolt production from the Northwest Miramichi in 1999 was estimated to have been almost three times higher than in 2000. The survival of 1999 smolts to 1SW salmon in 2000 was 3%.

	Smolts		Survival (%)	
Year	Est.	per 100 m²	to 1SW[1]	to 2SW
1999	420,000	2.5	3.0%	-
2000	155,000	0.9		

[1] Value is preliminary

In the **Buctouche** River, returns of large salmon ranged from 95 to 244 fish between 1993 and 2000 with the current year the second lowest. Small salmon returns have generally been about 100 fish annually with the 2000 returns the lowest recorded. The

proportion 2SW salmon in the large salmon returns was 69%.

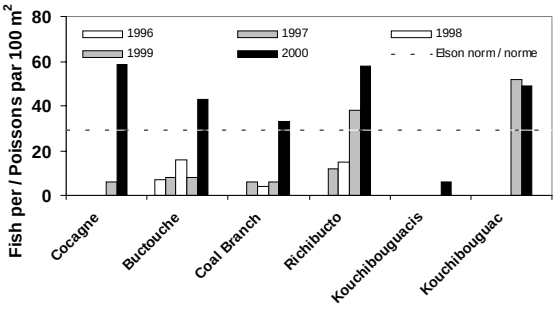
Buctouche River				
	Returns		Escapement	
Year	Small	Large	Small	Large
1993	95	78	94	21
1994	225	77	212	59
1995	154	98	147	67
1996	134	127	124	78
1997	200	97	191	67
1998	102	92	101	91
1999	244	115	244	111
2000	100	38	100	28

Egg deposition from large and small salmon in the **Buctouche** River in 2000 was estimated at only 36% of the conservation requirement, the third lowest in eight assessed years.

Egg deposition (%) relative to conservation requirement		
Year	Returns	Escapement
1993	38	35
1994	77	72
1995	61	58
1996	49	46
1997	74	70
1998	33	33
1999	103	102
2000	37	36

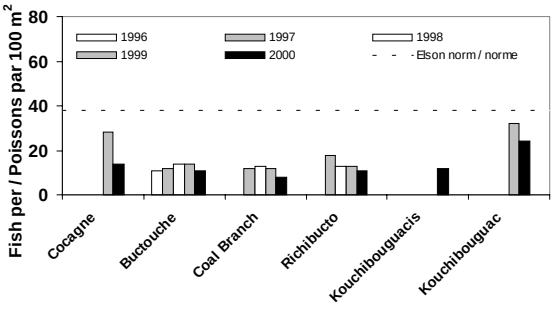
In 2000, fry densities in the Buctouche and four other southeastern New Brunswick rivers (Cocagne, Richibucto, Coal Branch, and Kouchibouguac) exceeded the Elson norm, confirming the 1999 estimate of high adult returns to the Buctouche and indicating substantial spawning escapement for most rivers in the southeast. The exception was the Kouchibouguacis River where fry densities were low.

Fry / Alevins



Mean parr densities in 2000 were below the Elson norm in all rivers sampled. Quality spawning and rearing habitat on the Buctouche River appears to be limited. Juveniles are generally found throughout the river with the highest concentrations in the South Branch however abundance is normally below Elson norms. Egg-to-fry survival is generally low suggesting there may be a habitat constraint at that life stage. Age-0+ to age-1+ parr survival, as inferred from stocking of fall fingerlings, does not appear to be a constraint.

Parr / Tacons



Juvenile surveys conducted on the small rivers of southeast New Brunswick indicate that adult returns are highly variable annually, and that relative abundance may not be synchronous among rivers. In most years the conservation requirement as presently defined was probably not met. However, as currently seen in the Buctouche, in years of high egg depositions these rivers will respond by producing more juveniles.

Average fry densities (99 fry per 100 m²) in the **Tabusintac** River in 2000 were improved from levels measured in 1999 and above the Elson norm. The average parr density (27 parr per 100 m²) measured at 24 sites in 2000 was 10% below 1999 average and below the Elson norm. Spawning in 1998 and 1999 in the Tabusintac River, as inferred from fry densities, had occurred throughout the watershed.

Outlook

For the **Miramichi River**, the sustained high juvenile abundance levels observed since 1990 suggest that returns should be similar to those of the last five years. The ratios of small salmon to large salmon the following year suggest a return of large salmon in 2001 similar to that of 2000. Based on the range of ratios observed in the last five years, large salmon returns in 2001 are expected to be between 14,700 and 25,200.

With the expectation of small salmon based on the previous five-year average return (32,000 fish: 22,600 - 44,400), there is a 54% chance that eggs from the returns of small and large salmon combined will meet or exceed the egg requirement. The expected contribution by small salmon to the eggs in the returns is 17% (9% - 26%).

For the **Southwest Miramichi**, the return of large salmon in 2001 is expected to be between 8,200 and 20,600 fish. The average small salmon return in the previous five years has been 21,000 fish (13,500 – 30,200). Eggs in the returns of small and large salmon have a 39% probability of meeting or exceeding conservation requirement. Small salmon may account for 14% (5% to 25%) of the eggs in the total returns.

For the **Northwest Miramichi**, the return of large salmon in 2001 is expected to be between 2,900 and 7,700 fish. The average small salmon return in the previous five years has been 12,100 fish (7,900 - 18,900 fish). There is a 31% chance that eggs in the returns of small and large salmon will meet or exceed the conservation requirement. Small salmon may account for 27% (10% to 46%) of the eggs in the total returns.

The conservation requirement for the **Buctouche River** was not met in 2000. Based on the average returns of the past five years there is a 4% chance of meeting the egg conservation requirement in 2001.

For the **Tabusintac River**, the conservation requirement has been exceeded for the five years the stock was assessed between 1993 and 1999. Juvenile levels are close to or above the Elson norm. The expectation is for this stock to continue meeting or exceeding the conservation requirement.

Management Considerations

In the absence of fisheries-related mortality on salmon in the **Miramichi** River in 2001, there is a 54% chance that the eggs in the returns of small and large salmon will meet the requirement. In 1998 to 2000, the late run of large salmon was smaller compared to previous years. Considering the uncertainties in the expected small and large salmon returns in 2001, a precautionary approach to fisheries management is recommended.

The early-run small salmon have a higher female proportion (>25%) than late-run fish (10%). In years of low large salmon abundance, the harvest of early-run small salmon has a greater impact on achieving conservation requirements than fisheries removing fall-run fish.

The aboriginal fisheries in 2000 removed small and large salmon bearing about 4% of

the eggs in the total returns to the Miramichi. On average, between 1992 and 1997, the aboriginal fisheries removals were 1.7% of the total eggs in the annual returns whereas recreational fisheries removed 5% of the total eggs in the returns.

In the **Tabusintac River**, the escapement of salmon exceeded the conservation requirement in every year assessed. Present fisheries exploitation levels are similar to those in the years assessed and are not a conservation concern.

The **Buctouche River** is used as an index river for New Brunswick Northumberland Strait rivers. The conservation requirement was not met in 2000 and is unlikely to be met in 2001. Small salmon have contributed an average of 2% (0-6%) of total egg deposition from all salmon. Based on parallel changes in juvenile abundance in the Buctouche and four of the five Northumberland Strait NB rivers surveyed in 2000, the Buctouche River appears to be a valid index and provides a basis for the management of this group of rivers.

Prince Edward Island (SFA 17)

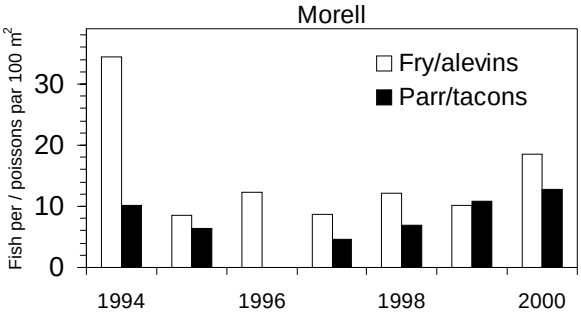
The last assessment of rivers in SFA 17 was for 1999 (DFO 2000a). The assessment is updated for 2000.

Most original runs of Atlantic salmon in Prince Edward Island were eliminated due to over-exploitation, barriers to migration, and habitat degradation. Salmon are stocked in up to six of PEI's larger rivers by release of smolts that have been raised semi-naturally in open impoundments. This program has been most successful in the **Morell River**, which has accounted for more than half of the province's salmon angling catch in recent years. Angling catches of PEI salmon have been declining since 1996, and estimated catches in 2000 were 26% of the 1995-1999 mean. A small amount of natural production occurs in the **Morell** and other stocked rivers. Small runs of late-returning salmon persist in several unstocked rivers.

Resource Status

Egg deposition in the **Morell River** cannot be estimated because the Leards Pond counting facility did not operate in 2000. Estimated egg deposition was below conservation requirements in three of the four years in which the counting facility operated between 1995 and 1999. Most (86%) adult salmon captured for broodstock on the Morell in 2000 were of hatchery origin.

Mean total densities of juvenile salmon (fry plus age 1 and older parr) on the **Morell** were 16.1 fish per 100 m^2 in 1995-1999 and 31.3 fish per 100 m^2 in 2000.



Salmon returns to hatchery-stocked PEI **rivers other than the Morell** are far below conservation requirements.

Outlook

Based on recent years' experience, returns in 2001 to the Morell River will probably not meet conservation requirements, but broodstock needs for the stocking program (minimum 50 fish) will be met. Egg depositions have little influence on future returns because most returns are of hatchery

origin. Returns in 2001 will probably be similar to those of recent years because the intensity of stocking has not changed.

In **other PEI rivers**, conservation requirements will not be met, but returns will continue because of ongoing stocking programs.

Management considerations

The chief limitation to Atlantic salmon production in PEI is stream sedimentation caused by agriculture and other land use activities (DFO 2000b). Cultivation techniques which reduce erosion and pesticide run-off have become more widespread in recent years, but potato acreage has also increased. Substantial self-sustaining salmon runs cannot be re-established until these impacts are severely reduced. It is recommended that protection for wild-reared salmon be provided.

No change is recommended to current management for hatchery-reared fish, which comprise most of PEI's salmon runs.

Some PEI rivers produce small numbers of wild-reared fish. Egg deposition from wild-reared spawners is far below conservation requirements in all systems. It is recommended that protection be provided for wild-reared salmon (as indicated by an intact adipose fin). Increased spawning escapement of wild-reared fish can be expected to benefit wild production and also provide more fish of wild origin for broodstock use. Measures to protect wild fish would affect the Morell and other large streams. They would not affect unstocked systems with late-running salmon that enter rivers after the angling season has closed.

Northumberland Strait Nova Scotia (part of SFA 18)

The last assessment for these rivers was for 1999. Stock status information for 2000 is provided for nine of these stocks (Table 2). Sixteen rivers on the Northumberland Strait shore of Nova Scotia support Atlantic salmon stocks and salmon typically enter these rivers in late autumn, usually after September 15.

The information available for estimating Atlantic salmon returns to this area in 2000 was angling data derived from angler license stub returns and a diver survey of adult salmon in Sutherlands River. Use of angling data to estimate returns in this area can be difficult because of the variability in capture rates resultant of e.g., discharge, run timing, and the limited angling season which runs from September 1 to October 31.

Resource Status

Stock status for River Philip for 1996-1999 was estimated with a mark-and-recapture experiment to arrive at a population estimate. The stock status for the other rivers in the area was based on population estimates for River Philip and capture rates. Capture rates were calculated as the ratio of total reported catch (derived from angler data reported on license stubs) and the population estimate.

River Philip Capture Rates

	Salmon	
	Large	Small
1996	0.60	0.87
1997	0.16	0.27
1998	0.70	0.72
1999	0.58	0.47
Average	0.50	0.59

Eggs for the rivers on the Northumberland Shore are expected to come almost exclusively from large salmon because 95% of small salmon are male.

Using the average capture rate for large salmon for **River Philip**, returns in 2000 were about 170 fish, with a range of 130-480 based on the range in capture rates for the river. A similar approach results in an estimate of 80 (range 60-170) small fish returning to the river. Estimates of Atlantic salmon escapement were likely below the conservation levels of 358 large and 75 small fish.

The average and range of capture rates from River Philip were used to estimate returns to **East River (Pictou)** of about 60 (range 50-200) large and 50 (range 40-100) small salmon. Escapement estimates were below the conservation requirement of 271 large and 57 small fish.

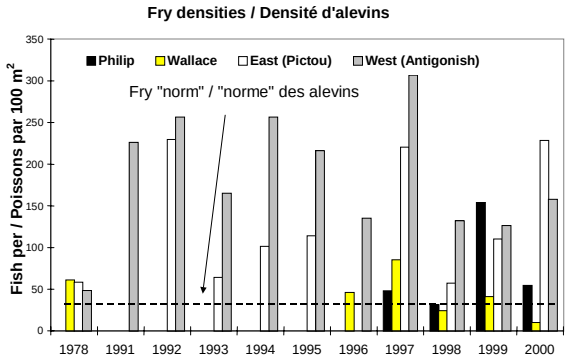
West River (Antigonish) Atlantic salmon returns were approximately 230 (range 163-713) fish. Estimated escapements of large salmon may have been below the conservation levels of 353 fish.

Snorkel divers have obtained escapement estimates from the **Sutherlands River** for six years by enumeration of adult salmon. A total of 14 large salmon and 10 small salmon were counted in 2000. Conservation requirements for the small area of this river accessible to salmon are 25 large and 5 small fish. The count of fish in 2000 is the lowest in the time series.

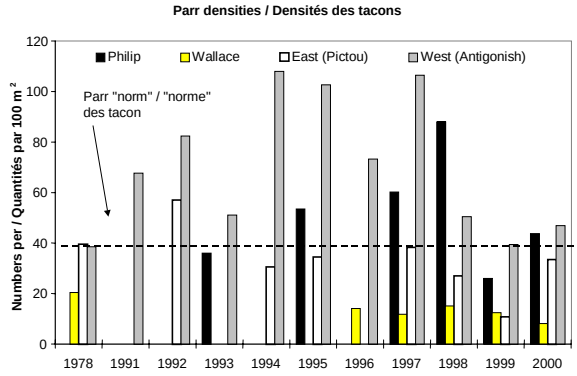
Atlantic salmon return and escapement estimates were obtained for several other rivers in the area where the angling data was sufficient to apply the capture rates from River Philip. Those estimates indicate that on **River John**, **South**, **Wallace, Waugh** and **West (Pictou)** rivers conservation levels were probably not met in 2000.

River discharge can affect angler access to fish and water levels in 2000 may have reduced angler access and biased return estimates downwards.

Fry densities on most rivers in this area have remained above the Elson norm. Wallace River fry populations have been lower than on neighboring rivers.



Except in 1999, parr (age 1+ and older) densities on most monitored rivers have remained consistently at or above the Elson norm. Parr numbers on the Wallace River, in contrast, have been below those levels.



Outlook

Forecasts of returns to four rivers in the area, **East River (Pictou)**, **River Philip**, **West River (Antigonish),** and **Sutherlands River**, are based on five-year averages, 1996-2000,

for both large and small salmon (with 90% confidence intervals).

Average large salmon returns to **East River (Pictou)** were about 360 (80-710) fish or 130% of the conservation requirement. The probability that returns in 2001 will be greater than the 271 large fish conservation requirement is 70%. The forecast small salmon return of 90 (40-150) fish is 165% of the requirement and the probability of exceeding the 57 fish requirement is about 90%.

On **River Philip**, the mean number of returns during the past five years for large salmon was about 560 (110-1130) fish or 160% of the conservation level of 358 salmon. The probability of exceeding the conservation requirement in 2001 is about 75%. Similarly, small salmon returns are expected to exceed requirements; the five-year average was 200 (50-360) fish and the probability of returns being above the 75 fish requirement is about 90%.

About 480 (130-860) large salmon have returned to **West River (Antigonish)** on average over the last five years, 135% of the requirement. The probability of exceeding the conservation requirement of 353 large fish in 2001 is about 70%. The number of small salmon spawners which could be surplus, if consistent with the five-year average, would be about 280 (60-550) fish.

Return estimates for the year 2001 on **Sutherlands River** are expected to be about 30 (5-60) large salmon and 20 (0-30) small salmon, 120% and 380% of the respective conservation requirements of 25 large and 5 small fish.

Spawners in 2001 and beyond for the **Wallace River** are likely to be below requirements because of low juvenile numbers and adult salmon return estimates which have been consistently below requirements.

Management Considerations

The rivers in this area are relatively small and returns of salmon typically number from a few dozen to a few hundred. The level of directed fisheries exploitation in recent years generally has not been of concern to conservation. Directed fisheries for large salmon should be avoided on **River John** and **Wallace River** until it has been determined that returns to those rivers in subsequent years will provide a surplus to conservation. Little or no data were available for First Nation catches on many of the area rivers. Closer monitoring of returns and harvests in 2001 and beyond would be necessary to improve the accuracy of the stock status and reduce the risk of seriously impacting a year class through removals.

Based on indicator rivers, it is expected that returns of large salmon to most rivers will meet or exceed conservation requirements in 2001. Returns and spawning escapements of small salmon during the 1990s have generally exceeded conservation requirements and returns in excess of requirements are anticipated in 2001.

The smaller rivers in the area, the **Afton**, **Tracadie (Monastery)**, and **Sutherlands** are more vulnerable to exploitation.

Cape Breton (SFA 19 and part of SFA 18)

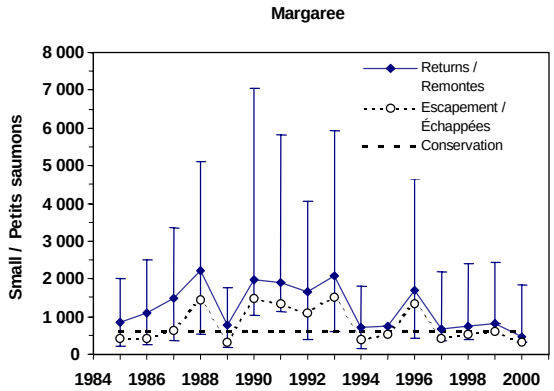
The last assessment for these rivers was for 1999 (DFO 2000a). These are updated for 2000.

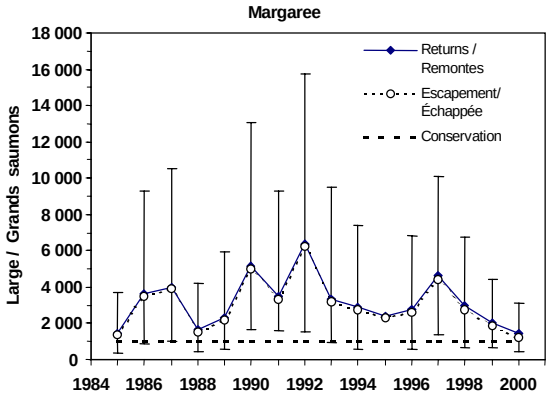
Salmon stocks of Cape Breton Island include those of the Margaree, Middle, Baddeck and

North rivers with headwaters in the Cape Breton Highlands. These rivers have relatively pristine water quality and no significant impediments to fish migration. The non-Highlands, Grand River is of lower gradient, has flows and temperatures moderated by headwater lakes and a fishway that by-passes Grand River falls.

Resource Status

Based on angling, catches and estimated catch rates, 1991-1996, estimates of salmon returning to the **Margaree** in 2000 were 460 (140-1,370) small and 1,440 (990-1,650) large salmon. Small salmon returns were down 44% from 1999. Large salmon were down 30% from 1999 and are the lowest in 16 years of estimates. Escapements numbered 320 small and 1,220 large salmon. Ninety-seven percent of the fish sampled during broodstock collection were of wild origin.

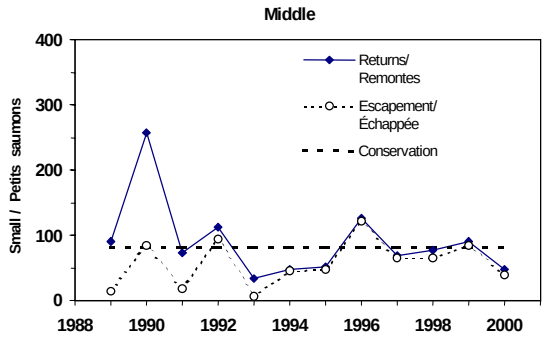


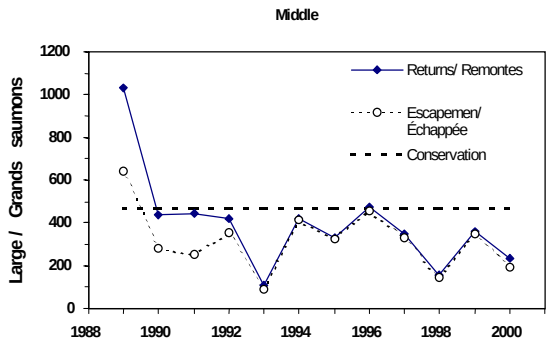


Conservation requirements are 1,036 large salmon and 582 small salmon. In 2000, small salmon escapement was about 55% of requirement and large salmon was about 120%. Egg requirements have been exceeded in every year since 1985.

Mean juvenile densities at three index sites in 2000 were 151 fry and 91 parr (age-1+ and older) per 100 m^2 and are 5.2 and 2.4 times the Elson norms. These densities are consistent with those monitored since 1991 and with escapements of two to six times the conservation requirement.

Returns to **Middle River** in 2000 were estimated from diver counts to be 280 (220-440) fish, comprised of 50 small and 230 large salmon. Large salmon returns were down 36% from 1999.

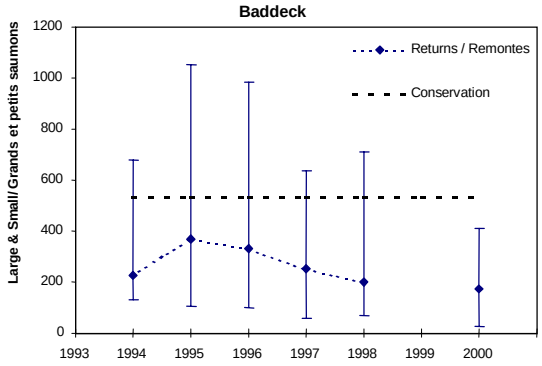




Conservation requirements for the Middle River of 2.07 million eggs have been expected from 470 large and 80 small salmon. Small salmon escapement (about 40 fish) was about 49% of requirement, large salmon

(about 190 fish) were about 41% of requirement. Both estimates take into account some unallocated removals from returns.
Mean juvenile densities of 49 fry and 52 parr per 100 m^2 at two mainstem index sites on Middle River in 2000 were 1.7 and 1.4 times the Elson norms. Monitoring since 1996 revealed densities to be at or slightly above norms.

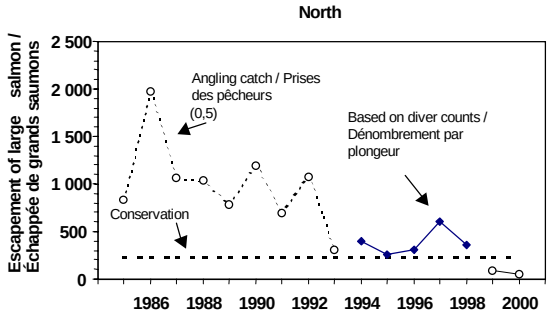
Returns to the **Baddeck River** in 2000 were estimated from diver counts to be 180 (150-240) fish comprised of 25 small and 155 large salmon.



The conservation requirements for the Baddeck River are 2.0 million eggs, expected from 450 large and 80 small salmon. Small salmon escapement (about 20) was 21% of requirement, large salmon (about 125) were about 28% of requirement. Both estimates take into account some unallocated removals from returns. No estimate was calculated in 1999, but available evidence suggested that the egg conservation requirement was not met.

Mean juvenile densities of 142 fry and 32 parr per 100 m^2 for three mainstem sites on Baddeck River in 2000 were 4.9 and 0.9 times the Elson norms. Monitoring since 1996 indicates that densities of fry fluctuate above, and that densities of parr fluctuate around the Elson norms.

Based on angling data, estimated returns to the **North River** in 2000 were 64 small and 56 large salmon. Estimates based on angling, 1994–1998, were on average 66% (39%-159%) of those based on diver counts.



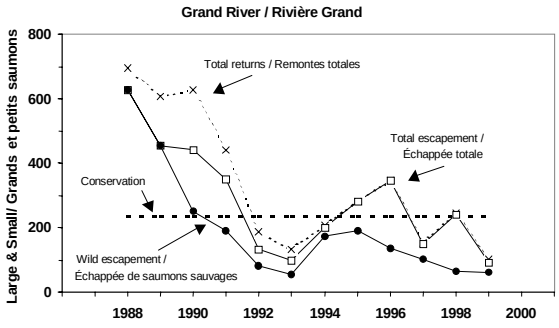
Conservation requirements for the North River are 0.85 million eggs expected from 200 large and 30 small salmon. Adjustment of angler-based escapement estimates of large fish by factors of 0.39 and 1.59 (to approximate diver-based estimates) suggests a possible escapement of 35-145 large fish. Thus egg conservation requirements were unlikely to have been met in 2000.

Mean juvenile densities of 48 fry and 38 parr per 100 m^2 for four mainstem sites on North River in 2000 were 1.7 and 1.0 times the Elson norms.

Grand River is obstructed to salmon passage at low discharge by a falls located 10.2 km upstream of head-of-tide. A fishway at the falls passes about 60% of small and 43% of large salmon. Most salmon are small, the few large fish are usually repeat-spawning 1SW fish. About 45% of the total juvenile production area is upstream of the falls. There are now no stocked fish contributing to returns.

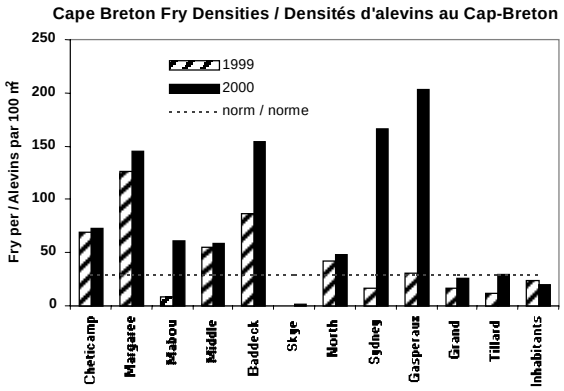
The salmon count at the Grand River fishway, from June 5 to July 15, 2000, was 48 small wild fish. Although the count was discontinued thereafter, the pattern to July 15 and recent low returns of wild fish to Grand

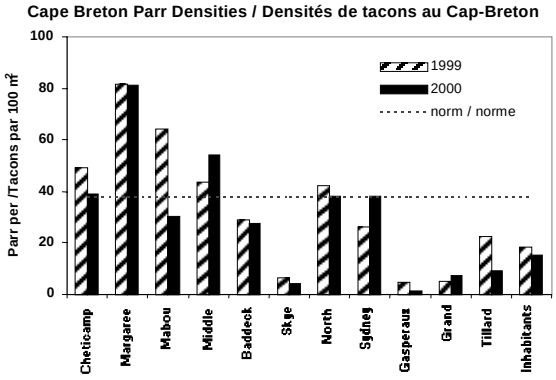
River suggest a low probability that egg conservation requirements were met. Conservation requirement upstream of the fishway is 475,000 eggs which would be expected from 234 salmon.



Juvenile densities at four main stem index sites in 2000 averaged 26 fry and 7 parr per 100 m^2, 0.9 and 0.2 times the Elson norms.

Juvenile salmon surveys were again conducted on the **Cheticamp** and **Mabou** rivers in SFA 18 and **Skye**, **Sydney**, **Gaspereaux**, **Tillard** and **Inhabitants** rivers in SFA 19. Densities of fry and parr relative to Elson norms suggest: (1) that most stocks of SFA 18, Gulf Cape Breton, have met or exceeded egg conservation requirements, (2) that stocks of Victoria County SFA 19 e.g., Middle, Baddeck and North rivers, the Skye River excepted, have approximated egg conservation requirements, and (3) that Atlantic coast rivers e.g., Sydney, Gaspereaux, Grand, Tillard, and Inhabitants were variable but less likely to have met conservation requirements than the other Cape Breton stocks.





Outlook

The outlook is based on the average returns of the previous five years.

Escapement to the **Margaree River** has exceeded the egg conservation requirement in each of the last 16 years. The forecast of returns in 2001 is about 2,780 (890-4,740) large fish with a greater than 93% probability that the conservation requirement of 1,036 large salmon will be met. This estimate does not, however, reflect the downward trend of the last 4 years. Returns of small salmon may number 880 fish (215-1,645) and the probability of meeting the 582 fish conservation requirements is about 75%.

For the **Middle River**, the forecast of small and large salmon returns in 2001 is about 395 fish (159-630). The probability of returns exceeding the 550 fish requirement is about

15%. Juvenile densities, however, are above the Elson norm.

For the **Baddeck River**, the forecast return in 2001 is 235 fish (120-450) and the probability of exceeding requirements of 530 salmon is near zero. However, as on the Middle River, juvenile densities are at the Elson norm.

Projected returns of small and large salmon to **North River** in 2001 are 365 fish (100-650). The probability of exceeding the conservation requirement of 230 fish is 80%.

Projected returns to the area upstream of **Grand River** Falls are about 95 fish (40-145) wild small salmon. There is a near-zero probability that the conservation requirement of 234 fish will be met.

Management Considerations

Conservation requirements are expected to be exceeded in 2001 in the **Margaree** (as in previous years) and probably other west coast Cape Breton rivers. Current forecast and trend in returns indicate that previous allocation and exploitation levels may be a concern in 2001. Small salmon are predominantly male, usually are less abundant than large salmon, and generally are not constraining to stock conservation.

On the basis of adult escapements, conservation requirements have generally not been achieved in recent years on the **Middle** and **Baddeck** rivers and perhaps other tributaries of Bras d'Or Lakes. Juvenile densities are, however, at or above the Elson norm. Expectations are that returns will not meet adult requirements in 2001.

Expectations for the **North River** are that returns in 2001 will be sufficient to meet conservation requirements of 230 salmon (probability of 80%). Because of the low estimated escapement in 1999-2000, current levels of exploitation and allocation should be reviewed.

The **Grand River** salmon did not meet the conservation requirement upriver of the fishway in 1999 and are unlikely to have done so in 2000. Returns in 2001 are now dependent totally on wild production, which has not met requirements since 1990. There is a near-zero probability that conservation requirements will be met in 2001.

Parr densities in other rivers along the Atlantic coast, Sydney River excepted, are relatively low (e.g., **Tillard, Inhabitants, Gaspereaux**) and indicate a need for caution and river-specific assessments.

Eastern and Southern Shores of Nova Scotia (SFAs 20 and 21)

The last assessment of rivers in SFA 20 and 21 was for 1999 (DFO 2000a). With the exception of the East River Sheet Harbour the information presented here is an update of that assessment. East River Sheet Harbour data was included in this update because the Liscomb River fishway, a previous index, was not operated in an assessment mode in 2000.

Rivers of SFAs 20 and 21 are generally organic-acid stained, of lower productivity, and, when combined with acid precipitation can result in acidic conditions toxic to salmon. At pH below 5.1, salmon production is considered unstable and only remnant populations may persist. Interspersed within drainages are areas of limestone rich soils (drumlins) that provide local areas of less acidified water.

Fourteen rivers in SFA 20 and eight rivers in SFA 21 are **low- or non-acidified (**pH

greater than 5.1) and have a history of Atlantic salmon angling catch. Two of these rivers, St. Mary's River (SFA 20) and LaHave River above Morgans Falls (SFA 21), were used as index rivers.

There are twenty rivers which are **partially acidified** where main river annual mean pH is between 4.7 and 5.0.

At least fourteen rivers are **heavily acidified** (<pH 4.7) and have lost their population of Atlantic salmon and fisheries are supported on three of these by stocking with hatchery-reared smolts.

There is evidence that reductions in river water quality attributed to acid precipitation have occurred since 1986. Some of these rivers are additionally impacted by impoundment for hydroelectric or domestic water use.

At recent measured acidity and marine survival levels, salmon in 85% of the 47 rivers analysed from the Southern Upland of Nova Scotia (SFAs 20 and 21) are or are expected to be extirpated (DFO 2000c).

Resource Status

Low- or non-acidified rivers

Conservation requirements have been assigned for two low acidified rivers: 1.9 million eggs equivalent to 1,320 fish for the LaHave above Morgans Falls, and 7.4 million eggs equivalent to 3,155 fish for the entire St. Mary's River.

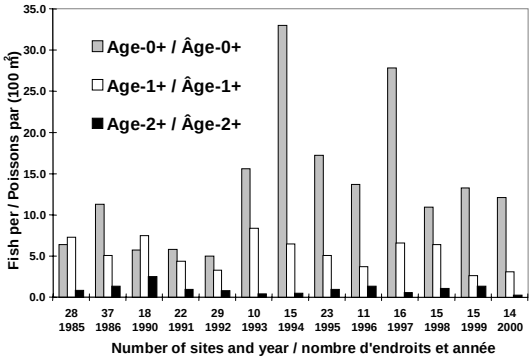
The estimated escapement to the **West River St. Mary's**, in 2000, was 340 fish (275 - 435). Based on the proportion of habitat sampled, total escapement to **St. Mary's River** in 2000 was estimated to be 618 fish or 16% of the egg requirement.

Salmon escapement estimate – St. Mary's River

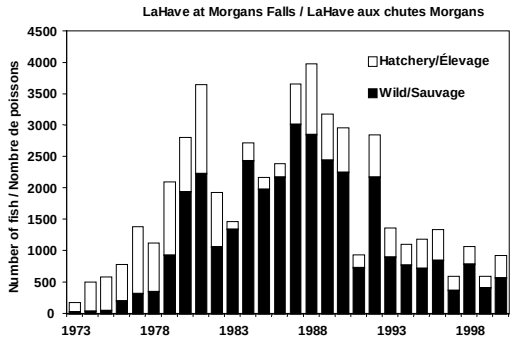
Year	Small	Large	Conservation (%)
1995	2,038	437	92
1996	1,535	590	93
1997	709	110	28
1998	1,926	74	55
1999	559	150	30
2000	572	46	16

Parr (age 1+ and age 2+) densities remain low while fry (age 0+) densities are higher since 1993.

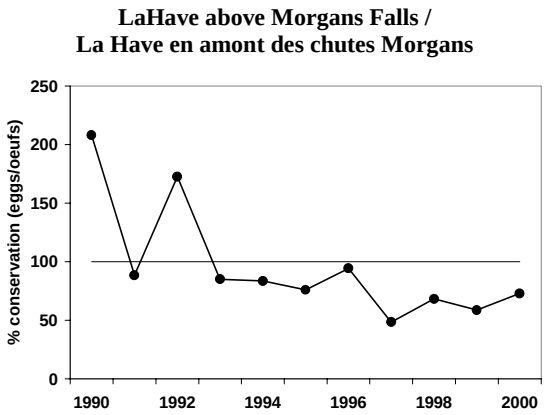
St. Mary's



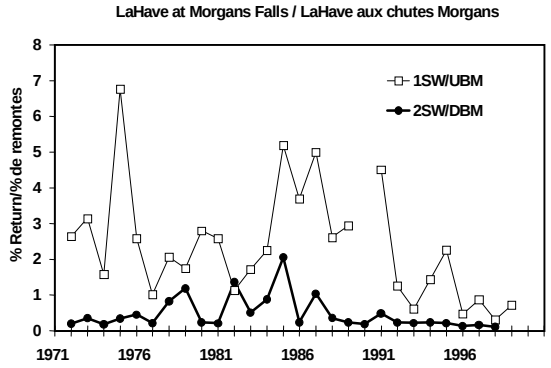
Counts at Morgans Falls fishway on the **LaHave River** were 914 fish, which indicated a return of 91% of the egg requirement in 2000. After broodstock removals, egg deposition was 63% of the egg requirement. Hatchery fish contributed 38% of the potential egg deposition.



This was the eighth consecutive year that egg deposition above Morgans Falls has been less than the conservation requirement.



After a period of higher return rates, 1984 to 1991, hatchery smolt return rates have dropped to lower levels since 1992. The return rate of hatchery smolts to Morgans Falls, LaHave River has declined since 1984. Return rate of 1999 hatchery smolts as 1SW fish in 2000 increased to 0.7% from 0.3% the previous year, which was the lowest in the time series. Returns of 2SW hatchery salmon in 2000 (1998 smolt class) declined to 0.11%, the lowest in the time series.



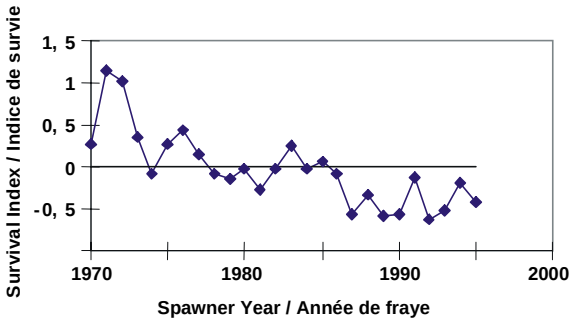
Smolt Year / Année comme saumoneau

In 2000, a total of 16,300 wild smolts were estimated to have migrated from above Morgans Falls, similar to the 1996 to 1999 average of 15,750 smolts.

LaHave River above Morgans Falls

Year	Wild smolts Estimate	Wild smolts per 100 m²	% Survival to 1SW
1996	20,510 (19,890 – 21,090)	0.40	1.5
1997	16,550 (16,000 – 17,100)	0.32	4.3
1998	15,600 (14,700 – 16,625)	0.31	2.0
1999	10,420 (9,760 – 11,060)	0.20	4.8
2000	16,300 (15,950 – 16,700)	0.32	

Survival rate of wild salmon, as inferred from recruits per spawner above Morgans Falls, has been below replacement (values less than 0) since the 1985 escapement.



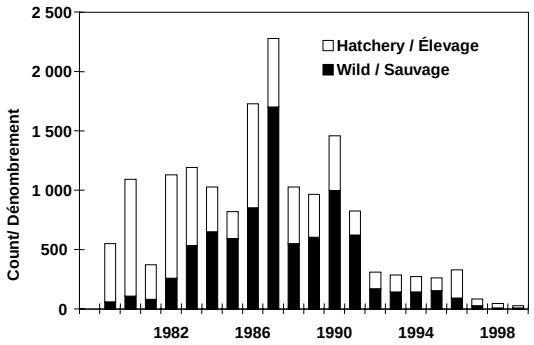
Status for all low-acidified rivers in SFAs 20 and 21, which are still capable of producing wild Atlantic salmon, is expected to be similar or worse than the index rivers. Dissimilarities in the status of salmon stocks among rivers of these SFAs may be attributed to the levels of acidification and to supplementation with hatchery produced smolts.

Partially-acidified rivers

The **Liscomb River** fishway was not operated in 2000. Liscomb River counts had provided a measure of wild and hatchery returns in SFA 20 with minor fish passage encumbrance. Returns in 1999 were 9 wild and 16 hatchery fish, less than desirable for adult broodstock selection. The low numbers of salmon returning and an assessment of

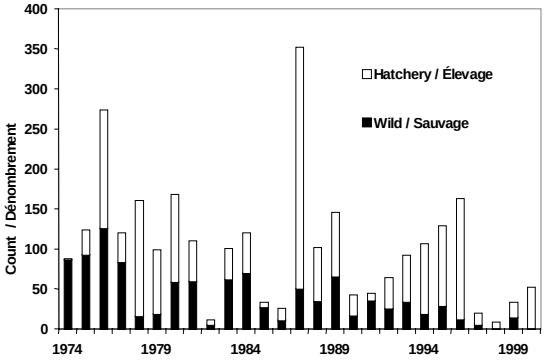
the prognosis for the stock based on recent pH and marine survival contributed to the decision to discontinue the counts in 2000 and use of the Liscomb River as an indicator for partially-impacted rivers of SFA 20.

Liscomb



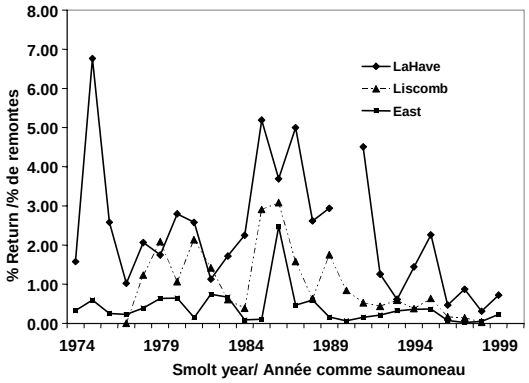
The **East River Sheet Harbour** fishway count data, 1974 to 2000, is being provided here as an alternative indicator for this class of river in SFA 20. Counts at East River Sheet Harbour fishway, similar to Liscomb River, have been low for the last three years (9 to 46 fish) and totaled 52 fish in 2000, one of which was wild origin.

East River Sheet Harbour



Mortality of stocked smolts attributed to low pH (i.e., increased acidity) may account for the difference in the hatchery smolt return rate to these rivers. Returns of 1SW salmon for hatchery smolts stocked in LaHave River, a low acid-impacted river, were consistently higher compared to those stocked in the East River Sheet Harbour, a partially acidified river.

Hatchery 1SW return rates /
Taux de retours des UBM d'élévage



Heavily acidified rivers

Heavily acidified rivers can no longer support the production of salmon. The **Mersey, Clyde** and **Jordan** rivers have received hatchery smolts for fisheries enhancement.

Outlook

Low- or non-acidified rivers

Based on the average estimated return to **St. Mary's River** from 1996 to 2000 of 1,060 small salmon (225-2,100) and 194 large salmon (4–1,118), there is less than a 3% chance that eggs in the returns of large and small salmon in the year 2001 will exceed the conservation requirement.

For **LaHave River** above Morgans Falls, forecast models based on cohorts for MSW and the previous five-year average return of 1SW salmon by smolt origin, suggest a 25-30% chance that eggs in salmon returning in 2001 will be greater than the conservation requirement. About a third of the forecast return is expected to originate from 58,000 hatchery smolts stocked at or above Morgans Falls in 2000.

Based on the number of wild smolts emigrating from above Morgans Falls in 1999 and 2000 there is less than a 2% chance that returns of wild small and large salmon to Morgans Falls in year 2001 will be sufficient to meet conservation requirements.

Returns of wild salmon to LaHave River above Morgans Falls have been below replacement since 1986. A measure of generation-to-generation survival shows a consistent decline independent of escapement. This trend does not bode well for the recovery of salmon stocks in SFA 20 and 21.

Hatchery smolts stocked in other low- or non-acidified rivers are expected to return to those rivers at rates similar to that observed at Morgans Falls. Stocking in these other rivers in 2000 was similar to 1999 and not as extensive as that above Morgans Falls.

River	Origin of stock	Number of smolt
LaHave	LaHave	57,900
Mushamush	LaHave	7,900
Petite	LaHave	8,000
Musquodoboit	Musquodoboit	19,200

Partially-acidified rivers

Deteriorating water quality due to acid precipitation, declining wild salmon returns and low smolt-to-adult return rates indicate that wild returns will be inadequate to meet conservation requirements in 2001. Survival rates of hatchery smolts are low. Even in rivers receiving hatchery smolts, returns of wild and hatchery fish will not be sufficient to meet conservation in 2001.

River	Origin of stock	Number of smolt
Sackville	Sackville	23,900
Tusket	Tusket	57,600
Gold	Gold	11,600
Medway	Medway	67,600
Salmon (Digby)	Salmon (Digby)	25,500
East R. Sheet Hbr.	East R. Sheet Hbr.	9,700
Liscomb	Liscomb	19,400

No broodstock were obtained from the Liscomb River in 1998 and the last hatchery smolts were released in 2000. Few, if any, wild fish are expected to return to the Liscomb River in 2001.

Heavily acidified rivers

The numbers of smolts stocked in the three heavily acidified rivers in 2000 were similar to 1999 and returns in 2001 are expected to be low, similar to 2000.

River	Origin of stock	Number of smolt
Clyde	LaHave	9,100
Jordan	LaHave	4,400
Mersey	LaHave	10,000

Management Considerations

Based on the status and recent performance of the wild salmon stock above Morgans Falls on the **LaHave River** and estimates of returns to **St. Mary's River**, rivers in SFA 20 and 21 are not expected to achieve conservation requirements in the year 2001. Return rates of hatchery smolts have declined to levels where even rivers receiving hatchery supplementation are again not likely to meet conservation requirements in year 2001.

Small and large salmon have contributed equally to egg depositions in these rivers. Therefore, the harvest of small salmon has the potential to significantly affect stock conservation.

Under present acid precipitation and low marine survival conditions, prognoses for salmon populations in 47 rivers of SFA 20 and 21 indicate that 40 populations are likely to be extirpated (DFO 2000c).

The year 2000 was the first time since 1996 that a fishery was allowed on Liscomb River. Returns to this river have shown an almost total loss of wild salmon and severe decline in the survival of stocked hatchery salmon. An assessment of viability of salmon in this river suggests little or no potential for natural production persisting.

Returns of adipose fin clipped hatchery smolts to the **Mersey, Clyde and Jordan rivers** (all heavily acidified rivers) will again be available for harvest in 2001. Hatchery returns to these rivers have been dependant upon broodstock collected from the LaHave River. Because returns to the LaHave River have been and are again forecast to be below conservation, other options for broodstock collections need to be considered.

The general decline in survival of hatchery smolts has decreased the opportunity to mitigate the loss of freshwater production with hatchery products. Also, the availability of broodstock surplus to conservation, preferably wild salmon, for donation to non self-sustaining programs, has been diminished.

Inner Bay of Fundy (SFA 22 and part of SFA 23)

The last assessment of rivers of the inner Bay of Fundy was for 1998 (DFO 1999). Updates were provided for 1999 and are again provided here for 2000.

Due to high water conditions in the fall of 2000, the standard electrofishing adult survey for the Stewiacke River was not available and a new mark and recapture estimate for Big Salmon River was not completed. The standard and an additional juvenile survey of rivers and streams of the inner Bay of Fundy were undertaken in 2000.

Salmon of the inner Bay of Fundy rivers may have occupied at least 32 rivers (22 rivers of SFA 22 in Nova Scotia and 10 rivers in SFA 23, New Brunswick). Rivers in these areas have a variety of habitats and are well suited to the production of salmon. In general, habitat is impacted by forest harvesting and agriculture practices to varying degrees but not susceptible to acidification. Some rivers have lost their salmon production because of barriers to migration e.g. Petiticodiac, Shepody, and Avon rivers. The Petiticodiac River represents about 22% of the salmon production potential of the inner Bay of Fundy.

Moderate-to-high production of salmon has been documented in many of these rivers as recently as 1985 and no widespread degradation of freshwater habitat is known to have occurred since.

Salmon usually enter these rivers in the fall of the year, have a high proportion that return to spawn after one winter at sea, rarely migrate to the north Atlantic Ocean, and have a high survival between consecutive spawning years.

Historic catches in the inner Bay of Fundy averaged 1,061 fish in the commercial fishery (1970-1984), and 1,462 small salmon and 597 large salmon (1970 - 1990), in the recreational fishery. Two rivers, the Big Salmon River, New Brunswick, and

Stewiacke River, Nova Scotia, accounted for more than half of the historical recreational catch.

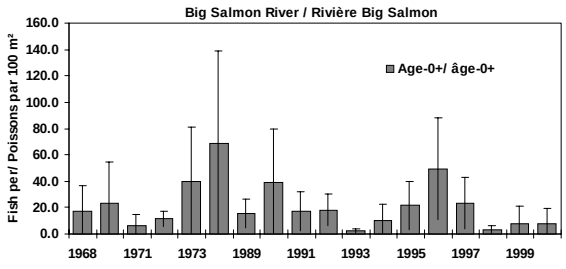
Resource Status

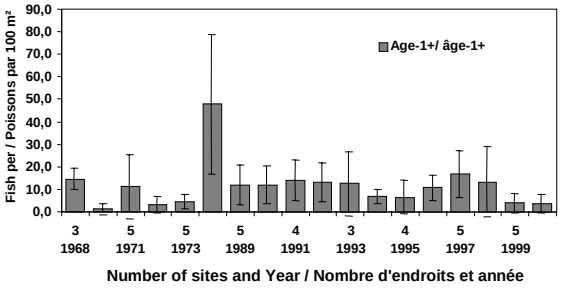
These rivers were assessed through electrofishing of juvenile salmon, counting and seining of adult salmon as well as streamside observation of adult salmon.

No quantitative or qualitative observations indicated that salmon returns increased in the years 1999 or 2000.

The adult survey of the **Big Salmon River** in 2000 was incomplete. A total of 11 fish were captured, sampled and marked for a re-capture estimate. However, water levels subsequently increased to levels that prevented useful re-capture information. No hatchery or escaped-farmed salmon were noted in the capture sample.

The population of Atlantic salmon in the **Big Salmon River** was enhanced through captive rearing during mid 1990s. Hatchery-reared smolts of wild stock were grown to adults in sea-cages and released to spawn in 1994 and 1995.

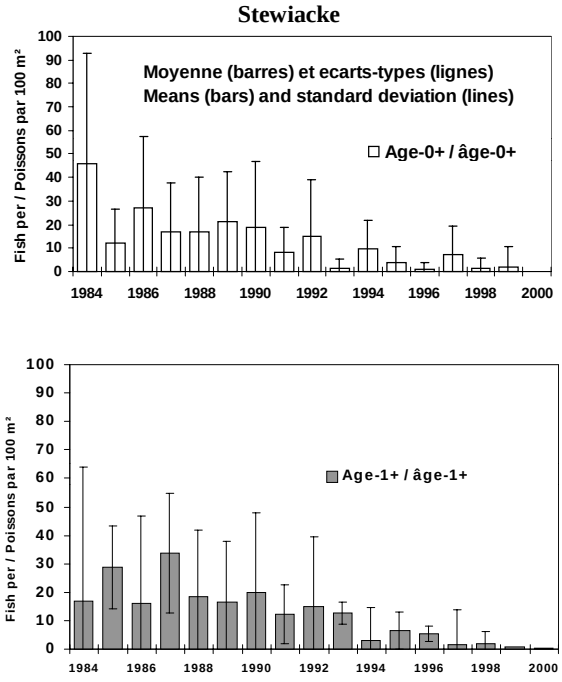




The subsequent increased densities of age-1+ parr from 1996 to 1998, indicates that the decline in parr densities generally noted in other inner Bay of Fundy rivers, was the result of reduced spawning escapements and not a general loss of habitat productivity.

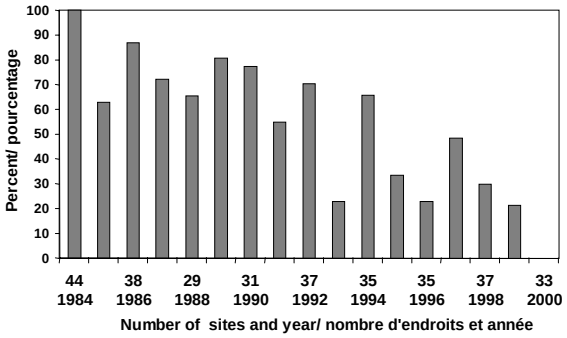
Electrofishing at five sites in the Big Salmon River in 2000 indicated that age-0+ parr densities have declined since 1998 and remain low.

Electrofishing for juvenile salmon at 33 sites in the **Stewiacke River** in 2000 indicated a continued decline of juvenile salmon. The density of age-0+ parr was zero and the density of age-1+ parr was 0.51 per 100 m^2.



The percentage of electrofishing locations that contained age-0+ parr decreased from 100% in 1984 to 0% in 2000.

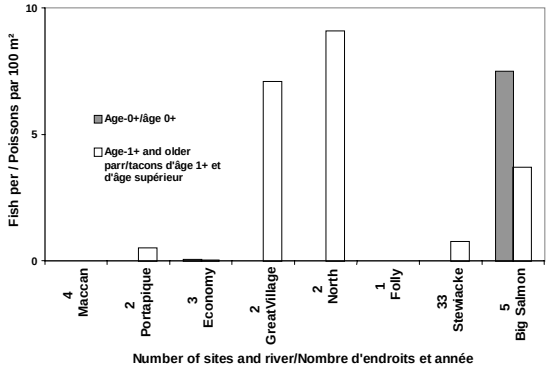
Stewiacke River electrofishing sites containing age-0+ parr Endroits d'électropêche contenant des tacons d'âge 0+ - rivière Stewiacke



An additional electrofishing survey of 42 rivers and streams from Black River, New Brunswick to Cornwallis River in Nova Scotia in 2000 indicated that juvenile salmon were detected in about half of the rivers. Where salmon were detected populations were only at trace levels.

Electrofishing at a total of fourteen locations in six rivers (**Maccan, Portapique, Economy, Great Village, Folly and North**) indicates that there were few salmon of any age in rivers of the inner Bay of Fundy in 2000.

Other inner Bay of Fundy rivers / Autres rivières de l'arrière-baie de Fundy



Salmon of the **Gaspereau River**, Kings County, Nova Scotia, although genetically identified as an inner Bay of Fundy salmon stock, migrate to the northwest Atlantic, and have followed a recruitment and life history pattern similar to other Atlantic coast rivers. This year a total of 76 fish (48 hatchery and 28 wild) were counted at the White Rock Dam fishway. This number is potentially 16% of the egg deposition. A total of 32 fish was removed for broodstock. Egg deposition in 2000 after broodstock removal was 9% of the conservation requirement.

Gaspereau River at White Rock Dam fishway

			Year			
	Origin	Size	1997	1998	1999	2000
Escapement	Wild	Large	5	6	11	3
		Small	30	9	1	7
	Hatchery	Large	2	10	13	4
		Small	22	42	0	30
Broodstock	Wild	Large	7	3	14	4
		Small	23	7	2	14
	Hatchery	Large	5	2	0	9
		Small	8	20	0	5
Total count	All	Large	19	21	38	20
		Small	83	78	3	56
Total count	All	Both	102	99	41	76
% of	Counted		74	56	30	16
Conservation	Escapement		43	42	15	9

The status of salmon in the **Annapolis River**, an outer Bay of Fundy stock, may be implied from the inability to locate or capture sufficient broodstock again in 2000. Only one hatchery return and four wild salmon (three large salmon and one small salmon), were observed at the Martyn's Mills fishway on the Nictaux River in 2000. A total of 12 aquaculture escapes were removed from the fishway in 2000.

Outlook

Atlantic salmon spawners and juveniles of the **inner Bay of Fundy** are critically low. It is unlikely that any salmon surplus to conservation will be available until three generations of recovery.

Both the **Gaspereau** and **Annapolis** rivers received hatchery supplementation but did not meet conservation requirements in 2000 and are not expected to do so in 2001.

Management Considerations

Inner Bay of Fundy salmon stocks (e.g., **Stewiacke, Big Salmon**) are critically low. Surveys of juveniles and adults, conducted in 2000, were able to detect juvenile salmon in less than half of the rivers and there are few Atlantic salmon of any age remaining. As a result, smolt production must be very low and all adult recruitment is required for spawning.

Special measures are required to prevent complete extirpation of inner Bay of Fundy salmon. A live gene bank program to prevent the extirpation of inner Bay of Fundy salmon was initiated in 1998. Two river stocks (Stewiacke and Big Salmon) are presently held and some early success in captive breeding and rearing has been achieved. Stocking to selected rivers with products from the live gene bank is being considered for 2001.

Outer Bay of Fundy (western part of SFA 23)

The last assessment of rivers of the outer Bay of Fundy was for 1999 (DFO 2000a). The following information is an update of that document, with the addition of recently assembled fry data sets (1981-2000) for the Nashwaak and Kennebecasis rivers and the fry and parr data sets for the Hammond River.

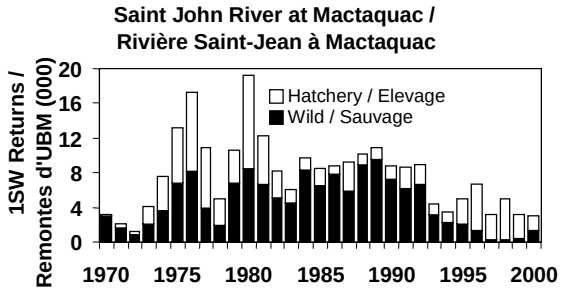
Stocks in this area generally have not met conservation requirements during the last decade. Many of these stocks face a multitude of constraints including hydroelectric dams (with upriver passage facilities but mostly devoid of safe downstream passage) artificial flow regimes, headponds, significant industrial, and municipal effluents, run-off from intensive agricultural operations, and new developing communities of potentially effective predators on juveniles and smolts. As well, escapes from the Fundy-Isle (NB) and Cobscook Bay (ME) aquaculture industry (1999 production of about 32,000 t) have been identified at all primary counting facilities and have the potential to transmit diseases and genetically swamp those small wild stocks proximate to cage sites and production hatcheries.

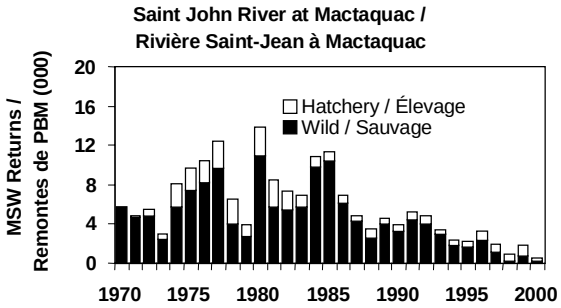
Resource Status

<u>Saint John River upstream of Mactaquac</u>

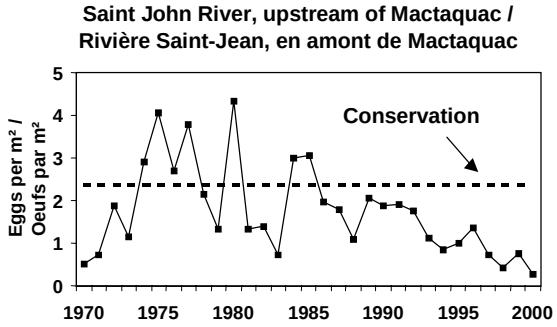
The total count of salmon on the **Saint John River at Mactaquac** dam in 2000 was 3,574 fish. Total returns (including assumed losses downriver of Mactaquac) were estimated to be 3,068 1SW and 544 MSW salmon, exclusive of 6 fish that were identified as farm escapes. About 56% of 1SW and 49% of MSW returns were of hatchery origin. Run-timing in 2000 was relatively normal compared to the unusually early arrival of fish in 1999.

Wild 1SW returns were the fifth lowest of a 31-year record; wild and hatchery MSW returns were the lowest of the 31-year record. Hatchery 1SW returns were fewer than returns estimated since 1994.

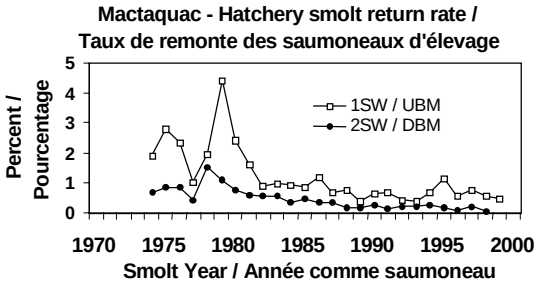




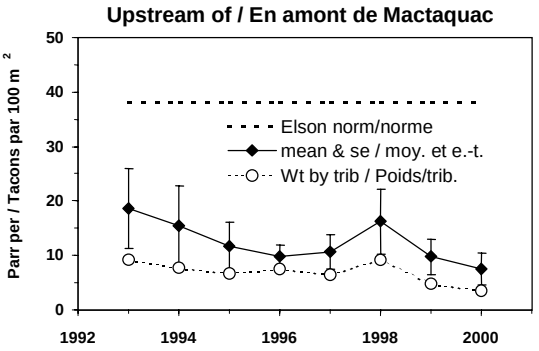
Spawning escapement upriver of Mactaquac numbered an estimated 330 MSW (38% wild) and 2,795 1SW (43% wild) salmon. Ninety-five percent of escaping MSW fish were female, 82% of escaping 1SW fish were male. Conservation requirements upriver of Mactaquac are 32.3 million eggs to be provided by 4,900 MSW and 4,900 1SW fish. Only 11% of the conservation egg requirement was met - the lowest value in 31 years. Hatchery-origin fish provided 53% of the eggs. A total of 1.2 million eggs, representing 25% of the total eggs arriving at Mactaquac, were retained for hatchery incubation and rearing. These eggs came from 134 MSW and one 1SW female salmon of which 70% were wild origin fish. Eggs in total returns (4.8 million) would have accounted for 15% of conservation requirement.



Aged returns from reared smolts released via Mactaquac smolt migration channel have been used as an index of marine survival. Preliminary assessment indicates that the return rates remain low with the 2SW rate the lowest on record.



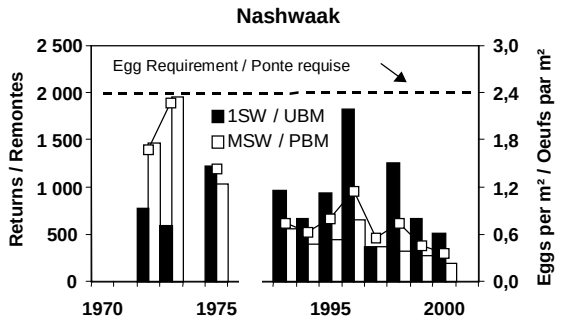
Mean densities of wild parr (age 1 and older) at 15 sites upriver of Mactaquac, and mean densities weighted according to relative production area of the tributaries in which they are located were, 7.6, and 3.5 parr per 100 m^2, respectively. These values are the lowest estimated since 1993 and consistent with declining egg depositions.



Saint John River downstream of Mactaquac

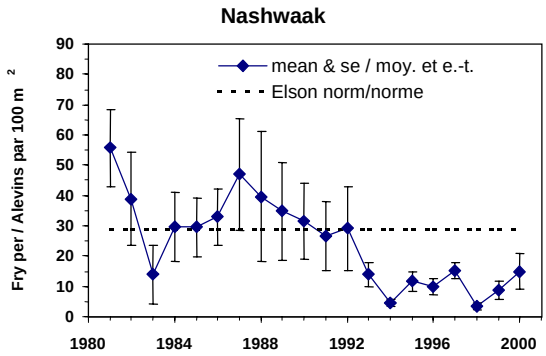
Counts of 428 small and 161 large salmon at the **Nashwaak River** fence and a late-October mark-and-recapture estimate indicated a run of 510 1SW (470-690) and 190 MSW (170-260) salmon to the fence. No hatchery returns or farm escapes were identified at the fence.

Returns of 1SW salmon were the second lowest since 1993 and only 75% of 1999 returns. MSW returns were the lowest on record and have been steadily declining since 1996.

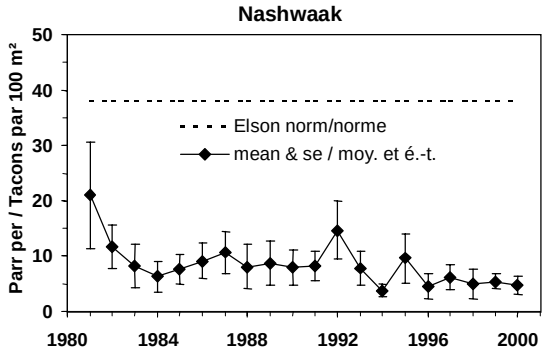


The conservation egg requirement (12.8 million) upstream of the fence is expected from 2,040 MSW salmon and an equal number of 1SW salmon to provide males. Escapement of about 490 1SW and 190 MSW salmon indicates egg deposition in 2000 to have been only about 15% of requirement. Females among 1SW salmon (36%) contributed to 31% of the estimated egg deposition. Approximately 25,000 eggs, representing less than 2% of the total eggs returning to the Nashwaak, were retained for future enhancement activities on the river. Broodstock consisted of three MSW and two 1SW wild female salmon and 12 wild male 1SW salmon.

Juvenile densities have been monitored since 1981 at six sites upriver and one downriver of the Nashwaak River counting fence. The mean fry density observed in 2000 was 14.9 fish per 100 m^2; an increase over that of 1999. Values previous to 1992 have been adjusted for recent changes in sampling protocols. Fry densities since 1981 trend downwards and since 1993 have fluctuated around 10 fry per 100 m^2, about one-third the Elson norm.



Densities of parr at the seven sites in 2000, averaged 4.8 parr per 100 m^2 - similar to that for 1999. These values are low with respect to Elson norms and trend downwards since 1981.



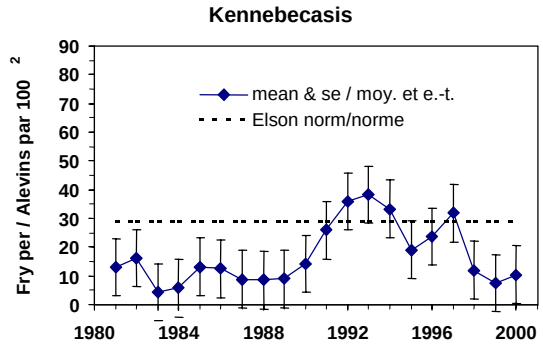
Smolts emigrating from upstream of the fence were estimated to number 15,800 in 2000, equivalent to 0.3 smolts per 100 m^2. This value is about one-half the number estimated in 1999 and consistent, at least for the dominant 2-year smolts, with the estimated decrease in egg deposition in 1997.

Nashwaak River

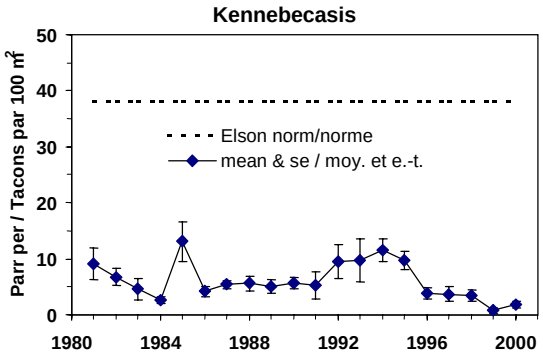
Year	Wild smolts Estimate	Wild smolts per 100 m²	% Survival to 1SW
1998	22,750 (17,900 - 32,850)	0.4	2.9
1999	28,500 (25,300 – 33,200)	0.5	1.8
2000	15,800 (13,400 – 19,700)	0.3	

Adult returns to the headwaters of the **Kennebecasis River** were assessed in 1996

and 1997 and found to be less than 50% of egg conservation requirement. Juvenile densities have been monitored since 1981 at four sites. Fry densities in 2000, averaged 10.4 fish per 100 m^2, about one-third the Elson norm and the second lowest in the last 11 years.

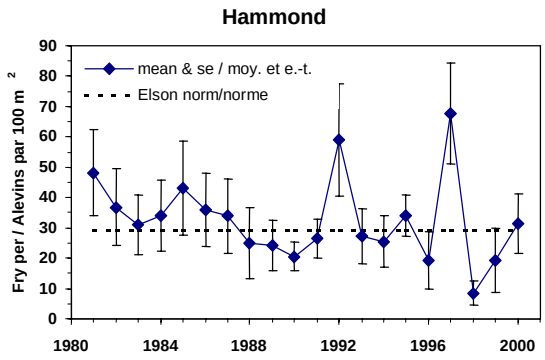


Values for parr in 2000 are low (1.9 parr per 100 m^2) with respect to the Elson norm and values previous to 1996.

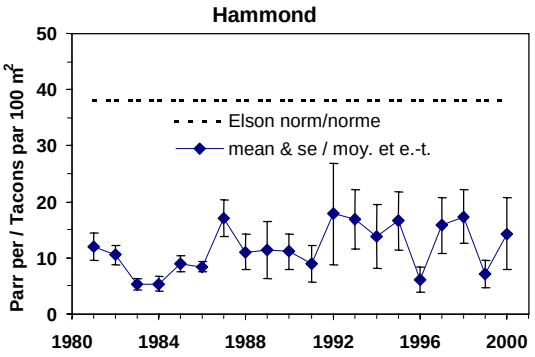


There was no assessment of adults returning to the **Hammond River** in 2000.

In 2000, fry averaged 31.5 fish per 100 m^2 at four sites, an increase over that of 1998-1999. (The value for 1997 was influenced by hatchery stocking.) In general, fry densities have declined since 1981 but over the last decade have fluctuated about the Elson norm.

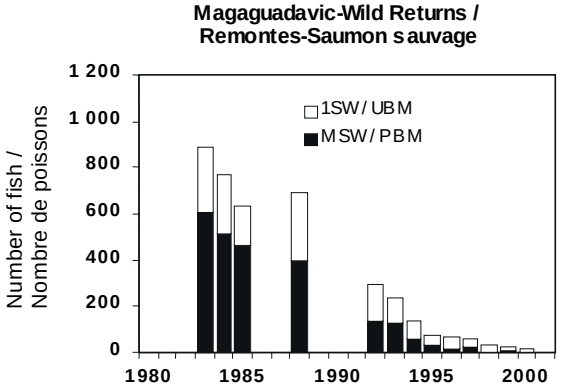


Densities of parr in 2000 averaged 14.3 parr per 100 m^2, double those in 1999. Unlike the Nashwaak and Kennebecasis, the parr densities since 1981 appear to trend upwards. Parr densities on the Hammond have generally been several magnitudes greater than those of either the Nashwaak or Kennebecasis rivers. The influence of hatchery stocking on these densities is believed to be minimal.

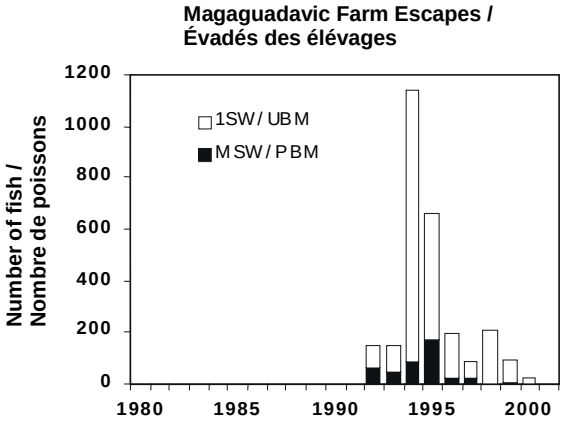


<u>Other outer Bay of Fundy rivers</u>

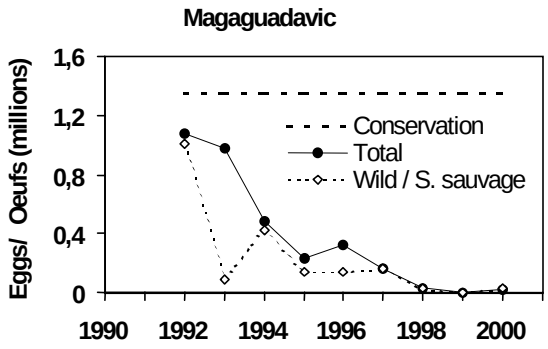
Wild returns to the St. George fishway and trap located at the head-of-tide on the **Magaguadavic River** in 2000 numbered only 13 1SW and 1 MSW salmon, the fewest of record.



Farm escapes ascending the fishway in 2000 numbered 3 postsmolts, 25 1SW, and 2 MSW salmon; none tested positive for ISA virus.

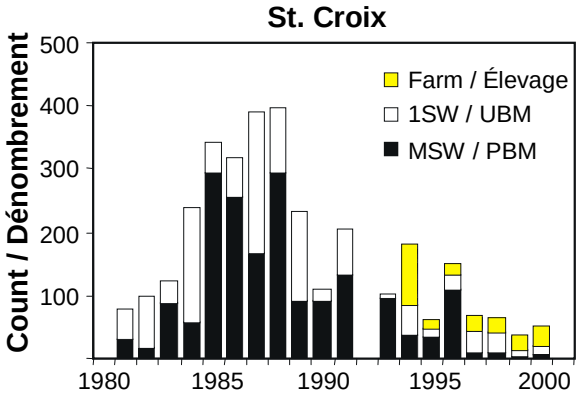


Interim conservation requirements are 1.35 million eggs from 230 MSW and 140 1SW salmon, an objective which in all likelihood was met by returns in the 1980s. In 2000, 12 wild 1SW (5 females) and one MSW salmon were released to the river. Potential egg deposition was 23,350 eggs. One female farm-escape was mistakenly released upriver of the fishway carrying a potential 3,740 eggs, 14% of the total potential egg deposition. Some 170 juveniles from 1998 adult returns are being reared to maturity in captivity.



Surveys of juvenile salmon in 1995 and 1997 revealed low fry and highly variable parr densities. Also found were parr escapes from hatcheries supplying the aquaculture industry and as many as 12 juvenile smallmouth bass (*Micropterus dolomieui* Lacépède) per 100 m^2. Nine electrofishing sites completed in 1999 were again fished in 2000. Sites proximate to aquaculture industry hatcheries contained up to 18.7 parr per 100 m^2 (14 parr per 100 m^2 in 1999), sites distant to the hatcheries had 0 to 0.4 fish per 100 m^2 as in 1999.

Counts of salmon at the Milltown fishway, near head-of-tide on the **St Croix River** in 2000 numbered 5 MSW and 15 1SW hatchery-origin fish, and 6 MSW and 24 1SW farm escape fish; there were no wild fish. All farm escapes were removed from the trap for disease analysis and found to be negative.



As part of a salmonid restoration program, all hatchery returns and their estimated 60,000

eggs (52% from 1SW fish) were transported as broodstock to the Mactaquac Fish Culture Station.

Spawning is known to have occurred, however, among 750 aquaculture-reared adults from St. Croix and Maine Downeast stocks that were released into the St. Croix River at five sites, October 17-25. A total of 412 of these fish was female, and at an average weight of 6.4 kg, might have been expected to yield 5.7 million eggs (78% of conservation requirements). Subsequent canoe-based redd surveys in segments of the river sighted 170 redds believed to be resultant of the stocking.

Outlook

The following projections and probabilities are for the most part, based on the average returns of the previous five years.

Saint John River upstream of Mactaquac

Projected returns for stocks originating on the **Saint John River** at and upriver of **Mactaquac** in 2001 are 4,250 (1,695-6,820) 1SW and, at best, 1,720 (350–3,460) MSW salmon. The probabilities of attaining conservation requirements of 4,900 of each of 1SW and MSW fish are 35% for 1SW salmon and near zero for the MSW forecast. Low densities of wild parr, reliance on hatchery production and persistently low MSW return rates suggest that MSW returns will not be adequate to achieve egg conservation requirements for the next several years.

Saint John River downstream of Mactaquac

Predicted returns to the **Nashwaak River** in 2001 are 930 1SW fish (180-1,940). There is less than a 5% probability that 1SW requirements of 2,040 fish will be met. The forecast of MSW returns is 360 fish (100-650) and the probability that conservation requirements of 2,040 MSW fish will be met is near-zero. An estimate based on smolts-to-1SW survival suggests that 1SW returns in 2001 could be as few as 440 fish (315-465). Declining numbers of adult returns, particularly MSW salmon, and low densities of parr suggest that returns will not be adequate to achieve egg conservation requirements for the next several years.

Current low fry and parr densities on the **Kennebecasis River** suggest that returns are likely to be similar to those in recent years.

Hammond River fry densities have approximated the Elson norm on several occasions during the last decade. Parr densities over the last decade, however, have averaged about 0.4 of the Elson norm, and suggest that returns in the next several years will likely be similar to those of recent years.

Other outer Bay of Fundy Rivers

Wild 1SW and MSW returns to the **Magaguadavic River** in 2001 are projected to be no greater than the few fish returning in 2000. There is a near-zero probability of attaining conservation requirements and without hatchery assistance and a recovery plan, there is a strong possibility that the stock will be extirpated soon.

Mean numbers of wild and hatchery returns to the **St. Croix River**, 1996 to 2000, have been 22 1SW and 28 MSW fish. Recent levels of natural spawning indicate that returns of each of 1SW and MSW fish, 2001-2003, are unlikely to exceed 100 fish. Returns from hatchery stocked St. Croix-origin parr and Penobscot River-origin smolts should provide some additional 1SW and MSW returns in 2001. Under any scenario for returns in 2001-2003, there is a near-zero probability of attaining conservation requirements. Returns

of progeny from the release of aquaculture-grown spawners in 2000 will yield few spawners before 2004.

Management Considerations

Saint John River upstream of Mactaquac

For the **Saint John River** stocks **upriver of Mactaquac**, egg depositions have been less than 50% of requirements for seven of the last eight years. There is essentially a zero probability that MSW returns will be adequate to meet conservation requirements in 2001. For 1SW salmon, there is less than a 50% probability of attaining the 4,900 1SW salmon requirement.

In 2000, 96% of the MSW salmon returns to Mactaquac were female. Females comprised only about 12% of returning 1SW salmon, but 25% of egg depositions. Thus, female 1SW salmon become more important to egg depositions as MSW returns decline.

Saint John River downstream of Mactaquac

The **Nashwaak River** stock met only about 15% of conservation requirement in 2000 and has failed to achieve more than 50% of requirements since 1993. Prospects for attaining the conservation requirement in 2001 are near-zero and based on parr densities, the prospects for increased returns for the next several years are low.

1SW salmon average 44% (5-year mean) female and make a significant contribution towards egg depositions (31% in 2000; 38%, 5-year mean). Losses of 1SW salmon will have an increasing impact on egg depositions as large salmon returns diminish.

The prospects for returns to the **Kennebecasis River** are similar to those of the Nashwaak River. Female composition of 1SW salmon is similar to that of the Nashwaak and thus losses of 1SW salmon will have an increasing impact on egg depositions as large salmon returns diminish.

The number of salmon returning to the **Hammond River** in 2000 is unknown. Returns to the Hammond River in 2001 are unlikely to change from those of recent years. Like other assessed tributaries downriver of Mactaquac, 1SW salmon make an important contribution to egg depositions.

Other outer Bay of Fundy Rivers

Stocks of these rivers have declined dramatically in the last decade. Returns of wild salmon to the **Magaguadavic** and the **St. Croix rivers** in 2000 are near zero. There is no chance that conservation requirements will be met from natural production on these rivers in 2001 or before 2004. Actions are required to prevent extirpation of salmon stocks of these and other outer Bay of Fundy rivers.

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Table 1. Fisheries removals (number of fish) of Atlantic salmon from rivers of the Maritime provinces, 1996 to 2000. Removals refer to losses to spawning resulting from the fishing activity. For the recreational fisheries, the removals include losses estimated to have occurred as a result of hook-and-release induced mortality. 2000 data are provisional.

			Aboriginal Fisheries Removals[1]										Recreational Fisheries Removals[1]									
			Small Salmon					Large Salmon					Small Salmon					Large Salmon				
River	SFA	Index	'96	'97	'98	'99	'00	'96	'97	'98	'99	'00	'96	'97	'98	'99	'00	'96	'97	'98	'99	'00
Restigouche System[2]	15	1&2	77	26	26	-	-	213	166	234	-	-	3395	2956	2958	2589	3131	1170	865	528	702	806
Matapédia	15	1	0	0	0	0	0	0	0	0	0	0	721	450	653	708	856	922	719	442	588	684
Restigouche-NB	15	2	77	26	26	-	-	37	11	37	-	-	2674	2506	2305	1881	2275	248	146	86	114	122
Jacquet	15	3	-	-	-	-	-	-	-	-	-	-	67	67	-	-	-	2	2	-	-	-
Nepisiguit	15	4	84	85	-	-	-	28	0	-	-	-	450	190	150	300	450	13	9	6	3	10
Tabusintac	16	5	171	-	18	31	-	187	-	18	19	-	76	75	16	38	75	2	2	2	3	3
Miramichi	16	6&7	2583	1197	1180	2400	2953	372	548	214	700	274	-	8311	-	-	-	-	152	-	-	-
NW Miramichi	16	6	1504	871	782	1700	2502	317	548	195	650	274	-	3153	-	-	-	-	46	-	-	-
SW Miramichi	16	7	1074	326	378	627	451	0	0	0	0	0	-	5158	-	-	-	-	106	-	-	-
Buctouche	16	8	25	25	Closed	Closed	Closed	4	5	Closed	Closed	Closed	21	5	Closed	Closed	Closed	1	0	Closed	Closed	Closed
Morell	17	9	17	1	28	0	28	0	0	0	0	0	405	201	237	150	73	4	1	2	3	0
River Philip	18	10	2	0	0	14	6	45	21	7	17	20	165	43	85	104	35	33	5	12	15	4
Wallace	18	11	-	-	-	-	-	-	-	-	-	-	20	13	30	11	10	4	5	3	3	1
Waugh	18	12	-	-	-	-	-	-	-	-	-	-	24		18	10	11	7	1	2	1	0
River John	18	13	-	-	0	-	-	-	-	18	-	-	22	25	21	17	5	6	3	2	3	1
West (Pictou)	18	14	-	-	0	-	-	-	-	12	-	-	57	5	32	30	14	10	1	5	8	2
East (Pictou)	18	15	11	0	3	0	11	49	40	15	12	2	34	23	29	26	12	14	3	6	8	2
Sutherlands	18	16	-	0	0	0	7	-	14	14	14	12	0	0	0	0	0	0	0	0	0	0
West (Antig.)	18	17	-	-	-	-	-	-	-	-	-	-	109	21	67	81	33	24	5	9	11	6
South	18	18	-	-	-	-	-	-	-	-	-	-	10	1	3	11	4	1	0	1	1	1

[1] "Closed" means no salmon fishing was allowed, "-" means no data were available, "0" means no removals occurred.
[2] Aboriginal fisheries removals exclude removals by the Listiguij First Nation in the estuary because the data are not available.

Table 1. (continued). Fisheries removals (number of fish) of Atlantic salmon from rivers of the Maritime provinces, 1996 to 2000. Removals refer to losses to spawning resulting from the fishing activity. For the recreational fisheries, the removals include losses estimated to have occurred as a result of hook-and-release induced mortality. 2000 data are provisional.

			Aboriginal Fisheries Removals[1]										Recreational Fisheries Removals[1]									
			Small Salmon					Large Salmon					Small Salmon					Large Salmon				
River	SFA	Index	'96	'97	'98	'99	'00	'96	'97	'98	'99	'00	'96	'97	'98	'99	'00	'96	'97	'98	'99	'00
Margaree	18	19	7	20	30	8	10	89	124	120	45	49	306	204	213	206	123	93	105	66	41	32
Middle	19	20	4	3	5	Closed	Closed	16	15	9	Closed	Closed	5	4	6	1	1	7	4	2	3	2
Baddeck	19	21	2	5	3	Closed	Closed	7	13	7	Closed	Closed	2	1	2	1	1	8	3	3	2	3
North	19	22	1	0	0	0	0	2	0	0	0	0	9	4	4	1	1	6	7	4	1	1
Grand	19	23	0	0	0	Closed	Closed	0	0	0	Closed	Closed	5	4	2	1	1	1	1	1	0	0
St. Mary's	20	24	0	0	Closed	Closed	Closed	0	0	Closed	Closed	Closed	60	8	22	1	Closed	18	3	0	0	Closed
Liscomb	20	25	Closed	Closed	Closed	Closed	-	Closed	Closed	Closed	Closed	-	0	0	Closed	0	0	0	0	Closed	0	0
East Sheet Hbr.	20	26	13	0	0	0	0	0	0	0	0	0	16	1	0	2	0	0	0	0	0	0
LaHave	21	27	220	58	Closed	42	Closed	0	0	Closed	Closed	Closed	1131	377	Closed	7	Closed	33	17	Closed	3	Closed
Mersey	21	28	-	-	-	-	-	-	-	-	-	-	5	1	3	4	6	-	-	-	-	-
Jordan	21	29	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	-	-	-	-	0
Clyde	21	30	-	-	-	-	-	-	-	-	-	-	40	19	3	8	34	-	-	-	-	0
Annapolis	22	31	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Gaspereau	22	32	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Stewiacke	22	33	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Big Salmon	23	34	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Saint John at / abv Mactaquac	23	35	675	361	Closed	154	105	285	265	Closed	76	18	50	24	Closed	Closed	Closed	25	15	Closed	Closed	Closed
Nashwaak	23	36	-	-	Closed	Closed	Closed	-	-	Closed	Closed	Closed	14	5	Closed	Closed	Closed	5	3	Closed	Closed	Closed
Kennebecasis	23	37	-	-	Closed	Closed	Closed	-	-	Closed	Closed	Closed	-	-	Closed	Closed	Closed	-	-	Closed	Closed	Closed
Hammond	23	38	-	-	Closed	Closed	Closed	-	-	Closed	Closed	Closed	-	-	Closed	Closed	Closed	-	-	Closed	Closed	Closed
Magaguadavic	23	39	0	0	Closed	Closed	Closed	0	0	Closed	Closed	Closed	<1	<1	Closed	Closed	Closed	1	<1	Closed	Closed	Closed
St. Croix	23	40	0	0	Closed	Closed	Closed	0	0	Closed	Closed	Closed	<1	<1	Closed	Closed	Closed	<1	<1	Closed	Closed	Closed

[1] "Closed" means no salmon fishing was allowed, "-" means no data were available, "0" means no removals occurred.

[2] Aboriginal fisheries removals exclude removals by the Listiguij First Nation in the estuary because the data are not available.

Table 2. Summary of stock status of Atlantic salmon in the Maritime provinces. All 2000 information is provisional.

River	SFA	Method	Map Index	Returns in 2000		% hatchery Origin	Conservation Met			Abundance			Potential Constraints To Production
				Small	Large		In 2000 Returns	In 2000 Escapement	in 1984 - 2000	All Juveniles	Adults Wild	Hatchery	
Restigouche System	15	Ang	1&2	13000	11000	< 1%	No	No	9 of 16⇔				
Matapédia	15	Vi	1	1586	2583	0%	227%	166%	7 of 7⇔	High	Med		
Restigouche NB	15	Ang	2	11000	8500	< 1%	< 85%	<85%	9 of 16⇔	High⇧	Med⇔		
Jacquet	15	Fe	3	-	-	0%	-	-	2 of 5🡻				
Nepisiguit	15	RC	4	-	1900	?	> 100%	>100%	10 of 14⇔	Med⇧	Med	Low🡻	
Tabusintac	16	-	5	-	-	0%	-	-	5 of 5	Med⇔	Med⇔		
Miramichi	16	MR	6&7	35600	18200	< 2%	95%	<95%	11 of 17⇔	High⇔	Med🡻	Low ⇔	
NW Miramichi	16	MR	6	12900	4700	< 2%	87%	<87%	6 of 9⇔	High⇧	Med🡻	Low ⇔	
SW Miramichi	16	MR	7	22600	13100	< 1%	97%	<97%	5 of 9🡻	High⇔	Med🡻	Low ⇔	
Buctouche	16	CR	8	38	100	18%	36%	36%	1 of 8 ⇔	Low	Low⇔	Low	
Morell	17		9			86%			8 of 14	Low⇧	Low	Low	LU
River Philip	18	Ang	10	80	170	0%	50%	40%	6 of 9⇔	Med⇔	Med⇔		
Wallace	18	Ang	11	-	-	0%	<100%	<100%	1 of 6⇔	Low	Low⇔		
Waugh	18	Ang	12	-	-	0%	<100%	<100%	1 of 6⇔		Low⇔		
River John	18	Ang	13	-	-	0%	<100%	<100%	2 of 6⇔		Low⇔		
West (Pictou)	18	Ang	14	40	70	0%	50%	50%	5 of 6⇔		Med⇔		
East (Pictou)	18	Ang	15	50	60	0%	35%	34%	6 of 9⇔	Med⇔	Low⇔		
Sutherlands	18	Vi	16	>10	>14	0%	-	60%	5 of 6⇔		Med⇔		
West (Ant.)	18	Ang	17	130	230	0%	66%	65%	6 of 9⇔	High⇧	Med⇔		
South	18	Ang	18	30	44	0%	64%	62%	-				Fp

Assessment methods: Ang = angling catches and assumed exploitation rates; CR = catch rate index; RC = redd count; Fe = counting fence; Fw = fishway; MR = mark and recapture experiment; Electro = electrofishing; Sh = shore count; Vi = snorkel count; ViM = snorkel count and mark/recapture calibration

Map index numbers refer to text figure and legend.

Trend symbols (over recent ten years): 🡻 = decline; ⇔ = no change; ⇧ = increase

Potential constraints to production: Ac = acid impacted rivers; Aq = aquaculture escapes; Fp = fish passage constraints; LU = land use practices; WU = water use practices

Table 2. (continued). Summary of stock status of Atlantic salmon in the Maritime provinces. All 2000 information is provisional.

River	SFA	Method	Map Index	Returns in 2000 Small	Returns in 2000 Large	% hatchery origin	Conservation Met: In 2000 Returns	Conservation Met: In 2000 Escapement	Conservation Met: in 1984 - 2000	Abundance: All Juveniles	Abundance: Adults Wild	Abundance: Hatchery	Potential Constraints To Production
Margaree	18	Ang	19	459	1439	3%	140%	120%	16 of 16	High⇔	High⇔	Low⇔	
Middle	19	ViM	20	48	232	0%	50%	40%	2 of 12	High⇔	Low⇔	-	
Baddeck	19	ViM	21	22	154	0%	33%	28%	0 of 7	High⇔	Low⇔	-	
North	19	Ang	22	64	56	0%	<100%	<100%	14 of 16	Med⇔	Low🡻	-	
Grand	19	Fw	23	-	-	0%	<100%	<100%	7 of 13	Low⇔	Low🡻	-	Fp
St. Mary's	20	MR	24	474	235	0%	16%	16%	8 of 17🡻	Med⇔	Low🡻	-	Ac
Liscomb	20	Fw	25	-	-	-	-	-	0 of 16🡻	Low⇔	Low🡻	Low🡻	Ac, Fp
East Sheet Hbr	20	Fw	26	51	1	98%	-	-	-	-	Low🡻	Low🡻	Ac, Fp
LaHave	21	Fw	27	794	120	38 %	91%	63%	7 of 17🡻	Med⇧	Med⇔	Med⇔	Ac, Fp
Mersey	21		28			100%	-	-	-	-	-	-	Ac, Fp
Jordan	21		29			100%	-	-	-	-	-	-	Ac
Clyde	21		30			100%	-	-	-	-	-	-	Ac
Annapolis	22	Fw	31	-	-	20%	No	No	0 of 16	-	-	-	
Gaspereau	22	Fw	32	46	21	63%	16%	9%	0 of 4	Low	Low	Low	WU, Fp, Aq
Stewiacke	22	Electro	33	-	-	-	-	-	0 of 11	Low🡻	Low🡻	Low🡻	
Big Salmon	23	Sh+Vi	34	-	-	0%	-	-	1 of 12	Low	Low	-	
Saint John at / abv. Mactaquac	23	Fw	35	3068	544	55%	15%	11%	2 of 17🡻	Low ⇔	Low🡻	Med⇔	Fp, LU, WU
Nashwaak	23	Fe/MR	36	510	190	0%	15%	15%	0 of 8⇔	Low🡻	Low⇔	Low🡻	LU, WU
Kennebecasis	23	Electro	37	-	-	0%	-	-	-	Low🡻	-	-	Aq, LU
Hammond	23	Electro	38	-	-	-	-	-	-	Med⇔	-	-	Aq, LU
Magaguadavic	23	Fw	39	13	1	0%	2%	2%	3 of 12🡻	-	Low🡻	-	Fp, Aq, WU
St. Croix	23	Fw	40	15	5	100%	<1%	<1%	0 of 16🡻	-	Low🡻	Low🡻	Fp, Aq, WU

Assessment methods: Ang = angling catches and assumed exploitation rates; CR = catch rate index; RC = redd count; Fe = counting fence; Fw = fishway; MR = mark and recapture experiment; Electro = electrofishing; Sh = shore count; Vi = snorkel count; ViM = snorkel count and mark/recapture calibration

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