

## Atlantic Salmon Maritime Provinces Overview for 1998

### 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.

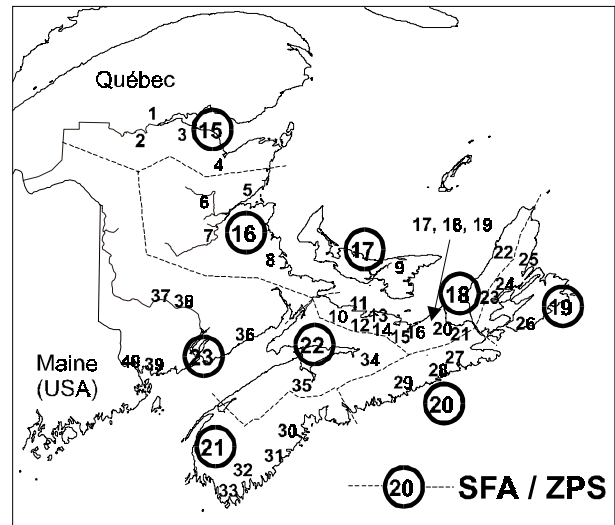
Spawning populations consist of varying proportions of small salmon (fork length <63 cm) and large salmon (fork length >= 63 cm). In the majority of rivers, small salmon are predominantly maiden fish (never spawned before) which have spent one year at sea before returning to spawn (one-sea-winter salmon, 1SW). The large salmon component 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.

Conservation for Atlantic salmon is considered to be a threshold reference point. The consequences of egg depositions below conservation 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<sup>2</sup> 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.

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,
- Southern Gulf of St. Lawrence rivers are characterized by declining through stable through slight increased abundance.



### Index of Rivers

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

### Summary

- In response to client demands to advance the announcement of management plans for Atlantic salmon, early assessments were conducted on all the Maritime salmon stocks in January 1999. Where potentially critical to management considerations, new and more refined analyses will be reviewed in March 1999 and advice updated accordingly.

- **In Chaleur Bay (SFA 15)**, the Restigouche River (in New Brunswick) fell short of the conservation requirement in 1998 but returns in 1999 may meet the requirement. Similarly, requirements may be met on the Jacquet River but are not expected to be achieved on the Nepisiquit River. Small salmon in these rivers are predominantly male and their current harvest generally is not limiting stock conservation.
- **In SFA 16**, the Miramichi River failed to meet the conservation requirements in 1998 for the second year in a row. The outlook for 1999 is for a modest increase in returns of large salmon over 1998, but uncertainty exists as to whether the improved returns will be sufficient to meet conservation requirements. The early-run small salmon have a high female proportion (>25%) and their harvest in 1999 would have a greater impact on conservation than the harvest of fall-run small salmon. The Tabusintac River exceeded the conservation requirement again in 1998 and is expected to repeat in 1999, whereas the Buctouche River, an index river for New Brunswick Northumberland Strait rivers, achieved only a third of the conservation requirement in 1998, thereby failing to meet the requirement for the sixth consecutive year.
- The majority of salmon returning to the Morell (95% in 1998) and other PEI rivers (**SFA 17**), since the mid-1980s, have been of hatchery origin. Because of this, the current fisheries are having little impact on future runs, although the selective harvest of hatchery salmon (those with a missing adipose fin) would enhance protection of the few returning wild salmon.
- **In Northumberland Strait**, mainland Nova Scotia rivers (**part of SFA 18**), conservation requirements continue to be exceeded and are expected to be met in almost all rivers in 1999.
- **On Cape Breton Island (part of SFA 18 and SFA 19)**, conservation requirements continue to be exceeded in the Margaree and probably other west coast Cape Breton rivers. Continued exploitation at current levels should not be a conservation concern. In contrast, North River appears to be the only assessed river in SFA 19 (eastern Cape Breton) that met the conservation requirement in 1998 and the only assessed river expected to achieve its requirement in 1999.
- Salmon returns to rivers along the Atlantic Coast of mainland Nova Scotia (**SFAs 20 and 21**) were insufficient to meet conservation requirements in 1998. Egg depositions in these rivers are contributed equally by small and large salmon. Wild returns in 1999 are not expected to be sufficient to meet requirements for any of the rivers. Returns in 1999 may be above conservation requirements in some rivers supplemented by hatchery stocking. The acid impacted rivers dependent on stocking, which include the East River Sheet Harbour, Mersey, Clyde and Jordan rivers, are expected again to yield returns available for harvest, considering these rivers have no conservation requirements.
- **Inner Bay of Fundy (SFA 22 and part of SFA 23)** salmon stocks are critically low, should not be harvested, and require immediate action to prevent their extirpation.

• **Outer Bay of Fundy (western part of SFA 23)** stocks did not meet conservation requirements in 1998 and probabilities of achieving requirements in 1999 are virtually zero. Egg depositions for the Saint John River stock upriver of Mactaquac reached a low in 1998 of 16% of the conservation requirement. Wild salmon returns were the lowest since the completion of Mactaquac Dam in 1968. The Nashwaak River stock is assumed to be representative of stocks of the Saint John River downstream of Mactaquac and achieved only 31% of its requirement. Stocks of other outer Bay of Fundy rivers (e.g., Magaguadavic River) have declined dramatically in the last decade and action is required to prevent their extirpation.

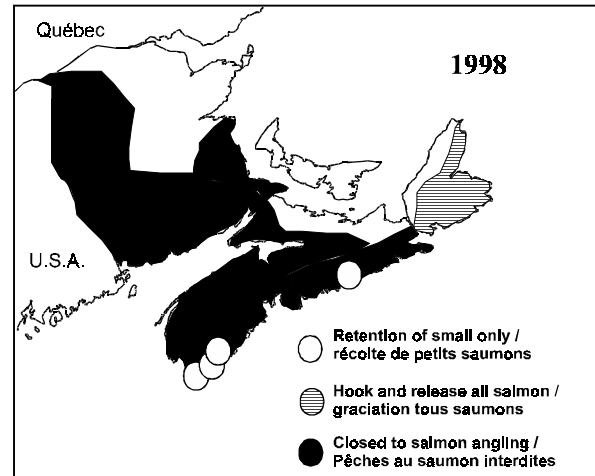
### *The Fishery*

Atlantic salmon were harvested by two user groups in 1998: 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 1998 occurred only in the southern Gulf of St. Lawrence rivers, generally in accordance with agreements and communal fishing licenses. Several 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, when retention angling fisheries for small salmon were allowed only in the southern

Gulf of St. Lawrence, and in four acid-toxic rivers of the Atlantic coast.

### Angling Management in 1998



In northern New Brunswick only (SFA 15 and 16), the daily small salmon retention limit was reduced from two to one fish and the maximum daily catch limit was reduced from four to two fish. For the Miramichi River only, the daily catch limit was relaxed to four fish per day after a mid-July in-season review. Season bag limits remained unchanged from previous years in all areas with angling fisheries in 1998.

Other management measures in effect in 1998, which potentially affected the salmon stocks from the Maritime provinces, include the seventh year of the commercial salmon moratorium for insular Newfoundland, the first closure of the entire Labrador commercial fishery, and a voluntary buy-back of the remaining commercial fishery along the Québec north shore.

There was a small commercial fishery (58 t) at west Greenland in the August and September of 1997 which was estimated to have intercepted about 13,000 salmon. These fish were destined to return as large salmon to North America in 1998.

Reported harvests in aboriginal fisheries in 1998 declined in the Gulf New Brunswick rivers with greater declines for small salmon than for large salmon. In Gulf shore Nova Scotia, aboriginal harvests in 1998 were unchanged or increased minimally from previous years (Table 1).

Removals (kept plus mortalities from hook and release angling) of large salmon in the recreational fisheries of the Restigouche River were down substantially from previous levels but removals of small salmon increased slightly (Table 1). For the Miramichi River, the removals of small salmon and large salmon from the crown reserve waters were similar to the previous five-year mean (-2% and +4%, respectively). Removals of small salmon in the Gulf shore of Nova Scotia rivers in 1998 were similar to removals in recent years.

### ***Resource Description***

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, from 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.

Updates are presented for 40 rivers in 1998. Estimates of returns are based on various

techniques ranging from entire counts (such as fishways) to indices of abundance based on catch rates (Table 2). In the absence of river-specific salmon escapement information and where quantitative electrofishing for juvenile salmon has been conducted, the status of stocks were assessed relative to P.F. Elson's "normal index of abundance" for Maritime streams of 29 fry per 100 m<sup>2</sup> and 38 older parr per 100 m<sup>2</sup>.

### **Chaleur Bay (SFA 15)**

SFA 15 includes northern New Brunswick rivers of which the major ones are the Restigouche, Jacquet and Nepisiguit rivers.

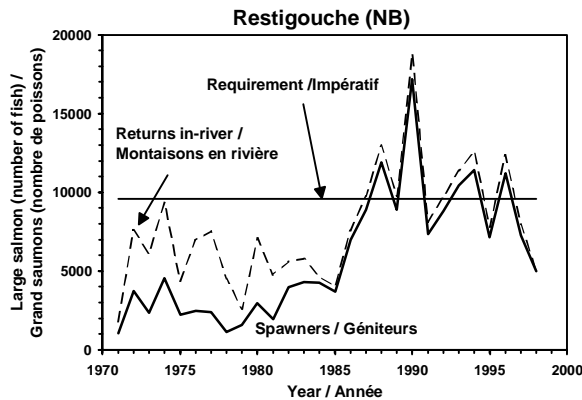
The Restigouche River was assessed as two components. The Matapédia River (PQ) empties into the Restigouche River just above the head-of-tide and is managed by the province of Québec. Most of the remaining watershed, referred to as Restigouche (NB) is in New Brunswick or borders the two provinces. The conservation requirements for the Matapédia River are based on 1.68 eggs per m<sup>2</sup> whereas the Restigouche (NB) has a conservation requirement based on 2.4 egg per m<sup>2</sup>. This discrepancy is under review.

### *Status*

Returns to the **Matapédia River** in 1998 were estimated at 2,084 large salmon and 1,473 small salmon; a decline of 8% in the total returns from 1997 and declines of 38% and 18% for 1996 and 1995, respectively. The end-of-year escapement to the Matapédia River was estimated at 1,643 large salmon and 823 small salmon. For the Matapédia River, conservation requirements are based on an egg deposition rate of 1.68 eggs per m<sup>2</sup>. Spawning escapement in 1998 was estimated to have exceeded the

conservation requirement for the fourth consecutive year. Conservation requirements were not achieved between 1984 and 1994.

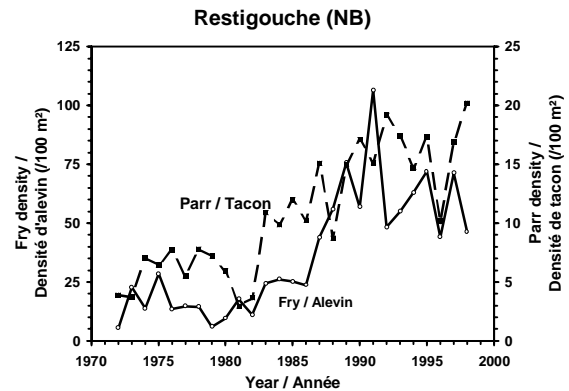
Returns to the **Restigouche (NB)** were estimated at 5,000 large salmon and 9,000 small salmon. The escapement of about 5,000 large salmon (loss of 86 fish from the fisheries) was a 31% decline from 1997 and a 47% decline from the previous five-year average. Spawning escapement in 1998 was the lowest since 1985 but remained above the spawning escapements estimated during 1971 to 1985.



Conservation requirements for the Restigouche (NB) of 55 million eggs are based on 2.4 eggs per m<sup>2</sup> and would on average be obtained from 9,600 large salmon. The estimated escapement of 5,000 spawners in 1998 represents just over 50% of the requirement with a 4% chance that the conservation requirement was achieved. Point estimates of the escapements since 1984 indicate conservation requirements were met in five of the last 15 years.

Use of the Matapédia egg deposition requirement (1.68 eggs per m<sup>2</sup>) for the Restigouche (NB) would indicate that the conservation requirement (6,500 large salmon) was met or exceeded every year since 1986, except for 1998.

Densities of both fry (young-of-the-year) and small and large parr from index sites sampled annually since 1972 remain at greatly improved levels relative to the 1970s and early 1980s. Annual variations in densities represent both variations in egg depositions and survival rates.



Counts of small salmon at the protection barrier at the mouth of the **Jacquet River** in 1998 were improved (8%) from 1997 but large salmon counts were down 22% from 1997 and were the lowest of record. A fence washout in October may have resulted in an underestimation of the returns in 1998. Conservation requirements of 3.8 million eggs would be obtained from 571 large salmon. About 55% of conservation requirements were achieved in 1998, the lowest of record.

Jacquet River				
Year	Returns		Egg Depositions	
	Small salmon	Large salmon	% of conservation	by large salmon
1994	613	595	109%	95%
1995	344	589	106%	98%
1996	634	359	67%	92%
1997	372	384	70%	96%
1998	402	298	55%	95%

The preliminary assessment for the **Nepisiguit River** in 1998 indicates that there was no improvement in status from recent years. Since 1982, the conservation requirements have only been met/exceeded in two years and since 1994, egg depositions

have remained at 50-60% of requirements. Juvenile abundance increased during the 1990s. The contribution of hatchery-stocked fish is difficult to determine since the majority of 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 1999.

Expectations for the **Restigouche (NB)** are based on the mean values of small and large salmon returns in the previous five years. There is a 50% chance that returns of large salmon in 1999 will meet or exceed the conservation requirements in the Restigouche (NB) waters. The relatively high juvenile abundance levels observed since 1990 suggest that returns should be similar to those of the last five years. Small salmon returns should continue to exceed 8,000 fish with a high probability (68% chance).

For the **Jacquet River**, declining abundance of large salmon since 1994 suggests that the returns in 1999 will be below conservation requirements.

No improvements from recent years in returns to the **Nepisiguit River** are expected in 1999.

#### *Management Considerations*

Large salmon returning to the **Restigouche River (NB)** in 1998 were short of the conservation requirement but returns in 1999 may meet the requirement (50% chance). Losses of large salmon to fishing in 1999 will reduce the probability of meeting the conservation requirement to below 50%. If fisheries proceed as last year on the Restigouche, the probability of achieving conservation requirements is about 40%; if all retention fisheries were closed, this probability rises to 47%; if all fisheries are closed, the probability rises to 50%.

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

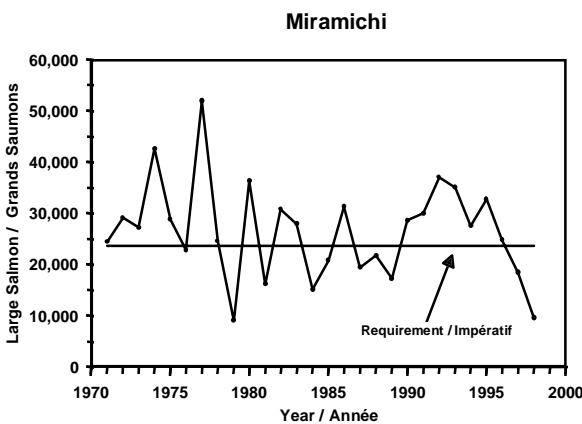
Small salmon returning to the **Restigouche** and **other rivers** are predominantly male and contribute minimally to egg depositions. Escapements of small salmon in recent years have exceeded the conservation requirements based on a 1:1 sex ratio. Harvests in recent years have not jeopardized achievement of the 1:1 sex ratio.

#### **Miramichi and Southeast Gulf New Brunswick (SFA 16)**

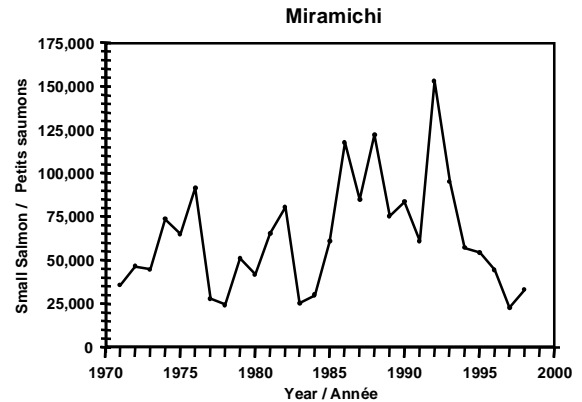
SFA 16 includes the Miramichi River, the largest salmon producing river of eastern Canada, and numerous small coastal rivers along the Northumberland Strait shore of New Brunswick. The Northwest and Southwest branches of the Miramichi River are assessed separately. Other rivers assessed in 1998 include the Buctouche and Tabusintac rivers.

Status

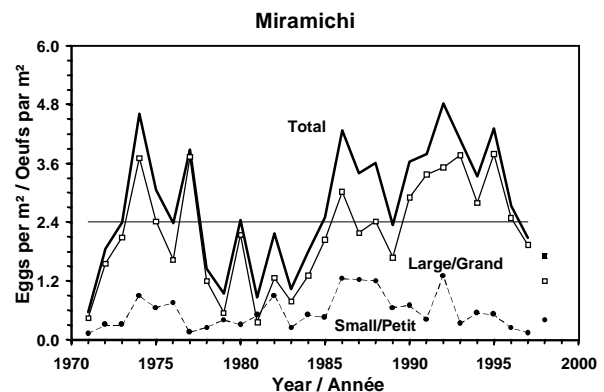
The estimated return of 9,500 large salmon (7,500 - 12,500) to the **Miramichi River** in 1998 was the second lowest of record. About 7,000 large salmon (6,000 - 9,500) returned to the **Southwest Miramichi** and 2,200 large salmon (2,100 - 3,100) returned to the **Northwest Miramichi**, representing declines relative to 1997 of 36% for the Southwest Miramichi and 70% for the Northwest Miramichi. The low abundance of large salmon in 1998 was not unexpected given the low returns of small salmon in 1997. Additionally, the low abundance in 1998 was the result of a very low return of fish during the fall.



Small salmon returns in 1998 were 33,000 fish (27,500 - 41,000), up 46% from the record low return in 1997. A total of 24,000 small salmon (19,000 - 32,000) returned to the Southwest Miramichi, up 78% from 1997, whereas 7,900 small salmon (6,200 - 10,700) returned to the Northwest Miramichi, a decline of 19% from 1997. Small salmon run timing in 1998 was similar to previous years when about 50% of the total run occurred early.



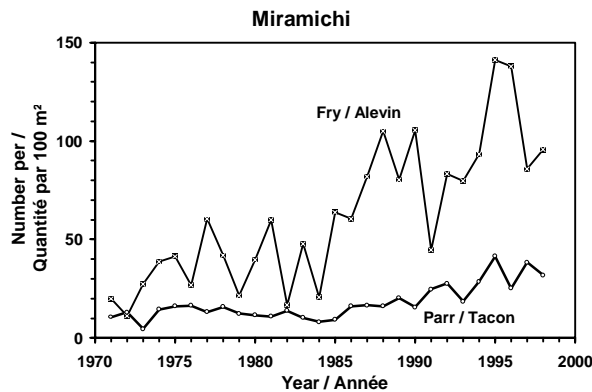
Conservation requirements for the Miramichi River of 132 million eggs would be contributed on average by 23,600 large salmon. Egg depositions by all salmon returning to the Miramichi River (before any removals) would have equalled about 70% of the conservation requirements (54 - 88%). Egg depositions by large salmon alone would have equalled 50% of requirements. In the Southwest Miramichi, egg depositions at most would have equalled about 70% (50 - 96%) of conservation requirement of 88 million eggs whereas in the Northwest Miramichi, egg depositions would have been 50% (42 to 79%) of the 41 million conservation egg requirement. Egg depositions after accounting for removals were less than these values.



Small salmon could potentially have contributed 36% of the total eggs in the Northwest Miramichi and 24% of the total in the Southwest Miramichi. Egg depositions in

1998, even before accounting for removals, were the lowest since 1984.

Densities of both fry (young-of-the-year) and small and large parr estimated annually at index sites remain at higher levels than those of the 1970s and early 1980s. Annual variations in densities represent both variations in egg depositions and survival rates.



Estimated returns and escapements to the **Tabusintac River** have been more than double the conservation requirements in every year assessed (1993, 1994, 1996 and 1998). Conservation requirements were in all likelihood exceeded during 1998.

Quality spawning and rearing habitat on the **Buctouche River** appears to be limited. Returns of large salmon have varied between 95 and 225 fish between 1993 and 1998 with the 1998 return the lowest since 1993. Small salmon returns have generally been about 100 fish annually with the 1998 returns the second highest since 1993. Egg depositions relative to conservation have at best been 72% of the requirement (in 1994) and were the lowest in 1998 at 33% of the requirement.

**Buctouche River**

	1993	1994	1995	1996	1997	1998
Returns (number of fish)						
Small	78	77	98	127	97	120
Large	95	225	154	134	200	102
Egg depositions (as % of conservation requirement)						
	35%	72%	58%	46%	70%	33%

Juveniles are generally found throughout the river with the highest concentrations in the South Branch but abundance is low compared to levels in the Miramichi River. Egg-to-summer fry survival rates are low suggesting there may be a habitat constraint at that life stage. Parr survival rate as inferred from stocking of fall fingerlings does not appear to be a constraint.

*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. Based on the previous five-year mean, adult returns of 22,600 large salmon (7,900 - 37,300) and 42,000 small salmon (18,000 - 66,000), there is a 72% chance that eggs from returns of large and small salmon in 1999 will meet or exceed the conservation requirements for the Miramichi River. The probabilities of meeting or exceeding conservation for the **Northwest Miramichi** are 79% and for the **Southwest Miramichi**, 62%.

For the **Tabusintac River**, the conservation requirement has been exceeded for the four years the stock was assessed. The expectation is for this stock to continue meeting or exceeding the conservation requirement.

The conservation requirement for the **Buctouche River** was not met between 1993 and 1998. Based on the average returns of the last five years, there is a 1% chance of



meeting the conservation requirement in 1999.

### *Management Considerations*

The **Miramichi River** did not meet conservation requirements in 1998 for the second year in a row. The outlook for 1999, determined as the mean of returns in the previous five years, may be overly optimistic considering the downward trend in recent years. Regardless, a modest increase in returns of large salmon over 1998 is expected, but uncertainty exists as to whether the improved return will be sufficient to meet conservation requirements.

Small salmon returns to the **Miramichi River** in 1998 increased modestly over 1997 returns but were the second lowest since 1984. In 1998, the relative pre-fishery contribution to egg depositions by small salmon in the Miramichi could have exceeded 25% because of the low abundance of large salmon. The early-run small salmon have a higher female proportion (>25%) than fall-run fish (10%), and fisheries harvesting early-run small salmon in 1999 will have a greater impact on achieving conservation requirements than fisheries removing fall-run fish.

If fisheries proceed as last year on the Miramichi, the probability of achieving conservation requirements is about 51% on the **Southwest** and 68% on the **Northwest** tributaries; if all retention fisheries were closed, these probabilities rise to 61% and 79%. The probability of meeting conservation requirements appears relatively insensitive to various angling management scenarios for small salmon that considered early season hook-and-release followed by retention compared to early season retention followed by late-season hook-and-release. In

both cases chance of meeting conservation requirements changed by only 2%.

The **Tabusintac River** exceeded the conservation requirement again in 1998 and is expected to repeat in 1999.

The **Buctouche River**, an index river for New Brunswick Northumberland Strait rivers, achieved only a third of conservation requirement in 1998, thereby failing to meet the requirement for the sixth consecutive year.

### **SFA 17 (Prince Edward Island)**

The principal salmon river on Prince Edward Island is the Morell.

#### *Status*

The **Morell River** receives heavy silt loading from agriculture and other sources, which limits availability of clean gravel bottom for spawning and rearing. In three of the past four years, egg deposition in the west branch of the river was below the conservation requirement. A high proportion of salmon returning to the river are of hatchery origin (95% in 1998). Juvenile densities in 1998 were similar to those of recent years.

**Other PEI rivers** which are stocked with Atlantic salmon suffer intense siltation, and have returns which are far below conservation requirements.

#### *Outlook*

Based on recent years experience, 1999 returns to the **Morell** will probably not meet the conservation requirement, but broodstock needs for the stocking program (50 fish) will be met. Egg deposition has

little influence on future returns because most returns are of hatchery origin. Returns in 1999 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*

Since the mid-1980s, the majority of salmon returning to the **Morell** (95% in 1998), and **other PEI rivers**, have been of hatchery origin. Because of the high proportion of hatchery fish in returns, runs are largely independent of egg deposition in the rivers. Removals of small salmon in aboriginal and recreational fisheries, and hook-and-release fisheries on small and large salmon, have little impact on future runs, which are largely dependent on stocking levels.

Low numbers of natural spawned salmon returning to **PEI rivers** continue to be exploited in directed fisheries even though these could be distinguished from stocked salmon on the basis of the presence of an adipose fin. Selective harvest of stocked salmon (those with a missing adipose fin) would enhance protection of the few returning wild salmon.

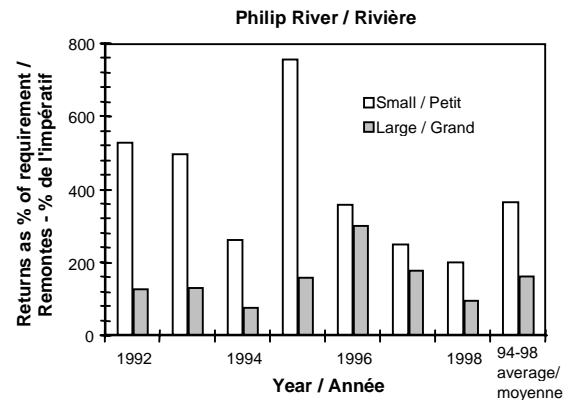
**Northumberland Strait Nova Scotia (part of SFA 18)**

Fifteen rivers on the Northumberland Strait shore of Nova Scotia support Atlantic salmon stocks. Stock status information for 1998 is provided for eight of these stocks. The Atlantic salmon stocks of the Northumberland Strait area typically enter

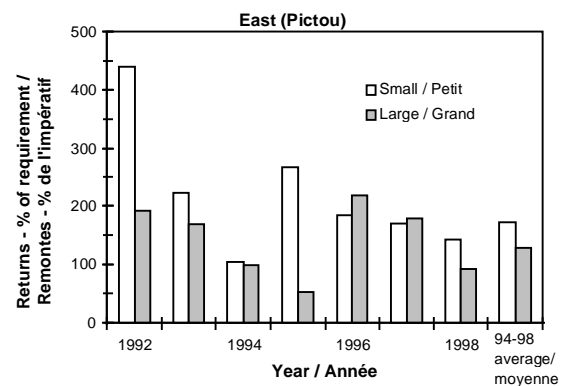
rivers in late autumn, usually after September 15.

*Status*

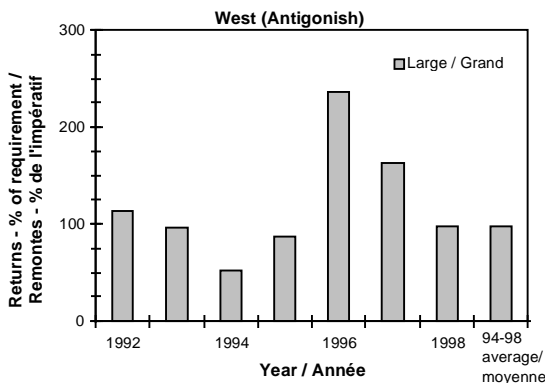
The estimated return of salmon to **River Philip** in 1998 was 350 large and 150 small fish. Escapements were 333 large (206 - 2,482) and 72 small salmon which were 96% and 93% of the respective conservation requirements of 358 large and 75 small fish. Although the escapement in 1998 was down somewhat from 1997 and the previous five-year average, it represents the fourth year in a row that conservation requirements were approximately met or exceeded.



Returns to **East River (Pictou)** of 263 large salmon and 84 small salmon were similarly near the conservation requirements of 271 large and 57 small fish. Escapements were estimated at 241 large and 52 small salmon.

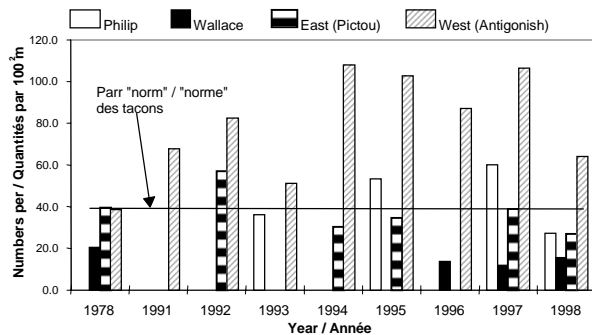


**West River (Antigonish)** Atlantic salmon returns have exceeded or approximately met the conservation requirements of 353 large and one small salmon for the third consecutive year. Escapements of large salmon in 1998 were estimated to be 95% of the requirement.



Returns to the other rivers in the area also approximated the conservation requirements. Exceptions were the **Wallace River** and **River John**. Returns to these two rivers over the past several years have been variable and not in synchrony with returns to the other area rivers.

Fry and parr densities on most rivers in this area have consistently remained at or above the Elson norms. Juvenile numbers on the Wallace River have been lower than those on neighbouring rivers.



*Outlook*

Forecasts of returns to the three principal rivers of the area, East River (Pictou), River Philip, and West River (Antigonish) are based on five-year averages for both large and small salmon.

Average returns to **East River (Pictou)** were 170% (62 - 193%) and 130% (116 - 231%) of the requirement for small and large salmon, respectively. The probability of achieving the conservation level for large fish in 1999 is 68%.

On **River Philip**, the mean number of returns during the past five years for small salmon was about 370% (152 - 582%) and for large salmon, about 160% (80 - 246%) of the requirement. The probability of reaching the spawning requirement for large salmon in 1999, based on the five-year average, is 77%.

Large salmon returns averaged over the past five years for **West River (Antigonish)** were about 130% (57 - 197%) of the conservation requirement with a probability of achieving this level of 67%. The number of small salmon spawners which could be surplus, if consistent with the five-year average, would be about 260 (105 - 409) fish.

*Management Considerations*

Based on indicator rivers, it is expected that returns to almost all rivers will meet or exceed conservation requirements in 1999. The level of directed fisheries exploitation in recent years generally has not been of concern to conservation.

Small salmon in these rivers are predominantly male (95% or more). Returns

and spawning escapements of small salmon in recent years have exceeded the conservation requirements and returns in excess of requirements are anticipated in 1999.

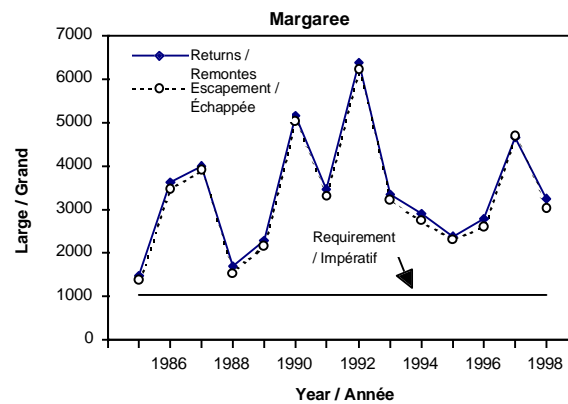
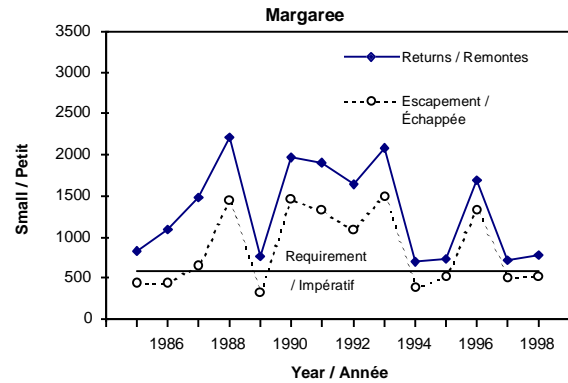
Returns (as inferred from angling catches and parr densities) to **Wallace River** and **River John** appear inconsistent with returns to other rivers of the area and warrant a cautionary approach to their management in 1999.

**Cape Breton (SFA 19 and part of SFA 18)**

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 are of excellent water quality and without 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.

*Status*

Estimates of salmon returning to the **Margaree** in 1998 were 774 small and 3,260 (2,300 - 5,700) large salmon. Small salmon returns are similar to those of 1994, 1995 and 1997 but only 65% of the mean of 1993 - 1997. Large salmon are down 30% from 1997 but equal the mean of the previous five years. Escapements numbered about 500 small and 3,000 large salmon. Hatchery stocked fish may have comprised 5-10% of the total.

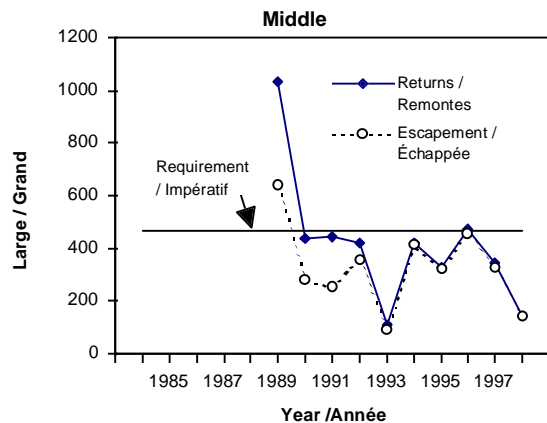
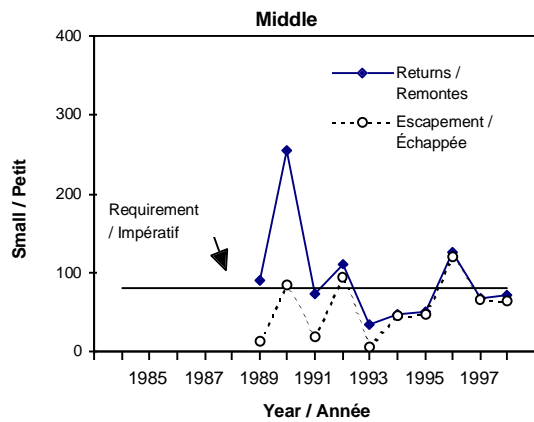


Conservation requirements are 1,036 large salmon and 582 small salmon. In 1998, small salmon escapement was about 85% of requirement, and large salmon were about 290% of requirement. The egg requirement (6.7 million eggs) has been exceeded in every year since 1985.

Mean juvenile densities in 1998, not unlike those of recent record, were 167 fry per 100 m<sup>2</sup> and 75 parr per 100 m<sup>2</sup>, 5.8 and 1.8 times the Elson norms and are consistent with escapements of two to six times the conservation requirement.

Approximate returns and escapement to the **Middle River** were 222 salmon (157 - 421) comprised of 70 small, 143 large and 9 farmed salmon escapees. Estimated returns of small and large salmon (combined) have

been decreasing and were fewer than in any year since 1993.

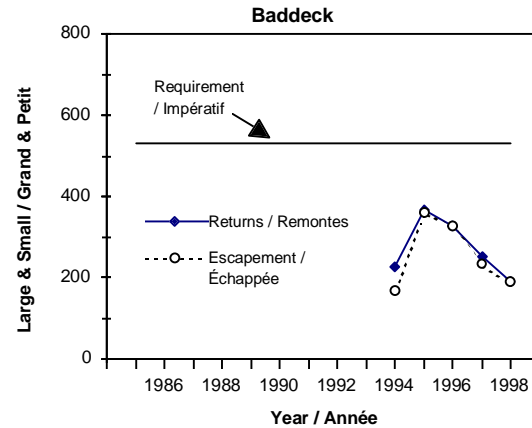


The conservation requirement for the Middle River of 2.07 million eggs is expected from 470 large and 80 small salmon. Small salmon were about 85% of requirement, and large salmon were 30% of requirement. The probability that returns equalled the requirement is less than 1%.

Mean juvenile densities of 29 fry per 100 m<sup>2</sup> and 52 parr per 100 m<sup>2</sup> for two mainstem sites on Middle River in 1998 were 1.0 and 1.4 times the Elson norms. Monitoring since 1995 found densities to be at or slightly above norms.

Approximate returns and escapement to the **Baddeck River** in 1998 were estimated at

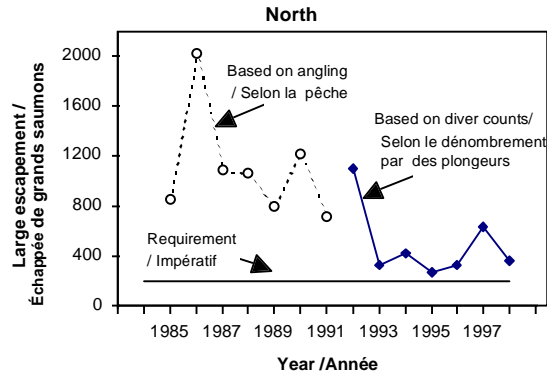
195 (127 - 503) salmon comprised of 51 small, 139 large and 5 farmed escapees. Estimated returns of small and large salmon are fewer than any year since 1994 and 78% of those of 1997 and 66% of the previous four-year mean.



The conservation requirement for the Baddeck River is 2.0 million eggs, expected from 450 large and 80 small salmon. Total escapement in 1998 met about 35% of the conservation requirement and the probability that returns equalled the requirement is 4%.

Mean juvenile densities of 64.7 fry per 100 m<sup>2</sup> and 30.1 parr per 100 m<sup>2</sup> for three mainstem sites on Baddeck River in 1998 were 2.2 and 0.8 times the Elson norms. Monitoring since 1996 indicates that densities of fry fluctuate above while densities of parr fluctuate around the Elson norms.

Approximate returns and escapement to the **North River** in 1998 were estimated at 488 (311 - 1,438) salmon comprised of 74 small, 359 large and 55 farmed escapees.



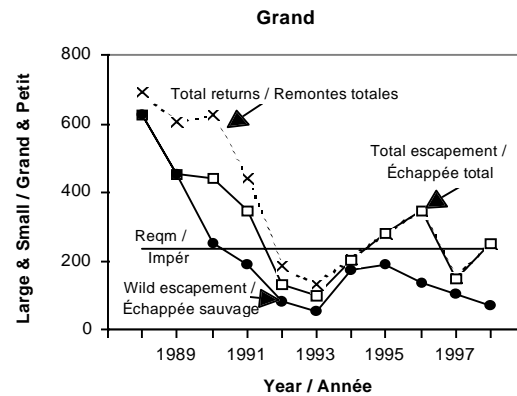
The conservation requirement for the North River is 0.85 million eggs expected from 200 large and 30 small salmon. In 1998, excluding farmed escapees, escapements were about 190% of requirements. There is a greater than 99% probability that the estimated returns met conservation requirements.

Mean juvenile densities of 79.4 fry per 100 m<sup>2</sup> and 21.6 parr per 100 m<sup>2</sup> for four mainstem sites on North River in 1998 were 2.7 and 0.6 times the Elson norms. Monitoring, mostly at different sites during 1996 and 1997, indicated that fry approximated the norm and parr were less than the norm.

**Grand River** is obstructed to salmon passage at low discharge by a falls located 10.2 km above head-of-tide. A fishway at the falls by-passes about 60% of small and 43% of large salmon that approach it (most salmon are small, the few large fish are usually repeat-spawning 1SW fish). About 45% of the total juvenile production area is above the falls. Hatchery fish were last stocked in 1997 and served only to supplement returns in 1998.

The fishway count of wild and hatchery-origin salmon in 1998 was 112 small and eight large fish. Based on this, the estimate of returns upstream of the falls is about 250

salmon of which 72% was hatchery origin. Approximate returns and escapement of wild fish in 1998 numbered 70 fish, and were the fewest since 1993.

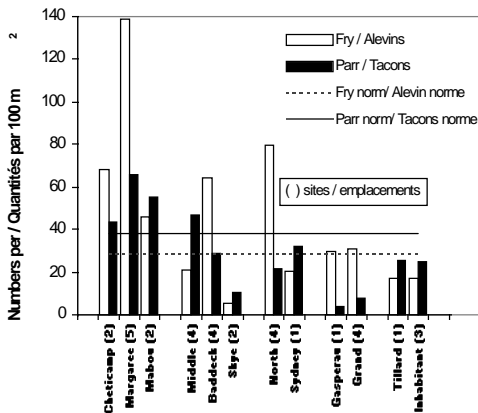


The conservation requirement above the fishway are 234 salmon (475,000 eggs). In 1998, escapement of wild and hatchery salmon above the fishway was 107% of requirement, the third highest of the previous seven years. Wild fish accounted for 30% of the conservation requirement.

Juvenile densities at four sites on the main stem averaged 31 fry and 8.0 parr per 100 m<sup>2</sup>, 1.1 and 0.2 times the respective Elson norms and the highest of any mean annual values for 1995 to 1997.

In 1998, juvenile salmon surveys were also 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 in 1998 relative to Elson norms suggest that other stocks of SFA 18, west Cape Breton, may all be meeting or exceeding conservation requirements, and that the Skye River of Bras d'Or Lakes and the other stocks of the Atlantic coast rivers have not been meeting conservation requirements.

Cape Breton Juvenile Densities / Densité de juvéniles au Cap-Breton



### Outlook

The following projections are based on the average returns of the previous five years.

Recruitment to the **Margaree River** has exceeded the conservation requirement in each of the last 40 years. The forecast of returns in 1999 is 3,200 (1,760 - 4,617) large salmon with a greater than 99% probability of meeting the conservation requirement. Returns of small salmon may number 940 fish (280 - 1,630) and the probability of meeting the 582 fish conservation requirement is about 80%.

For the **Middle River**, the forecast of small and large returns in 1999 is 429 fish (192 - 663). The probability of returns exceeding requirement is about 20% (6% for eggs). For the **Baddeck River**, the forecast return in 1999 is 274 fish (156 - 391) and the probability of exceeding the requirement is less than 1%.

Projected returns of small and large salmon to **North River** in 1999 are 547 fish (300 - 783). The probability of exceeding the conservation requirement is 98%, 93% based on eggs. In contrast, returns to the **Grand River** could be 135 fish (54 - 218), mostly

wild small salmon (hatchery returns will be few if any). There is only about a 2% probability that the fish conservation requirement (0% for eggs) will be met above the falls.

### Management Considerations

Conservation requirements are expected to be exceeded in 1999 in the **Margaree** (as in previous years) and probably other west coast Cape Breton rivers. Small salmon are predominantly male, usually are less abundant than large salmon, and generally are not constraining to stock conservation.

Exploitation levels, both realized and potential, on the **Margaree River** have not been a conservation concern. Directed fisheries on small and large salmon could remove 22% of the potential egg deposition with relatively little reduction in the probability (99% to 95%) of meeting conservation.

Conservation requirements have generally not been achieved in the **Middle** and **Baddeck** and perhaps other Bras d'Or Lake rivers and expectations are that returns will not meet requirements in 1999. An aboriginal food fishery and recreational hook-and-release fishery could reduce the 1999 forecast of egg deposition by 16% and 2% respectively on the Middle River and by 11% and 2-3% respectively on the Baddeck River.

The conservation requirement of **North River** continues to be exceeded and returns are again expected to exceed the requirement in 1999 (93 to 98% chance). An aboriginal food fishery and hook-and-release recreational fishery could reduce the probability of meeting the requirement to 86-93%.

**Grand River** met the conservation requirement upriver of the fishway as a result of significant returns from hatchery stocking (72%). Returns in 1999 will be dependent on wild production and are not expected to meet the conservation requirement (0 to 2% chance). A hook-and-release recreational fishery could reduce egg deposition in 1999 by 2%.

Parr densities in other rivers along the Atlantic coast (e.g., **Sydney, Tillard, Inhabitants, Gaspereaux**) indicate a need for caution.

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

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 rivers 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 acid-impacted** on the Southern Upland of Nova Scotia where main river pH is between 4.7 and 5.0.

Fourteen rivers have **lost** their population of Atlantic salmon and public fisheries are

supported on four of these by stocking with hatchery-reared smolts.

There is evidence that water quality in rivers of the Southern Uplands of Nova Scotia has deteriorated since 1986. Some of these rivers are also impacted by hydroelectric or impoundment for domestic water use.

### *Status*

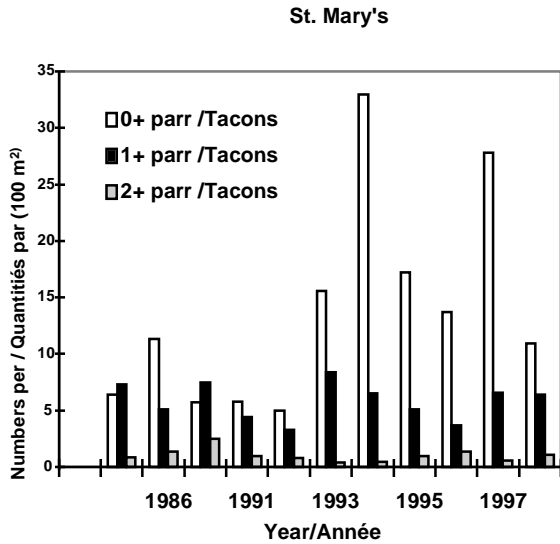
#### Low- or non-acidified rivers

Conservation requirements have been assigned for two low acidified rivers, LaHave and St. Mary's. These requirements are equivalent to 1,320 fish for the LaHave above Morgans Falls and 3,155 fish for the St. Mary's.

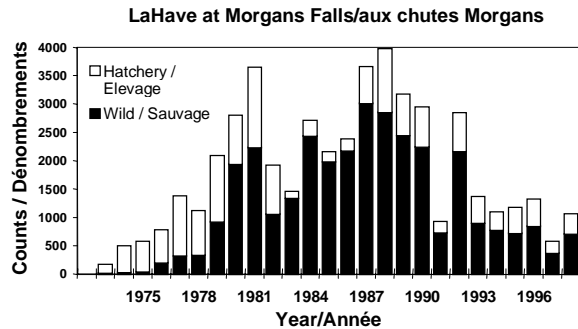
Status for all low-acidified rivers in SFAs 20 and 21, which are still capable of producing wild Atlantic salmon, is expected to be similar or worse than the index rivers. Dissimilarities in the status of salmon stocks among rivers of these SFAs may be attributed to the levels of acidification and to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

Total escapement to **St. Mary's River** in 1998 was 2,000 fish (1,618 - 2,709), 63% of the fish conservation requirement and 55% of the egg requirement. Age-1<sup>+</sup> and age-2<sup>+</sup> parr densities remain low while age-0<sup>+</sup> parr have increased periodically since 1985.





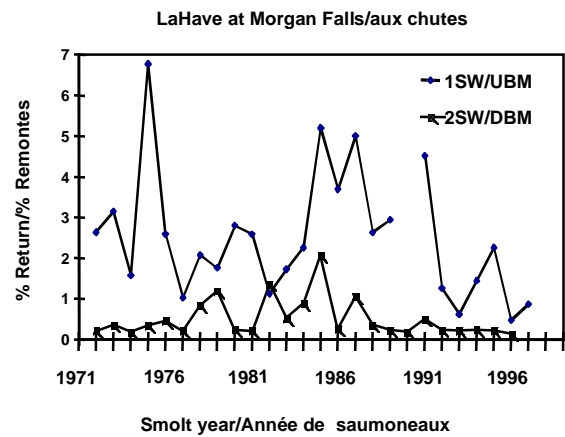
Counts at Morgans Falls fishway on the **LaHave River** indicated a return of 80% of the fish requirement and 84% of the egg requirement in 1998. After broodstock removals, egg deposition was 68% of the requirement. Hatchery fish contributed 33% of the potential egg deposition.



This was the fifth consecutive year that escapement of salmon above Morgans Falls on the LaHave River, before adjustment for non-return fall back, was at or below the conservation requirement.

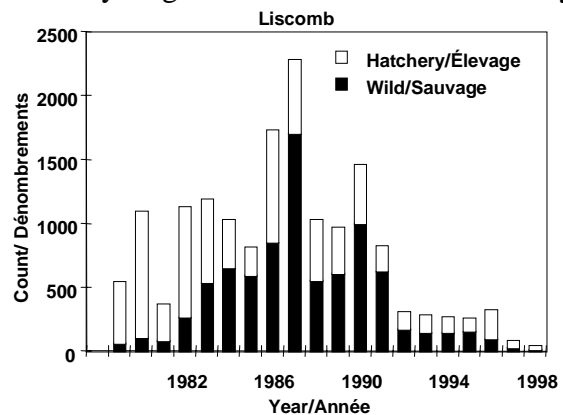
The return rate of hatchery smolts to Morgans Falls, LaHave River has declined since 1984. Return rate of 1997 hatchery smolts as 1SW fish in 1998 increased to 0.87% from 0.47% experienced in 1997. Returns of 2SW hatchery salmon in 1998

(1996 smolt class) declined to 0.14% from the 0.22% value in 1997 (1995 smolt class).



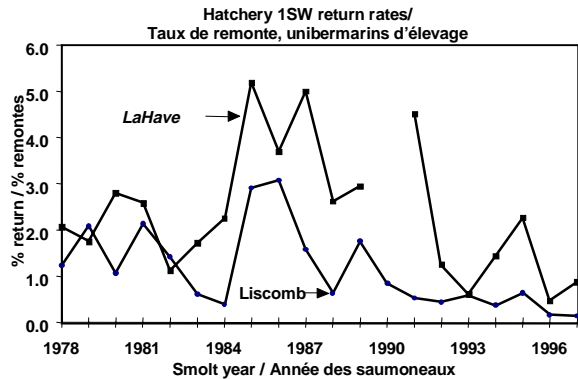
Partially-acidified rivers

Returns to the **Liscomb River** fishway numbered only 46 fish in 1998. Wild salmon have almost disappeared and survival of hatchery-origin salmon has declined severely.



Delayed mortality of stocked smolts attributed to falling pH (i.e., increased acidity) may account for the decrease in the hatchery smolt return rate to these rivers. Therefore, hatchery supplementation as a mitigation technique for acidification is now less effective than when the stocking programs originally began. This can be seen in the comparison of 1SW return rates for hatchery smolts stocked in LaHave River, a

low acid-impacted river, and the Liscomb River, a partially acidified river.



Acid-impacted rivers

Some rivers can no longer support the production of salmon because of inadequate fish passage, flooding of habitat and acidification. The East River Sheet Harbour, Mersey, Clyde and Jordan rivers receive hatchery smolts placed below barriers.

*Outlook*

Low- or non-acidified rivers

Based on the average estimated return to **St. Mary's River** from 1994 to 1998 of 1,504 small salmon (340 - 2,870) and 511 large salmon (80 - 1,270), there is less than a 25% chance that the returns in 1999 will exceed the conservation requirement.

Forecasts of 1999 returns to Morgans Falls, **LaHave River**, based on cohort and smolt origin forecast models, indicate more than a 83% chance that the returns in 1999 will be greater than the conservation requirement. However, 42% of the forecast return would be derived from about 44,000 hatchery smolts estimated to have migrated from above Morgans Falls in 1998. In comparison, there was an estimated 15,600 wild smolts (14,700 - 16,625) emigrating from above

Morgans Falls. There is less than a 10% chance that returns in 1999 of wild small and large salmon to Morgans Falls will be greater than conservation requirements. 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 1998 was not as extensive as that above Morgans Falls.

River	Origin of stock	Number of smolt
LaHave	LaHave	49,691
Mushamush	LaHave	11,612
Petite	LaHave	11,224
Musquodoboit	Musquodoboit	10,704

Returns of salmon to LaHave River above Morgans Falls, an area minimally impacted by acidification, have been below replacement since 1986. A measure of generation-to-generation survival, shows a consistent decline independent of escapement.

Partially-acidified rivers

Deteriorating water quality, declining wild salmon returns and low return rates relative to less acidified rivers indicates no expectation that wild returns will be sufficient for conservation in 1999. Worsening water quality in many of these rivers negatively affects expectations from hatchery smolts stocked in 1998.

River	Origin of stock	Number of smolt
Sackville	Sackville	24,137
Tusket	Tusket	55,660
Gold	Gold	20,592
Medway	Medway	28,482
Salmon (Digby)	Salmon (Digby)	30,150
Liscomb	Liscomb	45,036

### Acid-impacted rivers

The numbers of smolts stocked in 1998 were similar to 1997 and returns in 1998 to these acid-impacted rivers are expected to be similar to those of 1998.

River	Origin of stock	Number of smolt
Clyde	LaHave	9,920
Jordan	LaHave	3,852
Jordan	Medway	1,000
Mersey	LaHave	10,704
East Sh.Hbr.	East	33,756

### *Management Considerations*

Reduced performance of the stocks in low- or non-acidified rivers has initiated new management actions in SFAs 20 and 21 to decrease in-river exploitation through reductions in daily catch limits, early closure of recreational and Aboriginal peoples fisheries. 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**, non- or low-acidified rivers that have not received substantial hatchery supplementation are not expected to achieve conservation requirements in 1999.

Egg depositions in these rivers are contributed equally by small and large salmon.

Both the St. Mary's and LaHave rivers are representative of low acid-impacted rivers. Returns to the St. Mary's River in 1998 were again insufficient to achieve the conservation requirement, and are unlikely to be sufficient in 1999 (25% chance). Conservation requirement was also not met on the LaHave River (above Morgans Falls) for the second year in a row but is expected to be achieved in 1999 (83% chance). More than 40% of the expected return in 1999 will originate from hatchery stocking. Because of the extensive hatchery stocking, and low acidification above Morgans Falls, the LaHave River salmon returns in 1999 can be expected to exceed the conservation requirement.

Returns to the **Liscomb River**, representative of the partially-acidified rivers, have shown an almost total loss of wild salmon and severe decline in the survival of stocked hatchery salmon. Conservation requirements are not likely to be met in 1999 in the Liscomb or other partially-acidified rivers.

The acid-impacted rivers include the **East River Sheet Harbour, Mersey, Clyde and Jordan rivers**. Because these rivers are no longer able to support wild salmon production, they have no conservation requirements. They do however offer the potential to supply hatchery broodstock, an opportunity currently being considered.

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

Salmon of the inner Bay of Fundy occupy about twenty-six rivers of SFA 22 in Nova Scotia and about ten rivers in SFA 23, New Brunswick. Rivers in these areas have a variety of habitat and are well suited to the production of salmon. In general, habitat is

minimally impacted by forest harvesting and agriculture practices and not susceptible to acidification. Some rivers have lost their salmon production because of barriers to migration. Moderate-to-high production of salmon has been documented in many of these rivers as recently as 1985 and no wide-spread degradation of freshwater habitat is known to have occurred.

Salmon usually enter these rivers in the fall of the year, have a high proportion that return to spawn after one winter at sea, are not generally known to migrate to the North Atlantic Ocean, and have a high survival between consecutive spawnings.

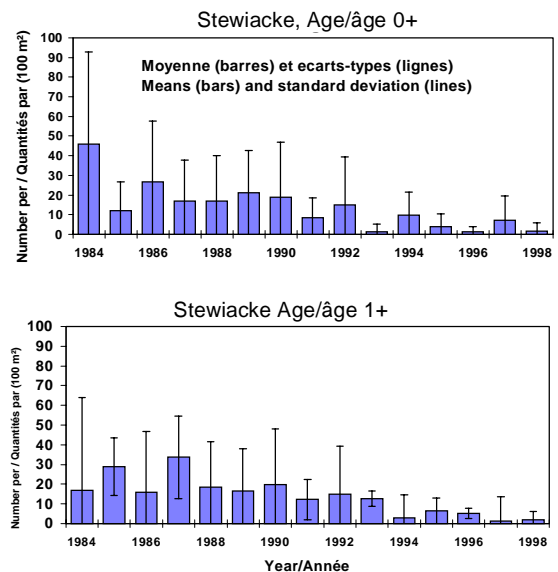
The inner Bay of Fundy historic catches averaged 1,061 fish in the commercial fishery (1970-1984), and 1,462 small salmon and 597 large salmon (1970 - 1990), in the recreational fishery. Two rivers, the Big Salmon River, New Brunswick, and Stewiacke River, Nova Scotia, account for more than half of the historical recreational catch.

### Status

Increased effort to document and/or sample salmon in inner Bay of Fundy Rivers, provided no quantitative or qualitative observations to indicate increased salmon returns in 1998. These observations indicate that no improvement in marine survival occurred in 1998 and returns have consistently declined since 1993.

Electrofishing for juvenile salmon at 37 sites in the **Stewiacke River** and at a total of ten locations in six other rivers (Maccan, Portapique, Economy, Great Village, Debert, Folly and North) of the inner Bay of Fundy, indicates that there were few Atlantic salmon

of any age in rivers of the inner Bay of Fundy in 1998.



Smolt production is very low and therefore all recruitment is required for spawning. If in the near future marine survival were to increase to previously documented levels, recovery of the inner Bay of Fundy salmon stock would take at least three generations or twelve years.

Salmon of the **Gaspereau River**, Kings County, unlike other inner Bay of Fundy rivers, migrate to the Northwest Atlantic and have followed a recruitment and life history pattern similar to other Atlantic coast rivers. A total of 95 fish (74 hatchery and 25 wild) or a potential 56% of the required spawning escapement upstream of the White Rock Dam fishway, was counted in 1998. A total of 32 fish was removed for enhancement through a fish culture program.

Information concerning the status of salmon in **Annapolis River** may be implied from the results of broodstock collections in 1998. In twelve and one-half hours of beach- and drift-net seinings, on two dates in October 1998, 10 fish were captured. All were

hatchery origin, 90% were grilse and 20% were female.

### Outlook

Atlantic salmon spawners and juveniles of the **inner Bay of Fundy** are critically low. No salmon surplus to conservation will be available until three generations of recovery have been documented.

### Management Considerations

Inner Bay of Fundy salmon stocks (e.g., **Stewiacke, Big Salmon**) are critically low. Surveys of juveniles and adults, conducted in 1998, indicate that there are few Atlantic salmon of any age remaining in these 30-some rivers. Special measures are required to prevent extirpation of inner Bay of Fundy salmon. An action plan is urgently required.

Salmon of the **Gaspereau** and **Annapolis** rivers have received hatchery supplementation, did not meet conservation requirements in 1998 and are not expected to do so in 1999.

### Outer Bay of Fundy (western part of SFA 23)

Stocks in this area generally have not met conservation requirements during the last decade. Saint John River stocks originating upriver of Mactaquac face many constraints including hydroelectric dams (with upriver passage facilities) mostly devoid of safe downstream passage, artificial flow regimes, headponds and new communities of potentially effective predators on smolts.

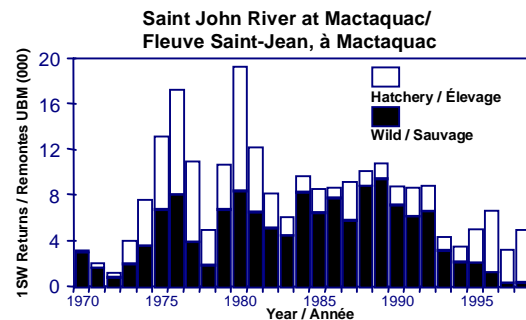
Rivers downstream of Mactaquac are not obstructed. Stocks of other outer Fundy rivers such as the Magaguadavic and St. Croix face similar perils to stocks upriver of

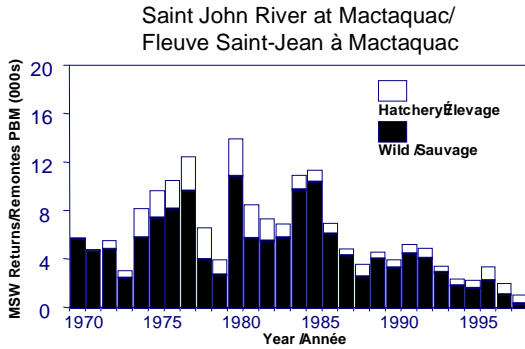
Mactaquac and additionally, potential genetic swamping by farmed salmon escapees from the nearby Fundy-Isle (NB) and Cobscook Bay (ME) aquaculture industry (1998 production of about 32,000 t).

### Status

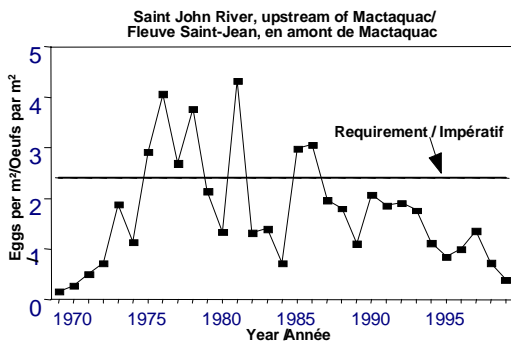
The total count of salmon originating at and upriver of **Mactaquac Dam, Saint John River** in 1998 was 5,880 salmon. Total returns (including assumed losses downriver of Mactaquac) were estimated to be 4,950 1SW and 1,000 MSW salmon of which only four were identified as farm escapees. About 90% of 1SW and 65% of MSW returns were of hatchery origin.

Wild 1SW returns were nearly as few as those of 1997 and are the second lowest of a 29-year record; wild MSW returns number less than one-half those of 1997 and are the lowest of the 29-year record. Hatchery 1SW returns were, with the exception of returns in 1996, the highest in 17 years. Hatchery MSW returns were down from 1996-1997 but equal to the mean of the last five years.



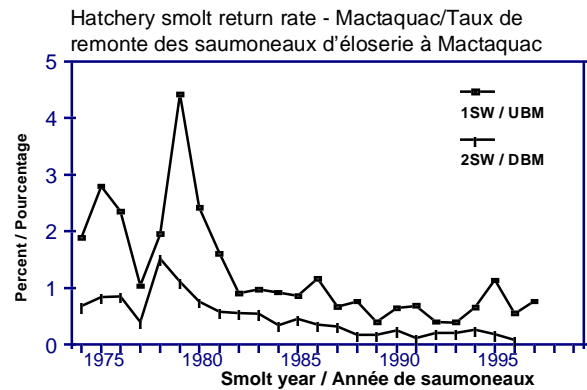


Escapements upriver of Mactaquac numbered slightly fewer than 700 MSW and 4,600 1SW salmon. More than 80% of escaping MSW fish were female, and more than 90% of escaping 1SW fish were male. The conservation requirement of the Saint John upriver of Mactaquac is 32.33 million eggs to be provided by 4,900 MSW and 4,900 1SW fish. Only 16% of the conservation egg requirement was met in 1998 with hatchery-origin fish providing 68% of the total. This is the lowest value in 30 years. A total of 1.7 million eggs, representing 20% of the total eggs arriving at Mactaquac, were retained for hatchery incubation and rearing.



Aged returns from reared smolts released via Mactaquac smolt migration channel have been used as an index of marine survival. Preliminary assessment indicates a 1SW return rate of 0.8% from smolts released in 1997, up from the 0.6% value in 1997. The return rate for 2SW salmon from 1996

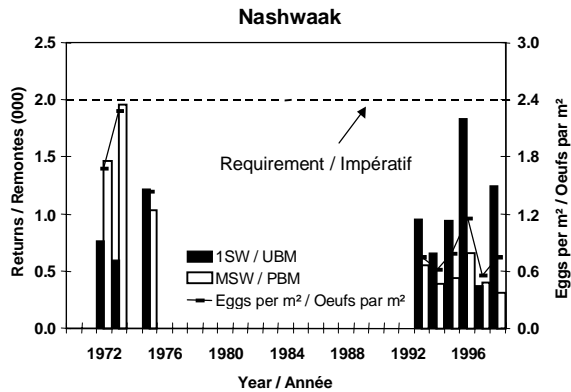
smolts decreased to 0.1% and is the lowest of the entire record.



Densities at 11 sites upriver of Mactaquac during 1993 to 1997 averaged 11.6 fry and 8.5 parr per 100 m<sup>2</sup> (exclusive of the few identifiable hatchery-stocked fish), and are 0.4 and 0.25 the Elson norms, respectively. Egg depositions from which they originated were only 50% of conservation requirements.

Counts of 464 small and 152 large salmon at the **Nashwaak River** fence and a late-October mark-and-recapture estimate indicated a run of 1,250 1SW (998 - 1,943) and 315 MSW salmon (243 - 699) to the fence. Hatchery returns contributed less than 5% of the total and no farmed escapees were identified.

Returns of 1SW salmon were the second highest since resumption of the fence operations in 1993, and three times the 1SW return of 1997. MSW returns were the lowest on record but consistent with the low 1SW returns observed in 1997 from the same smolt class.



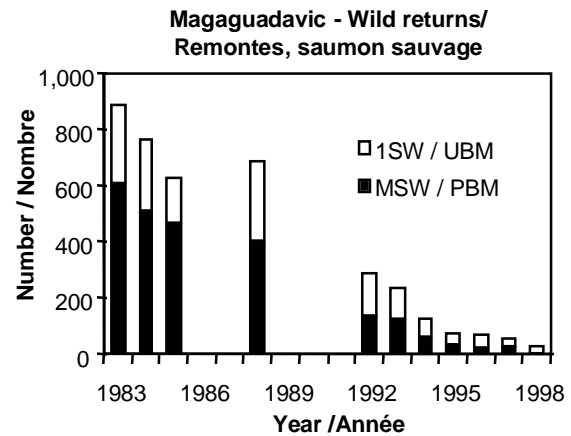
The conservation egg requirement above the fence of 12.8 million eggs is expected from 2,040 MSW salmon with an equal number of 1SW salmon to provide males. Escapement of about 1,230 1SW and 310 MSW salmon indicates egg deposition in 1998 to have been about 31% of requirement. Females among 1SW salmon (51%) contributed to 54% of the estimated egg deposition.

Juvenile densities have been monitored since 1981 at seven sites upriver of the Nashwaak River counting fence. The 1998 density for fry was the lowest in the 18-year time series. Fry densities are trending downwards and the most recent five-year average of 9.5 fry per 100 m<sup>2</sup> is only 0.3 of the Elson norm. The 1998 parr density was the third lowest on record (there is no trend in the data) and the recent five-year average density of 8.5 parr per 100 m<sup>2</sup> is about 0.2 of the Elson norm. Low fry and parr densities are consistent with the low percentages (25-50%) of the egg conservation requirement met since 1993. A first-time-ever estimate of spring smolts emigrating from upstream of the fence was 23,000 fish (0.4 smolts per 100 m<sup>2</sup>).

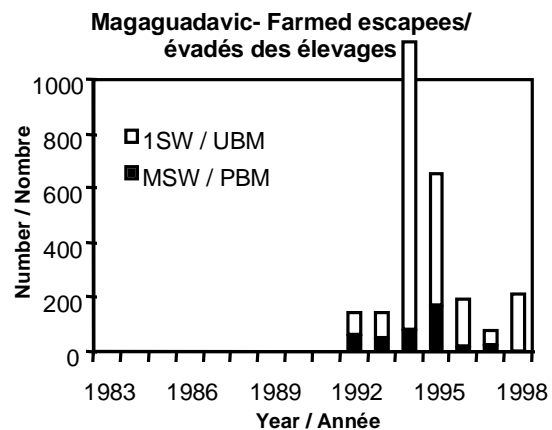
Partial counts of fish on the **Kennebecasis River** and counts of redds on the **Hammond River** are consistent with the assumption that escapements to these and other rivers

downstream of Mactaquac are of a similar magnitude as that of the Nashwaak River, i.e., low probability of achieving even one half of conservation requirements.

Wild returns to the St. George fishway and trap located at the head-of-tide on the **Magaguadavic River** in 1998 numbered only 28 1SW and 3 MSW salmon, the fewest on record.

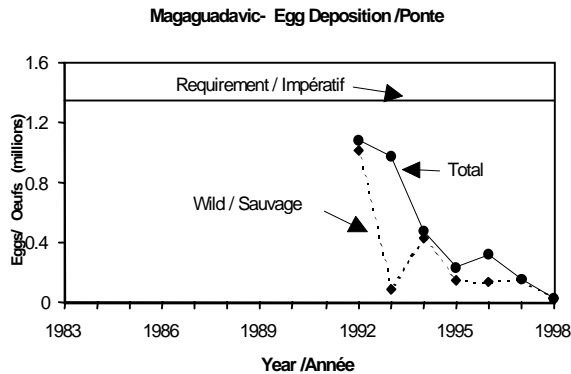


Farmed escapees ascending the fishway in 1998 numbered 211 1SW, 8 MSW (and 8 post smolts) and represent the third highest count since 1992.



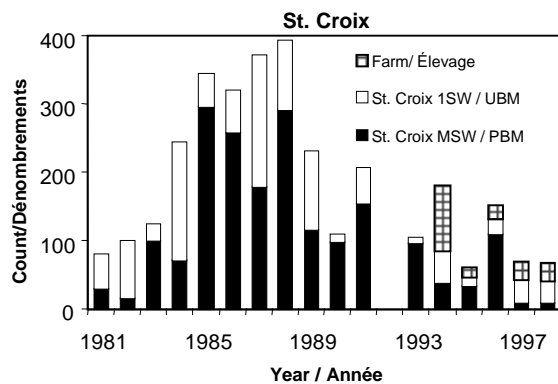
The conservation requirement is 1.35 million eggs from 230 MSW and 140 1SW salmon, an objective which in all likelihood was met by returns in the 1980s. Potential deposition of

30,400 eggs from wild fish was 2.3% of requirement and the lowest on record. As in 1997, farmed escapees were not released upriver of the fishway.



Surveys of juvenile salmon in 1995 and 1997 revealed low fry and highly variable parr densities, parr escapees from hatcheries supplying the aquaculture industry and as many as 12 juvenile smallmouth bass (*Micropterus dolomieu* Lacépède) per 100 m<sup>2</sup>.

Counts of salmon at the Milltown fishway, near head-of-tide on the **St Croix River**, in 1998 numbered nine St. Croix (wild and hatchery) MSW fish, 33 St. Croix (wild and hatchery) 1SW fish and 11 farmed MSW and 14 farmed 1SW fish. All farmed escapees were removed from the trap for disease analysis. Hatchery-origin fish comprised 56% of St. Croix-origin returns.



Egg depositions from an escapement of 29 fish (mostly 1SW fish of which approximately one-

third were female) was about 46,000 eggs or <1% of requirement and the lowest in recent years. In an on-going effort to re-establish salmon in the St. Croix, 39,000 eggs were also taken for hatchery incubation.

Outlook

Projected returns for the stock originating at and upriver of **Mactaquac** in 1999 are 4,700 1SW (2,420 - 6,970) and perhaps 2,200 MSW (845 - 3,530) salmon. The probabilities of attaining conservation requirements in 1999 are 56% for the 1SW and < 1% for the MSW salmon. The probability of attaining the egg requirement is 1%. Densities of wild juvenile salmon and no increased stocking suggest that returns in the near future will not increase.

Predicted returns to the **Nashwaak River** in 1999 are 1,030 1SW salmon (230 - 1,940) and 410 MSW salmon (215 - 650). The probability that conservation requirements will be met for 1SW fish is 3%, for MSW fish is <1%, and for total eggs is <1%.

Wild salmon returns to the **Magaguadavic River** in 1999 are projected to be no greater than the few fish returning in 1997-1998. There is a zero probability of attaining the conservation requirement.

During 1994-1998, the mean numbers of wild and hatchery MSW and 1SW returns to the **St. Croix River** have been 40 and 30 fish, respectively. Neither recent levels of stocking nor natural spawning indicate returns of salmon in either 1999 or 2000 will number more than the recent average. There is a zero probability of attaining the conservation requirement.

Management Considerations

Despite the 1998 closure of all in-river fisheries directed to the Saint John River



stock **upriver of Mactaquac**, egg depositions were only 16% of the conservation requirement. There is essentially a zero probability that egg depositions in 1999 will be sufficient to meet the conservation requirement. There is a 56% chance of attaining the 1SW salmon requirement. An aboriginal food fishery (1SW fish without MSW bycatch) and hook-and-release recreational fishery could reduce egg deposition in 1999 by 7% and 1%, respectively.

Wild salmon returns to the area upriver of Mactaquac, Saint John River, were the lowest since the completion of Mactaquac Dam and contributed to only 32% of the total egg deposition. In the relative absence of wild (and hatchery) MSW salmon, the few females (approx. 10%) among more abundant hatchery and wild 1SW fish contributed to one-quarter of the eggs deposited upriver of Mactaquac in 1998.

The **Nashwaak River** stock met 31% of the egg requirement and there is a near zero probability for achieving conservation in 1999. An aboriginal food fishery (1SW fish downriver of Fredericton without MSW bycatch) and hook-and-release fishery could reduce egg deposition in 1999 by 8% and 1%, respectively.

For the Nashwaak stock and presumably other stocks downriver of Mactaquac, 1SW salmon were in 1998 as much as 50% female and contributed as many as 50% of eggs to the conservation requirements. With projected low returns of MSW salmon to the entire Saint John drainage in 1999, the survival of 1SW fish is increasingly important to the maintenance of stocks.

Stocks of other outer Bay of Fundy rivers, including **Magaguadavic** and **St. Croix**,

have declined dramatically in the last decade. There is no chance that conservation requirements will be met on these rivers in 1999. Action plans to prevent extirpation of salmon stocks of these and other outer Bay of Fundy rivers are urgently required.

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**Table 1. Fisheries removals (number of fish) of Atlantic salmon from rivers of the Maritimes, 1994 to 1998. Removals refers 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. 1998 data are provisional.**

River	SFA	Index	Aboriginal Fisheries Removals <sup>1</sup>										Recreational Fisheries Removals <sup>1</sup>									
			Small Salmon					Large Salmon					Small Salmon					Large Salmon				
			'94	'95	'96	'97	'98	'94	'95	'96	'97	'98	'94	'95	'96	'97	'98	'94	'95	'96	'97	'98
Restigouche System <sup>2</sup>	15	1&2	58	21	77	26	26	380	202	213	166	234	4869	1620	3475	3125	2959	1308	1164	1361	953	528
Matapedia	15	1	0	0	0	0	0	0	0	0	0	0	822	337	721	450	654	917	829	922	691	442
Restigouche-NB	15	2	29	21	77	26	26	32	24	37	11	37	4047	1283	2754	2675	2305	391	333	439	262	86
Jacquet	15	3	-	-	-	-	-	-	-	-	-	-	33	61	67	67	-	3	0	2	2	-
Nepisiguit	15	4	120	131	84	85	-	0	44	28	0	-	380	350	450	200	-	8	9	13	9	-
Tabusintac	16	5	30	106	171	-	18	44	42	187	-	18	197	33	-	74	-	9	1	-	2	-
Miramichi	16	6&7	2977	3004	2583	1197	1180	124	185	372	548	214	11203	5533	-	8311	-	154	94	-	152	-
NW Miramichi	16	6	2921	1795	1504	871	782	81	172	317	548	195	4131	1705	-	3153	-	56	19	-	46	-
SW Miramichi	16	7	0	1170	1074	326	378	0	13	0	0	0	7072	3828	-	5158	-	98	76	-	106	-
Buctouche	16	8	11	15	25	25	Closed	12	0	4	5	Closed	7	33	21	5	Closed	1	0	1	0	Closed
Morell	17	9	0	19	17	1	28	0	1	0	0	0	89	449	397	230	-	0	0	0	0	-
River Philip	18	10	9	29	2	0	0	15	37	45	21	7	61	105	165	43	80	9	12	33	5	10
Wallace	18	11	-	2	-	-	-	-	6	-	-	-	11	16	20	13	33	3	1	4	5	3
French, (Col.)	18	12	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-	-	1	-	-
Waugh	18	13	-	-	-	-	-	-	-	-	-	-	7	14	24	8	25	2	2	7	1	3
River John	18	14	0	3	-	-	0	17	5	-	-	18	12	10	22	25	29	2	1	6	3	2
West (Pictou)	18	15	0	0	-	-	0	8	3	-	-	12	4	26	57	5	35	1	2	10	1	6
East (Pictou)	18	16	5	2	11	0	3	141	28	49	40	15	14	22	34	23	27	4	2	14	3	7
Sutherlands	18	17	2	-	-	0	0	10	-	-	14	14	-	1	-	-	-	-	-	-	-	-
French (Pictou)	18	18	2	-	-	0	0	10	-	-	13	13	-	-	1	3	-	-	-	-	-	-

<sup>1</sup> "Closed" means no salmon fishing was allowed, "-" means no data were available, "0" means no removals occurred.

<sup>2</sup> Aboriginal fisheries removals exclude removals by the Listiguj First Nation in the estuary because these data are not available.

**Table 1 (continued). Fisheries removals (number of fish) of Atlantic salmon from rivers of the Maritimes, 1994 to 1998. Removals refers 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. 1998 data are provisional.**

River	SFA	Index	Aboriginal Fisheries Removals <sup>1</sup>										Recreational Fisheries Removals <sup>1</sup>									
			Small Salmon					Large Salmon					Small Salmon					Large Salmon				
			'94	'95	'96	'97	'98	'94	'95	'96	'97	'98	'94	'95	'96	'97	'98	'94	'95	'96	'97	'98
Barney's	18	19	2	-	-	0	0	10	-	-	13	13	-	1	10	-	-	-	-	-	-	-
West (Ant.)	18	20	-	-	-	-	-	-	-	-	-	-	29	50	109	21	67	6	7	24	5	10
South	18	21	-	-	-	-	-	-	-	-	-	-	4	1	10	1	2	1	-	1	-	-
Margaree	18	22	14	2	7	20	30	50	4	89	124	120	298	206	306	204	218	95	70	139	121	73
Middle	19	23	7	1	4	3	-	67	7	16	15	na	1	2	5	4	10	8	3	7	4	4
Baddeck	19	24	9	2	2	5	-	50	5	7	13	na	2	10	2	1	2	3	4	8	3	3
North	19	25	0	0	1	0	0	0	0	2	0	0	4	9	9	4	4	5	10	6	7	4
Grand	19	26	0	0	0	0	0	0	0	0	0	0	4	-	5	4	2	1	1	1	1	1
St. Mary's	20	27	-	-	-	-	-	-	-	-	-	-	21	421	60	8	Closed	3	13	18	3	Closed
Liscomb	20	28	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
West Sheet Har.	20	29	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
LaHave	21	30	0	81	220	58	0	0	0	0	0	0	138	565	1131	377	Closed	12	24	33	17	Closed
Mersey	21	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jordan	21	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clyde	21	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stewiacke	22	34	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Gaspereau	22	35	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Big Salmon	23	36	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
Saint John at Mactaquac	23	37	250	50	675	361	Closed	90	25	285	265	Closed	27	Closed	50	24	Closed	18	Closed	25	15	Closed
Nashwaak	23	38	40	Closed	-	-	Closed	30	Closed	-	-	Closed	3	Closed	14	5	Closed	3	Closed	5	3	Closed
Magaguadavic	23	39	-	Closed	-	-	Closed	0	Closed	-	-	Closed	<1	Closed	<1	<1	Closed	<1	Closed	1	<1	Closed
St. Croix	23	40	-	Closed	-	-	Closed	-	Closed	-	-	Closed	<1	Closed	<1	<1	Closed	<1	Closed	<1	<1	Closed

<sup>1</sup>“Closed” means no salmon fishing was allowed, “-” means no data were available, “0” means no removals occurred.

**Table 2. Summary of stock status of Atlantic salmon in the Maritimes Region. All 1998 information is provisional pending peer review.**

River	SFA	Method	Map Index	Returns in 1998		% hatchery origin	Conservation met		Abundance			Status in 1998		Potential Constraints to Production
				Small	Large		1998	1984 - 1998	Juveniles	Adults		rel. to 1997	1984 to 1997	
Restigouche System	15	Ang	1&2	10500	7100	< 1%	No	5 of 15 ↑				⬇	⬇	
Matapedia	15	Vi	1	1473	2084	0%	Yes	4 of 15 ↑			↑			
RestigoucheNB	15	Ang	2	9000	5000	< 1%	No	5 of 15 ↑	Med ↑	Med ⇄		⬇	⬇	
Jacquet	15	Fe	3	402	298	0%	No	2 of 5 ⬇		⬇		⬇	⬇	
Nepisiguit	15	Ang	4				No	2 of 15 ⬇	Med ↑	Med	Low ⬇			
Tabusintac	16	MR	5	1740	1260	0%	Yes	4 of 4						
Miramichi	16	MR	6&7	33000	9500	< 1%	No	11 of 15 ⇄	High ↑	Med ⇄	Low ⇄	⬇	⬇	
NW Miramichi	16	MR	6	7900	2200	< 1%	No	6 of 7 ⇄	High ↑	Med ⬇	Low ⇄	⬇	⬇	
SW Miramichi	16	MR	7	24000	7000	< 1%	No	5 of 7 ⬇	High ↑	Med. ⬇	Low ⇄	⬇	⬇	
Buctouche	16	MR	8	120	102	0%	33%	0 of 6 ⇄	Low	Low		⬇	⬇	
Morell	17		9			95%		9 of 14	Low ⇄					LU
River Philip	18	ViM	10	153	350	0%	93%	5 of 7 ⇄	Med ⇄	High ⇄		⬇	⬇	
Wallace River	18	CR	11	58	103	0%	43%					⬇		
Waugh	18	CR	13	61	93	0%	78%					↑		
River John	18	CR	14	87	74	0%	36%					⬇		

Assessment methods: Ang = angling catches and assumed exploitation rates CR = catch rate index  
 Fe = counting fence Fw = fishway MR = mark and recapture experiment  
 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 escapees  
 Fp = fish passage constraints LU = land use practices WU = water use practices

**Table 2 (continued). Summary of stock status of Atlantic salmon in the Maritimes Region. All 1998 information is provisional pending peer review.**

River	SFA	Method	Map Index	Returns in 1998		% hatchery origin	Conservation met		Abundance			Status in 1998		Potential Constraints to Production
				Small	Large		1998	1984 - 1998	Juveniles	Adults		rel. to 1997	1984 to 1997	
										Wild	Hatchery			
West (Pictou)	18	CR	15	61	201	0%	148%	3 of 4 ⇔				↑		
East (Pictou)	18	CR	16	84	263	0%	89%	4 of 7 ⇔	Med ⇔	High ⇔		⬇	⬇	
Sutherlands	18	Vi	17	20	40	0%	104%	4 of 4 ⇔		High ⇔		⬇		
West (Ant.)	18	CR	20	206	344	0%	95%	3 of 7 ⇔	High ↑	High ⇔		⬇	⇔	
Margaree	18	Ang	22	774	3260	5 to 10%	298%	14 of 15 ⇔	High ⇔	Med ⇔	Low ⇔	⬇	⇔	
Middle	19	ViM	23	70	143	0%	30%	2 of 10 ⬇	High ⇔	Low ⬇		⬇	⬇	
Baddeck	19	ViM	24	51	139	0%	35%	0 of 5 ⇔	High ⇔	Low ⇔		⬇	⬇	
North	19	ViM	25	74	359	0%	190%	14 of 14 ⇔	Med ⇔	Low ⬇		⬇	⬇	Aq
Grand	19	Fw	26	233	17	72%	107%	7 of 11 ⬇	Low ⇔	Low ⬇	Med ⇔	↑	⬇	Fp
St. Mary's	20	MR	27	1990	100	0%	No	9 of 15 ⬇	Med ⇔	Low ⬇	Low ⬇	↑	⬇	
Liscomb	20	Fw	28	45	1	80%	No		Low ⇔	Low ⬇	Low ⬇	⬇	⬇	Ac, Fp
LaHave	21	Fw	30	1669	211	26%	68%	10 of 15 ⬇	Med ↑	Med ⬇	Low ⇔	↑	⬇	Ac, Fp
Mersey	21		31											Ac, Fp
Jordan	21		32											Ac
Clyde	21		33											Ac

Assessment methods: Ang = angling catches and assumed exploitation rates CR = catch rate index  
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River	SFA	Method	Map Index	Returns in 1998		% hatchery origin	Conservation met		Abundance			Status in 1998		Potential Constraints to Production
				Small	Large		1998	1984 - 1998	Juveniles	Adults		rel. to 1997	1984 to 1997	
										Wild	Hatchery			
Stewiacke	22	Electro	34				No		Low ⬇️	Low ⬇️	Low ⬇️	⬇️	⬇️	
Gaspereau	22	Fw	35	74	21	75%	56%			Low	Low			WU, Fp, Aq
Big Salmon	23	Sh+Vi	36				No		Low	Low		⬇️	⬇️	
Saint John at Mactaquac	23	Fw	37	4950	1000	87%	16%	2 of 15 ⬇️	Low ⇄	Low ⬇️	High ⬆️	⬇️	⬇️	Fp, LU, WU
Nashwaak	23	Fe/MR	38	1250	315	< 5%	31%	0 of 6 ⇄	Low ⇄	Low ⇄	Low ⇄	⬆️	⇄	LU, WU
Magaguadavic	23	Fw	39	28	3	0%	2%	3 of 10 ⬇️		Low ⬇️		⬇️	⬇️	Fp, Aq, WU
St. Croix	23	Fw	40	33	9	58%	<1%	0 of 14 ⬇️		Low ⬇️	Med ⇄	⇄	⬇️	Fp, Aq, WU

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

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Trend symbols (over recent ten years): ⬇️ = decline      ⇄ = no change      ⬆️ = increase

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