



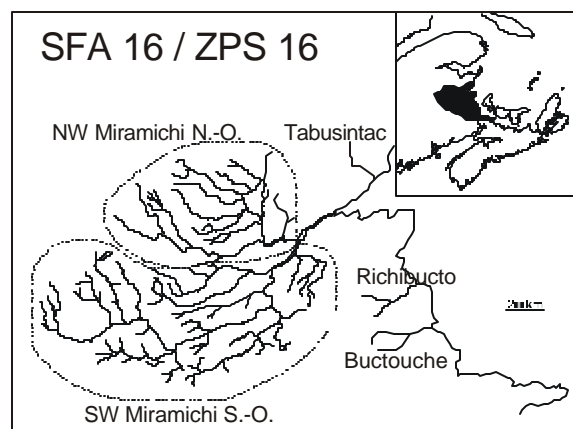
Atlantic Salmon Miramichi and SFA 16 Rivers

Background

The management area known as Salmon Fishing Area (SFA) 16 contains 41 rivers with Atlantic salmon runs. The Miramichi River is the largest river representing 90% of the salmon-producing habitat in SFA 16.

Most juveniles spend two to three years in the river before migrating to the ocean in spring. Spawning populations consist of varying proportions of small salmon (fork length < 63 cm) and large salmon (fork length \geq 63 cm). The small salmon are predominantly maiden fish (never spawned before) which have spent one year at sea before returning to spawn (one-sea-winter salmon). These small salmon, are generally > 80% male. The large salmon component contains a mixture of maiden fish which have spent two and occasionally three years at sea before spawning and previous spawners which are returning for a second or more spawning. The majority (>80%) of the large salmon are female. The relative proportions of the size groups in the returns vary geographically. In the Miramichi, the ratio is two to five small salmon for every large salmon. In the smaller rivers, large salmon tend to be more abundant. The large salmon undertake extensive marine migrations to Labrador, Greenland and the Faroe Islands. The small salmon undertake less extensive migrations to Labrador, Newfoundland and the Grand Banks. The highly refined homing abilities of Atlantic salmon result in discrete stocks in individual rivers; the Miramichi River contains several stocks. Most salmon return to the smaller rivers in September and October but the Miramichi River has an important component which returns during May to August.

Conservation requirements are established for individual rivers based on $2.4 \text{ eggs} \cdot \text{m}^{-2}$ of river habitat. The objective is to obtain the egg depositions from the large salmon component.



Summary

- Return of 33,000 small salmon to the **Miramichi River** in 1998 was a 46% increase from the record low return of 1997 but remained 40% below the 1993-1997 average return.
- Return of 9,500 large salmon was 48% below the 1997 return and the lowest since 1979.
- Total returns (before homewater removals) of small and large salmon would have contributed to 68% of conservation requirement in the Miramichi.
- There is an 11% chance that eggs in the returns of small and large salmon in 1999 will meet the conservation requirement of the Miramichi River.

- Fry abundance in 1998 was lower than in recent years, in response to reduced egg depositions in 1997. Both fry and parr abundances in the Miramichi River remain at historically high levels.
- The **Tabusintac River** exceeded the conservation requirement in 1998 and is expected to repeat in 1999. Current fisheries exploitation levels are not a conservation concern.
- The **Buctouche River** is used as an index river for New Brunswick Northumberland Strait rivers. It achieved only a third of conservation requirement in 1998, thereby failing to meet the requirement for the sixth consecutive year. Based on the average returns of the last five years, there is a 1% chance of meeting the conservation requirement in 1999.
- 2SW salmon abundance was low in all assessed rivers in 1998. Previous spawners were the most important component of the large salmon returns. These previous spawners have provided a buffer in years when 2SW salmon abundance is low.

The Fishery

Atlantic salmon are harvested by two user groups: First Nations and anglers. Fishing agreements have been signed with five of six First Nations having access to salmon in SFA 16 rivers. Harvests were in most cases less than agreed upon allocations.

First Nations allocations (A) and harvests (H) from the rivers in SFA 16 assessed in 1998.

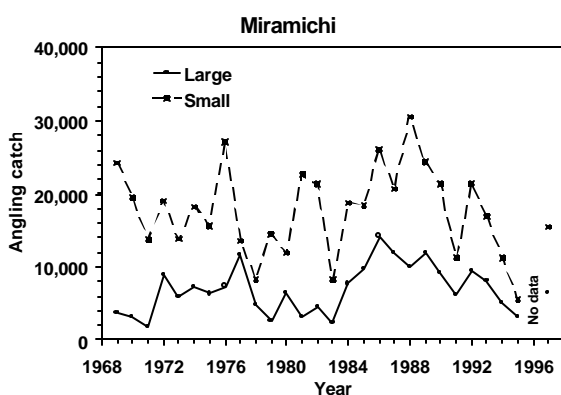
		1994	1995	1996	1997	1998
Miramichi River						
Large	A	120	441	823	900	895
	H	124	185	372	548	214
Small	A	8400	11000	11000	11000	11000
	H	2977	3004	2583	1197	1180
Tabusintac River						
Large	A	380	-	304	-	304
	H	44	42	187	Unk	18
Small	A	200	-	112	-	112
	H	30	106	171	Unk	18
Buctouche River						
Large	A	36	36	36	36	0
	H	12	0	4	5	0
Small	A	56	56	56	56	0
	H	11	15	25	25	0

There were changes in recreational fishery management in 1998. Rivers of the Kent and Westmorland counties of the Northumberland Strait shore of SFA 16 were closed to all salmon fisheries in 1998 based on the status of the Buctouche River. For the remainder of the SFA, daily retention limits of small salmon were reduced from two fish to one fish and daily hook-and-release limits were reduced from four fish to two fish of any size. Following a review of counts at the end of July, the daily hook-and-release limits for the Miramichi River were relaxed to four fish per day. The salmon season for the Miramichi River opened April 15 and closed August 31 or September 15 for the upper portions of the river and October 15 for

the lower sections. Angling seasons closed October 15 except the Tabusintac River which closed October 23.

Results of the annual mail-out survey (FISHSYS) conducted by the province of New Brunswick are not yet available. Crown Reserve catches of small salmon for the Northwest Miramichi in 1998 were 20% above the 1997 catch but 31% below the 1991 to 1995 average. For large salmon, catch in 1998 was 9% above 1997 and similar (-1%) to the 1991 to 1995 average.

In the Miramichi, angling catches of small and large salmon peaked during 1986 to 1989 and have since declined. Reduced catches in 1995 were the result of low water conditions and extensive closures throughout the regular angling season.



Catches in the other rivers of SFA 16 have generally represented less than 10% of the total SFA 16 catch.

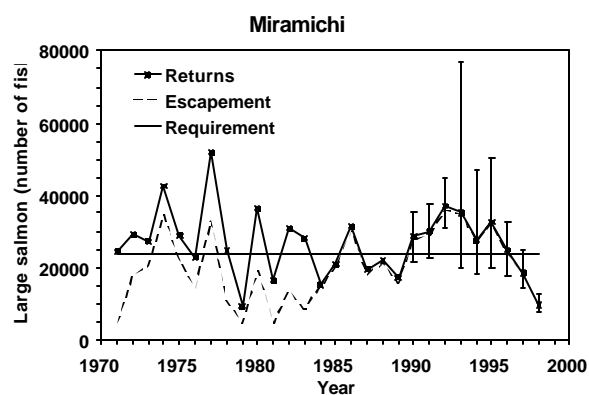
Resource Status

Returns to the Miramichi, Tabusintac and Buctouche rivers were estimated using mark-and-recapture experiments. The Tabusintac River assessments in 1996 and 1998 were conducted by the Burnt Church First Nation.

The Miramichi River and Buctouche River assessments were completed through collaborations with angling associations, First Nations and the province of New Brunswick. For the Miramichi River, returns have been estimated separately for the Northwest and Southwest branches since 1992. Escapements are the differences between returns and total removals (including First Nations harvests, angling harvest, hook and release mortality of 3%, enforcement seizures and broodstock collections). Egg depositions are estimated from the average annual length of fish applied to a length-fecundity relationship and the annual sex ratio from sampling at trapnets.

Returns

The estimated returns of large salmon to the Miramichi River have declined from the peak returns in 1992. Large salmon returns in 1998 were at the lowest level since 1979 and were estimated at about 9,500 fish (lower confidence estimate 8500 fish; 90% error bars in figure).

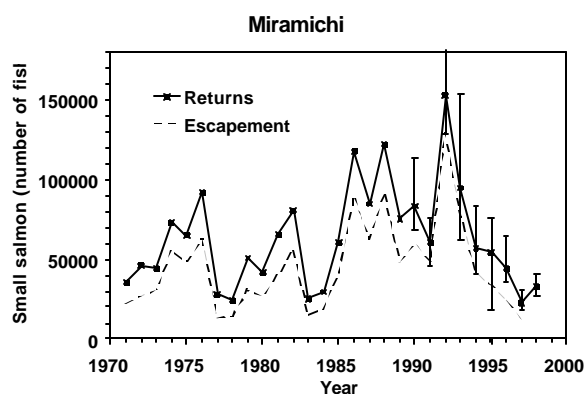


The low returns in 1998 parallel the low small salmon returns in 1997. Repeat spawners comprised 50% of the total returns of large salmon in 1998 and were more abundant than the 2SW maiden salmon. The abundance of 2SW salmon, 4000 fish, was at the lowest level during 1985 to 1998. The low abundance of large salmon was a consequence of low late-run

returns (after Sept. 1). The early-run of large salmon was improved, unchanged or slightly lower depending on the monitoring location.

	Change in 1998 relative to			
	Small Salmon		Large Salmon	
	1997	1993 - 1997	1997	1993 - 1997
Northwest Miramichi				
Northwest Barrier (early)	+107%	+55%	+90%	+36%
Catamaran Brook (late)	-13%	-51%	-7%	-35%
Trapnet estimate (early & late)	-18%	-66%	-70%	-80%
Southwest Miramichi				
Juniper Barrier (early)	+73%	-8%	+34%	-20%
Dungarvon Barrier (early)	+51%	+26%	+42%	+5%
Clearwater Brook (early & late)	+39%		-34%	
Trapnet estimate (early & late)	+78%	-21%	-36%	-56%

Returns of small salmon to the Miramichi River peaked in 1992 and declined to the lowest level of record at about 22,500 fish in 1997. In 1998, small salmon returns increased 45% from 1997 to 33,000 fish.



Small salmon returns were most improved in the early-run but overall returns were below the 1993-97 average.

Returns of large salmon to the Northwest Miramichi peaked in 1995 whereas Southwest returns peaked in 1992. Returns in 1997 of both small and large salmon in both branches were the lowest since 1992.

Returns (number of fish) of small and large salmon

	1994	1995	1996	1997	1998
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Miramichi River

Small	56929	54145	44377	22565	33000
Large	27544	32627	24812	18381	9500

Northwest Miramichi

Small	20600	22379	18943	9788	7900
Large	12600	15227	7957	7104	2200

Southwest Miramichi

Small	33775	31675	30241	13486	24000
Large	14000	17097	15734	10991	7000

In the **Tabusintac** River, the returns in 1998 were estimated to have been greater than 900 small and 700 large salmon. Periodic assessments in other years (1993 to 1998) indicated returns ranging from 599 to 1067 small and 799 to 1414 large salmon. Previous spawners, as estimated from fork length distributions, were the dominant component of the large salmon returns. This contrasted with previous years when 2SW maiden salmon were the most important component.

Returns (number of fish) of small and large salmon

	1994	1995	1996	1997	1998
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Tabusintac River

Small	1067	Unk	615	Unk	> 900
Large	1414	Unk	920	Unk	> 700

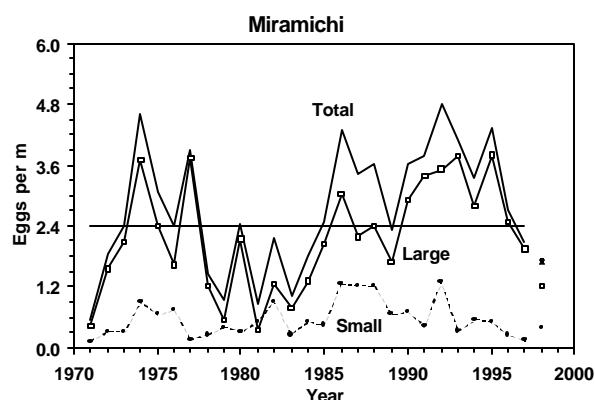
Buctouche River

Small	77	98	127	97	120
Large	225	154	134	200	102

In the **Buctouche** River, returns of large salmon ranged from 95 to 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. The proportion 2SW salmon in the large salmon returns decreased to 33% in 1998 from the previous average of about 87%.

Egg depositions relative to conservation

The eggs of small and large salmon returning to the Miramichi River in 1998 were below the conservation requirements. The calculated egg depositions will be less after accounting for removals. The conservation requirements in the Miramichi have been exceeded in 11 of 15 years since 1984 but conservation requirements were not met in the last two years.



Egg depositions in the Northwest Miramichi were below requirement in 1998 for the first time of the assessed time series (1992-1998).

Egg deposition relative to conservation requirement (%). ¹The egg depositions relative to conservation are for the total returns.

Year	Northwest Miramichi	Southwest Miramichi	Miramichi River
1992	119%	238%	201%
1993	177%	149%	170%
1994	200%	108%	139%
1995	269%	139%	179%
1996	134%	114%	114%
1997	104%	78%	87%
1998 ¹	57%	70%	68%

The conservation requirement for the **Tabusintac** River has been exceeded in the four years the stock was assessed between 1993 and 1998.

Egg deposition relative to conservation requirement (%)

Year	Tabusintac River	Buctouche River
1993	200%	35%
1994	404%	72%
1995	Unk	58%
1996	245%	46%
1997	Unk	70%
1998	> 100%	33%

The returns and escapements of large salmon to the **Buctouche** River have been below the conservation requirement every year assessed (1993 to 1998). Egg deposition in 1998 was 33% of requirement, the lowest in the time series.

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 but abundance is low compared to levels in the Miramichi River. Egg-to-summer fry survival is 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.

Outlook

For the **Miramichi River**, the high juvenile abundance levels 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 (95% C.I. 7,900 - 37,300) and 42,000 small salmon (95% C.I. 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 requirement for the Miramichi. The probabilities of meeting or exceeding conservation based on the previous five-year

average are 79% for the **Northwest Miramichi** and 62% for the **Southwest Miramichi**.

The outlook for 1999 based on the previous five-year return may be overly optimistic considering the downward trend in recent years. Alternatively, the ratios of small salmon to large salmon the following year suggest a modest increase in the large salmon returns in 1999. Based on the range of ratios observed in the last five years, large salmon returns in 1999 are expected to be about 13000 fish (median value, 95% C.I. 9500 - 18500). 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.

With the expectation of small salmon based on the previous five-year average return (42500 fish, 95% C.I. 15000-71000), there is an 11% 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 25% (95% C.I. 10% - 39%). The egg contributions by small salmon become more important when large salmon abundance is low.

Returns from hatchery progeny of both small and large salmon are expected to be similar to recent years and represent less than 1% of the total returns.

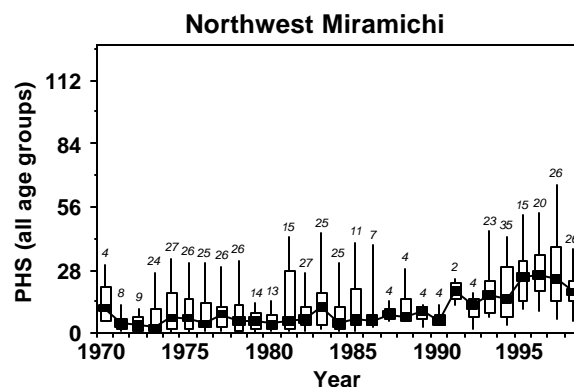
For the **Tabusintac River**, the conservation requirement has been exceeded in all four years that the stock has been assessed. The expectation is for this stock to continue meeting or exceeding the conservation requirement.

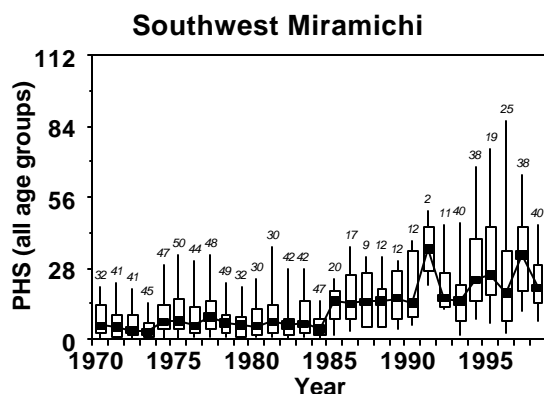
The conservation requirement for the **Buctouche River** was not met between 1993

and 1998. Based on the average returns of the last five years, there is a 1% chance of meeting the conservation requirement in 1999. Juvenile densities in the Buctouche River are low compared to those of the Miramichi River, are consistent with estimates of low escapement to the river in recent years, and provide little optimism for increased returns of salmon to the river over the next five years.

Previous spawners were the most important component of the large salmon returns in all the assessed SFA 16 rivers in 1998. These previous spawners have provided a buffer in years when 2SW salmon abundance is low.

In the **longer term**, juvenile densities in the Miramichi River remain high although the abundance of fry in 1998 declined in response to the reduced egg depositions in 1997. Parr abundance also remains high and the index of habitat utilization (Percent Habitat Saturation or PHS) by juveniles in 1998 was among the highest, 1970 to 1998 (number of sites sampled above the annual box plots), in both the Northwest and Southwest branches.





Management Considerations

Under a management plan similar to 1997 and 1998 (First Nations allocations of small and large salmon equal to the maximum of the 1992 to 1998 harvests, catch-and-release angling of large salmon, retention of small salmon), the probability of meeting the conservation requirement by large salmon in 1999 is 0%. The total removal of large salmon in 1998 was low relative to the return (6% in the Miramichi River overall) but was more important in the Northwest Miramichi (16%) than in the Southwest Miramichi (3%). Small salmon are more heavily exploited. In 1997, 55% of the Miramichi small salmon return, 53% in the Northwest and 54% in the Southwest Miramichi, was removed by all the fisheries.

In the absence of any fisheries-related mortality in 1999, there is a 11% chance that the eggs in the returns of small and large salmon will meet the requirement. Considering the uncertainties in the expected small and large salmon returns to the Miramichi River in 1999, a precautionary approach to fisheries management is recommended.

The index trapnet on the Southwest Miramichi and counts at the three protection barriers by

the end of July may provide a qualitative indicator of the end-of-year return.

In 1998, the pre-fishery egg contribution by small salmon in the Miramichi could have exceeded 25% of the total eggs because of the low abundance of large salmon. The early-run small salmon have a higher female proportion (>25%) than fall-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.

For the Miramichi, one large salmon is equivalent to the eggs produced by seven to ten small salmon. The aboriginal fisheries in 1998 removed small and large salmon bearing 2.7% of the eggs in the total returns to the Miramichi. Between 1992 and 1997, the aboriginal fisheries removals were 1.7% of the total eggs in the returns. Aboriginal harvests have accounted for 26% of the total loss of eggs in all the fisheries.

The proportion of the total eggs from small and large salmon lost in a retention angling fishery for small salmon is 10%. Egg losses from the angling fishery on small salmon are expected to amount to about 30% of the total eggs returned by small salmon. Under catch-and-release management for all salmon, only 1% of the total eggs would be expected to be lost to the fishing activity (assuming a 3% catch-and-release mortality).

If fisheries proceed as last year on the Miramichi, the probability of achieving conservation requirement is less than 1% in both the **Southwest** and **Northwest** Miramichi. If all retention fisheries were closed, the probabilities rise to 13% in the Northwest Miramichi and 7% in the Southwest Miramichi.

The probability of meeting conservation requirement appears relatively insensitive to the angling management scenarios considered. In all cases, the chance of meeting conservation requirements varied by only 3% in the Northwest and 6% in the Southwest.

Fisheries in the Miramichi River exploit the early-run component more heavily than the fall-run component. In the aboriginal fisheries in most years, more than 80% of the small and large salmon harvests are taken from the early season. The angling catch of small salmon has on average been 80% in the early season (before August 31) and 20% in the late season (Sept. and Oct.). Large salmon angling catches have occurred 75% early and 25% late. This contrasts with returns at monitoring trapnets in the estuary which indicate that generally about 50% of the total annual return of small salmon and 25% of the annual large salmon are sampled during May to August. Similar exploitation rates on the early and late runs would reduce the risk of over-exploiting a component of the Miramichi stock.

The **Tabusintac River** exceeded the conservation requirement again in 1998 and is expected to repeat in 1999. Current fisheries exploitation levels are not a conservation concern.

The **Buctouche River** is used as an index river for New Brunswick Northumberland Strait rivers. It achieved only a third of the conservation requirement in 1998, thereby failing to meet the requirement for the sixth consecutive year. Small salmon have contributed about 3% of the eggs in the total returns of small and large salmon. In 1997, the Richibucto River was estimated to have achieved less than 15% of the requirement for the portion of the river assessed. It is not

expected to have improved above the level observed in the Buctouche River in 1998.

Prior to 1998, the Buctouche First Nation had limited its harvest of small and large salmon from the Buctouche River to well below fishing agreement values. Returns to the Buctouche in 1999 are expected to be below conservation requirements. The total loss of eggs from the First Nations and angling fisheries between 1993 and 1997 has amounted to about 3-8% of the potential annual egg deposition.

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