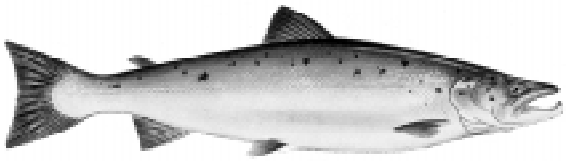
Fisheries and Oceans / Pêches et Océans
Eastern Canada

DFO Science
Stock Status Report D0-01



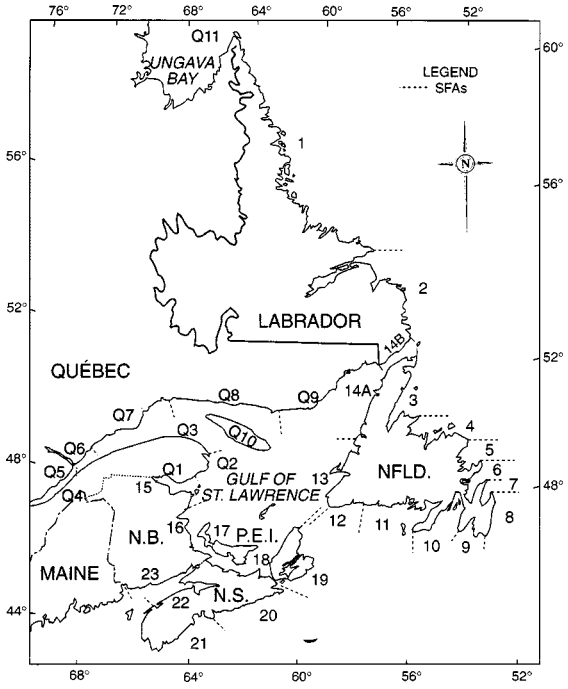
Atlantic Salmon Eastern Canada Overview for 1996

Background

There are approximately 550 Atlantic salmon rivers in eastern Canada. Each river is assumed to consist of at least one stock with the larger rivers containing several stocks. There is a diverse life history structure including variations in 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). 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 subsequent spawning. The majority of the large salmon spawners are female whereas small salmon spawners comprise varying proportions of male and female fish depending upon the geographic area. The relative proportions of the size groups in the returns also vary geographically.

Conservation for Atlantic salmon is considered to be a threshold reference point. Conservation requirements for Atlantic salmon define the level of egg deposition below which the consequences are likely to be deleterious. The conservation requirements are established for individual rivers based on 2.4 eggs per m^2 of river habitat with an additional egg requirement for the lacustrine habitat in Newfoundland and Labrador. 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.

Assessments are prepared for a limited number of specific rivers, mostly on the basis of the size of the Atlantic salmon resource within the river, the demands by user groups, and as a result of requests for biological advice from fisheries management..



The Fishery

The 23 areas for which DFO manages the salmon fisheries directly are called Salmon Fishing Areas (SFA); for Québec, the management is delegated to the Ministère de l'Environnement et de la Faune and the fishing areas are designated by Q1 through Q11. Harvest (fish which are killed and retained) and catches (including fish caught and released in recreational fisheries) are categorized in two size groups: small and large. Small salmon in the recreational fisheries refer to salmon less than 63 cm fork length, whereas in commercial fisheries, it refers to salmon less than approximately 2.7 kg whole weight. Large salmon in recreational fisheries are greater than or equal to 63 cm fork length and in

commercial fisheries refer to salmon greater than or equal to about 2.7 kg whole weight.

Three user groups exploited salmon in Canada in 1996: Native peoples, commercial fishers, and recreational fishers.

The following management measures were in effect in 1996.

Native peoples' fisheries: Native peoples' food fisheries took place subject to agreements or through permits issued to the bands. The permits generally describe gear and fishing effort and catch limits. Harvests which occurred both within and outside agreements were obtained directly from the Native peoples. Harvest by Native peoples with recreational or commercial licenses are reported under the recreational and commercial harvest categories.

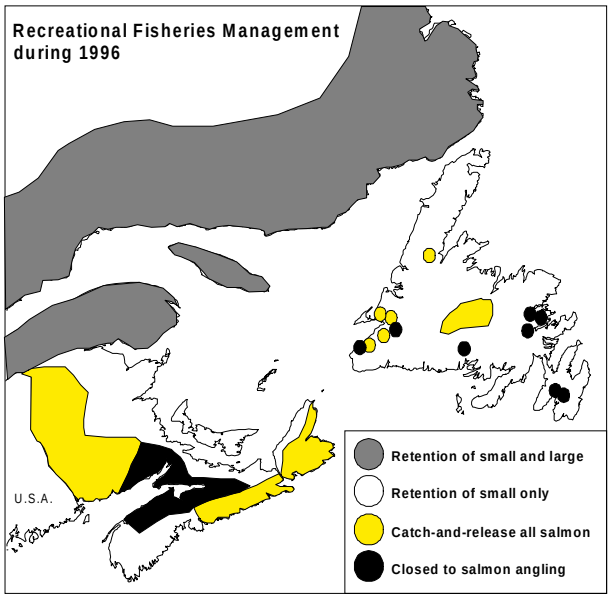
Commercial fisheries: The five-year moratorium which was placed on the commercial fishery in insular Newfoundland in 1992 continued in 1996. In Labrador, commercial fishing quotas assigned by SFA were reduced further from 1995 and the number of fishers declined minimally.

	Labrador (SFA 1,2, 14B)		Québec (Q7 to Q9)	
	Licensed effort	Quota (t)	Licensed effort	Quota (number)
1990	570	340	165	29,605
1991	570	295	152	28,359
1992	495	273	147	23,400
1993	288	178	94	15,325
1994	218	92	90	15,175
1995	218	73.5	90	15,175
1996	215	55	87	12,068

The opening of the Labrador commercial fishery was moved forward to June 20 from the delayed opening of July 3 in 1995. Previously, the Labrador commercial fishery opened on June 5. The season was to close on October 15 or when the quota was caught.

Commercial fisheries in Quebec in 1996 occurred in Zone Q9 (July 1 to August 23) and in Ungava Bay (Zone Q11 by Native peoples). The quota for Q9 in 1996 was reduced by 20% from 1995.

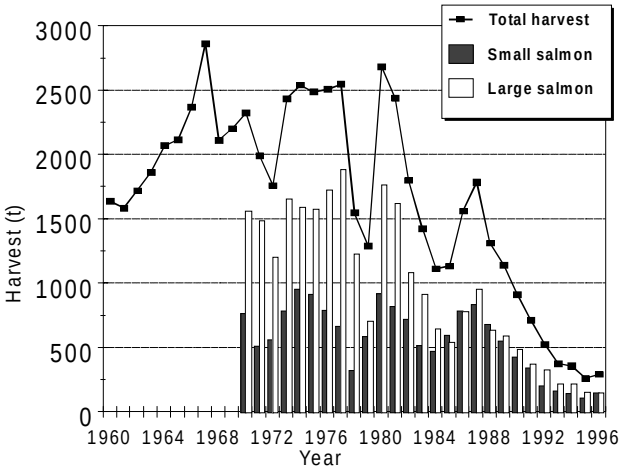
Recreational fisheries: Recreational fisheries management in 1996 consisted of four strategies: 1) retention fisheries for small and large salmon, 2) retention fisheries for small salmon with mandatory catch-and-release for large salmon, 3) catch-and-release of all salmon regardless of size reflecting reduced stock levels, and 4) complete closure reflecting depressed stock levels.



Except in Québec and Labrador, only small salmon could be killed and retained in the recreational fisheries. The seasonal bag limits in the recreational fishery remained at eight small salmon in New Brunswick (SFA 15, 16) and Nova Scotia (SFA 18 and 21) with a daily limit of two retained. In SFA 17 (PEI), the season and daily bag limits were 7 and 1 respectively. Catch-and-release fishing for all

sizes of Atlantic salmon was in effect in SFA 20 of Nova Scotia and SFA 23 of New Brunswick. SFA 22 was closed to salmon angling. For insular Newfoundland (SFA 2 to 14A), the seasonal bag limit was similar to 1994 and 1995: six fish of which three small salmon could be retained prior to July 31 and three small salmon after that date. After the bag limit of three was reached in each time period, catch-and-release fishing only was permitted. In Labrador (SFA 1, 2 and 14B), there was no seasonal division of the bag limit but the season limit for large salmon was set at one as in 1995 with a daily limit of two fish. In Québec, season and bag limits varied by zone: for Q1 to Q8 and Q10, the season limit was 7 fish of any size. For rivers in zone Q9 and Q11, the season limit was 10 fish with daily limits of two fish in Q8, three fish in Q9 and four fish in Q11. In most rivers of zones Q1 to Q7 and Q10, fishing for the day would end if the first fish kept was a large salmon. If the first fish kept was a small salmon, then fishing could continue until a second fish was caught, regardless of the size of the second fish.

The **provisional harvest** of salmon in 1996 by all users was 291 t, an increase of 12% by weight from the 1995 harvest of 260t.



The 1996 harvest represented about 87,141 small salmon and 30,066 large salmon, an increase of 41% for small salmon but a reduction of 12% for large salmon from the 1995 harvests. The dramatic decline in harvested tonnage since 1988 is mostly the result of the large reductions in commercial fisheries effort and, since 1992, the closure of the insular Newfoundland commercial fishery. The abundance of salmon has also declined.

	% of Provincial Harvest			% of eastern	Number
	Native peoples'	Recreational	Commercial	Canada	of fish
Small salmon					
Newfoundland / Labrador	0.0[1]	83.5	16.5	54.7	47,657
Québec	0.9	60.8	38.3	13.6	11,833
New Brunswick	14.4	85.6	0.0	27.5	23,922
P.E.I.	3.8	96.2	0.0	0.5	446
Nova Scotia	10.6	89.4	0.0	3.8	3,283
Large salmon					
Newfoundland / Labrador	0.0[1]	6.3	93.7	25.8	7,756
Québec	22.6	42.6	34.8	71.2	21,405
New Brunswick	100.0	0.0	0.0	2.2	661
P.E.I.	0.0	0.0	0.0	0.0	0
Nova Scotia	100.0	0.0	0.0	0.8	244

[1] Native peoples in Conne River Newfoundland (SFA 11) did not fish in 1996 because of low returns.

The 1996 harvest of small and large salmon, by number, was divided among the three user groups in different proportions depending on the province and the size group exploited.

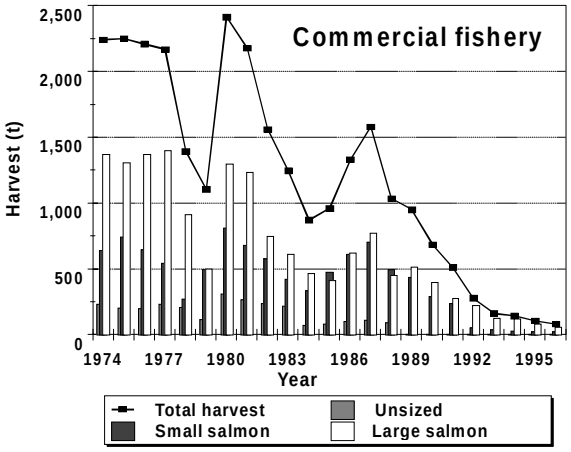
Newfoundland reported the largest proportion of the total harvest of small salmon and Québec reported the greatest share of the large salmon harvest. Recreational fisheries exploited the greatest number of small salmon in all the provinces and overall in Canada (81.3%). Commercial fishers took the largest share of large salmon (49.7% by number). Native peoples' harvested 4.5% (by number) of the total small salmon and 19.1% of the total large salmon in eastern Canada.

In many cases, **Native peoples' food fisheries** harvests in 1996 were less than the allocations. Harvests in 1996 (by weight) were 21% above the previous year's harvest and 10% above the previous 5-year average harvest. The proportion of the harvest composed of large salmon remained unchanged relative to previous years.

Native peoples' fisheries

	Harvest (t)	% large
1990	31.9	78%
1991	29.1	87%
1992	34.2	83%
1993	42.6	83%
1994	41.7	83%
1995	32.8	82%
1996	39.8	84%

The **commercial harvest** in 1996 declined to 81.2 t from a peak of more than 2,400 t in 1980.



Commercial harvest in Labrador and Québec was the lowest ever. The harvest and the proportion large salmon in the commercial fishery continued to decline in 1996, as a result of license retirements and reduced quotas.

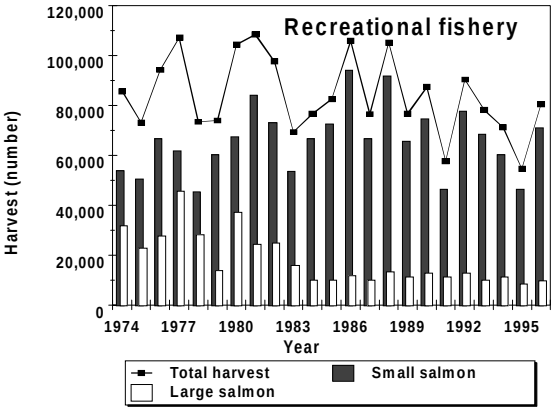
Commercial fisheries harvests

	Weight (t)	Number	% large (by number)
Labrador (SFA 1,2, and 14B)			
1992	204	56,590	57%
1993	112	34,170	50%
1994	93	24,017	64%
1995	55	19,156	59%
1996	48	15,116	48%
Québec (Q7 to Q9)			
1992	63	19,363	80%
1993	46	14,657	75%
1994	43	13,800	72%
1995	42	13,653	71%
1996	32	11,718	61%

The commercial fishery in Zone Q11 (Ungava Bay) has harvested between one and three tons of salmon since 1990, representing between 212 and 485 fish, sizes combined.

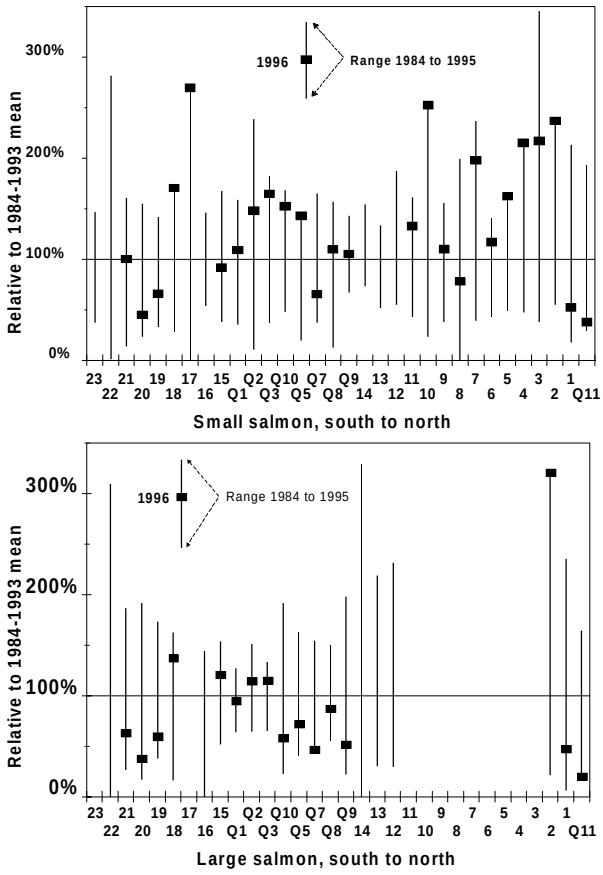
The **Greenland fishery** took an estimated 83 t of salmon in the summer and fall of 1995: 65% were estimated to have been of North American origin, largely Canadian (20,700 fish). All of the salmon caught at Greenland in 1995 irrespective of the continent of origin would not have returned to homewaters until 1996, the year following the fishery. The 1996 Greenland fishery harvested 92 t of which 42% was estimated to have been of North American origin (12,900 fish). These fish would have returned to North America in 1997.

Harvest in **recreational fisheries** in 1996 totalled 80,438 small and large salmon, 14% above the previous five-year average and 47% above the 1995 harvest level.



Small salmon harvest (70,840 fish) increased 19% from the previous five-year mean while the large salmon harvest of 9,598 fish was a 10% increase. Small salmon harvests were 53% above the harvests in 1995 and this size group has contributed more than 86% on average of the total harvests since the imposition of catch-and-release recreational fisheries in the Maritimes and insular Newfoundland (SFA 3 to 14B, 15 to 23) fisheries in 1984.

Recreational catches (including retained and released fish) of small salmon in 1996 increased relative to the 1984 to 1993 mean in most fishing areas of Québec, Newfoundland and Labrador. Large salmon catches were up in the Gulf shore of Nova Scotia (SFA 18) and the Québec/New Brunswick Chaleur Bay area (SFA 15, Q1 and Q2). Large salmon catches in Labrador (SFA 2) were the highest observed since 1984. Catches in SFA 17 (PEI) were above average but more than 90% of the returns originate from smolt stocking programs.



Changes in the management of the recreational fisheries since 1984 have compromised the use of angling catches as indices of abundance. Therefore, the interpretation of trends in abundance relies mostly on rivers where returns have been estimated or completely enumerated. Numerous areas in the Maritimes Region in 1996 were closed to all retention of salmon,

regardless of size. Caught-and-released fish are not considered equivalent to retained fish and their inclusion in catch statistics further compromises the reliability of interpretation of trends.

Unreported removals are defined as harvests which are caught and retained, but do not enter into the reported harvest statistics; such harvests could be both legal and illegal, but would not include catch and release mortalities whether they arise from nets or angling gear. Such estimates would not include fish retained by public or private agencies for broodstock purposes.

These removals are difficult to quantify. To develop such estimates, regional fisheries officials were asked to provide their best estimates, based on enforcement knowledge, of the magnitude of the unreported harvest in their areas. Because of the reduced commercial fishery landings, the unreported removals now make up a large proportion of the reported harvest and the magnitude of the unreported removals increased in 1996. In spite of the salmon and cod commercial fishing moratoria, salmon are still encountering fishing gear throughout the Newfoundland coastal areas, based on the incidence of net-marked salmon observed at counting facilities. These fish are the survivors of encounters with fishing gear and depending upon the retention rate and the short-term mortality rate from such encounters, this could infer a substantial loss of fish if either or both of these rates are high. Salmon could be encountering fishing gear which has been legally set for other species, such as herring, capelin, and mackerel.

Reported and unreported removals for eastern Canada

Year	Unreported removals (t)	Reported harvest (t)	Unreported as % of reported
1986	315	1559	20
1987	234	1784	13
1988	161	1311	12
1989	174	1139	15
1990	111	911	12
1991	127	711	18
1992	136	522	26
1993	161	373	43
1994	105	355	30
1995	98	260	38
1996	156	287	54

Commercial **aquaculture of Atlantic salmon** first occurred in 1980 in the Bay of Fundy with the reported production of 11 t. Commercial operations in the Bay of Fundy account for over 90% of the total Canadian production.

Atlantic salmon commercial aquaculture production (t) in eastern Canada

Year	Eastern Canada	Québec[1] Q1	NB SFA 23	NS SFA 19-21	NFLD SFA 11
1980	11		11		
1981	21		21		
1982	38		38		
1983	68		68		
1984	227		223	5	
1985	360		350	10	
1986	673		636	36	1
1987	1,357		1,318	37	2
1988	3,315	5	3,273	27	10
1989	4,760	10	4,500	250	0
1990	7,810	10	7,500	300	0
1991	9,395	50	9,000	320	31
1992	10,380	30	10,000	300	75
1993	11,115	20	10,145	850	100
1994	12,441	15	11,836	544	46
1995	12,805	30	12,000	630	145
1996[2]	16,874	0	16,000	750	124

[1] All land-based facilities, [2] 1996 values are preliminary

Other species cultured commercially in eastern Canada include Arctic charr and rainbow (steelhead) trout. The Arctic charr production occurs in Newfoundland, all in shore-based facilities. Rainbow trout are cultured in the Bay of Fundy (all land-based), Bras d'Or Lakes (SFA 19), and in Bay d'Espoir Newfoundland (SFA 11). In 1996, production of rainbow trout was 530 t from Nova Scotia and 315 t from Newfoundland. Escapees of Atlantic salmon, Arctic charr and steelhead trout have been recorded in many rivers in proximity to these production facilities.

Resource Status

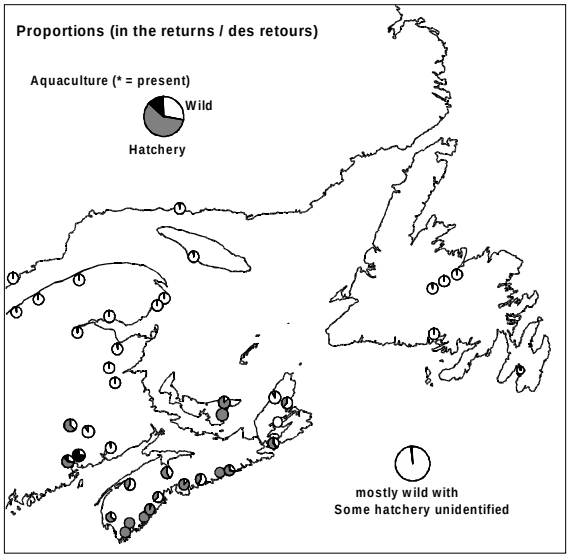
The returns represent the size of the population before any in-river removals. Spawning escapement is determined by subtracting all the known removals, including food fisheries, recreational harvests, broodstock collections, and scientific samples from the total returns.

A total of 85 rivers were assessed in eastern Canada in 1996. Estimates of total returns of small and large salmon were obtained using various techniques: 47 were derived from counts at fishways and counting fences; 7 were obtained using mark and recapture experiments; 18 using visual counts by snorkeling or from shore; 1 from an acoustic system; and 12 from angling catches or catch rate indices.

Origin of returns

Salmon returning to rivers of eastern Canada were either of wild origin, hatchery origin, or aquaculture escapees. Fish designated as being of wild origin are defined as the progeny of fish where mate selection occurred naturally (eggs not stripped and fertilized artificially) and whose life cycle is completed in the natural environment. Hatchery origin fish, designated as fish introduced into the rivers regardless of life stage, were identified on the basis of a clipped adipose fin, from fin deformations, and/or from scale characteristics. Stocking of early life stages often precludes their later identification as hatchery origin fish. Aquaculture escapees were identified from hatchery fish on the basis of fin erosion (especially of the tail) and from scale characteristics.

The returns to the majority of the rivers in Newfoundland and to most rivers of the Gulf of St. Lawrence and Québec were comprised exclusively of wild salmon. Hatchery origin salmon made up varying proportions of the total returns and were most abundant in the rivers of the Bay of Fundy and the Atlantic coast of Nova Scotia. Aquaculture escapees were sampled from the returns to several rivers of the Bay of Fundy (St. Croix, Magaguadavic, Saint John in SFA 23) as well as in the Baddeck River (SFA 19).



Rainbow trout and Atlantic salmon smolt escapees from the Bay d'Espoir aquaculture industry, were observed at Conne River (SFA 11) in 1996. In 1994, escapes of Atlantic salmon in the Bay of Fundy area

were estimated at 20,000 to 40,000 salmon, an amount greater than the total returns of wild and hatchery origin salmon (both small and large) (13,000 to 21,000 fish) to the entire Bay of Fundy and Atlantic coast of Nova Scotia (SFA 19 to 23) in the same year. The level of escapes in 1993 was similar to that of 1994. Estimates of escapes for 1995 and 1996 are low.

Aquaculture escaped fish have increased in abundance in the Magaguadavic River (SFA 23) which is in close proximity to the centre of the aquaculture production area. Escaped fish were not observed between 1983 and 1988. Since 1992, escaped fish have comprised between 33% and 90% of the total counts at the fishway.

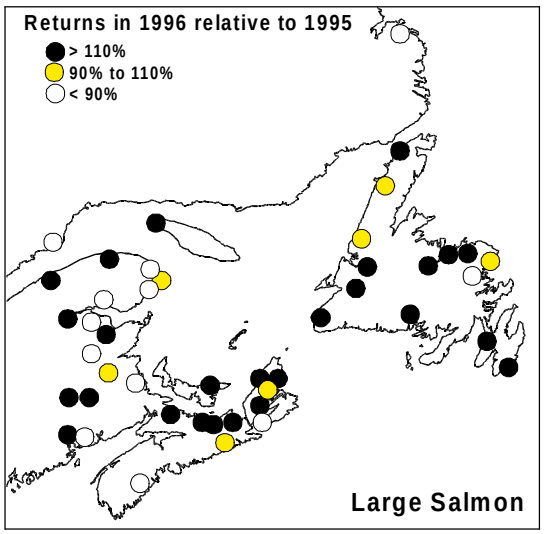
Magaguadavic River (SFA 23)

Year	1SW	Prop. Aqua	MSW	Prop. Aqua	Total	Prop. Aqua
1983	303	-	637	-	940	-
1984	249	-	534	-	783	-
1985	169	-	466	-	635	-
1988	291	-	398	-	689	-
1992	238	0.35	201	0.31	439	0.33
1993	208	0.46	177	0.29	385	0.38
1994	1064	0.94	228	0.73	1292	0.90
1995	540	0.90	198	0.85	738	0.89
1996	195	0.89	68	0.29	263	0.74

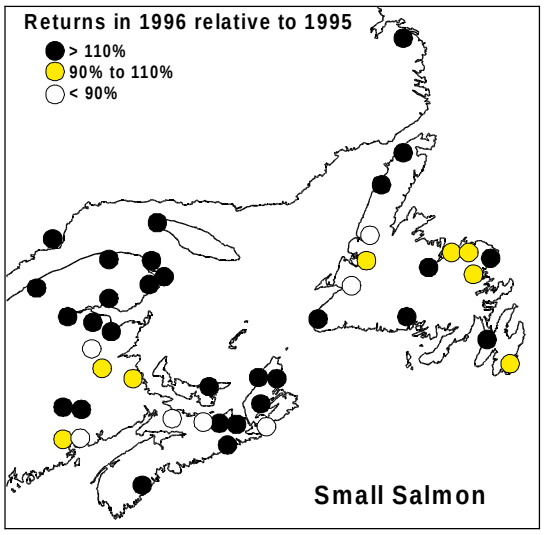
Aquaculture escapees comprised 54%, 22% and 13% of the total run of salmon to the St. Croix River during 1994 to 1996, respectively.

Returns and Escapements in 1996

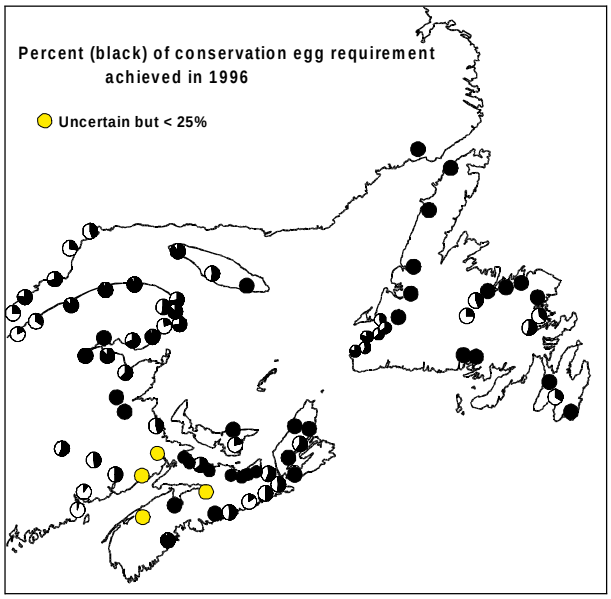
Of the 85 stocks for which returns of salmon were determined in 1996, comparable data were collected on 45 of these in 1995. Large salmon returns in 1996 increased from 1995 in rivers throughout eastern Canada with notable exceptions: Gaspé rivers of Québec (Q1, Q2), southeast New Brunswick (SFA 16) and the Atlantic coast of Nova Scotia (SFA 19 to 21).



Small salmon returns in 1996 relative to 1995 improved in Québec and Nova Scotia. Returns to rivers in Newfoundland and New Brunswick were mixed.



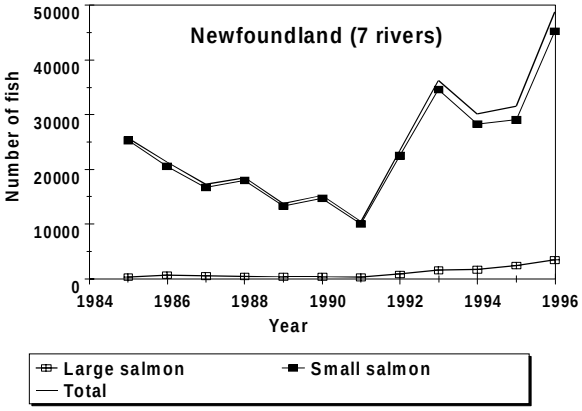
Egg depositions exceeded or equalled the river specific conservation requirements in 32 of the 85 assessed rivers and were less than 50% of conservation requirements in 22 other rivers. Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where 10 of the 20 rivers assessed had egg depositions which were less than 50% of conservation requirements. None of the rivers in the Bay St. George area of Newfoundland (SFA 13) had egg depositions which exceeded the conservation requirements. Several other rivers in Newfoundland and Québec which were deficient in eggs have colonization programs where salmon have gained access in recent years to previously inaccessible habitat.



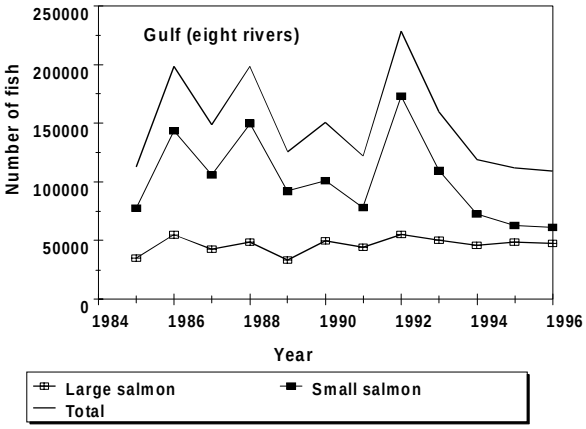
Trends in Returns, Escapement, and Production

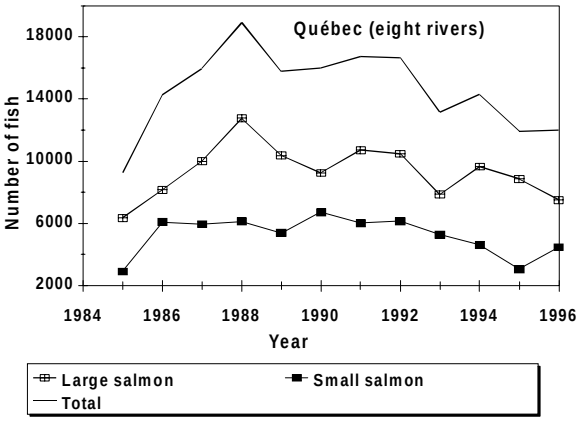
Annual returns of salmon by size group are available for 26 rivers in Atlantic Canada since 1985. These returns do not account for commercial fisheries removals in Newfoundland, Labrador and Greenland and in some rivers include returns from hatchery stocking. Peak return years differed for regions within eastern Canada. The returns during the Newfoundland commercial fishery moratorium years (1992 to 1996) for all areas except Newfoundland are lower than returns in 1986 to 1988 when there were commercial fisheries in Newfoundland, Labrador and Greenland harvesting mainland Canada origin salmon.

The total returns to seven Newfoundland rivers have more than doubled since 1993 from the low levels observed during 1989 to 1991.

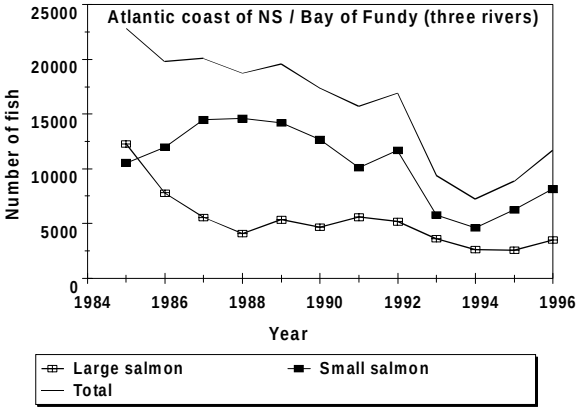


Returns of small salmon to eight Gulf rivers (NB, NS, PEI) have fluctuated annually but declined between 1994 and 1996 to the lowest levels since 1985. Returns of large salmon have not fluctuated as greatly as the small salmon returns and have levelled off at about 45,000 fish.



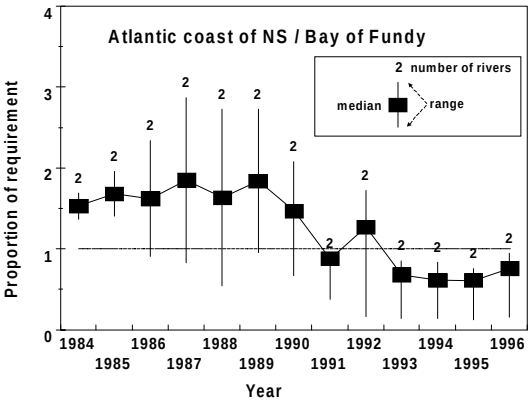


Returns to the rivers of the Atlantic coast of Nova Scotia and Bay of Fundy improved from 1994 to 1996 for both large salmon and small salmon but returns of both size groups remain well below the levels observed in the 1980s.

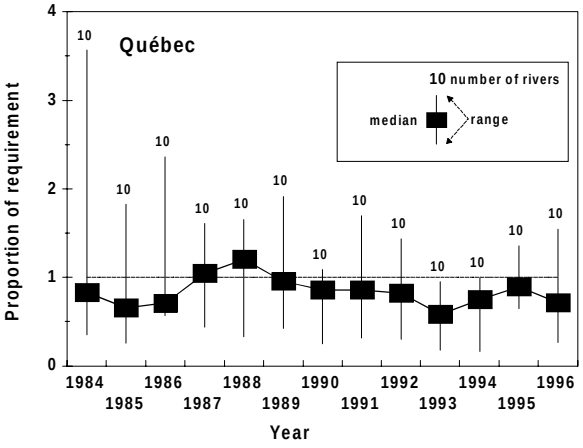


Returns to eight rivers of Québec in 1996 were the third lowest since 1985 with large salmon returns declining from the peak returns of 1988.

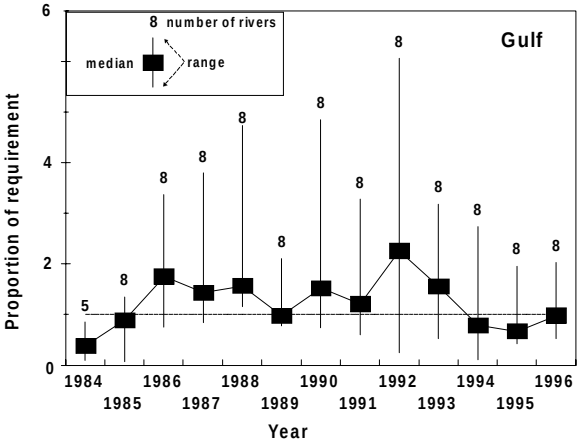
Escapements over time relative to conservation requirements have improved in some areas of Atlantic Canada but have declined in others. Egg depositions in two Bay of Fundy/Atlantic coast of Nova Scotia rivers has severely declined, especially since 1991.



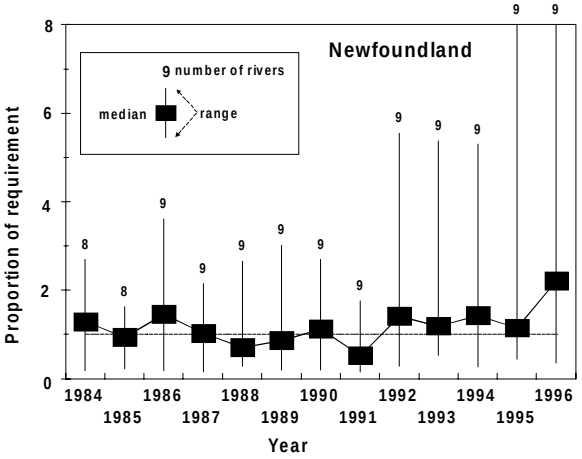
For the Québec rivers, egg depositions declined continually from a peak median value in 1988 with a slight recovery in 1995.



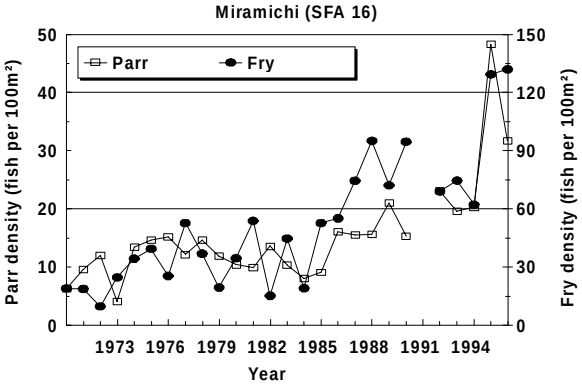
The eight rivers of the southern Gulf have been the most consistent in equalling or exceeding the conservation requirements but the median egg depositions were below conservation requirements in the last three years.



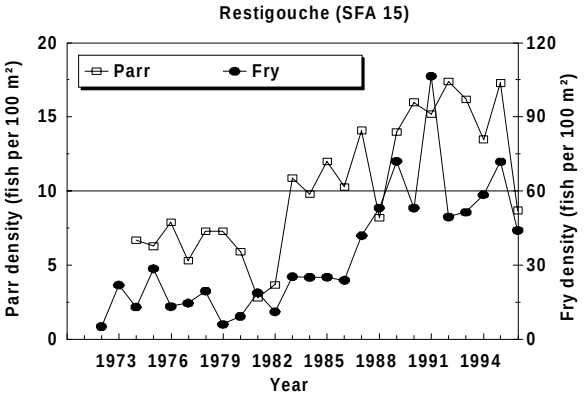
Newfoundland rivers have shown the greatest improvement in the proportion of the conservation requirement achieved as a direct result of the commercial salmon and groundfish moratoria initiated in 1992.



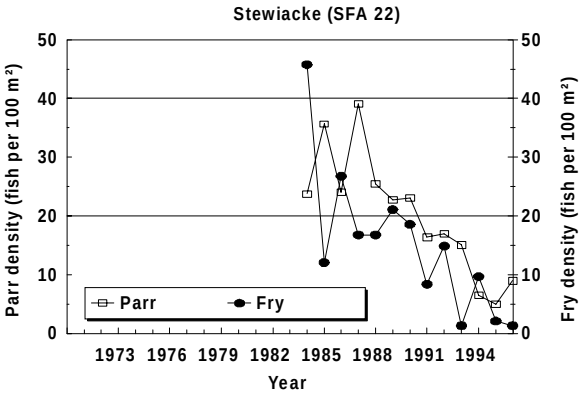
Densities of **juveniles** have been monitored annually since 1971 in the Miramichi (SFA 16) and Restigouche (SFA 15) rivers. In these rivers, juvenile densities of young-of-the-year (fry) and parr (juveniles of one or more years old) have increased since 1985 in response to increased spawning escapements. Densities of fry remained high in 1996 in the Miramichi but parr densities declined.



In the Restigouche River, both fry and parr densities declined 1996. The observed declines in both rivers may be related to overwintering conditions during 1995/1996.



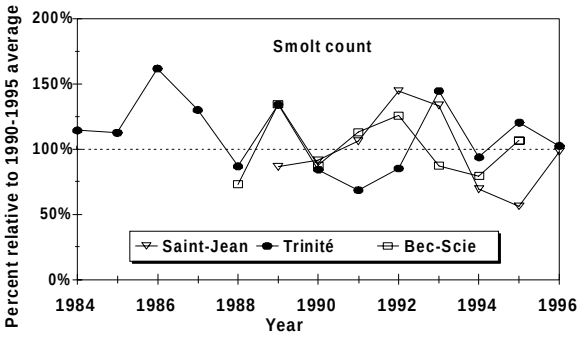
High densities of juveniles have also been reported from Nova Scotia rivers along the Gulf of St. Lawrence (SFA 18) and in several Cape Breton Island streams (SFA 19). This is in contrast to juvenile densities from an inner Bay of Fundy river (Stewiacke River; SFA 22) which have declined since 1984, as a result of reduced spawning escapement. Fry densities in 1996, an index of spawning escapement in 1995, were the lowest in the time series.



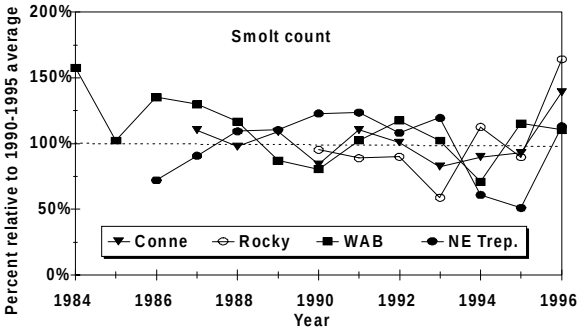
Counts of **smolts** provide direct measurements of the outputs from the freshwater habitat. There is high variability in the annual smolt output; in tributaries, annual smolt output can vary by five times but in the counts for entire rivers, annual smolt output has generally varied in magnitude by a factor of two.

The number of wild smolts leaving the rivers depends upon the number of eggs deposited adjusted by variable survival rates throughout the juvenile stages. The production among river systems is also not necessarily synchronized and it is not possible to calculate how many smolts in total leave the rivers of Atlantic Canada for any given year.

In the Québec rivers where smolt production has been monitored, the 1996 smolt production was similar to the average during 1990 to 1995.



In Newfoundland, smolt production increased in three rivers along the south and southeast coasts. The production of smolts from Western Arm Brook (WAB) was similar to the recent years' average.

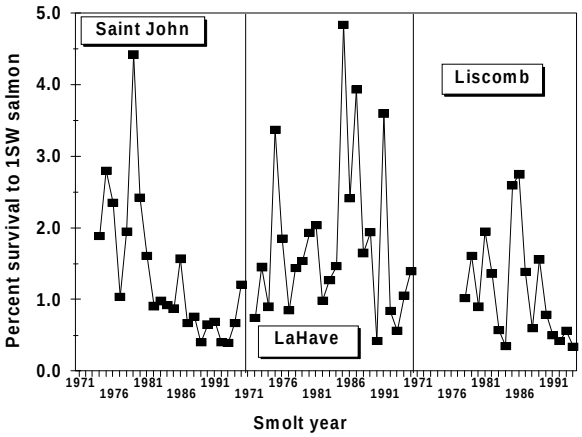


Except for the rivers along the eastern and southern shores of Nova Scotia (SFA 20 and 21) which have been impacted by acid

precipitation and rivers of the Bay of Fundy (SFA 22 and 23) the freshwater production of the monitored rivers in Atlantic Canada has increased or remained constant at high levels since 1985.

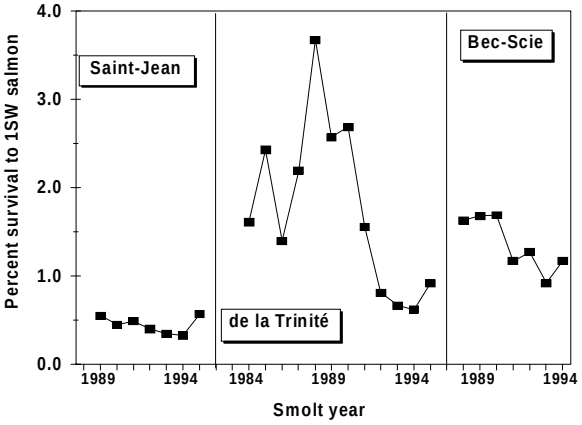
Counts of smolts and adult salmon returns enable estimates of **marine survival** to be derived. Examination of trends over time provide insight into the impact of changes in management measures or other factors that can influence the production of salmon. Information from 12 rivers in Atlantic Canada with smolt counts and corresponding adult counts are available; four are hatchery stocks and eight are wild populations. Geographically, populations for which data were available ranged from the Saint John River (SFA 23 Bay of Fundy) in the south, LaHave River (SFA 21) and Liscomb River (SFA 20) along the Atlantic coast of Nova Scotia, Saint-Jean (Q2) in the Gaspé region, de la Trinité and aux Rochers (Q7) on the Quebec North Shore, Bec-Scie (Q10) on Anticosti Island, and other populations from southern (SFAs 9 and 11), eastern and northern Newfoundland (SFA 4, 14).

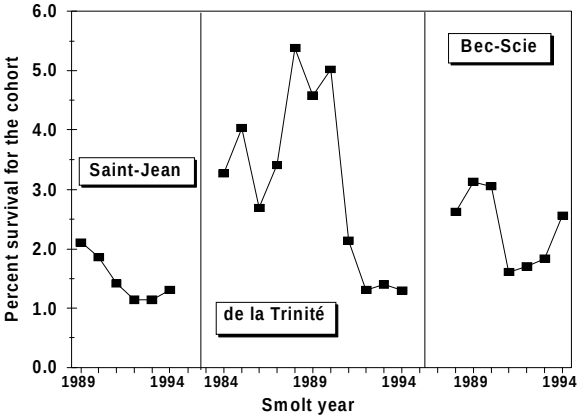
In general, survival of hatchery stocks is lower and more variable than that of wild stocks. The survival of hatchery 1SW returns from the Saint John and LaHave rivers improved over those of the last several years; that of the Liscomb River reached the lowest level of record.



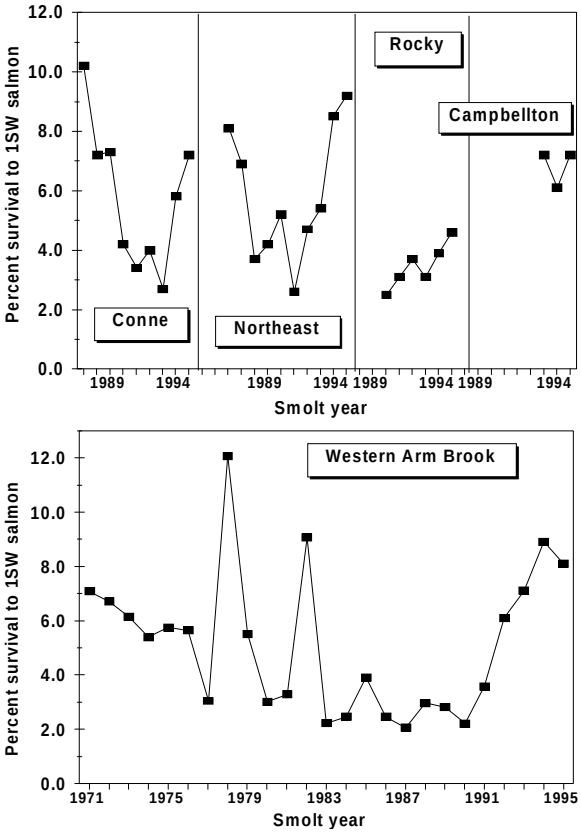
The single hatchery stock from Québec (Anse a la Barbe) also showed a declining trend (over a shorter time series) with very low smolt survivals (<1.0%) to both the 1SW and 2SW stages.

Sea survivals in the Québec wild stocks declined from the peak survivals of the 1989 smolt migration with a slight improvement in the sea survival of the 1995 smolt migration.





Survivals of the 1995 smolt migration improved for all the Newfoundland stocks and attained levels observed historically. Considering that the historical survival rates (prior to 1992) represent survival to the river after commercial fisheries, the recent survival rates, although improved in recent years, are still dismal.



Given the large scale reductions in marine exploitation that have occurred over the past several years, sea survival of the salmon populations from eastern Canada has not increased in the manner expected.

Environmental Considerations

Freshwater environmental conditions affect the timing and availability of salmon to the fisheries. Discharges in 1996 were above normal in both winter and summer with no important low flow events. This contrasts with the 1995 water levels when summer flow conditions were exceptionally low. Warm water temperatures in 1996 were not as extreme as in the two previous years. Above-normal discharges and cooler water temperatures provided excellent angling opportunities in those areas where fisheries were open.

Rivers along the south and eastern shore of Nova Scotia (SFA 20 and 21) remain vulnerable to acid precipitation. Populations of Atlantic salmon are considered extinct in 14 rivers and remnant populations survive in 19 other rivers as a result of water quality impaired by acidification.

Marine conditions in 1995/96 would have affected the small salmon returning to the rivers in 1996 while conditions in 1994/95 and 1995/96 would have affected the large salmon stocks. Limited surface layer temperature data suggest that the waters in the Labrador Sea, including the Labrador and northern Newfoundland shelves, were generally cold in 1995 but warmer than 1994. Similar cold conditions persisted on the northeastern Scotian Shelf and along the Atlantic coast of Nova Scotia.

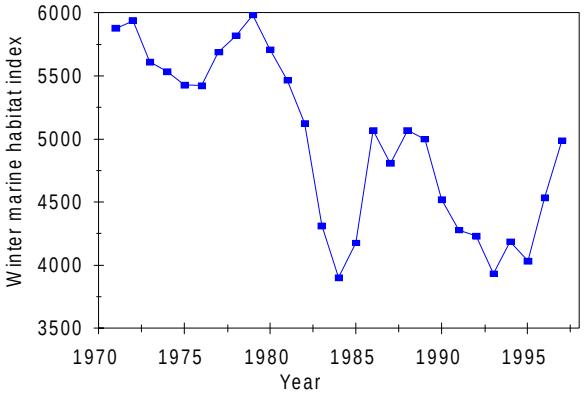
Marine conditions were more temperate in 1996 relative to those of the preceding several years (1990 to 1995). Ice coverage in the winter of 1996 was below the median distribution and ice retreat was earlier in the spring of 1996 than in previous years. This earlier ice retreat could in part account for the earlier run-timing of salmon to most areas of eastern Canada.

Recent analyses have described a significant correlation between the estimated production of North American 2SW salmon and an

index of marine habitat in the northwest Atlantic. It has been used to predict the prefishery abundance at Greenland of non-maturing 1SW salmon destined to return to North America as 2SW spawners in the subsequent year.

Significant correlations between this habitat index and return rates of hatchery smolts to the Saint John River and smolt survival rates to Conne River suggest that colder marine conditions may be having a detrimental effect on the natural survival at sea.1 The habitat index does not correlate with all the Atlantic salmon stocks but appears to be a useful predictor of the potential returns of hatchery smolts to the Saint John River and to rivers of the Atlantic coast of Nova Scotia.

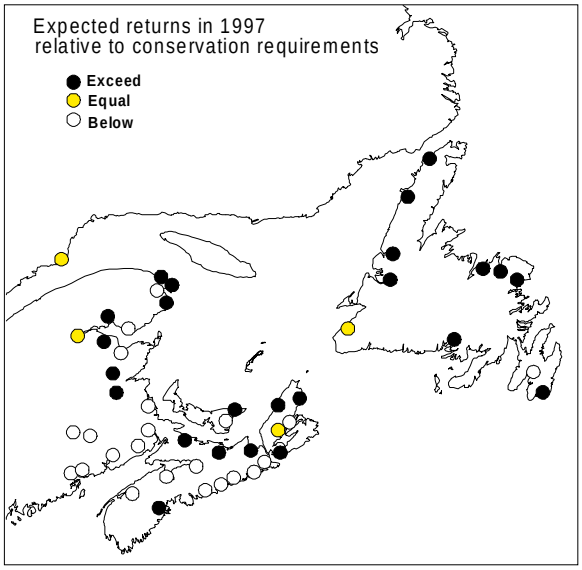
The January to March habitat index improved in 1996 and 1997 to levels similar to those of the late 1980s.



Outlook

Short term

Expectations of returns for 1997 are based on a combination of methods: use of the previous 5-year average returns, forecast models based on small salmon returns in the current year to predict large salmon returns in the coming year, stock-and-recruitment relationships, and trends in survival rates of juveniles and smolts from hatchery stocking combined with stocking levels in previous years. The performance of these methods varies. Expectations for 1997 are described in terms of whether the total returns of salmon (small and large) will be below, meet, or exceed the conservation egg requirements for the river.



Returns to the Bay of Fundy and Atlantic coast of Nova Scotia are expected to be deficient in 1997. Returns to Gulf of St. Lawrence rivers and generally throughout Newfoundland are expected to equal or exceed the conservation requirements. Most rivers which recently have been underseeded are expected to have insufficient returns in 1997.

Colder oceanic conditions both nearshore and in the Labrador Sea are negatively associated with marine survival of salmon in eastern Canada. Environmental conditions tend to be autocorrelated and the upward trend in warming of the water temperatures in 1994 to 1996 may represent the return to

temperate marine conditions favouring salmon production.

Long term

The long term prospects for Atlantic salmon stocks of eastern Canada can be categorized geographically. In the southern Gulf of St. Lawrence, the abundance of wild salmon is at best at medium levels relative to historical or expected values. The juvenile abundance in the rivers are at medium to high levels and generally increasing over time. Juvenile abundance is high in these rivers for two reasons: 1) they have a high proportion of large salmon in the returns (produce large quantities of eggs), 2) a large portion of the run returns late in the season and are not as heavily exploited as are early-run fish. High juvenile abundances have not translated into high adult returns to date. The ocean environment appears to be an important factor in the low at-sea survivals of Atlantic salmon in eastern Canada because returns to rivers have not increased markedly following closure of fisheries in Newfoundland and reduced fisheries in Labrador and Greenland. When sea survivals improve, the abundance of salmon is expected to increase above current levels.

Most Atlantic salmon stocks of the Atlantic coast of Nova Scotia and the Bay of Fundy are not expected to show any important improvements over the next five years. The abundance of wild adult salmon and juveniles is generally low and declining. For the inner Bay of Fundy stocks, sea survival of the salmon is the most important constraint. Returns of wild adult salmon which will meet the conservation requirements are not anticipated in the near future. Returns of hatchery origin salmon may produce returns which approach or even meet the conservation requirements but the long-term sustainability of the hatchery initiative is uncertain (from logistic and biological standpoints). The populations of salmon in this area are also impacted by numerous industrial activities: acid rain deposition, fish passage constraints (upstream and downstream), water use practices (regulation of discharge asynchronous with seasonal movements of fish) and escapees from aquaculture facilities.

The long-term prospects for the Newfoundland salmon stocks are improved in all areas except for the Bay St. George area (SFA 13). This latter area has not shown any dramatic improvements in escapements in spite of the commercial fishing moratoria. The Labrador stock status is poorly known but the best indicators suggest that improved spawning escapements have been achieved in the last two years. Large salmon returns and escapements continue to be below conservation levels and this size group continues to be impacted by the Labrador and Greenland commercial fisheries.

The stocks of the Québec region are generally maintaining themselves although at lower levels than expected. The predominantly large salmon stocks of the Gaspé area and the North Shore continue to be depressed by low marine survival and are impacted by the local recreational fisheries, Native peoples fisheries, and interceptory fisheries of Greenland and to some extent Labrador. A number of rivers are being rehabilitated and previously inaccessible habitat areas are being modified for fish passage.

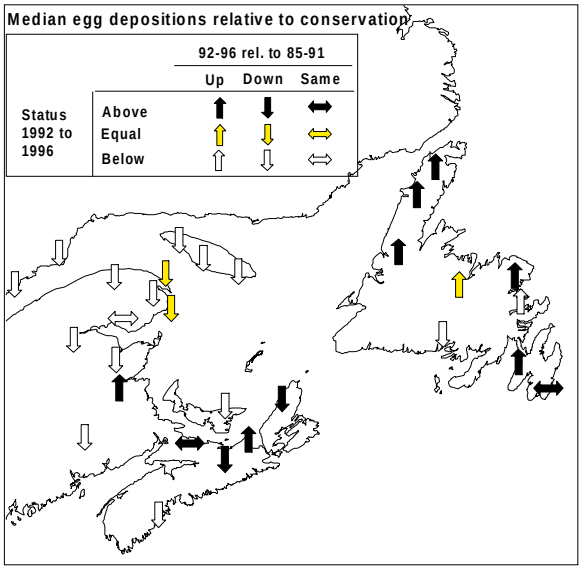
Management Considerations

A precautionary management approach is advisable for most of the Atlantic salmon stocks of eastern Canada. The precautionary approach considers the relative uncertainty of the assessment and management practices. Under this approach there should be no increase, and preferably a decrease, in the level of exploitation, thereby minimizing the risk of not achieving the conservation requirement.

The closure of the commercial fisheries in the Maritime Provinces in 1985 and the delayed opening of the Newfoundland and Labrador fisheries resulted in a noticeable increase in returns of small and large salmon to the rivers. The effect of this reduced commercial exploitation and the reduced in-river mortality, as a result of the mandatory catch-and-release in the recreational fishery of large salmon in many areas of eastern Canada, has been increased egg depositions and increased juvenile abundance. In some areas, such as the Bay of Fundy, the increased escapement has not been sustained; returns to these rivers are now lower than they were prior to 1985. Mature aquaculture-origin salmon continue to enter rivers in proximity to production areas. A more thorough assessment of the impact of aquaculture escapees on wild salmon stocks is urgently required in the context of the growing abundance of escapees within rivers and the depressed state of some of the wild stocks.

The commercial fishery moratorium in Newfoundland introduced in 1992 and maintained through 1996 has had the most noticeable impact on the escapement to rivers of Northeast and Northwest coasts of Newfoundland.

Some areas in Newfoundland (SFAs 11 to 13) which showed little or no improvement in escapement to the rivers during the moratorium years have either early run stocks and/or the exploitation on these stocks had already been reduced by the closure of the Port-aux-Basques drift-net fishery in 1971, closure of the SFA 12 fishery in 1984 and the delayed opening of the commercial seasons in 1978 and 1985.



Egg depositions in many rivers of Québec and the Maritimes were higher in the pre-moratoria years (1985 to 1991). The median egg depositions during the moratoria years in Québec rivers are mostly below the conservation requirements and have declined.

Generally, the proportion of large salmon in the returns to the rivers during the moratorium years were higher than in the period 1986 to 1991. While returns of small and large salmon to the rivers showed an overall improvement in the last five years in Newfoundland, higher returns had been observed at several monitoring facilities in years prior to the moratorium. Had the moratorium not been in effect during 1992 to

1996, severe over-exploitation of many Atlantic salmon stocks would have occurred.

The failure of the Labrador commercial fishery to achieve its reduced quota again in 1996 indicates that large salmon abundance in Labrador remains low. Consequently, exploitation on Labrador stocks and in particular the large salmon component, which contributes substantially to egg deposition, should be as low as possible.

With few exceptions, for the rivers of the southern Gulf of St. Lawrence, exploitation levels similar to those of 1996 are not expected to reduce the escapements below conservation requirements, primarily because the exploitation rates on the large salmon component are very low. A precautionary management approach is advised for the Restigouche River where large salmon are exploited more heavily by both Native peoples' fisheries and the recreational fishery.

Overall abundance of Atlantic salmon in eastern Canada during the 1990s has been lower than during the 1980s. Various factors have been proposed as contributing to the lower abundance, including environmental effects (depressed sea survival) and over-exploitation in fisheries. Most of the interceptory fisheries on salmon have been closed with a corresponding greater emphasis on terminal fisheries managed on a river-specific basis. Terminal fisheries provide the greatest flexibility for ensuring that egg depositions within individual rivers do not fall below the designated conservation levels. They also provide the greatest flexibility of resource use options for maximizing the benefits from the resource while respecting the conservation principles.

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