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DFO Atlantic Fisheries
Research Document 94/22

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MPO Pêches de l'Atlantique
Document de recherche 94/ 22

Status of Atlantic Salmon Stocks
of Scotia-Fundy Region, 1993

by

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ABSTRACT

Retained catches of small salmon in the recreational fisheries of SFAs 19, 20, and 21 in Nova Scotia were again low, i.e., <65% of the previous 5- and 10- year mean landings. Released catches of large salmon in SFAs 19, 20 and 21 were also low. All rivers of inner Bay of Fundy (portions of SFAs 22 and 23) were closed to any exploitation. The retained catch of small salmon in the outer Fundy portion of SFA 23 was <50% of the previous 5- and 10-year means.

Counts of wild 1SW fish at counting facilities in the Liscomb (SFA 20), LaHave (SFA 21) and Saint John (SFA 23) rivers were <45% of the previous 5-year means; wild MSW counts were 20%-70% of the 5-year means. Counts of 1SW and MSW salmon on the Magaguadavic River (SFA 23), (about one-third of aquaculture origin) were down 17% and 60%, respectively, from the mean of the five most recent annual counts. Few salmon were counted at the causeway on the Petitcodiac River (SFA 23). In-river count of salmon in the Middle River (SFA 19) was lower than in 1992, while that in the Big Salmon River (SFA 23) was historically low but marginally higher than in 1992.

Return rates of 1SW fish from hatchery smolts released to the Liscomb, LaHave, and Saint John rivers were the second lowest, fifth lowest and lowest of record, respectively. MSW return rates from hatchery smolts released to the Saint John and Liscomb rivers remained among the lowest of the series; the return rate for the LaHave River was 82% of a 12-year average.

Forecasts indicate that wild MSW salmon returns to the Liscomb Falls and Morgan Falls in 1994 will be about 50% and 60%, respectively, of the previous 5-year mean counts. Neither forecast accounts for the possible impacts of the moratoria in 1992 and 1993 in the insular Newfoundland commercial salmon fisheries and the Greenland fishery in 1993. The estimated return of MSW salmon destined for Mactaquac on the Saint John River will be fewer than the 4,400 target spawners for above the dam. Forecast of 1SW fish destined for Mactaquac in 1994 are uncertain but projected to exceed the 3,200 required spawners.

RÉSUMÉ

Les prises de petit saumon gardées dans les ZPS 19, 20 et 21 de Nouvelle-Écosse ont à nouveau été faibles, représentant moins de 65 % des moyennes des cinq et des dix années antérieures. Les prises de grand saumon remises à l'eau dans ces ZPS ont aussi été basses. La pêche était interdite dans toutes les rivières de l'arrière-baie de Fundy (parties des ZPS 22 et 23). Dans la partie de la ZPS 23 qui se trouve dans l'avant-baie de Fundy, les prises de petit saumon gardées représentaient moins de 50 % des moyennes des cinq et des dix dernières années.

Les résultats obtenus aux installations de dénombrement des rivières Liscomb (ZPS 20), LaHave (ZPS 21) et Saint-Jean (ZPS 23) en ce qui concerne le saumon sauvage unibermarin étaient inférieurs de plus de 45 % aux moyennes des cinq dernières années; quant aux pluribermarins, leur abondance se situait entre 20 % et 70 % des moyennes des cinq dernières années. Dans la Magaguadavic (ZPS 23), les unibermarins et les pluribermarins (dont un tiers environ d'origine aquicole) étaient en recul de 17 % et de 60 % respectivement par rapport à la moyenne des cinq recensements annuels les plus récents. On a dénombré peu de saumons à la chaussée de la Petitcodiac (ZPS 23). Les dénombrements directs dans la Middle (ZPS 19) et la Big Salmon (ZPS 23) étaient inférieurs à ceux de 1992, tandis que ceux de la Big Salmon étaient faibles par rapport aux résultats historiques, mais légèrement supérieurs à ceux de 1992.

Les remontées d'unibermarins issus de saumoneaux d'écloserie lâchés en 1992 dans les rivières Liscomb, LaHave et Saint-Jean se situaient respectivement aux deuxième, cinquième et premier rangs des plus basses jamais connues. Quant aux taux de remontée des pluribermarins provenant initialement de poissons d'écloserie lâchés dans la Saint-Jean et la Liscomb en 1991, ils demeuraient parmi les plus bas de la série. Dans la rivière LaHave, le taux de remontée correspondait à 82 % de la moyenne sur 12 ans.

D'après les prévisions, les remontées de pluribermarins sauvages aux chutes Liscomb et Morgan s'établiront en 1994 à environ 50 % et 60 % respectivement des moyennes des cinq dernières années. Ces prévisions ne tiennent pas compte des effets possibles du moratoire sur les pêches commerciales insulaires de Terre-Neuve en vigueur en 1992 et en 1993 et de celui imposé sur la pêche au Groenland en 1993. On s'attend à ce que les remontées estimées de pluribermarins sauvages à Mactaquac, sur la Saint-Jean, soient inférieures à la cible des 4 400 reproducteurs nécessaires en amont du barrage. Les prévisions d'unibermarins revenant à Mactaquac en 1994 sont incertaines, mais elles devraient dépasser la cible des 3 200 reproducteurs nécessaires.

INTRODUCTION

This document presents a review, similar to those of 1987 to 1993 (Marshall *et al.* 1988, Amiro *et al.* 1989, O'Neil *et al.* 1989a, Amiro *et al.* 1991; 1992; 1993), of the status of Atlantic salmon (*Salmon salar*) stocks of the five Salmon Fishing Areas (SFAs 19 to 23) of Scotia-Fundy Region and, as such, documents sport landings, fishway counts, diver counts and electrofishing results for specific rivers in 1993 and provides, where possible, forecasts of returns in 1994. Summary sheets are provided for the Grand, Middle, Liscomb, LaHave and Saint John rivers (App. 2-6)

METHODS

Sport fishery data for 1993 in SFAs 19 to 22 (Nova Scotia) were derived from an analysis of Nova Scotia salmon license stubs. Recreational catches, 1974-1986, for all SFAs of Scotia-Fundy Region, Department of Fisheries and Oceans (DFO) appear in the "Redbook" series (DFO, Halifax) and O'Neil *et al.* (1985, 1986, 1987, 1989a, 1989b, 1991). Sport landings for SFAs 19-22, 1974-1983, were adjusted upward to a Nova Scotia license stub equivalency (1984-1991) based on a ratio of DFO district officer reports to license stub comparison in 1983 which indicated that DFO catch estimates were lower. It was, therefore assumed that DFO catches for that pre-1983 period were also underestimated. Sport fishery data for 1992, 1993 and 1988-1992 mean catches and effort for individual rivers appear in Appendix 1. Catch data for outer Bay of Fundy rivers in SFA 23 were obtained from New Brunswick Department of Natural Resources and Energy (NBDNRE) and DFO field personnel (Atlantic salmon harvest was prohibited in inner Bay of Fundy rivers of SFAs 22 and 23).

Monitoring and biological sampling of upstream-migrating wild and hatchery-origin adult salmon were conducted at nine key counting facilities in Scotia-Fundy Region: 1) Grand River in SFA 19; 2) Liscomb River in SFA 20; 3) LaHave River in SFA 21; 4) Stewiacke River in SFA 22; 5) Petitcodiac; 6) Nashwaak, 7) Saint John, 8) Magaguadavic and 9) St. Croix rivers in SFA 23. Counts of returning hatchery-origin fish from the Liscomb, LaHave and Saint John fishways and the number of smolts from which they originated are provided as an index of marine survival, 1976-1993. Counts of seaward-migrating smolts are available at Little River, a tributary of the Stewiacke River, for 1990-1993.

Estimates of adult salmon populations above the fishway on Grand River (SFA 19) were made by use of counts at the fishway and estimates of fishway by-pass rates. Rates were established in 1989 (9% for fish <63 cm and 43% for larger fish) and again in 1991 (43% for grilse and salmon). An estimate of removals by the angling fishery above the Grand River fishway was based on the 1993 sport catch and results of a 1990 phone survey that indicated 31% of the 1990 Grand River sport catch occurred above the fishway. Escapement of adult salmon above the Nashwaak fence was estimated from a partial count in 1993, and counts for the same dates during full season fence counts in 1973 and 1975.

Indices of river escapements were derived from counts of adult salmon by divers in the Big Salmon (St. John Co.) and Middle (Victoria Co., N.S.) rivers.

Escapement of salmon above the Stewiacke River counting fence was estimated from marks applied at the fence and recaptures by electrofishing boat on three occasions after all returns were believed to have

ascended the river. Estimates were derived by a Bayesian estimation (Gazey and Staley 1986)

Juvenile densities were determined by electrofishing in the Stewiacke River in SFA 22 and in Big Salmon River in SFA 23. Densities in the Big Salmon River were determined by the removal method from within barriered sites. Densities of age-1+ and older parr in the Stewiacke River were determined by mark-recapture methods in unbarriered sites. Age-0+ parr densities for the Stewiacke River were estimated by dividing the count of the 'mark-run', by the capture efficiency estimated for the age-1+ parr population estimate. Tests for differences in juvenile salmon densities were conducted using ANCOVA models as reported in Amiro (1992).

Forecasts of wild multi-sea-winter (MSW) returns for 1994 (unadjusted for potential fish benefits from the Newfoundland commercial fishery moratorium in 1992 and Greenland and Newfoundland moratoria in 1993) were based on regressions of wild MSW counts on wild one sea-winter (1SW) counts of the same smolt class at the Liscomb and LaHave river facilities. The MSW run destined to Mactaquac Dam, Saint John River (adjusted for potential benefits of the 1992 and 1993 moratoria in Newfoundland and Greenland on returning 2SW fish), was forecasted by regression methods from total returns of wild 1SW salmon (and their fork length) destined for Mactaquac in 1993 (Marshall and Cameron 1994). The 1993 potential run of wild 1SW fish to Mactaquac was estimated using the regression of 1SW returns on egg depositions in the fourth and fifth previous years.

RESULTS and DISCUSSION

SFA 19 (Cape Breton East)

Reported effort in the 1993 sport fishery totaled 5,004 rod days or 43% of the 1988-1992 and 55% of the 1983-1992 mean rod-day effort (Table 1 & App. 1 & Fig. 1). The 1993 estimated sport catch of small salmon is 268 or 37% of the 1988-1992 mean and 38% of the 1983-1992 mean. An estimated 431 MSW salmon was reported released in the 1993 sport fishery, 34% of the 1988-1992 mean.

Grand River

The count of wild salmon in 1993 at the Grand River fishway, Richmond Co., was 49 fish <63cm, and four fish \geq 63 cm (Table 2 & App. 2). The count of wild 1SW salmon was 69% of that of 1992 and 20% of the 1988-1992 mean; the count of salmon \geq 63 cm was 33% of the 1992 count and 10% of 1988-1992 mean count. The 1993 counts of 39 1SW, one 2SW and two repeat-spawning hatchery fish were 45% of the total count at the fishway. Counts at the fishway are known to underestimate the population above the falls because some fish ascend the falls adjacent to the fishway. Previous adjustments for by-pass rate were 9% for fish <63 cm and 43% for fish equal to or greater than 63 cm. Broodstock collected above the fishway on Oct 17, 1991, indicated 43% of the fish less than 63cm had not passed through the trap at the fishway. Because only two fish were captured above the fishway in 1993, an average (26%) of the 1989 and 1991 by-pass rates for fish <63 cm was used to estimate the population above the fishway in 1993. A population of 123 fish <63 cm and 9 fish \geq 63 cm was estimated above the fishway before removals. Spawning escapement for the entire river is unknown because of the location of the fishway 10.2 km above the river

mouth. Native food fishery removals below or above the fishway are unknown. Recreational fishery retained catch above the fishway of 30 fish <63 cm was estimated using the 1990 follow-up phone survey which indicated 31% of retained grilse was caught above the fishway. The estimated spawning escapement above the fishway in 1993 is 102 fish or 19% of the required escapement for the entire river.

Middle River

Underwater counts of adult salmon were conducted on Oct. 20, 1993, in two sections of the Middle River (SFA 19) (sections 2 and 3, Fig. 1 in Amiro *et al.* 1991) where an estimated 55% of the fish was observed in a complete census in 1989 (App. 3). Counts totalled two small salmon thought to be 1SW and 33 salmon thought to be MSW fish of which one was of hatchery origin and three were of unknown origin, possibly aquaculture escapees. Spawning escapement was estimated about 62 fish or 12% of the required spawning escapement. Escapements have been declining since 1989, the first year of swim-through counts of salmon (App. 3).

North River

An estimated 110 salmon ≥ 63 cm was reported released before the fishery was closed in the first week of September 1993. This estimate may be 5% less than a complete season estimate because 95% of the catch normally occurs before August 27 (Amiro and Marshall 1990). If catch rates in recent years are similar to the 60 to 85% rates previously reported, then 129-183 salmon entered the river before September 1993. If in-river losses were 10%, then 58%-82% of the required spawning escapement of 200 salmon was met. Estimates of 51 grilse retained and 18 grilse released indicate 27-60 grilse escaped to spawn, or 100%-200% of the grilse requirement. Most of the egg deposition is derived from salmon and therefore only 58%-82% of target egg deposition was likely met in 1993.

SFA 20 (Eastern Shore)

The 1993 estimated retained catch of 1,252 small salmon is approximately 64% of both the 1988-1992 and the 1983-1992 means (Table 1 & Fig. 1). An estimated 532 MSW salmon was reported released in 1993 (69% of the 1988-1992 mean).

Several of the rivers in SFA 20 have had salmon runs negatively impacted by acidic precipitation. The East River, Sheet Harbour, Atlantic salmon run is entirely supported by stocking, since 95% of the river's salmon habitat is inaccessible due to hydropower development.

St. Mary's River

The retained angling catch of 701 small salmon on the St. Mary's River was 79% of the average retained catch, 1988-1992. Release of 315 MSW fish was 85% of the previous 5-year mean (App. 1). Angling catch on the St. Mary's River in 1993 increased over the 1992 level. However, a significant relationship between St Mary's River angling catches and counts of wild fish at the Liscomb River

enumeration site suggests that the general decline at Liscomb is occurring on the St. Mary's ($Y_{1SW \text{ St. Mary's}} = 334.12 + 1.07 X_{1SW \text{ Liscomb}}$ [$r^2=0.44$, $p<0.015$, $n=11$] $Y_{MSW \text{ St. Mary's}} = 37.3 + 6.79X_{MSW \text{ Liscomb}}$ [$r^2=0.68$, $p<0.001$, $n=12$]). Angling catches of small and MSW fish on the other rivers of SFA 20 were not consistently lower or higher than in 1992. However, catches of both small and MSW salmon in 1993 were lower (and often much lower) than the previous 5-year mean catches, without exception. Angler effort varied (increased or decreased) consistent with catch.

Liscomb River

The count of 132 wild 1SW fish at the Liscomb Falls fishway was the lowest since 1984 (Semple and Cameron 1990) and only 25% of the 546 fish recorded in 1991. The 1992 return of 145 1SW fish was the previous low (since 1981) and the current year count of 132 fish is only 91% of that figure (Table 2 & App. 4). The count of 11 wild salmon was the lowest since 1982. The return rate to the fishway of hatchery-origin 1SW fish was 0.42% (Table 3 & Fig. 2) which is the second lowest return rate noted since the fish trap was constructed and compare poorly with the 1985-1992 mean of 1.31%. Counts of wild and hatchery adults (Table 2 & App. 4) in 1993 totalled 283 fish or about 14% of river targets of 1,908 1SW and 280 MSW fish (Semple and Cameron 1990) estimated without consideration for habitat adversely impacted by acidification. Revised spawning targets are being developed.

The equation used to predict a return of 30 MSW salmon (90% CL 0-94) to the Liscomb River in 1993 (as compared with an observed return of 11 MSW salmon) from 1SW returns in 1992, was updated in 1993 to $Y = 19.84 + 0.051X$ ($r^2=0.32$, $p<0.05$, $n=14$). The return of MSW salmon to the Liscomb River in 1994 is predicted to be 27 fish (90% CL 0-86).

SFA 21 (Southwest N.S.)

The preliminary estimate of the angling catch of small salmon in SFA 21 is 1,655 or 72% of the 1992 catch and 62% of the 1988-1992 mean (Table 1 & Fig. 1). Similarly an estimated 399 MSW salmon was reported released in 1993, 56% of the 1988-1992 mean.

LaHave River

A count of 777 wild 1SW fish at the Morgan Falls fishway, LaHave River, was 41% of the 1992 count, 44% of the 1988-1992 mean count, and 57% of the mean count of the past seventeen years at this salmon development project. The estimated recreational catch of small salmon in the LaHave River was 953, 93% of the 1992 catch and 66% of the 1988-1992 mean (App. 1 & 5). The return rate for 1SW fish from 27,500 hatchery smolts stocked above Morgan Falls in 1992 was 1.39% which is 73% of the prior 14-year annual mean return rate (Table 3 & App. 5).

A total of 121 wild MSW salmon was counted at Morgan Falls during 1993, which is 35% of the 1988-1992 mean count of 350 MSW salmon (Table 2). The return rate for 2SW salmon from 21,900 hatchery smolts stocked above Morgan Falls in 1991 was 0.36% which compares well with the 0.4% average rate

observed in the prior 13 years (Table 3 & Fig. 2). The regression equation $Y = 17.26 + 0.212X$; $r^2=0.48$, $p<0.01$, $n=20$; and the 381 hatchery-return 1SW fish count in 1993 forecasts an MSW hatchery-return count in 1994 of 98 fish (90% CL 0-236), 118% of the 1993 count and 98% of the 1988-1992 mean count, an estimate that assumes marine survival returns to more average levels for the 1994 return.

Estimated egg deposition in 1993 was 1.66 million eggs (2.4 eggs m^{-2} , adjusted for angling removals but not for poaching and disease) which is the interim 2.4 eggs m^{-2} standard for non-acid-impacted rivers, though the LaHave is acid-impacted. The regression equation $Y = 69.07 + 0.171X$ ($r^2=0.52$, $p<0.01$, $n=19$) and the 777 wild 1SW fish count in 1993 forecasts a count in 1994 of 202 (90% CL 0-457) MSW salmon, 167% of the 1993 count and 58% of the 1988-1992 mean count.

SFA 22 and portion of SFA 23 (Inner Bay of Fundy N.S. and N.B.)

A continuation of the 1989 management measure to close all inner Bay of Fundy salmon fisheries until sufficient indication that spawning escapement would be met at Big Salmon River, N.B., and/ or Stewiacke River, N.S., was in place throughout most of SFA 22 and the portion of SFA 23 east of the Saint John River.

Big Salmon River

Counts of salmon in the Big Salmon River, N.B., from stream bank observation on Aug. 27, 1993, indicated approximately 165 salmon of which 69% was classed as <63 cm length. A later-season count could not be conducted because of high water conditions; however, sightings at Catt's Pool in the lower river in October indicated few fish entered the river later in the season. These observations suggest fewer than 300 salmon entered the river in 1993 (T. Pettigrew¹ pers comm). Average density of age-1+ parr for three sites on the Big Salmon River in 1993 were similar to values obtained 1989-1992 (Fig. 3). Age-0+ parr densities were, however, the lowest recorded since 1970 (Fig. 3).

Petitcodiac River

Count of salmon returning to the Petitcodiac River fishway in 1993 continued to be affected by increased numbers of fish using the by-pass notch in the tidal gate and therefore is not consistent with some previous counts at the fishway. Observations at the fishway (G. Griffin² pers comm) and in up-river holding pools indicate few fish entered the river in 1993. These observations are consistent with the uncertainties associated with fish passage at the dam and with the downturn in inner Bay of Fundy salmon returns.

¹ NBDNRE, P.O. Box. 150, Hampton, N.B. E0G 1Z0.

² NB Wildlife Federation, RR#2, Moncton, N.B. E1C 8J6.

Stewiacke River

A total of 178 fish <63 cm and 47 fish \geq 63 cm was counted at the Stewiacke River counting fence from Jun. 8 to Oct. 19, 1993. The combined catches by electrofishing boat above the fence on Oct. 27, Nov. 16 and Dec. 2, 1993, indicated that five out of eight fish were tail punched and had been counted at the fence. These data indicate approximately 320 (95% CL 214-466) fish <63 cm and 93 (95% CL 57-235) fish \geq 63cm entered Stewiacke River in 1993. These estimated 413 fish are approximately 38% of the target spawning escapement of 1,100 fish (Amiro 1990). Ages of salmon, interpreted from scales samples collected at the fence, indicate that 78% of the run was recruit grilse, an increase over the previous year's return.

Mean juvenile densities 100^{-1} m^2 at 35 sites in the Stewiacke River, 1993, were 1.3 age-0+, 12.7 age-1+ and 2.5 age-2+ parr (Fig. 3). Post-hypothesis comparison of annual mean density, adjusted for habitat and distance above tide head, indicated significantly lower densities ($p < 0.0001$ for age-0+, age-1+ and age-2+ parr) for 1993 means contrasted against 1984 to 1992 means. A paired comparison of annual adjusted mean densities indicates significantly ($p < 0.0006$) lower mean density of fry in 1993 compared to every previous year. Age-1+ parr density in 1993 was significantly lower than five previous years; 1984 ($p = 0.014$), 1985 ($p < 0.0006$), 1987 ($p < 0.0006$) and 1990 ($p = 0.014$) by the same test procedure. Age-2+ parr density in 1993 was significantly lower ($p < 0.001$ or less) than every year except 1992. These data indicate lower parr populations consistent with the lower spawning escapements estimated in 1991 and 1992.

The count of smolts at Little River (a tributary of Stewiacke River) was 1,303 in 1993, or about 66% of the 1992 count and 45% of the 1990-1992 mean count.

SFA 23 (South Western N.B.)

A fishing effort of 16,502 rod-days yielded estimated landings of 1,121 small salmon in SFA 23, 36% of that of 1992 and 35% and 38% of the respective 5- and 10-year means (Table 1 & Fig. 1). Low catches resulted from low 1SW returns to the Saint John River above Mactaquac, in particular, and a Sept. 15 closure of all rivers of SFA 23 (normal closing dates for various rivers/sections included Sept. 15, Sept. 30, Oct. 15 and Oct. 31). Inner Fundy rivers which were again closed to angling in 1993, accounted for only 6% of the mean retained catch in SFA 23, 1984-1989.

Magaguadavic River

Counts of salmon by Atlantic Salmon Federation (ASF) staff at the St. George fishway on the Magaguadavic River numbered 208 1SW and 177 MSW fish of which 45% and 29%, respectively, were estimated to be of aquaculture origins (J. Carr³ pers comm). Counts made by ASF in 1992, and previously by DFO but without distinction as to fish origin, have been as follows:

³ Atlantic Salmon Federation, P.O. Box 429, St Andrews, N.B. E0G 2X0.

<u>Year</u>	<u>1SW</u>	<u>Prop.</u> <u>Aqua.</u>	<u>MSW</u>	<u>Prop.</u> <u>Aqua.</u>
1983	303		637	
1984	249		534	
1985	169		466	
1988	291		398	
1992	238	0.35	201	0.31
1993	208	0.46	177	0.29

Counts suggest that escapement was below the lowest advocated target of 230 MSW and 140 1SW salmon.

St. Croix River

Counts of salmon (L. Sochasky⁴ pers comm) were resumed at the Milltown fishway on the St. Croix River, 1993, after a one-year break. Wild salmon counts were the lowest of the 11-year data set (Table 2), while hatchery-origin returns of 5 1SW and 66 MSW salmon were 24% and 106%, respectively, of the 1988-92 mean counts (hatchery and wild origins based on examination of scales by DFO from a sample of 78 fish). The St. Croix River is an international development project with a target spawning requirement of about 2,300 MSW fish (Fletcher and Meister 1982).

Nashwaak River

Counts of salmon were also initiated on the Nashwaak River, tributary to the Saint John below Mactaquac, by St. Mary's First Nation. A partial season count, mid-August through early October, of 83 1SW and 155 MSW salmon and counts for the same period of full seasons of operation in 1972 and 1975 suggested a 1993 run size of as many as 954 1SW and 555 MSW salmon passed the fence (Marshall and Cameron 1994). Spawning requirements above the fence are 10.7 million eggs (2.4 eggs m⁻², 1,530 1SW and 1,620 MSW fish). Escapement of the estimated run would have contributed 4.04 million eggs, or 38% of the target.

Saint John River (above Mactaquac)

The count of wild 1SW fish at Mactaquac, Saint John River, in 1993 was 50% of that of 1992 and 42% and 46% of the previous 5- and 10-year mean counts (Table 2 & App. 6; Marshall and Cameron 1994). Return of hatchery 1SW fish was 53% of 1992 and 66% of the previous 5- and 10-year means. 1SW return originating from smolts released at Mactaquac was 0.41%, a value which is about the lowest on record (Table 3 & Fig. 2) and about one-half of the 1986-1992 mean return rate for largely 1-year smolts.

A count of 2,601 wild MSW salmon at Mactaquac in 1993 was 74% of the 1992 count and 81% and 69% of the respective 5- and 10-year mean counts (Table 2). The estimated total wild MSW return of 2,958 fish (fishway count comprised 88% of the estimated number of fish destined for Mactaquac) was 78% of the

⁴ St. Croix International Waterway Commission, St. Stephen, N.B., E3L 2Y7.

1993 preseasonal forecast (Marshall and Cameron 1994). Returns of hatchery MSW salmon were 56% of those in 1992, and 61 and 67%, respectively, of those of the previous 5- and 10-year means. The return rate for 2SW salmon from smolts originating at Mactaquac in 1991 was 0.13%, the lowest of record (Table 3 & Fig. 2).

Spawning requirement above Mactaquac is 4,400 MSW fish. The estimated 1993 escapement of 2,149 wild and hatchery MSW spawners (inc. losses to poaching and disease) is 49% of the requirement. Total egg deposition is estimated to be 51% of the 2.4 eggs m² target; eggs contributed by 1SW fish were only 3.6% of the total.

Forecast 1SW returns destined for above Mactaquac in 1994 could number 8,000 fish (6,400 wild and 1,600 of hatchery origin)(Marshall and Cameron 1994). However, because of the very low marine survival in 1993 and, quite possibly in 1994, returns, like those of 1993, could be only one-half of the forecast value but still exceed the target spawning requirements.

Forecast MSW returns destined for above Mactaquac in 1994 could number 3,100 (2,300 wild and 800 of hatchery origin) or 4,800 fish (3,600 wild and 1,200 of hatchery origin) depending on models supposing either none or total benefits, respectively, from the moratoria in distant fisheries. The model that ascribed no benefits from the moratorium in Newfoundland best forecasted the 1993 MSW return. Neither MSW forecast fully accounts for potentially low marine survival in the winter of 1994 or the fact that the 1SW and fork length data used to predict MSW returns were, together, outside the range of data in the models. It is unlikely that MSW returns will be adequate to meet target spawning requirements above Mactaquac (Marshall and Cameron 1994).

Saint John River (below Mactaquac)

The significant shortfalls in egg deposition in 1993 above Mactaquac (50%) and in the Nashwaak River (<40%) may well reflect escapement levels in unmonitored portions of SFA 23. The Saint John area above Mactaquac (44%) and the Nashwaak River (17%) comprise 61% of the traditional estimate of total accessible salmon production area in the Saint John River basin. Estimated returns of fish 10⁻⁴ m² production area destined for Mactaquac, 1970-1985 (Marshall 1985), are:

	<u>Wild 1SW</u>	<u>Wild MSW</u>
Above Mactaquac	3.9	5.2
Below Mactaquac	2.4	2.5

A weak correlation between 1SW returns above and below Mactaquac, 1970-1985, ($r^2=0.264$, $p=0.024$, $n=16$) suggests that the 15-year low return of 1SW fish destined for Mactaquac in 1993 was paralleled by generally low 1SW returns below Mactaquac (evidenced in the estimated returns to the Nashwaak). Low 1SW returns inserted into MSW forecast models, such as those used above Mactaquac, provide correspondingly low estimates of MSW returns the following year.

Low wild returns of 1SW fish to the Magaguadavic River in 1993, at least relative to those in 1983, do not auger well for the number of wild MSW returns to SFA 23 in 1994. In total, it is reasonable to suggest

that target escapements of MSW salmon in 1994 are unlikely to be met in any of the outer Bay of Fundy rivers.

SFA ADVISORIES

SFA 19

Status of the salmon stocks in SFA 19 in 1993 can best be described as serious. Spawner returns to monitored rivers were well below target spawning levels. Returns continued the decline begun in 1990. In the face of this decline, which is documented at Grand River, a river which relies on its 1SW fish for egg deposition, it is important that stakeholders be alert that continuation of exploitation at current levels may be sufficient to imperil some stocks. SFA 19 stocks returning in 1994, especially because of their high MSW fish content, may have been negatively impacted by the reduced marine habitat demonstrated for the North Atlantic (Reddin *et al.* 1993). Strong consideration should be accorded to restraining harvests in 1994 in all rivers until in-season information confirms that declining river return has moderated substantially.

SFA 20

In almost all cases, recreational catches in SFA 20 rivers in 1993 were less than the mean value for 1988-1992. Many rivers continue to bear the burden of impact from acid precipitation, thus lowering the salmon production. West River (Sheet Harbour) is an example of a river which is staggering under the impacts of acidity-caused mortalities and harvest removals. A four-year downward trend in the survival rate of hatchery-origin smolts in the Liscomb River re-inforces the observation that marine survival of smolts is impacting in a major negative way on Atlantic coastal rivers. Significant relationships between returns of wild fish to the Liscomb River facility and the St. Mary's River angling catches provide evidence to support the general decline in returns to eastern shore rivers, in spite of the doubling of the angling catch in the St. Mary's River in 1993 over that of 1992. Salmon management in 1994 in SFA 20 will show careful restraint in exploitation until in-season indicators show that the current phase of low marine survival has started to improve.

SFA 21

The salmon production potentials of most rivers in SFA 21 are affected deleteriously by acid rain. In 1993, only the three larger, better salmon rivers experienced recreational catches higher than in 1992, and these rivers have had the benefit of substantial stocking. Zonal catches are showing the same gradual diminishment over the past five years as do other Atlantic coastal rivers. Lower counts of 1SW fish at enumeration facilities in 1993 suggest lower returns of MSW fish in 1994, i.e., half the 10-year mean count, as well as pointing to the continuing reduced sea survival of the smolts. Continuation of the state of reduced marine wintering habitat may reduce MSW returns in 1994, particularly, to SFA 21. In-season assessments are recommended before exploitation is permitted at even current levels of effort.

SFA 22

Harvesting of salmon in rivers of SFA 22 and in the Inner Bay of Fundy rivers in SFA 23 has been restricted for three years to rivers entering Avon Bay and westward; most of the zonal rivers have

been closed to licensed exploitation. Estimates of the number of spawners in 1993 seem to suggest a weak improvement over the numbers there in 1992. Regardless, the modest improvement is insufficient to consider seriously the likelihood of any salmon harvesting in 1994 and possibly longer. Juvenile population estimates are now showing reduced levels, which increases the likelihood that river returns will be low in the next three to five years.

SFA 23

Forecasts of 1SW and MSW returns above Mactaquac on the Saint John River in 1994 are not expected to be attained, considering the 15-year-low 1SW return in 1993 and the likelihood of a second winter of low marine survival. Although target spawning level for 1SW fish will likely be met, the MSW run is expected to fall below conservation needs. A similar shortfall is expected for the Nashwaak and Magaguadavic rivers and most rivers of the outer Bay of Fundy given the low 1SW return in 1993, the parallel between returns to Mactaquac and to the Nashwaak, and the implication of low MSW returns following low 1SW returns from that smolt class. Harvesting of salmon in 1994 should be restrained until in-season forecasts of end-of-season run-size at Mactaquac can be evaluated.

ACKNOWLEDGEMENTS

Compilation and synthesis of this assessment have been made possible only with the support of DFO technical, clerical, fishery officer and hatchery staff; several First Nations; NBDNRE regional biologists; Atlantic Salmon Federation; New Brunswick Wildlife Federation and St. Croix International Waterway Commission. The review committee consisted of DFO personnel S. Gavaris, C.J. Harvie, B.M. Jessop, J.A. Ritter, and M. Sinclair.

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Table 1. Numbers of 1SW salmon retained, MSW salmon retained and released, and effort, by SFA, in the sport fisheries of Scotia-Fundy Region, 1974-1993.**

Year	SFA 19			SFA 20			SFA 21			SFA 22***			SFA 23							
	Catch		Effort in rod-days	Catch		Effort in rod-days	Catch		Effort in rod-days	Catch		Effort in rod-days	Catch		Effort in rod-days					
	1SW	MSW		1SW	MSW		1SW	MSW		1SW	MSW		1SW	MSW						
Ret.	Rel.		Ret.	Rel.		Ret.	Rel.		Ret.	Rel.		Ret.	Rel.							
1974	416	588	7,229	3,462	434	24,977	2,462	397	13,236	2,004	714	7,418	1,312	1,798	16,897					
1975	117	213	2,157	694	94	8,455	1,416	656	8,286	818	293	3,662	1,888	1,691	17,078					
1976	278	445	4,209	2,652	219	18,530	2,474	321	16,026	1,931	537	8,815	3,150	2,498	20,511					
1977	768	561	6,703	1,639	422	14,364	3,434	643	20,278	296	898	9,267	2,040	2,553	22,792					
1978	257	456	10,780	396	272	12,403	460	481	9,748	1,681	334	6,078	843	924	17,128					
1979	281	304	16,761	2,178	267	22,312	2,969	374	14,834	1,258	490	13,030	3,034	927	21,420					
1980	997	795	30,143	3,483	469	25,458	2,773	1,104	25,682	151	526	6,408	2,734	2,860	28,947					
1981	1,265	496	9,365	2,556	581	30,840	4,342	1,284	38,111	1,045	379	6,887	1,963	1,473	30,423					
1982	857	523	18,661	1,657	201	28,187	1,847	494	28,351	983	444	8,717	3,129	2,361	45,520					
1983	240	269	15,322	1,336	401	37,352	471	409	13,743	2,402	386	16,764	2,210	1,103	40,311					
1984	821	108	358	8,759	1,744	128	282	14,426	2,159	232	316	18,868	966	29	257	10,226	2,891	0	28,912	
1985	1,015	0	833	7,749	2,555	0	1,713	17,578	2,790	0	1,567	18,863	1,634	0	578	11,619	4,485	0	38,716	
1986	804	0	1,976	8,901	2,268	0	1,622	20,150	3,110	0	1,583	23,240	830	0	843	11,710	4,033	0	33,555	
1987	890	0	1,390	8,139	1,771	0	686	13,251	4,395	0	799	24,593	255	0	311	6,347	3,870	0	26,870	
1988	836	0	1,514	9,925	2,641	0	1,223	20,483	2,907	0	812	26,131	549	0	167	6,503	2,991	0	26,627	
1989	682	0	1,262	8,081	1,874	0	953	17,908	4,073	0	1,166	27,981	1,781	0	369	10,572	3,590	0	26,354	
1990	865	0	1,370	9,141	3,029	0	696	17,787	3,497	0	933	29,029	274	0	114	5,598	2,613	0	21,915	
1991	452	0	1,076	7,076	1,390	0	604	13,133	557	0	313	13,411	9	0	27	845	1,915	0	12,635	
1992	495	0	1,020	6,688	905	0	400	11,482	2,229	0	349	21,284	16	0	6	516	3,083	0	25,389	
1993*	268	0	431	5,004	1,252	0	532	14,708	1,652	0	399	23,376	10	0	21	569	1,121	0	16,502	
Means																				
1978-92	717		11,699	1,986		20,183	2,572		22,258	1,062		9,266	2,892		28,315					
1983-92	710		8,978	1,951		18,355	2,619		21,714	1,086		9,917	3,168		28,128					
1988-92	666	1,248	8,182	1,968	775	16,159	2,653	715	23,567	654	169	5,880	2,838		22,584					

* Preliminary

** SFA's 19-22 based on DFO estimates 1974-1983 adjusted by differential between DFO and Nova Scotia license stub returns, 1983; i.e., 1.52, 1.32, 1.36, and 1.04 and license stub returns since 1983. SFA 23 based on DFO estimates.

*** SFA 22 data for 1983 are based on Nova Scotia license stub data, not converted DFO figures. Most area 22 rivers were closed to fishing in 1991 and 1992; means exclude 1991 and 1992 data on closed rivers.

Table 2. Counts of wild and hatchery Atlantic salmon from fishway traps in SFAs 19, 20, 21 and 23, Scotia-Fundy Region. (MSW fish => than 63 cm except Saint John where 1SW fish could be up to 66 cm in length.)

Year	SFA 19 Grand (a)				SFA 20 Liscomb				SFA 21 LaHave				SFA 23						
	Wild		Hatchery		Wild		Hatchery		Wild		Hatchery		Saint John		St. Croix(b)				
	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW	
1973											138	9	1,854	2,367	1,760	475			
1974								29	2	442	19		3,389	4,775	3,700	1,907			
1975								38	5	466	68		5,725	6,200	5,335	1,858			
1976								178	23	468	108		6,797	5,511	7,694	1,623			
1977								292	25	974	84		3,504	7,257	6,201	2,075			
1978								275	67	567	209		1,584	3,034	2,556	1,951			
1979					60		485	2	856	67	1,064	99	6,234	1,993	3,521	892			
1980					111	0	931	51	1,637	288	336	489	7,555	8,157	9,759	2,294			
1981					76	6	241	49	1,866	366	1,181	226	4,571	2,441	3,782	1,089			
1982					252	10	827	41	799	256	621	230	3,931	2,254	2,292	728	10	51	
1983					520	15	594	63	1,129	213	27	100	3,613	1,711	1,230	299	22	78	
1984					608	48	331	42	2,043	384	250	36	7,353	7,011	1,304	806	166	64	
1985					507	87	49	175	1,343	638	102	77	5,331	6,390	1,746	571	41	264	
1986					736	117	766	108	1,579	584	135	78	6,347	3,655	699	487	38	204	
1987					1,614	88	523	54	2,529	632	673	79	5,106	3,091	2,894	344	128	135	
1988	527	54			477	76	431	44	2,464	390	1,056	59	8,062	1,930	1,129	670	93	190	
1989	490	50			532	75	288	71	2,087	511	443	183	8,417	3,854	1,170	437	79	94	
1990	267	54	237		955	44	438	22	1,880	396	596	112	6,486	3,163	1,421	756	10	52	
1991	117	22	109	4	586	38	178	22	495	238	109	90	5,415	3,639	2,160	587	16	75	
1992	71	12	43	6	145	27	125	12	1,915	215	558	59	5,729	3,522	1,935	681			
1993	49	4	42	1	132	11	128	12	777	121	381	84	2,873	2,601	1,034	379	3	30	
Means:																			
1988-92	294	38	N/A	N/A	539	52	292	34	1,768	350	552	101	6,822	3,222	1,563	626	50	103	
1983-92	N/A	N/A	N/A	N/A	668	62	372	61	1,746	410	385	87	6,186	3,797	1,569	564	66	128	
1993 as % of:																			
1988-92	17%	10%	N/A	N/A	24%	21%	44%	35%	44%	35%	69%	83%	42%	81%	66%	61%	6%	29%	
1983-92	N/A	N/A	N/A	N/A	20%	18%	34%	20%	44%	30%	99%	96%	46%	69%	66%	67%	5%	23%	

a. By-pass rate may vary annually; (b) wild designation under review.

Table 3. Estimated numbers of 1SW and 2SW returns from hatchery-reared smolts released at or above counting facilities on Scotia-Fundy rivers, 1975-1992

Sea- scape	River	1,000s of smolts/ Returns	Smolt year ↓																	
			1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1SW	LaHave	Smolts a.				83.9	21.9	61.4	28.0	2.0	19.6	7.2	5.6	23.4	26.9	21.4	33.2	12.5	21.9	27.5
		Ret. (↑+1)				1,064	336	1,181	621	27	250	102	135	573	1,056	406	573	109	511	381
		%				1.27	1.54	1.92	2.14	1.32	1.27	1.42	2.42	2.45	3.92	1.89	1.72	0.87	2.33	1.39
	Tusket	Smolts						11.3	29.4	15.8	52.1	10.0	22.6	55.7	30.3	48.1	32.4	36.7	-	-
		Ret. (↑+1)						110	108	102+	41+	51+	71	735	348+	314	323	-	-	-
		%						0.97	0.37	0.64+	0.08+	0.51+	0.31	1.32	1.15+	0.65	1.00	-	-	-
	Liscomb	Smolts				47.4	57.5	26.9	42.4	43.8	58.2	50.0	29.6	19.0	31.3	48.4	28.0	22.4	25.1	30.5
		Ret. (↑+1)				485	931	241	827	594	331	175	766	523	431	288	438	178	125	128
		%				1.02	1.61	0.90	1.95	1.35	0.57	0.35	2.59	2.75	1.38	0.60	1.56	0.79	0.50	0.42
	Saint John	Smolts b.	324.2	297.4	293.1	196.2	244.0	232.3	189.1	172.2	144.5	206.5	89.1	191.5	113.4	142.4	238.2	241.1	178.1	204.8
		Ret. (↑+1)	9,074	6,992	3,044	3,827	10,793	5,627	3,038	1,564	1,410	1,869	773	3,006	792	1,085	966	1,610	1,298	831
		%	2.80	2.35	1.04	1.95	4.42	2.42	1.61	0.91	0.97	0.92	0.87	1.57	0.67	0.76	0.40	0.67	0.71	0.41
MSW	LaHave	Smolts a.				83.9	21.9	61.4	28.0	2.0	19.6	7.2	5.6	23.4	26.9	21.4	33.2	12.5	21.9	
		Ret. (↑+2)				395	118	102	64	0	63	49	54	54	164	83	72	55	79	
		%				0.46	0.53	0.17	0.22	0.00	0.32	0.68	0.97	0.23	0.61	0.39	0.22	0.44	0.36	
	Tusket	Smolts						11.3	29.4	15.8	52.1	10.0	22.6	55.7	30.3	48.1	32.4	-	-	
		Ret. (↑+2)						12	16+	6+	17+	8	11	59+	65	44	-	-	-	
		%						0.11	.05+	.04+	.03+	0.08	0.05	0.11+	0.21	0.09	-	-	-	
	Liscomb	Smolts				47.4	57.7	26.9	42.4	43.8	58.2	50.0	29.6	19.0	31.3	48.4	28.0	22.4	25.1	
		Ret. (↑+2)				51	49	41	83	42	49	108	54	44	71	22	22	12	12	
		%				0.11	0.08	0.15	0.15	0.10	0.08	0.22	0.18	0.23	0.23	0.05	0.08	0.05	0.05	
	Saint John	Smolts b.	324.2	297.4	293.1	196.2	244.0	232.3	189.1	172.2	144.5	206.5	89.1	191.5	113.4	142.4	238.2	241.1	178.1	
		Ret. (↑+2)	2,725	2,534	1,188	2,992	2,728	1,769	1,104	863	799	714	403	678	374	474	443	636	223	
		%	0.84	0.85	0.40	1.52	1.12	0.76	0.58	0.56	0.55	0.35	0.45	0.35	0.33	0.33	0.19	0.26	0.13	

a. Estimated "good quality" smolts.

b. Smolts > 12 cm.

c. Incl. some repeat spawners.

+ Potentially higher.

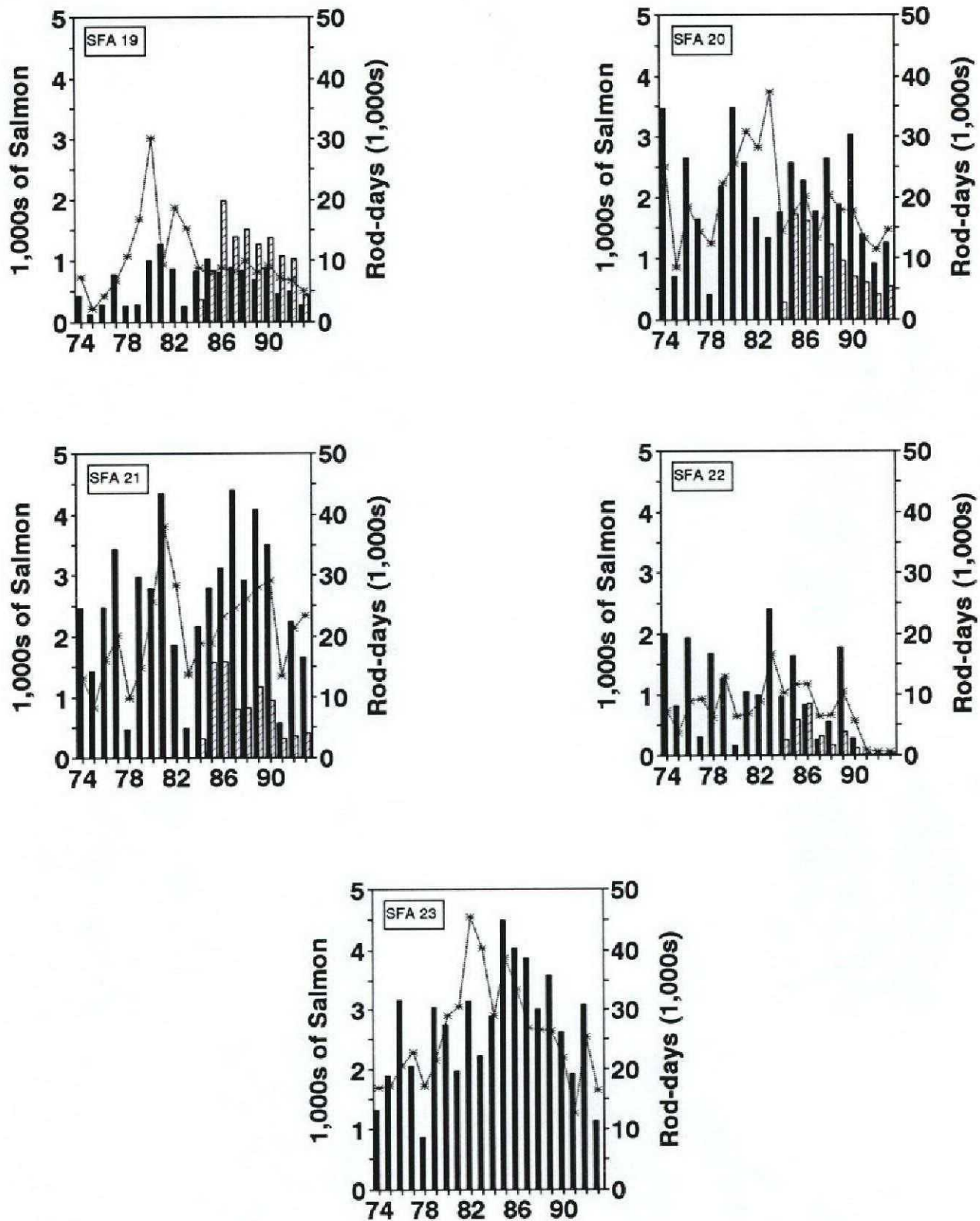


Fig. 1. Recreational harvest of 1SW salmon (filled bars), catch of released MSW fish (since 1984; slashed bars) and effort (*) in the 5 SFAs of Scotia-Fundy Region, 1974-93.

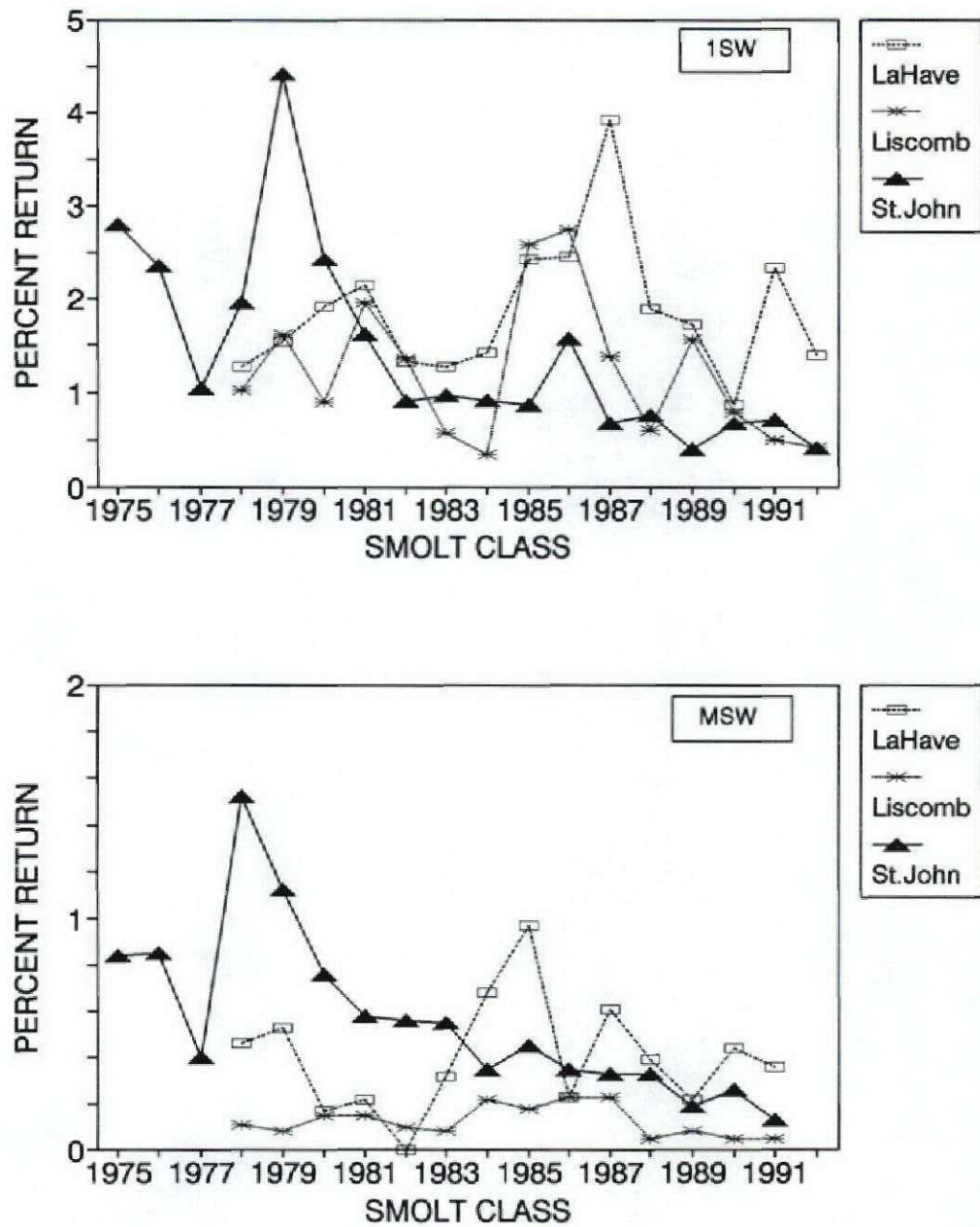


Fig. 2. Percent return of hatchery smolts as 1SW (above) and MSW salmon (below) to the Liscomb and LaHave rivers, N.S., for the 1978-92 smolt classes and Saint John River, N.B., for the 1975-92 smolt classes.

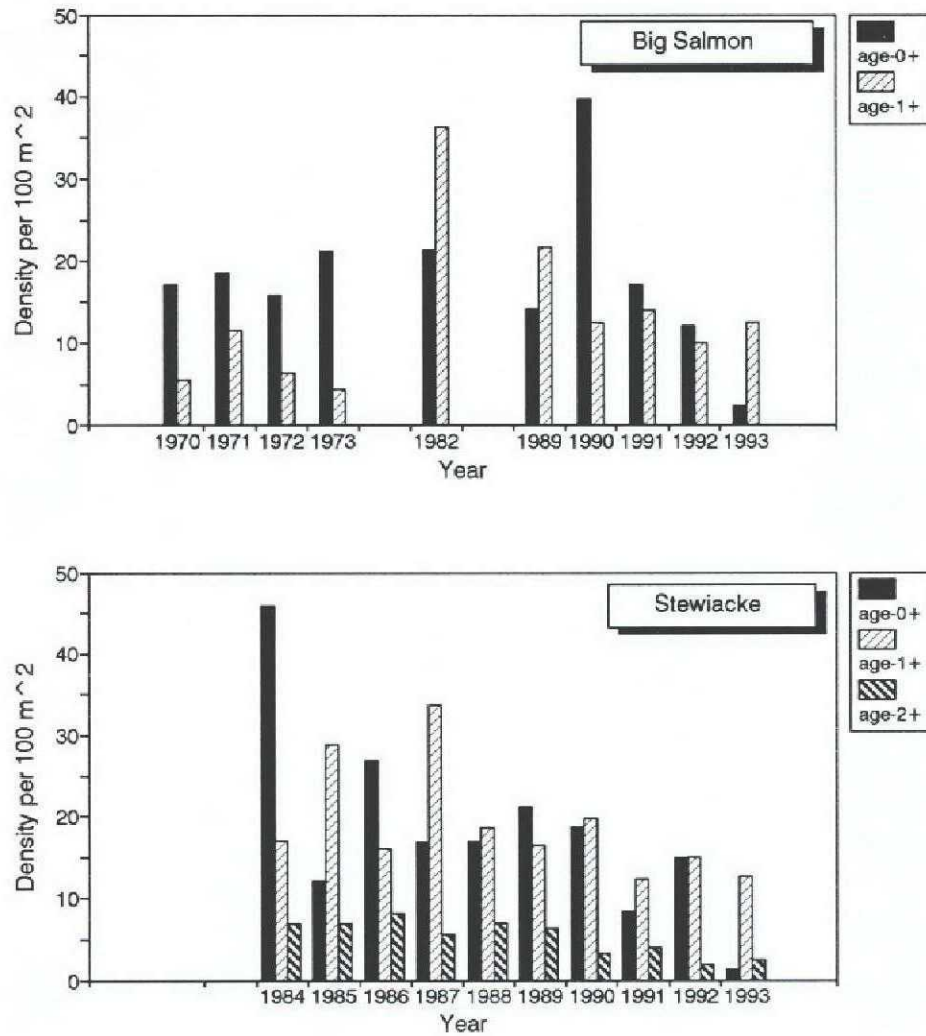


Fig. 3. Mean annual densities of Atlantic salmon parr at 11-3 sites in the Big Salmon River, 1970-1993, and at 29-44 sites in the Stewiacke River, 1984-1993. (Age-2+ parr not reported for Big Salmon River.)

Appendix 1. Atlantic salmon sportcatch and effort for Scotia-Fundy Region rivers, 1992 and 1993, contrasted with mean catches, 1988-92.

River	1993 (Preliminary)				1992				1988 - 92 means							
	Grilse		Salmon	Effort	Grilse		Salmon	Effort	Grilse		Salmon		Effort			
	retained	released	released		retained	released	released		retained	95% C.I.	released	95% C.I.	rod days	95% C.I.		
Salmon Fishing Area 19																
Aconi Brook					4	4	9	27	6.6	3.9	1.0	1.5	6.6	5.4	55.8	38.1
Baddeck	34	15	105	799	50	6	165	698	29.0	14.6	17.4	8.5	196.4	29.4	570.4	91.6
Barachois	8	3	26	144	3	0	6	69	4.4	1.0	2.8	2.7	13.6	6.6	77.2	23.1
Catalone	0	0	0	53	8	1	3	201	30.6	27.5	4.0	5.0	21.6	23.6	503.4	329.9
Clyburne									1.0	1.8	0.0	0.0	2.3	2.3	24.0	14.7
Framboise	4	1	0	204	16	3	5	357	47.0	27.9	6.0	2.0	34.0	20.9	417.2	97.5
Gaspereau: Cape Breton Co.	0	0	0	9	0	0	0	12	0.8	0.7	0.0	0.0	0.4	0.5	23.4	15.9
Gerratt	0	0	0	9	0	0	0	5	1.2	1.4	1.4	2.3	0.2	0.4	19.8	14.1
Grand	98	15	22	1430	148	11	44	1925	238.2	87.2	29.0	24.4	67.8	31.9	2557.2	520.1
Indian Brook	3	3	1	48	0	0	0	19	1.4	1.0	2.2	2.9	10.2	9.4	40.0	26.4
Ingonish	19	8	25	125	0	1	1	45	6.4	3.6	1.6	2.2	13.0	9.1	77.0	39.9
Inhabitants	17	0	74	259	29	0	141	434	34.2	6.7	5.2	4.0	132.2	41.3	407.6	48.4
Little Lorraine									0.5	0.9	0.0	0.0	0.0	0.0	1.0	1.8
Lorraine Brook	0	0	0	21	11	3	9	62	14.0	10.1	2.0	0.9	5.6	3.5	144.6	76.2
MacAskill's Brook	0	0	1	11					0.3	0.4	1.5	2.6	2.3	3.9	16.3	28.5
Marie Joseph	0	0	0	44	9	3	5	134	13.2	8.6	1.4	1.7	2.8	2.3	88.0	34.9
Middle: Victoria Co.	26	3	46	403	8	4	30	217	36.6	24.3	13.0	7.9	166.8	79.9	732.4	267.9
Mira	0	1	0	103	3	4	1	123	15.0	6.6	1.2	1.4	10.6	5.3	208.6	65.8
North Aspy	3	0	11	57	5	0	25	108	6.0	3.7	1.4	1.5	35.6	21.1	103.6	26.2
Northwest Brook (River Ryan)	0	0	0	11					0.3	0.4	0.0	0.0	2.5	4.4	21.5	18.4
North: Victoria Co.	51	18	110	1071	184	40	550	1845	154.8	32.7	40.0	15.5	490.0	94.4	1601.2	210.7
River Bennett					1	0	1	6	1.0		0.0		1.0		6.0	
River Deny's	0	0	0	3	1	0	3	10	2.0	3.5	0.4	0.8	1.8	2.4	4.2	3.7
River Tillard	3	1	4	28	5	1	5	51	9.2	5.1	1.8	1.4	11.8	5.5	87.0	30.6
Saint Esprit					1	0	0	23	2.6	4.1	0.0	0.0	1.8	3.1	26.6	28.8
Salmon: Cape Breton Co.	1	0	3	148	6	1	8	282	10.2	4.6	2.2	1.9	16.2	9.0	375.4	136.7
Skye	0	1	0	7												
Sydney	1	0	3	17	3	1	9	35	0.6	1.2	0.2	0.4	4.0	4.1	11.0	12.1
Totals	268	69	431	5004	495	83	1020	6688	665.8		135.4		1248.8		8183.0	15.6

Appendix 1. (continued)

River	1993 (Preliminary)				1992				1988 - 92 means							
	Grilse		Salmon	Effort	Grilse		Salmon	Effort	Grilse		95% C.I.		Salmon		Effort	
	retained	released	released		retained	released	released		retained	95% C.I.	released	95% C.I.	released	95% C.I.	roddays	95% C.I.
Salmon Fishing Area 20																
Clam Harbour					0	0	0	3	0.6	1.2	0.0	0.0	0.0	0.0	6.4	8.3
Cole Harbour					0	0	0	26	3.2	4.0	0.2	0.4	1.0	1.5	14.6	15.6
Country Harbour	11	7	3	94	5	0	1	75	24.4	11.5	5.0	4.6	8.6	4.9	161.2	52.5
East Sheet Harbour	18	1	1	204	28	0	6	234	53.0	42.6	14.0	16.9	8.6	7.9	376.4	259.7
Ecum Secum	46	1	7	489	63	0	10	522	73.0	31.3	5.4	4.5	9.4	5.6	623.0	187.5
Gaspereau Brook	0	0	0	16	1	0	0	32	3.8	4.6	0.0	0.0	0.0	0.0	34.2	19.5
Guysborough	3	0	4	16	0	0	0	3	2.8	2.1	0.0	0.0	2.8	2.4	19.2	15.3
Halfway Brook					0	0	0	3	0.6	0.8	0.0	0.0	0.0	0.0	5.2	3.6
Isaac's Harbour	7	0	0	46	8	0	0	69	19.6	11.4	0.2	0.4	1.4	2.3	115.4	44.2
Kirby	0	0	0	14	4	0	0	30	5.4	2.9	0.2	0.4	1.6	3.1	29.4	9.5
Larry's								1	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.9
Lawrencetown Lake	0	0	0	3	0	0	0	5	2.2	2.0	1.2	1.4	0.2	0.4	21.4	18.9
Liscomb	10	1	0	357	18	1	0	626	82.6	56.0	9.8	7.1	8.2	7.2	719.2	140.7
Little Salmon	0	0	1	6					0.0	0.0	0.0	0.0	3.0	5.3	11.0	15.5
Moser	83	17	11	1102	80	0	5	1093	169.4	66.3	16.4	11.8	13.6	7.7	1113.6	254.2
Musquodoboit	101	15	74	2676	54	8	23	704	184.0	85.1	56.0	35.8	147.0	78.0	2749.8	1206.6
Necum Teuch									0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4
New Harbour	14	0	0	214	23	6	1	447	38.2	30.7	2.0	2.5	1.2	1.0	396.8	131.4
Port Dufferin	8	0	1	187	3	0	0	116	15.6	14.0	0.8	1.6	0.2	0.4	153.4	59.8
Porters Lake (East Brook)									0.3	0.4	0.0	0.0	0.0	0.0	1.0	1.8
Quoddy	0	0	0	19	0	0	0	9	2.0	3.5	0.0	0.0	0.2	0.4	19.4	9.2
Rocky Run Porters Lake									0.3	0.4	0.0	0.0	0.0	0.0	8.5	13.2
Saint Francis	0	0	0	1					0.0	0.0	0.0	0.0	0.0	0.0	1.3	2.2
Saint Mary's	701	163	315	6354	284	35	152	4288	882.8	463.2	205.4	142.9	369.2	186.7	6178.2	1258.6
Salmon: Guysborough Co.	185	37	108	1490	279	34	197	1892	240.8	29.2	22.0	10.9	180.8	38.6	1746.8	135.3
Salmon: Halifax Co.	0	0	0	10	0	0	0	13	9.0	7.3	0.8	1.6	2.0	1.9	77.4	47.5
Ship Harbour Lake Charlotte	19	4	4	332	0	0	1	232	25.6	20.7	0.4	0.8	3.0	2.4	351.4	109.2
Tangier	0	0	0	3	0	0	0	3	0.0	0.0	0.0	0.0	0.0	0.0	12.8	4.9
West Sheet Harbour	46	1	3	1075	55	4	4	1056	126.4	75.6	13.8	16.1	13.8	8.5	1213.8	426.9
Totals	1252	247	532	14708	905	88	400	11482	1965.4				353.6		775.2	16157.8

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Appendix 1. (continued)

River	1993 (Preliminary)				1992				1988 - 92 means							
	Grilse		Salmon		Grilse		Salmon		Grilse		Salmon		Effort			
	retained	released	released	Effort	retained	released	released	Effort	retained	95% C.I.	released	95% C.I.	released	95% C.I.	roddays	95% C.I.
Salmon fishing area 21																
Broad									0.0	N/A	0.0	N/A	3.0	N/A	21.8	N/A
Clyde	34	1	3	560	106	9	15	730	55.4	44.5	7.4	9.2	14.4	16.5	569.2	186.7
East: Lunenburg Co.	0	0	0	9	0	0	0	8	0.0	0.0	0.4	0.5	0.2	0.4	8.6	1.7
Gold	223	25	32	2635	194	9	30	1920	248.0	140.3	32.8	25.7	60.6	39.9	2251.0	738.8
Ingram	3	4	3	147	6	1	0	74	4.6	1.3	1.6	1.7	0.0	0.0	57.2	12.2
LaHave	953	168	237	10614	1021	102	181	8829	1445.0	755.4	212.4	146.1	376.6	207.9	10474.0	3475.4
Martins									0.0	N/A	0.0	N/A	0.0	N/A	1.0	N/A
Medway	252	28	63	4502	473	39	52	4704	450.4	201.7	30.2	15.1	129.0	66.9	4756.0	1084.7
Mersey	12	0	1	1440	44	3	1	1620	95.6	35.5	9.0	5.1	23.2	18.9	1979.6	233.6
Middle: Lunenburg Co	0	0	0	14	0	0	0	3	1.2	1.4	2.4	2.0	0.2	0.4	11.4	7.5
Mushamush	12	3	1	154	18	3	4	87	23.6	9.2	1.2	1.0	4.2	2.9	218.6	126.8
Nine Mile									0.0	0.0	0.0	0.0	0.0	0.0	2.5	3.5
Petite Riviere	80	10	26	1179	185	16	11	1174	132.4	53.1	13.2	8.7	17.8	7.8	957.6	214.5
Sackville	11	1	10	434	24	39	13	453	25.2	9.6	15.6	12.5	10.4	4.3	271.4	145.6
Salmon: Digby Co.	15	1	6	244	30	3	3	299	52.0	25.0	7.2	5.9	13.8	9.5	534.8	169.1
Tusket	57	1	17	1444	128	23	39	1383	119.2	34.5	16.2	5.2	62.0	40.0	1456.2	162.7
Totals	1652	242	399	23376	2229	247	349	21284	2652.6		349.6		714.8		23565.8	

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Appendix 1. (continued)

River	1993 (Preliminary)				1992				1988 - 92 means								
	Grise		Salmon	Effort	Grise		Salmon	Effort	Grise		Salmon		Effort				
	retained	released	released		retained	released	released		retained	95% C.I.	released	95% C.I.	released	95% C.I.	rod days	95% C.I.	
<u>Salmon fishing area 22</u>																	
Annapolis	0	0	0	10	0	0	0	8	1.6	1.9	0.0	0.0	0.2	0.4	33.6	25.9	
Apple									2.0	3.0	0.3	0.4	0.5	0.5	24.3	17.1	
Bass																	
Chiganois									0.0	0.0	0.0	0.0	0.0	0.0	12.3	8.3	
Cornwallis	0	0	0	11	0	0	0	23	1.0	1.1	0.8	1.6	0.4	0.5	45.4	19.5	
Debert									14.8	14.0	1.5	2.6	2.8	2.8	132.5	89.0	
Diligent									0.0	0.0	0.0	0.0	0.0	0.0	2.8	4.8	
East Colchester									0.8	1.3	0.0	0.0	1.0	1.8	4.8	7.8	
Economy									4.0	4.1	0.0	0.0	1.5	1.5	52.8	40.2	
Folly									20.3	16.9	4.3	2.9	3.5	3.5	129.8	92.7	
Gaspereau: Kings Co.	10	10	21	506	16	23	6	469	30.2	17.9	6.8	8.6	28.4	14.8	572.4	75.7	
Great Village									6.0	8.8	1.8	3.1	0.5	0.5	20.3	18.2	
Harrington									0.0	0.0	0.3	0.4	1.0	1.8	6.3	11.0	
Kennetcook									0.0	0.0	0.0	0.0	0.0	0.0	4.3	3.0	
Lequille	0	0	0	1					0.0	0.0	0.0	0.0	0.0	0.0	10.0	17.5	
Maccan	0	1	0	28	0	0	0	0	47.3	50.5	5.8	4.1	10.3	14.6	537.3	390.3	
Meander (Avon)									0.0	0.0	0.0	0.0	0.0	0.0	8.3	14.5	
Nappan									0.0	0.0	0.0	0.0	0.0	0.0	10.8	13.6	
Nictaux	0	0	0	4					0.0	0.0	0.0	0.0	0.0	0.0	1.8	3.1	
North : Colchester					0	0	0	0	56.5	54.2	6.3	5.9	6.3	6.6	290.0	216.2	
Portapique									7.5	5.7	2.3	1.9	1.0	0.7	32.5	19.9	
Ramshead (Ramsey)																	
River Hebert	0	0	0	3					24.0	32.9	2.0	3.5	2.0	3.0	194.3	143.3	
Round Hill	0	0	0	1	0	0	0	16	0.0	0.0	0.0	0.0	0.0	0.0	3.2	6.3	
Saint Croix									11.3	11.7	4.8	8.3	0.0	0.0	169.3	132.9	
Salmon: Colchester									32.8	39.9	14.3	21.0	9.5	9.5	223.8	161.1	
Shubenacadie	0	0	0	1					28.8	22.6	2.5	4.4	10.0	6.7	309.3	195.8	
Stewiacke	0	1	0	4	0	0	0	0	360.8	432.0	75.0	96.3	84.5	80.6	3013.5	2150.0	
Totals	10	12	21	569	16	23	6	516	653.5		124.5		169.0		5879.5		

* The means for rivers closed to angling in 1992 were based on the years 1988 to 1991.

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Appendix 1. (continued)

River	1993 (Preliminary)				1992				1988 - 92 means							
	Grilse		Salmon		Grilse		Salmon		Grilse		Salmon		Effort			
	retained	released	released	Effort	retained	released	released	Effort	retained	95% C.I.	released	95% C.I.	released	95% C.I.	rod days	95% C.I.
<u>Salmon fishing area 23</u>																
Alma									6.8	7.9			0.5	*	48.5	*
Big Salmon									56.3	57.2			0.0	*	505.8	*
Canaan	0			0	15		10	130	9.2	9.4			2.0	*	60.4	*
Dennis Stream	0	0	0	10					3.3	3.3			0.5	*	20.8	*
Digdeguash	3	0	0	56	34		9	205	13.8	5.2			3.5	*	106.0	*
Gaspereau					30		20	250								
Hammond	12		12	400	120		120	2100	109.0	54.8			24.0	*	966.4	*
Kennebecasis	75		120	1500	200		150	3000	88.0	64.8			34.0	*	1015.4	*
Keswick	30	0	0	55	22			75								
Magaguadavic	12		10	205	41		9	373	87.2	47.4			25.8	*	490.0	*
Nashwaak	137		41	2393	416		235	4358	386.2	269.6			260.2	*	3674.6	*
Nerepis	0	0	0	70	24		6	270	11.8	6.6			2.2	*	232.8	*
New				0	0		0	5	0.8	1.1			2.0	*	4.6	*
Oromocto					1		0	33								
Saint John	440		228	4100	1211		527	5334	1007.8	131.9			293.2	*	6720.2	*
Salmon: Queens Co.	2			U	60		40	500	50.4	27.4			9.6	*	314.4	*
Salmon: Victoria Co.	30			U	60		40		172.0	162.5			43.0	*	712.5	*
St. Croix	8		3	105	13		5	69	12.6	6.3			6.8	*	218.2	*
Tobique	372			7588	833			8633	752.6	122.0			0.0	*	8137.4	*
Waweig	0		0	20	3		2	54	6.6	3.1			3.6	*	97.0	*
Totals	1121		414	16502	3083		1173	25389	2762.8				710.0		23067.8	

* Confidence limits were not calculated on SFA 23 released fish or effort because of the number of missing values.

** Salmon released partial estimate only.

APPENDIX 2

STOCK: Grand River, SFA 19.
TARGET: 1.1 million eggs

Year	1988	1989 ¹	1990	1991 ¹	1992	1993	MIN ²	MAX ²	MEAN ²
First Nations catch:			24	39	UK	UK			
Recreational catch:									
Small	338	307	416	115	139	113	115	416	263
Large	105	74	98	15	46	22	15	105	68
Broodstock:	33	25	18	19	10				
Count at fishway:									
Small	554	512	527	234	114	91	114	554	388
Large	31	25	27	18	18	5	18	31	24
% Hatchery:	NA	NA	43	45	38	45	38	45	42
Correction for by-pass:									
Small	55	51	52	176 ⁵	40	32	40	176	75
Large	54	19	20	14	14	4	14	54	24
Total above fishway:	694	607	626	442	186	132	186	694	511
Pop'n est below fishway:	143	UK	UK	UK	UK	UK			
% angled above:	UK ⁶	42 ³	31 ³	31 ³	31 ³	31	31	42	34
Required spawning escapement:	539	545	545	545	545	545			
Estimated escapement⁴:	736	453	442	348	143	102	143	736	424
% of Adults required:	136	83	83	64	26	19	26	136	78

¹ In-season variation closures.
² For the period 1988-1992; not shown where only 1988-1992 data are available.
³ Determined from post-season phone survey.
⁴ Above fishway in relation to entire river.
⁵ 1991 by-pass rate for fish <63cm.
⁶ 20% Assumed angled above fishway.

Recreational catches: Have ranged from 422 fish in 1984 to 115 fish in 1991, the period since the Nova Scotia license-stub return system. This river is the highest or second highest producer of fish smaller than 63 cm on Cape Breton Island.

Data and assessment: Counts and scale samples are taken at the fishway 10.2 km above the head of the tide on the main river. By-pass of fish ascending the falls was estimated in 1989 at 9% for fish less than 63 cm and 43% for fish equal to or greater than 63 cm but may have been different in 1991 when flood conditions followed a prolonged drought. The 1991 by-pass rate for small salmon of 43% was estimated from broodstock collected above the fishway (8 of 14 were marked). Numbers below the fishway were estimated from redd counts in 1988 only.

State of the stock: The target spawning escapement for the Grand River has not been met during the past three years, based on the number of salmon estimated to be spawning above the fishway.

Forecast: No quantitative forecast is possible for 1994.

APPENDIX 3

STOCK: Middle River, SFA 19
TARGET: 2.07 million eggs (80 small salmon, 470 large salmon)

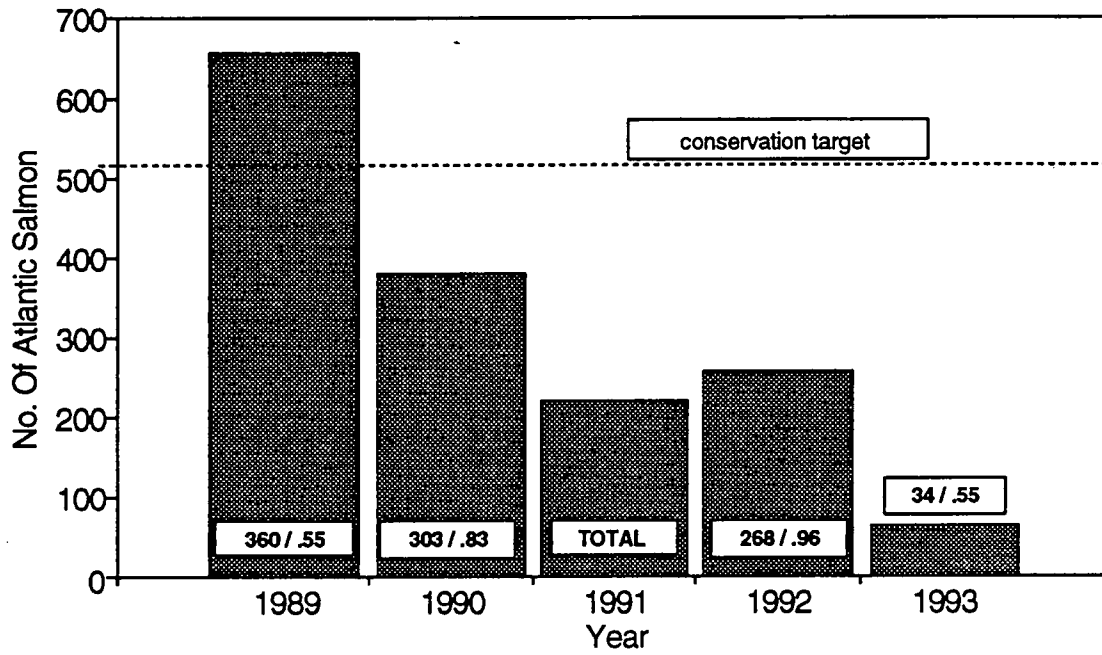
Year	1988	1989	1990	1991	1992	1993	MIN ¹	MAX ¹	MEAN ¹
First Nations catch:	UK	UK	UK	UK	UK	UK			
Recreational catch:									
Small	52	51	107	27	11	29	0	158	37
Large	148	276	197	186	30	46	9	276	84
Counts by divers:									
Wild									
Small		7	53	18	56	2	2	56	27
Large		323	208	244	211	31	31	323	203
Hatchery									
Small		5	16	0	0	0	0	16	4
Large		25	26	10	1	1	1	26	13
Proportion covered:		0.55	0.83	1	0.96	0.55	0.55	1	0.78
Estimated post angling population:		655	365	272	279	62	62	655	327
% adults required:		119	66	49	51	11	11	119	59
¹ 1974-93 for the recreational catches and for the period shown for all other means.									

Harvests: First Nations fisheries occur outside the estuary and river. About 130 large salmon have been allocated to the Wagmatcook Band since 1983. These salmon are traditionally harvested in gillnet fisheries in the Bras D'or Lake adjacent to Wagmatcook. Other Bands have harvested within the river. Few salmon were harvested in 1993.

Data and assessment: Annual counts of adult salmon are conducted by teams of divers following the closure of the recreational fishery. Counts cover from 100% to 55% of the holding area in the main river and have recorded up to 65% of the target requirement before population estimates were made.

State of the stock: Estimates of escapements have declined steadily since 1989 and were critically low in 1993.

Forecast: No quantitative forecast is possible for 1994.



App. 3. Fall population estimates of Atlantic salmon in Middle River, Victoria County (inserts are fish counted/ proportion of river swum by divers).

APPENDIX 4

STOCK: Liscomb River above Liscomb Falls Fishway, SFA 20
TARGET: Under development for this acid-stressed river.

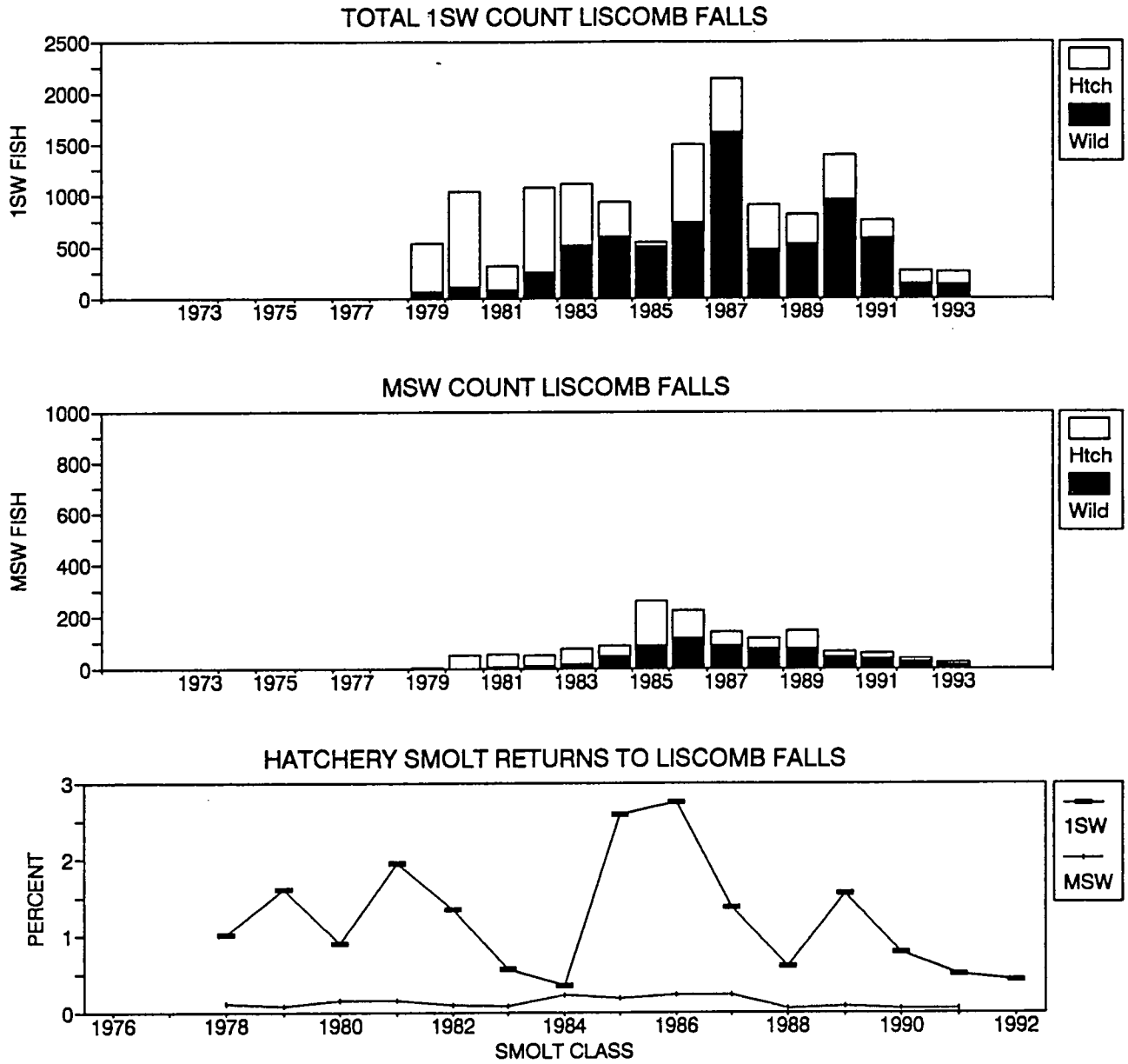
Year	1988	1989	1990	1991	1992	1993	MIN ¹	MAX ¹	MEAN ¹
Recreational catch (1SW)^a:	138	65	177	68	19	11	19	289	61
Counts:									
Wild 1SW	477	532	955	586	145	132	145	1614	694
Wild MSW	76	75	44	38	27	11	27	117	69
Hatchery 1SW	431	288	438	178	125	128	125	766	366
Hatchery MSW	44	71	22	22	12	12	12	108	48
TOTAL	1028	966	1459	824	309	283	309	2279	1176
Egg deposition/m^{2b}:	1.2	1.2	1.6	0.9	0.4	0.34	0.4	2.5	1.5
Ret'n rate hatchery smolts:									
1SW(%)	1.38	0.6	1.56	0.79	0.5	0.42	0.35	2.75	1.31
MSW(%)	0.23	0.23	0.05	0.08	0.05	0.05	0.05	0.23	0.14
¹ For the period 1985-1992. ^a below fishway; harvest and release ^b above fishway									

Recreational catches: No retention of MSW fish since 1984; 1SW catches (1985-1993) have ranged from 11 in 1993 to 289 in 1987. Prior to 1993 the recreational fishery was limited to the 5 km of river below the fishway.

Data and assessment: Counts of adult fish are obtained at Liscomb Falls fishway.

State of the stock: Since 1979, target egg requirements according to the 2.4 eggs/m² have been met only in 1987; a significant contribution to egg deposition comes from hatchery-origin fish of the Liscomb River stock. The 1993 escapement resulted in an egg deposition of approximately one-seventh (14%) of nominal target.

Forecast: Forecasts of 1SW returns are not possible. An annually-updated relation between 1SW returns in year *i* and MSW returns in year *i*+1 predicts a return of 27 MSW salmon ($p < 0.05$; 90% CL 0-86) in 1994.



App. 4. Counts of wild and hatchery salmon and percent return from hatchery smolts at the Liscomb Falls fish counting facility in recent years.

APPENDIX 5

STOCK: LaHave River above Morgan Falls Fishway, SFA 21
TARGET: Under development for this acid-stressed river

Year	1988	1989	1990	1991	1992	1993 ¹	MIN ²	MAX ²	MEAN ²
Harvest:									
Recreational Small ³	1585	2411	2008	233	1058	1655	233	2411	1459
Counts⁵:									
Wild 1SW	2464	2087	1880	495	1915	777	495	2464	1768
Wild MSW	390	511	396	236	215	121	215	511	350
Hatchery 1SW ⁴	1056	443	596	109	558	381	109	1056	552
Hatchery MSW ⁴	59	183	112	90	59	84	59	183	101
TOTAL	3969	3224	2984	930	2747	1363	878	4214	2771
Return rate of hatchery smolts:									
1SW (%)	3.92	1.89	1.72	0.87	2.33	1.37	0.87	3.92	2.15
MSW (%)	0.23	0.61	0.39	0.22	0.44	0.36	0.22	0.61	0.38
¹ Preliminary data. ² For the period 1988-1992. ³ Retained catch taken mostly below the enumeration site. ⁴ Mostly as a result of smolt releases. ⁵ Errors corrected from prior publications.									

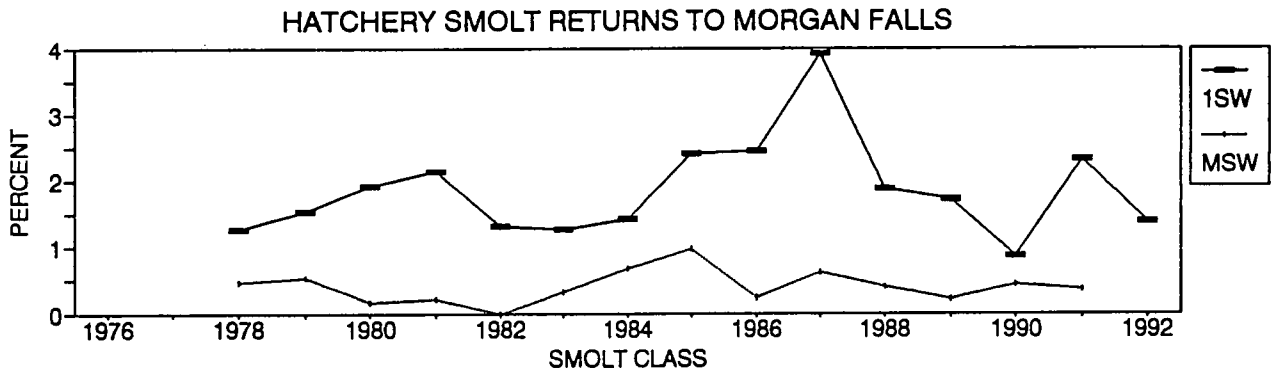
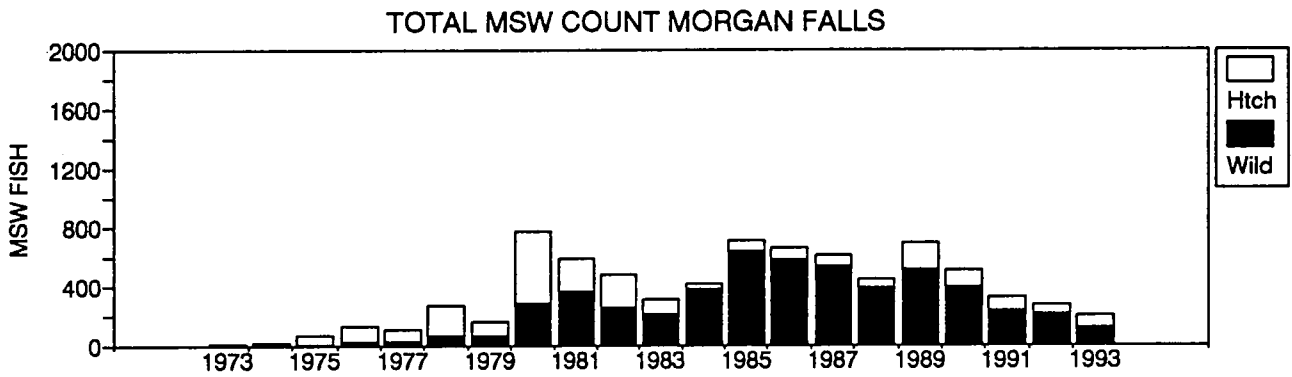
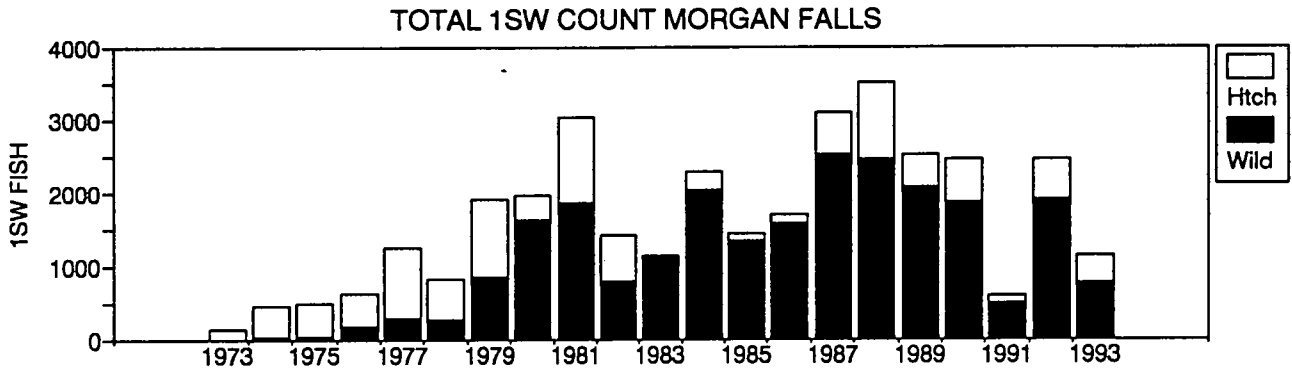
Recreational catches: Catches are for the entire river rather than only those from the stock above Morgan Falls. Retention of MSW catch since 1983 has been prohibited, but large numbers have been released after hooking.

Data and assessment: Spawner counts are made at a fishway at a natural falls, 25.3 km above tidehead.

State of the stock: Target egg requirements according to the 2.4 eggs m⁻² (approx. 2,800 1SW and 500 MSW salmon for the entire river; 60% of the drainage is below Morgan Falls) have been exceeded except for 1991, but the adequacy of that rate under conditions of some acid stress is uncertain at this time. The estimated egg deposition in 1993 is 2.4 eggs m⁻², without any downward adjustment for instream losses above Morgan Falls.

Conditions in 1993: River discharge during the angling season declined, but was adequate until mid-August when low flows persisted until mid-October.

Forecast: A significant regression (n=19) of wild MSW counts at Morgan Falls on wild 1SW counts at Morgan Falls in the previous year forecasts a count of 202 MSW salmon in 1994. A significant regression (n=20) of hatchery-return MSW counts at Morgan Falls on hatchery-return 1SW counts there in the previous year forecasts a count of 98 MSW salmon in 1994.



App. 5. Counts of wild and hatchery salmon and percent return from hatchery smolts at the Morgan Falls fish counting facility in recent years.

APPENDIX 6

STOCK: Saint John River, N.B. (above Mactaquac) SFA 23
TARGET: 29.4 million eggs (4,400 MSW and 3,200 1SW fish)

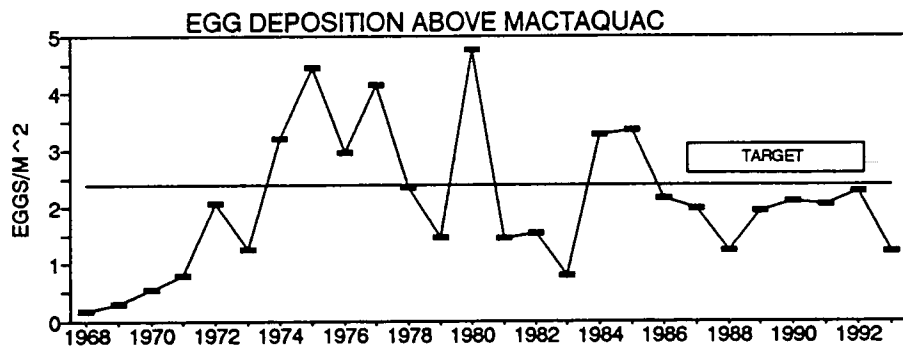
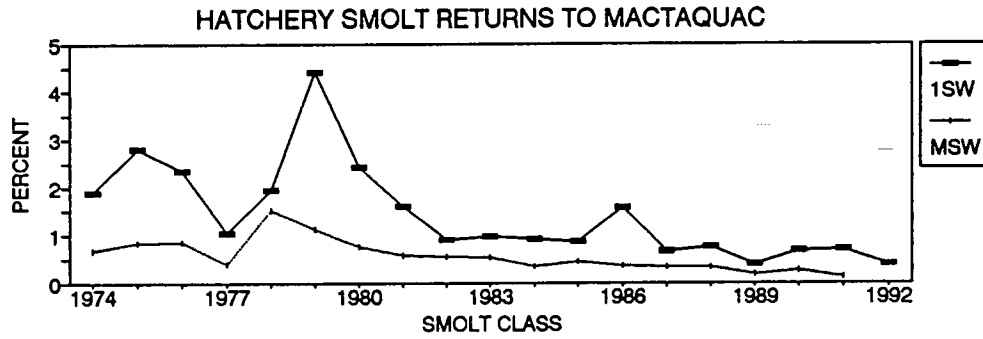
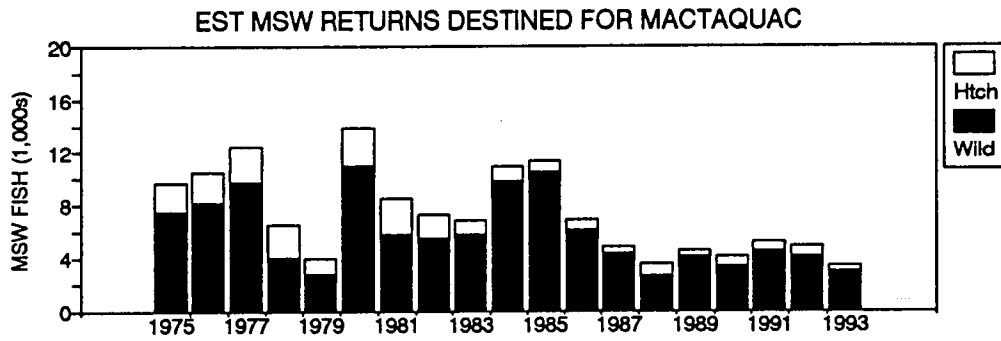
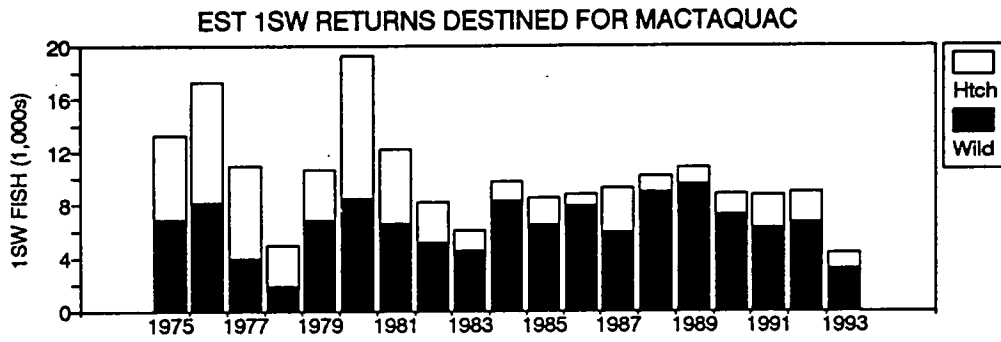
Year	1988	1989	1990	1991	1992	1993 ³	MIN	MAX	Mean
Harvest:									
First Nations									
Small	300	560	273	657	560	241	241 ²	657 ²	470 ²
Large	1200	240	247	957	748	462	240 ²	1200 ²	678 ²
Recreational									
Small	1755	2304	2110	1690	2104	852	852 ¹	3580 ¹	2248 ¹
Counts:									
1SW	9191	9587	7907	7575	7664	3907	3907 ¹	17314 ¹	8793 ¹
MSW	2600	4291	3919	4226	4203	2980	2010 ¹	10451 ¹	5164 ¹
Returns:									
1SW	10180	10861	8804	8751	8940	4369	4369 ¹	19275 ¹	10235 ¹
MSW	3537	4541	4125	5215	4898	3389	3389 ¹	13916 ¹	7356 ¹
Spawning:									
1SW	7810	7533	6057	5721	5128	2819	2819 ²	7810 ²	6450 ²
MSW	1704	3491	3202	3481	3269	2149	1704 ²	3491 ²	3029 ²
% of target met:									
1SW	244	235	189	179	160	88	88 ²	244 ²	201 ²
MSW	39	79	73	79	74	49	39 ²	79 ²	69 ²
Eggs	50	95	85	87	81	51	50 ²	95 ²	80 ²
¹ For the period 1975-1992. ² For the period 1988-1992; ³ Preliminary data.									

Harvests: The harvest by First Nations reflects poor river returns, voluntary lifting of some nets and a late closure for conservation purposes. MSW salmon have not been retained since 1984; 1SW harvests were the lowest in 20 years because of low returns and a reduced angling season.

Data and methodology: Counts of fish were obtained from the collection facility at Mactaquac the Dam; returns to the Dam equal counts plus estimates of down river removals. Spawners equal releases above Mactaquac minus estimates of upriver removals, not including poaching and disease.

State of the stock (see over): 1SW and MSW returns were the fewest in 19 years. Egg deposition (nearly all from MSW fish) was 51% of requirement; the target has not been met since 1985. Hatchery fish comprised 26% of 1SW and 13% of MSW returns; return rates for hatchery smolts were virtually the lowest on record.

Forecast: 1SW returns destined for Mactaquac in 1994 could number 8,000 fish (6,400 wild and 1,600 of hatchery origin). However, because of the very low marine survival in 1993 and, quite possibly in 1994, returns like those of 1993, could be only one-half of the forecast value. In any event, the return should exceed the target spawning requirements of 3,200 1SW fish above Mactaquac. Forecast MSW returns destined for Mactaquac in 1994 could number 3,100 (2,300 wild and 800 of hatchery origin) or 4,800 fish (3,600 wild and 1,200 of hatchery origin) depending on models supposing either none or total benefits, respectively from the moratoria in distant fisheries. The model that ascribed no benefits from the moratorium in Newfoundland best forecasted the 1993 MSW return but the reason may have been the low marine survival. Neither MSW forecast fully accounts for potentially low marine survival in the winter of 1994 or the fact that the 1SW and fork length data used to predict MSW returns were, together, outside the range of data in the models. Therefore, it is likely that MSW returns will be inadequate, with incidental losses below Mactaquac and the removal of 400 MSW broodstock at Mactaquac, to meet the 4,400 target spawning requirements for MSW fish above Mactaquac or requirements for salmon development initiatives in the Aroostock River and above Grand Falls. Early in-season forecasts are the best basis for determining a toleratable level of harvesting in 1994.



App. 6. Stock status of Atlantic salmon, Saint John River above Mactaquac, various years to 1993.