137915

International Council for
Exploration of the Sea

C.M. 1991/M:6
Anadromous and Catadromous
Fish Committee

REPORT OF THE STUDY GROUP ON THE NORTH AMERICAN SALMON FISHERIES

Leetown, West Virginia, USA
25 February - 1 March 1991

This document is a report of a Study Group of the International Council for the Exploration of the Sea and does not necessarily represent the views of the Council. Therefore, it should not be quoted without consultation with the General Secretary.

*General Secretary
ICES
Palægade 2-4
DK-1261 Copenhagen K
Denmark

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Terms of Reference and Main Task

At the ICES Statutory Meeting in 1990 the Council adopted the following resolution (C. Res. 1990/2:5:6):
"The Study Group on the North American Salmon Fisheries (Chairman: Dr. P. J. Rago, USA) will meet in Leetown, West Virginia, USA from 25 February - 1 March 1991 to prepare the relevant data for presentation to the Working Group on North Atlantic Salmon at its meeting in March 1991."

The agenda for the meeting is in Appendix 1 and a list of working papers reviewed at the meeting is in Appendix 2.

1.2 Participants

E. Baum	USA
F. Caron	Canada
G. Chaput	Canada
K. Friedland	USA
J. Moller Jensen	Denmark
J. Marancik	USA
L. Marshall	Canada
D. Meerburg	Canada
R. Porter	Canada
P. Rago (Chairman)	USA
D. Reddin	Canada

2. THE FISHERIES AND STATUS OF STOCKS

2.1. United States of America

2.1.1 Desribe events of the 1990 fisheries with respect to gear, effort, and composition and origin of catch.

The sport catch (number of fish killed) of Atlantic salmon in Maine in 1990 was as follows:

River	Number of Atlantic Salmon 1SW	2SW	3SW	P.S	Total 1990	Total 1989
St. Croix	2	(grilse only)			2	7
Dennys	1	31	0	1	33	12
E. Machias	1	46	0	1	48	31
Machias	0	2	0	0	2	16
Pleasant	0	(grilse only)			0	0
Narraguagus	1	49	0	1	51	39
Union	0	0	0	0	0	4
Penobscot	45	348	12	11	416	368
Ducktrap	0	3	0	0	3	0
Sheepscot	1	8	0	0	9	5
Kennebec	1	45	0	0	46	2
Saco	0	16	0	0	16	3
Other (Marine)	0	1	0	0	1	0
Total	52	549	12	14	627	487

Recreational catches of Atlantic salmon were about 30% higher in 1990 than in 1989. The increased catch was attributed to increased effort as evidenced by higher sales of licenses (Table 1), excellent angling conditions and, in some instances, larger runs of salmon. The number of salmon caught and released in Maine rivers exceeded the number caught and killed. The only new management measure instituted in 1990 was the reopening of the Pleasant River to grilse-only angling.

2.1.2 Status of USA Stocks

The status of Atlantic salmon in USA rivers was assessed by utilizing Maine and documented adult returns and estimated spawning escapements for New England rivers, angling catches and juvenile salmon releases.

Long-Term Angling Catches

Angling catches in Maine rivers in recent years were as follows:

Years(s)	Rivers with Wild Salmon Runs						Penob. River	All Others	Grand Total
	Na	Ma	EM	De	Sh	Total			
1990	51	2	48	33	9	143	416	68	627
1989	39	16	31	12	5	103	368	16	487
1988	35	8	14	9	1	67	179	13	259
1987	7	4	14	1	15	71	184	27	282
1967-1986 Av.	77	48	25	49	17	216	229	41	48

Na = Narraguagus, Ma = Machias, EM = East Machias, De = Dennys, Sh = Sheepscot

Catches in 1990 in Maine rivers with salmon runs that are primarily of wild origin increased but were 44% below the long-term average. Angling conditions in the Penobscot River were excellent with favorable flows and temperature prevailing throughout the fishing season. Numbers of fish killed increased in proportion to the run size (8%) but the estimated number of fish caught and released increased by 35% (500 in 1989 to 675 in 1990).

Spawning Escapement, Broodstock Collection, and Egg Take

Egg sources for the New England Atlantic salmon program came from sea-run salmon, captive salmon broodstock, and reconditioned kelts. Broodstock collections in Maine included 543 MSW salmon from Penobscot River and 20 from the Union River. On the Merrimack River 226 salmon were captured for the broodstock program. For the Connecticut River 36 salmon for broodstock were taken from the Leesville trap, 37 from the Rainbow trap, and 170 from the Holyoke trap.

Salmon entering a counting/trapping facility, yet allowed to proceed upstream, included 18 on the Connecticut, 16 on the Merrimack, 2 on the Pawcatuck, and 869 on the Penobscot rivers.

Total observed counts, including hatchery broodstock, of Atlantic salmon at fishway traps were:

River (Target:MSW Females)	Year Size	Total Run (both sexes)	No. MSW Females
Penobscot River (Target: 3,000)	1985	3,356	1,400
	1986	4,529	1,750
	1987	2,510	858
	1988	2,855	1,002
	1989	3,087	972
	1990	3,341	1,219
Merrimack River (Target: 1,537)	1985	214	105
	1986	103	53
	1987	139	62
	1988	65	33
	1989	84	41
	1990	248	134
Connecticut River (Target: 4,076)	1985	310	153
	1986	318	170
	1987	353	193
	1988	95	59
	1989	109	57
	1990	263	147

In 1990 approximately 5.4 million juvenile Atlantic salmon were released into 15 rivers of New England. This total is nearly equal to the number of juveniles released during the previous year (roughly 5.5 million juvenile salmon). The Connecticut, Merrimack and Penobscot rivers received the greatest share of the total; 38%, 21%, and 19%, respectively. The stocking of salmon fry constituted over 50% of the releases.

Increasing numbers of hatchery reared Atlantic salmon fry, parr and smolts have been released in Maine rivers in recent years. Numbers released have more than tripled in the last 10 years (Table 2).

Total Documented Adult Returns

Documented Atlantic salmon returns to rivers in the United States totalled 4,442 in 1990 (Table 3). This figure is 23% greater than that recorded for 1989. Significant increases in run sizes occurred in the Connecticut, Merrimack, Androscoggin, and Saco rivers. The increases for these four rivers amounted to 539 salmon. Moderate increases were observed in most other rivers except for three, the Union, Machias, and St. Croix rivers, where decreases were observed.

It is important to realize that Table 3 represents minimum documented salmon returns, defined as fish counts at traps associated with fish passage facilities and rod catches (fish killed) downstream from the traps.

In contrast, estimates of run size in rivers without trapping facilities are computed by dividing reported angling harvest by the product of the reporting rate of 80% and long-term exploitation rate of 20%. In years of low abundance, small variations in reporting rate or low reported catches

can yield erroneously low estimates of run size. In some instances, redd counts have indicated many more salmon than the catch-based estimates. The Study Group examined a regression between population estimates derived from redd counts and angler catches. For rivers in which the redd counts were complete, the regression had a significant positive intercept ($P < 0.05$). This indicates that population abundance estimates from angling catches may be imprecise when total catches are low. The relationship between numbers of spawners and redd counts remains to be validated. Until that can be done, the Study Group concluded that changes to the population estimation methodology for the harvest model (Sec 2.2.4.1) were not warranted.

Summary of Status of Stocks-US Rivers

While the total number of juvenile salmon stocked in 1990 remained the same as in 1989, there was an increase in the numbers of fry and smolts and a decrease in parr. The numbers of smolts marked with coded wire tags (200,000) and Carlin tags (50,000) released into Maine rivers did not change from 1989 releases. In recent years, greater emphasis has been placed on fry releases in all US programs.

Recorded returns of adults were higher in 1990 than in 1989 in most US rivers. The Study Group also noted that the number of wild-origin salmon in the Penobscot River has been increasing in recent years for both one and two sea-winter salmon (Table 4). The percent of wild salmon in Penobscot River trap counts has increased from less that 1% in 1981 to over 8% for 2SW in 1990 (Fig 1). Increases for 1SW salmon have been even greater (17% wild in 1990).

2.1.3 Exploitation Rate in USA Fisheries

The angling exploitation rate on combined age classes in the Penobscot River for 1990 (13.0%) was the same as for 1989 (12.6%). Estimates are based upon the fish passage efficiency (.85) and reporting rates (.80) used in Section 2.2.4.1 (Anon 1990a).

2.2 Canada

2.2.1 Describe events of the 1990 fisheries with respect to gear and effort.

Two new management measures were introduced in the Newfoundland and Labrador commercial fisheries in 1990:

1) Quotas by Salmon Fishing Area (SFA) (Fig. 2) were introduced in the Newfoundland commercial salmon fishery. The quotas in 1990 are shown in Table 5. Salmon Fishing Area 1 had an allowance of 80 t. An allowance is an estimate of expected catch and not a limitation on allowable harvest. Monitoring of the quotas was conducted by Fisheries Officers who were in contact with buyers and fishermen on a weekly or daily basis.

2) Caution Notices were moved seaward on many major salmon rivers in Newfoundland. Commercial fishing, for any species, is prohibited inside (towards the river) these Caution Notices. Caution Notices were moved outward to increase spawning escapement in specific rivers and to reduce commercial harvest on salmon stocks when salmon are "staging" in or near the estuaries during periods of low river discharge. Fishing

effort was displaced to berths further out in the bays. It is not possible to quantify the effects on the harvests outside the Caution Notices.

Along the Quebec North Shore, the opening of the commercial fishing season, previously 1 June, was delayed by 10 days in Q7 and Q8 and by 1 month in Q9 (Fig. 2). Total quota in numbers was reduced by 12% to 29,605 salmon. Commercial fishing was prohibited within a 500 m zone from the mouth of the rivers.

A more detailed description of other aspects of the commercial fisheries was provided in Anon (1985) and updated annually by the Working Group (Anon, 1986a,b, 1987, 1988a, 1989a,b, 1990a,b).

The total salmon landings for Canada in 1990 were 870 t (Table 6); this is the lowest recorded landing in the 1960-90 data set. The landings of small salmon (405 t) in 1990 were 26% below the 1989 landings (549 t) and 41% below the previous 5-year mean (686 t). The landings (465 t) of large salmon in 1990 were 21% below the landings of large salmon in 1989 and 34% below the previous 5-year mean (699 t). Of the total Canadian landings by weight, 17% were in Quebec, 74% in Newfoundland and Labrador, and 9% in the Maritimes. The recreational fisheries harvested 22%, commercial fisheries 74%, and Native fisheries harvested 4% of the total landings by weight. The decline in total commercial landings from 1,596 t in 1987 to 652 t in 1990 was spread over all Salmon Fishing Areas of Newfoundland and Labrador and the Quebec North Shore (Table 5). Landings in Newfoundland and Labrador of 586 t were the lowest of a 20-year data set (1971-90) (Table 7). In Newfoundland and Labrador in 1990 3,194 fishermen were licensed to fish 12,758 units of gear (1 unit = 50 fathoms of gill net or salmon trap), (Table 8). There are 37% fewer fishermen and 35% less gear units licensed to fish salmon than in 1983. Total recreational effort in 1990 of 325,00 rod-days was about the same as in 1989.

A description of the commercial, recreational and Native fisheries in 1990 in Atlantic Canada, are provided by SFA (Fig. 2) in Tables 9, 10, and 11, respectively. The most significant change in the fisheries from the description reported for 1989 (Anon, 1990a) was the imposition of quotas in the commercial fisheries for SFAs 2-14 which resulted in early closure of the commercial fisheries in SFAs 4, 5, 6, 8, 10, 11, 13, and 14. Fifty percent of the licensed salmon fishermen are in SFAs 2, 3, 4, 14. About 45% of the angling effort was in SFAs 16 to 23. The landings in the commercial (in numbers and weight), and angling fisheries (in numbers) in 1990 by SFA and comparisons to the mean landings 1984-89 are provided in Tables 12, 13, and 14, respectively. Historical commercial and recreational landings are presented in Fig. 3. Additional analyses of the 1990 quota are contained in Section 3 and Appendix 3.

The commercial landings of small and large salmon, by weight, declined from the mean landings 1984-89 throughout Newfoundland and Labrador SFA 1 to 14 (Table 13). The early closure in SFAs 4, 5, 6, 8, 10, 11, 13, and 14 contributed to the decrease in landings. However, low abundance of salmon also appears to be a contributing factor, particularly in SFAs 1, 2, and 3. The landings of small salmon in Q7 and Q9, the Quebec north shore, increased by 66% and 7% respectively over the mean landings 1985-89; but, declined by 36% in Q8 (Table 9). The declines in large salmon catch in Q7 (32%), Q8 (9%) and Q9 (8%) may be related to the delay in opening of the fishing season, reductions in quotas and displacement of some fishing gear.

The recreational landings of large salmon in Labrador (SFA 1, 2 and part of SFA 14) were below the 1984-89 mean (Table 14). In Quebec the recreational landings of large salmon declined below the mean landings 1985-89 in Q2, Q7, Q9, Q10 and Q11: whereas increases were noted in Q1, Q3, Q5, Q6 and Q8 (Table 14). The landings of small salmon were below the 1984-89 mean landings in SFAs 1 and 2 (Labrador), SFAs 4-8 (east coast of Newfoundland) and SFAs 10-12 (south coast of Newfoundland). Increases in landings of small salmon in the recreational fisheries were observed in all other SFAs in Canada except for SFAs 15, 16, 22, 23, Q9, Q10 and Q11 (Table 14).

2.2.2 Composition and Origin of Catch

Salmon of Canadian and USA stock origin were captured in Canada during 1990. Recaptures of tagged 1SW salmon of USA and Canadian origin occurred in the Newfoundland and Labrador fisheries.

Salmon in twelve commercial salmon fishing ports in Newfoundland and Labrador were scanned for CWTs in 1990. All sampling ports were located within the southern portion of SFA 2 and SFAs 3 and 4. A total of 19,953 salmon (about 16% of the total landings in the SFAs sampled) were examined from the landings of commercial vessels. Of this sample, 112 salmon were found to be adipose clipped, of which 44 contained coded wire tags (Table 15). Approximately 8% of the salmon examined were from catches in the Labrador location (SFA 2) with the balance coming from Newfoundland (SFA 3,4). The highest percentage of tagged salmon were observed in Harbour Deep, but this can be misleading since the port was not sampled through the entire season.

The CWTs recovered in Canada were of United States and Canadian origin (Table 16). Of the 44 tags recovered, 40 were from USA-origin hatchery releases in the Penobscot, Connecticut and Merrimack rivers. All recoveries were from 1989 releases except one US tag from a 1988 Penobscot release. The Canadian origin tags were from 1989 releases in the Saint John River and a 1987 release in the Margaree River. It would be inappropriate to infer differential exploitation on the USA and Canadian tagged salmon because of the differences in relative numbers of tags at large, and the location and time of sampling.

Carlin tags reported (to date) in 1990 from Penobscot River smolts total 8 which is a 85% decrease from the 1989 return. Some of this decrease may be due to a 50% decline in Carlin-tagged smolts from 100,000 in 1988 to 50,000 in 1989. Most tags were recovered in southern Labrador (SFA 2), and northern Insular Newfoundland (SFAs 3, 4).

	Salmon Fishing Areas							
	1	2	3	4	5	6	7-14	Total
Penobscot Carlin Tags	0	2	2	2	0	0	2	8

Estimates of harvest of USA-origin salmon harvested in the 1990 fishery will not be available until after 1991 returns to homewaters.

2.2.3 Status of Canadian Stocks

Biological assessments are available for seven Atlantic salmon stocks. Annual estimates of run size and spawning escapements relative to a target spawning requirement are provided for the Restigouche, (SFA 15; Fig. 2) Miramichi (SFA 16) and Saint John (SFA 23) in New Brunswick, Margaree (SFA 18) and LaHave (SFA 21) in Nova Scotia and Conne River (SFA 11) in Newfoundland (Table 17) as in previous years (Anon. 1990a). An assessment of the Rivière de la Trinité (Q7) in Quebec for 1990 and comparable historical data are presented for the first time (Table 17). The estimated range of returns to the Restigouche in 1990 reflects computations based on sport catch and an upper and lower limit of sport exploitation; the estimated range of returns to the Margaree reflects calculations using the upper and lower limits of the estimated sport. The absence of predictions on all rivers in recent years reflects major changes in the ratio of 1SW:MSW returns from the same smolt class which has reduced the precision of parametric predictors of MSW returns to the extent that they became unreliable.

Estimates of egg depositions in 1990 may have approximated (Restigouche), approximated (Conne and Rivière de la Trinité) or exceeded (Miramichi, Margaree and LaHave) target egg requirements in six rivers. In the Miramichi River, 38% of MSW spawners were repeat spawning salmon (age at first spawning still being assessed), the highest proportion or number on record. Egg deposition was 32% below target on the Saint John River. Targets were approximated or exceeded for the first time in nine years on the Restigouche, the seventh time in the last nine years on the Miramichi, the eighth time in nine years on the Rivière de la Trinité, the sixth time in the last eight years on the Margaree and for the eighth and fifth consecutive years on the LaHave and Conne rivers, respectively (Table 17). Egg depositions were below target for the fifth consecutive year on the Saint John. With the exception of the Conne River, most rivers obtained a major component of eggs from MSW salmon.

Additional assessments (based on counts obtained at fishways, counting fences and by divers) made in 1990 suggest that target egg depositions were about 65% below requirements on Gander River (SFA 4) and about 35% below requirements on Middle River, Cape Breton (SFA 19) and Western Arm Brook (SFA 14). Four rivers (Big Salmon, Alma, Point Wolfe and Petitcodiac) of inner Bay of Fundy (SFA 23), had returns that were down relative to historical returns. The Liscomb River (SFA 20) was 35% below target egg deposition. Reasons for shortfalls in target egg deposition vary by river system and include effects of low water levels on juvenile survival in 1987, natural cycles, low pH and increased marine mortality.

Counts of 1SW and large salmon obtained at fishways and counting fences since 1974 are provided in Tables 18, 19, 20, and 21. Counts of 1SW fish at 10 of 12 fishways on systems in insular Newfoundland were down from the 1984-1989 mean. In 8 of 12 cases, the few large salmon counted in Newfoundland were below the 1984-1989 mean. In the Maritime provinces, counts of 1SW salmon were similar to or above the mean at all 3 fishways (in SFA 20, 21, 23); counts of MSW salmon declined at all fishways. Counts of 1SW fish in Québec increased over the 1984-1989 mean at all fishways; counts of MSW salmon were similar to or increased over the mean at 2 out of 4 fishways.

Stock status in Canada, 1990, may be summarized as follows for grouped management areas.

Labrador, East and South Coast Nfld. (SFAs 1-11):

The total abundance of small and large salmon in SFAs 1 to 9 was well below average. Spawning escapements in rivers of SFAs 1 to 9 were also generally low, except in rivers in SFA 3. In each of the SFAs, there were some rivers with average or above average spawning escapement. In SFA 10, escapements of salmon into most rivers were low in spite of the early closure of the commercial fishery in the SFA. In SFA 11, the escapements to most rivers appeared to be well above average.

There are several factors that may have contributed to the overall low abundance of salmon in SFAs 1-10. In northern areas, there appeared to be low egg depositions in 1983-84. In SFAs 4-10, the exceptionally low water levels and high water temperatures in 1987 may have resulted in high mortalities of juvenile salmon. Also the smolt-to-grilse survival in 1989 and 1990 was 34% below the survival rates observed in 1987 and 1988 for two rivers (one in SFA 9 and the other in SFA 10).

West Coast Nfld., Gulf NB, NS (SFAs 12-18):

Recreational catch of 1SW fish and returns to counting facility at Torrent River indicated that abundance was similar to or up relative to the previous 5 years. Returns in 1990 relative to previous 5 years were variable in SFAs 15-18 although in SFAs 16 and 18, there were large increases in returns of MSW salmon in the fall.

Atlantic Nova Scotia, Bay of Fundy N.S. and N.B. (SFAs 19-23):

Counting facility and river spawner counts indicate, with one exception, that returns of wild 1SW and wild MSW salmon were lower than either those of 1989 or the 1984-1989 mean.

Gaspé PQ (Q1-Q4):

Counting facility, river spawner counts and catch statistics show that 1990 1SW returns were above 1989 and the 1984-89 mean; MSW returns were lower than 1989 but slightly above the 1984-1989 mean.

North Shore PQ (Q5-Q9):

Counting facility, and catch statistics show that 1990 1SW returns were above the 1989 and 1984-89 mean; MSW returns were similar to 1989 returns but above the 1984-89 mean.

Anticosti and Ungava PQ (Q10-Q11):

Catch statistics and spawner counts for SFA Q10 and catch statistics for SFA Q11 reveal that both 1SW and MSW returns were lower than 1989 and the 1984-89 mean.

2.2.4 Harvest Estimates of USA-Origin Salmon in Canada

2.2.4.1 Carlin-Based Estimates

Neither the structure of the harvest model nor its parameter values were changed from the previous assessment in Anon. (1990b). Updated values and the new data for the 1990 run size used to calculate the RATIO parameter are presented in Table 22. There were several minor changes for recent years and modifications of the historical rod catch data for the Machias River. Changes in the Machias rod catch do not reflect any new data, but instead reflect the reallocation of fish to age groups by an improved methodology. Estimates for tags and total run size of 2SW salmon to Maine rivers, using a fishway efficiency of 85%, are presented in Table 23. For 1990, the estimates of tags and run size were 172 tags and 4,355 fish, respectively; the RATIO parameter was 0.0394.

The Study Group updated the time series of tag returns and harvest estimates of Maine-origin 1SW salmon in Newfoundland and Labrador. Tag returns for Maine-origin 1SW salmon can be found in Table 24. Estimated harvest of 1SW salmon in Newfoundland and Labrador are summarized by year for 85% fish passage efficiency in Table 25. The total harvest of 1717 Maine-origin salmon in the 1989 fishery was distributed primarily in SFAs 1-5. Harvests in SFA 1 were the highest on record for that SFA and were centered around the Nain area. Nearly 90% of the harvests in SFA 1 occurred after standard week 29; in the other SFAs most of the catches occurred prior to standard week 30 (Table 26). The harvest total of 1717 for the fishery was an increase from the relatively low harvests that occurred during the years 1986 to 1988. Updated values for 1SW:2SW ratios and ratios of harvest to run size of 2SW salmon are presented in Table 27.

Detailed summaries of the tag returns and harvests for 1SW salmon in mainland Canada and 2SW salmon in Newfoundland-Labrador and mainland Canada (Anon. 1990a, Tables 39-52) are not presented in this assessment since there were no new tag returns for these areas and age groups.

2.2.4.2 CWT-Based Estimates for Locations Sampled

The Study Group considered harvest estimates of Maine-origin stocks in Newfoundland and Labrador, derived from CWT and Carlin-tagged salmon for areas sampled. Estimates based on Carlin tags for the 1989 fishery were calculated identically to the methods used in other reports of Carlin-derived harvest estimates (Anon. 1987b, Anon. 1990b). CWT harvest estimates were computed identically to the methods used in Anon (1990b). To compute the tag raising factor for the 1989 recovery the following input data were used:

Run Estimate	4355 2SW salmon
Total CWT	454
CWT at the trap	334
Angled CWT	61
Untagged Trap	2298
Untagged Angled	336

From these data, the CWT to run ratio was 0.10424 and the raising factor for tags was 9.593. Estimated number of tags for a sample strata in the fishery was first raised for non-catch fishing mortality (Anon 1989a) and raised to total harvest for the strata.

Comparative harvest estimates based on CWT and Carlin tag recoveries for the communities and Statistical Sections sampled are presented in Table 28. As observed in Anon. (1989b) and Anon. (1990b), the ratio between the two estimates varied among locations, but unlike previous experiments, the sectional and community sums tended to suggest parity between the two estimation procedures. Whereas the experiments in 1987 and 1988 suggest reporting rate for Carlin tags may be overestimated in the commercial fisheries, the results for 1989 do not support that conclusion.

2.2.4.3 Proportional Harvest Model for Locations Sampled

The proportional harvest method is based on the fact that US and Canadian hatcheries both produce river age 1 salmon and almost no wild river age 1 salmon are produced in North America. The harvests of US salmon in Newfoundland can then be estimated based on the assumption that harvests will be proportional to production in Canadian and US hatcheries. The number of river age 1 salmon in commercial catches can be estimated from scale reading.

The numbers of US and Canadian 1SW salmon caught were estimated for three communities in Newfoundland from 1980-89: Nain and Square Islands, Labrador, and Twillingate, Newfoundland. All of an individual boat's catch, or catches of several boats, were examined up to approximately 100 salmon per day. A scale sample was taken to obtain an age estimate.

The number of salmon caught per week at each community sampled came from the catch statistics. For samples obtained at Nain, Labrador the total estimated numbers of salmon caught are for the communities of Nain, Black Island, and Cutthroat. Samples obtained at Square Island and Fox Harbour represent catches in the communities of Fox Harbor in 1981 and 1990 and Square Island from 1982 to 1989. Samples obtained at Twillingate represent catches in the communities of Twillingate and Crow Head.

The proportional harvest model used to estimate harvests of Maine-origin 1SW salmon is similar to that developed for Greenland in Anon. (1990b). The only difference is that the proportion of river age 1 salmon in the catches is estimated for those weeks in which samples were available.

River Age Distribution within a Statistical Area

One of the limitations to the applicability of the proportional harvest model is the difference in river age composition of the catch in Newfoundland. To assess this difference the Study Group examined earlier data from SFA 4.

In 1981 and 1982, salmon caught in commercial fisheries were sampled in SFA 4 (Section 7) at Twillingate, on an island at what could be defined as a 'headland' in Notre Dame Bay, and in the inner part of the bay at Embree and Campbellton. In 1981 and 1982 there were 16% and 23% river age 2 1SW salmon caught at Twillingate, while in the inner bay there were 1% and 5%, respectively. In general, the inner bay catches showed higher percentages of smolt age 3 and 4 salmon (Table 29).

The difference in river age distributions between the two areas was even more pronounced for the MSW salmon component. River age 2 salmon caught at Twillingate represented 42% and 32% of the sample in 1981 and 1982, respectively, while at the inner bay locations they were 0% and 2%. This may imply a greater mixing of stocks in the outer bay area. Similarly, the

inner bay area catches again showed higher percentages of river age 3 and 4 salmon in comparison with Twillingate (Table 29). The river age distributions at inner and outer bay sites, compared by Kolgomorov-Smirnov test, were significantly different from each other as shown below.

Year	Age	Dmax	P
81	1SW	0.11	0.05
82	1SW	0.18	<0.05
81	MSW	0.43	<0.05
82	MSW	0.29	<0.05

This illustrates how the contribution of each smolt age can differ even within a single bay and suggests wide variations may occur in interception rates between locations.

Comparison of Harvest Estimates

It is instructive to compare the proportional harvest estimates with those based on Carlin tag recoveries (Anon. 1990a, Table 37). The total Carlin harvest estimate for the three SFAs should not be lower than the catch in a single community within each SFA. Yet on many occasions the community catch is higher than the catch recorded in Anon. (1990a) for the entire SFA. In total, there are 48 out of 154 instances or 31.6% when there are harvests from the proportional harvest model with no corresponding harvest listed from the Carlin tag model. There are 52 out of 154 instances or 33.8% where the proportional harvest model shows a harvest greater than the Carlin tag model. The following table shows the differences (proportional harvest - Carlin harvest) between model results for those instances where proportional harvests were greater than or equal to Carlin tag harvests:

Difference	0	1-5	6-10	11-15	16-19
Frequency	22	9	11	7	3
Percent	42	17	21	14	6

Assumptions and Data Requirements:

1. The weekly distribution of US and Canadian hatchery origin salmon at a given site was assumed to be directly proportional to the production of US and Canadian river age 1 salmon. Previous analyses presented in Anon. (1990a) show that the numbers and proportions of US and Canadian origin salmon of river age 1 and sea age 1 vary independently of each other spatially and temporally. Carlin tag harvests, if available from Canadian and US river age 1 stocks could be used to give a representative sampling of the weekly distribution of Canadian and US salmon in the Newfoundland fishery. Information should be given by week and SFA. Instead of basing harvests on a proportionality factor from production estimates of smolts, the factor could be derived from the Carlin harvests. This will require estimates of Carlin harvests of Canadian and USA salmon based on the entire production of river age 1 salmon.

2. If the proportional harvest model is to be used to estimate harvests in the entire Newfoundland-Labrador fishery, samples sufficient to characterize the spatial and temporal variation of stocks in the

exploited populations of each SFA are required. The following number of sites might be required to apply this method:

SFA	1	2	3	4	5	6	7	8	9	10	11	14	All SFAs
No. Sites	2	3	4	4	4	1	1	1	1	2	2	1	26

The Study Group concluded that applicability of the proportional harvest model to Canada was limited by the complexity of the fishery and inadequate sampling effort.

2.2.4.4 Discrepancies between commercial catch statistics and scientific sampling.

The Study Group was asked to investigate discrepancies between recorded landings in the catch statistics and the numbers of salmon reported by crews sampling for coded-wire tags in Newfoundland-Labrador. The basis of the Newfoundland-Labrador catch record system (Anon. 1985) is the purchase slip issued to commercial salmon fishermen when their catches are sold to salmon buyers. The purchase slip records catches in kilograms, information on size category (small or large), the community and the date of sale. Purchase slips are sent to the Department of Fisheries and Oceans for compiling and entry into the catch record system. To ensure completeness of the records, fisheries officers are responsible for filing on a monthly basis records of those sales made locally by fishermen that are not recorded on the purchase slips from buyers. Local sales are recorded in kilograms and are not separated by size.

The landings in these catch records are then converted to size categories and numbers of salmon by a statistical system that relies on information on a community basis. Landings on purchase slips which are recorded daily are summed for standard weeks. Local sales are allocated into standard weeks and size categories based on the purchase slips. When information is unavailable from purchase slips, broader geographic categories are used.

Possible sources of errors are summarized below:

1. Errors in Catch Records:

- Incorrect information on local sales or plant records.
- Loss of purchase slips from buyers.
- Fishermen fish from one community but land salmon in another.
- Incorrect recording of dates or communities on buyers' purchase slips.

2. Errors in Catch Statistics:

- Inaccurate estimation of numbers in small and large categories.
- Allocation of monthly local sales into weeks.

The net effect of these possible sources of bias is to reduce the reliability of weekly estimates of small and large salmon. The overall magnitude of the problem is unknown but it is thought to be low for total.

2.2.5 Exploitation Rates in Canadian Fisheries

No new information on exploitation rates in commercial fisheries was available to the Study Group. Exploitation rates in the recreational fisheries of three SFAs not previously reported in Anon (1990a) are shown in Table 30. These rates were estimated from mark recapture studies and

include adjustments for reporting rate and tag availability with the exception of Restigouche River which were estimated from angled fish divided by angled fish plus spawners (obtained by visual counts from canoes after closure of river to angling). Exploitation rates on 1SW salmon for Restigouche River have been higher than for the other rivers. Exploitation rates on early run 1SW and MSW salmon were higher than on late run salmon. Exploitation rates on MSW salmon from Margaree have consistently been lower than on 1SW salmon (Table 30). Variation in the estimated rates suggest that exploitation rates should be calculated annually or that a range of rates be used when returns to a river are calculated from recreational catch.

2.3 France (Islands of St. Pierre and Miquelon)

No new information on the current fisheries of St. Pierre and Miquelon was provided to the Study Group. The Study Group, however, reviewed a report on the 1976 commercial fishery which revealed catches of 831 salmon weighing 2.5 mt. These catches were not markedly different from those reported in Anon (1990) for the period 1987 to 1989.

2.4 Aquaculture Production and Influence upon Native Stocks

2.4.1 United States

There are about 20 private aquaculture companies in Maine. Harvest has increased from 365 t in 1987 to 2,075 t in 1990 (Table 31). Information on existing aquaculture facilities in other states is unavailable. Most smolts stocked in net pens in Maine are of Penobscot River or Saint John River (N.B.) origin; however, some European stocks (Iceland, Scotland, Norway, Finland) have also been used to a limited extent. While all of the salmon farming sites in Maine are located east of the Penobscot River, most (75%) are located within Cobscook Bay in close proximity to the Maine - New Brunswick boundary.

The total number of salmon that escape from net pens in Maine is unknown, but the following escapes during 1983, 1988, and 1990 have been documented:

Date	Number of Fish	Size (kg)	Origin	Location
Dec. 1983	25,000	0.5	Penobscot	Cobscook Bay
Feb. 1988	4,700	3.7	Penobscot	Cobscook Bay
Nov. 1990	15,000-20,000	0.1-0.6	Saint John	Taunton Bay

Evidence of Atlantic salmon originating from the aquaculture industry in Maine rivers is very limited, since most rivers in the vicinity of net pens do not have counting facilities. About 20% of the 1990 angling catch (17 of 83) in the East Machias River was comprised of salmon of aquaculture origin. Additionally, a few fish were also captured at the St. Croix River fish trapping facility and one at the Penobscot River trapping facility in 1990.

2.4.2 Canada

The production of commercially-cultured Atlantic salmon in Canada (Atlantic seaboard only) for the period 1980-1990 is shown in Table 32. Most of the production in Canada occurs in New Brunswick, where the estimated harvest increased from 10 t in 1980 to 7,810 t in 1990. In southern New Brunswick, aquaculture production is based primarily upon the Saint John River stock which is close to the culture area.

The number of salmon that escape from net pens annually is unknown, although there are occasionally losses of fish due to predators or storm damage. A recent example (1990) was the loss of about 19,000 large salmon from one cage site in southern New Brunswick. The Study Group noted that the aquaculture facility in Quebec is land-based; therefore the probability of escape from this facility is very low.

Documentation of aquaculture escapees in Canadian rivers during 1990 was restricted to the Saint John River at the Mactaquac trap facility. A provisional estimate is that 6% (221) of the total MSW returns were of farmed origin. The incidence of farmed salmon in the Saint John River will continue to be evaluated annually.

2.4.3 Summary

Total annual aquaculture production in the Atlantic Coast of North America now exceeds landings of wild salmon by nearly ten fold. The Study Group recommends that the USA and Canada maintain an inventory of aquaculture production and escapees and continue monitoring the presence of escapees in rivers and fisheries.

3. EVALUATE THE EFFECTS OF 1990 QUOTA ON COMMERCIAL SALMON FISHERY OF NEWFOUNDLAND AND LABRADOR ON STOCKS OCCURRING IN THE COMMISSION AREA.

In 1990, Canada introduced quota management for the Newfoundland and Labrador commercial salmon fisheries. The quotas, in tonnes, were set by Salmon Fishing Area (SFA) (Table 33, Fig. 2). The fishing season in 1990 began on June 5 and closed in each SFA when the quota was reached, or October 15 as in previous years. The quota was controlled by weekly and daily monitoring of landings by Fisheries Officers. Quotas were attained in 8 of the 12 SFAs (4, 5, 6, 8, 10, 11, 13 and 14) resulting in closing dates in these fisheries ranging from June 21 to July 25 (Table 33). The fisheries in SFAs 1-11 and 14 harvest salmon of Canadian and U.S.A. origin (Anon, 1990a, b).

To evaluate the effects of the closures, the Study Group used two approaches, both of which relied on the weekly distribution of landings by SFA for 1984 to 1989. In the first approach, the closure date that occurred in each SFA in 1990 was applied to the temporal distribution of catches each SFA and year (1984-1989) to compute the percent reduction in harvest for that year. The minimum, maximum and mean percents were then applied to the 1990 catches to predict the range of catches forgone in 1990. This approach was called the "Fixed Closure Date Predictions". In the second approach, the 1990 quota was applied to the temporal distribution of catches in each SFA for the years 1984 to 1989. The Study Group computed the date on which the quota used in 1990 would have been fulfilled, the landings that would not have been caught, and the estimated reduction in the interceptions of Maine-origin salmon. This approach was called the "Fixed Quota Predictions".

3.1 Fixed Closure Date Predictions

The effects of the quotas on Canadian stocks were evaluated by examining the seasonal distribution of catches, 1984-89, in SFAs 4, 5, 6, 8, 10, 11, 13, and 14. The minimum and maximum percent of the total catch of a given year caught during a time period similar to that which was closed in 1990, varied among SFAs. For small salmon (mostly 1SW), the range varied from 3%-15% for SFA 8 to 35%-89% for SFA 11 (Table 34); similarly, the harvests of large salmon during the same period varied from 2%-14% for SFA 8 to 19%-72% of the total landings of large salmon for SFA 11 (Table 34). It would appear that, in the SFAs where the quotas limited the catch, the quotas had a greater effect on proportionally reducing the catch of 1SW salmon than large salmon. This was to be expected since large salmon tend to migrate along the coast earlier than 1SW salmon. It is estimated that the numbers of 1SW salmon not caught in SFAs 4, 5, 6, 8, 10, 11, 13, and 14 due to early closure was between 20,000 and 120,000 (Table 35). The number of large salmon not caught in these SFAs was between 4,000 and 22,000 (Table 35). Some salmon affected by the closure may be caught in commercial fisheries which remained open or in recreational fisheries. No estimates were made of additional spawning escapement because of the unknown composition of the population affected by the closures and possible subsequent exploitation.

The effects of the introduction of quotas on the harvest of 1SW Maine origin salmon were evaluated by examining the estimates of the weekly distribution of the harvests 1984-89 in SFAs 4, 5, and 6 (Anon. 1990a). The total average harvest of 1SW Maine-origin salmon, 1984-89, was 159 fish, with a range of 0 to 327 fish (Table 36). It is apparent that the number of 1SW Maine-origin salmon in SFAs 4-6 is small and there is a high

variability between years in the percent and numbers of salmon in these SFAs. Also, the variability in the percent that could be affected by the closures is high. Thus it is difficult to estimate the effects of the quota on 1SW Maine-origin salmon. The effects could range between 0% and 71% reduction in the harvest, equivalent to 0 to 185 fish.

3.2 Fixed Quota Predictions

The Study Group examined the effects that the quotas, introduced in 1990, would have had on landings if the quotas had been in effect in 1984-89. There was no quota limitation in SFA 1 and SFA 12 was closed since 1984. The landings after October 15 in 1984 and 1985 were deducted from each SFA since the fisheries were closed on this date in subsequent years. The date that the fishery would have been closed in each SFA, each year (1984-89) was determined from cumulative catch curves. Results of these analyses are presented in Appendix 3. The predicted reduction in catch and harvest of 1SW salmon of Maine origin is the landings in each SFA, each year after the predicted closure date up to October 15. The Maine-origin harvest of unknown week of capture was prorated over the weekly harvests.

The predicted closure dates are highly variable among years in some SFAs, particularly SFAs 2, 3, and 4. In years of low abundance, the closure dates would be later and have less effect on reducing the total catch and the mortality of 1SW Maine-origin salmon. Some salmon released from one SFA due to closure of fisheries may be caught in fisheries that are still open. This may lower the predicted reduction in harvests.

The predicted reduction in total catch 1984-1989 ranged from 98 t (13%) to 746 t (53%) with a mean predicted reduction of 321 t (30%) (Table 37). The total predicted reduction in harvests of 1SW salmon of Maine-origin ranged from 130 to 364 fish with a mean reduction of 228 fish (Table 37). The range in the predicted percent reduction was 16 to 75%. The predicted percent reduction of 1SW salmon of Maine-origin was greater than the percent reduction of total landings in SFAs 2, 3, and 4 (Table 38).

The average number of fishing days for each SFA varied between 26 and 60 (Table 37). The high standard deviation supports high variability between SFAs.

The Study Group noted that Maine-origin fish were harvested in 45 of the 72 cells in the year and SFA matrix (6 years and 12 SFA's). Of those 45 cells, reductions in harvest would have occurred in 24 totalling 1,369 fish (57 on average over the 24 cells) or 80.4% of total catch from the SFAs by year. Reduction in harvest over the 1984-1989 period would have averaged 228 fish, ranging between 130 and 364.

The mean predicted reduction in catch and mean reduction in 1SW salmon of Maine-origin by SFA, 1984-89, are provided in Table 38. The highest predicted reduction in landings occurred in SFAs 2 (70 t) and 3 (48 t). Although the highest percent reduction would occur in SFAs 8 (52%) and 5 (51%). The highest predicted reduction in harvest of 1SW salmon of Maine-origin would occur in SFA 3 (64 fish); whereas the highest percent reduction would occur in SFA 5 (46%). It was noted that there was low variability of effort within SFAs over years.

4. ADVANCES IN MODELING APPROACHES TO DESCRIBE FISHERY INTERACTIONS AND EFFECTS OF MANAGEMENT MEASURES.

4.1 Index Rivers

The term "Index Rivers" is synonymous with "indicator stocks" which was previously defined as an individual stock or a group of stocks which can represent the stocks in a larger geographic area (Anon 1988b). The term "River" is synonymous with "stock" for Atlantic salmon if it is accepted that individual rivers, regardless of size, contain distinct populations or stocks for which the fidelity of returns to the natal river is greater than the straying rate between rivers. Index rivers are those for which sufficient biological information, such as biological characteristics, spawning escapement, productive habitat, etc. has been accumulated over time. The representativeness of these monitored rivers to wider geographical areas depends upon the length of the time series, the productivity of the river relative to others in the geographic area and corroborating information on other rivers within the area. In selecting rivers to be used as an indicator or an index, consideration should be given to the above points. With limited resources, emphasis should be placed on monitoring of annual variation within rivers rather than between rivers.

4.2 Regional Run Reconstruction Models

The Study Group reviewed a preliminary run reconstruction model for North American fisheries. The model employs a simple mass balance approach to deduce the total number of 1SW and MSW spawners in North America and the estimated fraction of non-maturing salmon in the major commercial fishery of Canada. A diagram of the model structure is given in Fig. 4. Further aspects of the results of the regional run reconstruction will be examined by the Working Group.

The model examines the general behavior of multiple stocks by estimating the numbers of fish that survive the commercial and recreational fisheries of Greenland and Canada. The model deductions apply to broad geographical areas but offer no insights for specific stocks or fisheries. An alternative approach, using collections of index stocks to reconstruct the total population was discussed by the Study Group. While this approach offers a more mechanistic understanding of the stocks, the paucity of long time series of data and a poor understanding of appropriate regional weighting factors for individual stocks impedes progress in modeling.

The Study Group noted that the model provided some insights into the population dynamics of Atlantic salmon in North America but needed improvements in order to have management utility. Recommendations included:

- Examine the model behavior for presumed smolt classes.
- Examine the behavior of the model over several smolt years. If similar patterns occur over several years the model's general applicability would be strengthened.
- Conduct sensitivity analyses of the exploitation rates used for West Greenland (0.6) and Canada (0.5). Exploitation rates have a major impact on the derived numbers of spawners, maturation rates and in-river exploitation rates.

- Use estimated fraction of non-maturing salmon in the commercial catch rather than deduced values.

- Examine the sensitivity of the model to errors in the designation of sea age in the small and large market categories of the Canadian commercial fishery.

- Obtain estimates of the general range of smolt production for North America.

Questions arising from the analysis include:

- Does a large pool of unexploited salmon exist?

- Can an estimate of the non-maturing fraction of salmon be derived for commercial fisheries?

- What is a plausible range of total smolt production in North America given known estimates of productivity for salmon rivers?

- What is a plausible range of total adult returns to North America given known recreational harvests?

- Are exploitation rates for small salmon greater than those for large salmon in spawning rivers?

General ecological information on the biological productivity of geographical regions and data from existing surveys may answer some of these questions but increased numbers of specific fishery monitoring surveys will be required to answer others.

4.3 Estimation of Maturation Rates in Newfoundland-Labrador Fishery.

The Study Group reviewed three techniques to determine the state of maturity of 1SW salmon caught in the Newfoundland commercial fishery. This fishery exploits 1SW salmon that would have matured and spawned in the year in which they were caught and immature salmon that would not have matured until at least one year after the year the fishery. The proportion of mature 1SW salmon caught in the commercial fishery in Newfoundland and Labrador is an important parameter in models designed to assess the harvests of non-Newfoundland origin salmon. Also, models recently developed to assess the Greenland fishery require estimates of the proportion of salmon from the same smolt class at Greenland that remain in the Newfoundland area. Little is known however, on maturity rates aside from tagging studies which confirm the presence of immature 1SW salmon of US and mainland Canadian origin in the Newfoundland fishery.

The data on salmon of unknown maturity came from commercial catches sampled at Twillingate, Newfoundland and Square Islands, Labrador, 1985-88. Samples of immature salmon were obtained from gill net catches in the Labrador Sea in the fall of 1987-89. Maturing salmon were sampled in the Conne River estuary during a tagging study and from catches of recreational fishermen in Conne River, 1986-88 and 1990. Salmon were measured for whole weight to the nearest 0.01 kg, wet gonad weight to the nearest 0.1 g and fork length to the nearest cm. Gonadosomatic index (GSI) was calculated:

GSI = gonad weight (g) / whole weight (kg).

The text table below summarizes the available data:

Location	Years						Total
	1985	1986	1987	1988	1989	1990	
Conne estuary	-	344	60	-	-	-	404
Conne River	-	82	120	95	-	96	393
Labrador Sea	-	-	82	102	102	-	286
Twillingate	171	457	719	575	-	-	1922
Square Is.	237	292	314	327	-	-	1170
Total	408	1175	1295	1099	102	96	4175

The three techniques examined for estimating the state of maturity are:

1. Fork length distributions:

Fork length distributions were used to examine the possibility that differential growth rates of maturing and immature 1SW salmon could result in bimodality in the fork length distributions similar to those occurring in precocious male parr (Thorpe et al. 1977). Plots of fork length distributions of male and female salmon by week did not indicate bimodality. The usefulness of this technique was further limited by the absence of known maturing and immature salmon from the same time period and location from which the samples were obtained.

2. Gonadal development:

The gonadal development technique uses the distribution of gonadal development stages within GSI groups. The specimens examined histologically to determine stage of gonadal development were sampled in June, 1975 at Bonavista, Newfoundland. The numbers of maturing and immature fish were estimated from the GSI frequencies of 1SW salmon sampled at Twillingate and Square Is. The reliability of this technique was tested with samples of known maturity from the Labrador Sea, Conne estuary, and Conne River (Table 1). The high level of misclassified salmon (Table 39) was considered unacceptable.

3. Discriminant analysis of GSIs:

This technique uses GSIs from immature salmon caught in the Labrador Sea and from maturing salmon caught in the Conne estuary as a database for discriminant analysis. Quadratic discriminant analysis was used separately for male and female salmon to determine the maturity of salmon sampled in the commercial fishery at Twillingate and Square Is.

Samples of known maturity were also used to test the accuracy of the discriminant analysis by a resubstitution technique. The results for male salmon show a misclassification rate of 4.7% and error rates of ± 0.7% (Table 40a). The results for female salmon show a misclassification rate of 7.7% and error rates of ±1.1% (Table 40b). Because samples from Conne River estuary and Labrador Sea were used to develop the discriminant analysis it's accuracy on samples of known maturity from other stocks is unknown. Validation of this technique with other stocks is necessary. Further complications may arise if GSIs increase during the fishery,

particularly for the maturing component.

The results of classifying samples of unknown maturity from Square Islands and Twillingate, 1985-88 are presented in Table 41. For samples collected at Square Is. the mean percentages of immature salmon were 2.0% for males and 15.8% for females. For samples collected at Twillingate, mean percentages of immature salmon were 13.1% for males and 13.6% for females.

The above maturity rates are not applicable to the entire fishery because samples have not been weighted to the catch and may not be representative (see Section 2.2.4.3). In order to demonstrate the effect of catch-weighted versus unweighted maturity rates, the weekly proportions at Twillingate in 1987 were weighted to the weekly catches. The catch-weighted fractions immature were 15.5% for males and 28.6% for females. In contrast, the unweighted proportions immature were 21.0% for males and 27.4% for females. Clearly, to be applicable to the entire fishery the maturity rates should be catch weighted.

Differences in the sea-age and river-age distributions among stocks might allow prediction of stock composition. Most Newfoundland-Labrador salmon mature at 1SW in age while mainland (Maritime Provinces, Quebec and USA) salmon mature at sea ages ranging from one to three. In contrast most Newfoundland salmon smoltify at 3 and 4 years of age while rivers ages of mainland salmon are mostly 2 and 3 years. If it is hypothesized that there should be more mainland origin salmon in the immature group and that Newfoundland-origin salmon should be in the mature group then the river age distributions of maturing and immature should be different from each other. The river age distribution of immature salmon was compared to that of maturing salmon at Twillingate and Square Island for males and females using the Kolgomorov-Smirnov D-statistic. The following table summarizes the results:

Location	Sex	Dmax	P
Square Is.	male	0.339	<0.05
Square Is.	female	0.312	<0.05
Twillingate	male	0.168	<0.05
Twillingate	female	0.382	<0.05

Results indicate that all of the river age distributions of immature salmon are significantly different from the maturing salmon (Fig. 5 and 6). This test of GSI discriminant technique supports its utility, but the high proportion of river age 1 and 2 fish classified as maturing (Fig. 6) was disturbing because most of these fish are thought to be destined for rivers south of Newfoundland.

Assumptions and Data Requirements:

1. The discriminant technique, by substituting GSIs of samples from the Labrador Sea for samples of known immature fish at 13-14 months of age, assumes that relative somatic growth and gonadal growth rates are similar from 13 months to 16 months age. The Study Group concluded that this was the most important assumption of this method. If during the summer period somatic growth rates exceed rates gonadal growth then GSIs from the Labrador Sea in October will be lower than those in June-July and their use in the discriminant technique will underestimate the number of immature salmon in the samples from Twillingate and Square Is. **It is recommended that samples be obtained to test the hypothesis of equivalent rates between gonadal and somatic growth.**

2. The discriminant technique requires samples of salmon from the sea with known maturity status. Maturity status might be determined either histologically or biochemically by measuring levels of gonadotrophins. For some gonadotrophins it will also be necessary to have samples of known maturity. **It is recommended that samples of known maturity be obtained to determine histologically or biochemically the state of maturity.**

3. The discriminant technique assumes that no between-stock differences in GSIs exist and that Conne estuary and Labrador Sea samples are representative of maturing and immature salmon, respectively. Chadwick et al. (1986) however, demonstrated differences in gonadal characteristics among stocks. **It is recommended that this assumption should be tested with Miramichi data.**

4. Either analysis assumes that there are no timing differences in GSI and maturity over the weeks and years that the samples were taken. It can be expected that maturity state and GSIs would vary annually with stock mixture, water temperature, and food availability. A significant improvement would be to have samples of known maturity over the entire fishery. **It is recommended that future analyses include samples collected over time.**

5. Also, it has been observed in sea cages that some salmon that initially appear to be maturing do not mature. The effect of this would be to reduce the overall rates of maturing salmon presented herein.

5. RESEARCH NEEDS AND DATA DEFICIENCIES

5.1 Progress on Research Needs

The Study Group reviewed the list of research requirements for future meetings from Anon. (1990a, Section 9.2) and Anon (1990b, Section 12.3). The requirements and progress made to date are summarized below:

Research Requirement	Progress
1) Present data on the production of farmed salmon, the number of salmon that have escaped from specific localities, the size and age of the fish, and the time of escape. Present estimates of the proportion of farmed salmon in fisheries and spawning populations in their home waters.	Working papers submitted for USA and Canada. See Section 2.4.
2) Develop run reconstruction models of their stocks for discussion at Study Groups and input to a North Atlantic model at the Working Group. Data useful to the modelling should be brought to the Working Group in the format specified in Appendix 5.	Working paper presented and initial regional model examined. See Section 4.2. No additional data presented related to Appendix 5 of Anon. (1990b)
3) Report on progress toward the development of methods to distinguish maturing and non-maturing components of fisheries.	Working paper submitted. See Section 4.3.
4) Provide historical records of the recreational harvest (killed) Atlantic salmon in Maine rivers and commercial harvest by year for SFAs 1-14.	Information was available to Study Group but not summarized in this report.
5) Review methodology to estimate run-size in Maine rivers without counting traps.	Methodology was reviewed to use redd counts to estimate run size in rivers without counting traps. Population estimates were compared using redd counts and angling exploitation estimates. Insufficient data were available to make adjustments for all years. See Section 2.1.2.

Research Requirement	Progress
6) Provide estimates of the proportion of Carlin tags that could go undetected where individual salmon are not handled at monitoring facilities.	No progress.
7) Prepare a computer disk containing catches by week for the Canadian fisheries.	Computer disk for 1990 catches provided.
8) Investigate discrepancies between recorded landings in the catch statistics and the numbers of salmon reported by crews sampling for CWTs in communities of Newfoundland-Labrador.	Some information provided. See Section 2.2.4.4.
9) Examine historical forecast models for MSW salmon and age at maturity as they relate to observed decreases in the numbers of MSW salmon and increases in the numbers of 1SW fish returning to some Canadian and USA rivers, particularly during recent years in which management measures have been introduced to increase home river returns of MSW fish.	No new information provided.
10) Investigate the use of the proportional harvest method on salmon of 1-year smolts in communities of Newfoundland-Labrador.	Working paper presented; see section 2.2.4.3.
11) Estimate p values (proportion of a stock that was in a particular fishery) for Maine and Saint John River stocks that would minimize the differences between exploitation rates generated in the run-reconstruction and hence advance the understanding of migratory patterns of salmon in West Greenland and Canada.	No new information presented.

5.2 Requirements for Future Meetings.

1. Investigate stock recruitment relationship for naturally spawning fish in the Penobscot and Saint John Rivers.

2. Examine forecast models for MSW salmon in an attempt to explain observed recent decreases in the numbers of MSW salmon and increases in the numbers of 1SW salmon returning to some Canadian and USA rivers.

3. Evaluate relationships between redd counts and spawning populations and its applicability for North American rivers.

4. Estimate abundance of returning salmon which remain below Veazie dam on the Penobscot River and continue evaluation of passage efficiency.

5. Consideration should be given to stratifying sampling for CWT's in the commercial fisheries in Newfoundland-Labrador into size categories.

6. Catches by week for the commercial fisheries in SFA's 13 and 14 are to be provided for missing years (1984-88).

7. Provide updated estimates of exploitation rates, where available, on an annual basis.

8. Maintain an inventory of production by area, and escapes from aquaculture sites, as well as estimates of escapees found in rivers and fisheries.

9. With respect to the estimation of maturation rates in salmon in the Newfoundland-Labrador salmon fishery (Section 4.3), the following recommendations were noted:

   a. Samples be obtained to test the hypothesis of equivalent rates between gonadal and somatic growth.

   b. Samples of known maturity be obtained to determine histologically or biochemically the state of maturity.

   c. Test the hypothesis of no stock differences in GSIs between The Conne River estuary and the Labrador Sea by contrasting these GSIs with samples obtained from the Miramichi River.

   d. Further studies should investigate temporal trend in maturity over the entire fishery.

5.3 Future Meeting

It is recommended that the Study Group meet in 1992 in St. John's, Newfoundland at an appropriate time before the meeting of the Working Group on North Atlantic salmon.

6. REFERENCES

Anon. 1985. Report of Meeting of the Working Group on North Atlantic Salmon. St. Andrews, New Brunswick, Canada, 18-20 September 1984. ICES, Doc. C.M. 1985/Assess:5.

Anon. 1986a. Report of Meeting of the Working Group on North Atlantic Salmon. Woods Hole, Massachusetts, USA, 16-20 September 1985. ICES, Doc. C.M. 1986/Assess:8.

Anon. 1986b. Report of the Working Group on North Atlantic Salmon, Copenhagen. 17-26 March 1986. ICES, Doc. C.M. 1986/Assess:17.

Anon. 1987. Report on the Working Group on North Atlantic Salmon. Copenhagen, 9-20 March 1987. ICES, Doc. C.M. 1987/Assess:12.

Anon. 1988a. Report of the Study Group on the North American Salmon Fishery. St. John's, Newfoundland, 1-4 March 1988. ICES, Doc. C.M. 1988/M:4.

Anon. 1988b. Report of the Working Group on North Atlantic Salmon. Copenhagen, 21-31 March 1988. ICES, Doc. C.M. 1988/Assess:16.

Anon. 1989a. Report of the Study Group on the North American Salmon Fishery. Leetown, West Virginia, USA, 28 February - 3 March 1989. ICES, Doc. C.M. 1989/M:3.

Anon. 1989b. Report of the Working Group on North Atlantic Salmon. Copenhagen, 15-22 March 1989. ICES, Doc. C.M. 1989/Assess:12.

Anon. 1990a. Report of the Study Group on the North American Salmon Fisheries. Halifax, Nova Scotia, 26 February - 2 March, 1990. ICES, Doc. C.M. 1990/M:3.

Anon. 1990b. Report of the North Atlantic Salmon Working Group. Copenhagen, 15-22 March 1990. ICES, Doc. C.M. 1990/Assess:11.

Chadwick, E. M. P., R. Randall, and C. Leger. 1986. Ovarian development of Atlantic salmon (Salmo salar) smolts and age at first maturity, p. 15-23. In D. J. Meerburg [Ed.] Salmonid age at maturity. Can. Spec. Publ. Fish. Aquat. Sci. 89.

Thorpe, J. E. 1977. Bimodal distribution of length of juvenile Atlantic salmon (Salmo salar L.) under artificial rearing conditions. J. Fish. Biol. 11:175-184.

Table 1. Maine Atlantic salmon stamp/license sales, 1974-90. Stamps were sold from 1974-84; licenses were sold from 1985 onward.

Year	Number of Stamps Sold		
	Resident	Non-resident	Total
1974	1,156	195	1,351
1975	1,521	125	1,646
1976	2,130	196	2,326
1977	1,919	187	2,106
1978	2,899	229	3,128
1979	3,765	255	4,020
1980	4,306	253	4,559
1981	5,227	452	5,679
1982	6,103	481	6,584
1983	3,532	419	3,951
1984	3,156	361	3,517
1985	1,973	348	2,321
1986	2,439	414	2,853
1987	2,274	405	2,679
1988	2,375	333	2,708
1989	2,375	268	2,643
1990	2,888	411	3,299

Table 2. Number (in thousands) of hatchery-reared Atlantic salmon fry, parr, and smolts released in Maine rivers, 1970-1990.

Year	Fry	Parr	Smolts				All Life Stages
			CWT Tagged	Carlin Tagged	Untagged	Total	
1970	-	25.0	-	49.0	-	49.0	74.0
1971	-	16.0	-	30.0	59.0	89.0	105.0
1972	129.0	-	-	62.0	55.0	117.0	246.0
1973	-	17.0	-	38.0	77.0	125.0	142.0
1974	-	44.0	-	44.0	102.0	146.0	190.0
1975	-	15.0	-	29.0	141.0	170.0	185.0
1976	-	186.0	-	25.0	282.0	307.0	493.0
1977	-	-	-	49.0	326.0	375.0	375.0
1978	-	116.0	-	-	298.0	298.0	414.0
1979	-	95.0	-	60.0	312.0	372.0	467.0
1980	-	-	-	50.0	627.0	677.0	677.0
1981	227.0	50.0	-	50.0	208.0	258.0	535.0
1982	349.0	375.0	-	50.0	346.0	396.0	1120.0
1983	20.0	78.0	-	50.0	488.0	538.0	636.0
1984	134.0	135.0	-	100.0	695.0	795.0	1064.0
1985	472.0	267.0	-	100.0	622.0	722.0	1461.0
1986	576.0	124.0	100.0	100.0	577.0	777.0	1477.0
1987	882.0	302.0	100.0	100.0	518.0	718.0	1902.0
1988	639.0	115.0	100.0	100.0	735.0	935.0	1689.0
1989	580.0	712.0	202.0	50.0	352.0	604.0	1896.1
1990	761.0	475.0	200.0	49.9	390.0	640.0	1876.0

Table 3. Documented Atlantic Salmon returns to New England rivers in 1990.[1]

River	Number of Atlantic Salmon by Sea Age				Total for 1990	Total for 1989
	1-S-W	2-S-W	3-S-W	P.S.		
Penobscot	523	2773	17	28	3341	3087
Union	1	20	0	0	21	30
Narraguagus	1	49	0	1	51	39
Pleasant[2]	-	-	-	-	-	-
Machias	0	2	0	0	2	16
East Machias	1	46	0	1	48	31
Dennys	1	31	0	1	33	12
St. Croix	18	85	0	9	112	241
Kennebec	1	45	0	0	46	17
Androscoggin	7	177	0	1	185	19
Sheepscot	1	8	0	0	9	5
Ducktrap	0	2	0	0	2	0
Saco	4	69	0	0	73	19
Merrimack	27	219	2	0	248	84
Pawcatuck	0	8	0	0	8	6
Connecticut	1	262	0	0	263	109
TOTALS	586	3796	19	41	4442	3606

[1] These are considered minimum numbers, reflecting only trap counts and rod catches.

[2] Unknown number of salmon returned but were not documented.

Table 4. Summary of returns to Penobscot River by sea age, and hatchery vs. wild origin for trap counts and angler harvest, 1968-1990.

	Trap Counts				Angler Harvest			
	Hatchery		Wild		Hatchery		Wild	
Year	1SW	2SW	1SW	2SW	1SW	2SW	1SW	2SW
1968	-	-	-	-	0	13	0	0
1969	20	42	0	1	0	7	0	0
1970	7	123	0	2	0	1	0	0
1971	21	86	0	2	0	3	0	0
1972	11	307	0	10	0	4	0	0
1973	10	275	0	2	0	15	0	0
1974	30	492	0	1	1	24	0	0
1975	42	848	0	8	3	69	0	0
1976	62	522	0	20	13	41	0	0
1977	37	403	0	3	7	178	0	0
1978	103	1259	0	48	20	288	0	7
1979	202	541	0	6	1	130	0	2
1980	587	1838	0	14	65	732	0	4
1981	805	1826	3	15	83	628	0	3
1982	137	2986	12	48	18	900	1	7
1983	163	577	1	39	16	128	4	12
1984	210	1103	18	72	29	284	7	35
1985	234	2595	20	158	10	273	2	44
1986	475	3339	15	272	59	281	2	60
1987	726	1360	18	136	23	117	1	26
1988	675	1866	14	58	41	127	0	6
1989	766	1770	51	89	104	230	17	14
1990	397	2217	81	208	33	303	12	46

Table 5. Nominal catch in tonnes of Atlantic salmon of all ages for Salmon Fishing Areas of Newfoundland and Labrador and Quebec commercial fisheries in 1986-90. Numbers in parentheses are catch totals in numbers of fish. Catches for 1990 are preliminary.

Salmon Fishing Areas	1986	1987	1988	1989	1990	
					Catch	Quota
1	89	75	65	76	30	80[a]
2	309	407	292	213	151	200
3	192	369	192	151	135	155
4	200	180	104	133	92	100
5	61	60	39	37	15	25
6	54	48	25	27	12	20
7-11	167	137	82	108	64	82
13-14	159	212	174	122	87	95
Q7-Q9	85	97	89	79	64	NA[c]
	(21,802)[d]	(23,525)[d]	(22,863)[d]	(20,525)[d]	(19,249)	(29,605)
Q11	15	11	9	1	1	15
Total	1329	1596	1071	947	652	692[b]

[a]Allowance.
[b]Excludes an allowance of 80 t for SFA 1.
[c]NA=Not Applicable-Quote expressed in numbers rather than weight.
[d]Quotas for 1986 to 1989 were 33,125 per year.

Table 6. Canadian Atlantic salmon catches in tonnes since 1960 and numbers since 1982. **NOTE: All catch figures for 1990 are preliminary.**

	Grilse		Salmon		Total	
Year	Tonnes	Numbers	Tonnes	Numbers	Tonnes	Numbers
1960	-		-		1,636	
1961	-		-		1,583	
1962	-		-		1,719	
1963	-		-		1,861	
1964	-		-		2,069	
1965	-		-		2,116	
1966	-		-		2,369	
1967	-		-		2,863	
1968	-		-		2,111	
1969	-		-		2,202	
1970	761		1,562		2,323	
1971	510		1,482		1,992	
1972	558		1,201		1,759	
1973	783		1,651		2,434	
1974	950		1,589		2,539	
1975	912		1,573		2,485	
1976	785		1,721		2,506	
1977	662		1,883		2,545	
1978	320		1,225		1,545	
1979	582		705		1,287	
1980	917		1,763		2,680	
1981	818		1,619		2,437	
1982*	716	358,000	1,082	240,000	1,798	598,000
1983*	513	265,000	911	201,000	1,424	466,000
1984*	467	234,000	645	143,000	1,112	377,000
1985	593	333,084	540	122,621	1,133	455,705
1986	780	417,269	779	162,305	1,559	579,574
1987	833	435,799	951	203,731	1,784	639,530
1988	677	372,178	633	137,637	1,311	509,815
1989	549	304,620	590	135,484	1,139	440,104
1990	405	222,944	465	101,910	870	324,854

*Numbers for 1982-84 are estimated (assuming 2.0 kg for average 1SW salmon; 4.5 kg for large salmon).

The 1990 total catch of salmon (870 tonnes) is:

- 37.3% below the previous 5 year mean (1,385.2)
- 47.0% below the previous 10 year mean (1,637.7)
- 51.3% below the previous 15 year mean (1,783.0)
- 54.1% below the previous 20 year mean (1,889.6)

The 1990 total catch of large salmon only (465 tonnes) is:

- 33.6% below the previous 5 year mean (698.6)
- 51.2% below the previous 10 year mean (951.3)
- 58.1% below the previous 15 year mean (1,108.0)
- 61.5% below the previous 20 year mean (1,205.3)

The 1990 total catch of grilse only (405 tonnes) is:

- 41.1% below the previous 5 year mean (686.4)
- 41.1% below the previous 10 year mean (686.3)
- 40.1% below the previous 15 year mean (674.9)
- 41.0% below the previous 20 year mean (684.3)

Table 7. Nominal catches (tonnes) in Newfoundland and Labrador commercial Atlantic salmon fishery, 1971-90.

Year	Small	Large	Total[a]	Quota
1971	-	-	1577	-
1972	-	-	1394	-
1973	-	-	2011	-
1974	-	-	2010	-
1975	750	1294	2043	-
1976	632	1380	2013	-
1977	533	1404	1938	-
1978	274	907	1180	-
1979	494	495	987	-
1980	809	1295	2103	-
1981	676	1233	1910	-
1982	578	743	1321	-
1983	417	611	1028	-
1984	332	465	797	-
1985	470	411	881	-
1986	608	622	1230	-
1987	705	780	1485	-
1988	511	461	972	-
1989	431	436	867	-
1990	265	322	586[c]	677[b]

[a] Differences between total and sum of small and large are due to rounding.
[b] Excludes an allowance of 80 t for SFA 1.
[c] Preliminary.

Table 8. The number of licensed commercial Atlantic salmon fishermen and (b) licensed gear units, for each Salmon Fishing Area and the total for the Province of Newfoundland and Labrador.

(a)

Year	No. of Fishermen by SFA														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1974	108	323	626	1203	693	519	513	320	135	331	314	176	231	388	5880
1975	187	421	732	1399	765	596	635	314	103	388	402	217	321	501	6981
1976	179	464	660	1234	685	525	518	308	103	335	354	193	268	442	6287
1977	196	432	621	1154	622	469	446	264	86	303	334	178	239	412	5756
1978	290	403	629	1148	621	473	459	261	87	284	326	176	239	419	5815
1979	272	410	630	1148	617	457	445	266	85	296	321	173	233	415	5768
1980	271	352	617	1163	591	446	449	246	81	279	311	165	225	396	5592
1981	266	350	602	1126	550	412	429	246	75	269	305	162	218	392	5402
1982	262	339	569	1047	493	394	375	239	71	255	279	159	203	384	5069
1983	273	417	578	1033	479	383	356	239	68	250	263	153	195	376	5063
1984	248	378	512	892	395	317	277	200	58	201	213	7	153	325	4176
1985	234	351	439	695	283	259	229	186	45	162	182	0	102	285	3452
1986	212	356	438	696	281	257	231	183	45	164	185	0	118	288	3454
1987	213	362	433	693	275	255	231	175	43	163	182	0	119	285	3429
1988	182	361	432	682	259	241	217	177	43	156	173	0	116	269	3308
1989	196	353	425	679	257	238	216	175	42	156	172	0	113	265	3287
1990	151	349	427	669	248	234	212	169	38	150	172	0	113	262	3194

(b)

Year	No. of Gear Units (50 Fathoms) by SFA														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1974	288	1,900	2,371	3,151	2,014	1,589	1,861	1,608	407	1,031	1,008	862	587	1,121	19,798
1975	556	2,164	2,704	3,962	2,565	2,074	2,567	1,875	432	1,330	1,504	1,064	986	1,398	25,181
1976	549	2,418	2,528	3,547	2,354	2,074	2,276	1,823	347	1,207	1,377	1,023	802	1,336	23,661
1977	612	2,253	2,364	3,327	2,163	1,876	1,973	1,582	292	1,063	1,288	957	737	1,288	21,775
1978	1,001	2,167	2,406	3,371	2,172	1,901	2,066	1,588	287	1,069	1298	939	720	1,299	22,284
1979	979	2,244	2,418	3,349	2,169	1,853	1,971	1,617	283	1,051	1,279	928	702	1,326	22,169
1980	1,018	1,958	2,378	3,485	2,320	1,834	2,024	1,536	268	1,003	1,268	881	680	1,266	21,919
1981	981	1,948	2,309	3,390	1,944	1,709	1,954	1,524	252	979	1,254	871	656	1,260	21,032
1982	1,046	1,828	2,083	3,002	1,551	1,536	1,548	1,395	222	837	1,097	736	534	1,214	18,629
1983	1,080	1,879	2,315	3,729	1,661	1,499	1,402	1,089	235	934	1,069	644	674	1,495	19,705
1984	992	1,471	1,892	3,124	1,341	1,160	1,012	774	201	718	786	26	513	1,233	15,243
1985	936	1,402	1,750	2,768	1,122	1,036	914	744	178	644	722	0	408	1,140	13,764
1986	848	1,424	1,752	2,782	1,124	1,028	922	732	180	656	740	0	472	1,152	13,812
1987	852	1,471	1,730	2,764	1,100	1,018	920	700	172	652	728	0	476	1,140	13,723
1988	728	1,444	1,728	2,728	1,036	964	868	708	172	624	692	0	464	1,076	13,232
1989	784	1,412	1,700	2,716	1,028	952	864	700	168	624	688	0	452	1,060	13,148
1990	604	1,392	1,708	2,674	988	932	848	676	152	600	688	0	448	1,048	12,758

Table 9. A description of the commercial fisheries in Salmon Fishing Areas (SFA) in Atlantic Canada 1990.

SFA	No. of Fishermen	Licensed Gear (Fathoms)	Minimum Mesh Size (Stretched)	Season	Quota
1	151	30,200	127 mm	Jun 5-Oct 15	80 t (allowance)
2	349	69,600	127 mm	Jun 5-Oct 15	200 t
3	427	85,400	127 mm	Jun 5-Oct 15	155 t
4	669	133,700	127 mm	Jun 5-Oct 15 (closed Jul 25 quota reached)	100 t
5	248	49,400	127 mm	Jun 5-Oct 15 (closed Jul 7 quota reached)	25 t
6	234	46,600	127 mm	Jun 5-Oct 15 (closed Jul 14 quota reached)	20 t
7	212	42,400	127 mm	Jun 5-Oct 15	15 t
8	169	33,800	127 mm	Jun 5-Oct 15 (closed Jul 21 quota reached)	10 t
9	38	7,600	127 mm except 114 mm west of Cape Pine	Jun 5-Oct 15	7 t
10	150	30,000	114 mm	Jun 5-Oct 15 (closed Jun 30 quota reached)	25 t
11	172	34,400	127 mm except 114 mm east of Terrenceville	Jun 5-Oct 15 (closed Jun 21 quota reached)	25 t
12	-	-	closed	-	0
13	107	21,400	127 mm except Cape Anguille to Cape St. George 114 mm	Jun 5-Jul 10 (quota reached Jul 3)	35 t
14	249	49,800	127 mm	Jun 5-Oct 15 (quota reached Jul 14 - reopened Jul 20-30 in Southern Labrador)	60 t
15-18	49	-	-	closed	-
19,20,21,22	17	-	-	closed	-
23	24	-	-	closed	-

(cont'd)

Table 9. (Continued)

SFA	No. of Fishermen	Licensed Gear (Fathoms)	Minimum Mesh Size (Stretched)	Season	Quota
Q1,Q2,Q3,Q4	35	-	-	closed	-
Q5,Q6	18	-	none	closed	-
Q7 (west)					
Q7 (east)	23	-	none	Jun 10-Aug 31	2,755 (fish)
Q8	56	-	none	Jun 10-Aug 31	9,900 (fish)
Q9	86	-	none	Jul 1-Aug 31	16,950 (fish)
Q10	0	-	-	closed	-
Q11	-	-	none	Jun 1-Aug 31	15 t

Table 10. A description of the recreational fisheries in Salmon Fishing Areas in Atlantic Canada, 1990. In all areas, only fly fishing is permitted.

Salmon Fishing Area	Effort (Rod Day)	Season	Quota Fish Per License	
			Per Day	Per Season
1, 2	3,852	16 Jun-3 Sep	2	15
3-8	38,956	Varies by river 16 Jun-3 Sep	2 (<63 cm)	15
9-12	28,598	Varies by river 9 Jun-3 Sep	2 (<63 cm)	15
13	21,856	Varies by river 6 Jun-9 Sep	2 (<63 cm) quota on some rivers ranging from 50 to 350 fish <63 cm	15
14	21,519	16 Jun-3 Sep Varies by river	2 (<63 cm for insular Nfld. only) quota on some rivers ranging between 10 and 350 <63 cm	15
15	6,049[a]	1 Jun-31 Aug	2 (<63 cm)	10
16	28,725[a]	8 Jun-30 Sep Varies by river	2 (<63 cm)	10
17	8,916	Varies by river 1 Jun-31 Oct	2 (<63 cm)	10
18	16,415	Varies by river 1 Jun-31 Oct	2 (<63 cm)	10
19,20,21,22	60,550	Varies by river 10 May-31 Oct	2 (<63 cm)	10
23	21,915[a]	Varies by river 8 Jun-31 Oct	2	10
Q1,Q2,Q3,Q4	36,468	1 Jun-31 Aug	1 large or 1 small plus 1 fish. Rivers are closed if spawner count is low in mid-summer	7
Q5,Q6,Q7 (west)	7,709	1 Jun-31 Aug	1	7
Q7 (east),Q8,Q9	19,205	1 Jun-15 Sep	2	10
Q10	1,948	1 Jun-15 Sep	3	10
Q11	2,561	1 Jun-30 Sep	4	10

[a]Exclusive of the kelt season (Apr. 15-May 15).
[b]Kelt season Apr. 15-May 15.

Table 11. A description of the Native fisheries in Salmon Fishing Areas (SFA) 1990.

SFA	Number of Bands	Gear	Season	Quota
1,2	all	N/A	none	no
3-10	0	-	-	-
11	1	2 trap nets or gill nets	May 3-Jul 31	1,200
12-14	0	-	-	-
15,16	5	gill nets and trap nets	none	no
17,18	0	-	-	-
19,20,21,22	8	gill nets dip nets jigs	N/A	-
23	2	140 mm gill net gill nets	N/A 15 Jun-15 Sep	Oromocto-150 fish. Tobique - 919 fish of which no more than 20% may be large (>63 cm)
Q1,Q2,Q3,Q4	2	N/A	N/A	Maria R.- 150 fish Restigouche- 1000 fish
Q5,Q6,Q7,Q8 Q9,Q10	6	restricted for each band	N/A	no
Q11	all	gill net	1 Jun-30 Aug	N/A

Table 12. Preliminary landings, in numbers, of Atlantic salmon harvested in the commercial fisheries in Atlantic Canada, 1990. Comparisons are made to the average landings, 1984-89.

SFA	Small		Large		Total	
	Numbers	% Change 1984-89	Numbers	% Change 1984-89	Numbers	% Change 1984-89
1	4,452	-54	4,368	-60	8,820	-57
2	25,062	-44	20,269	-42	45,331	-43
3	22,917	-57	19,104	-9	42,021	-43
4	32,024	-30	6,944	-42	38,968	-33
5	4,899	-71	1,757	-70	6,656	-71
6	3,835	-74	1,106	-70	4,941	-73
7	1,346	-64	649	-77	1,995	-70
8	849	-85	332	-88	1,181	-87
9	1,162	-68	189	-59	1,351	-67
10	9,406	-30	1,913	-15	11,319	-27
11	5,000	-65	4,270	-27	9,270	-54
12	0	0	0	0	0	0
13	16,650	-26[1]	3,226	-29[1]	19,876	-27[1]
14	12,213	-52[1]	3,608	-59[1]	15,821	-53[1]
15-23	0	0	0	0	0	0
Q1-6	0	0	0	0	0	0
Q 7	258	66[1]	1,732	-32[1]	1,990	-27[1]
Q 8	189	-36[1]	6,561	-9[1]	6,750	-10[1]
Q 9	2,971	7[1]	7,538	-8[1]	10,509	-4[1]
Q10	0	0	0	0	0	0
Q11	NA	-	NA	-	225	-871

[1]Percent change from 1985-89.
NA=Not Available.

Table 13. Preliminary landings, in tonnes, of Atlantic salmon harvested in the commercial fisheries in Atlantic Canada, 1990. Comparisons are made to the average landings, 1984-89.

SFA	Small		Large		Total	
	Weight(t)	% Change 1984-89	Weight(t)	% Change 1984-89	Weight(t)	% Change 1984-89
1	8	-58	22	-57	30	-58
2	52	-41	100	-40	151	-41
3	43	-57	92	-3	135	-31
4	61	-30	31	-43	92	-35
5	9	-71	7	-70	15	-72
6	7	-73	4	-75	12	-72
7	3	-56	3	-76	6	-70
8	1	-91	2	-83	3	-87
9	2	-70	1	-50	3	-67
10	16	-36	7	-30	23	-34
11	9	-66	20	-21	29	-42
12	0	0	0	0	0	0
13	29	-28[1]	14	-31[1]	43	-29[1]
14	25	-48[1]	19	-54[1]	44	-51[1]
15-23	0	0	0	0	0	0
Q1-6	0	0	0	0	0	0
Q 7	<1	66[1]	8	-32[1]	8	-27[1]
Q 8	<1	-36[1]	30	-9[1]	30	-10[1]
Q 9	4	7[1]	21	-8[1]	26	-4[1]
Q10	0	0	0	0	0	0
Q11	NA	-	NA	-	NA	-

[1]Percent change from 1985-89.
NA=Not Available.

Table 14. Preliminary landings, in numbers, of Atlantic salmon harvested in the recreational fisheries in Atlantic Canada, 1990. Comparisons are made to the average landings, 1984-89.

SFA	Small		Large		Total	
	Numbers	% Change 1984-89	Numbers	% Change 1984-89	Numbers	% Change 1984-89
1	272	-62	70	-50	342	-60
2	1,971	-9	189	-9	2,160	-9
3	17187	54	0	0	1,718	-54
4	5,662	-37	0	0	5,662	-37
5	2,414	-24	0	0	2,414	-24
6	334	-10	0	0	334	-10
7	49	-51	0	0	49	-51
8	86	-14	0	0	86	-14
9	1,866	4	0	0	1,866	4
10	835	-34	0	0	835	-34
11	4,446	-16	0	0	4,446	-16
12	853	-24	0	0	853	-24
13	6,689	6	0	0	6,689	6
14	6,121	4	97	-41	6,218	2
15	4,277	-9	0	0	4,277	-9
16	12,060	-21	0	0	12,060	-21
17	768	192	0	0	768	192
18	1,115	50	0	0	1,115	50
19	896	6	0	0	896	6
20	2,995	38	0	0	2,995	38
21	3,747	15	0	0	3,747	15
22	312	-69	0	0	312	-69
23	2,613	-20	0	0	2,613	-28
Q 1	1,399	49[1]	3,054	14[1]	4,453	23[1]
Q 2	608	119[1]	1,020	-27[1]	1,628	-3[1]
Q 3	881	111[1]	1,233	27[1]	2,114	36[1]
Q 4	0	0	0	0	0	0
Q 5	70	223[1]	81	212[1]	151	221[1]
Q 6	368	68[1]	744	44[1]	1,112	51[1]
Q 7	1,244	40[1]	630	-7[1]	1,874	20[1]
Q 8	977	33[1]	4,211	86[1]	51880	73[1]
Q 9	947	-13[1]	470	-24[1]	1,417	-17[1]
Q10	465	-9[1]	398	-50[1]	863	-34[1]
Q11	792	-19[1]	590	-30[1]	1,382	-24[1]

[1]Percent change from 1985-89.

Table 15. The number of salmon examined for CWTs, periods of sampling and origin of tags recovered in Canada, 1990.

Location	Sampling Period	Number Examined	Adipose Clipped	Percent Clipped	Origin Canada	USA	Total CWT	Percent CWT
Fox Harbour	6/28-7/28	1566	8	0.51	0	0	0	0.00
Goose Cove	6/18-7/24	5140	3	0.06	0	2	2	0.04
Croque	6/14-7/31	1773	9	0.51	1	3	4	0.23
Conche	6/25-7/21	1567	2	0.13	0	0	0	0.00
Englee	6/15-7/24	1961	12	0.61	1	3	4	0.20
Harbour Deep	7/14-8/3	566	24	4.24	2	11	13	2.30
Shoe Cove	6/13-7/23	4746	26	0.55	0	15	15	0.32
Leading Tickles	6/15-7/23	613	12	1.96	0	2	2	0.33
Campbelton	6/25-7/5	15	0	0.00	0	0	0	0.00
Twillingate	6/6-7/23	1121	9	0.80	0	2	2	0.18
Fogo	6/16-7/21	885	7	0.79	0	2	2	0.23
Musgrave	6/25-7/21	114	0	0.00	0	0	0	0.00
Total Average		19953	112	0.92	4	40	44	0.35

Table 16. Summary of CWT recoveries in Canada, 1990.

Tab Ref	Location	Recovery Date	Length FL(CM)	Weight KG(1)	Tag Code AG	Tag Code D1	Tag Code D2	Clips	Origin	Release Date
1	Goose Cove	July 20	62	2.0G	7	17	51	AC	Penobscot	1989
2	Goose Cove	July 22	58	1.8G	7	17	28	AC	Connecticut	1989
3	Croque	July 19	61	1.8W	7	17	40	AC	Penobscot	1989
4	Croque	July 19	58	1.8W	7	17	47	AC	Penobscot	1989
5	Croque	July 27	64	2.25W	7	17	40	AC	Penobscot	1989
6	Croque	July 27	66	2.7W	62	17	18	AC	St. John	1989
7	Englee	June 28	65	2.25G	7	16	9	AC	Penobscot	1989
8	Englee	July 2	64	1.75G	7	17	50	AC	Penobscot	1989
9	Englee	July 11	65	2.2G	7	17	47	AC	Penobscot	1989
10	Englee	July 16	66	2.7G	62	2	21	AC	St. John	1989
11	Harbour Deep	July 16	65	2.7G	7	17	42	AC	Connecticut	1989
12	Harbour Deep	July 16	70	3.0G	7	17	29	AC	Connecticut	1989
13	Harbour Deep	July 16	58	1.7G	7	17	39	AC	Penobscot	1989
14	Harbour Deep	July 17	60	1.8G	7	17	30	AC	Conn. Bay	1989
15	Harbour Deep	July 17	63	2.2G	7	17	51	AC	Penobscot	1989
16	Harbour Deep	July 18	67	1.8G	7	17	39	AC	Penobscot	1989
17	Harbour Deep	July 18	82	4.7G	55	16	16	AC	Margaree	1987
18	Harbour Deep	July 20	54	1.5G	7	17	27	AC	Connecticut	1989
19	Harbour Deep	July 21	56	1.6G	7	17	40	AC	Penobscot	1989
20	Harbour Deep	July 23	63	2.4G	7	17	42	AC	Connecticut	1989
21	Harbour Deep	July 24	54	2.3G	7	17	46	AC	Penobscot	1989
22	Harbour Deep	July 25	60	2.0G	7	17	49	AC	Penobscot	1989
23	Harbour Deep	July 30	68	3.4G	62	2	27	AC	St. John	1989
24	Shoe Cove	June 28	59	1.82G	7	17	23	AC	Merrimack	1989
25	Shoe Cove	June 30	66	2.52G	7	17	26	AC	Connecticut	1989
26	Shoe Cove	July 2	58	1.8G	7	17	43	AC	Connecticut	1989
27	Shoe Cove	July 4	55	1.42G	7	17	49	AC	Penobscot	1989
28	Shoe Cove	July 4	58	1.76G	7	17	21	AC	Merrimack	1989
29	Shoe Cove	July 4	58	1.8G	7	17	48	AC	Penobscot	1989
30	Shoe Cove	July 5	62	1.88G	7	17	49	AC	Penobscot	1989
31	Shoe Cove	July 6	67	2.65G	7	17	42	AC	Connecticut	1989
32	Shoe Cove	July 10	59	1.87G	7	17	23	AC	Merrimack	1989
33	Shoe Cove	July 10	62	2.18G	7	17	23	AC	Merrimack	1989
34	Shoe Cove	July 18	64	2.36G	7	17	47	AC	Penobscot	1989
35	Shoe Cove	July 18	68	2.45G	7	16	50	AC	Penobscot	1988
36	Shoe Cove	July 19	59	1.76G	7	17	50	AC	Penobscot	1989
37	Shoe Cove	July 19	64	2.32G	7	17	48	AC	Penobscot	1989
38	Shoe Cove	July 23	70	3.12G	7	17	39	AC	Penobscot	1989
39	Leading Tickles	July 11	56	1.5G	7	17	49	AC	Penobscot	1989
40	Leading Tickles	July 17	70	2.7G	7	17	46	AC	Penobscot	1989
41	Twillingate	June 30	64	2.98W	7	17	27	AC	Connecticut	1989
42	Twillingate	July 6	63	2.52W	7	17	27	AC	Connecticut	1989
43	Fogo	July 3	65	2.6G	7	17	26	AC	Connecticut	1989
44	Fogo	July 11	60	2.1G	7	17	47	AC	Penobscot	1989

(1) W=whole weight and G=gutted weight

Table 17. Estimated numbers of wild returning and spawning Atlantic salmon, egg depositions, ratios of MSW spawners to returns and fraction of target egg deposition attained in the Restigouche, Miramichi, Saint John, LaHave, Margaree, Conne rivers, and Rivière de la Trinité. Empty cells mean no prediction available. Bold numbers are target spawners and eggs.

Year	Returns (10^3) 1SW	Returns (10^3) MSW	Predicted	Spawners (10^3) 1SW	Spawners (10^3) MSW	Eggs (10^6)	MSW Spawners/ MSW Returns	Eggs/ Target Eggs
Restigouche River								
TARGET				**2.6**	**12.2**	**71.4**		
1982	8.0	11.2		2.0	1.8	10.9	0.16	0.15
1983	3.3	10.2	13.5	0.6	1.4	8.7	0.14	0.12
1984	10.9	7.8	11.3	1.3	3.1	18.6	0.40	0.26
1985	7.0	9.9	12.2	2.5	6.3	37.4	0.63	0.52
1986	10.7	14.1	14.8	3.8	8.8	52.6	0.62	0.74
1987	10.0	10.1	21.9	3.5	5.9	35.0	0.58	0.49
1988	13.5	12.6	12.9	4.7	8.2	49.3	0.65	0.69
1989	7.4	11.1		2.6	6.6	39.2	0.59	0.55
1990[2]	10.3-17.1	10.6-16.6		4.4-10.2	6.4-11.4	37.8-68.5	0.65[5]	0.53-0.96
Miramichi River[1]								
TARGET				**22.6**	**23.6**	**132.0**		
1982	80.4	30.8		52.0	12.3	109.8	0.40	0.83
1983	25.2	27.9	43.0	10.8	7.5	48.1	0.27	0.36
1984	29.7	15.1	10.2	14.9	13.7	77.0	0.91	0.58
1985	60.8	20.7	18.4	37.8	19.1	130.0	0.92	0.98
1986	117.5	31.3	28.4	85.4	29.2	226.4	0.93	1.72
1987	84.8	19.4	54.2	58.8	17.1	175.9	0.88	1.33
1988	121.9	21.7	36.4	86.3	20.0	189.3	0.92	1.43
1989	75.2	17.2		50.6	14.6	124.1	0.85	0.94
1990	90.5	28.6		66.9	26.6	195.4	0.93	1.48
Saint John River[1] above Mactaquac Dam								
TARGET				**3.2**	**4.4**	**29.5**		
1982	7.8	6.5		4.9	2.3	16.5	0.35	0.56
1983	5.8	4.0		3.7	1.3	8.5	0.33	0.29
1984	9.8	10.9	6.2	7.2	7.2	39.5	0.66	1.34
1985	8.5	11.3	10.5	4.5	6.3	36.3	0.56	1.23
1986	8.8	6.9	8.8	5.9	3.5	26.1	0.51	0.88
1987	9.2	4.8	11.0	7.0	2.8	21.3	0.58	0.72
1988	10.2	3.5	8.0	7.5	1.5	13.1	0.43	0.44
1989	10.9	4.5	7.1	7.2	3.1	21.1	0.69	0.72
1990	8.8	4.1		5.8	2.9	20.0	0.71	0.68

Table 17. (Continued)

Year	Returns (10^3) 1SW	Returns (10^3) MSW	Predicted	Spawners (10^3) 1SW	Spawners (10^3) MSW	Eggs (10^6)	MSW Spawners/ MSW Returns	Eggs/ Target Eggs
LaHave River above Morgan Falls								
TARGET				**0.6**	**0.1**	**1.7**		
1983	1.1	0.2		1.1	0.2	2.0	1.00	1.18
1984	2.0	0.4	0.2[3]	2.0	0.3	3.1	0.75	1.82
1985	1.3	0.6	0.3[3]	1.3	0.4	3.4	0.67	2.00
1986	1.6	0.6	0.4[3]	1.6	0.4	4.1	0.67	2.41
1987	2.5	0.5	0.4[3]	2.5	0.4	4.9	0.80	2.88
1988	2.5	0.4	0.7[3]	2.4	0.3	4.4	0.75	2.59
1989	2.1	0.5		2.5	0.4	4.3	0.80	2.53
1990	1.9	0.4		1.8	0.3	3.3	0.75	1.94
Margaree River[1]								
TARGET				**0.6**	**1.0**	**6.7**		
1983	0.2	0.5		0.1	0.3	1.8	0.60	0.27
1984	0.4	0.4		0.2	0.3	2.0	0.75	0.30
1985	0.6	0.8		0.4	0.8	5.3	1.00	0.79
1986	0.8	2.0		0.5	2.0	12.9	1.00	1.93
1987	1.6	2.2		1.2	2.1	14.0	0.95	2.09
1988	2.1	1.0		1.5	1.0	6.5	1.00	0.97
1989	0.8	1.3		0.6	1.2	7.8	0.92	1.16
1990[2]	0.5-1.5	4.2-14.6		0.3-1.2	4.1-14.5	26.8-93.8	0.98[5]	4.0-14.0
Conne River								
TARGET				**4.0**	**-**	**7.8**		
1986	8.3	0.4		5.0	0.4	10.6	0.60[4]	1.36
1987	10.2	0.5	7.9-8.8	7.3	0.5	15.7	0.72[4]	2.01
1988	7.6	0.4	6.2-6.8	5.2	0.4	11.7	0.68[4]	1.50
1989	5.0	0.3		3.4	0.3	7.6	0.68[4]	0.97
1990	5.4	0.4		3.5	0.3	8.2	0.65[4]	1.05

Table 17. (Continued)

Year	Returns (10^3) 1SW	Returns (10^3) MSW	Predicted	Spawners (10^3) 1SW	Spawners (10^3) MSW	Eggs (10^6)	MSW Spawners/ MSW Returns	Eggs/ Target Eggs
Rivière de la Trinité								
TARGET				1.0	0.5	2.7		
1982	2.4	0.3		1.6	0.2	1.2	0.66	0.44
1983	0.9	0.5		0.7	0.5	2.5	1.00	0.93
1984	1.8	0.5		1.4	0.4	2.2	0.80	0.81
1985	1.1	0.6		0.9	0.4	2.2	0.67	0.81
1986	1.6	0.6		1.1	0.4	2.3	0.67	0.85
1987	1.3	0.6		0.8	0.4	2.6	0.67	0.96
1988	1.6	0.8		1.0	0.7	4.5	0.88	1.67
1989	1.9	0.5		1.3	0.3	2.3	0.60	0.85
1990	1.9	0.5		1.2	0.4	2.6	0.80	0.96

[1]Hatchery and wild origin.
[2]Range of estimates provided for Restigouche and Margaree rivers in 1990.
[3]Prediction does not adjust for increased counts resulting from release of MSW fish from angling.
[4]1SW spawners/1SW returns.
[5]Mean value

Table 18. Counts of grilse from fishways and counting fences in insular Newfoundland 1974-90 by Salmon Fishing Area (SFA); also shown are means, standard deviations (SD), and coefficients of variation (CV).

	Fishways									Counting fences				
	SFA 4			SFA 5			SFA 9	SFA 10	SFA 11	SFA 4	SFA 9			SFA 11
Year	1A	1B	2	3	4	5	6	7	8	9	10	11	12	13
1974	2538		862	770a		161		224						
1975	9010	6012		1119a		782		186a						
1976	4106	3037				346		294						
1977	6058	4294				371								
1978	3757	2633	755	1412	810	436		390						
1979	6693	3923	404a	283a	569	455		454						
1980		4550	997	1703	842	422		433						
1981	9015a	4286	2459	2415	1115	619		334a						
1982	7654a	2836	1425	1281	963	625		86a					133	
1983		3031a	978	1195	1210	853		233			2330		272	
1984	17389	6398a	1081	1379	1232	911		419			2430	89	359	
1985	16648	5987	1663	904	1557	960		384			1377a	124	170	
1986	9674	3065	1064	1036	1051	726		725	211		2516	158	296	7515
1987	8977	2316	493a	914	974	570	80	325a	155a		1302a	91	368	9687
1988	8972	3436	1562	772	1737	795	307	543	149		1695	97	202a	7118
1989	7192	1694	596	496	1138	668	167	706	175	7685	889a	62	431	4469
1990	6629	1057	328a	744	1149	410a	391	551	208	7513	1657	71	307	4321
1974-83														
Mean	5360.3	3946.4	1246.0	1601.2	918.2	507.0		338.0						
SD	2353.4	1111.8	636.5	494.0	230.4	211.1		101.1						
CV	43.90	28.17	51.08	30.85	25.09	41.64		29.91						
N	6	8	6	5	6	10		6						
1984-89														
Mean	11475.3	3299.6	1193.2	916.8	1281.5	771.7	184.7	555.4	178.3		2213.7	103.5	324.8	7197.2
SD	4377.9	1646.3	430.9	291.9	301.4	147.6	114.5	157.8	31.1		451.2	33.2	98.9	2140.8
CV	38.15	49.89	36.11	31.84	23.52	19.13	61.99	28.41	17.44		20.38	32.08	30.45	29.74
N	6	5	5	6	6	6	3	5	3		3	6	5	4

1 Exploits River
(a) Bishop's Falls
(b) Gt. Rattling Brook
2 Gander River (Salmon Brook)
3 Middle Brook
4 L. Terra Nova River
5 U. Terra Nova River
6 Rocky River
7 Northeast River (Placentia)
8 Grand Bank Brook
9 Gander River
10 Biscay Bay River
11 Northeast Brook (Trepassey)
12 Colinet River
13 Conne River

[a]Partial counts: not included in means

Table 19. Counts of large salmon from fishways and counting fences in insular Newfoundland 1974-90 by Salmon Fishing Area (SFA); also shown are means, standard deviations (SD), and coefficients of variation (CV).

	Fishways									Counting fences				
	SFA 4			SFA 5			SFA 9	SFA 10	SFA 11	SFA 4	SFA 9			SFA 11
Year	1A	1B	2	3	4	5	6	7	8	9	10	11	12	13
1974	411		8	77a		122		9						
1975	1441	544		9a		48		36a						
1976	493	121				37		56						
1977	584	221				262								
1978	302	78	52	16	20	88		32						
1979	276	119	6a	54a	170	30		37						
1980		418	15	91	40	15		34						
1981	1695a	514	33	38	90	28		62a						
1982	133a	123	18	20	19	8		36a					116	
1983		233a	12	75	57	76		22			88		43	
1984	355	111a	38	57	107	98		44			83	33	97	
1985	181	38	26	27	112	60		0			21a	41	42	
1986	353	174	12	15	140	58		39	4		101	30	31	397
1987	310	41	9a	19	56	38	1	16a	2a		106a	30	55	498
1988	147	10	24	14	206	45	6	11	2		58	19	14a	418
1989	89	14	24	19	142	51	9	15	7	451	104a	18	81	319
1990	122	15	7a	13	144	34a	17	25	15	508	73	9	50	361
1974-83														
Mean	584.5	267.2	23.0	48.0	66.0	71.4		31.7						
SD	435.2	193.6	16.6	33.5	57.4	75.8		15.7						
CV	74.46	72.46	72.17	69.79	86.97	106.16		49.53						
N	6	8	6	5	6	10		6						
1984-89														
Mean	239.2	55.4	24.8	25.2	127.2	58.3	5.3	21.8	4.3		80.7	28.5	61.2	408.0
SD	114.7	67.7	9.2	16.3	49.6	21 1	4.0	18.9	2.5		21.6	8.7	27.4	73.6
CV	47.95	122.20	37.10	64.68	38.99	36.19	75.47	86.70	58.14		26.77	30.53	44.77	18.04
N	6	5	5	6	6	6	3	5	3		3	6	5	4

1 Exploits River
(a) Bishop's Falls
(b) Gt. Rattling Brook
2 Gander River (Salmon Brook)
3 Middle Brook
4 L. Terra Nova River
5 U. Terra Nova River
6 Rocky River
7 Northeast River (Placentia)
8 Grand Bank Brook
9 Gander River
10 Biscay Bay River
11 Northeast Brook (Trepassey)
12 Colinet River
13 Conne River

[a]Partial counts: not included in means

Table 20. Counts of wild Atlantic salmon at fences (Western Arm Brook) and fishway traps in Salmon Fishing Areas 14, 20, 21, and 23. Numbers in parentheses indicate number of salmon returning to Western Arm Brook before removals for Torrent River transfer.

Year	SFA 14				SFA 20		SFA 21		SFA 23	
	Western Arm Brook		Torrent		Liscomb		LaHave		Saint John	
	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW
1974	299(399)	4	38	3			29	2	3,389	4,775
1975	393(631)	1	191	25			38	5	5,725	6,200
1976	420(520)	0	341	47			178	23	6,797	5,511
1977	341	3	789	33			292	25	3,504	7,247
1978	285	1	971	21			275	67	1,584	3,034
1979	1,578	0	1,984	39	60		856	67	6,234	1,993
1980	430	3	792	63	111	0	1,637	288	7,555	8,157
1981	447	1	2,101	97	76	6	1,866	366	4,571	2,441
1982	387	3	2,112	523	252	10	799	256	3,932	2,262
1983	1,141	4	2,007	442	520	15	1,129	213	3,623	1,712
1984	117	0	1,805	288	606	48	2,043	384	7,353	7,011
1985	162	1	1,553	30	507	87	1,343	638	5,331	6,391
1986	252	0	2,815	90	736	117	1,579	584	6,347	3,656
1987	378	1	2,505	68	1,614	88	2,529	532	5,097	3,088
1988	102	1	2,065	41	477	76	2,449	386	8,062	1,930
1989	414	1	1,339	54	532	75	2,084	501	8,417	3,854
1990	124	0	2,296	82	955	44	1,880	396	6,486	3,163
Mean 1974-83	616	2	1,133	129	204	8	710	131	4,691	4,333
Mean 1984-89	238	0.7	2,014	95	745	82	2,005	504	6,768	4,322

Tableau 21. Montaisons dans les passes-migratoires 1975-90 dans Q3 and Q7.

	Q7		Q3					
	de la Trinité		Matane		Madeleine		Mitis	
Annee	1AM	GS	1AM	GS	1AM	GS	1AM	GS
1975			943	1487			66	159
1976			1067	1393	115	155	90	165
1977			1189	1078	77	70	83	170
1978			807	2571	56	374	77	133
1979			1540	725	93	57	281	141
1980	1144	156	1466	2102	81	79	193	387
1981	1892	367			313	146	270	151
1982	2173	828			259	317	114	563
1983	891	461			96	167	46	157
1984	1663	421	876	931	74	392	239	236
1985	1008	519	762	1003	156	301	181	378
1986	1364	546	2364	1397	359	439	636	451
1987	1115	514	1018	2290	406	951	225	557
1988	1324	760	692	2086	499	781	477	314
1989	1744	441	1218	923	482	926	338	428
1990	1637	460	1270	1520	452	932	528	282
Mean								
75-83	1525	453	1169	1559	136	171	136	225
84-89	1370	533	1155	1438	329	632	349	394

Table 22. List of input parameters by river and year (i+1) used to estimate run size and tag returns to Maine Rivers. Data for years prior to 1978 are the same as those given in Anon. (1989b) except for those listed below.

Year (i+1)	River Code	River Name	Angler Recoveries Tagged Ta	Angler Recoveries Untagged Ua	Trap Counts Tagged Tt	Trap Counts Untagged Ut
1978	1	Penobscot	17	278	64	1243
	2	Union	0	9	0	138
	3	Narraguagus	0	129	0	0
	4	Pleasant	0	16	0	0
	5	Machias	0	102	0	0
	6	East Machias	0	59	0	0
	7	Dennys	0	75	0	0
	9	Kennebec	0	0	0	0
	10	Androscoggin	0	0	0	0
	11	Sheepscot	0	32	0	0
	12	Ducktrap	0	0	0	0
	13	Saco	0	0	0	0
1979	1	Penobscot	5	127	25	522
	2	Union	0	9	0	29
	3	Narraguagus	0	58	0	0
	4	Pleasant	0	8	0	0
	5	Machias	0	66	0	0
	6	East Machias	0	25	0	0
	7	Dennys	0	36	0	0
	9	Kennebec	0	6	0	14
	10	Androscoggin	0	0	0	0
	11	Sheepscot	0	7	0	0
	12	Ducktrap	0	0	0	0
	13	Saco	0	0	0	0
1980	1	Penobscot	0	736	0	1852
	2	Union	0	24	0	173
	3	Narraguagus	0	112	0	0
	4	Pleasant	0	5	0	0
	5	Machias	0	71	0	0
	6	East Machias	0	58	0	0
	7	Dennys	0	190	0	0
	9	Kennebec	0	3	0	0
	10	Androscoggin	0	0	0	0
	11	Sheepscot	0	27	0	0
	12	Ducktrap	0	0	0	0
	13	Saco	0	0	0	0

Table 22. (Continued)

Year (i+1)	River Code	River Name	Angler Recoveries Tagged Ta	Angler Recoveries Untagged Ua	Trap Counts Tagged Tt	Trap Counts Untagged Ut
1981	1	Penobscot	61	570	169	1672
	2	Union	3	24	151	106
	3	Narraguagus	0	69	0	0
	4	Pleasant	0	23	0	0
	5	Machias	1	49	0	0
	6	East Machias	1	76	3	11
	7	Dennys	0	117	0	0
	9	Kennebec	0	13	0	0
	10	Androscoggin	0	0	0	0
	11	Sheepscot	0	14	0	0
	12	Ducktrap	0	0	0	0
	13	Saco	0	0	0	0
1982	1	Penobscot	52	855	182	2852
	2	Union	0	7	0	111
	3	Narraguagus	0	68	0	0
	4	Pleasant	0	14	0	0
	5	Machias	0	52	0	0
	6	East Machias	0	37	0	0
	7	Dennys	0	29	0	0
	9	Kennebec	1	21	0	0
	10	Androscoggin	0	0	0	0
	11	Sheepscot	0	14	0	0
	12	Ducktrap	0	0	0	0
	13	Saco	0	0	0	0
1983	1	Penobscot	18	122	92	524
	2	Union	0	5	0	115
	3	Narraguagus	0	86	0	0
	4	Pleasant	0	0	0	35
	5	Machias	0	16	0	0
	6	East Machias	0	8	0	0
	7	Dennys	0	28	0	0
	9	Kennebec	1	15	0	0
	10	Androscoggin	1	0	1	17
	11	Sheepscot	0	11	0	0
	12	Ducktrap	0	0	0	0
	13	Saco	0	0	0	0

Table 22. (Continued)

Year (i+1)	River Code	River Name	Angler Recoveries Tagged Ta	Angler Recoveries Untagged Ua	Trap Counts Tagged Tt	Trap Counts Untagged Ut
1984	1	Penobscot	3	316	49	1126
	2	Union	0	0	0	37
	3	Narraguagus	0	67	0	0
	4	Pleasant	0	1	0	15
	5	Machias	0	29	0	0
	6	East Machias	0	42	0	0
	7	Dennys	0	61	0	0
	9	Kennebec	0	1	0	0
	10	Androscoggin	0	0	0	86
	11	Sheepscot	0	20	0	0
	12	Ducktrap	0	0	0	0
	13	Saco	0	0	0	0
1985	1	Penobscot	20	297	136	2617
	2	Union	0	1	0	78
	3	Narraguagus	0	56	0	0
	4	Pleasant	0	1	0	27
	5	Machias	0	30	0	0
	6	East Machias	0	30	0	0
	7	Dennys	0	20	0	0
	9	Kennebec	0	0	0	0
	10	Androscoggin	0	0	0	20
	11	Sheepscot	0	5	0	0
	12	Ducktrap	0	15	0	0
	13	Saco	0	58	0	0
1986	1	Penobscot	12	329	250	3361
	2	Union	0	5	0	54
	3	Narraguagus	0	43	0	0
	4	Pleasant	0	0	0	19
	5	Machias	0	40	0	0
	6	East Machias	0	13	0	0
	7	Dennys	0	15	0	0
	9	Kennebec	0	0	0	0
	10	Androscoggin	0	1	0	79
	11	Sheepscot	0	10	0	0
	12	Ducktrap	0	12	0	0
	13	Saco	0	3	0	33

Table 22. (Continued)

Year (i+1)	River Code	River Name	Angler Recoveries Tagged Ta	Angler Recoveries Untagged Ua	Trap Counts Tagged Tt	Trap Counts Untagged Ut
1987	1	Penobscot	5	138	95	1401
	2	Union	0	5	0	38
	3	Narraguagus	0	35	0	0
	4	Pleasant	0	0	0	9
	5	Machias	0	4	0	0
	6	East Machias	0	13	0	0
	7	Dennys	0	1	0	0
	9	Kennebec	0	4	0	0
	10	Androscoggin	0	0	0	21
	11	Sheepscot	0	12	0	0
	12	Ducktrap	0	0	0	0
	13	Saco	1	11	0	23
1988	1	Penobscot	6	127	258	1666
	2	Union	0	2	0	45
	3	Narraguagus	0	31	0	0
	4	Pleasant	0	0	0	0
	5	Machias	0	6	0	0
	6	East Machias	0	13	0	0
	7	Dennys	0	9	0	0
	9	Kennebec	0	2	3	10
	10	Androscoggin	0	0	3	8
	11	Sheepscot	0	0	0	0
	12	Ducktrap	0	0	0	0
	13	Saco	0	3	1	33
1989	1	Penobscot	11	233	149	1710
	2	Union	0	3	0	22
	3	Narraguagus	0	35	0	0
	4	Pleasant	0	0	0	0
	5	Machias	0	9	0	0
	6	East Machias	0	16	0	0
	7	Dennys	0	11	0	0
	9	Kennebec	0	2	1	13
	10	Androscoggin	0	0	0	18
	11	Sheepscot	0	2	0	0
	12	Ducktrap	0	0	0	0
	13	Saco	0	3	0	13

Table 22. (Continued)

Year (i+1)	River Code	River Name	Angler Recoveries Tagged Ta	Angler Recoveries Untagged Ua	Trap Counts Tagged Tt	Trap Counts Untagged Ut
1990	1	Penobscot	13	336	127	2298
	2	Union	0	0	0	20
	3	Narraguagus	0	49	0	0
	4	Pleasant	0	0	0	0
	5	Machias	0	2	0	0
	6	East Machias	0	46	0	0
	7	Dennys	0	31	0	0
	9	Kennebec	0	45	0	0
	10	Androscoggin	0	0	5	172
	11	Sheepscot	0	8	0	0
	12	Ducktrap	0	3	0	0
	13	Saco	0	16	0	53

Table 23. Estimated Carlin tag recoveries and run size in Maine rivers. Ratio = tag to run size of 2SW salmon in homewaters. RATIO (year i) for use in estimation of distant water harvest (year i-1).

Year	Tags	Run	RATIO
1967	0	1019	0.0000
1968	168	729	0.2307
1969	7	690	0.0104
1970	13	856	0.0155
1971	68	687	0.0985
1972	318	1449	0.2197
1973	206	1448	0.1425
1974	215	1411	0.1520
1975	450	2345	0.1920
1976	184	1341	0.1374
1977	97	2025	0.0478
1978	97	4145	0.0233
1979	36	1878	0.0190
1980	0	5662	0.0000
1981	470	5122	0.0918
1982	284	6023	0.0472
1983	138	1930	0.0716
1984	61	3045	0.0202
1985	185	4855	0.0381
1986	309	5568	0.0555
1987	119	2397	0.0498
1988	319	2855	0.1118
1989	190	2946	0.0646
1990	172	4355	0.0394

Table 24. Carlin tag returns from 1SW salmon of Maine origin in Newfoundland and Labrador by year and Salmon Fishing Area.

	Salmon Fishing Area															
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Unknown	Total
1967	3	1	7	14	5	0	4	0	1	1	2	0	0	0	2	40
1968	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	3
1969	0	0	2	0	1	0	0	1	0	0	0	0	0	0	0	3
1970	5	2	13	5	1	1	0	1	0	1	0	0	0	0	0	29
1971	10	2	4	18	10	3	0	0	0	0	1	0	0	0	0	48
1972	6	1	0	0	4	0	0	0	0	0	0	1	0	0	0	12
1973	6	1	6	4	1	1	1	3	1	0	0	0	0	1	0	25
1974	0	5	19	38	13	10	5	3	3	3	0	1	0	3	0	103
1975	16	4	18	36	14	6	1	4	1	2	0	0	0	1	0	102
1976	18	6	26	14	5	5	0	0	0	3	2	0	0	1	0	80
1977	2	1	6	5	0	0	0	0	0	1	1	0	0	0	0	16
1978	4	0	1	2	1	0	0	0	0	0	0	0	0	0	0	5
1980	55	24	112	72	22	6	0	3	2	3	12	0	0	3	1	315
1981	14	0	2	10	7	5	1	0	1	0	0	0	0	1	0	41
1982	14	7	20	21	7	6	1	0	0	1	4	0	2	2	0	85
1983	8	1	11	6	0	0	0	0	0	0	0	0	0	0	0	26
1984	12	4	7	7	4	2	1	0	0	1	1	0	0	0	0	39
1985	20	3	15	36	11	1	3	2	0	0	0	0	0	2	1	94
1986	3	5	6	2	1	0	0	1	0	0	0	0	0	3	0	21
1987	14	2	16	4	6	2	0	2	1	1	0	0	0	0	1	49
1988	8	2	5	0	1	0	1	0	0	1	1	0	0	1	0	20
1989	25	5	10	6	4	1	1	1	0	1	0	0	0	0	0	54
1990	0	2	2	2	0	0	0	0	0	0	2	0	0	0	0	8
Unknown	2	0	1	1	0	0	1	1	0	0	0	0	0	0	0	6
Total	245	78	309	303	116	49	20	22	10	19	26	2	2	18	5	1224

Table 25. Estimated harvest of 1SW salmon of Maine origin in Newfoundland and Labrador by year and Salmon Fishing Area.

Year	Salmon Fishing Area															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Unknown	Total
1967	14	5	43	87	31	0	25	0	6	6	12	0	0	0	12	242
1968	0	0	0	274	137	0	0	0	0	0	0	0	0	0	0	411
1969	0	0	185	0	0	0	0	92	0	0	0	0	0	0	0	277
1970	56	23	188	72	14	14	0	14	0	14	0	0	0	0	0	398
1971	51	10	26	117	65	20	0	0	0	0	7	0	0	0	0	295
1972	47	8	0	0	40	0	0	0	0	0	0	10	0	0	0	105
1973	44	7	56	38	9	9	9	28	9	0	0	0	0	9	0	220
1974	0	29	141	283	97	74	37	22	22	22	0	7	0	22	0	758
1975	129	32	187	374	135	62	10	42	10	21	0	0	0	10	0	1014
1976	418	139	777	418	149	149	0	0	0	90	60	0	0	30	0	2230
1977	95	48	368	307	0	0	0	0	0	61	61	0	0	0	0	940
1978	234	0	75	0	0	0	0	0	0	0	0	0	0	0	0	309
1980	666	291	1744	1121	343	93	0	47	31	47	187	0	0	47	16	4631
1981	330	0	61	303	212	151	30	0	30	0	0	0	0	30	0	1147
1982	217	109	399	419	140	120	20	0	0	20	80	0	40	40	0	1603
1983	441	55	779	425	0	0	0	0	0	0	0	0	0	0	0	1700
1984	350	117	262	262	150	75	37	0	0	37	37	0	0	0	0	1329
1985	400	60	386	926	283	26	77	51	0	0	0	0	0	51	26	2288
1986	67	112	172	57	29	0	0	29	0	0	0	0	0	86	0	552
1987	139	20	204	51	77	26	0	26	13	13	0	0	0	0	13	580
1988	138	34	111	0	22	0	22	0	0	22	22	0	0	22	0	393
1989	705	141	363	218	145	36	36	36	0	36	0	0	0	0	0	1717
Total	4542	1239	6528	5752	2078	857	305	388	123	390	466	17	40	349	66	23140

Table 26. Estimated harvest of 1SW salmon of Maine origin in Newfoundland and Labrador by standard week and Salmon Fishing Area in 1989.

	Salmon Fishing Area															
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Unknown	Total
24	0	0	0	0	0	0	0	36	0	0	0	0	0	0	0	36
26	0	0	0	36	73	0	36	0	0	0	0	0	0	0	0	145
27	0	0	36	73	0	0	0	0	0	36	0	0	0	0	0	145
28	0	56	36	36	0	0	0	0	0	0	0	0	0	0	0	129
29	85	0	36	73	36	0	0	0	0	0	0	0	0	0	0	230
30	113	0	36	0	0	0	0	0	0	0	0	0	0	0	0	149
31	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
32	141	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141
33	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
34	85	28	0	0	0	0	0	0	0	0	0	0	0	0	0	113
35	56	0	36	0	0	0	0	0	0	0	0	0	0	0	0	93
36	169	28	36	0	0	0	0	0	0	0	0	0	0	0	0	234
Unknown	0	28	145	0	36	36	0	0	0	0	0	0	0	0	0	246
Total	705	141	363	218	145	36	36	36	0	36	0	0	0	0	0	1716

Table 27. Estimated total run size of 1SW and 2SW salmon returning to Maine rivers and estimated harvests of 1SW salmon in Newfoundland and Labrador fisheries. All run size and harvests estimates are computed assuming 85 percent fish passage efficiency.

Year i	Run 1SW i	Run 2SW i+1	1/2SW Ratio	Harvest i	Harvest /2SW Run Ratio
1967	100	729	0.138	242	0.332
1968	24	690	0.035	411	0.595
1969	36	856	0.041	277	0.324
1970	14	687	0.021	398	0.579
1971	44	1449	0.030	295	0.204
1972	32	1448	0.022	150	0.073
1973	43	1411	0.030	220	0.156
1974	99	2345	0.042	755	0.322
1975	116	1341	0.086	1014	0.756
1976	231	2025	0.114	2230	1.101
1977	98	4145	0.024	933	0.227
1978	161	1878	0.086	309	0.165
1979	251	5582	0.045	NA	NA
1980	847	5122	0.166	4607	0.902
1981	1148	6023	0.191	1137	0.189
1982	315	1930	0.163	1586	0.828
1983	271	3045	0.089	1689	0.558
1984	388	4855	0.080	1322	0.274
1985	337	5568	0.061	2274	0.409
1986	711	2397	0.297	533	0.222
1987	950	2855	0.333	584	0.204
1988	881	2946	0.299	393	0.134
1989	1267	4355	0.291	1717	0.394

NA=Not Available; no smolts were tagged in 1978.

Table 28. Comparison of harvest estimates of 1SW Maine-origin salmon based on Carlin tags reported by fisherman and coded-wire tags (CWT) recovered by sampling in 1989.

Location Sampled		Carlin Tags Included[1]	CWT Estimate Type[2]	Estimated Harvest		
Section	Community			CWT	Carlin	Ratio
2	Goose Cove	Imputed	S	218	36	6.00
			C	72	0	-
3	Croque	Imputed	S	65	0	-
			C	30	0	-
4	Conche	Actual	S	86	73	1.19
			C	14	0	-
		Imputed	S	86	181	0.48
			C	14	36	0.39
	Englee	Actual	S	0	73	0
			C	0	0	-
		Imputed	S	0	181	0
			C	0	36	0
	Harbour Deep	Actual	S	45	0	-
			C	13	0	-
		Imputed	S	45	109	0.41
			C	13	36	0.36
6	Shoe Cove	Imputed	S	0	73	0
			C	0	36	0
	Leading Tickles	Imputed	S	0	36	0
			C	0	0	-
7	Cambellton	Imputed	S	0	73	0
			C	0	0	-
	Twillingate	Imputed	S	0	73	0
			C	0	36	0
51	Square Island	Actual	S	206	56	3.65
			C	22	28	0.78
		Imputed	S	206	85	2.43
			C	22	28	0.78
	Community Total	Actual	C	151	101	1.50
		Imputed	C	151	210	0.72

[1]Defines whether or not Carlin tag recoveries with unknown dates are included in the estimate. "Actual" means that tags with unknown dates are not considered; "Imputed" means that tags with unknown dates are included in the estimate

[2]Defines the geographical region applicable to CWT estimate. S=Section, C=Community only. Section estimates are based entirely on recoveries from single community individually, hence the different section estimates in Section 4.

Table 29. River age distribution (%) of 1SW and MSW salmon caught in outer Notre Dame Bay at Twillingate and in the inner bay at Embree and Campbellton.

Site	Year	Sea Age	River Age % 1	2	3	4	5	6	7	N
Inner	1981	1SW	0	1	45	52	2	0	0	158
Outer	1981		1	16	44	32	6	1	0	924
Inner	1982		0	5	55	36	4	1	0	949
Outer	1982		0	23	49	24	3	0	0	882
Inner	1981	MSW	0	0	80	20	0	0	0	44
Outer	1981		1	42	46	11	0	0	0	327
Inner	1982		0	2	64	32	2	1	0	125
Outer	1982		0	32	49	18	1	0	0	148

Table 30. Summary of exploitation rates in the Canadian recreational fisheries from SFA's 15, 16, and 18. Early season refers to exploitation on fish entering the river prior to September 1 while late season refers to fish entering after August 31.

River	Season	Exploitation Rate N	Mean	SD	Range	Reporting Rate Range
SFA 15	Restigouche River (1982-89)					
1SW	Combined	8	0.48	0.06	0.40-0.55	NA
SFA 16	Miramichi River (1985-90)					
1SW	Early	6	0.27	0.05	0.18-0.31	0.5-0.8
	Late	6	0.13	0.10	0.00-0.28	0.5-0.8
	Combined	6	0.25	0.06	0.17-0.30	0.5-0.8
SFA 18	Margaree River (1988-90)					
1SW	Late	3	0.17	0.08	0.10-0.25	0.51-0.67
MSW	Late	3	0.11	0.06	0.07-0.17	0.51-0.67

NA=Not Applicable
N=Number of years

Table 31. Summary of the Atlantic salmon aquaculture industry in Maine, USA, 1982-1990.

Year	Number of Companies	Number Smolts Stocked	Estimated Harvest
1982	2	85,000	-
1983	1	155,000	-
1984	1	30,000	-
1985	1	131,000	-
1986	4	208,000	-
1987	8	293,000	365
1988	15	1,086,000	410
1989	19	2,609,000	890
1990	20	2,797,000	2,075

Table 32. Summary of the Atlantic salmon production in the Canadian aquaculture industry (Atlantic Drainage only), 1980-1990.

Year	N.B. (SFA23)	N.S. (SFA19-21)	Nfld. (SFA11)	Que. (Q1)	Ont. (Georgian Bay)	Total
1980	11	-	-	-	-	11
1981	21	-	-	-	-	21
1982	38	-	-	-	-	38
1983	69	-	-	-	-	69
1984	222	5	-	-	-	227
1985	349	10	-	-	-	359
1986	635	36	1	-	-	672
1987	1315	37	2	-	-	1334
1988	3500	27	10	5	-	3542
1989	5600	250	0*	10	5	5865
1990	7500	300	0	10	NA	7810

* All production destroyed due to disease problems.

NA=Not Available

Table 33. Quotas, closing date and landings for the commercial fisheries, SFA, 1-14 in 1990. The commercial fisheries opened June 5 in all SFAs. The landings are preliminary, landings for SFAs 1-5 and 10-14 are nominal where as landings for SFAs 6-9 are from the quota monitoring.

SFA	Quota (t)	Date Closed	Landings (t)
1	[a]	Oct. 15	30
2	200	Oct. 15	151
3	155	Oct. 15	135
4	100	July 25	92
5	25	July 7	25
6	20	July 14	19
7	15	Oct. 15	13
8	10	July 21	9
9	7	Oct. 15	6
10	25	June 30	23
11	25	June 21	29
12	0	not open	0
13	35	July 3	43
14	60	July 14[b]	44
Total	677		619[c]

[a] Allowance of 80 t
[b] Southern Labrador re-opened July 20-July 30.
[c] Includes 30 t in SFA 1 which did not have a quota.

Table 34. Preliminary estimates of (a) small and (b) large salmon by weight which were affected by the early closure of the commercial fisheries in 8 SFAs in Newfoundland in 1990. Number in parenthesis is the percent of the harvest which would not have been caught, 1984-89 if the season was closed on the same date as in 1990. Predictions illustrate potential consequinces in 1990 of within season variations in catches for 1984-1989.

SFA	1990 Harvest (t)	Predicted Weight (t) not Caught Min%	Max%	Mean
(a) Small Salmon				
4	61	5 (8)	19 (24)	10
5	15	4 (23)	18 (54)	9
6	11	2 (17)	11 (50)	5
8	3	<1 (3)	1 (15)	1
10	16	9 (35)	36 (69)	14
11	9	5 (35)	73 (89)	14
13	29	8 (21)	30 (51)	13
14	25	4 (15)	36 (65)	11
Total	169	37	224	77
(b) Large Salmon				
4	31	5 (14)	10 (24)	6
5	10	1 (13)	5 (32)	3
6	8	1 (9)	6 (43)	2
8	6	<1 (2)	1 (14)	0
10	7	2 (18)	7 (50)	3
11	20	5 (19)	51 (72)	13
13	14	2 (12)	8 (36)	4
14	19	3 (15)	16 (46)	7
Total	115	19	104	38

Table 35. Preliminary estimates of numbers of (a) small and (b) large salmon which were affected by the early closure of the commercial fisheries in 8 SFAs in Newfoundland in 1990. Number in parenthesis is the percent of the harvest which would not have been caught, 1984-89 if the season was closed on the same date as in 1990. Predictions illustrate potential consequences in 1990 of within season variations in catches for 1984-1989.

SFA	1990 Harvest (Numbers)	Predicted Numbers not Caught Min	Max	Mean
(a) Small Salmon				
4	32,024	2,785 (8)	10,113 (24)	5,213
5	8,333	2,350 (22)	9,782 (54)	5,107
6	5,789	1,186 (17)	5,789 (50)	2,601
8	1,765	133 (3)	311 (15)	218
10	9,406	5,065 (35)	20,936 (69)	8,341
11	5,000	2,692 (35)	40,455 (89)	7,500
13	16,600	3,920 (21)	15,570 (49)	6,850
14	12,200	2,090 (15)	16,710 (58)	4,860
Total	91,117	20,221	119,666	40,690
(b) Large Salmon				
4	6,944	1,130 (14)	2,193 (24)	1,422
5	2,703	369 (12)	1,272 (32)	854
6	2,051	203 (9)	1,547 (43)	545
8	1,714	35 (2)	279 (14)	90
10	1,913	420 (18)	1,913 (50)	859
11	4,270	695 (14)	10,454 (71)	2,730
13	3,220	420 (12)	1,670 (34)	980
14	3,620	640 (15)	3,100 (46)	1,370
Total	26,435	3,912	22,428	8,850

Table 36. Estimates of total harvests, in numbers of 1SW salmon of Maine origin, June 5-October 15, 1984-89, and harvest and percent reduction of total harvest which would have occurred during period similar to the period of closure in 1990, in SFAs 4, 5, and 6.

	SFA 4			SFA 5			SFA 6			SFA 4, 5, 6		
Year	June 5 to Oct 15	July 26 to Oct 15	%	June 5 to Oct 15	July 7 to Oct 15	%	June 5 to Oct 15	July 14 to Oct 15	%	June 5 to Oct 15	Closure Period	%
1984	74	37	50	111	111	100	74	37	50	259	185	71
1985	77	0	0	33	33	100	26	26	100	136	59	43
1986	58	0	0	29	0	0	0	0	0	87	0	0
1987	52	0	0	65	4	6	26	2	8	143	6	4
1988	0	0	0	0	0	0	0	0	0	0	0	0
1989	218	0	0	109	36	33	0	0	0	327	36	11
Mean	80	6	8[1]	58	31	40[1]	21[1]	11	26[1]	159	48	22[1]
SD	73	15	0	45	43	0	29	16	0	118	71	0

[1]Mean of percents

Table 37. Summary of predicted reduction in total catch and reduction in numbers of Maine-origin 1SW salmon for all SFAs (2-11, 12-14) combined, 1984-89. 1 gear unit = 50 fathoms. Standard deviations of predictions are given in parentheses.

	Observed		Predicted				
				Reductions			
	Effort (Gear Units)	Catch	Duration[1] Fishery (d)	Catch		Maine	
Year	x 10^3	t	(S.D.)	t	%	No.	%
84	14.3	746	54 (41)	98	13	264	41
85	12.8	794	60 (48)	226	29	131	27
86	13.0	1141	26 (13)	474	42	364	75
87	12.9	1413	32 (33)	746	53	323	58
88	12.5	908	54 (39)	252	28	130	51
89	12.4	792	55 (42)	130	16	157	16
Mean	13.0	966	47	321	30	228	45

[1]Average duration of fishery (mean across SFAs)

Table 38. Summary of predicted mean reduction in total catch and mean reduction in numbers of Maine-origin 1SW salmon by Salmon Fishing Area, 1984-89. 1 gear unit = 50 fathoms. Standard deviations of predictions are given in parentheses. From 1984 to 1989 the duration of the fishery in SFA 1-11, and 14 was 133d; in SFA 13 the fishery was 36d.

	Observed		Predicted				
				Reductions			
	Effort	Catch	Duration[1]	Catch		Maine	
SFA	(Gear Units) x 10^3	t	Fishery (d) (S.D.)	t	%	No.	%
2	1437	255	80	70	21	22	38
	(29)	(100)	(48)	(82)	(21)	(35)	(45)
3	1759	195	84	48	16	64	38
	(68)	(90)	(54)	(83)	(23)	(82)	(44)
4	2814	140	51	36	21	32	42
	(154)	(41)	(25)	(44)	(23)	(30)	(38)
5	1125	54	26	29	51	43	46
	(114)	(5)	(13)	(13)	(13)	(56)	(45)
6	1026	42	30	22	46	15	42
	(74)	(16)	(12)	(16)	(20)	(17)	(49)
7	917	20	53	5	21	13	17
	(53)	(4)	(40)	(4)	(17)	(31)	(41)
8	726	23	17	13	52	9	33
	(29)	(7)	(10)	(7)	(19)	(14)	(52)
9	179	9	59	2	20	0	0
	(12)	(2)	(36)	(2)	(16)	(0)	(0)
10	653	35	55	12	26	6	17
	(35)	(13)	(43)	(12)	(23)	(15)	(41)
11	726	52	39	27	41	6	17
	(36)	(29)	(47)	(28)	(28)	(16)	(41)
13	464	57	26	23	33	0	0
	(34)	(23)	(6)	(19)	(23)	-	-
14	1134	84	45	34	33	18	33
	(62)	(35)	(45)	(35)	(24)	(34)	(52)

[1]Average duration of fishery in each SFA (mean across years)

Table 39. Test of the gonad development technique for identifying maturing and non-mature salmon using samples of known maturity from Labrador Sea, Conne estuary, and Conne River. %IM = % immature; %M = % maturing.

Location	Known Maturity %IM	Known Maturity %M	Sex	N	Calculated Maturity %IM	Calculated Maturity %M
Labrador Sea	100	0	M	58	97.3	2.7
Labrador Sea	100	0	F	227	60.0	40.0
Conne estuary	0	100	M	88	75.7	24.3
Conne estuary	0	100	F	315	7.3	92.7
Conne River	0	100	F	393	0.5	99.5

Table 40. Resubstitution summary using quadratic discriminant function for determining stage of maturity for (a) male salmon and (b) female salmon.

(a)

Known Maturation Stage	Number of Observations and Percent Classified		
	Immature	Mature	Total
Immature	55	4	59
	93.22	6.78	100.00
Mature	3	86	89
	3.37	96.63	100.00
Total	58	90	148
Percent	39.19	60.81	100.00

Misclassification rate: 4.7% Error rate: ±0.7%

(b)

Known Maturation Stage	Number of Observations and Percent Classified		
	Immature	Mature	Total
Immature	209	18	227
	92.07	7.93	100.00
Mature	24	291	315
	7.62	92.38	100.00
Total	233	309	542
Percent	42.99	57.01	100.00

Misclassification rate: 7.7% Error rate: ±1.11%

Table 41. Numbers of maturing (M) and non-maturing (IM) 1SW salmon sampled at Twillingate and Square Islands, Nfld, 1985-88. Maturity was based on discriminant analysis of known maturing and immature salmon based on GSIs. %IM = % immature, %M = % maturing, ( ) = total sample size.

	Location			
	Square Is.		Twillingate	
	Males	Females	Males	Females
Year	%IM %M	%IM %M	%IM %M	%IM %M
1985	1.7 98.3 (180)	19.3 80.7 (57)	6.9 93.1 (58)	5.3 94.7 (113)
1986	2.2 97.8 (225)	19.4 80.6 (67)	7.6 92.4 (263)	11.9 88.1 (194)
1987	3.2 96.8 (217)	17.5 82.5 (97)	18.9 81.1 (440)	28.3 71.7 (279)
1988	0.9 99.1 (215)	7.1 92.9 (112)	18.8 81.2 (266)	8.7 91.3 (309)
Mean	2.0 98.0	15.8 84.2	13.1 86.9	13.6 86.4
S.D.	0.96	5.88	6.70	10.2
N	837	333	1027	895

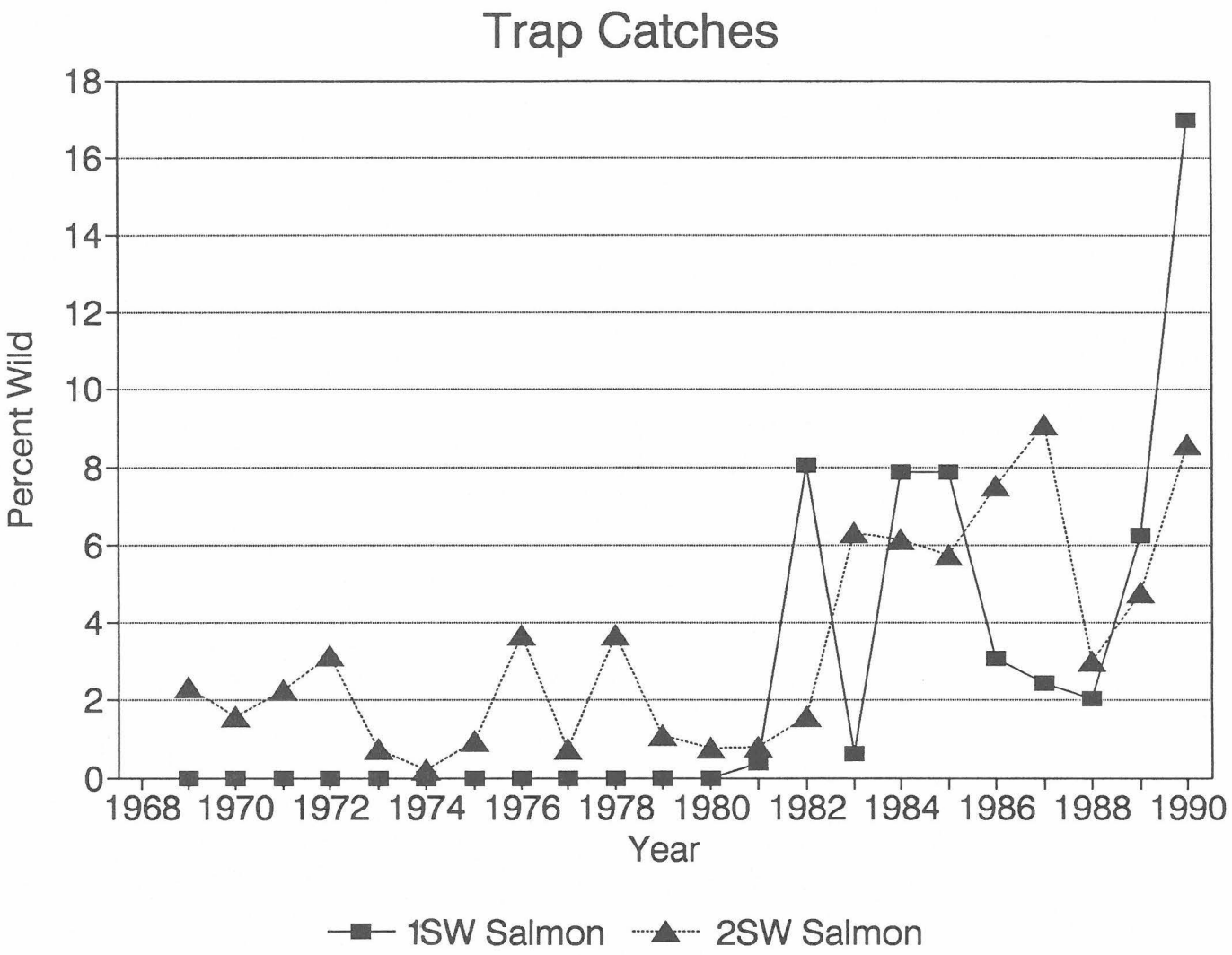


Figure 1 Wild salmon as a percentage of total 1SW and 2SW returns observed at the trap on the Penobscot River from 1968 to 1990.

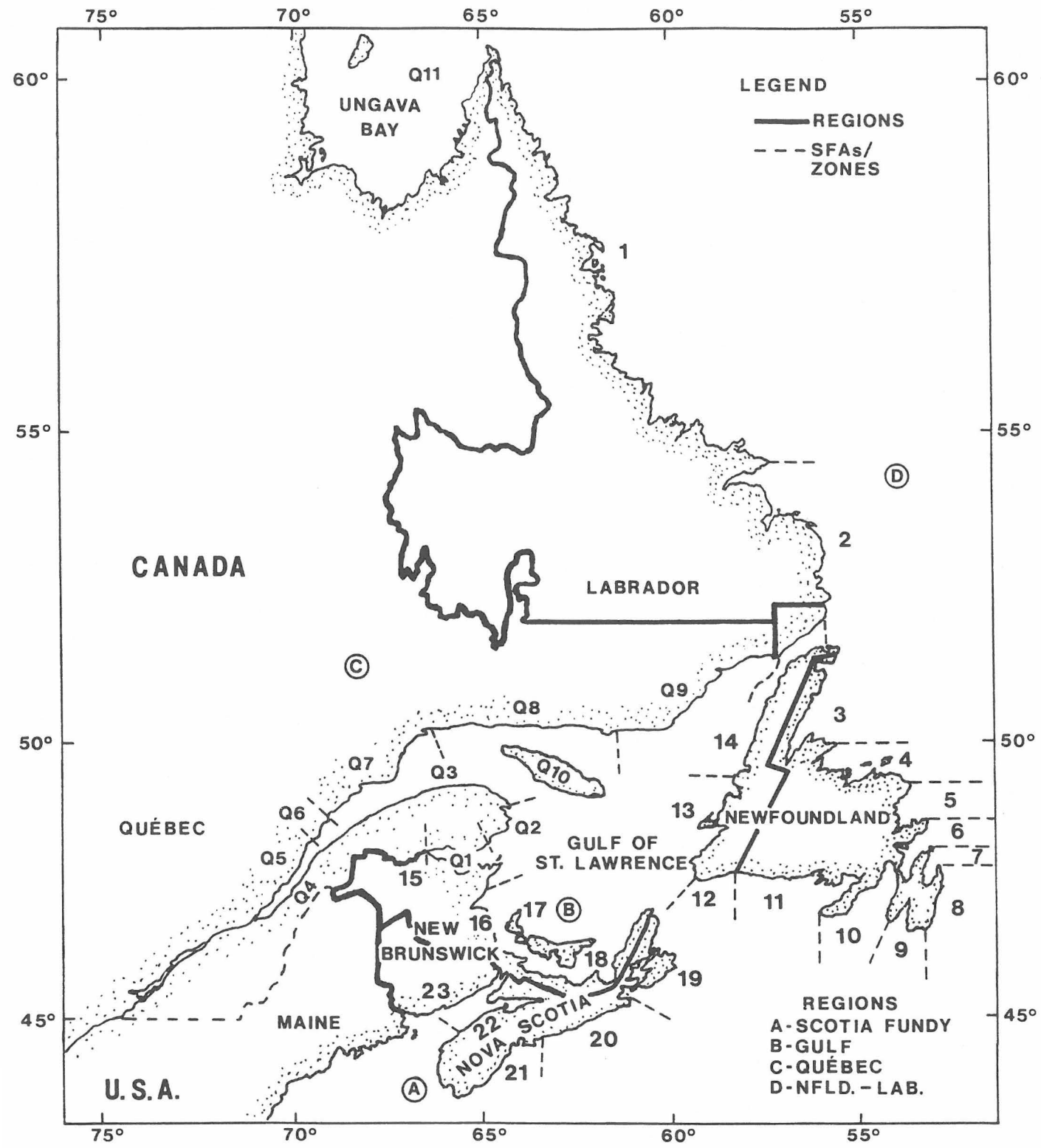


Figure 2. Map of Eastern Canada showing Salmon Fishing Areas.

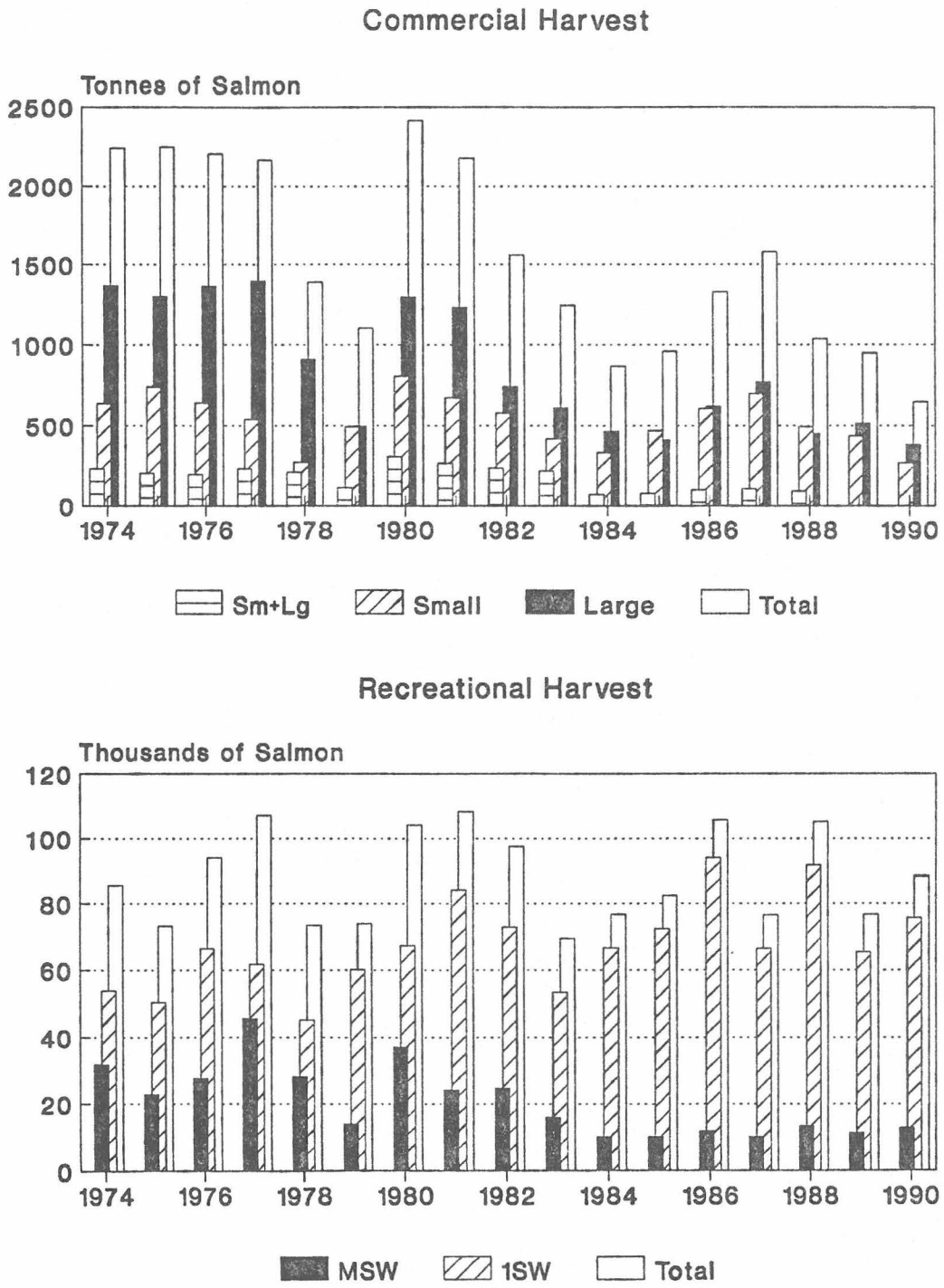


Fig. 3 Canadian landings of Atlantic salmon, 1974-1990.

Fig. 4 North American Run Reconstruction Model

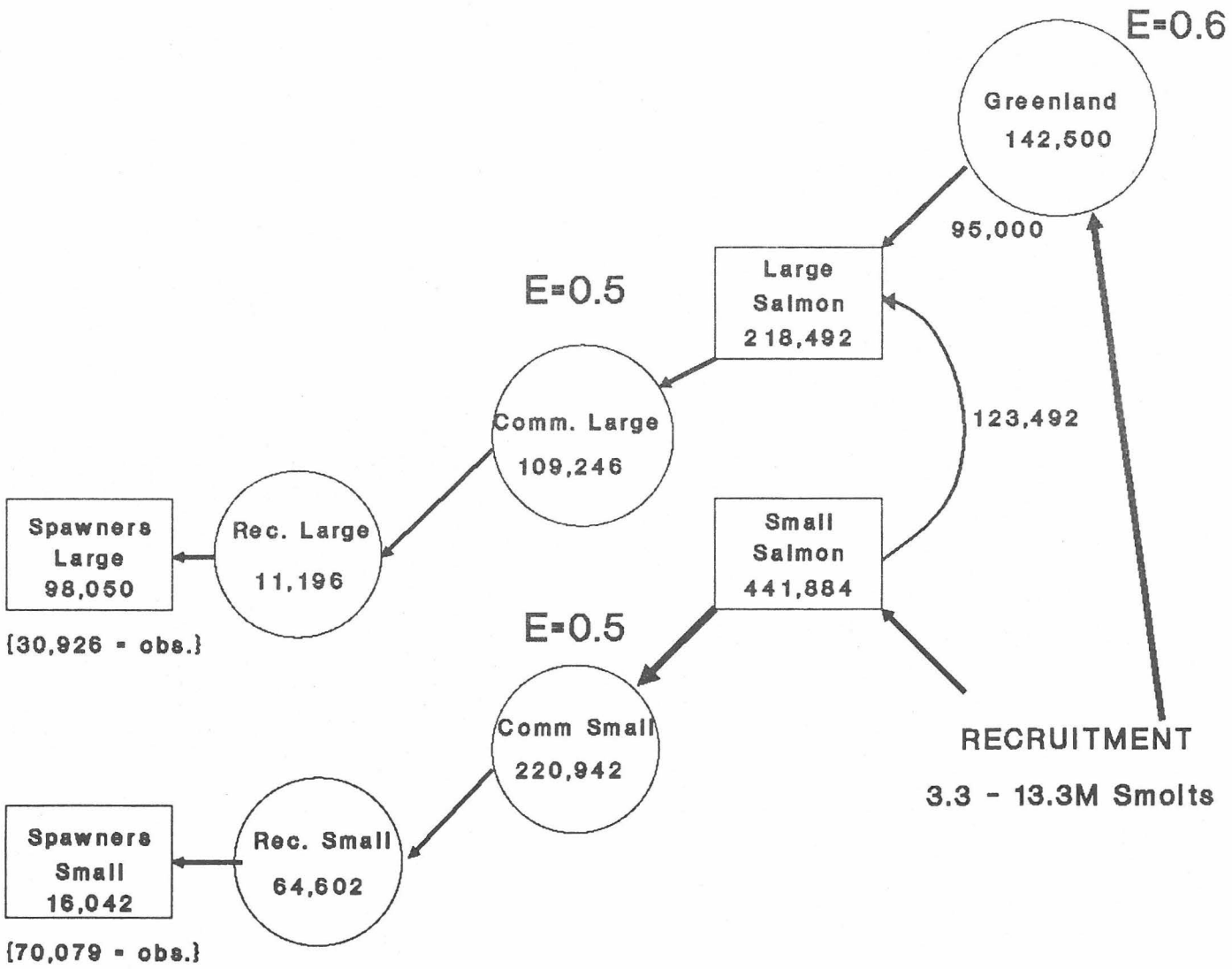


Fig.5 Percentage of maturing and immature salmon , 1985-88.

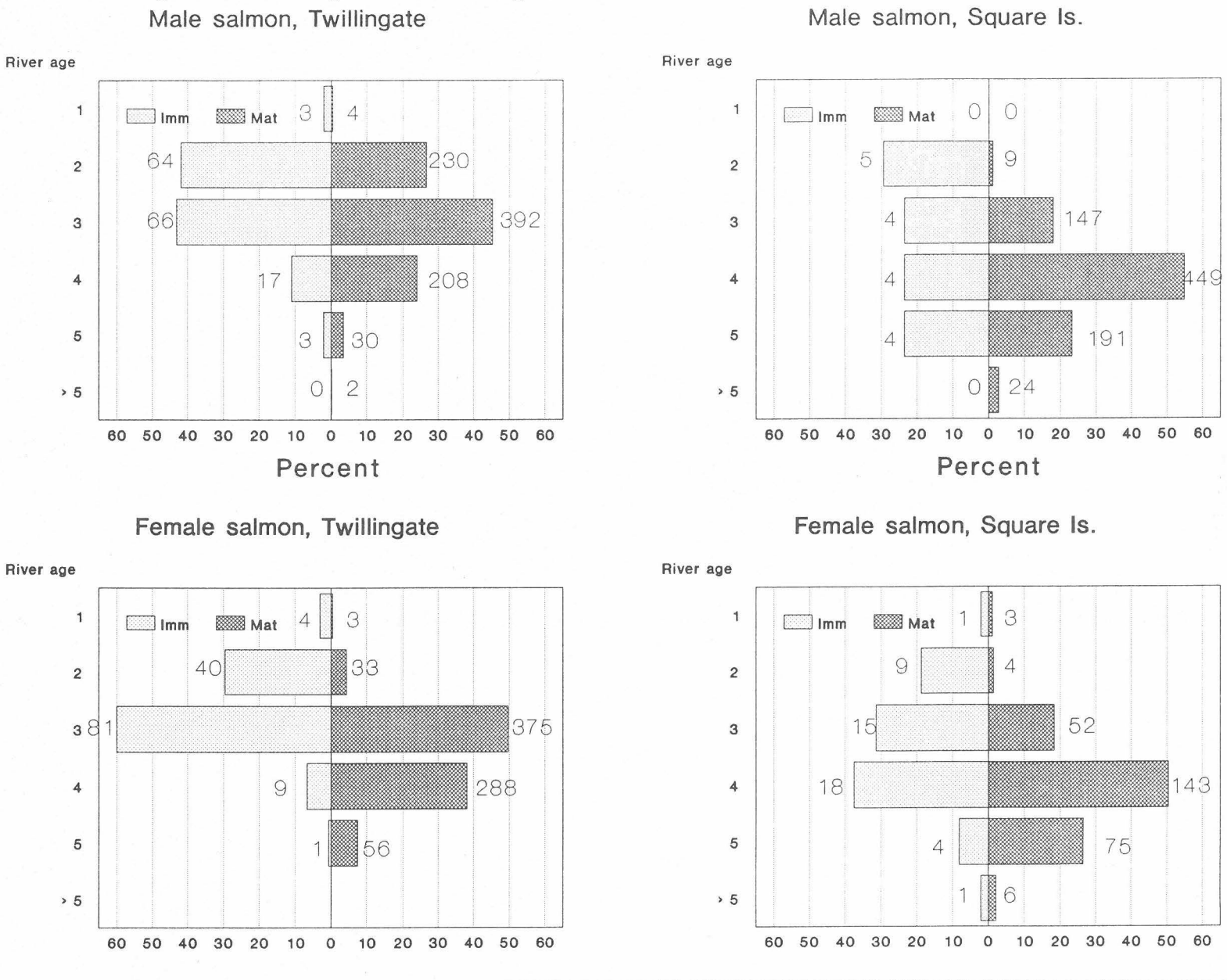
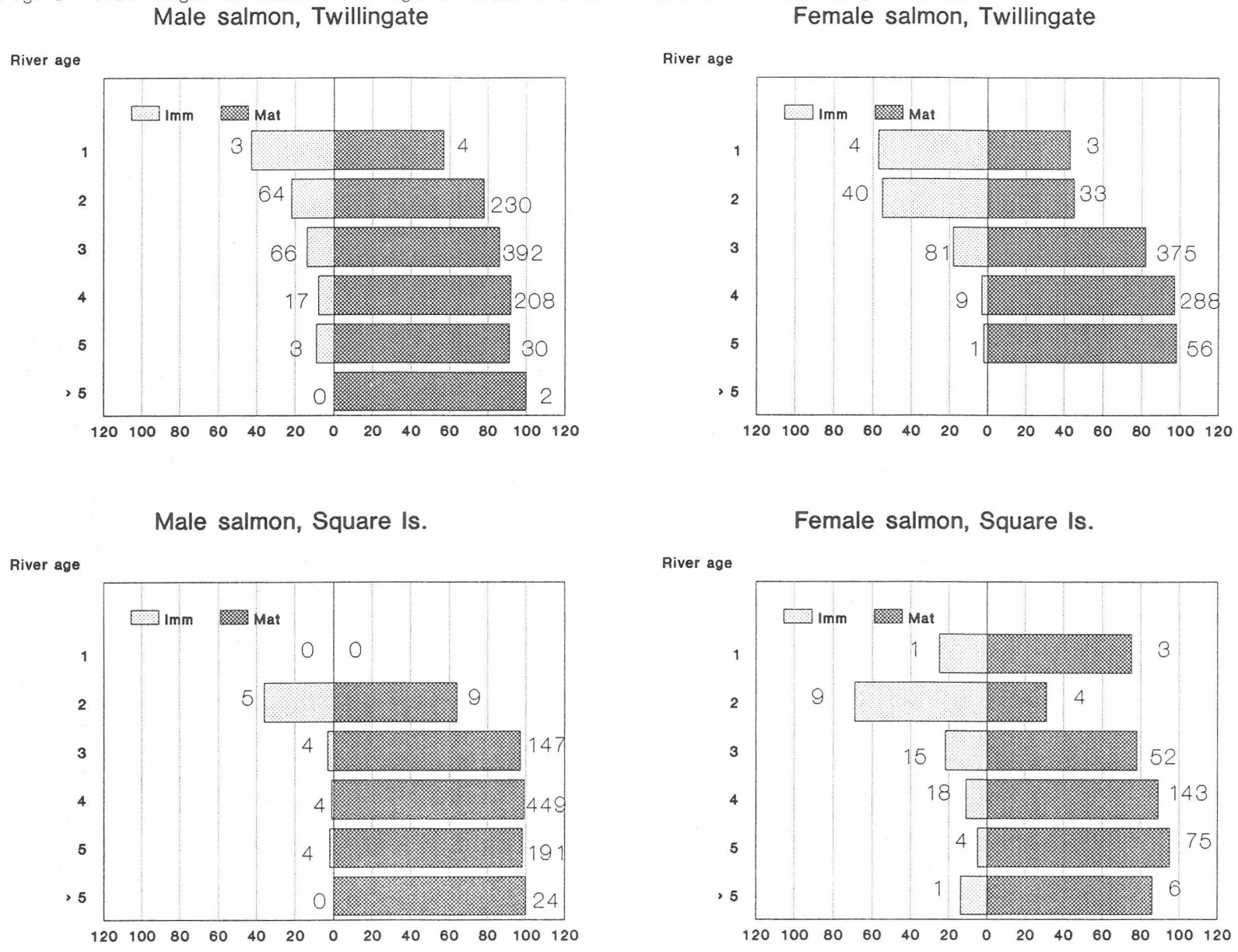


Fig. 6 Percentage for each river age of mature and immature 1SW salmon, 1985-89.



APPENDIX 1

AGENDA

ICES STUDY GROUP ON NORTH AMERICAN SALMON FISHERIES

1000 - February 25 to 1000-March 1, 1991
National Fisheries Research Center--Leetown
Leetown, West Virginia, USA

1. Adoption of agenda

2. Distribution of documents

3. Organization of meeting

4. Terms of reference

   a. Describe events of the 1990 fisheries with respect to gear, effort, composition and origin of the catch.

   b. Continue the development of run-reconstruction models of national stocks for input to a North Atlantic salmon model to describe fisheries interactions and stock dynamics;

   c. Estimate exploitation rates and status of stocks in homewater and interception fisheries for stocks occurring in the North American Commission area.

   d. Evaluate the effects of the newly-introduced quota in the commercial salmon fishery of Newfoundland and Labrador on stocks occurring in the North American Commission area.

   e. Specify data deficiencies and research needs.

   f. With respect to Atlantic salmon in the NASCO area, provide a definition of the term "Index Rivers" and provide a commentary on how they could be used to assess the status of salmon stocks.

5. Recommendations from Study Group and Working Group meetings in 1990

   a. Working Group Report (C.M. 1990/Assess: 11)

   b. Study Group Report (C.M. 1990/M:3)

6. Other Business

APPENDIX 2

DOCUMENTS SUBMITTED TO THE STUDY GROUP

1. Anonymous. Annual report of the US Atlantic salmon assessment committee. Report No. 3 - 1990 Activities.

2. Baum, E. T. History and status of the Atlantic salmon farming industry in Maine, USA.

3. Porter, T. R. and D. G. Reddin. Effects of the quotas introduced in 1990 in the commercial salmon fisheries of Newfoundland and Labrador on stocks occurring in the North American Commission Area.

4. Porter. T. R., T. L. Marshall, F. Caron, G. Chaput, M. R. O'Connell, and D. Meerburg. Description of the Atlantic salmon fisheries and status of stocks in Canada in 1990.

5. Rago, P. J. Run reconstruction model for North American fisheries: a speculative hypothesis.

6. Reddin, D. G. and P. R. Downton. Estimation of 1SW salmon of US origin in Newfoundland fishery - the proportional harvest technique.

7. Reddin, D. G. and P. R. Downton. Maturity of 1SW salmon in Newfoundland commercial fishery.

8. Carey, T. G. Aquaculture production of Atlantic salmon in Canada.

9. Friedland, K. D., P. J. Rago, and E. T. Baum. Harvest estimates of US origin salmon from coded wire tag and Carlin tag return data in Canada, 1989.

10. Friedland, K. D., P. J. Rago, and E. T. Baum. Carlin tag returns and harvest estimates of US origin salmon in Canada, 1967-1990.

11. Friedland, K. D. and D. G. Reddin. Recoveries of coded wire micro tags in Newfoundland and Labrador during the 1990 fishing season.

APPENDIX 3

Estimates of reduction in Canadian commercial catches and Maine-Origin Harvests and Predicted Closure Dates for Salmon Fishing Areas (SFA) 2 to 14 for 1984 to 1989.

Table A3.1. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 2. Opening date was June 5. Quota was 200 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t	%	No.	%
84	1471	169009	Oct. 15	0	0	0	0
85	1402	138003	Oct. 15	0	0	0	0
86	1424	308584	July 16	109	35	89	80
87	1471	407069	July 4	207	51	10	50
88	1444	291798	July 14	92	32	34	100
89	1412	212758	Sept 11	13	7	0	0
Mean		254769		70	21	22	38

Table A3.2. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 3. Opening date was June 5. Quota was 155 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t.	%	No.	%
84	1892	144467	Oct. 15	0	0	0	0
85	1750	119919	Oct. 15	0	0	0	0
86	1752	191939	July 15	37	19	103	60
87	1730	368639	June 29	214	58	204	100
88	1728	192245	July 11	37	19	74	67
89	1700	150942	Oct. 15	0	0	0	0
Mean		195391		48	16	136	59

Table A3.3. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 4. Opening date was June 5. Quota was 100 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t.	%	No.	%
84	3124	122478	July 25	0	0	38	50
85	2768	102756	Sept 6	0	0	0	0
86	2782	199992	July 2	100	50	57	100
87	2764	180130	June 29	80	44	26	50
88	2728	103573	Aug 5	4	4	0	0
89	2716	132697	July 17	33	25	73	50
Mean		141821		36	21	32	42

Table A3.4. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 5. Opening date was June 5. Quota was 25 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t.	%	No.	%
84	1341	56939	June 22	32	56	150	100
85	1122	69960	June 30	45	64	28	100
86	1124	60959	June 26	36	59	0	0
87	1100	60177	July 1	35	58	31	40
88	1036	38760	July 8	14	36	0	0
89	1028	37013	July 2	12	32	48	33
Mean		54512		29	51	43	46

Table A3.5. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 6. Opening date was June 5. Quota was 20 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t.	%	No.	%
84	1160	33844	July 11	14	41	38	50
85	1036	64844	July 6	45	69	26	100
86	1028	53643	June 19	34	63	0	0
87	1018	47545	June 19	28	58	26	100
88	964	24604	July 18	5	20	0	0
89	952	27436	July 8	7	26	0	0
Mean		42008		22	46	15	42

Table A3.6. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 7. Opening date was June 5. Quota was 15 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t.	%	No.	%
84	1012	18617	July 22	4	21	0	0
85	914	24449	July 4	9	38	77	100
86	922	19174	July 10	4	21	0	0
87	920	25712	June 26	11	42	0	0
88	868	16287	July 24	1	6	0	0
89	864	14497	Oct 15	0	0	0	0
Mean		19808		5	21	13	17

Table A3.7. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 8. Opening date was June 5. Quota was 10 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t.	%	No.	%
84	774	31067	June 14	21	68	0	0
85	744	30529	June 12	21	68	0	0
86	732	24370	June 25	14	58	29	100
87	700	23164	June 17	13	56	26	100
88	708	19246	June 19	9	47	0	0
89	700	12070	July 10	2	17	0	0
Mean		23411		13	52	9	33

Table A3.8. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 9. Opening date was June 5. Quota was 7 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t.	%	No.	%
84	201	11933	July 10	5	42	0	0
85	178	10758	July 21	4	36	0	0
86	180	7884	July 24	1	13	0	0
87	172	6925	Oct 15	0	0	0	0
88	172	8174	July 23	1	13	0	0
89	168	7916	July 15	1	13	0	0
Mean		8932		2	20	0	0

Table A3.9. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 10. Opening date was June 5. Quota was 25 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t.	%	No.	%
84	718	26128	Aug 20	1	4	0	0
85	644	51062	July 4	26	51	0	0
86	656	48926	June 24	24	49	0	0
87	652	28326	July 18	3	11	0	0
88	624	17581	Oct 15	0	0	0	0
89	624	39709	June 30	15	38	36	100
Mean		35292		11	26	6	17

Table A3.10. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 11. Opening date was June 5. Quota was 25 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t.	%	No.	%
84	786	33205	July 7	8	24	38	100
85	722	101388	June 25	76	75	0	0
86	740	67040	June 19	42	63	0	0
87	728	53015	June 14	28	53	0	0
88	692	21389	Oct 15	0	0	0	0
89	688	34770	June 26	10	29	0	0
Mean		51802		27	41	6	17

Table A3.11. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 13. Opening date was June 5. Quota was 25 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t.	%	No.	%
84	513	42400	July 1	7	17	0	0
85	408	32300	July 10	0	0	0	0
86	472	79300	June 23	44	56	0	0
87	476	66300	June 24	31	47	0	0
88	464	77600	June 28	43	55	0	0
89	452	46300	July 2	11	24	0	0
Mean		51802		23	33	0	0

Table A3.12. Effect of 1990 quota on Nfld-Labrador commercial fisheries, 1984-89 for SFA 14. Opening date was June 5. Quota was 25 t. One (1) Gear unit=50 fathoms.

	Observed			Predicted Reduction			
	Effort	Catch	Predicted Close	Catch		Maine	
Year	(Gear Unit)	(kg)	Date	t.	%	No.	%
84	1233	55700	July 19	6	10	0	0
85	1140	48100	Oct 15	0	0	0	0
86	1152	79300	June 12	29	37	86	100
87	1140	146000	June 27	96	66	0	0
88	1076	96200	July 1	46	48	22	100
89	1060	76000	July 6	26	34	0	0
Mean		51802		27	33	27	50