Fisheries and Oceans / Pêches et Océans

Canadian Stock Assessment
Proceedings Series 99/24

Évaluation des stocks canadien
Séries des comptes rendus 99/24

Proceedings of the 1999 Newfoundland Region Salmonid Stock Assessment Meeting

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September 1999

Canada

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ABSTRACT

The sixth annual Salmonid Stock Assessment Meeting for the Newfoundland Region was held in St. John's, Newfoundland on October 26, 1998, March 8-10, 1999 and April 27, 1999. The general status of Atlantic salmon stocks in Newfoundland and Labrador and status of salmon stocks on 20 individual rivers in 1998 were examined. An overview of landings in the Arctic charr commercial fishery in Labrador in 1998 was provided and biological characteristics data were updated. Data and analyses involved in status of stock determinations were contained in 30 working papers. This report summarizes each of the working papers, provides stock status summary sheets for individual stocks, and discusses issues related to the data used in stock assessments.

A Workshop on brook trout studies in the Indian Bay watershed was held on 20-21 January 1999 at the Provincial Wildlife office in St. John's, Newfoundland. During the workshop methodologies were examined and results discussed from two working papers. The overall conclusion by workshop participants was that there is sufficient information to assess status of brook trout in the Indian Bay watershed and provide advice to managers as part of the stock assessment process. Output from brook trout exploitation modeling should prove very useful for fisheries managers and the general public.

INTRODUCTION

The sixth annual Newfoundland Region Salmonid Stock Assessment meetings were held in St. John's, Newfoundland on October 26, 1998, March 8-10, 1999 and April 27, 1999. In addition to Department of Fisheries and Oceans (DFO) scientific and fisheries management staff, the meetings were attended by representatives of the Government of Newfoundland and Labrador, Parks Canada, Memorial University of Newfoundland, and the Indian Bay Ecosystem Corporation. Working papers containing information and analyses related to status of stocks, estimates of population size, and future abundance were presented and discussed.

A brook trout workshop was held at the Government of Newfoundland and Labrador, Inland Fish and Wildlife Division offices in St. John's, Newfoundland, in January, 1999. During the Workshop, the results of population estimates from several ponds in the Indian Bay watershed, catch statistics, biological characteristics of the exploited fish populations and exploitation model were discussed.

This report contains a summary of each of the working papers presented and associated discussion. Complete details of the data and methodologies used in the assessments will be published in the DFO Canadian Stock Assessment Secretariat Research Document series. Additional summaries, environmental considerations, future prospects, and management issues are presented in Anon. (1999)[1]. A copy of the agenda is shown in Appendix 1, the list of participants in Appendix 2, the list of working papers in Appendix 3, a report from a Trout Workshop held January 20-21, 1999 in Appendix 4, and individual stock summary sheets in Appendix 5.

SUMMARY OF PRESENTATIONS

A total of 30 working papers was presented, 27 on Atlantic salmon, one on Arctic charr, and two on brook trout. Three papers provided a general overview of the status of Atlantic salmon at the Salmon Fishing Area (SFA), sub-regional, and regional levels separately for insular Newfoundland and Labrador. Trends in recreational fishery catch and effort data, and counts at various facilities were examined in relation to the 1998 Salmon Management Plan and the moratorium on the Atlantic salmon commercial fishery, which was implemented in 1992 and entered its seventh year in 1998. Commercial fishing moratoria were also in place in Straits area (SFA 14B) in 1997 and southern and northern Labrador (SFAs 1 & 2) in 1998. Papers were presented that examined the status of Atlantic salmon in relation to conservation requirements for 20 rivers (plus three sections for Exploits River) in insular Newfoundland. Also compared were total river escapements, spawning escapements, and estimates of total population size (certain rivers) prior to and during the commercial fishery moratorium in insular Newfoundland and Labrador. Elements of the results of these analyses for individual rivers are shown in the attached Summary Sheets (Appendix 5). A map

[1]DFO Science Stock Status Report Series 1999 D2-01.

showing the SFAs of the Newfoundland Region, the individual rivers assessed, and percent of conservation egg requirements achieved for each river in 1998 is provided in Figure 1. The paper on Arctic charr presented information on commercial fishery landings for 1998 as well as historical landings and quotas. One additional paper examined the potential impact of climate warming on recreational salmon fishing opportunities in Newfoundland.

GENERAL DISCUSSION

For the past several years, there have been concerns that continued management changes in the recreational fishery as well as reduced enforcement staff due to budget restraints have seriously eroded the usefulness of angling data for historical comparisons, especially in terms of abundance indices and long-term trends. This is especially true for 1997-98, wherein angling catch data was derived solely through the License Stub Return System, with the exception of SFAs 1 and 2 in Labrador and a small number of rivers in SFAs 12 and 13 which are derived from fish camp operators and DFO Fishery Officers. This lack of comparability of present to the historical data is also influenced by the myriad of management changes, albeit necessary ones, that have altered fishing practices over the years and severely constrained our ability to assess status of stocks in Newfoundland and Labrador. Until a sufficient time series has been developed from the License Stub Return System, we must rely almost exclusively on the monitoring facility rivers for stock assessments and information on trends in population sizes. In 1998, there were no assessment results for Labrador salmon stocks. The closure of the commercial fishery in Labrador should have increased returns to freshwater; however, without assessment facilities the degree to which this occurred is unknown and without counting facilities in the future will remain so.

Unrecorded mortalities of salmon in freshwater in relation to estimates of spawning escapement and egg deposition continues to be an issue that creates some uncertainty in the estimated spawners and egg depositions. Potential sources of unrecorded mortality include poaching activity, hook-and-release fishing, and natural causes. Mortalities from some if not all of these sources are potentially applicable to most river systems; although, the rate probably varies annually and among rivers. The conservation requirement for fluvial habitat currently used throughout Atlantic Canada for Atlantic salmon is 240 eggs per 100 m^2. Removals due to poaching and disease have been incorporated into this value. In insular Newfoundland, a substantial portion of total production is derived from pond habitat which also appears to some degree to be the case in Labrador. Pond habitat is evaluated using a conservation requirement of 368 eggs per hectare (105 eggs per hectare is used in northern areas), but there is no allowance for poaching or disease in this value. In addition, at the time that the conservation requirements for fluvial and pond habitat were derived, hook-and-release fishing was not as popular as it is today and no mortalities for this factor were included. A factor of 10% is now routinely applied to hook-and-release records in Newfoundland and Labrador and subtracted from spawning escapement. Refinements to hook and release mortality rates are highly desirable and should be done through experimentation on rivers in Labrador and Newfoundland.

Most information on the amount and type of fluvial Atlantic salmon habitat in Newfoundland and Labrador comes from river surveys conducted from helicopter, with minimal groundtruthing. In Newfoundland and Labrador, salmon parr are known to rear in lakes as well as rivers. Over the last few years, work on developing conservation requirements for lake habitat for rivers in several SFAs in insular Newfoundland has been ongoing, and is now nearing completion. Very little in this regard has been done for Labrador rivers. In insular Newfoundland, habitat surveys utilized 1:50,000 topographical maps. However, in Labrador surveys were based on 1:250,000 topographical maps, which were the only maps available in the 1970s when Labrador rivers were surveyed. These smaller scale maps would eliminate the inclusion of substantial amounts of habitat contained in smaller tributaries that would be visible on the 1:50,000 scale maps. Efforts are continuing to produce new habitat estimates for Labrador rivers based on 1:50,000 maps that are now becoming available in electronic format.

ADVICE TO FISHERIES MANAGEMENT

The Newfoundland and Labrador regional assessment of salmonid stocks for 1998 was initiated on 26 October, 1998 to provide advice to Fisheries Management Branch on the general status of salmonids and in particular salmon stocks in insular Newfoundland (SFAs 3-14A), Straits Area of Labrador (SFA 14B), and southern and northern Labrador (SFAs 1&2). The assessments utilized information from rivers monitored for smolts and adult salmon, and those for which angling data were available as collected by river guardians, monitors or sport-fishing camps and from the License Stub Return System. Detailed assessments of the status of salmon in individual rivers was completed in March and April of 1999.

A summary of the results of the general stock status with supporting tables and figures is provided in this proceedings report. Total returns of small salmon to northwest, northeast and east coast rivers in 1998, while generally improving over 1997, remained similar to the mean for the moratorium years 1992-96, in spite of greatly increased spawning escapements beginning in 1992. Available data suggest that there was an overall decline in total returns of small salmon in SFAs 11, 12 and 13 in 1998 compared to 1997. Particular consideration should be given to the conservation needs of the salmon populations in SFAs 11, 12, and 13. The mortality associated with the severe flood in

SFAs 12 and 13 in February 1996 is expected to keep the populations depressed in these areas for another one or two years. Marine survival remains very low for rivers on the south coast, while on the northeast and northwest coasts survival rates in 1998 improved compared to those in 1997; however, survival rates in 1998 are still lower than observed in 1995 and 1996. Unless there is an improvement in marine survival rates, it is likely that salmon populations in 1999 will, in general, be slightly lower or similar to those observed in 1998.

It was not possible to determine the status of the salmon stocks in Labrador for 1998 due to the lack of any in-river assessment programs. Although, there are catch statistics for the angling fishery in Labrador, the available information suggests that angler catch and catch rates are not reliable indicators of abundance without other corroborative data. Based on previous estimates of spawning stock size, it is not expected that populations will increase in 1999 without an improvement in natural survival rates. It is not possible to evaluate the benefits to the spawning stock of the closure of the commercial fishery in 1998.

A summary of stock status information for various rivers and areas of the province follows:

<u>General stock status of Atlantic salmon in insular Newfoundland SFAs 3 – 14A</u>

- Available data includes: monitoring of adult salmon returns on 20 rivers; enumeration of smolts emigrating from 6 rivers; angling data on 4 rivers.

- Small and large salmon, in 1998, generally entered the rivers earlier, and the daily numbers declined at an earlier date than normal.

- Total returns of small salmon in 1998: 1) increased over those of 1997 for 10 out of 20 rivers where adult salmon were monitored; 2) were similar to 1997 returns (±10%) for 4 rivers; and 3) decreased in 6 rivers - Little River (SFA 11), Highlands, Crabbes, Fischells and Humber rivers (SFA 13), and Lomond River (SFA 14A).

- Total returns of small salmon in 1998: 1) were similar to the mean for 1992-96 for 6 out of 17 monitored rivers; 2) exceeded the mean for 6 rivers; and 3) declined for 5 rivers, namely: Gander (SFA 4), Terra Nova (SFA 5), Highlands (SFA 13), Humber (SFA 13), and Lomond (SFA 14A) rivers.

- The returns of small salmon in 1998 decreased from those of 1996 in more than 50% of the monitored rivers. Total returns of small salmon in 1996, were among the highest since the closure of the commercial fishery for many monitored rivers. Run timing also occurred early in 1996.

- Analyses of angling catch rates suggest that the returns of small salmon to Garia Bay

Brook (SFA 12) and La Poile River (SFA 12) were lower than in 1997 and 1996; whereas returns to Grand Codroy were similar to 1996. However, catch rates are affected by run timing, management plans, water levels, etc.

- Total returns of small salmon to northwest, northeast and east coast rivers in 1998, while generally improving over 1997, remained similar to the mean for the moratorium years 1992-96. This is in spite of greatly increased spawning escapements beginning in 1992, which contributed to the 1998 returns.

- Available data suggest an overall decline in total returns of small salmon in SFAs 11, 12 and 13 in 1998 compared to 1997.

- Northeast River (Trepassey) and Conne River, both south coast rivers, had returns of small salmon in recent years that are lower than average returns during the 5 years prior to the closure of the commercial fishery.

- Total returns of large salmon in 1998 exceeded those of 1997 for 10 out of 19 monitored rivers, while returns were similar or declined from the 1997 levels in 9 rivers. The nine rivers were primarily in SFAs 5 and 13.

- Total returns of large salmon in 1998 exceeded the 1992-96 mean for 12 of 16 monitored rivers, and were similar to or below the mean for 4 rivers.

- Returns of large salmon in 1998 were greater than the returns in 1996 to 56% of the monitored rivers.

Marine survival and smolt production of Atlantic salmon in insular Newfoundland - 1998

- Marine survival rates were monitored on six rivers.

- Marine survival from smolts to small salmon decreased in three rivers relative to 1997, while increasing in three.

- The lowest survival rate on record occurred at Rocky and Highlands rivers, while at Conne River, the second lowest survival occurred.

- Marine survival still remains low. In rivers where survival rates increased in 1998, rates were lower than rates observed in 1995 and 1996. Rates are still less than 10%, and were either lower than past averages or below values recorded when commercial fisheries were in operation.

- Smolt production in all monitored rivers in 1998 fell by 6 to 32% in comparison with 1997;

- With the exception of Highlands River, smolt production in all other cases is still either moderately high, or consistent with long term average smolt production.
- The low smolt production in Highlands River appears to be related to the severe floods that occurred in February, 1996. This phenomenon probably affected most rivers in SFA 12 and Bay St. George (SFA 13).

- Expectations for 1999 are that if sea survival does not improve in 1998-99, then returns of small salmon in 1999 could be lower than in 1998 due to the decreased smolt production that occurred in 1998.

- General stock status of Atlantic salmon in SFA 14B

- There are no means of assessing the status of the stocks in 1998 or of evaluating the effect of the management changes because no monitoring facilities were operated.

- Anglers reported higher catch rates in 1998 compared to recent years for both small and large salmon and that runs were earlier than normal but tapered off early, similar to insular Newfoundland.

- Increased angling success could have been caused by either one or more of the following: 1) lower than normal water levels in June and July, while water temperatures remained cool; 2) increased returns to the river because of the closure of commercial fisheries in SFA 1 & 2 and/or 3) increased natural marine survival.

- Since there are a number of factors that could affect angler success, it is not possible to determine the relative size of the salmon populations in SFA 14B from angling data.

- The number of spawners, in 1992 and 1993, that contributed to the 1999 returns to Pinware River were less than 50% of the spawning requirement. The spawning stock in the Forteau River was below 50% of the spawning requirement in 1992 but exceeded the requirement in 1993.

- The 1997 Stock Status Report indicated that the salmon stocks in SFA 14B were at critically low levels.

- It is expected that adult salmon returns in 1999 will be similar to those in 1998 unless there is a change in marine survival.

- General Stock Status of Atlantic Salmon in Labrador, SFAs 1 & 2 - 1998

- Based on preliminary catch statistics, primarily from commercial sport-fishing camps, angling catches and catch rates in SFAs 1 & 2 were higher than in 1997.

- Catch rate in SFA 1 was somewhat higher than 1997 and the 1992-97 mean, but lower than observed in 1994 and 1995.

- Catch rate in SFA 2 was higher than in 1997, similar to the 1992-97 mean, but lower than in 1994 and 1995.

- Water levels in most rivers in 1998 were near or lower than average, whereas in 1997 water levels were considerably above average. Thus, angling conditions were much better in SFAs 1 & 2 in 1998 than in 1997 and should have resulted in higher angling catch rates.

- Higher catch rates observed in 1998 compared to 1997 could be related to improved catchability of salmon due to improved angling conditions and/or higher population size due to closure of the commercial fisheries and/or improved natural survival rates.

- Analysis of data from Sand Hill River indicates that there is no relationship between angling catch rates and numbers of salmon in the river. Thus, changes in angling catch rates are not necessarily indicative of changes in population size of salmon, at least not on Sand Hill River. Inclusion of information on angling conditions such as the effects of varying water levels, which were not incorporated into the analysis, may improve the relationship.

- Notwithstanding the above points, the angling catch rates, and catches do not reflect an increase in population size as would have been expected with the closure of the commercial fisheries. However, the angling catch statistics may not reflect the population size of salmon in Labrador.

- With no indices of abundance or data from enumeration facilities in Labrador in 1998, it is impossible to determine the status of salmon stocks in Labrador rivers.

- Based on the estimated numbers of spawners in previous years, there should be improvements in returns of salmon to SFA 1 & 2 rivers in 1999, but noticeably higher returns are not expected until year 2000, assuming the sea survival (although unknown for Labrador stocks) remains at present levels.

RESEARCH RECOMMENDATIONS

The following recommendations are crucial for our ability to assess status of salmonid stocks in Newfoundland and Labrador:

1. There is a need to assess parr-rearing habitat in Labrador in order to determine conservation requirements for individual rivers. The estimates of the number of small and large salmon required for conservation in Labrador were derived from estimates of production during a time when it was high. These estimates should be replaced by habitat-based conservation requirements similar to other rivers in Eastern Canada.

2. There is an urgent need for counting facilities in Labrador. Without counting facilities, as was the situation in 1998, the stock status of Labrador salmon rivers, with the closure of the commercial fishery in SFAs 1 and 2 in 1998, will remain largely unkown. This situation applies equally to northern Labrador Arctic charr which are still being harvested in commercial fisheries.

3. Participants at the assessment meeting reiterated a previous recommendation that no fishing mortality should occur on stocks below conservation requirements.

4. The License Stub Return System reports should include variances for licence stub catches for use in calculating confidence limits. Mandatory return of license stubs would raise return rates to acceptable levels and may improve reliability of the results.

5. The inclusion of repeat spawners and large salmon as part of conservation requirements should be examined.

6. It is recommended that datasets be examined to refine conservation requirements. This should include reference to techniques described in Workshops held in France in 1997 and Dublin, Ireland in 1998.

7. Trout assessment studies should be expanded into other areas using as a model the project design from the Indian Bay trout studies carried out by the Indian Bay Ecosystem Corporation and Wildlife Division, Government of Newfoundland and Labrador.

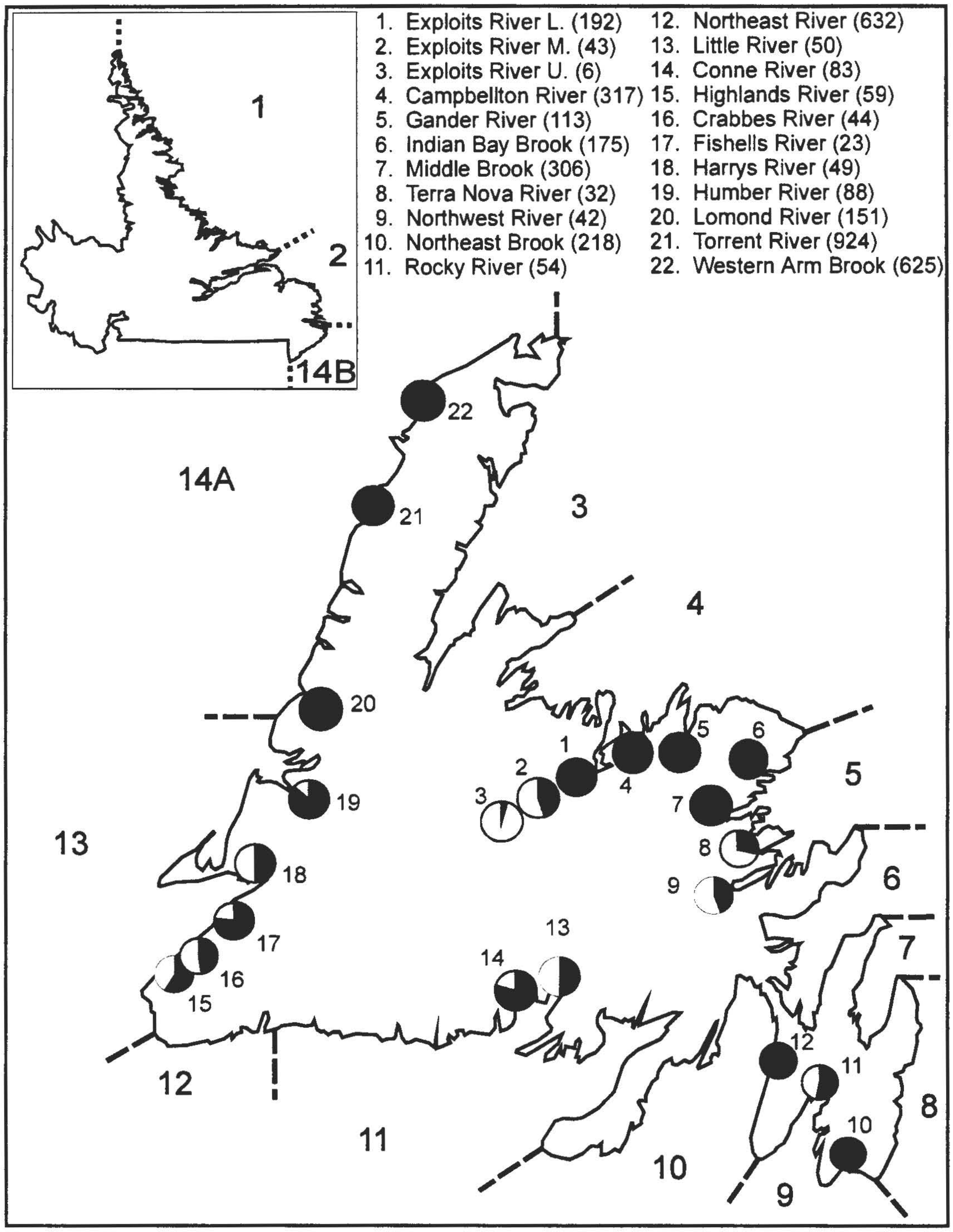

Figure 1. Map showing the Salmon Fishing Areas of Newfoundland and Labrador and the location of rivers, or river sections, for which Atlantic salmon egg deposition in relation to conservation requirement was determined. The black portion of the circle indicates the percentage of egg conservation requirement achieved in 1998.

SUMMARIES OF PAPERS PRESENTED DURING ASSESSMENT MEETINGS

Status of Atlantic salmon (*Salmo salar* L.) stocks of Insular Newfoundland (SFAs 3-8 and 12-14A), 1998

Authors: M. F. O'Connell, J. B. Dempson, C. C. Mullins, D. G. Reddin, N. M. Cochrane, and D. Caines

Summary: The commercial Atlantic salmon fishery moratorium implemented in 1992 entered its seventh year in 1998. The moratorium placed on the Northern Cod Fishery in 1992, which should have eliminated by-catch of Atlantic salmon in cod fishing gear in SFAs 1-9, continued in 1998. There was a small inshore index cod fishery in this area in September-October, which is outside the main migration period of June-early September for most Atlantic salmon destined for insular Newfoundland rivers. A moratorium was placed on cod fishing in SFAs 10-14A in August 1993. In 1997, the cod fishery in SFAs 10 and 11 opened for the first time since 1993 with a TAC of 10,000 t; the quota was increased to 20,000 t in 1998. This fishery opened in May and continued through the summer into autumn. There was a cod TAC of 3,000 t for NAFO areas 4RS and 3PN that affected SFAs 12-14A from June through autumn in 1998. On the northeast and east coasts (SFAs 4 and 5), total returns of small salmon in 1998 increased over those of 1997 in six out of seven monitored rivers; two rivers showed increases in 1998 in relation to the 1992-96 mean, while the remainder, with the exception of one, were similar or recorded slight declines. Available data suggest an overall decline in total returns of small salmon in SFAs 12 and 13 (which includes Bay St. George) in 1998 compared to 1997. Total returns of small salmon in 1998 increased over 1997 and the 1992-96 mean in two out of three monitored rivers in SFA 14A (northwest coast). Total returns of large salmon in 1998 increased over those of 1997 in six (located in SFAs 4 and 14A) out of twelve monitored rivers while the remainder (located in SFAs 5 and 13) were similar to or declined from 1997; most rivers showed increases over or were similar to the 1992-96 mean.

Comments:

None

Recommendations:

Research document should include a brief summary for Labrador salmon stocks.

Status of Atlantic salmon (*Salmo salar* L.) stocks of SFAs 9-11, south coast Newfoundland, 1998

Authors: J. B. Dempson

Summary: The preliminary status of south coast Newfoundland salmon stocks was reviewed based on information obtained from counts of salmon that returned to five rivers: Northeast Brook (Trepassey) and Rocky River (SFA 9), Northeast (Placentia) (SFA 10), Conne River and Little River (SFA 11). Average returns of small salmon during the moratorium years (1992-1998) were still lower than pre-moratorium returns in Conne River and Northeast Brook (Trepassey), but increased in Northeast River (Placentia), Rocky and Little rivers. Returns of small salmon in 1998 increased substantially at Northeast Brook (Trepassey) and Northeast River (Placentia) relative to 1997, while returns in the other monitored rivers decreased from the previous year. Similar results apply to the large salmon component where Conne and Northeast Brook (Trepassey) on average, had greater returns in pre-moratorium years. Overall, however, returns of large salmon improved substantially in 1998 as Northeast River (Placentia) and Rocky River had the highest large salmon returns on record, while at Conne River, large salmon returns were the highest observed during the moratorium and only 15% less than the average during the 1986-91 pre-moratorium period.

Comments:

The absence of counts at Biscay Bay River, SFA 9, were again noted. Continuation of the long time series of information (1983 - 1996) would be invaluable in terms of monitoring the continued status of south coast Newfoundland salmon stocks, some of which have shown little or no improvement as a result of the commercial salmon fishery moratorium.

Recommendations:

Fish counting fence operations should be resumed at Biscay Bay River in 1999, and continued in subsequent years.

Summary of marine survival and smolt production for selected rivers in Newfoundland, 1998

Authors: J. B. Dempson

Summary: Marine survival from smolts to adult small salmon is monitored in six Newfoundland rivers. Survival of salmon that returned in 1998 decreased in three of six cases and was now the lowest (Rocky and Highlands rivers) or second lowest (Conne River) values recorded from the time series of data available. In those rivers where survival increased over the previous year (Northeast Brook (Trepassey), Campbellton and Western Arm Brook), survival was still less than 10% and was either lower than past averages (Northeast and Campbellton) or below values recorded previously when commercial fisheries were still in operation (Western Arm Brook). Thus, the phenomenon of high or above average natural mortality at sea that has been occurring throughout much of the 1990's continues and is of concern given the large-scale reductions in directed marine fishing mortality on this species.

In all six monitored rivers, smolt production in 1998 fell 5.6 to 30.8% when compared with 1997. Smolt production at Highlands River was the lowest recorded and is anticipated to remain low until the year 2000 when the effects of the 1996 flood have ended. Also, at Conne River at Northeast Brook (Trepassey), higher egg-to-smolt survival and smolt production is coinciding with years in which egg depositions were moderately low.

Comments:

It was noted that with the exception of Rocky river, the other rivers where smolt monitoring also occurred prior to the 1992 moratorium (Conne, Northeast Trepassey, Western Arm Brook, Highlands), smolt runs as high or higher than that obtained in 1998 have also been realized at some time during the pre-moratorium period. Information on trends in marine survival is of fundamental importance in evaluating the status of salmon stocks. With over 150 scheduled salmon rivers in insular Newfoundland alone, monitoring six rivers is barely adequate.

Recommendations:

Minimally, all smolt monitoring projects in operation in 1998 should be continued in 1999 and maintained in subsequent years. Additional smolt monitoring programs should be initiated in other rivers especially in Labrador where there are currently none.

Status of the Atlantic salmon (*Salmo salar* L.) stock of SFA 14B, southern Labrador

Authors: C. C. Mullins

Summary: The status of the salmon stocks in two rivers in SFA 14B of Straits area of Labrador was examined. In the absence of counting fences in this area of Labrador in 1998, stock status remains largely unknown. Examination of spawning levels in previous years, which were low, suggests that returns to these rivers are not expected to improve in the near future. On the other hand, closure of the commercial salmon fishery in 1997 in the Straits area and in southern and northern Labrador in 1998 will probably result in increased returns to freshwater. The extent to which this may of occurred is unknown.

Comments:

Stock status of SFA 14B rivers in the absence of assessment projects is mainly unknown.

Recommendations:

1. An assessment should be conducted for Pinware River (mark-recapture) and Forteau Brook (counting fence) to examine salmon returns in the absence of the commercial fishery in northern and southern Labrador.

2. Present information is insufficient to warrant changing advice for 1999 from that given in 1998. Given that spawning escapements leading to returns in 1999 were relatively low and that this stock has experienced several years of declining abundance, the current reductions in fishing mortality are warranted and should continue.

Status of Atlantic salmon (*Salmo salar* L.) stocks in Labrador, 1998

Authors: D. G. Reddin, M. F. O'Connell, N. M. Cochrane and C. C. Mullins

Summary: Information available for determining the status of Labrador salmon stocks was reviewed. No counting facilities were operated in Labrador in 1998. The commercial fishery, which previously had provided data for an assessment model, was closed in 1998. The only time series of data remaining was from the angling fishery on 17 of the approximately 80 rivers in Labrador. For Sand Hill River, for the periods of 1970-73 and 1994-96, there was no relationship between abundance of salmon in the river as enumerated at the counting fence and angling data from that river. This may be due to the expertise of the guides and guests at the angling camp. The stock status of Labrador salmon in 1998 remains unknown.

Comments:

None

Recommendations:

The establishment of counting facilties on Labrador rivers should receive the highest priority. There should be at least two in each of the three SFAs and one with a smolt count so that sea survival can be adequately assessed.

Oceanographic conditions in NAFO Divisions 2J3KLMNO during 1998 with comparisons to the long-term (1961-1990) average

Author: E. Colbourne

Summary: Oceanographic observations from Hamilton Bank on the Southern Labrador Shelf to the Southern Grand Bank during 1998 were presented and referenced to the long-term (1961-1990) mean. Temperatures at Station 27 ranged from 0.3 to 0.5 °C above normal during winter and spring over most of the water column and into early summer near the surface. By mid summer, however, a negative temperature anomaly developed in the upper water column with temperatures reaching 1.0 to 2.0 °C below normal by late summer. These colder than normal temperatures propagated deeper into the water column reaching below 100 m depth by November. Bottom temperatures throughout the year at Station 27 were slightly above normal and upper layer salinities were below normal during the first half of the year, particularly during the summer months. The 1998 summer CIL area off Bonavista and Hamilton Bank increased over 1997 values but was still below normal, continuing a trend established in 1995. Along the Flemish Cap transect across the Grand Bank the CIL was normal during 1998, a decrease from 1997 and identical to the 1996 value. The total volume of sub-zero °C water on the Newfoundland Shelf during both summer and fall is continuing a below normal trend established in 1995. Bottom temperatures on the Grand Bank during the spring were up to 1.0 °C above the long-term average. During the fall of 1998 bottom temperatures were still above normal over many areas, particularly on the offshore portion of Northeast Newfoundland. An analysis of the areal extent of bottom water in different temperature bins revealed a significant decrease in the areal extent of sub-zero °C water and a corresponding increase of about 70 % in the extent of water above 1.0 °C during the spring of 1998 compared to 1997. In general, the analysis shows that the below normal oceanographic trends in temperature and salinity, established in the late 1980s, reached a peak in 1991, started to moderate during 1994 and were above normal by 1996. During 1997 and 1998, temperatures continued above normal over many areas, particularly on the Grand Bank during spring and over the deeper portions of the northeast Newfoundland Shelf. The main exception was the near shore coastal regions in the upper to mid water column where temperatures were colder than normal during summer and early fall.

Comments:

None

Recommendations:

None

Report of assessment activities on Paradise River, Labrador in 1998

Authors: D. G. Reddin, P. B. Short, R. Johnson and J. Bird

Summary: In collaboration with the Sandwich Bay Watershed Authority, an Atlantic salmon assessment project was initiated on Paradise River in 1998. A river survey the previous summer had concluded that the best method of determining the total population size of salmon in the river was by mark-recapture with salmon taps located at two sites. A counting fence was installed on Southwest Brook a tributary near the river mouth to provide an independent estimate of tagged:untagged ratio. Because of the lateness in receiving funds to pay for the project, salmon had entered the river prior to fence and trap installation. Catches of salmon were low at all sites. One hundred and forty-two (142) salmon were tagged and released from the lower site but only four tagged salmon were recaptured. The low number of recaptured tagged salmon precluded deriving a population estimate.

Comments:

1. The high number of river age two salmon compared to other Labrador rivers suggests that readings from scales may be too low and should be re-evaluated.

2. The recapture in Eagle River of a salmon tagged and released in Paradise River estuary indicates the presence of Eagle River salmon at the tagging site. Population estimates without accounting for the Eagle River salmon will over-estimate the numbers of Paradise River salmon.

3. The use of counting fence and recapture traps to provide for independent estimates of tagged:untagged salmon should be repeated.

Recommendations:

Repeat mark-recapture in 1999 if funds are available.

Status of the Exploits River stock of Atlantic salmon (Salmo salar L.) in 1998

Authors: C. E. Bourgeois, J. Murray, and V. Mercer

Summary: The status of Atlantic salmon in the Exploits River in 1998 was derived from three fishway counts, recreational fishery data, fecundity data and biological characteristic data for the Exploits stock. The 1998 run was the second earliest on record and resulted in the second highest escapement to the watershed. River escapement of 29,052, composed of 27,093 small and 1,959 large, salmon is second only to the 1996 river escapement. The watershed received 63% of the required conservation egg deposition with the lower, middle and upper sections of the watershed receiving 192%, 43% and 6%, respectively. Since 1996 the portion of the river escapement migrating upstream of Grand Falls has been increasing suggesting previous enhancement efforts are proving worthwhile. The 1998 recreational catch was 3,006 small salmon (1,218 retained and 1,788 released).

Comments:

1. Concern was expressed over the low level of returns to the upper section (area upstream of Red Indian Lake) of the watershed. This was of additional concern as the Exploits River management plan called for an adult transfer from Grand Falls to Red Indian Lake which was not done in 1998.

2. Results of angling creel conducted on the area below Bishop Falls in 1998 resulted in review committee members questioning the validity of the 1997 catch statistics collected for the area below Bishop Falls in 1997. The catch statistics for 1997 for the entire watershed were derived from the catch below Bishop Falls. While the review committee members were concerned with the 1997 angling catch statistics the committee felt that the angling creel conducted in 1998 should be repeated in 1999 and the three years data assessed prior to making any recommendation.

Recommendations:

1. Increase the management target on the Exploits River from 13,000 to 18,000 spawners.

2. Conduct an angling creel on the area below Bishop Falls similar to that conducted in 1998.

3. Numbers of net marked fish should be recorded at Bishop Falls and Grand Falls.

Status of Atlantic salmon (Salmo salar L.) in Campbellton River, Notre Dame Bay (SFA 4), Newfoundland in 1998

Authors: P. R. Downton and D. G. Reddin

Summary: The status of Atlantic salmon in Campbellton River in 1998 was determined from the number of salmon counted through a portable fish counting weir (fence) located on the main stem just above head of the tide as well as from biological data collected from the recreational fishery. The assessment was conducted in response to major management changes that were introduced in 1992 and continued into 1998. Specifically, there was a moratorium on the commercial Atlantic salmon fishery in insular Newfoundland and restrictions were placed on recreational fishing in each Salmon Fishing Area. The proportion of the conservation egg requirement achieved for Campbellton River in 1998 was 317 %. On average for the period of 1993-98, Campbellton River achieved 275 % of its conservation requirement. Adult returns averaged 3058 for small and 306 for large salmon, 1993-98. Historical records indicate that circa. 1800, adult returns to a harvesting weir were about 12,000 salmon annually. The Campbellton River assessment was done in collaboration with the Lewisporte Area Development Association.

Comments:

1. Smolt and adult counts were complete in 1998. Kelt count is under-estimated due to the late installation of the counting fence. This may have resulted in an over-estimate of survival rate of 1SW salmon returning in 1998 from 1997 smolts.

2. There is an apparent increase in age 4 smolts to 50% in 1998 from about 40% in 1997. This should be further monitored.

Recommendations:

1. Repeat mark-recapture on kelt in 1999 if funds are available.

2. Long-term funds should be found for Campbellton River project out of A-base DFO resources to ensure this very valuable project continues in the future.

In-season forecast for Atlantic salmon (Salmo salar L.) returning to Campbellton River in 1998

Authors: D. G. Reddin

Summary: This document examined techniques that could be used for in-season forecasts for Atlantic salmon returning to Campbellton River in 1998. Three techniques were examined: proportional, regression and regression with environmental correction. Regression with environmental correction gave the most accurate forecasts with a standard error of less than 10% of the forecasted value. While thermal habitat was used as an environmental variable in the regression model there are other data that could be used.

Comments:

1. Low water and higher water temperatures could result in quite different run timing than shown in the paper which could increase the residuals and error substantially.

2. Correlations between smolt and adult run timing were examined but were inconclusive due to shortness of the time series.

Recommendations:

The predictive model may be over-parameterized for such a short time series. Analysis should be updated as more data becomes available.

Predation on Atlantic salmon smolts (*Salmo salar* L.) by avian and gadoid predators in Campbellton River estuary, Newfoundland, 1998

Authors: P. Downton, D. G. Reddin and R. Johnson

Summary: Observations of marine predation on salmon smolts were made during the spring of 1998 near the vicinity and in the estuary of Campbellton River. Birds and cod were observed preying and feeding on salmon smolts. A seal was also captured during gill netting for cod. Out of 145 Atlantic cod stomachs examined 2 or 1% contained salmon smolts. Out of 11 rock cod stomachs examined 3 or about 30% contained salmon smolts. Avian predators included herring gulls, black-backed gulls, terns and gannets. All four species were observed feeding on smolts in shallow water at the river mouth. Also, herring gulls were observed feeding on smolts in the vicinity of the counting fence. While the feeding rate by Atlantic cod was low, the higher feeding rates by rock cod and avian predators suggests that the accumulative effects of predation in the estuary could be important to survival of adult salmon back to Campbellton River. More research would be required to quantify the effects of predation on the salmon population.

Comments:

Results are very useful for explaining effects of predation on sea survival.

Recommendations:

1. The predation study should be repeated in 1999.

2. If possible, cod predation experimentation would be greatly enhanced by a mark-recapture experiment to estimate the number of cod in the area.

Migration of Atlantic salmon kelts (*Salmo salar* L.) in relation to sea water temperature in Newfoundland, 1998

Authors: D. G. Reddin, J. B. Dempson, P. Downton, C. C. Mullins and K. D. Friedland

Summary: Data storage tags (DST) manufactured by Kiwi Inc. were applied to 139 Atlantic salmon kelts at enumeration facilities on Western Arm Brook, Humber, Campbellton and Highlands rivers, Newfoundland in 1998. In total, 12 of these Kiwi DSTs were subsequently recaptured and water temperatures downloaded from 11 of them. Control DSTs for verification purposes were applied to kelts held in a freshwater fluvarium and indicated that water temperatures recorded by the DSTs were accurate.

Results from 11 recaptured tags indicated differences between rivers and among fish within a river. Water temperature profiles are useful for indicating water temperatures encountered by salmon in freshwater and in the sea and may prove useful for determining temperature preferences. This information is important for marine climate change models and water temperature protocols for opening/closing angling fisheries in freshwater due to high water temperatures. Unlike some Pacific salmon, no diurnal movements could be inferred. Salmon spent most of their time in water from 4.7 to 16.8 °C.

Comments:

Data series should be trimmed to exclude all data except for time salmon were in the water.

Recommendations:

The Kiwi DST study should be repeated in 1999.

Status of Atlantic Salmon (*Salmo salar* L.) in Gander River, Notre Dame Bay (SFA 4), Newfoundland, 1998

Authors: M. F. O'Connell, E.G.M. Ash, and A. Walsh

Summary: The status of Atlantic salmon in Gander River in 1998 was determined using counts of small and large salmon from a counting fence located on the main stem just above head of tide, recreational fishery data, and biological characteristics information. Total returns of small salmon in 1998 increased by 77 % over the number recorded in 1997. Total returns in 1997 were the lowest since the implementation of the commercial salmon fishery moratorium in 1992. Returns of large salmon in 1998 increased by 95% over 1997 and were the second highest of the moratorium years. The proportion of large salmon (0.163) in 1998 was also the second highest of the moratorium years. In contrast to 1997, when conservation egg requirement was not achieved (63%), requirement was exceeded in 1998 (113%). In 1998, a number of stomachs of Atlantic cod (*Gadus morhua* L.) was examined for evidence of predation on Atlantic salmon smolts. Sampling was conducted off Main Point, Gander Bay, during the period of out-migration of smolts. Of 125 cod stomachs examined, 2 (1.6%) contained smolts.

Comments:

None

Recommendations:

None

Juvenile Atlantic salmon (*Salmo salar* L.) abundance in the Experimental Ponds Area relative to subsequent adult returns to the Gander River as an index of marine survival: apparent evidence for density-dependent marine mortality

Authors: R. Knoechel, P. M. Ryan, and M. F. O'Connell

Summary: A marine survival ratio index was calculated as the number of adult salmon returning to the Gander River divided by the total juvenile salmon populations in the Experimental Ponds Area (EPA) at the headwaters of the river in the previous spring. This survival index increased more the four-fold in the first four years (1992-95) following closure of the commercial fishery in 1992 but then dropped moderately in 1996 and then precipitously in 1997, suggesting a large decrease in marine survival despite the continued closure of the commercial fishery in insular Newfoundland. The decreases in marine survival index occurred in the context of increasing juvenile abundance, a pattern consistent with an interpretation of density-dependent mortality. Juvenile abundance declined in 1997 and the marine survival index increased, as would be expected if mortality were density-dependent. The negative correlation between juvenile abundance and the marine survival index leads to a prediction of a dome-shaped relationship between juvenile abundance and subsequent adult returns to the Gander River. This relation suggests that the Gander River conservation requirement of 21,828 small adult spawners will be met when EPA juvenile abundance in 1998 was 2,385 individuals which yields an estimated 1999 return of 19,740 small salmon which would be 10% below the conservation requirement. The predicted return would increase to 25,643 small salmon if the high marine survival observed during the early moratorium years (1992-95) was achieved.

Comments:

None

Recommendations:

1. Small salmon returns to Gander River in 1999 probably will not be lower than in 1998.

2. Increased exploitation over present levels is not recommended.

Status of Atlantic Salmon (*Salmo salar* L.) in Indian Bay Brook, Middle Brook, and Terra Nova River (SFA 5), Northeast Brook, Trepassey (SFA 9), and Northeast River, Placentia (SFA 10), Newfoundland, 1998

Authors: M. F. O'Connell, E.G.M. Ash, and A. Walsh

Summary: The status of Atlantic salmon stocks in 1998 was determined for Indian Bay Brook, Middle Brook, and Terra Nova River in Salmon Fishing Area (SFA 5), Northeast Brook, Trepassey in SFA 9, and Northeast River, Placentia in SFA 10. Total returns of small salmon to Indian Bay Brook and Middle Brook in 1998 increased by 89% and 98% over 1997, the highest since the closure of the commercial Atlantic salmon fishery in 1992 for Middle Brook but the fourth highest for Indian Bay Brook. Returns for both these rivers in 1997 were the lowest of the moratorium years. Total returns of small salmon to Terra Nova River in 1998 were similar to 1997 in which year the second lowest returns of the moratorium years were recorded. Increases in small salmon returns were also recorded for Northeast Brook, Trepassey (82%) and Northeast River, Placentia (22%) in 1998; returns for the former river in 1997 were the lowest of the moratorium years and second lowest for the latter. Returns of large salmon in 1998 decreased from those of 1997 in Middle Brook (25%) and Terra Nova River (26%) but remained similar for Indian Bay Brook (5%). Record high returns of large salmon occurred in Middle Brook in 1997 while for Terra Nova River returns in that year were the second highest recorded. Returns of large salmon to Northeast Brook, Trepassey in 1998 increased by 22% over 1997, still among the lowest of the moratorium years, while returns to Northeast River, Placentia were the highest on record. Conservation egg requirement was achieved in all rivers except Terra Nova River. It should be noted that accessible rearing habitat above the lower Terra Nova River fishway more than doubled with the opening of the area above Mollyguajeck Falls in the early 1990s. Smolt-to-adult survival for Northeast Brook, Trepassey in 1998 (adult year) was 5.0%, an improvement over the 2.9% observed in 1997, but low compared with the record high of 9.2% in 1996. The survival value for 1997 was the lowest of the moratorium years and the second lowest of the entire time series.

Comments:

None

Recommendations:

None

Status of two enhanced Atlantic salmon (*Salmo salar* L.) stocks of the Newfoundland Region in 1998

Authors: C. E. Bourgeois, J. Murray, and V. Mercer

***Summary*:** Stock assessments were conducted for two enhanced rivers namely Rocky (SFA 9) and Little River (SFA 11). Stock status was determined for Rocky River and Little River through complete counts of large and small salmon at a fishway and a counting fence respectively. No fry stocking was conducted on Rocky or Little rivers in the spring of 1998. Rocky and Little rivers received 54% and 50% of their respective conservation egg depositions. Rocky and Little rivers are closed to recreational fishing. The 1998 escapement to Rocky River was the highest in time series. Smolt-to-1SW survival for Rocky River decreased to 2.2% for the 1997 smolt class. Rocky River recorded the third highest smolt run to date in 1998 of 12,163.

***Comments*:**

None

***Recommendations*:**

None

Potential impact of climate warming onrecreational fishing opportunities for Atlantic salmon in Newfoundland

Authors: J. B. Dempson, M. F. O'Connell, and N. Cochrane

Summary: Potential impacts of climate warming on recreational fishing opportunities were addressed by examining the frequency and extent that Atlantic salmon rivers in Newfoundland were closed to recreational fishing over a 17-year period (1982 - 1998) because of warm water temperatures and low water levels. The potential number of fishing days available was calculated and was found to vary among Salmon Fishing Areas (SFAs), among years (SFAs combined), and among years within SFAs. Similarly, the number of rivers that have been closed for environmental reasons also varied among SFAs, years (SFAs combined) and among years within SFAs. While 1998 experienced the greatest number of rivers being affected with temporary closures because of environmental conditions (N = 121, 77%), overall only 13.7% of potential fishing days were lost. In contrast, almost 37% of the total potential fishing days for all SFAs in 1987 were closed to angling, and varied from as low as 12% to as high as 65% among individual areas. Geographically, west and south-west coast rivers were impacted less from environmental closures than east and some south coast fishing areas (SFAs 5 - 10). Six of the eight years with the highest percentage of days when rivers have been closed were in the 1990's with 1997 and 1998 being the second and third highest to date. A trend for increased closures of rivers related to environmental reasons could affect the economic importance of the recreational salmon fishery and also impact on the ability to assess the status of stocks relative to conservation of the resource. Whether or not climate warming affects Newfoundland in the long term, the analysis clearly illustrates that over the past 17 years, variations in climate have already impacted recreational fishing opportunities in the Province.

Comments:

1. This was the first time that these data have been summarized and examined for any spatial or temporal trends. Given the increased public awareness and attention related to potential global warming scenarios, this information is expect to be of interest to the recreational angler population and to fishery managers.

2. Annual updates of river closures for environmental reasons should be routinely compiled and summarized.

Recommendations:

None

Estimation of the Labrador component of prefishery abundance of North American Atlantic salmon (*Salmo salar* L.) in 1998

Authors: D. G. Reddin and C. C. Mullins

Summary: For the years 1969-97, the Labrador component of North American prefishery abundance (PFA) through estimates of returns to rivers and spawning escapement was estimated based on the commercial fishery catch data. Since the commercial fishery in Labrador was not open in 1998, and because the PFA is used to provide catch advice on North American salmon stocks, an alternate method was required. Five options were examined including not providing an estimate for Labrador, removing Labrador from the time series, providing new estimates based on exploitation rate/habitat model using angling catch data, and estimating prefishery abundance based on proportions from previous time series or regression estimates based on the previous time series. It is recommended that no method be used to adjust PFA estimates to include Labrador without corroborative evidence from salmon counting facilities. There were no counting facilities in 1998. Also, none of the methods examined should be used to provide an assessment of the status of Labrador salmon stocks in 1998.

Comments:

The data series of prefishery abundance can be adjusted to include Labrador which will then represent about 10-15% of the total prefishery abundance. However, the adjusted numbers should not be used to represent stock status of salmon in Labrador rivers where they would be 100% of the number.

Recommendations:

The establishment of counting facilties on Labrador rivers should receive the highest priority. There should be at least two in each of the three SFAs.

Status of Atlantic salmon in Conne River, SFA 11, Newfoundland, 1998

Authors: J. B. Dempson, G. Furey, and M. Bloom

Summary: Conne River flows into Bay d'Espoir on the south coast of Newfoundland. Adult salmon escapements have been monitored with a fish counting fence since 1986 while smolt populations have been surveyed by mark-recapture since 1987. In 1998, returns to home waters (river and estuary) were 2931 salmon < 63 cm in length (small) and 295 salmon ≥ 63 cm (large) in size. This represented a decrease of 8% for small salmon compared with 1997 while large salmon returns increased by 59% to the highest level since 1990. Sea survival of smolts to 1SW salmon fell to 2.46%, the lowest value recorded. Estimated egg deposition from small and large salmon represented 83% of the current Management Target of 7.8 million eggs, but was 150% of the conservation egg requirement. Analysis of biological characteristic data indicated that the proportion of previous spawners in the small salmon category continues to remain high in recent years. Although the smolt run in 1998 was 31% less than the previous year, it was still above the 1987-1995 average. There has been an increase in egg-to-smolt survival coincident with decreasing egg deposition per unit of fluvial habitat suggestive of possible density-dependent processes. Results to date suggest there is little merit in maintaining a Management Target of 7.8 million eggs.

As specified in past years, the commercial salmon fishery moratorium has had a negligible impact on the Conne River salmon stock. Salmon returns and sea survival rates continue to remain below levels experienced during the premoratorium period (1986-1991).

Information on occurrences of escaped farmed rainbow (steelhead) trout in Conne River and the surrounding Bay d'Espoir area are also provided.

Comments:

1. Conne River is distinguished from other Newfoundland salmon rivers in having a defined <u>management target</u> for the required number of eggs or fish. This is different, and higher, than a conservation requirement based on the habitat approach in place elsewhere in the Province. The management target was derived from fluvial habitat x 2.4 eggs/m^2 and egg/recruit applied to the 1987 total population size as determined from an assumed commercial exploitation rate and should be reevaluated.

2. It was noted that estimates of egg-to-smolt survival have increased coincident with declining egg depositions per unit area of fluvial habitat. The increased freshwater

survival and highest smolt production on record is consistent with a number of other salmon stocks that have experienced increased freshwater survival in recent years.

Recommendations:

None

Status of Atlantic salmon at Highlands River, Bay St. George, SFA 13, Newfoundland, 1998

Authors: J. B. Dempson and G. Clarke

Summary: Highlands River flows into Bay St. George on the southwest coast of Newfoundland. Adult salmon escapements have been monitored with a fish counting fence from 1980 to 1982 and again from 1993 to 1998. In 1998, returns were 96 salmon less than 63 cm in length (small) and 117 salmon greater than or equal to 63 cm (large) in size. This represented a decrease of 76% for small salmon compared with 1997 while large salmon returns declined by 25%. Sea survival was again low (less than 1.5%) for both small and large salmon components. Estimated egg deposition from small and large salmon represented 59% (46 - 74%) of the conservation requirement. Analysis of biological characteristic data indicated that small salmon were predominantly one-sea-winter fish whereas 65% of large salmon were 2SW salmon, 27% previous spawners and 4% were virgin 3SW fish. The smolt run in 1998 was the lowest on record (5,922) and is believed to have been a result of the extreme flood that occurred in February, 1996. If so, then low smolt production is expected again in 1999. Conservation requirements are also not expected to be met in 1999.

A review of hydrological conditions at Highlands River for the period 1982 - 1997 indicates that extreme high water events have happened periodically in the past suggesting that Highlands is an unstable system from a hydrological point-of-view. This instability could mean that density independent factors may be more important in regulating salmon production levels than density dependent processes. It could also mean that over the past 17 years, Highlands may have been 'flushed' on several occasions contributing to a continuing pattern of high variability in salmon production.

Comments:

1. It was noted that historically, when commercial fisheries were operating, there were a few occasions when the reported recreational salmon catch at Highlands River approximated the total returns to the river that occurred in 1998. It was also noted that substantive amounts of the Highlands River watershed have been forest harvested and may have contributed to the apparent periodic hydrological instability. Given that commercial fisheries have been closed since 1992 and that Highlands River itself has been closed to angling since 1978, there is little to show for the substantive conservation efforts in terms of improved spawning escapements.

2. A simple simulation exercise was used to illustrate that the impact of allowing a hypothetical selective and controlled recreational harvest of large salmon at

Highlands River during the past six years (10 or 20 fish per year) would have been minimal. It was shown that current estimates of the percent egg conservation levels attained would be correspondingly lowered an additional 4.2 or 8.5% (i.e., 1998 value of 58.9% would have been reduced to 54.7% (10 fish harvest) or 50.4% (20 fish harvest)).

Recommendations:

1. Scale samples of smolts collected in 1995 should be re-examined as ages are inconsistent with other years.

2. Information on the timing and extent of forest harvesting activities in the Highlands River watershed should be examined in relation to the frequency and extent of the periodic extreme water discharge events that have been documented.

Status of the Atlantic salmon (*Salmo salar* L.) stock of Harrys River/Pinchgut Brook, Newfoundland, 1998.

Authors: C. C. Mullins, D. Caines and S.L. Lowe

Summary: Counts of small and large salmon at the counting fence on Pinchgut Brook in 1998 were less than 4% below those in 1997. The proportion of large salmon was also only slightly less than in 1997 which was the highest of record. Spawning surveys conducted on Harrys River in the fall of 1995-97 indicated that 33-41% of the spawning occurred on the Pinchgut Brook tributary. The total spawning escapements on Harrys River in 1998 based on counts at the counting fence on Pinchgut Brook, were 1,596 small and 177 large salmon. Egg depositions from these spawners potentially represent 49% of the conservation requirement. The Harrys River stock has been at most 52% of the conservation requirement in the last seven years. This is alarming considering the recreational fishery has been restricted to catch and release angling only since 1996 and that the commercial fishery has been closed since 1992. Hence, there is reason to be concerned for the health of this stock. Protection of the spawning and rearing areas are important to the rebuilding of this stock. Increasing juvenile densities indicate a potential for improvement in the status of the stock but the low water levels and high water temperatures in 1998 create continued uncertainty in the short term. If retention angling had been permitted on the river in 1998, potential egg depositions would have been even lower.

Comments:

There is a great deal of concern about the status of the salmon stock on Harrys River. The river once produced the highest catches of all rivers in the Bay St. George area of SFA 13. The technique of using the percentage of spawning on Pinchgut Brook to estimate the total spawning escapement on Harrys River is a reasonable and inexpensive method of assessing the status of this stock. Previous attempts at using a counting fence to assess the entire run were unsuccessful due to extreme fluctuations in water level. There was little variation in the distribution of spawning on Harrys River in the three years of the survey. At this point, the spawning survey needs to be completed every year until all spawning areas are identified.

Recommendations:

1. The percentage of salmon spawning on Pinchgut Brook tributary should be verified using other methods such as visual spawner surveys, tagging in the estuary or a complete count.

2. On future spawning surveys, redds at the test site should be checked for the presence of eggs to determine if false redds are being counted.

3. On future spawning surveys, survey crews should recount the redds at the test site after the survey is completed in order to evaluate the overall accuracy of redd counts.

4. Biological characteristics information for small and large salmon needs to be updated for Harrys River based on internal sex determination.

Status of the Atlantic salmon (*Salmo salar* L.) stock of Humber River, Newfoundland, 1998

Authors: C. C. Mullins and D. Caines

Summary: This is the ninth assessment of that portion of the Humber River salmon stock that enters the river in June to August. A mark and recapture technique was used to estimate the run size and indicates that returns of small salmon in 1998 were lower than in 1997. Total returns of large salmon are currently estimated from returns of small salmon based on the proportion of large salmon observed in the estuary. Total returns of large salmon in 1998 were the highest in the period of assessment. The percentage of virgin 2SW did not increase in 1998 suggesting that increase returns were not due to delayed maturity of 1SW that had been expected to return to the river in 1997. Based on estimates of returns, angling removals and biological information, it is unlikely that conservation requirements were achieved in 1998. A significant relationship between the catch of small salmon in the lower tagging trap and total population size could be useful in in-season evaluation of returns. Catch rates of small salmon at Big Falls were not significantly correlated with the total population size.

Comments:

The fall run of salmon to the Lower Humber River appears to contain all age groups including previous spawners. Thus, the actual population of three-sea-winter salmon may be very low. The mark-recapture project is essential for assessing the Humber River salmon population.

Recommendations:

1. In order to assess the status of the Humber River stock in 1999 using the mark-recapture technique, greater effort will need to be put into developing a method of tag recoveries that is independent of the recreational fishery.

2. The relationships between the count in the lower trap, the catch rates at Big Falls and total population size could be refined by including water conditions in a multiplicative model.

3. Double marking of fish is recommended to estimate tag retention rate for the Humber River.

The status of the Atlantic salmon stock of the Northwest River, Bonavista Bay (SFA 5), Newfoundland, 1998

Author: M. Simpson

Summary: The status of the Atlantic salmon on the Northwest River in 1998 was determined. Total returns to the river were enumerated at a trap located in Northwest Falls fishway approximately 3.0 km upstream from the river mouth with a count of 540 small and 104 large salmon. This is an increase in small salmon of 16% and a decline in large of 43%. In 1998, Northwest River achieved 42% of its conservation egg requirement compared to 46% in 1997, 55% in 1996, and 37% in 1995. The river was closed to recreational fishing in 1996-98.

Comments:

None

Recommendations:

1. Biological characteristics data from the SIAC system should be incorporated into future assessments.

Status of Atlantic Salmon (*Salmo salar* L.) Populations in Crabbes River and Fischells Brook, Newfoundland, 1998

Author: T. R Porter

Summary: Adult Atlantic salmon were visually counted in Crabbes River and Fischells Brook, in 1998. The surveys were conducted during the period 26 August and 2 September by swimmers snorkelling down each river. Almost all of the salmon were found in pools, generally with water depths greater than 1 m. An adjustment factor, ranging from 1.0 from 2.0, was applied to the counts in each river section surveyed to account for fish not observed in the larger pools. There were no known removals after the survey, therefore the adjusted count is considered to be the spawning escapement for the river. An estimate of the numbers of salmon hooked-and-released and numbers retained in the recreational fishery were available from the License Stub Return System. A hook-and-release mortality of 10% was assumed. The estimated total returns to Crabbes River were 490 small and 176 large salmon, and to Fischells Brook was 202 small and 72 large salmon. The percentage of the egg deposition conservation requirements achieved in Crabbes River in 1998 was 44%, which is 54% lower than observed in 1997. In Fischells Brook 23% of the conservation egg deposition requirements were achieved, 48% lower than achieved in 1997. The spawning stock on Fischells Brook is at seriously low levels and no fishing mortality should be permitted. The information available did not lend itself to forecasting the abundance of salmon in 1999. The abundance on small salmon in 1998 may have been due to the severe flooding in February 1996, which could have caused an increase in mortality of juvenile salmon.

Comments:

1. The 6 June opening date for the recreational fishery should have been early enough for salmon to be available to the angling fishery.

2. Are the conservation requirements too high?

3. Are parr distributed throughout the system or they in contagious groups?

Recommendations:

1. Collect tissue samples to examine DNA variation in large and small salmon.

Status of Atlantic salmon (*Salmo salar* L.) stocks of three selected rivers in Salmon Fishing Area 14A, 1998

Author: C. C. Mullins, D. Caines and S. L. Lowe

Summary: Returns of small salmon to Lomond River in 1998 were 46% less than in 1997 and 29% less than the 1992-96 mean. Returns of large salmon were the second highest on record and 66% higher than in 1997. Returns of small salmon to Torrent River were 30% higher than in 1997 and 8% higher than the 1992-96 mean. Returns of large salmon in 1998 were the highest on record. Returns of small salmon to Western Arm Brook were the highest and large salmon were the second highest on record. Sea-survival of returning 1SW salmon to Western Arm Brook was 6.6% in 1998, more than twice that in 1997. Conservation requirements were exceeded on all three rivers in 1998. On the basis of the smolt production in 1998, returns of 1SW salmon in 1999 are expected to be less than in 1998 but higher than the 1992-96 mean provided sea-survival remains the same. Spawning escapements are expected to exceed conservation requirements on all three rivers in 1999. Based on observations of the presence of avian predators in the estuary of Western Arm Brook in 1998, incidence of predation on smolts was low.

Comments:

There has been a significant increase in the total population size of small salmon on Torrent River. This is attributed to the enhancement program carried out in the early 1970s that involved transfers of adult salmon from Western Arm Brook.

Recommendations:

1. Conservation requirement of 105 eggs per ha of lacustrine habitat used for Torrent River and Western Arm Brook should be re-examined.

2. A recreational fishery could be considered for Western Arm Brook provided angling removals can be accurately recorded in order to maintain scientific integrity of long time series of adult return and spawning escapement data.

3. Available harvest for Western Arm Brook should be determined based on the spawner-recruit curve.

4. Habitat estimates for Torrent River should be verified from digitized 1:50,000 scale topographic maps and from in-stream measurements. In comparison to the available habitat on Lomond River, the available habitat on Torrent River seems quite small given the larger drainage basin area.

Status report for northern Labrador Arctic charr, 1998

Authors: J. B. Dempson and M. Shears

Summary: Northern Labrador Arctic charr landings in 1998 totaled 37.5 t, which were similar to 1997 but were derived entirely from within the Nain Fishing Region as there was no reported commercial harvest of charr from the Makkovik Region in 1998. Landings from the Nain Region were 10% higher than the previous year and were the highest since 1992. Increased effort in the Nain stock unit and the highest catch rates since 1990 at both the Nain and Voisey stock units contributed to the higher commercial production in 1998. Effort in recent years is still low relative to the 1980's, and interpretation of current commercial catch rates as an index of stock abundance could be problematic. Landings of Arctic charr from the Nain Fishing Region over the past 25 years (1974 - 1998) totaled approximately 2589 tonnes, or over 5.7 million pounds. Of this amount, 77% has been harvested from the three primary stock complexes (Voisey, Nain, Okak) and illustrates the overall capacity of this north coast area to produce fish.

Information on catch- and weight-at-age for each of the Voisey, Nain, and Okak stock units were updated. Mean weight of charr harvested increased in each of the three stock units in 1998; for the Voisey's unit, it was the highest mean weight since 1991. It was again noted that there are no independent estimates of Arctic charr abundance for any of the stock unit areas. In the absence of river-specific information on charr abundance and monitoring of stock characteristics, only general statements can be made regarding the status of north Labrador charr populations.

There was no commercial Atlantic salmon fishery in Labrador during 1998, including the Nain Region. However, a by-catch of about 100 salmon was reported by DFO Fisheries Officers.

Comments:

None

Recommendations:

Fish counting facilities are required in order to obtain actual information on Arctic charr abundance. Given the increased commercial harvests in recent years, and the expansion of food fishing activities, at least one counting facility should be installed in a brook in each of the three primary stock complex areas (Voisey, Nain, Okak).

An Examination of the Inclusion of Repeat Spawners and Large Salmon as Part of the Egg Deposition and Conservation Requirements

Author : C. E. Bourgeois

Summary: The working paper addressed the egg deposition and conservation requirements of salmon in relation to repeat spawners and large salmon in Newfoundland and Labrador. Salmon stocks of the Newfoundland Region are comprised of grilse and multi-sea winter stock components (MSW). Salmon Fishing Areas (SFA's) 1, 2, 13, and 14 B contain both MSW and grilse stock components in the Newfoundland Region. All other stocks appear to be mainly grilse (1SW) stocks based on (Anon., 1991) (i.e. greater than 60% of the one-sea winter fish are female). The listing above is not absolute and is reported only as a guideline to acknowledge that there are different stocks/complexes within Newfoundland and Labrador. The likelihood that most insular Newfoundland rivers had a large (in terms of numbers) MSW component is quite remote. The work of Calderwood (1930), Belding (1937), Dempson et.al (1986) and O'Connell & Dempson (1995) suggest that Newfoundland stocks are comprised of predominantly grilse fish. According to (Taylor, 1985) "Newfoundland and Labrador salmon stocks have survived almost three centuries of fishing exploitation, having undergone large variations in apparent abundance during that time due mainly to natural causes."

Management of salmon stocks, in Eastern Canada, on an individual river basis began in 1978 (Anon., 1978). In 1991, the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC) produced Advisory Document 91/15 which defines conservation for Atlantic salmon.

Fecundity is considered to be a genetic trait and is unique for each stock of Atlantic salmon (Saunders, 1981). Generally, grilse are more fecund than MSW salmon although MSW salmon have more eggs per fish than grilse. Because fecundity is a genetic trait and is different for grilse and MSW salmon in the same population, warrants the inclusion of both groups of fish in the egg deposition required for conservation. Fecundity data is available on the Exploits River salmon for 280 fish over three years which reveals very little inter annual variation within the same stock. It is apparent that for the Exploits River stock that the increase in size of adult does not correspond to a similar increase in number of eggs which is similar to the findings of (Randall 1989). Data suggest that repeat spawning grilse are just larger fish, which does not justify a requirement for inclusion of these fish in conservation requirements for grilse stocks. In an effort to determine the contribution of various life stages to the egg deposition of the Exploits River the biological characteristics of the returns to the Grand Falls fishway from 1975 to 1998 (sample size = 15,830 aged fish) were examined. On average from 1975-1998, 3.4% of the returns were large fish with 0.1%

of MSW origin. The apparent absence of MSW returns suggests that the Exploits River is a grilse stock. In this particular instance, Exploits River salmon should be managed as a single stock complex irrespective of size of fish. The conservation egg deposition requirement for the Exploits should be calculated as a number of fish with achievement of that number meeting conservation again regardless of size.

With respect to the issue of inclusion of eggs from repeat spawners and large salmon in the calculation of egg deposition the answer must surely be yes which indeed is the present case. All eggs must be included in egg deposition calculations to enable calculations such as egg-to-smolt survival. To include any grouping of fish in the conservation egg deposition requirement it is logical that there should be sound scientific/biological rationale for doing so. The answer to the above question in part has to be addressed on an individual stock basis, as the composition of stocks/complexes is required to deal with the issue. It is the authors opinion that the only basis at present for inclusion of large/repeat salmon in the conservation egg requirement would be for fish of MSW origin. There is merit in requiring stocks with both grilse and MSW salmon to achieve there egg requirement from both stock components based on genetics. It should also be noted that whether a salmon returns to spawn as a grilse or MSW is only partially determined by genetics. The determination of the egg deposition to be achieved from each stock component requires additional analysis/research. The present situation in the Newfoundland Region leads to a selective process for rivers which favours all fish above 63cm (i.e. conservation egg deposition to be derived from small salmon only) whether or not there is any scientific/biological rationale. With respect to large repeat spawners which are 1SW salmon prior to first spawning there is no sound scientific/biological rationale for treating these fish different from small repeat spawning 1SW fish.

Comments:

Where the data is available conservation requirements should take into account egg deposition from large salmon.

Recommendations:

There is no biological requirement in SFAs 3-11 and 14A to restrict angling harvests to small salmon only provided that conservation requirements are being exceeded.

1998 Atlantic salmon survey, Labrador Sea

Authors: P. B. Short, R. Johnson and D. G. Reddin

Summary: Experimental fishing was conducted by a Canadian research vessel from St. John's, NF fishing in the Labrador Sea in the fall of 1998. In total, 9 stations were fished with fleets of monofilament gillnets of mesh size 77 mm, 89 mm, 102 mm, 115 mm, and 127 mm set to fish on the surface. In total, 38 salmon were caught, 24 of which were postsmolts and the remainder were 1SW salmon. Catch rates ranged from 0 to 1.24 salmon per mile-hour of gear fished. Catch rates were lower than previously experienced by research vessels fishing in the same area in the late 1980s. These data will be added to the information base of research in the Labrador Sea. More research on postsmolt and adult salmon at sea is encouraged.

Comments:

Research survey gear should include pelagic trawl gear similar to that used by the Norwegian and Scottish researchers in the northeast Atlantic.

Recommendations:

The research survey should be repeated in 1999.

Brook trout (*Salvelinus fontinalis* Mitchill) population dynamics and recreational fishery in Indian Bay Brook, Newfoundland (1995-98)

Authors: M. C. van Zyll de Jong, N. P. Lester, R. M. Korver, W. Norris and B. L. Wicks

Summary: In response to anglers allegations of declining trout stocks, a monitoring and research program was initiated in the Indian Bay Brook watershed. The program was designed to collect life history and fisheries information on brook trout. The results presented describe the life history, recreational fishery and provide initial input parameters needed to develop a brook trout exploitation model. The data presented in this paper will provide a scientific basis from which management guidelines and further data requirements can be developed.

Comments:

It was agreed that the data and input parameters for exploitation rate modelling were adequate to provide managers with advice on trout stocks.

Recommendations:

The research work on brook trout in Indian Bay Brook should continue and be expanded into other watersheds in Newfoundland and Labrador.

A model for managing exploitation of brook trout (*Salvelinus fontinalis* Mitchill) in Indian Bay Brook, Newfoundland

Authors: N. P. Lester, R. M. Korver , M. C. van Zyll de Jong, W. Norris and B. L. Wicks

Summary: Creel and index fishing data from ponds in Indian Bay Brook, Newfoundland were used to construct a model for managing the exploitation of brook trout (*Salvelinus fontinalis* Mitchell). The model describes the expected relationship between angling effort (angler-hour per ha) and brook trout yield (kg per ha) and predicts a maximum yield of approximately 0.4 kg per ha at a fishing effort of 3 angler-hours per ha and extinction of the fish population at 8 angler-hours per ha. A dynamic simulation model (calibrated for Indian Bay brook trout) was used to compare the effectiveness of various types of management regulations (e.g. creel limits, size-based restrictions, etc on harvest). Our simulation results indicate that creel limits will not prevent overfishing and that size-based management is needed to offer a sustainable high quality fishery.

Comments:

1. It was agreed that the input parameters and model for exploitation rate modelling were adequate to provide managers with advice on trout stocks. Model output should be regarded as a guideline rather than an absolute indication of population size resulting from various levels of exploitation and management regimes.

2. Output from the model indicated that only size-based fishery regulations were effective in maintaining a sustainable high quality fishery.

Recommendations:

Managers will have to consider changing fisheries regulations for brook trout so that size-based regulations can be implemented to control fishery exploitation rates.

Appendix 1
Newfoundland Region Salmonid Stock Assessment Meeting
March 8-10 & April 27, 1999
Northwest Atlantic Fisheries Centre, St. John's
Chair: Dave Reddin

AGENDA

The series of 1998/99 Salmonid Assessment meetings are scheduled to start on Monday, October 26, 1998 and resume on March 8, 1999 at 0900 hrs. There will be a further meeting on Tuesday, April 27 to complete the Humber River assessment and any unfinished business from previous meetings. The later date for the Humber assessment is so knowledge gained at the Mark-recapture Workshop can be incorporated into the assessment. The following is an outline of the topics for discussion and an order of presentation of working papers. You will recall that we had a preliminary review of stock status in October based on the fence counts and we will not be covering that information again.

Monday, 26 October 1998 (EPS Boardroom)

0830-1230 Morning session only

1. Call to order

2. 1998 Review of returns to monitored rivers, smolt production and sea survival

    2.1 Insular Newfoundland - O'Connell and Dempson
    2.2 Labrador - Reddin and Mullins

3. Advice for fisheries management

Monday, 8 March, 1999 (E B Dunne Boardroom)

(0830-1215) Morning session

1. Call to order (0830 hrs)

2. Finalization of agenda

3. The Newfoundland Region stock assessment and documentation process - format and contributors to the Stock Status Reports (overall summary and four areas) and individual stock summary sheets, and proceedings documentation.

4. Marine & freshwater environments in 1998

5. Atlantic salmon licence stub returns for 1998 & revisions to previous years

6. Atlantic salmon river-specific stock assessments

   6.1 Labrador (SFAs 1, 2, & 14B)

   6.11 Paradise River

   6.2 Northeast and east coasts Newfoundland (SFAs 3-8)

   6.21 Exploits River

(1300-1700) Afternoon session

6.2 Northeast and east coasts Newfoundland (SFAs 3-8) cont'd

6.22 Campbellton River (includes assessment, DSTs, & predation)
6.23 Gander River
6.24 Gander River - juvenile production and predicted adult returns
6.25 Middle Brook
6.26 Indian Bay Brook

Tuesday, 9 March, 1999 (E B Dunne)

(0830-1215) Morning session

6.2 (Cont'd) Northeast and east coasts Newfoundland (SFAs 3-8)

6.27 Terra Nova River
6.28 Northwest River, Terra Nova National Park

6.3 South Newfoundland (SFAs 9-11)

6.29 Northeast River (Trepassey)
6.30 Rocky River
6.31 Northeast River (Placentia)

(1300-1700) Afternoon session

6.3 (Cont'd) South Newfoundland (SFAs 9-11)

6.32 Little River
6.33 Conne River

6.4 Southwest Newfoundland (SFAs 12-13)

6.41 Highlands River
6.42 Crabbes, Robinsons, Middle Barachois, Fischells, & Flat Bay
6.43 Harry's/Pinchgut
6.44 Humber River

Wednesday, 10 March, 1999 (E B Dunne)

(0830-1215) Morning session

6.5 Northern Peninsula West (SFA 14A)

6.51 Lomond River
6.52 Torrent River
6.53 Western Arm Brook

7. Re-analysis & 2nd thoughts

8. Advice for Fisheries Management

9. ICES returns & spawners

10. Arctic Charr

(1300-1700) Afternoon session

11. Brook trout in Indian Bay watershed

11.1 Summary of trout population dynamics, parameters and fish statistics in Indian Bay Brook, 1995-98

11.2 Brook trout exploitation model for Indian Bay

11. Any other business

Tuesday, April 27, 1999 (E B Dunne)

(0900-1230) Morning session

12. Humber River assessment revisited

13. Exploits River

14. Managing exploitation of brook trout fisheries: Indian Bay Brook ponds

October 15, 1998

To: Distribution

Subject: **1998/99 Regional Salmonid Assessments**

Science Branch will be resuming its annual assessments of salmonid stocks in Newfoundland and Labrador on 8-10 March, 1999 at the Northwest Atlantic Fisheries Centre, St. John's. The assessment meeting provides an opportunity for peer review of assessment methodology and interpretation of results. Accordingly, we are inviting you as an expert to participate in the review process.

Attached you will find the agenda for the meeting. You will recall that we had an early session in October that dealt with the stock assessment information available from counts at enumeration facilities and DFO angling catch statistics. This was done so that we could provide fisheries management advice for the various Salmon Advisory meetings. In addition to our salmon assessments, we have several other topics to deal with including trout for Indian Bay, Arctic charr, salmon predation work at Campbellton and Western Arm Brook, in-season review techniques, egg deposition from small and large salmon, and the results from archival tags applied to salmon last year.

I intend to run the meeting in the standard assessment format of presentation of the working paper by the author with a rapporteur for each paper to keep track of comments. There are three sets of documentation emanating from the regional salmonid assessments - Research Documents which are up to individual authors, a proceedings report providing summaries of the meeting, and Stock Status Reports with the Stock Summary Sheets. I anticipate having completed the review of working papers by Wednesday 10 March. I request that all authors come to the meeting with a summary of their working paper for the Proceeding Report already prepared in electronic form to which the author will add the comments and recommendations after he (she) has presented their paper. I have a template for the Stock Status Reports in Microsoft Word and a copies of last years report if anyone wants it. It would simplify matters if Stock Status Reports could be prepared in Word. Also please use last years Stock Summary Sheet obtainable from Geraldine. Some of these were extensively retyped last year and starting again will be a complete waste of time.

Looking forward to seeing you at the assessments,

Dave Reddin

Appendix 2
List of Participants

Meeting on 26 October, 1998

Bourgeois, Chuck	DFO, Science Branch, St. John's NF
Campbell, Scott	DFO, Science Branch, St. John's NF
Dempson, Brian	DFO, Science Branch, St. John's NF
Gibson, John	DFO, Science Branch, St. John's NF
Hinks, Ross	Conne River Indian Band Conne River NF
Montevecchi, Bill	Dept. of Psychology, Memorial University of Newfoundland and Labrador, St. John's NF
Mullins, Conrad	DFO, Science Branch, Corner Brook NF\
O'Connell, Mike	DFO, Science Branch, St. John's NF
Porter, Rex	DFO, Science Branch, St. John's NF
Reddin, Dave	DFO, Science Branch, St. John's NF
Simpson, Mark	Parks Canada Terra Nova National Park, Gloverton NF
Wissink, Renee	Parks Canada Terra Nova National Park, Gloverton NF

Meetings on 8-10 March, 1999

Bourgeois, Chuck	DFO, Science Branch, St. John's NF
Colbourne, Eugene	DFO, Science Branch, St. John's NF
Curnew, Ken	Dept. of Natural Resources and Agrifoods Gov't of Newfoundland and Labrador St. John's NF
Dempson, Brian	DFO, Science Branch, St. John's NF
Gibson, John	DFO, Science Branch, St. John's NF
Hinks, Ross	Conne River Indian Band Conne River NF
Knoechel, Roy	Dept. of Biology, Memorial University of Newfoundland and Labrador, St. John's NF
Mullins, Conrad	DFO, Science Branch, Corner Brook NF
O'Connell, Mike	DFO, Science Branch, St. John's NF
Perry, Geoff	DFO, Science Branch, St. John's NF
Porter, Rex	DFO, Science Branch, St. John's NF
Reddin, Dave	DFO, Science Branch, St. John's NF
Simpson, Mark	Parks Canada Terra Nova National Park, Gloverton NF
Slade, Berkley	DFO, Science Branch, St. John's NF

Meeting on 27 April, 1999

Bourgeois, Chuck	DFO, Science Branch, St. John's NF
Curnew, Ken	Dept. of Natural Resources and Agrifoods Gov't of Newfoundland and Labrador St. John's NF

Dempson, Brian	DFO, Science Branch, St. John's NF
Mullins, Conrad	DFO, Science Branch, Corner Brook NF\
Norris, Wins	Indian Bay Watershed Corporation
O'Connell, Mike	DFO, Science Branch, St. John's NF
Porter, Rex	DFO, Science Branch, St. John's NF
Reddin, Dave	DFO, Science Branch, St. John's NF
van Zyll de Jong, Mike	Dept. of Natural Resources and Agrifoods Gov't of Newfoundland and Labrador St. John's NF
Wicks, Barry	Indian Bay Watershed Corporation

Appendix 3
List of Working Papers

Meeting on 26 October, 1998

1) O'Connell, M. F., J. B. Dempson, C. C. Mullins, D. G. Reddin, N. M. Cochrane, and D. Caines. 1998. Status of Atlantic salmon (*Salmo salar* L.) stocks of insular Newfoundland (SFAs 3-14A), 1998.

2) Dempson, J. B. 1998. Status of Atlantic salmon (*Salmo salar* L.) stocks of SFAs 9-11, south coast of Newfoundland, 1998.

3) Dempson, J. B. 1998. Summary of marine survival and smolt production for selected rivers in Newfoundland, 1998.

4) Mullins, C. C. 1998. Status of the Atlantic salmon (*Salmo salar* L.) stock of SFA 14B, Straits Shore Labrador.

5) Reddin, D. G., M. F. O'Connell and N. M. Cochrane. 1998. Status of Atlantic salmon (*Salmo salar* L.) stocks in Labrador, 1998.

Meeting on 8-10 March, 1999

6) Colbourne, E. 1999. Oceanographic conditions in NAFO Divisions 2J3KLMNO during 1998 with comparisons to the long-term (1961-1990) average.

7) Reddin, D. G. P. B. Short, R. Johnson and J. Bird. 1999. Report of the assessment activities on Paradise River, Labrador in 1998.

8) Bourgeois, C. E., J. Murray and V. Mercer. 1999. Status of the Exploits River stock of Atlantic salmon (*Salmo salar*) in 1998.

9) Downton, P. R., and D. G. Reddin. 1999. Status of Atlantic salmon (*Salmo salar*) in Campbellton River, Notre Dame Bay (SFA 4), Newfoundland in 1998.

10) Reddin, D. G. 1999. In-season forecast for Atlantic salmon (*Salmo salar* L.) returning to Campbellton River in 1998.

11) Downton, P., D. G. Reddin and R. Johnson. 1999. Predation on Atlantic salmon smolts (*Salmo salar* L.) by avian and gadoid predators in Campbellton River estuary, Newfoundland, 1998.

12) Reddin, D. G., J. B. Dempson, P. Downton, C. C. Mullins and K. D. Friedland. 1999. Migration of Atlantic salmon kelts (*Salmo salar* L.) in relation to sea water temperature in Newfoundland, 1998.

13) O'Connell, M. F. and A. Walsh. 1999. Status of Atlantic salmon (*Salmo salar* L.) in Gander River, Notre Dame Bay (SFA 4), Newfoundland, 1998.

14) Knoechel, R., P. M. Ryan and M. F. O'Connell. 1999. Juvenile Atlantic salmon (*Salmo salar* L.) abundance in the Experimental Ponds Area relative to subsequent adult returns to the Gander River as a index of marine survival: apparent evidence for density-dependant marine mortality.

15) O'Connell, M. F. and A. Walsh. 1999. Status of Atlantic salmon (*Salmo salar* L.) In Indian Bay Brook, Middle Brook, and Terra Nova River (SFA 5), Northeast Brook, Trepassey (SFA 9), and Northeast River, Placentia (SFA 10), Newfoundland, in 1998.

16) Bourgeois, C. E. 1999. Status of Rocky and Little rivers Atlantic salmon (*Salmo salar* L.) stocks of the Newfoundland Region in 1998.

17) Dempson, J. B., M. F. O'Connell and N. M. Cochrane. 1999. Potential impact of climate warming on recreational fishing opportunities for Atlantic salmon (*Salmo salar* L.) in Newfoundland.

18) Reddin, D. G. and C. C. Mullins. 1999. Estimation of the Labrador component of prefishery abundance of North America Atlantic salmon (*Salmon salar* L.) in 1998.

19) Dempson, J. B. G. Furey and M. Bloom. 1999. Status of Atlantic salmon in Conne River, SFA 11, Newfoundland, 1998.

20) Dempson, J. B. and G. Clarke . 1999. Status of Atlantic salmon at Highlands River, Bay St. George, SFA 13, Newfoundland, 1998.

21) Mullins, C. C. D. Caines, and S. L. Lowe. 1999. Status of Atlantic salmon (*Salmo salar* L.) stock of Harry's River/Pinchgut Brook, Newfoundland, 1998.

22) Mullins, C. C. and D. Caines. 1999. Status of Atlantic salmon (*Salmo salar* L.) stock of Humber River, Newfoundland, 1998.

23) Simpson, M. 1999. The status of Atlantic salmon Stock of the Northwest River, Bonavista Bay (SFA 5), 1998.

24) Porter. T. R. 1999. Status of Atlantic salmon (*Salmo salar* L.) populations in Crabbes River and Fischells Brook, Newfoundland, 1998.

25) Mullins, C. C. D. Caines, and S. L. Lowe. 1999. Status of Atlantic salmon (*Salmo salar* L.) stocks in Lomond River, Torrent River and Western Arm Brook, Newfoundland, 1998.

26) Dempson, J. B. and M. Shears. 1999. Status report for northern Labrador Arctic charr, 1998.

27) Bourgeois, C. E. 1999. An examination of the inclusion of repeat spawners and large salmon as part of the egg deposition and conservation requirements.

28) Short, P. B., R. Johnson and D. G. Reddin. 1999. 1998 Atlantic salmon survey, Labrador Sea.

Meeting on 27 April, 1999

29) van Zyll de Jong, M. C., N. P. Lester, R. M. Korver, W. Norris and B. L. Wicks. 1999. Brook trout (*Salvelinus fontinalis* (Mitchill)) population dynamics and recreational fishery in Indian Bay Brook, Newfoundland (1995-1998).

30) Lester, N. P., R. M. Korver, M. C. van Zyll de Jong, W. Norris and B. L. Wicks. 1999. A model for managing exploitation of Brook trout (*Salvelinus fontinalis* Mitchill) in Indian Bay Brook, Newfoundland.

Appendix 4
Indian Bay Brook Trout Workshop
January 20-21, 1999

Introduction

A workshop was held in St. John's to review methodology and results from trout studies in the Indian Bay Brook watershed (see Appendix I for agenda). This occasion provided an opportunity for biologists not directly involved in the project to understand what has been accomplished so far in Indian Bay. A workshop format was chosen because an informal unstructured meeting provides plenty of opportunity for questions and discussion. In addition to Department of Fisheries and Oceans (DFO) scientific staff, the workshop was attended by representatives of the Government of Newfoundland and Labrador-Wildlife and Inland Fish Division, Memorial University of Newfoundland, Ontario Ministry of Natural Resources and the people who began the study, the Indian Bay Ecosystem Corporation (see Appendix II). Two working papers were presented and discussed containing information and analyses related to the biological program on salmonid resources in Indian Bay Brook, analyses related to status of Indian Bay Brook brook trout stocks, estimates of population size, trout assessment model and results. Angler opinions from a survey on the most suitable management options to use in managing trout stocks were presented (see Appendix III).

Methods & Results

Stock Assessment Program

In response to observations of declining trout stocks by local anglers, residents of Indian Bay recommended and DFO implimented, in 1995, a management strategy for restoration of declining trout stocks. Also, a monitoring and research program was initiated in the ponds of the Indian Bay Brook watershed to evaluate the effectiveness of the management strategy. The program was designed to collect life history and fisheries information on brook trout (*Salvelinis fontinalis* Mitchill). The program, which began in 1994, was able to describe the life history, recreational fishery and provided initial input parameters needed to develop a brook trout exploitation model. The results from the research program will provide a scientific basis from which management guidelines and further data requirements can be developed.

Angler motivation & attitudes

The methods and results presented in this section were summarized by B. Wicks from a paper by L. Hunt entitled "Results of a Maximum Difference Conjoint for Motivations and Regulations of Indian Bay Brook Trout Anglers". The Indian Bay Ecosystem Corporation has been giving increasing attention to understanding the client, i.e. the angler. By understanding the motivations for fishing and the preferences towards possible management regulations, fisheries management can be more effective and better accepted by anglers. This study highlights findings of interviews conducted during creel surveys of anglers fishing for brook trout in the Indian Bay Brook watershed. As part of the creel survey, the importance of motivations and preference towards brook trout angling regulations was collected from anglers.

Anglers were asked to select the single most and single least important motivation for fishing from a card consisting of five motivational statements (items). Each angler evaluated a total of four cards that experimentally controlled the placement of a total of 11 motivational statements. Preferences for brook trout management regulations were also asked of anglers in a similar fashion. Again anglers responded separately to four cards consisting of five regulation based items. Respondents were asked to select the one regulation they would most prefer and the one item they would least prefer. The total design consisted of four sets (versions) of four cards, of which, one respondent would only complete one set of cards. In total, 68 respondents completed the motivational survey and 71 respondents completed the preference for management regulations.

The aggregate analyses showed that non-catch related motivations exceeded catch-related motivations in importance. This finding is not a surprising and is consistent with reviews of other angling groups (Fedler and Ditton, 1994), including from the nearby Southwest Pond (Sutton, 1997). Of the catch-related motivations, the opportunity to catch a few fish was most important even more important than the motivations of trophy, consumption, or filling of bag limit. The variability in responses suggested that there is no typical Indian Bay angler. In general, most anglers would be happy with an experience that meets many of the non-catch related motivations while providing an opportunity to catch some fish.

With regard to regulations, the aggregate analysis showed that maintaining the status quo in regulations is most preferred by anglers. Surprisingly, the preference for the status quo even exceeds the preference for an extension to the brook trout season. Less restrictive regulations are next preferred by the anglers including a 25 cm minimum size limit, one line in winter only, and a one trophy fish allowance (fish over 40 cm). The remaining regulations received about the same level of angler preference.

Simulation modelling for exploitation of Indian Bay brook trout

An age-structured equilibrium model was developed to describe the relationship between yield and fishing mortality rate for a generalized Indian Bay brook trout population. This model was derived by combining a generalized stock-recruitment relationship with conventional yield-per-recruit and biomass-per-recruit functions but calibrated to Indian Bay brook trout populations. Further modelling was carried out to compare the effectiveness of various types of management regulations on brook trout abundance and productivity. In this case, a stochastic component was added to the stock-recruit relationship and then run to simulate the effects of various management regulations on brook trout populations. The creel, index fishing, and biological data from ponds in Indian Bay were used as a basis for these models as follows:

INPUT PARAMETERS

The following life history parameters, defining rates of growth, natural mortality and reproduction in the absence of intraspecific competition were used in the simulation modelling:

Growth (Von Bertalanffy):

Linf = 40.6 cm
k = 0.37

Weight-length (gm-cm):

$W = 0.0092\ L^{3.05}$

Length at Maturation:

L05% = 15.0 cm
L50% = 22.5 cm
L95% = 30.0 cm

Length at vulnerability (to angling):

L05% = 15 cm
L50% = 20 cm
L95% = 25 cm

Relative fecundity: 2540 eggs/kg

Maximum early survival (egg to age 1): 0.0068

Natural mortality (instantaneous, age > = 1): M = 0.45/yr

Stock-recruitment (Shepherd function):

Recruits at age 1 = Max Rec rate * Spawn Biomass/ (1 + (Spawn Biomass/Bo)^Beta)

where:

Beta (shape) = 1
Bo (related to carrying capacity) = 2 kg/ha
Maximum recruitment rate (Max early survival x relative fecundity) = 17.3

Catchability factor:

q = 0.07 hectare/hr

RESULTS FROM MODELLING

Creel and index fishing data from ponds in Indian Bay, Newfoundland were used to construct a model for managing the exploitation of brook trout. The model described the expected relationship between angling effort (angler-hour per ha) and yield (kg per ha) and predicted a maximum yield of approximately 0.4 kg per ha at a fishing effort of 3 angler-hours per ha. At an angling pressure of 8 angler-hours per ha, the population goes extinct. A dynamic simulation model (calibrated for Indian Bay brook trout) was used to compare the effectiveness of various types of management regulations (e.g. creel limits, size-based restrictions on harvest, etc). The simulation suggested that creel limits will not prevent overfishing and that size-based management is needed if the goal is a sustainable high quality fishery.

General Conclusions

- There is a large database for trout in ponds of the Indian Bay Brook, particularly for those intensively surveyed. These data are sufficient to initiate detailed stocks assessments;
- The brook trout exploitation model has application to the trout populations in Indian Bay, although some refinement is desirable. The model used is largely deterministic in structure and future improvements could concentrate on addressing uncertainty in key model parameters through a sensitivity analysis;
- Angler creels in Indian Bay watershed may not be a good index of trout abundance due to non-linearity in the catchability coefficient;
- The interactions between salmon and trout parr in Indian Bay Brook and the influence on carrying capacity would be a worthwhile study;

- Simulation modelling results indicated that the current regulations for Indian Bay brook trout stocks might not be sufficient to meet management objectives, especially those related to sustainability with the possibility of higher demands on the resource in the future. Results also suggested that size limits could be more effective in maintaining a high-quality fishery;
- Once stocks get into difficulties, drastic action is required to produce a return to healthy population sizes; and,
- Hook and release mortality experiments suggest that mortality rates on released trout during the winter are very low. No mortalities were observed in experiments conducted during the winter fishery on angler caught trout held for 11 days. Experiments that hold fish for a longer period of time and during the summer fishery are encouraged.

Recommendations

- The results from Indian Bay trout assessments and modelling impacts under different management options holds promise to be very useful for fisheries managers and to have general applicability to other insular Newfoundland trout populations; and,
- A review of the status of Indian Bay Brook trout stocks and management options are encouraged by bringing forward information to the Newfoundland and Labrador Regional Stock Assessment Process.

References

Fedler, A. J., and R. B. Ditton. 1994. Understanding angler motivations in fisheries management. Fisheries 19(4): 6-13.

Sutton, S. G. 1997. The Mystery Fish of Bonavista North: a Multidisciplinary Approach to Research and Management of a Unique Recreational Salmonid Fishery in Newfoundland. M.Sc. thesis, Department of Biology, Memorial University of Newfoundland, 133 pp.

Appendix I

Indian Bay Brook Trout Workshop
January 20-21, 1988
E. B. Dunne Boardroom, White Hills DFO

Agenda

Workshop Objective

To build a brook trout model that provides a basis for development of a management plan for Indian Bay Brook ponds.

Wednesday, January 20		Speaker
9:00	Introduction - Why are we here?	Barry Wicks
9:15	Overview of stock assessment program	Mike van Zyll de Jong & Wince Norris
9:30	Overview of modelling process	Nigel Lester
10:30	Coffee	
11:00	Building the Model	Nigel Lester
12;30	LUNCH BREAK	
1:30	Socio-economic objectives	Barry Wicks
3:00	Introduction to FMSS	Rob Korver
4:30	Closing and summing up of day 1	

Thursday, January 21

9:00	Evaluate effects of management actions: What actions are acceptable? Which are effective?	Nigel Lester
10:15	Coffee break	
10:30	Loose ends	
12:30	Closing remarks	

Appendix II
List of Participants

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Appendix III
List of Working Papers

1) van Zyll de Jong, M. Population dynamics and sustainable yield predictions for Brook trout (*Salvelinus fontinalis* Mitchill) in Newfoundland lakes.

2) Hunt, L. Results of a maximum difference conjoint for motivations and regulations of Indian Bay Brook trout anglers.

Appendix 5

STOCK: Exploits River (SFA 4) **Drainage area:** 11,272 km^2

CONSERVATION REQUIREMENT: 95.9 million eggs (equivalent to 56,670 small salmon) calculated as fluvial area x 2.4 eggs/m^2 and lacustrine area x 368 eggs/ha.

Year	1993	1994	1995	1996	1997	1998[3]	MIN[1]	MAX[1]
Total returns to river								
Small	22253	17603	16230	30429	15263	27094	4740	30429
Large	627	916	941	2053	881	1958	343	2053
Recreational harvest (small salmon)								
Retained	1655	3072	1336	1915	2996	1218	577	3072
Released	2980	1145	1531	3202	2169	1788	1145	3202
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	0	83
Released	59	30	72	111	0	14	0	111
Other removals[2]								
Small salmon	16	1	2	44	72	40	1	72
Large salmon	0	0	0	0	0	5	0	0
Broodstock removal	0	0	0	0	0	0	31	5111
Spawners[4]	20921	15263	15651	30345	12867	27609	2326	30345
Fry stocked	1692970	0	0	0	0	0	212610	6410426
Egg conservation requirement								
% met	43	31	40	69	29	62	6	69
Lower Exploits	157	103	121	210	88	192	26	210
Middle Exploits	23	18	24	43	19	43	2	43
Upper Exploits	6	7	12	26	10	6	0	125

[1] Min and max are for the period of record since 1974-97.
[2] Mortalities include removals for research.
[3] Preliminary
[4] No.'s of large and small unavailable.

Data and methodology: There are 35 million m^2 of fluvial habitat only, and 34,000 ha of lacustrine habitat. Conservation egg requirements are from small salmon. Previous fry releases are back-calculated to eggs for derivation of % of conservation egg deposition achieved in areas stocked. Total returns to the river are based on the count at Bishop Falls fishway plus angling below the fishway. Hook and release mortalities of 10% are included.

Broodstock requirements: None at present.

Recreational catches: The 1997 recreational fishery on the main stem of the Exploits River, upstream of Grand Falls was open only to hook and release for the entire season.

State of the stock: Overall returns to the Exploits River, have improved during the moratorium years; however returns to the upper section of the watershed are extremely low and all efforts should be made to increase escapement to this section of the watershed.

Forecast: No quantitative forecast available.

STOCK: Campbellton River (SFA 4) **Drainage area**: 296 km^2 (accessible)

CONSERVATION REQUIREMENT: 2.916 million eggs (~1480 small salmon) calculated as fluvial area x 2.4 eggs/m^2 and lacustrine area x 368 eggs per hectare.

Year	1993	1994	1995	1996	1997	1998	MIN[1]	MAX[1]
Total returns to the river								
Small	4001	2857	3035	3208	1975	3275	1975	4001
Large	145	191	218	560	321	402	145	560
Recreational harvest (small salmon)								
Retained	316	340	393	463	254	315	23	1547
Released	103	4	47	93	67	250	4	250
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	0	63
Released	0	1	1	31	9	8	0	31
Spawners								
Small	3675	2517	2637	2736	1714	2935	1714	3675
Large	145	191	218	557	320	401	145	557
Egg conservation requirement								
% met	311	239	279	304	200	317	200	317
Smolt count	31577	41633	39715	58369	62050	50441	31577	62050
% Sea survival								
(adult return year)		7.2	6.1	7.2	2.3	4.9	2.3	7.2

[1] Min and max are for the period of record since 1974.
[2] Preliminary.

<u>Data and methodology:</u> Smolts were enumerated at a counting fence. Returning adult salmon are enumerated at a fish counting fence with a video camera system. A hook-and-release mortality rate of 10% was used in the calculation of spawning escapements for the years 1993-98. Recreational data for 1997-98 were from the License Stub Return System and are preliminary. Sea survival is corrected to exclude previous spawners in the upstream migration. Previous spawners were estimated in 1998 from survival patterns in previous years. Egg conservation requirement met was calculated using average percent female and average whole weight, 1993-98 due to the low number of samples obtained from the angling fishery.

<u>State of the stock:</u> Conservation requirements were met from 1993 to 1998.

<u>Forecast:</u> No forecast available.

STOCK: Gander River (SFA 4) **Drainage area:** 6,398 km^2

CONSERVATION REQUIREMENT: 46.211 million eggs (21,828 small salmon) calculated as fluvial area x 2.4 $eggs/m^2$ and lacustrine area x 368 eggs/ha.

Year	1993	1994	1995	1996	1997	1998[2]	MIN[1]	MAX[1]
Total returns to river								
Small	26205	18273	22266	23946	10599	18805	6745	26205
Large	1734	1072	1121	1753	1883	3649	473	4180
Recreational harvest (small salmon)								
Retained	1271	2122	2598	2974	1061	1909	1061	4578
Released	1950	448	612	1153	1007	1652	448	1950
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	13	927
Released	92	39	74	73	189	214	39	214
Spawners								
Small	24739	16106	19606	20822	9437	16731	5565	24739
Large	1725	1068	1114	1746	1864	3628	473	4162
Egg conservation requirement								
% met	128	91	95	124	62	113	36	128

[1]Min and max are for the period of record since 1974.

[2]Preliminary.

Note: Any changes from previous years are due to the updating of preliminary data and biological characteristics information.

Recreational catches: Catches declined during 1981-91, before the commercial salmon fishing moratorium in 1992. Effort has increased substantially since 1994. The number of small salmon retained in 1998 was 1,909 (an increase of 80%) and the number released was 1,652 compared to 1,007 in 1997.

Data and methodology: Complete counts of salmon were obtained at a fish counting fence during 1989-98, and have historically been counted at a fishway located on a tributary, Salmon Brook. Recreational fishery data for 1998 are from the License Stub Return System and are preliminary. Data for large salmon for 1997 are incomplete. A hook-and -release mortality of 10% was used in the calculation of spawning escapements for the years 1993-98.

State of the stock: Conservation requirement was achieved in 1998, reversing the result for 1997, which was the lowest since the start of the commercial salmon fishery moratorium in 1992. Conservation egg requirement was achieved in four of the seven moratorium years. Conservation requirement in terms of small salmon was met only in 1993. Using Salmon Brook as an indicator of returns to the entire river, it is likely that returns of small salmon of a magnitude similar to or greater than those in 1992-98 occurred in pre-moratorium years.

STOCK: Indian Bay Brook (SFA 5) **Drainage area:** 703 km^2

CONSERVATION REQUIREMENT: 4.6 million eggs (~2,055 small salmon) calculated as fluvial area x 2.4 eggs/m^2 and lacustrine area x 368 eggs/ha.

	1993	1994	1995	1996	1997	1998[2]	MIN[1]	MAX[1]
Total returns to river								
Small	7286	2445	4553	3241	1439	2716	1411	7286
Large	N/A	N/A	N/A	N/A	353	336	336	353
Recreational harvest (small salmon)								
Retained	510	589	683	551	205	246	205	893
Released	225	171	288	36	57	154	36	288
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	0	6
Released	0	1	0	0	15	4	0	15
Spawners								
Small	6753	1839	3842	2687	1228	2455	1143	6753
Large	N/A	N/A	N/A	N/A	351	336	336	351
Egg conservation requirement								
% met	-	-	-	-	106	175	106	175

[1]Min and max are for the period of record since 1974.
[2]Preliminary.

Recreational catches: In 1998, a total of 246 small salmon was retained and 154 were released.

Data and methodology: Complete counts are available from a fish counting fence, which operated in 1997 and 1998. Total returns of small salmon and number of small salmon spawners prior to 1997 were derived from angling data and exploitation rates. Recreational fishery data for 1998 are from the License Stub Return System and are preliminary. A hook-and-release mortality of 10% was used in the calculation of spawning escapement.

State of the stock: Conservation requirement in terms of eggs and small salmon was achieved in 1998. The conservation requirement for small salmon was estimated to have been achieved in five of the seven moratorium years.

STOCK: Middle Brook (SFA 5) **Drainage area:** 276 km^2

CONSERVATION REQUIREMENT: 2.3 millions eggs (1,012 small salmon) calculated as fluvial area x 2.4 eggs/m^2 and lacustrine area x 368 eggs/ha.

Year	1993	1994	1995	1996	1997	1998[2]	MIN[1]	MAX[1]
Total returns to river								
Small	2247	1844	1448	2112	1287	2549	626	2549
Large	88	90	168	161	262	196	13	262
Recreational harvest (small salmon)								
Retained	299	409	402	476	77	137	28	789
Released	387	122	82	153	10	147	10	387
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	0	20
Released	37	0	0	0	1	16	0	37
Other mortalities								
Small	-	-	3	16	-	-	3	16
Large	-	-	-	-	-	-	-	-
Spawners								
Small	1909	1423	1037	1605	1209	2397	461	2397
Large	84	90	168	161	262	195	13	262
Egg conservation requirement								
% met	238	174	114	250	196	306	49	306

[1]Min and max are for the period of record since 1974.
[2]Preliminary.
Note: Any changes from previous years are due to the updating of preliminary data and biological characteristics information.

__Recreational catches:__ Rod days of effort peaked during the mid-1980s but declined substantially in recent years. A total of 137 small salmon was retained in 1998 and 147 were released.

__Data and methodology:__ Complete counts are available from a fishway located on the lower river. Recreational fishery data for 1997-98 are from the License Stub Return System and are preliminary. A hook-and-release mortality of 10% was used in the calculation of spawning escapements for the years 1993-98.

__State of the stock:__ Conservation requirement was exceeded in the moratorium years 1992-98. Egg deposition was below conservation requirement for pre-salmon moratorium years 1985-91. Counts of small salmon similar to or higher than those observed during the moratorium years occurred in pre-salmon moratorium years. Returns of large salmon in 1997 were the highest recorded and those in 1998 the second highest.

STOCK: Terra Nova River (SFA 5) **Drainage area:** 1,883 km^2

CONSERVATION REQUIREMENT: 14.30 million eggs (7,094 small salmon) calculated as fluvial area x 2.4 eggs/m^2 and lacustrine area x 368 eggs/ha.

Year	1993	1994	1995	1996	1997	1998[2]	MIN[1]	MAX[1]
Total returns to river								
Small	3050	2035	2638	2575	1800	1815	1127	3050
Large	472	246	638	472	528	390	56	638
Recreational harvest (small salmon)								
Retained	484	822	696	896	296	105	105	896
Released	569	178	132	260	148	263	132	569
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	0	43
Released	62	44	72	113	10	18	10	113
Broodstock removals[3]								
Small	-	64	222	225	352	337	64	352
Large	-	9	44	32	29	0	0	44
Spawners								
Small	2620	1305	1835	1577	1137	1347	815	2620
Large	467	232	587	429	498	389	56	587
Egg conservation requirement								
% met	53	26	45	36	32	32	14	53

[1]Min and max are for the period of record since 1974.

[2]Preliminary.

[3]In 1994-98, a number of adults were removed as broodstock for an incubation facility for subsequent fry stocking back to Terra Nova River above Mollyguajeck Falls; these adults were deducted from spawning escapements in the calculation of percent of conservation requirement met presented above.

Note: any changes from previous years are due to the updating of preliminary data and biological characteristics information.

Recreational catches: Harvests in pre-salmon moratorium years 1989-91 were low relative to those of the late 1970s and early 1980s. Rod days of effort have generally increased over time, especially in recent years. A total of 105 small salmon was retained in 1998 and 263 were released.

Data and methodology: Counts are available from a fishway located on the lower river. Recreational fishery data for 1997-98 are from the License Stub Return System and are preliminary. A hook-and-release mortality of 10% was used in the calculation of spawning escapements for the years 1993-98.

State of the stock: The proportion of conservation requirement achieved in 1998 was 32%. Although this river has never achieved conservation requirement, egg depositions during the moratorium years 1992-98 were generally higher than in pre-moratorium years. It should be noted that accessible rearing habitat for anadromous Atlantic salmon above the lower fishway more than doubled in 1985 with the opening of the area above Mollyguajeck Falls.

STOCK: Northwest River (SFA 5) **Drainage area:** 689 km^2

CONSERVATION REQUIREMENT: 4.1 millions eggs (1,726 small salmon) calculated as fluvial area x 2.4 eggs/m^2 and lacustrine area x 368 eggs/ha.

Year	1993	1994	1995	1996	1997	1998[2]	MIN[1]	MAX[1]
Total returns to the river								
Small	-	-	498	593	466	540	466	593
Large	-	-	135	203	182	104	104	203
Recreational harvest (small salmon)								
Retained	164	167	97	-	-	-	30	336
Released	73	1	0	7	-	-	0	73
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	0	45
Released	0	3	-	-	-	-	0	3
Egg conservation requirement								
% met	-	-	37	55	46	42	37	55

[1] Min and max are for the entire period of record since 1974.
[2] Preliminary.

Recreational catches: For the period 1974-91, harvests ranged from 30 to 336 small salmon. Effort in rod days peaked during the late 1970s and reached lowest levels in the early 1990s; effort in 1994 however was among the highest recorded. In 1988, the portion of the lower river within the boundaries of Terra Nova National Park came under park management, using the National Park license and tagging system. Outside the Park boundaries, the river was managed according to regulations in place for other rivers in insular Newfoundland. In 1996, the river was closed to all angling following a pre-season analysis which projected that less than 50% of conservation requirement would be achieved. The river was opened to hook-and-release fishing on August 10; however, the portion of the river inside Park boundaries was not opened due to low water levels and high water temperatures. In 1997, the pre-season analysis once again forecasted less than 50% of the conservation requirement could be achieved, so the river remained closed. The river was also closed in 1998.

Data and assessment: Counts of adults were obtained at a counting fence installed in the lower river in 1995-98. The fence was operated by Terra Nova National Park personnel.

State of the stock: The river received 37% of the conservation egg requirement in 1995, 55% in 1996, 46% in 1997, and 42% in 1998, representing the contribution to egg deposition of both small and large salmon.

STOCK: Northeast Brook, Trepassey (SFA 9) **Drainage area:** 21 km^2

CONSERVATION REQUIREMENT: 0.14 million eggs (~51 small salmon) calculated as fluvial area x 2.4 eggs/m^2 and lacustrine area x 368 eggs/ha.

Year	1993	1994	1995	1996	1997	1998[2]	MIN[1]	MAX[1]
Total returns to the river								
Small	79	99	80	73	50	91	49	158
Large	17	15	12	15	9	11	9	41
Recreational harvest (small salmon)								
Retained		--------------Closed to angling--------------						
Released								
Recreational harvest (large salmon)								
Retained		--------------Closed to angling--------------						
Released								
Spawners								
Small	79	99	80	73	50	91	49	158
Large	17	15	12	15	9	11	9	41
Egg conservation requirement								
% met	193	239	194	196	135	218	126	368
Smolt counts	1849	944	792	1749	1829	1727	792	1911
% sea survival (adult return year)	4.7	5.4	8.5	9.2	2.9	5.0	2.6	9.2

[1] Min and max are for the entire period of record since 1984.
[2] Preliminary.

__Data and methodology:__ Counts of adults and smolts have been available from a counting fence since 1984 and 1986. Up until a few years ago, this small system was part of a group of experimental rivers involved in research on stock-recruitment relationships and definition of smolt production in terms of various habitat types. The system has become an important indicator of smolt (year i) to (small salmon year i + 1) survival (repeat spawners included).

__State of the stock:__ Conservation egg requirement has been met every year in the time series, but the lowest level achieved occurred in 1997. In terms of small salmon, the second lowest percentage of conservation requirement achieved also occurred in 1997. The maximum number of smolts counted was 1,911 in 1991 while the lowest was 792 in 1995. Highest sea survival prior to the commercial salmon-fishing moratorium (8.1%) was recorded in 1987. Lowest survival (2.6%) occurred in 1992. Since the start of the moratorium in 1992, sea survival rose to a peak of 9.2% in 1996 only to plummet to 2.9% in 1997; an improvement was noted for 1998.

STOCK: Rocky River (SFA 9) **Drainage area**: 296 km^2

MANAGEMENT TARGET: 3.4 million eggs (~881 small salmon) calculated as fluvial area x 2.4 eggs/m^2 and lacustrine area x 368 eggs/ha.

	1993	1994	1995	1996	1997	1998	MIN[1]	MAX[1]
Total returns to river								
Small	292	158	385	356	435	423	80	435
Large	72	19	39	45	89	130	1	89
Recreational harvest (small salmon)								
Retained				CLOSED				
Released								
Recreational harvest (large salmon)								
Retained								
Released				CLOSED				
Other mortalities[2]								
Small salmon	0	0	0	1	0	0	0	1
Large salmon	0	2	0	0	0	0	0	2
Broodstock removal	0	62	76	0	0	0	0	76
Spawners								
Small	292	96	309	355	435	423	158	435
Large	72	17	39	45	89	130	1	89
Fry stocked	0	0	81983	162231	0	0	81983	434500
Egg conservation requirement								
% met	34	25	56	34	56	54	17	56
Smolt count	5115	9781	7577	14261	16900	12163	5115	16900
% Sea Survival								
(adult return year)	3.5	2.3	3.4	4.2	2.8	2.2	2.3	4.2

[1] Min and max are for the period of record since 1987-97.
[2] Known in river mortalities.

Background: Rocky River was stocked with salmon fry from 1983 to 1987 with the first returns to the reconstructed fishway realized in 1987. Also in 1987, 140 adult salmon were transferred into Rocky River from Little Salmonier River. Fry stocking also occurred in 1995 and 1996.

Data and methodology: Fluvial habitat consists of 1.08 million m^2 and lacustrine habitat includes 2200 ha. Biological characteristics used in calculations are those for Rocky River stock. Previous fry releases are back-calculated to eggs for % of egg conservation requirement achieved in areas stocked. Complete adult counts are available from a trap installed in the fishway. Smolts have been enumerated annually since 1990. Sea survival is smolt to 1SW salmon returns to the fishway.

Recreational fisheries: The recreational fishery is closed on this river.

State of the stock: Stock is still in the development phase.

Forecast: There is no forecast for 1999.

STOCK: Northeast River (SFA 10) **Drainage area:** 94 km^2

CONSERVATION REQUIREMENT: 0.72 million eggs (~224 small salmon) calculated as fluvial area x 2.4 $eggs/m^2$ and lacustrine area x 368 eggs/ha.

Year	1993	1994	1995	1996	1997	1998[2]	MIN[1]	MAX[1]
Total returns to river								
Small	980	710	774	1420	723	885	350	1420
Large	65	70	74	123	185	287	0	287
Recreational harvest (small salmon)								
Retained	132	39	127	268	95	105	19	349
Released	61	5	8	7	45	71	5	189
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	0	6
Released	0	0	0	0	33	18	0	33
Other mortalities								
Small	-	-	25	49	-	-	-	-
Large	-	-	5	-	-	-	-	-
Broodstock[3]								
Small	-	-	-	31	-	51	-	-
Large	-	-	-	-	-	-	-	-
Spawners								
Small	842	670	646	1102	592	722	317	1102
Large	65	70	74	123	182	285	0	285
Egg conservation requirement								
% met	527	434	422	736	486	632	152	736

[1]Min and max are for the period of record since 1974.

[2]Preliminary.

[3]In 1997and 1998, a total of 31 and 36 small salmon were removed as broodstock for enhancement projects in Rennies River and Waterford River, St. John's. Fifteen small salmon were removed to Ocean Sciences Center for research purposes.

Note: Any changes from previous years are due to the updating of preliminary data and biological characteristics information.

Recreational catches: Rod days of effort in 1996 were the highest recorded. In 1998, a total of 105 small salmon was retained and 71 were released.

Data and methodology: Counts are available from a fishway on the lower river. Recreational fishery data for 1998 are from the License Stub Return System and are preliminary. A hook-and-release mortality of 10% was used in the calculation of spawning escapements for the years 1993-98.

State of the stock: Conservation requirement has been exceeded every year since 1984. The return of large salmon in 1998 was the highest on record.

STOCK: Little River (SFA 11) **Drainage area**: 183 km^2

CONSERVATION REQUIREMENT: 0.306 million eggs (~230 small salmon) calculated as fluvial area x 2.4 $eggs/m^2$ and lacustrine area x 368 eggs per hectare.

Year	1993	1994	1995	1996	1997	1998	MIN[1]	MAX[1]
Total returns to the river								
Small	169	73	118	674	399	264	55	674
Large	11	11	17	127	79	49	3	127
Recreational harvest (small salmon)								
Retained	-	-	-	-	-	-	N/A	N/A
Released	-	-	-	-	-	-	N/A	N/A
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	N/A	N/A
Released	-	-	-	-	-	-	N/A	N/A
Other mortalities[2]								
Small	5	0	5	18	13	7	0	18
Large	0	0	0	1	1	2	0	1
Brood stock removals								
Small	96	0	80	118	0	N/A	0	79
Large	4	0	5	1	0	N/A	0	6
Spawners								
Small	68	73	33	538	386	N/A	13	538
Large	7	11	12	125	78	N/A	3	125
Fry stocked	131243	118472	0	92528	145921	0	20070	145921
Egg conservation requirement								
% met	80	37	56	288	202	50	29	288
Smolt Count	324	501	2712	4449	2521	3320	324	4449

[1]Min and max are for the period of record since 1974-97.
[2]Known in-river mortalities.

Data and methodology: Conservation egg deposition is derived for accessible habitat (1,308 riverine units). Biological characteristics used in calculations are those for salmon from Little River and Conne River. Current fry releases are back-calculated to eggs for % of conservation eggs achieved in areas stocked. Total returns to the river are based on fence counts.

Recreational catches: The recreational fishery was closed in 1989 and the only angling statistics for the river predated 1975.

State of the stock: The stock size appears to be increasing.

Forecast: There is no forecast for 1999.

STOCK: Conne River (SFA 11) **Drainage area**: 602 km^2

MANAGEMENT TARGET: 7.8 million eggs (~4000 small salmon) calculated as fluvial area x 2.4 $eggs/m^2$ and egg/recruit applied to total population as derived from assumed commercial exploitation rates.

	1993	1994	1995	1996	1997	1998	MIN[1]	MAX[1]
Total returns to home waters								
Small	2703	1533	3502	4440	3200	2931	1533	10155
Large	100	100	110	179	185	295	89	516
First Peoples' harvest								
Small	417	0	0	0	514	0	0	948
Large	3	0	0	0	1	0	0	11
Recreational harvest (small salmon)								
Retained	-	-	-	-	197	-	108	3302
Released	-	-	-	-	80	-	0	80
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	0	27
Released	-	-	-	-	0	-	0	0
Other mortalities								
Small salmon	3	5	9	13	6	5	3	48
Large salmon	1	1	2	0	0	1	0	2
Broodstock removal								
Small salmon	0	93	117	25	0	0	25	245
Large salmon	0	1	0	0	0	0	0	1
Spawners								
Small	2353	1435	3376	4402	2558	2926	1435	7823
Large	97	99	108	179	182	294	87	488
Management target								
% eggs met	61	40	81	112	70	83	40	214
Smolt estimate	55765	60762	62749	94088	100983	69841	55765	100983
% Sea survival[2]	4.0	2.7	5.8	7.2	3.4	2.9	2.7	10.2

[1] Min and max are for the period of record since 1974. First Peoples harvest in salt water includes some salmon from other rivers. First Peoples fishery quota of 1200 fish has been in effect since 1986, but was reduced to 500 fish for 1993. First Peoples fishery was closed from 1994-96, while 600 small salmon were allocated in 1997. This fishery was closed again in 1998 as was the recreational fishery at Conne River.

[2] Sea survival is from smolt to small salmon returns in year of adult return.

Data and methodology: Smolts estimates are derived from mark-recapture surveys. Returning adult salmon are enumerated at a fish counting fence. Angling harvests for Conne River are from DFO statistics. A video camera system was introduced in 1993.

State of the stock: The Management Target, which is higher than the conservation egg requirement, was met from 1986 to 1990 and again in 1996. Only 40-61% of the target was achieved from 1991-1994, rose to 81% in 1995 and was 83% in 1998. Sea survival to small salmon fell to the second lowest value (2.9%) recorded while survival to 1SW salmon was the lowest (2.5%). In contrast with the Management Target, the Conservation egg requirement was met or exceeded from 1986-1990, in 1993, and again from 1995-1998.

Forecast: Estimated smolt output in 1998 was: 69,841 (60,617-79,064). A sea survival of 5.73% would result in 4,000 1SW adult salmon returns in 1999. While survivals in the 7 - 10% range have occurred in the past, in recent years 1SW survival has remained low varying from 2.5 to 5.8%. Given the high variability in marine survival in recent years, a preseason forecast for 1999 is not provided.

STOCK: Highlands River (SFA 13) **Drainage area**: 183.1 km^2 (accessible)

CONSERVATION REQUIREMENT: 1.5 million eggs calculated as fluvial area x 2.4 eggs/m^2 and lacustrine area x 368 eggs per hectare.

Year	1993	1994	1995	1996	1997	1998	Min[1]	Max[1]
Total returns to the river								
Small	137	145	172	199	398	96	82	398
Large	78	148	120	142	157	117	29	157
Recreational harvest (small salmon)				**CLOSED SINCE 1978**				
Retained	-	-	-	-	-	-	21	47
Released	-	-	-	-	-	-	-	-
Recreational harvest (large salmon)				**CLOSED SINCE 1978**				
Retained	-	-	-	-	-	-	8	18
Released	-	-	-	-	-	-	-	-
Spawners								
Small	137	145	172	199	398	96	82	398
Large	78	148	120	142	157	117	29	157
Egg conservation requirement								
% met	46	77	67	79	105	59	28	105
Smolt count	9986	10503	12160	12383	6776	5922	5922	15839
% Sea survival (adult return year)								
Small	-	1.5	1.6	1.6	3.2	1.4	0.6	3.2
Large	-	-	1.2	1.4	1.3	0.9	0.4	1.4

[1] Min and Max are for the period of record since 1974.

<u>Data and methodology:</u> Counts of smolt and adult salmon were obtained with a fish counting fence in 1980-82 and in 1993-98. Juvenile densities were measured at 5 stations in 1998 to determine changes in juvenile salmon production. Sea survival is calculated for small salmon returning in year i + 1 and large salmon returning in yeari + 2 by dividing the number of returning adults by the number of smolts in year i.

<u>State of the stock:</u> The number of large salmon has increased since the closure of the commercial fishery although the number returning in 1998 was down considerably from 1997. Small salmon returns in 1998 were 76% lower than the previous year. Conservation requirements were achieved in 1997 but decreased to 59% (46% - 74%) in 1998. Juvenile densities had declined substantially in the summers of 1996-97 in association with a severe flood in the winter of 1996.

<u>Forecast</u>: The conservation requirement will likely not be met in 1999 owing to continued low production of smolts in 1998. Based upon the average egg deposition contribution from small and large salmon, respectively, over the past 6 years (1993 - 1998), marine survival rates approximating 4.3% for small salmon returns from the 1998 smolt class and 2.6% for large salmon returns from the 1997 smolt class would be required. To date, neither of these values have been recorded at Highlands River during the years in which the fish counting fence has been in operation.

STOCK: Crabbes River (SFA 13) **Drainage area**: 551 km^2

CONSERVATION REQUIREMENT: 4.6 million eggs (spawners not defined) calculated as fluvial area x 2.4 $eggs/m^2$ and lacustrine area x 368 eggs per hectare.

Year	1993	1994	1995	1996	1997	1998	MIN[1]	MAX[1]
Total returns to the river								
Small	354	774	N/A	844	1152	490	111	1916
Large	34	113	N/A	239	358	176	15	359
Recreational harvest (small salmon)								
Retained	150	174	26	-	3	-	26	561
Released	0	37	5	221	278	83	0	278
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	14	127
Released	24	45	32	96	119	53	0	119
Spawners								
Small	204	600	N/A	844	1121	482	64	1355
Large	34	113	N/A	239	346	171	15	346
Egg conservation requirement								
% met	13	41	N/A	68	95	44	3	95

[1] Min and max are for the period of record since 1974.

Data and methodology: Visual counts of salmon were made by swimmers in late August, 1996 to 1998. An adjustment factor was applied to the visual counts to give an estimate of the total number of salmon in the river. For years prior to 1995, the assessment was based on applying an angling exploitation rate to the recreational catches. Angling data prior to 1997 was collected by river guardians. In 1997 and 1998 angling catches are from the License Stub Return System. The 1998 angling data are preliminary. A hook-and-release mortality of 10% of released salmon is used.

State of the stock: In 1998, Crabbes River achieved 44% of its egg deposition required for conservation. This estimate is the lowest calculated since 1994. This stock has been at very low population size and has not achieved its conservation requirements in the past 46 years.

Forecast: There is no forecast of abundance for 1999.

STOCK: Fischells Brook (SFA 13) **Drainage area**: 350 km^2

CONSERVATION REQUIREMENT: 3.6 million eggs (spawners not defined) calculated as fluvial area x 2.4 eggs/m^2 and lacustrine area x 368 eggs per hectare.

Year	1993	1994	1995	1996	1997	1998[2]	MIN[1]	MAX[1]
Total returns to the river								
Small	391	1060	N/A	N/A	797	202	42	1276
Large	65	158	N/A	N/A	86	72	0	455
Recreational harvest (small salmon)								
Retained	157	216	80	315	182	6	6	374
Released	0	58	112	232	162	18	0	232
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	0	66
Released	34	47	43	150	127	4	0	150
Spawners								
Small	234	844	N/A	N/A	599	194	25	919
Large	65	158	N/A	N/A	73	72	0	415
Egg conservation requirement								
% met	24	71	N/A	N/A	44	23	1	96

[1] Min and max are for the years in which data are available from 1974 to 1997.
[2] Preliminary.

Data and methodology: Visual counts of salmon were made by swimmers in late August, 1996 to 1998. An adjustment factor was applied to the visual counts to give an estimate of the total number of salmon in the river. For years prior to 1995, the assessment was based on applying an angling exploitation rate to the recreational catches. Angling data prior to 1997 was collected by River Guardians. In 1997 and 1998, angling catches are from the License Stub Return System. The 1998 angling data are preliminary. A hook-and-release mortality of 10% is used.

State of the stock: In 1998, Fischells Brook achieved 23% of its egg deposition required for conservation. This estimate is about one-half that observed in 1997, but is similar to the estimate for 1993. This stock has been at very low population size and does not appear to have achieved its conservation requirements in the recent past. The numbers of both large and small salmon returning to the river are very low.

Forecast: There is no forecast of abundance for 1999.

STOCK: Harrys River (SFA 13) **Drainage area:** 816 km^2

CONSERVATION REQUIREMENT: 7.8 million eggs based on 2.4 $eggs/m^2$ of fluvial area and 368 eggs per ha of lacustrine area.

Year	1993	1994	1995	1996	1997	1998[2]	MIN[1]	MAX[1]
Total returns to the river								
Small	1663	1494	1982	1974	1718	1610	864	1982
Large	104	116	72	137	198	184	15	198
Recreational harvest (small salmon)								
Retained	319	153	149	34	2	-	2	1008
Released	23	84	60	1196	591	139	23	1196
Recreational harvest (Large salmon)								
Retained	.	.	.	.	.	.	1	68
Released	50	50	44	206	139	67	0	206
Spawners								
Small	1342	1333	1827	1820	1657	1596	518	1827
Large	99	111	68	116	184	177	12	184
Egg conservation requirement								
% met	37	46	48	52	50	49	12	52
Spawners on Pinchgut Brook tributary								
Small	548	544	749	601	613	593	212	749
Large	43	47	28	38	68	63	5	68

[1]Min and max are for the period of record since 1974.
[2] Preliminary.
Note: Any changes from previous reports are due to the updating of preliminary data and biological characteristics information.

<u>Recreational catches:</u> Harrys River produced the largest recreational catches in Bay St. George in the 1960s but catches declined in the 1970s and 1980s. The fishery was managed under a quota of 350 small salmon in 1987-93 and in-season reviews were conducted in 1994-95. The fishery has been limited to catch and release angling since 1996 and angling is not permitted in the headwaters upstream from Home Pool.

<u>Data and methodology:</u> Spawning escapement is estimated based on spawning redd surveys to determine the proportion of the total spawning escapment above the adult salmon counting fence on Pinchgut Brook tributary. Counts of small and large salmon are available from the counting fence for 1992-98 and spawning redd surveys of the entire river were completed in 1995-97. Monitoring of juvenile abundance at selected sites also contributes to the assessment of this stock. Juvenile density surveys were conducted in 1987-89 and 1992-98. Historical counting fence and spawning redd survey data are also available for 1966-67. Recreational fishery data for 1996-98 are from the Licence Stub Return System and are preliminary. A hook-and-release mortality of 10% was used in the calculation of total returns to the river.

<u>State of the stock:</u> The stock achieved 49% of the conservation requirement in 1998. The stock has improved in the last seven years of assessment but has averaged less than 50% of the conservation requirement. This is alarming considering the recreational fishery has been restricted to hook and release

only since 1996 and the commercial fishery was closed in 1992. There is still reason for concern for the conservation of this stock and protection of spawning and rearing areas. Increased juvenile densites indicate potential for long-term improvement in the status of the stock but record low water levels and high water temperatures in 1998 create continued uncertainty in the short-term.

STOCK: Humber River (SFA 13) **Drainage area:** 7,679 km^2

CONSERVATION REQUIREMENT: 28.3 million eggs (~15,749 small and 934 large salmon) based on 2.4 eggs/m^2 and 368 eggs per ha of lacustrine area.

Year	1993	1994	1995	1996	1997	1998[1]	MIN[2]	MAX[2]
Total returns to the river								
Small	18477	7995	27898	30445	14866	9476	5724	30445
Large	636	1030	2064	2679	2595	3542	401	3542
Recreational harvest (small salmon)								
Retained	4161	2523	5150	4740	2447	1285	804	5150
Released	303	1438	1881	3016	1433	1695	53	3016
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	27	303
Released	125	166	233	237	133	459	10	261
Spawners								
Small	14286	5328	22560	25404	12276	8022	4293	25404
Large	624	1013	2041	2655	2582	3496	400	3743
Egg conservation requirement								
% met	96	40	128	186	115	88	27	186

[1] 1998 information is preliminary
[2] Min and max are for the period of record since 1974.
Note: Any changes from previous reports are due to the updating of preliminary data and biological characteristics information.

<u>Recreational catches:</u> Total retained plus released catches improved overall since 1992 but declined in recent years due to low returns and early closure of the retention fishery in 1997 and due to a bag limit reduction to one fish before 5 July in 1998. A fall hook-and-release fishery was permitted below Deer Lake from 2-30 September 1997 and 8-27 September 1998. The fishery produced one small and 27 large salmon for 172 rod days in 1997. However, catch statistics were not available for 1998.

<u>Data and methodology</u>: Total returns of small salmon to the river in 1990-98 were based on retained catches and angling exploitation rates determined from mark-recapture experiments. The retained catch of small salmon in 1998 is from the licence stub return system. Estimates of retained catch based on licence stub returns in 1996-98 have been within 10% of those based on creel surveys at Big Falls that were used in previous assessments. Returns of large salmon are determined from returns of small based on the proportion of small and large salmon observed in the marking traps in the estuary. Released catches of large salmon are from DFO catch statistics except for 1997-98 which were based on the angler survey.

<u>State of the stock:</u> The stock achieved 88% (95% CI=60%-135%) of the conservation requirement in 1998, 23% less than in 1997. Returns and spawning escapements of small salmon have decreased in the last two years but increasing returns and escapements of large salmon have resulted in the egg conservation requirement continuing to be achieved.

<u>Management Considerations:</u> The low estimate of returns of small salmon in 1997 and in 1998 and the uncertainty associated with the mark-recapture method indicate that there is still a need for a

precautionary approach in controlling fisheries harvests on this stock. Based on the 1996 assessment, the fall run of large salmon to the Lower Humber River consists of 2SW and 3SW salmon and previous spawners. The assessment suggests that the population size has increased in recent years. However, the population size appears to be low, probably less than 600 salmon. The 3SW component is unique to Newfoundland rivers and should be given special protection to minimize and to prevent any increase in fishing mortality.

STOCK: Lomond River (above the fishway) (SFA 14A) **Drainage area:** 470 km^2
CONSERVATION REQUIREMENT: 1.1 million eggs (~ 658 small salmon) based on 2.4 eggs/m^2 of fluvial area and 368 eggs per ha of lacustrine area.

Year	1993	1994	1995	1996	1997	1998[3]	MIN[1]	MAX[1]
Total returns to the river[2]								
Small	816	1038	1365	982	1307	721	259	1365
Large	38	56	101	98	77	128	3	128
Recreational harvest (small salmon)								
Retained	281	325	343	371	490	158	158	650
Released	85	116	190	99	273	214	24	273
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	2	34
Released	40	58	62	49	52	22	2	62
Known removals above fishway								
Small	22	6	20	0	0	1	0	22
Large	1	1	0	0	0	1	0	1
Spawners								
Small	504	695	983	601	783	541	1	983
Large	33	49	95	93	72	125	0	125
Egg conservation requirement								
% met	118	142	187	143	161	151	31	187

[1] Min and max are for the period of record since 1974.
[2] Total returns are approximate because of spawning below the fishway.
[3] Preliminary.
Note: Any changes from previous reports are due to the updating of preliminary data and biological characteristics information.

Recreational catches: Angling is currently not permitted above the fishway located approximately 5.0 km upstream from the mouth of the river. Angling below the fishway is currently managed by a river quota of 375 small salmon. A quota of 350 small salmon was in place for 1986-94. The river quota was not reached in 1998 due to the bag limit reduction of one fish before 5 July. In spite of improvements in the stock, the river quota has only been reached in three out of seven years since 1992 due to other catch and effort controls being implemented in SFA 14A. As a result the quota on this river may no longer be relevant in terms of controlling harvests.

Data and methodology: Returns to the river above the fishway are determined from recreational catch data and counts at the fishway available since 1961 with the exception of 1968-70 and 1989-91 when the fishway was not monitored. Recreational fishery data for 1997-98 are from the License Stub Return System and are preliminary. A hook-and-release mortality of 10% was used in the calculation of spawning escapements for the years 1985-98.

State of the stock: The percentage of the conservation requirement achieved above the fishway in 1998 was the third highest on record, 6% less than in 1997. Returns of small salmon in 1998 were the lowest since 1992, 45% less than in 1997 and equal to the 1984-91 mean. However, returns of large salmon in 1998 were the highest on record resulting in continued high percentage of the conservation requirement being achieved. The area above the fishway represents about 40% of the total river area. This river has achieved the conservation requirement every year since the commercial salmon fishery moratorium. This has given a false impression that the status of the stock has improved relative to long-term abundance. Assessments of this river have shown that this is not the case.

STOCK: Torrent River (above the fishway), (SFA 14A) **Drainage area:** 619 km^2
CONSERVATION REQUIREMENT: 1.5 million eggs (~ 656 small salmon) based on 2.4 eggs/m^2 of fluvial area and 105 eggs per ha of lacustrine area.

Year	1993	1994	1995	1996	1997	1998[3]	MIN[1]	MAX[1]
Total returns to the river [2]								
Small	4215	3827	6168	7371	4033	5249	96	7371
Large	224	332	615	509	674	766	7	766
Recreational harvest (small salmon)								
Retained	179	227	331	421	327	206	31	477
Released	266	82	369	270	469	442	75	469
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	1	18
Released	15	9	36	20	79	85	0	85
Spawners								
Small	4009	3592	5800	6923	3659	4999	121	6923
Large	222	331	611	507	666	757	3	757
Egg conservation requirement								
% met	538	530	1033	1279	797	924	161	1279

[1]Min and max are for the period of record since 1974.
[2] Total returns are approximate because of spawning below the fishway.
[3] Preliminary.
Note: Any changes from previous reports are due to the updating of preliminary data and biological characteristics information.

Recreational catches: Angling is currently not permitted above the fishway located 2.0 km upstream from the mouth of the river. Hook-and-release angling is permitted below the fishway until a minmum spawning escapement of 750 salmon had passed through the fishway. Retention angling is then permitted until the end of the season. Catches and catch-per-unit-effort have increased over time with the highest values occurring since 1992. The total retained plus released catch of small salmon in 1998 was less than in 1997. The proportion of small salmon released in 1998 was the highest recorded.

Data and methodology: Returns to the river above the fishway are determined from recreational catch data and counts at the fishway available for 1966-98. Recreational fishery data for 1997-98 are from the License Stub Return System and are preliminary. A hook-and-release mortality of 10% is used in the calculation of spawning escapements for the years 1985-98.

State of the stock: The percentage of the conservation requirement achieved above the fishway in 1998 was the third highest on record, 16% higher than in 1997. Returns of small salmon in 1998 were the third highest on record and 30% higher than in 1997. Returns of large salmon in 1998 were the highest on record and 14% higher than in 1997. Returns to Torrent River have shown an increasing trend since the late 1970s with the highest returns occurring since 1992. It is estimated that the Torrent River stock has achieved conservation requirement every year since 1978. This is due to the successful enhancement program carried out in 1972-76 when adult salmon were used to colonize above the fishway.

STOCK: Western Arm Brook, (SFA 14A) **Drainage area:** 149 km^2

CONSERVATION REQUIREMENT: 0.91 million eggs (~ 292 small salmon) based on 2.4 $eggs/m^2$ of fluvial area and 105 eggs per ha of lacustrine area.

Year	1993	1994	1995	1996	1997	1998[3]	MIN[1]	MAX[1]
Total returns to the river								
Small	947	954	823	1230	509	1718	233	1718
Large	8	31	33	50	55	128	0	128
Recreational harvest (small salmon)								
Retained	-	-	-	-	-	-	0	171
Released	-	-	-	-	-	-	-	-
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	0	2
Released	-	-	-	-	-	-	0	2
Known removals above counting fence								
Small	0	0	27	41	1	68	0	223
Large	0	0	3	2	0	0	0	3
Spawners								
Small	947	954	796	1189	508	1650	117	1650
Large	8	31	30	48	55	128	0	128
Egg conservation requirement								
% met	288	292	286	415	200	625	30	625
Smolt count	13435	9283	15144	14502	23845	17139	5735	23845
% Sea survival[2]								
(adult return year)	5.3	6.8	8.9	8.1	3.0	6.6	2.1	12.0

[1] Min and max are for the period of record since 1974.
[2] Sea survival is from smolt to 1SW salmon returns in the year of returns.
[3] Preliminary.
Note: Any changes from previous reports are due to the updating of preliminary data and biological characteristics information.

Data and methodology: Counts of smolts and adult salmon are available from a counting fence located at the mouth of the river for 1971-98. A hook-and-release mortality of 10% was used in the calculation of spawning escapements for the years 1985-88 with a recreational fishery. River closed to angling after 1988.

State of the stock: The percentage of the conservation requirement achieved in 1998 was more than twice as high as in 1997. Returns of small and large salmon in 1998 were the highest on record. The increase in returns of small salmon in 1998 was due to an increase in sea survival compared to 1997 and the record high smolt production in 1997. Returns to the river of large salmon in 1998 were more than twice the record high set in 1997. This was the first year since the start of the commercial moratorium in 1992 in which the returns of small salmon were above those adjusted for commercial exploitation in 1984-91. Other evidence of improvement in the stock status relative to historical abundance are the record high smolt production in 1997 and increasing densities of juvenile salmon in the river.

Forecast: The smolt production in 1998 was 28% less than in 1997. Hence, assuming that sea survival remains constant, returns of 1SW salmon in 1999 are expected to be lower than in 1998. However, returns in 1999 are expected to be sufficient to achieve the conservation requirement. Given the variability in sea survival in recent years, there is uncertainty in this expectation.