Fisheries and Oceans Pêches et Océans

Canadian Stock Assessment Proceedings Series 98/01

Évaluation des stocks canadien Séries des comptes rendus 98/01

Proceeding of the 1997 Newfoundland Region Salmonid Stock Assessment Meeting

D. G. Reddin [editor]

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Abstract

The fourth annual Salmonid Stock Assessment Meeting for the Newfoundland Region was held in St. John's on February 24-28, March 5 and half days on March 13 and 14, 1997. The general status of Atlantic salmon stocks in Newfoundland and Labrador and for 23 individual rivers in 1996 was examined. An overview of landings in the Arctic charr commercial fishery in Labrador in 1996 and information on diet of anadromous Arctic charr were also reviewed. A summary of the experimental design for the trout assessments in the Indian Bay Watershed was presented orally and discussed. Data and analyses involved in status of stock determinations were contained in 25 working papers. For Atlantic salmon, information obtained from a series of public meetings held in Newfoundland and Labrador in the fall of 1996 and winter of 1997 were incorporated into the assessment process. This report summarizes each of the working papers, stock status summary sheets for individual stocks, reports of the public meetings, and a discussion of issues related to the data used in stock assessments.

INTRODUCTION

The fourth annual Newfoundland Region Salmonid Stock Assessment Meeting was held in St. John's on February 24-28, March 5 and half days on March 13 and 14, 1997 at the Northwest Atlantic Fisheries Centre in St. John's. In addition to Department of Fisheries and Oceans (DFO) scientific and resource management staff, the meeting was attended by representatives of the Government of Newfoundland and Labrador Conne River Band Council, Parks Canada, and Memorial University of Newfoundland. Working papers containing information and analyses related to status of stocks, estimates of population size, and future abundance were presented and discussed. The assessment process incorporated information obtained from a series of public meetings on science issues that were held in the winter of 1997. Also included was information from meetings held with the public during management consultations in Labrador in November of 1996 leading up to the 1997 Labrador Salmon Management Plan.

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 Atlantic Fisheries Research Document series. Additional summaries, environmental considerations, future prospects, and management issues are presented in Anon. (1997).[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, report of the public consultations in Appendix 4, and individual stock summary sheets in Appendix 5.

SUMMARIES OF PRESENTATIONS

A total of 25 working papers was presented, 23 on Atlantic salmon and two on Arctic charr. An oral presentation was made on trout studies in the Indian Bay Watershed. One paper provided a general overview of the status of Atlantic salmon at the SFA, sub-regional, and regional levels. Trends in recreational fishery catch and effort data, commercial fishery data (Labrador only), and counts at various facilities were examined in relation to the 1996 Management Plan and the moratorium on the Atlantic salmon commercial fishery, which was implemented in 1992 and entered it's fifth year in 1996. Papers were presented that examined the status of Atlantic salmon in relation to target spawning requirements for 23 rivers and also compared total river escapements, spawning escapements, and estimates of total population size (certain rivers) prior to and during the commercial fishery moratorium in insular Newfoundland. A prognosis of anticipated returns for 1997 was presented for several stocks. Elements of the results of these analyses for individual rivers are shown in the attached Summary Sheets (Appendix 5). A map showing the Salmon Fishing Areas (SFAs) of the Newfoundland Region, the individual rivers assessed, and percent of

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[1] DFO Science Stock Status Report Series D2-01 to D2-06.

target egg deposition requirement achieved for each river in 1996 is provided in Fig. 1. A paper was presented that provided a preliminary analysis of information obtained from the first year of the implementation of the Atlantic salmon angler license stub return system in the Newfoundland Region. The two papers on Arctic charr presented information on commercial fishery landings for 1996 as well as historical landings, quotas, and the results of study into diet of Arctic charr.

Follicular atresia in Atlantic Salmon (*Salmo salar* L.) in Newfoundland rivers

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

Summary: Follicular atresia is a degenerative process which can occur at any stage of egg development and differentiation, resulting in a loss of eggs from the ovary and ultimately affecting the number of mature eggs available for spawning. Fecundity values used in the calculations of Atlantic salmon conservation spawner requirements and egg depositions for most Newfoundland rivers are derived from ovaries collected in the recreational fishery during the summer. Eggs are in early stages of development at this time. In this study, the fecundity of small salmon (< 63 cm in length) determined from ovaries collected during the summer was compared to that derived from fish sampled during broodstock stripping in the fall for the same river. The rivers involved were Indian River, Exploits River, Conne River, and Little Salmonier River. A reduction in the number of eggs between summer and fall was attributed to atresia. Fecundity expressed in terms of length (eggs/cm) was a better indicator of atresia than weight (eggs/kg). There was a decrease in the number of eggs between summer and fall for Indian River in 1984 (11.2%) and 1985 (5.0%); the average was 8.2%. Decreases for Exploits River in 1985 and 1986 were 16.6 and 14.2% with an average of 13.7%. The greatest reduction (28.5%) occurred in the case of Conne River in 1987.

The onset of atresia has been attributed to adverse environmental conditions resulting in stress, among which is water temperature. During the summer of 1987, severe drought conditions affected most rivers in Newfoundland, including Conne River. Sustained low water levels and high water temperatures in 1987 could explain the high rate of atresia observed for this river. An increase was noted for Little Salmonier River in 1985 (16.9%) but this result might have been due to the small sample sizes involved. Results show that atresia can occur to varying degrees depending on environmental conditions. Fecundity estimates derived from ovaries collected in the recreational fishery therefore have to be regarded as potential and used as such, could result in underestimates of spawner requirements and overestimates of egg deposition.

Comments: The fact that broodstock for Indian and Exploits rivers were held under conditions designed to minimize stress suggests that atresia might be more severe under natural conditions. Broodstock for Conne River was collected in September after a prolonged period of exposure to low water levels and higher than normal water temperatures, therefore the result obtained might be extreme. Using ovaries collected in the recreational fishery, it is possible that fecundity is overestimated by 10-20%.

Recommendations: It was recommended that more information be collected on atresia and that a method be derived to correct summer estimates of fecundity for egg loss.

Inter-annual and Inter-river Variability in Fecundity in Atlantic Salmon (*Salmo salar* L.) in Newfoundland Region Rivers

Authors: M. F. O'Connell, J. B. Dempson, and D. G. Reddin

Summary: Fecundity is an important parameter used in the calculation of Atlantic salmon egg depositions in the Newfoundland Region. It is usually derived from ovaries collected in the recreational fishery during summer. The process involved in fecundity determinations is time consuming and expensive. From this perspective, it would be desirable to know the extent of inter-annual and inter-river variability in fecundity and the risk involved in using default values as a means of reducing cost. Annual fecundity data were available for one river in Labrador and nine rivers in insular Newfoundland. Most rivers showed significant annual variability in relative fecundity expressed in terms of weight (eggs/kg) and length (eggs/cm) and there were significant differences among rivers as well. There was also a suggestion that there are regional differences in fecundity, for instance between northeast coast rivers and south coast rivers. Fecundity for repeat spawning grilse tended to be higher than for virgin grilse and significantly so for some rivers. Given the magnitude of differences observed within and among rivers, in order to minimize the risk of error in calculating egg depositions, the use of default relative fecundity values should be avoided.

Comments: The results indicate that fecundity data should be collected for each river on an annual basis. In the event that a default has to be applied, the mean value for a given river should be used. In the absence of river-specific information, a fecundity value from another river could be used, but attention has to be paid to stock and regional differences.

Recommendations: Continue to collect river-specific fecundity information, especially for large salmon.

Status of Atlantic Salmon (*Salmo salar* L.) Stocks of the Newfoundland Region, 1996

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

Summary: The moratorium on the commercial Atlantic salmon fishery in insular Newfoundland entered its fifth year in 1996. There were further reductions in commercial quotas in Labrador in 1996 and the season opened on June 20 compared to July 3 in 1995. 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 1996. The moratorium on cod fishing introduced in SFAs 11-14A in August 1993 also continued in 1996. Of the three SFAs in Labrador, the commercial fishery quota was caught only in SFA 2 in 1996. Labrador stocks, particularly the large salmon component, continued to be low compared to the 1970s. However, in recent years, management measures appear

to have dramatically improved spawning escapements, with the potential for increased returns in subsequent years.

Seventy-two rivers throughout insular Newfoundland were closed to angling in mid- to late-August in 1997 due to low water levels and high water temperatures. These closures are not expected to have had a significant impact on catches since they occurred at a time of the year when normally most angling activity is drawing to a close. Specific management measures were in effect for several rivers which should have restricted catch and effort. Total recreational catch (retained plus released fish) and effort in 1996 in insular Newfoundland were the highest recorded since 1974. Catch per unit of effort in 1996 increased over 1995 and the 1984-89, 1986-91, and 1992-95 means. During the moratorium years 1992-96, counts of small and large salmon and proportions of large salmon at counting facilities on the western side of the Northern Peninsula and along the northeast and east coasts, increased significantly over pre-moratorium years 1984-91. However, several rivers along the south coast and in Bay St. George did not show an overall improvement over pre-moratorium years.

An analysis of trends in estimated total population sizes of small salmon for Gander River (SFA 4), Middle Brook (SFA 5), Biscay Bay River (SFA 9), Humber River (SFA 13), and Western Arm Brook (SFA 14A) for the period 1974-96, suggest overall total population sizes for insular Newfoundland in 1992-96 were low relative to pre-moratorium years. Adults returning in 1997 with a three-year-old smolt age will be the progeny of spawners in 1992, the first year of the moratorium. In 1997, for northern and eastern rivers where greatly increased spawning escapements were recorded in 1992, there should be an increase in total returns, exceeding levels for 1992-96. The magnitude of the increase will depend on the proportion of three-year-old smolts (many northern and eastern rivers are characterized by four-year-old smolts) and sea survival. For southern and southwestern rivers (Bay St. George in particular) where 1992 spawning escapements did not increase over pre-moratorium levels, it is not anticipated that adult returns in 1997 will increase, should sea survival not improve. These rivers typically have three-year-old smolts.

Comments: Consideration should be given to providing separate assessment documents for Labrador and insular Newfoundland.

Recommendations: Nil

Evaluation of changes in salmon stock abundance as a result of the commercial moratorium on Atlantic salmon using a scaled index of salmon escapements

Author: J. B. Dempson

Summary: A simple index of salmon escapements was used to evaluate the impact of the commercial salmon fishery moratorium on Newfoundland stocks. The index is easy to calculate and understand, and is scaled to a common meaningful value for ease of comparisons among rivers. It can be used to examine the impact of the moratorium within an individual river (stock), or across rivers for specific zones (e.g. northeast, south and west coasts). The index is not related to conservation requirements, but it can be used to infer past average levels of commercial fishery exploitation, or to provide insight as to the extent of declines or increases in total stock production in some areas. For the stocks examined, results indicate that salmon stocks along the northeast coast and west coast including Humber River and north, have increased substantially during the moratorium period (1992-1996) relative to premoratorium levels (1984-1991). This was not the case for south coast rivers. Here, overall total salmon abundance may have declined by 34 to 66% during the moratorium period. Many stocks reached their lowest or second lowest level of abundance in 1991. Several Newfoundland salmon stocks, for both small and large salmon components, were declining in abundance throughout the mid-to late 1980's into 1991. Minimum estimates of commercial exploitation rates assuming constant natural mortality and similar total production levels, were 48.8% (± 8%) on small salmon and 75.7% (± 6.8%) on large fish.

Comments: The index used information on counts at fishways or counting fences. As such, it may not be indicative of total returns to rivers. One possibility to account for the difference in the proportion of small to large salmon at Salmon Brook, a tributary of the Gander River, and Gander River itself, was related to the disproportionate removal of small salmon destined for Salmon Brook due to the recreational fishery.

Recommendations: Inferred exploitation rates derived from this approach should be examined in relation to updating or modifying those used in individual river spawner-to-recruit estimates of past stock levels or future returns.

Estimates of returns and spawners for Labrador Atlantic salmon (*Salmo salar* L.) stocks

Author: D. G. Reddin

Summary: An exploitation model was used to estimate the numbers of small and large salmon of Labrador origin prior to all commercial fisheries including those fisheries in Newfoundland and Greenland. Exploitation rates developed from a tagging study at Sand Hill River, 1969-73 were adjusted for effort reductions, season changes, and the effect of quotas in 1992-96 to estimate the number of recruits prior to fisheries and the

number of salmon entering freshwater. In 1996, exploitation rates ranged from 0.03 to 0.06 for small salmon and from 0.13 to 0.23 for large salmon. Other model parameters were the proportions of Labrador origin salmon in commercial catches (range 60-80%) and the sea age distribution of 1SW and MSW salmon including the proportion of 1SW salmon that were non-maturing (range for small salmon - 0.1-0.2, for large salmon in SFA 1 - 0.7-0.9 and SFAs 2 and 14B - 0.6-0.8). Salmon spawners were estimated by subtracting mortalities from total freshwater entrants. Mortalities included retained angled salmon and an assumed 10% mortality of hooked-and-released fish.

The population of large salmon has declined considerably from the high abundance experienced in the early 1970s. Large salmon spawners have also declined but recent management measures which were designed to reduce exploitation have resulted in spawning escapements that in 1995-96 were the highest on record. At the mid-point of the estimates, large salmon spawners attained 56% (range 30-83%) of conservation requirements in 1996. The population of small salmon fluctuated considerably but with no overall declining trends until the 1990s. Small salmon spawners attained 259% (range 128-389%) of conservation requirements in 1996.

Comments:

1. The commercial catch statistics used to derive numbers and weights of small and large salmon include a number of default values developed when catches were much higher then at present. The use of these defaults when catches are low, as they presently are, may over-estimate the number of small salmon and under-estimate the number of large salmon. If so then correction of the commercial statistics will increase the total recruits and spawners for large salmon while reducing those for small salmon.

2. The analysis includes correction for 1SW Labrador origin salmon caught in Newfoundland. However, some of the 1SW salmon may have been non-maturing individuals which may add bias to the analysis. If so then the results for small salmon would most likely be negatively biased and large salmon positively biased.

3. The conservation requirements for Labrador small and large salmon are calculated from estimates of total production in numbers of salmon including males and females. The conventional habitat-based conservation requirements are in numbers of eggs. It would be desirable to examine the feasibility of converting Labrador spawning requirements to eggs.

4. Probability density functions should be provided for small and large salmon spawners.

5. Small changes in some of the model parameters could produce large changes in estimated recruits and spawners. This is reflected in the wide range in estimates particularly for small salmon recruits and spawners in 1996.

Recommendations:

1. Request raw catch data from Statistics Branch and recalculate the numbers of salmon in the commercial catch.

2. Convert the conservation requirements to numbers of eggs from numbers of small and large salmon using biological characteristics from angling fishery or commercial fishery if angling data is insufficient.

3. Conduct habitat surveys on Labrador rivers so that habitat-based conservation requirements can be derived. Surveys should include some electrofishing to determine presence/absence of salmon parr in the various types of habitat.

Status of the Atlantic salmon (*Salmo salar* L.) stock of Pinware River, Labrador, 1996.

Authors: C. C. Mullins, S. L. Lowe, and G. Chaput

Summary: This is the first assessment of the status of the Atlantic salmon stock on Pinware River. A minimum of 6,110 ha of lacustrine habitat and 46,691 fluvial rearing units are available to salmon on this river (to be updated in 1997). The conservation egg deposition requirement based on this habitat is 11,847,390 eggs and on the basis of the proportion of small (73.8%) and large (26.2%) salmon observed in the tagging traps in 1996, the egg deposition requirement can be achieved by 3,360 small and 1,192 large salmon. The proportion of large salmon observed at tagging traps in 1996 was the same as observed in the recreational fishery in 1995, similar to the 1992-95 mean and almost twice the 1984-91 mean. Three estimates of total returns of small and large salmon to the Pinware River in 1996 were derived: 1) 3,849 (95% CI=1,967-6,147) based on 72 tagged salmon and 4 tags returned voluntarily by anglers; 2) 4,000 (CI=2,500-12,000) based on a Bayes probability distribution function; and 3) 3,036 based on snorkel surveys. The low number of salmon tagged and recaptured makes these estimates of the population size unreliable. However, since only a small number of fish were captured in the two estuarial tagging traps, it would appear that the population was low in 1996. The potential benefits of lower commercial effort and quotas and lower recreational bag limits implemented since 1992 did not result in the expected increase in the number of spawners on this river. Recreational catch and effort statistics were not collected by DFO in 1996. Therefore, it was not possible to accurately compare estimated catches and effort in 1996 with those in previous years.

Comments: The low numbers of salmon tagged and recaptured increases the uncertainty around the estimate of the angling exploitation rate in 1996, and the incomplete catch and

effort statistics increases the uncertainty around the estimate of total returns based on mark-recapture. However, the assessment does indicate that the decline in the population as evidenced by angling catch statistics in previous years was real and that even with the relatively high level of uncertainty it is unlikely that the conservation spawning requirement was achieved in 1996.

Recommendations:

1. Habitat measurements need to be verified from digitized 1:50,000 scale topographic maps and instream measurements.

2. The tagging trap should be relocated in 1997 to increase the number of tags applied.

3. Recreational catch and effort statistics need to be collected over the entire season to improve the estimate of returns.

Stock status of Atlantic salmon (*Salmo salar* L.) in Sand Hill River, Labrador, 1996

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

Summary: The status of Atlantic salmon in 1996 was determined for Sand Hill River, Labrador which is located in Salmon Fishing Area (SFA) 2. Assessments were conducted in relation to reduced Atlantic salmon commercial fisheries in Labrador due to quota restrictions and the five-year moratorium on the commercial Atlantic salmon fishery in insular Newfoundland, which entered the fifth year in 1996. A counting fence placed near to the sea on the main stem was used to enumerate adult returns. In 1996, total returns to Sand Hill River adjusted for the early removal of the counting fence were 3,319 small and 414 large salmon. An exploitation model corrected for commercial fishing effort reductions was used to estimate total production of Sand Hill River recruits prior to commercial fisheries. The total number of salmon produced of Sand Hill origin prior to commercial fisheries were 3,412 small and 684 large salmon. Both the total returns to Sand Hill River and total production prior to fisheries of small salmon increased in 1996 over 1995 but declined for large salmon.

Comments:

1. The habitat estimates for Sand Hill may be overestimated due to the inclusion of non-productive habitat in the upper part of the watershed. Consequently, no conservation requirements or % of egg requirements achieved will be referred to until the habitat survey is complete.

2. The production records of circa. 1790s may be unreliable due to charr in the records. Further investigation indicates that charr were reported separately and excluded.

3. Changes in sex ratio and other biological characteristics from 1969-73 to 1994-96 periods is of concern. Selective pressures from exploitation and low sea survival may be altering stock characteristics.

4. Continue fecundity studies in particular concentrating on the large salmon component.

Recommendations:

1. Complete the habitat survey begun in 1995 and include electrofishing surveys to assess productive habitat.

2. Consider expanding time series using range of angling exploitation rates and then use longer time series to forecast returns for following year.

Status of the Exploits River stock of Atlantic salmon (*Salmo salar* L.) in 1996

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

Summary: The Exploits River will receive the last returns from fry stocking programs in 1997 which will be the 4^+ river age recruits from the 1993 fry stocking. The status of Atlantic salmon in the Exploits River in 1996 was derived from four fishway counts, recreational fishery data, fecundity data and biological characteristic data for the Exploits stock. River escapement was 32,369, composed of 30,316 small and 2,053 large salmon, which is the highest freshwater escapement recorded to date. The watershed received 44% of the required conservation egg requirement with the lower, middle and upper sections receiving 216%, 42% and 26% respectively. Although egg requirements from natural spawning have previously been achieved only in the lower section of the Exploits all three sections of the watershed received their highest egg depositions from natural spawning in 1996. The recreational fishery had a reduced season for retention of small salmon, retained 1,915 small salmon and had a total hook and release catch of 3,313 small and large salmon. For the period June 10- September 6 sixteen percent of the fish at Bishop Falls fishway possessed marks. Escapement to the Grand falls fishway of 14,395 salmon more than doubled any previous escapement to this fishway. It is anticipated that returns in 1997 will be similar to the 1996 level of returns.

Comments: Concern was expressed over the low level of returns to the upper section (area upstream of Red Indian Lake) of the watershed and there should be no exploitation on this stock component.

Recommendations:

1. Numbers of net marked fish should be recorded at Grand Falls.

Status of Atlantic Salmon (*Salmo salar* L.) in Gander River, Notre Dame Bay (SFA 4), Newfoundland, 1996

Authors: M. F. O'Connell, D. G. Reddin, and E.G.M. Ash

Summary: The status of Atlantic salmon in Gander River in 1996 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. The assessment was also conducted in relation to the commercial salmon fishery moratorium which entered its fifth year in 1996. The number of small salmon retained in the recreational fishery in 1996 was the highest since 1985; effort expenditure was the highest recorded since 1974. The river received 124% of its conservation egg requirement in 1996, the third time since the start of the commercial salmon fishery moratorium in 1992 that the requirement was met; in excess of 90% of requirement was achieved in 1994 and 1995. Prior to the moratorium, 36-44% of conservation requirement was met during the period 1989-91.

There were significant increases in returns of small and large salmon during the moratorium (1992-96) over returns during pre-moratorium years 1989-91. However, proportions of large salmon in runs and proportions of repeat spawning grilse in the small salmon category did not change significantly from pre-moratorium levels. Weights and lengths of small salmon observed during the moratorium increased significantly over those prior to the moratorium but there was no significant difference in condition index. There was a significant decline in estimated total population sizes of small salmon during the period 1974-96. Recruitment during 1989-96 was among the lowest in the time series. The number of recruits per spawner in 1996 was the highest since 1988. It is anticipated that returns of small salmon in 1997 will be in excess of conservation requirement, without a recreational fishery. For the period June 17-August 4, of the small and large salmon examined, 12.8% and 5.9% possessed net marks.

Comments: Nil

Recommendations: An alternate approach for the retrospective estimation of total small salmon returns to the river and total population size prior to 1992 was presented. The method was based on a significant relationship between catch per unit of effort (CPUE) in the recreational fishery and total river returns since 1992. Total returns of small salmon prior to 1992 were obtained by solving the equation for the CPUE value for each year. Total population size was achieved by adding the numbers of small salmon caught in the commercial fishery in Gander Bay. It was felt that the commercial catch in Gander Bay constituted only a portion of the total population size, since fish destined for Gander River are also taken outside Gander Bay. It was recommended that an attempt be made to

reconstruct the population by building in commercial catch outside Gander Bay. Total population size could then be used to develop a stock-recruitment relationship, which should also incorporate an environmental variable.

Status of Atlantic salmon (*Salmo salar* L.) in Campbellton River, Notre Dame Bay (SFA 4), Newfoundland in 1996

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

Summary: The status of Atlantic salmon in Campbellton River in 1996 was determined using a count obtained from a combination of adult and smolt counting fences located on the main stem just above head of tide as well as recreational fishery and biological characteristics data. The assessment was conducted in response to major management changes to both commercial and angling fisheries which were introduced in 1992 and continued in 1993-96. 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. Adult returns in 1996 were 3,208 small and 560 large salmon and averaged about 3,554 small and large salmon, 1993-96. Historical records indicate that circa. 1800 adult returns to a harvesting weir were about 12,000 salmon. The smolt count in 1996 was 58,369; the highest in the period of 1993-96. Sea survival of the 1995 smolt class returning in 1996 as 1-sea winter salmon was 7.2%. The proportion of conservation requirements achieved for Campbellton River in 1996 was 294%. On average for the period of 1993-96, Campbellton River achieved 283% of it's conservation requirement. A forecast of adult returns in 1997 was made from the smolt count of 58,369 in 1996. Adult returns in 1997 may be 4,000 1SW salmon and a further 1,100 repeat spawners from the 1996 spawners for a total of 5,100

Comments: NIL

Recommendations:

1. Calculate predicted repeat spawners from previous spawning escapement adjusted for mortality rates back to freshwater.

2. Complete the analysis of the habitat survey data.

Ratio of adults to Experimental Ponds Area juveniles in a stock assessment of Atlantic salmon (*Salmo salar* L.) in the Gander River, Newfoundland with a projection of adult returns in 1997

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

Background: Spring population sizes of juvenile Atlantic salmon were determined by Schnabel multiple, mark-recapture methods in two Experimental Ponds Area (EPA) lakes at the headwaters of the Gander River from 1979-96. Juvenile abundance in 1995 and 1996 was considerably higher than expected as indicated by a previously derived stock-recruit relationship between juvenile abundance and adults returning to the Salmon Brook fishway on a lower river tributary four years earlier.

Total river adult (small salmon <63 cm) returns were obtained over the period 1989-96 at the counting fence near the mouth of the river and the fish angled downstream of the fence. Changes in the ratios of returning small salmon to the juvenile abundance one year earlier were indicative of a more than four-fold (4.5 X) increase in the average marine survival of Gander River salmon following closure of the commercial fishery in 1992. However, our results suggest that marine survival of the 1995 migrants was decreased relative to the other years during the closure of the commercial fishery. Total river adult returns in 1997 were projected from 1996 juvenile abundance and the ratio of small salmon returns to the Gander River to the juvenile abundance one year earlier. Projections indicate that 50,103 small salmon should return to the Gander River to spawn in 1997 and the current conservation spawning requirement will be exceeded.

Comments: NIL

Recommendations: Indications of a lower marine survival of the 1995 migrants (1996 adult returns) should be corroborated by an age and length-specific analyses of juvenile population structures to determine if the low survival ratio index for 1996 adults was attributable to an atypically high abundance of non-migrating juveniles in the spring of 1995. (Authors' note: Results of the above analyses were consistent with a comparatively low, marine survival of the 1996 returning adults).

Evaluation of age-specific and length-specific estimates of juvenile Atlantic salmon (*Salmo salar* L.) abundance in the Experimental Ponds Area as predictors of adult returns to the Gander River.

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

Summary: Models were evaluated which used age-specific and length-specific estimates of Experimental Ponds Area juvenile salmon abundance to predict total adult returns to the Gander River, Newfoundland the following year. Restricting the juvenile estimate to

age classes older than 2+, either singly or combined, resulted in lower statistical precision than using all age classes together. Length-specific models deleted the smaller juveniles from the population estimate starting with those ≤110 mm and then worked upwards in 10 mm increments. Restricting the juvenile estimate to fork lengths >120 mm provided adult return estimates with the greatest statistical precision and also produced a predicted 1996 adult return that was closer to the observed value. Incorporating the 1996 observed adult return into the length-specific models again resulted in maximum precision for the >120 mm fork length model. This model predicts a 1997 Gander River adult return of 53,620 which is well above the conservation spawning requirement of 21,828 small salmon.

Comments:

1. What happens if you eliminate the 4 year-olds from consideration?

   Reply: We have added models using either the 3+ or 4+ year classes alone. Both have lower precision than the model using all age classes combined which indicates that they do not fit the reference data as well.

2. Shouldn't you use predictions for years other than just 1996 to evaluate which is the best model?

   Reply: The confidence intervals around the predictions are a measure of the precision of the model for the reference years used in model construction. The tighter the confidence interval, the better the model fits those years. Gathering data for future years will allow further evaluation of the models.

Recommendations:

1. Add age data for 1996 to the age-specific models when it becomes available.

Stock status of Atlantic salmon from Conne River, SFA 11, Newfoundland, 1996

Authors: J. B. Dempson and G. Furey

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 1996, returns to home waters (river and estuary) were 4440 salmon <63 cm in length (small) and 179 salmon ☐ 63 cm (large) in size. The number of small salmon includes 286 fish that were reared from wild Conne River smolts in an aquaculture cage at Roti Bay. Returns, therefore, represented an increase by 27% for small salmon and 63% for large salmon over 1995, the highest since 1990. Sea survival to 1SW salmon increased to 5.76%, the highest level since 1989-90. Estimated egg deposition from wild small salmon contributed 99% of the current management target of 7.8 million eggs. Conne River salmon smolts that were

reared at an aquaculture site in Roti Bay, and released as 1SW adults in the early summer of 1996, contributed 5% of the total egg deposition. Analysis of Conne River salmon biological characteristic data indicated that the proportion of previous spawners in the small salmon category in 1996 was the highest to date.

An evaluation of the impact of the commercial salmon fishery moratorium showed that it has had a negligible impact on the Conne River salmon stock. Returns of either small or large salmon were lower, on average, during the moratorium (1992-96), than they were prior to the moratorium (1986-91). Sea survival of smolts to either small salmon, or 1SW salmon was 30-40% greater during the premoratorium years. However, there was a significant decline in sea survival through to the 1994 adult salmon return year. The proportion of large salmon in the run was no different following closure of the commercial fishery than it was when fishing was allowed. Fork length of 1SW salmon, while statistically larger, differed by 0.87 cm. Weight of salmon showed no change.

Based on associations between: 1) median smolt run timing and sea survival; 2) an index of marine thermal habitat and sea survival; and assuming a sea survival similar to that of 1996 (~6%), then returns in 1997 should easily exceed the management target of 4000 small salmon and possibly approach 5400 1SW salmon.

An escapement of over 100 thousand Saint John River strain Atlantic salmon from an aquaculture operation in Bay d'Espoir in February 1996, is of concern. Survivors from this escapement could begin returning to local rivers as 1SW salmon in 1997 or as 2SW fish in 1998.

Comments:

1. Conne River is distinguished from other Newfoundland salmon rivers in having a defined management target 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.

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:

1. Conne River data should be analysed further with the intent of evaluating the validity of the habitat-based conservation requirement relative to the biological information for the river that could support a river-specific stock recruitment relationship.

2. A systematic sampling program (scales) should be undertaken to estimate and monitor the contribution of escaped Saint John River strain of salmon in the 1997 escapement. Scales would also be available for genetic analyses. Genetic analyses of Saint John River fish should be carried out to establish baseline reference criteria and serve to compare with and calibrate results derived solely from scale analyses.

3. The index of marine thermal habitat should be evaluated against other Newfoundland salmon stocks for possible preseason predictions of salmon stock abundance.

Evaluation of an alternate strategy to enhance salmon populations: cage rearing wild Atlantic salmon smolts from Conne River, Newfoundland

Authors: J. B. Dempson, V. A. Pepper, G. Furey, M. Bloom, T. Nicholls, and G. Hoskins

Summary: Conne River flows into Bay d'Espoir on the south coast of Newfoundland (SFA 11). Total returns of adult Atlantic salmon have ranged from a high of 10,000 fish in 1987 to a low of 1600 fish in 1994. Over this time interval, marine survival from smolts to one-sea-winter (1SW) salmon declined at a rate of 1.16% per year, from 7-10% to 2.6%. In an effort to improve salmon production in Conne River, and compensate for precipitous declines in marine survival, an alternate enhancement strategy using aquacultured wild smolts was initiated.

Wild Atlantic salmon (*Salmo salar*) smolts from Conne River, Newfoundland, were captured during their downstream migration in May, 1995. From an estimated total run of 62,750 smolts, 5,000 (8%) were transferred over a thirteen day period to an estuarine aquaculture rearing site at Roti Bay, 23 km away. Feeding of smolts began four days after the first fish were transferred. Survival of smolts was monitored throughout the experiment with the greatest mortality occurring in July, approximately six-to-eight weeks following transfer. Mortalities were due mostly to the failure of these smolts to feed on the commercial dry diet. Overall survival of smolts to one-sea-winter salmon was 18.5%, and was over four times higher than the average survival of wild salmon to Conne River during the past six years. Growth of smolts was monitored at monthly intervals until November, 1995, with additional sampling undertaken in the spring and early summer of 1996.

One-sea-winter survivors from the cage rearing experiment were significantly smaller than wild salmon that returned to Conne River. Survivors were split into two groups and released directly into the Bay d'Espoir estuarine fiord; one group was released June 27-28, 1996, at a site approximately 7 km from the mouth of Conne River. The second group was retained at Roti Bay and released July 23, 1996. Less than 50% of the surviving fish were later accounted for in local Bay d'Espoir rivers. Approximately 80% of them returned to Conne River with 20% straying to other streams. Survival back to the Conne River, then, was similar to that of wild salmon in 1996. Lotek digitally encoded radio transmitter tags were used in evaluating the success of the experiment by tracking migration timing and subsequent distribution of cage released salmon throughout the Conne River system.

Comments: This project provided a unique opportunity to obtain information on survival and growth of wild salmon smolts in an aquaculture setting as well as information on the spawning distribution of salmon throughout the Conne River watershed.. It was noted that several aspects of the experiment would require additional attention if it was to be repeated including: 1) the immediate capture and transfer phase; 2) the grow-out stage; and 3) the release phase. Straying, for example, could largely be alleviated by releasing salmon directly into the river.

Recommendations: The utility of this approach as an alternate strategy to enhance depressed salmon populations should be evaluated further.

Status of five enhanced Atlantic salmon (*Salmo salar* L.) stocks of the Newfoundland Region in 1996

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

Summary: Stock assessments were conducted for three enhanced rivers namely Rocky (SFA 9), Flat Bay Brook (SFA 13) and Little River (SFA 11) with updates of enhancement activities provided on two other rivers namely Romaines (SFA 13) and Piper's Hole River (SFA 10). Stock status was determined for Rocky River and Little Rivers through complete counts of large and small salmon at a fishway and counting fence respectively. Total returns of large and small for Flat Bay Brook were estimated from a snorkeling survey which enumerated 1096 adult salmon while the fence enumerated 645 adult salmon. This may be indicative that the fence counts in 1995 and 1996 underestimated escapement as well. Fry stocking was conducted on all rivers in the spring of 1996. Partial counts of small and large salmon from Romaines and Piper's Hole rivers were determined from a snorkeling survey and counting fence respectively; however no attempt was made to determine egg deposition. Rocky, Flat Bay and Little rivers received 34%, 65% and 298% of their respective conservation egg depositions. Rocky, Flat Bay and Little River were closed to recreational fishing; Romaines is a nonscheduled river; however, Piper's Hole River had a recreational fishery in 1996. Smolt-to-adult survival for Rocky River increased to 3.8% for the 1995 smolt class. Rocky River recorded the highest smolt run to date in 1996 of 14,261. A forecast of returns is only available for Rocky

River which is not expected to achieve 50-60% conservation egg deposition in 1997. A partial fence count on Piper's Hole River enumerated 88 fish and a partial snorkeling survey on Romaine's River yielded 142 fish.

Comments: Nil

Recommendations:

1. For Rocky River the marine habitat index and median smolt run timing should be tested relative to smolt survival.

2. Smolt sampling should be conducted over the entire smolt run on Little River.

Status of Atlantic Salmon (*Salmo salar* L.) in Middle Brook and Terra Nova River (SFA 5), Biscay Bay River (SFA 9), and Northeast River, Placentia (SFA 10), Newfoundland, 1996

Authors: M. F. O'Connell, and D. G. Reddin

Summary: The status of Atlantic salmon stocks was determined for Middle Brook and Terra Nova River in SFA 5, Biscay Bay River in SFA 9, and Northeast River, Placentia in SFA 10 in 1996. Assessments were also conducted in relation to the commercial salmon fishery moratorium which entered its fifth year in 1996. Conservation egg requirement was achieved in all five years of the moratorium for Middle Brook and Northeast River and in three out of five years for Biscay Bay River (which included 1996). Although conservation requirement has never been achieved in Terra Nova River, egg depositions during the moratorium tended to be higher than prior to the moratorium.

There were significant increases in returns of small and large salmon and proportions of large salmon in moratorium years (1992-96) over pre-moratorium years (1984-91) for all rivers except Biscay Bay River. Contrary to expectations, proportions of repeat spawning grilse in the small salmon category decreased significantly in Terra Nova River and Biscay Bay River and also decreased in Middle Brook, but not significantly; however, the proportion for Northeast River did increase, but not significantly. Weights and lengths of small salmon observed during the moratorium were significantly higher than recorded prior to the moratorium for all rivers. Condition index increased significantly over that of the pre-moratorium period for Biscay Bay River and Northeast River while the reverse was true for Terra Nova River; there was no significant difference for Middle Brook. Compared to the late 1970s and early 1980s, estimated total population sizes of small salmon for Middle Brook and Biscay Bay River have been quite low. It is anticipated that returns of small salmon for Middle Brook and Biscay Bay River in 1997 will exceed conservation requirements.

Comments: Nil

Recommendations: It was recommended that the impact of the moratorium on levels of returns of repeat spawning grilse be examined by smolt class.

Status of Atlantic Salmon (*Salmo salar*) in the Highlands River, St. George's Bay (SFA 13), Newfoundland, 1996

Authors: R. J. Gibson, R. R. Whalen, K. G. Hillier, and G. T. Clarke

Summary: A fence and trap for enumerating downstream migrating fish was operated from April 26 until June 14, except for being inoperable from April 28 to May 4 due to high water. Few smolt were missed since the main run was between May 15 and June 14, during which time 12,383 smolt were counted. Although smolt counts lower than fifteen years ago, numbers were highest since counts were made in 1993. The majority (72.5%) of the smolts are 3+. Also migrating downstream were 110 kelt (55 small, 40 large).

Upstream migrating salmon were enumerated between June 14 and October 24. Unlike most salmon stocks in Newfoundland, the run is bimodal, with a well defined early run between mid-June to the end of July, and a fall run from the end of August to mid-October. There were 199 small salmon and 142 large salmon counted. Potential egg deposition ($1.17 * 10^6$) was 78% of the conservation level ($1.5 * 10^6$). It was estimated that 30.4% of the potential egg deposition was from small salmon, and that 69.6% of deposition was from large salmon. Sea survival from the 1994 smolt run, to 1995 grilse and the 1996 2SW salmon, was 2.8%.

Population estimates of juvenile salmon were made at 19 sites. At all stations, except one in the lower river, the underyearlings were fewer than in 1995, and biomass was lower. An exceptionally high flood in February, prior to emergence of fry, moved massive amounts of substrate and was likely to have had a negative effect on the 1996 year class. Densities of the older parr were somewhat less.

With present sea survival rates a run of about 195 grilse and 164 large salmon can be expected in 1997. The potential egg deposition may therefore be about 86% of the conservation level.

Comments: The large salmon component now forms about 45% of the adult salmon run, compared to 26% of the run a decade and a half ago. Nevertheless, the conservation level has yet to be met. The densities and biomass of juvenile salmon suggest that smolt yields will not be increasing over the next few years. The decline in underyearlings suggests that the smolt yield in 1999 will be less, with relatively few grilse returning in 2000. The electrofishing work has shown that River Brook, the major upstream tributary, was underseeded in the studies a decade and a half ago, and that underyearlings dramatically increased after the large salmon component of the run increased. The work has also shown that the river is relatively less productive than a number of others which have been studied, possibly partly due to hydrological and sediment changes due to

logging and road building practices, but suggesting that the system may not be capable of reaching conservation target levels.

Recommendations:

1. A different management approach should be taken with rivers that are unlikely to reach the "conservation level". An angling fishery would allow better estimates for size, fecundity and sex ratios. The unusual large salmon component should be conserved, by the present catch and release regulations for large salmon, and by closing the fishery before the fall run. If the large salmon are a unique genetic strain, they would be useful as a source for stocking fry in presently unused or inaccessible parts of the watershed.

2. A spring fishery for sea trout in the estuary causes mortality of smolt which are also caught, and the timing of the fishing season should be changed. The data from this system provides the best information of rivers in the St. George's area, and the river should be retained as an index river.

Stock Status of Atlantic Salmon (*Salmon salar*) in Crabbes Middle Barachois, and Robinsons rivers, St. George's Bay, Newfoundland ,1996.

Author: T. Rex Porter

Summary: Adult Atlantic salmon were visually counted in Crabbes, Middle Barachois, and Robinsons rivers in the last week of August by swimmers snorkeling down each river. Salmon were only found in pools, generally with water depths greater than 1 m. An adjustment factor was applied to the counts in each section surveyed to account for fish not observed in the larger pools. The actual count and the adjusted count provided an estimate of the minimum and maximum numbers of salmon in each river. There were no known removals before or after the survey since only hook-and-release angling was permitted. The minimum and maximum estimate of the numbers of salmon counted in each river are: Crabbes River, 144-239 large and 592-844 small salmon; Middle Barachois, 34-36 large and 755-805 small salmon; and Robinsons 102-120 large and 659-768 small salmon. Neither river attained its conservation egg requirements. Crabbes River obtained 44-68% of its Conservation requirements; whereas, Middle Barachois River received 76-81% and Robinsons River received 57-67% of their conservation requirements. The estimated percentage of conservation levels attained for each river in 1996 was similar to that previously estimated for 1994 using angling exploitation rates. The information available did not lend itself to forecasting the abundance of salmon in 1997.

Comments: The visual survey appears to be a reasonable and inexpensive technique for assessing the spawning populations in St. George's Bay rivers. There may be some observer differences in sizing salmon as well as completeness of counts. Further insight is

need into the observer effect. The biological characteristics information used in the assessment was derived from other stocks and may not be correct for the present populations. Survey crews noted differences, among rivers, in size of small and large salmon.

Recommendations:

1. The counts and the sizing of fish by each team should be calibrated and considered in the adjustment factor.

2. Biological characteristics information should be collected for each river. One method to collect this information would be by seining the fish in September.

3. Investigate techniques to improve estimates of numbers of salmon in the large pools where visual counting is ineffectual.

Status of Atlantic salmon (*Salmo salar* L.) in Northwest River, Bonavista Bay (SFA 5), Newfoundland, 1996

Author: M. Simpson

Summary: Prior to 1988, Northwest River was managed entirely the Department of Fisheries and Oceans. In 1988, the lower 2.5 km of the river were gazetted into Terra Nova National Park by revisions to the National Parks Act. In 1989, the park began to manage this section of the river using the National Park license and tagging system. Counts were obtained in 1995 and 1996 and were used in conjunction with historical recreational fishery data and biological characteristic data to calculate total river returns and spawning escapements. Annual egg depositions were compared against a conservation requirement based on available salmon rearing habitat. In 1996, an estimated 593 small and 203 large salmon passed through the counting fence. The percent of the conservation requirement achieved was 55%. Anticipated returns for 1997 will provide an egg deposition below that required for conservation.

Comments: Mortality factor for hook-and-release salmon should be included in the assessment.

Recommendations:

1. Counts should be monitored in 1997.

2. Biological characteristic data should be collected.

Status of the Atlantic salmon (*Salmo salar* L.) stock of Harrys River/Pinchgut Brook, Newfoundland, 1996.

Authors: C. C. Mullins and D. Caines

Summary: The recreational fishery on Harrys River in 1996 was open for hook-and-release angling only. Angling in the headwater areas upstream from Home Pool was not permitted. Anglers reported good fishing conditions early in the season and numerous sightings of salmon holding up in pools. The fishery was closed in mid-August due to low water levels and high water temperatures. Recreational catch and effort statistics were not collected by DFO in 1996 so comparison of released catches with previous years was impossible. Counts of small and large salmon at the counting fence on the Pinchgut Brook tributary were below those in 1995 but were above the 1992-95 mean. A spawning survey was conducted on the entire Harrys River system in mid-November. The results of the survey indicated that the Pinchgut Brook system accounted for 33% of the spawning on Harrys River in 1996 compared to 41% in 1995. Based on the results of the spawning survey, it was estimated that total spawning escapement on Harrys River in 1996 was 1,936 salmon which was the highest since assessment started in 1992. Spawning escapements have increased since 1992 but the conservation egg deposition requirement has not been achieved in five years of assessment. Potential egg depositions from spawners in 1996 represented 52% of the conservation egg deposition requirement of 7.8 million eggs. If there had been a recreational retention fishery in 1996 the percentage of the conservation requirement achieved 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 in the Bay St. George area. The technique of using the known spawning escapement and 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 on Harrys River to assess the entire run were unsuccessful due to extreme fluctuations in water level. The variation in percentage of spawning on Pinchgut Brook 1996 compared to 1995 was mainly due to the fact that some areas included in the 1996 spawning survey had not been surveyed in 1995 and vice versa. At this point in time, the spawning survey needs to be completed every year so that all spawning areas can be identified. The biological characteristics information used for large salmon was derived from other stocks and may not be correct for the present population.

Recommendations:

1. Recreational catch and effort statistics would help in the assessment. Harrys is currently the only monitored river in the Bay St. George area with a recreational fishery.

2. Refining the date of spawning would allow the survey to be done after the end of spawning.

3. Biological characteristics information should be collected for the river. This could be done by seining known holding areas in September.

Status of the Atlantic salmon (*Salmo salar* L.) stock of Humber River, Newfoundland, 1996.

Authors: C. C. Mullins, T. R. Porter, and J. B. Dempson

Summary: This is the seventh assessment of that portion of the Humber River salmon stock that enters the river in June to August. Indices of abundance are mark and recapture estimates of run size and angling catch and effort data. Returns of small salmon in 1996 were the highest and large salmon were the second highest in seven years of assessment which included two pre-moratorium years (1990 and 1991). Estimates of the total population size of salmon in pre-moratorium years, based on an assumed exploitation rate in the commercial fishery, indicated a significant decline since 1979. The total population size of salmon on the Humber River was the lowest recorded during the period 1992-94. Spawning escapements were above the conservation requirement in 1996 and in four out of five years in 1992-96 compared to zero out of 12 years in 1980-91. Spawners replaced themselves in four out of five years in 1992-96 compared to only four out of 12 years in 1980-91. Potential egg depositions in 1996 were 186% of the conservation egg deposition requirement.

The experience of anglers in 1996 was that salmon were abundant on the river. The catch of small salmon was greater than the 1992-95 and 1986-91 means. The interpretation of trends in recreational catch and effort is confounded by the unknown effects of various catch and effort controls implemented in the fishery in recent years. In addition, less emphasis is being placed on the collection of recreational catch and effort data.

It is anticipated that total returns in 1997 will be higher than in 1996 and assuming there are no changes to fisheries management measures, it is expected that the conservation requirement will be exceeded. Approximately 50% of the returns of small salmon in 1997 will be produced by spawners in the first year of the commercial moratorium.

A review was conducted of the information available on the reported late/fall run of large salmon to the Humber River in August and September. The mark-recapture traps operated in recent years in the Humber River estuary and historical sampling in the commercial fisheries in Bay of Islands suggested that there is a later run of large salmon entering the river primarily in August and September. This population appears to remain in the lower Humber downstream from Deer Lake and spawns there. Anglers report that there are bright salmon entering the lower Humber in October. In 1992 and 1996, a tagging trap was operated in the estuary until 2 October to assess the run but only 3 small and 3 large salmon were caught in 1992 and 2 small and 1 large salmon were caught in 1996. Recreational catch rates of large salmon after 31 July in 1994-96 in the Lower Humber were higher than for the early part of the season indicating that a late run may be present but, based on the low numbers caught plus the possibility that a single group of salmon

may be repeatedly fished over, it is expected that the run is quite small. Possibly numbering no more than 500 fish. We have little current information on the biology of salmon entering the river at this time of year but based on historical sampling, the run has a high percentage of three-sea-winter salmon compared to the summer run. This population is probably genetically distinct from the summer run of salmon to the Humber River. A precautionary approach should be taken in managing this unique stock. Fishing mortality should not be expanded.

Comments: The late run of salmon 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: Nil

Northern Labrador Arctic charr: catch and effort update for 1996

Authors: M. Shears and J. B. Dempson

Summary: Northern Labrador Arctic charr landings in 1996 totaled 15 t, approximately half that of the 1995 fishery and 80% below the previous ten-year (1986-95) mean of 75 t. Charr landings from the Nain Fishing Region were 13 t or 91% of the northern Labrador total. Fifty-six percent of this catch originated from subareas north of Black Island. The reduced catches are directly related to effort which has continued to decline to the lowest recorded in 22 years. The decrease in effort is largely related to the licence buy-out program, although other individuals who retained their licences chose alternate sources of employment. Ice conditions also impacted on catches of both charr and salmon in north Labrador during 1996. Aerial surveys of several Voisey's Bay rivers indicated that charr were quite abundant in the Kogluktokoluk River, especially the Ikadlivik Brook tributary. An in-river terminal harvest of charr at Southwest Arm Brook, Saglek Fiord caught just under 2000 commercial sized fish.

Comments:

1. In-river terminal harvests of charr in Southwest Brook, Saglek Fiord, were not indicative of overall abundance in 1996. This was because the 1996 program was set to harvest a defined amount of charr in as short a period possible, rather than have an extended program, as in past years, that served to enumerate the charr run over a greater period of the run. Future in-river fisheries should be moved to rivers other than Southwest Arm Brook.

2. Based on the limited catch information in 1996, there is no reason to advise changes to the 1996 management plan for the 1997 season. There is a possibility that new 'charr only' licences could be issued in 1997. If so, individuals would be required to fish in specified bay or fiord areas where the by-catch of Atlantic salmon is negligible.

Recommendations: Nil

Spatial and temporal variability in the diet of anadromous Arctic charr, *Salvelinus alpinus*, in north Labrador

Authors: J. B. Dempson, M. Shears, and M. Bloom

Summary: Information on food and feeding characteristics of anadromous Arctic charr from north Labrador were summarized. Over 2500 specimens were examined with substantial differences in feeding characteristics among stock complexes observed. Dominant prey items of charr from the Voisey stock complex included capelin and sand launce followed by mysids and sculpins. With respect to the Nain stock complex, there were obvious differences between inshore and offshore zones. Capelin were the predominant prey item for charr in the inshore zone while hyperiid amphipods and Arctic sculpins dominant gravimetric analyses of charr feeding characteristics in the offshore zone. Capelin and sand launce were of minor importance in the diet of Arctic charr from the northern fiords (Hebron, Saglek, Nachvak). In contrast, hyperiid amphipods, various sculpin species and mysids were the dominant prey organisms here.

Analysis of the temporal variability in the diet of charr was examined for the inshore zone of the Nain stock complex over the period 1982-1995. The contribution of capelin varied from 58% to 83% from the 1982-84 period through to the 1988-90 period. Since 1991, capelin have been virtually absent from the diet of charr contributing less than 10% during 1991-933 and 5% in 1994-95. The decline in the utilization of capelin has been balanced, at least in terms of the overall percentage of the total weight of all food, by corresponding increases in amphipods and sculpins. The apparent change in the abundance of capelin as inferred from Arctic charr stomach analyses is consistent with other evidence suggesting a displacement of northern capelin populations into more southern areas.

Comments: It was suggested that the apparent change in the contribution of capelin and sand launce in the diet of charr from the Nain stock complex may have resulted in a corresponding change in the flesh colour of fish from this area. Direct information, however, was not available to ascertain this although it was noted that some historic data was in various published reports.

Recommendations: Nil

Status of Atlantic salmon (*Salmo salar* L.) stocks in Lomond River, Torrent River and Western Arm Brook, Newfoundland, 1996.

Author: C. C. Mullins

Summary: Atlantic salmon stocks are assessed based on counts of adult salmon at fish passage facilities on Lomond River and Torrent River and at a counting fence on Western Arm Brook. These facilities have been monitored since 1962 in the case of Lomond River and since 1971 in the case of Torrent River and Western Arm Brook. Conservation egg deposition and spawner requirements were exceeded on all three rivers in 1996 and in all post-moratorium years. Counts of small and large salmon on all three rivers and the smolt-adult survival rate on Western Arm Brook in the five post-moratorium years (1992-96) were greater than the mean for pre-moratorium years (1984-91). The total returns in 1997 are anticipated to be greater than 1996 values for Lomond River and Torrent River and it is anticipated that spawning escapements on the three rivers will exceed conservation requirements. The total population size of small salmon in some pre-moratorium years was greater than in post-moratorium years for all rivers and this trend is not expected to change in 1997. There has been a significant increase in the total population size of small salmon for Torrent River.

Comments: Counts were not recorded at the Lomond River fishway in 1989-91 but salmon were observed passing through the fishway. Counts in these years were estimated based on the mean in the previous three years.

Recommendations:

1. Habitat estimates for Torrent River should be verified from digitized 1:50,000 scale topographic maps and from instream measurements. In comparison to habitat available on Lomond River which has a smaller drainage basin area, the available habitat on Torrent River seems quite small.

2. Because a large portion of the total salmon habitat on the Lomond River is downstream of the fishway it is recommended that a mark-recapture experiment be conducted to determine salmon distribution within the entire system.

An Analysis of the Results of the Stub Return System in the Newfoundland Region, 1995

Authors: M. F. O'Connell, E.G.M. Ash, and N. M. Cochrane

Summary: A license stub return system was implemented in the Newfoundland and Labrador recreational fishery in 1994. In that year, of a total of 22,596 licenses in the data base, overall response rate after a voluntary period and three post prompts was 55.5%. In 1995, there were 21,136 licenses in the data base and the overall response rate was 61.4%.

The return rate for residents in 1995 was 57.7% while for non-residents it was higher at 70.4%. In 1994 return rates for residents and non-residents were similar (51.5% and 52.4%). The voluntary response rate in 1995 (26.4%) nearly tripled that of 1994 (9.8%). Highest catches and effort expenditure (rod days) occurred in the voluntary group in 1995 with overall declines across response groups. Catch per angler was highest in the voluntary group for insular Newfoundland but in Labrador, the highest occurred in post prompt 3. Rod days expended per angler were highest in the voluntary group for both insular Newfoundland and Labrador. Catch per unit of effort (in terms of rod days) did not change appreciably across response groups.

Comments: Published literature reports show that failure to account for non-response bias and recall bias can lead to substantial error in estimating catch and effort in angler log systems. Bias is usually investigated through statistically designed telephone surveys; resources for such surveys were not available in 1994 and 1995.

Recommendation: In the absence of resources to conduct telephone surveys, it was recommended that the method of bias correction currently employed in Nova Scotia be attempted in the Newfoundland Region. The Nova Scotia method relies heavily on the fact that the overall response rate has been in excess of 90%. There is a certain amount of risk involved in applying the method to the Newfoundland Region where response rate is currently around 60%. It was also recommended that every effort should be made to increase response rate and suggestions were made accordingly.

The application of a comparative lakes approach to fisheries management in Indian Bay Brook Watershed, Newfoundland

Authors: M. C. van Zyll de Jong, P. S. Fowlow, J. M. Hoenig, and W. Norris

Summary: Indian Bay has adopted a comparative lakes approach to fisheries management. This approach proposes that effective management is possible without intensive monitoring of all lakes. A representative number of lakes were intensively studied. The knowledge gained from these intensively studied lakes were used to develop indices or indicators useful in evaluating the condition of other lakes with similar properties. An index is defined as a value derived from a series of observations and used as an indicator (e.g., the number of fish caught per unit of fishing effort (CPUE) is often used as an indicator of fish abundance). Preliminary results showed that CPUE (catch per net set) displayed a significant regression (R^2 = 0.415; p = 0.044) with absolute abundance estimates from mark-recapture studies. Preliminary results showed an increase in mean fork length over four years for two ponds that are currently closed. Further analysis is pending. This program will allow managers to describe how various measures (including effort, harvest, abundance, age structure, total mortality, mean catch at age, variation in year class strength, and growth) serve as indicators of overexploitation. From these indicators, reference values will be identified that can be used as a threshold value for concern when evaluating district lakes. Indian Bay is currently entering it's third year of a proposed six year cycle.

Comments:

1. There is evidence from the mark-recapture studies that emigration and immigration occur. This is recognized as potential bias to the results and further analysis is required.

2. It was suggested that habitat shift rather than change in abundance is influencing population estimates. Vertical baited traps could be employed to test size distribution.

3. The period of fishing was contained within an optimal temperature window and rotated over a five year period within 20-30 days.

Recommendations:

1. Investigate data to determine if time of sampling influenced mean fork length results.

2. Investigate possible changes in size distribution in different areas of each lake.

GENERAL DISCUSSION

For the past several years, there have been concerns that continued management changes in the recreational fishery as well as reduced 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 1996, wherein for several river systems especially those on the southwest coast and in southern Labrador (SFAs 12, 13 & 14B) there was no DFO angling catch data collected. This lack of angling catch data severely hampered our abilities to assess status of stocks in these areas.

Unrecorded mortality in freshwater in relation to estimates of spawning escapement and egg deposition continues to be an issue. 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 possibly 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 and Labrador, a substantial portion of total production is derived from pond habitat. Pond habitat is evaluated using a conservation requirement of 368 eggs per hectare, but there is no allowance for poaching or disease in this value. In addition, at the time that the conservation requirements of 240 for fluvial and 368 for pond habitat was derived, hook-and-release fishing was not as popular as it is today and no mortalities for this factor were included. At last years assessments and during public meetings, it was recommended that spawning escapments be corrected for hook-and-release mortalities. A factor of 10% was applied to hook-and-release records and subtracted from spawning escapment.

Most information on the amount and type of fluvial Atlantic salmon habitat in insular Newfoundland and Labrador comes from river surveys conducted from helicopter, with minimal groundtruthing. In Newfoundland and Labrador, salmon parr are know to rear in lakes and over the last few years effort have been made to include parr produced in lake habitat as part of the conservation requirements. This remains to be completed for several SFAs in Newfoundland. 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 at that time. These smaller scale maps would eliminate the inclusion of substantial amounts of habitat contained in smaller tributaries that are not visible. Efforts are continuing to produce new habitat estimates for Labrador rivers based on 1:50,000 now available.

RECOMMENDATIONS

1. Currently, the impacts of the commercial fishing moratorium on salmon stocks in insular Newfoundland are in several working papers. It is recommended that

the available information be drawn together and published in a Research Document.

2. In 1997, the general stock status report for Newfoundland and Labrador should be separated into to two documents: one for salmon stocks in Labrador and another for insular Newfoundland.

3. The level of marine mortality directly controls the number of adult salmon returning to a given river. Marine mortality has been shown for Conne River and some river systems in the Maritimes to be significantly correlated with thermal habitat in the northwest Atlantic. Correlations with thermal habitat should be examined using abundance data for other rivers in Newfoundland and Labrador and if practical forecasts made of potential returns for 1998.

4. There is a need to assess parr rearing habitat in Labrador in order to determine conservation requirements on an individual river basis. 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.

5. During next years assessments, further discussion should take place on including large salmon in the conservation requirements for salmon rivers dominated by large salmon and it's use by fisheries managers.

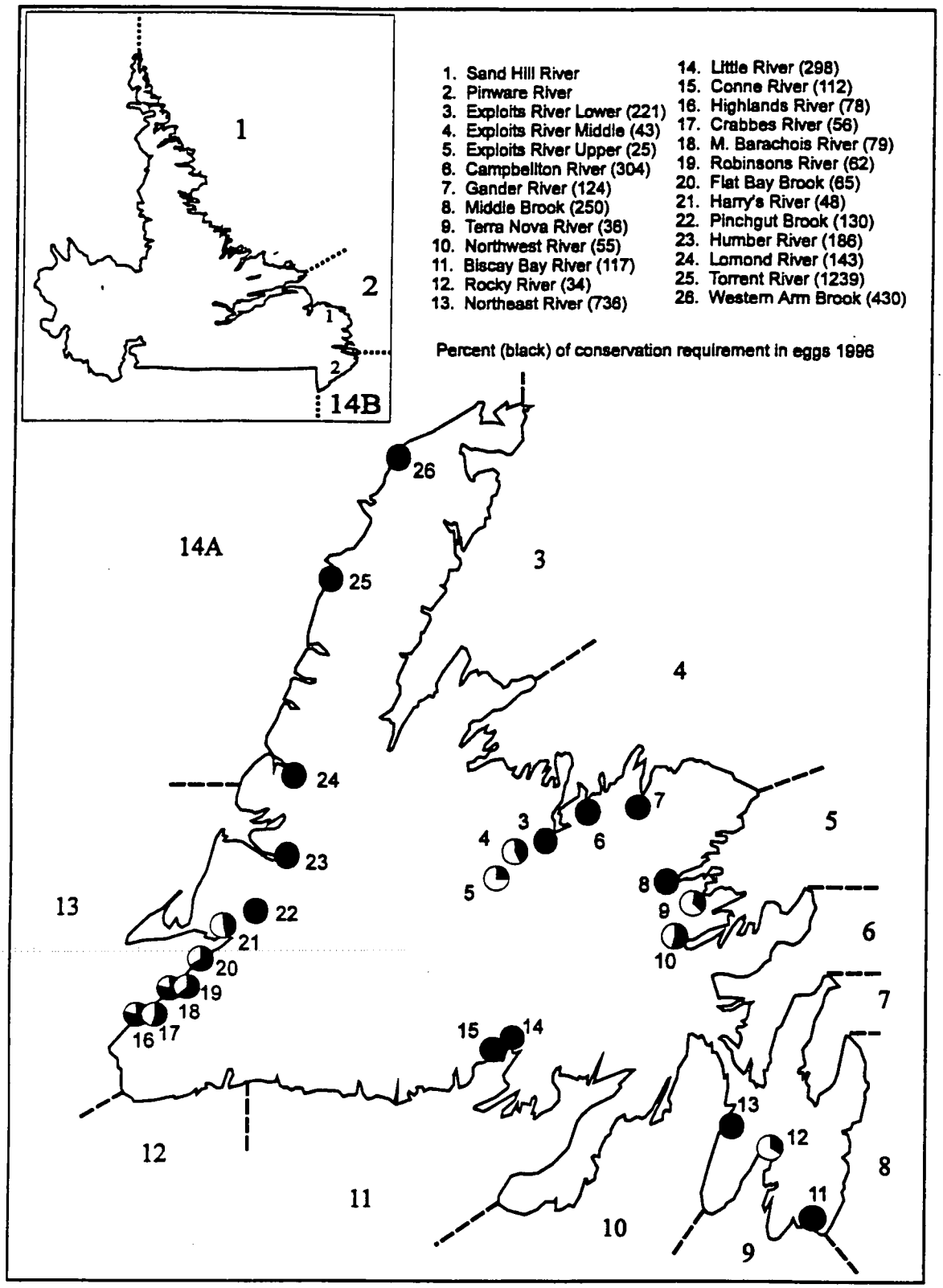

Fig. 1. Map showing the Salmon Fishing Areas of Newfoundland and Labrador, the locations of rivers assessed, and percent (black) of conservation requirement achieved in 1996.

APPENDIX 1

Newfoundland Region Salmonid Stock Assessment Meeting
February 24-28 and March 5, 1997
E. B. Dunne Boardroom
Northwest Atlantic Fisheries Centre, St. John's
Chair: Dave Reddin

AGENDA

The meeting is scheduled to start on Monday, February 24 at 0900 hrs and to end on Friday, February 28 at 1600 hrs. An additional day of March 5 has been reserved for reviewing the Stock Status Reports and other items. The following is an outline of the topics slated for discussion and an order of presentation of working papers.

Monday, 24 February

(0900-1215) Morning session

1. Call to order (0900 hrs)

2. Finalization of agenda

3. The Newfoundland Region stock assessment and documentation process - format and contributors to the Zonal Report, Stock Status Reports and individual stock summary sheets (5 areas), Manuscript Report with meeting proceedings, and Research Documents for individual stocks.

4. Fecundity & evaluation of atresia

5. Atlantic salmon licence stub returns for 1995

6. Marine & freshwater environments in 1996

(1300-1700) Afternoon session

7. 1996 General stock status report Newfoundland & Labrador salmon

8. Atlantic salmon river-specific stock assessments

   8.1 Labrador (SFAs 1, 2, & 14B)
   8.11 Labrador general stock status

Tuesday, 25 February

(0900-1215) Morning session

8.12 Sandhill River
8.13 Pinware River

8.2 Northern Peninsula East and Eastern Newfoundland (SFAs 3-8)
8.21 Exploits River
8.22 Campbellton River

(1300-1700) Afternoon session

8.23 Gander River
8.24 Gander River - juvenile production and predicted adult returns
8.25 Middle Brook
8.26 Terra Nova River
8.27 Northwest River, Terra Nova National Park

Wednesday, 26 February

(0900-1215) Morning session

8.3 South Newfoundland (SFAs 9-11)
8.31 Biscay Bay River
8.32 Rocky River
8.33 Northeast River, Placentia
8.34 Piper's Hole River
8.35 Little River

(1300-1700) Afternoon session

8.36 Conne River

8.4 Southwest Newfoundland (SFAs 12-13)
8.41 Highlands River
8.42 Robinsons, Barachois, & Crabbes
8.43 Flat Bay Brook
8.44 Harry's/Pinchgut
8.45 Humber River

Thursday, 27 February

(0900-1215) Morning session

8.5 Northern Peninsula West (SFA 14A)
- 8.51 Lomond River
- 8.52 Torrent River
- 8.53 Western Arm Brook

9. Arctic Charr

(1300-1700) Afternoon session

10. Trout
- 10.1 Indian Bay Watershed

11. Any other business

Friday, 28 February & Wednesday, March 5

(0900-1215 & 1300-1600) Morning & afternoon sessions

12. Review of Newfoundland Region Stock Status Reports and Manuscript Report o meeting proceedings.

APPENDIX 2

List of Participants

Bourgeois, Chuck	DFO, Science, St. John's NF
Curnew, Ken	Department of Natural Resources Gov't. of Nfld.and Labrador, St. John's NF
Dempson, Brian	DFO, Science, St. John's NF
Fitzgerald, Jennifer	MSC student (MUN/DFO)
Fowlow, Stacey	DFO, Science, St. John's NF
Gibson, R. John	DFO, Science, St. John's NF
Hinks, Ross	Conne River Indian Band Conne River NF
Meerburg, Dave	DFO, Science, Ottawa ON
Mullins, Conrad	DFO, Science, Corner Brook NF
O'Connell, Mike	DFO, Science, St. John's NF
Porter, T. Rex	DFO, Science, St. John's NF
Reddin. Dave	DFO, Science, St. John's NF
Robinson, Natalie	Department of Natural Resources Gov't. of Nfld.and Labrador, St. John's NF
Ryan, Pat	DFO, Science, St. John's NF
Simpson, Mark	Parks Canada, Terra Nova National Park, Gloverton NF
Slade, Berkley	DFO, Resource Management, St. John's NF
Winters, George	DFO, Science, St. John's NF
van Zyll de Jong, Mike	Department of Natural Resources Gov't. of Nfld.and Labrador, St. John's NF

APPENDIX 3

List of Working Papers

O'Connell, M.F. and J.B. Dempson. Follicular atresia in Atlantic salmon (*Salmo salar* L.) in Newfoundland rivers.

O'Connell, M.F., J.B. Dempson and D. G. Reddin. Inter-annual and inter-river variability in fecundity in Atlantic salmon (*Salmo salar*) in Newfoundland rivers.

O'Connell, M.F., J.B Dempson, C.C. Mullins, D.G. Reddin, N.M. Cochrane, and D. Caines. Status of Atlantic salmon (*Salmo salar*) stocks of the Newfoundland Region, 1996.

Dempson, J.B. Evaluation of changes in salmon stock abundance as a result of the commercial moratorium on Atlantic salmon using a scaled index of salmon escapements.

Reddin, D.G. Estimates of returns and spawners for Labrador salmon stocks.

Mullins, C.C., S.L. Lowe and G. Chaput. The status of the Atlantic salmon stock of Pinware River, Labrador, 1996.

Reddin, D.G., P.B. Short and R.W. Johnson. Atlantic salmon stock status for Sand Hill River, Labrador, 1996.

Bourgeois, C.E., J.Murray and V. Mercer. Status of the Exploits River stock of Atlantic salmon (*Salmo salar* L.) in 1996.

O'Connell, M.F., D.G. Reddin and E.G.M. Ash. Status of Atlantic salmon (*Salmo salar* L.) in Gander River, Notre Dame Bay (SFA 4), Newfoundland, 1996.

Reddin, D.G. and P.R. Downton. Status of Atlantic salmon (*Salmo salar* L.) in Campbellton River, Notre Dame Bay (SFA 4), Newfoundland in 1996.

Ryan, P.M., R. Knoechel, M.F. O'Connell and E.G.M. Ash. Ratio of adults to Experimental Ponds Area juveniles in a stock assessment of Atlantic salmon (*Salmo salar* L.) in the Gander River, Newfoundland with a projection of adult returns in 1997.

Knoechel, R., P.M. Ryan and M.F. O'Connell. Evaluation of age-specific and length-specific estimates of juvenile Atlantic salmon (*Salmo salar* L.) abundance in the Experimental Ponds Area as predictors of adult returns to the Gander River.

Dempson, J.B. and G. Furey. Stock status of Atlantic salmon from Conne River, SFA 11, Newfoundland, 1996.

Dempson, J.B., V.A. Pepper, G. Furey, M. Bloom, T. Nicholls and G. Hoskins. Evaluation of an alternate strategy to enhance salmon populations: cage rearing wild Atlantic salmon smolts from Conne River, Newfoundland.

Bourgeois, C. E., J. P. Davis, J. Murray and V. Mercer. Status of three enhanced Atlantic salmon (*Salmo salar* L.) stocks of the Newfoundland Region in 1996.

O'Connell, M.F. and D.G. Reddin. Status of Atlantic salmon (*Salmo salar* L.) in Middle Brook and Terra Nova River (SFA 5), Biscay Bay River (SFA 9) and Northeast River, Placentia (SFA 10), Newfoundland in 1996.

Gibson, R.J., R.R. Whalen, K.G. Hillier and G.T. Clarke. Status of Atlantic salmon (Salmo salar) in the Highlands River, St. George's Bay (SFA 13), Newfoundland, 1996.

Porter, T.R. Stock status of Atlantic salmon (*Salmo salar* L.) in Crabbes, Robinsons and Middle Barachois rivers, Bay St. Georges, Newfoundland, 1996.

Simpson, M. Status of Atlantic salmon (*Salmo salar* L.) in Northwest River, Bonavista Bay (SFA 5), Newfoundland, 1996.

Mullins, C.C. and D. Caines. The status of the Atlantic salmon stock on Harry's River/Pinchgut Brook, Newfoundland, 1996.

Mullins, C.C., T. R. Porter, and J. B. Dempson. The status of the Atlantic salmon stock of the Humber River, Newfoundland, 1996.

Shears, M. and J.B. Dempson. Northern Labrador Arctic charr and Atlantic salmon: catch and effort update for 1996.

Dempson, J.B., M. Shears and M. Bloom. Spatial and temporal variability in the diet of anadromous Arctic charr, *Salvelinus alpinus*, in north Labrador.

Mullins, C.C. The Status of the Atlantic salmon stock of three selected rivers in SFA 14A, 1996.

O'Connell, M.F., E.G.M. Ash and N.M. Cochrane. An analysis of the license stub return system in the Newfoundland Region, 1995.

van Zyll de Jong, M. C., P. S. Fowlow, J. M. Hoenig, and W. Norris. The application of a comparative lakes approach to fisheries management in Indian Bay Watershed, Newfoundland.

APPENDIX 4

Results of DFO Public Meetings on 1996 Atlantic salmon Stock Assessments in Newfoundland and Labrador

Purpose: to allow anglers and other members of the general public an opportunity to participate in the Department's annual stock assessment process.

Background: as in 1994-95, Science Branch assessment biologists were interested in obtaining anglers perceptions on several issues dealing with the status of salmon stocks in Newfoundland and Labrador in 1996. This process of public consultations provided the opportunity for fishers to review the scientific information available and to provide information to scientists on their observations regarding the status of the resource. By incorporating the knowledge of anglers and others into the stock assessment process, scientists improve their understanding of the stocks on monitored rivers and are better able to make inferences about stocks on adjacent, unmonitored rivers.

Each public meeting began with a brief presentation by DFO scientists showing information on catch statistics and counting facilities in the local area. The proceedings were then open for public comment and input.

Information requested from fishers included:

1. What environmental conditions were present in 1996 that may have affected angling success or the survival of adult or juvenile salmon?

2. What was the salmon abundance in 1996 relative to previous years?

3. Are there long term trends in:
   a) Salmon abundance?
   b) Size of fish?

4. What was the effect of run timing on angling success in 1996?

5. Is there a difference in hook-and-release mortality at different times of the year? If so when is it the highest? Lowest?

Public meeting locations and attendance, 1996:

LOCATION	DATE	DFO	ANGLERS & ANGLER REPRESENTATIVES	TOTAL
Clarenville	March 19	3	7	10
Gambo	March 19	2	8	10
Hawkes Bay	March 19	2	1	3
Corner Brook	March 20	2	13	15

CLARENVILLE, MARCH 19, 1997

1. **What environmental conditions were present in 1996 that may have affected angling success or the survival of adult or juvenile salmon?**

- Warm water temperatures in last two weeks of the angling season affected catch on Terra Nova River.
- The anglers present felt that there appeared to be less fish below the lower fishway on Terra Nova River, although there seemed to be no direct association with environmental conditions.
- Anglers were interested to know why all rivers in the area did not respond equally to the moratorium on commercial salmon fishing; examples cited were Terra Nova, Piper's Hole, and Northwest rivers.
- It was felt that the closure of Northwest and Southwest Rivers directed anglers to the Terra Nova and Gambo rivers.

2. **What was the salmon abundance in 1996 relative to previous years?**

- Fishing was better in the last two years on Terra Nova River, although the distribution of the fish was a cause of some discussion. No consensus was reached on the relative abundance of fish between the upper and lower fishways on the Terra Nova River compared to previous years.

3. **Are there long term trends in: a) salmon abundance? b) size of fish?**

- There appears to be more larger fish now, which have earlier run timing.

4. **What was the effect of run timing on angling success in 1996?**

- Anglers felt that the early run timing in the last two years affected total catch. Most individuals felt that early run fish angled better even though some of the fish were located further upstream than in an average year.

5. **Is there a difference in hook-and-release mortality at different times of the year? If so when is it the highest? Lowest?**

- Anglers felt hook-and-release angling should not be permitted when water temperatures exceed 20° C.
- Most anglers did not support hook-and-release angling and felt most anglers did not know the proper procedure to conduct this type of angling.

GAMBO, MARCH 19, 1997

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1. **What environmental conditions were present in 1996 that may have affected angling success or the survival of adult or juvenile salmon?**

- High water levels resulted in lower angling catches in July in Gambo and Terra Nova rivers while in August low water levels had the same effect.
- There were concerns that pollution in the estuary (sewage discharge, pesticides, and discharge from garages) might be negatively impacting on salmon migratory behaviour.

2. **What was the salmon abundance in 1996 relative to previous years?**

- Fishing was good in Gambo River early in the season up to the time high water levels were encountered.
- Judging from angling success there appeared to be a good run in Traverse Brook.

3. **Are there long term trends in: a) salmon abundance? b) size of fish?**

- There appeared to be more fish in Traverse Brook than in previous years.
- There are more larger fish present in recent years.

4. What was the effect of run timing on angling success in 1996?

- Runs appeared to be early in general.
- A lot of salmon were caught on the first day of the season in Middle Brook and Gambo River.

5. Is there a difference in hook-and-release mortality at different times of the year? If so when is it the highest? Lowest?

- Most of those present agreed with hook-and-release fishing in principle and in practice.
- One person objected to hook-and-release fishing and stated that it should be applied to mandatory release as in the case of large salmon and undersized salmon.
- Only barbless hooks should be allowed for hook-and-release fishing.
- A suggestion that hook-and-release fishing be permitted only for tourists met with strong opposition.
- It was suggested that certain pools should be designated for hook-and-retain fishing only as a means of preventing hogging of pools by anglers who hook-and-release fish after their retention limit has been taken.
- One person indicated that he did not know of any increase in sightings of dead salmon in rivers since 1992; another person said that he never saw dead fish prior to 1992 (except those bearing jigger marks), but since 1992, he has observed 2-3 dead fish per year.
- It was suggested that hook-and-release fishing should cease when the water temperature reaches 20° C instead of the currently recommended 22° C.

HAWKES BAY, MARCH 19, 1997

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1. What environmental conditions were present in 1996 that may have affected angling success or the survival of adult or juvenile salmon?

- July month was very dry.
- There were very low water levels at the end of July and during August.
- Silver Brook and Middle Pond areas of Torrent River have problems (or potential problems) with clear cutting. Pulpwood cutting began in the upper Torrent watershed area in 1990/91.

2. What was the salmon abundance in 1996 relative to previous years?

- There has been a dramatic increase in salmon abundance in recent years on Torrent River, Big East and River of Ponds.
- Even when water levels were low, there were fish present.
- Early hook-and-release fishery on the Torrent River was a good idea as there was an angler presence on the river, which resulted in less poaching in 1996.
- Very few large fish were present on Torrent River.

3. Are there long term trends in: a) salmon abundance? b) size of fish?

- Trends from this area are showing an increase in fish in all rivers in the last 3-5 years.
- More grilse are showing up versus large salmon.
- Grilse run appears to be small fish.
- Spawning observed in the lower sections of Torrent River in 1996. Torrent River traditionally had a good run of large salmon. Large salmon could be spawning below the fishway on Torrent River.

4. What was the effect of run timing on angling success in 1996?

- The salmon run on Torrent River was from early to mid-July.
- Best fishing was around this time.
- Fish did not appear to be in the rivers earlier this year.
- Run appeared to be lower in August.
- Years in which run timing was normal showed angling success was good in August.
- Most anglers gave up fishing by the end of July because of low water, fish not taking, and the water had turned slubby.
- Fish were holding up in pools more in August 1996 than in years when water was cooler.
- Torrent River should have been closed in August 1996 due to low water.

5. Is there a difference in hook-and-release mortality at different times of the year? If so when is it the highest? Lowest?

- Did not hear as much about hook-and-release mortalities in 1996 as in 1995 and did not see any mortalities.
- Local hearsay indicated that it was high in 1995.
- Total mortality is probably higher in July because there are higher numbers of fish available to be hooked.

Mortality rate is highest when the fish are aggressive and beat themselves up.
There is a feeling that hook-and-release fishing should not be permitted when water temperatures reach a certain level. Survival and resuscitation is less likely to be successful at higher water temperatures.
It is felt that hook-and-release mortality was 25% for the season.
Mortality is more related to poor handling practices once the fish is landed than in actually hooking and playing the fish.

CORNER BROOK, MARCH 20, 1997

1. **What environmental conditions were present in 1996 that may have affected angling success or the survival of adult or juvenile salmon?**

Water levels on the Humber River were excellent in June to mid-July therefore catch rates were good but there was also more fish in the river 1996.
Water levels were very poor in August on most rivers in the area.
Bay St. George rivers were low in August and should have been closed.
Humber and Harrys rivers hold water better than most Bay St. George rivers.
There is a new cutting plan in place for Lomond River watershed area, which may affect water levels in the future.

What was the salmon abundance in 1996 relative to previous years?

Abundance on Humber River was best very early in the season.
Large fish numbers have increased on the Humber particularly in June 1996.
Abundance on Harry's River was better than in previous years.
Most rivers in Bay St. George showed positive increases over previous years.
The first fish showed up on the Harry's system around June 10 - 12.
The percentage of large fish on Harry's River appeared to be up over 1995.
Large salmon enter Southwest & Bottom Brooks earlier in the season than small salmon; most fish on these two rivers were small salmon.
Abundance on the Southwest & Bottom Brooks and Little Barachois Brook was the best in 12 years.
Good sign of fish on Southwest & Bottom Brooks earlier in the season than small salmon. Most fish on these two rivers were small salmon.

COASTAL LABRADOR COMMUNITIES

NOVEMBER 5-7, 1996

During November 5-7, 1996 representatives from Fisheries Management and Science branches of DFO held public meetings in five Labrador coastal communities to gather information from fishers on various aspects of managing and harvesting of salmon stocks in Labrador. They were first presented with a brief summary of the history of management for both commercial and recreational fisheries and then Science Branch views on stock sizes and assessments. While the meetings were not specifically directed at Science Branch issues, there were still a number of relevant observations made:

Makkovik

- Very low landings in commercial fishery in Makkovik in 1996.
- Very low numbers of salmon seen in freshwater in Makkovik area in 1996 by both anglers and locals.
- Catches of salmon in the food fishery were nearly equal to commercial salmon catches.
- Seals take a lot of salmon from commercial nets.
- In Rigolet, some of the large salmon would have passed by when the commercial season opened.
- Fishers were very concerned that there were no counting facilities in northern Labrador (SFA 1). They would like to see some assessments done on northern Labrador rivers.

Cartwright

- Fishermen indicated that seals kill a lot of salmon.
- The active fishing effort in 1995 and 1996 was much lower than would be indicated from commercial licenses as many salmon fishermen chose to fish crab instead.
- Fishers were concerned about the increasing angling effort and noted that reductions in angling would also increase spawning escapements.
- Bycatches in trout fishery and trout food fishery are increasing.
- Some fishermen indicated that over the long-term stocks had declined somewhat and most fishermen agreed that in recent years abundance had increased substantially.

Charlottetown

- Fishers indicated that the majority of salmon entering local rivers were small salmon.
- Lots of large salmon in catches in 1996.
- Salmon catches in their nets have not changed dramatically over the past ten years. Salmon abundance has been high in recent years.
- Large schools of salmon were observed in the fall of 1996.
- Fishers were concerned that it was very difficult to estimate large salmon abundance when the season was so short in 1996.
- Trout fishery bycatches were not a problem in this area as salmon are mainly caught at the headlands.
- Seals are taking salmon out of nets, especially gray seals.
- Fishers were very concerned over hook-and-release angling fishery.

Mary's Harbour

- Salmon fishing in inland waters is increasing.
- More rivers should be scheduled, e.g. St. Lewis and Alexis.
- Concern was raised over the estimated stock sizes of large salmon, which must be very difficult to assess when they have mainly passed by when the fishery opens.
- Fishers were very concerned over possible mortalities in hook-and-release angling fishery that they felt could negate any gains made to spawning escapement from commercial fishing restrictions.
- Bycatch of salmon is a problem in commercial trout nets.
- Concern was expressed for the accuracy of recreational and commercial catch statistics.
- Seals are taking salmon out of nets and killing free swimming salmon.
- Fishers were very concerned that there were no counting facilities in the southern part of SFA 2 in Labrador. They would like to see more assessments done on southern Labrador rivers.

Lance au Clair

- One outfitter expressed the opinion that the angling catch statistics for Pinware are not accurate in 1996.
- Catch rate on Pinware River is down considerably reflecting decrease in abundance.
- Concern was expressed over hook-and-release fishery.
- Environmental conditions were excellent in 1996.

- Commercial fishers suggested that the salmon population and especially the large component was very low in the last couple of years; a position which was supported by the commercial outfitters and anglers.

APPENDIX 5
Summary Sheets

)CK: Sandhill River (SFA 2) **Drainage area:** 1276 km^2 (accessible)

ear	1990	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
otal returns:[2]										
Small					2180	2796	3319	2038	4761	3184
arge					730	560	414	138	730	398
Recreational harvest										
Small (retained)	372	197	448	258	279	289	321	100	702	372
arge (retained)	38	18	25	12	29	28	20	2	94	25
Small (released)			0	309	326	340	702	0	702	335
arge (released)			0	10	7	14	36	0	36	13
Other mortalities										
Small										
arge										
Spawners:[3]										
Small					1868	2472	2927	1819	4242	2900
arge					701	531	390	136	701	383
Conservation equirement % eggs met:[4]										
Smolt count								37007	55000	47556
Sea survival								4.6	6.9	5.8

[1] Min, max and mean for total returns are for all available years, recreational harvest (retained) for calculated period 1974-91, recreational harvest (released) for 1992-96, smolt counts for 1970-73 and sea survival for 1970-71. Prior to 1992 angling statistics for hook and released were not collected.

[2] Total returns are for the period 1970-73 and 1994-96. Values in this table have been updated from 1995.

[3] Hook and release mortality is 10% of released salmon.

[4] See Accessible habitat below.

ecreational catches: Catches have ranged from 122 to 785 during the period 1974-96. The number of small salmon ained in 1996 was 321 and 702 were released. The number of large salmon retained was 20 and 36 were released.

ata and assessment: Complete counts of smolt and adult salmon migrations were obtained from portable fish counting ces in 1970-73 and complete counts of adults were done in 1994-96.

State of the stock: Egg deposition in 1996 was 9.61 million eggs.

ccessible habitat: Not available until after review in 1997. Review will take into account distribution of parr d habitat.

STOCK: Pinware River (SFA 14B) **Drainage area:** 2,486 km^2

CONSERVATION REQUIREMENT[1]: 11.8 million eggs (~ 3,360 small and 1,192 large salmon) is based on 2.4 eggs /m^2 of fluvial area and 105 eggs per ha of lacustrine area.

Year	1991	1992	1993	1994	1995	1996[2]	MIN[3]	MAX[3]	Mean[3]
Angling catch:									
Small (retained)	829	628	654	373	556	412	409	1680	816
Smal (released)	.	38	336	68	195	342	.	.	.
Large(retained)	45	229	199	97	190	.	45	306	179
Large(released)	.	0	26	10	76	.	.	.	.
Returns[4]:									
Small	6027	4217	4197	2313	3671	2841	3951	13591	6867
Large	2138	1496	1489	821	1303	1008	1402	4823	2437
Estimated spawning escapement:									
Small	5198	3585	3510	1933	3095	2512	3542	11911	6051
Large	2093	1267	1288	723	1105	891	1238	4532	2257
Conservation requirement % eggs met:									
Small + Large	167	106	107	59	92	81	104	370	186

[1] The conservation requirement is based on fluvial and lacustrine habitat.
[2] The angling catch for 1996 is the total catch for small and large salmon combined.
[3] Min, Max, Mean are for 1974-91.
[4] Total returns for 1974-95 were estimated based on an angling exploitation rate of 0.1070 derived for 1996.

Methodology: Fluvial habitat includes 4.7 million m^2 and lacustrine habitat includes 6,110 ha (preliminary - includes all lakes >5ha). Biological characteristics used for small salmon to estimate potential egg deposition in 1996 were obtained from salmon landed in the recreational fishery and mortalities at the tagging traps. For large salmon, the 1992-96 mean for biological characteristics was used. The potential egg deposition for 1974-95 were based on mean biological characteristics in 1992-96. Total returns to the river for 1974-95 were estimated based on the 1996 angling exploitation rate of 0.1070. The total returns to the river were apportioned into numbers of small and large salmon based on relative proportions of small and large salmon captured in the lower estuary tagging trap. Spawning escapement in 1992-96 was derived from total returns by subtracting angling removals which include retained catches and a 10% mortality rate for released catches.

Recreational fishery: The recreational angling catch of small and large salmon for 1996 was estimated from information observed by three fishing lodges and four river monitors on the Pinware River. In previous years, angling catch information was compiled on a weekly basis by the Department of Fisheries and Oceans. The recreational catch information compiled in 1996 was not comparable to previous years, but the 1992-95 mean retained catch of small salmon was 48% below the 1974-91 mean but for large salmon, the means were similar.

Commercial fishery: The opening date of the SFA 14(B) commercial fishery in 1996 was June 20, compared to the July 3 opening in 1995. Only 3.4t of the 5.0t quota was caught in 1996.

Data and assessment: The 1996 assessment was the first for Pinware River salmon using the mark-recapture method, with three tagging traps - two in the estuary and one approximately 10km upstream.

State of the stock: In 1996, Pinware River achieved only 81% of the conservation egg requirement, 13.5% below the level in 1995, 13.5% below the 1992-95 mean, and 129% below the 1974-91 mean. The percent of conservation requirement achieved has been consistently the lowest during 1992-96.

Forecast: If the commercial and recreational fisheries harvests remain at the current levels, the status of stocks for the Pinware River is not expected to improve in 1997 or in future years.

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

)NSERVATION REQUIREMENT: 95.9 million eggs (equivalent to 56,670 small salmon); Lower Exploits 16.4 million eggs; Middle Exploits 64.2 million eggs; Upper Exploits 15.4 million eggs.

Year	1991	1992	1993	1994	1995	1996	MIN	MAX	MEAN[4]
Total returns[1]:	5758	13818	22777	18472	17090	32369	3845	19557	8966
ıall	5659	13504	22150	17556	16149	30316	4740	19205	8785
Large	99	314	627	916	941	2053	343	352	180
creational catch									
Small (retained)	1045	1408	1655	3072	1302	1915	577	2998	1660
ıall (released)	-	-	2980	1145	1531	3202	1145	3202	2787
.rge(released)	-	-	59	30	72	111	30	111	68
Other Mortalities									
ıall	-	-	298	115	153	361	115	361	232
Large	-	-	6	3	7	11	3	11	8
ood removals[2]:	1408	1078	0	0	0	0	31	5111	3371
Conservation requirement eggs met[3]:									
ower Exploits	31	69	117	105	126	216	27	39	31
Middle Exploits	15	17	15	18	19	42	8	15	12
)per Exploits	0.3	2	7	8	16	26	0.3	125	86
Total of Watershed	12	17	23	19	22	44	12	30	23

[1] lin, Max period from 1974-91.
[2] Min, Max period from 1974-92.
[3] lin, Max period from 1987-91.
[4] lean period from 1987-91

Methodologies: There are 35 million m^2 units of fluvial habitat and 34,000 ha of lacustrine habitat. Conservation requirements are to come from small salmon. Previous fry releases are backcalculated to eggs for % of servation egg deposition achieved in areas stocked. Total returns to the river are based on the count at Bishop alls fishway plus angling below the fishway. Spawning escapements for the tributaries of the Lower Exploits except Great Rattling Brook are derived from spawning surveys in 1992 and 1993.

Broodstock requirements: None at present.

creational catches: The 1996 recreational fishery on the Exploits below Grand Falls was restricted to hook and ease up to July 9. The main stem of the Exploits River, upstream of Grand Falls was open only to hook and release or the entire season.

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

Forecast: The high returns in 1996 appear to have resulted from very high natural survival rates. If these conditions vail the 1997 returns should be similar to the 1996 returns.

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 368 eggs per hectare of pond habitat.

Year	1991	1992	1993	1994	1995	1996	MIN	MAX	MEAN
Total returns:									
Small	-	-	4001	2857	3035	3208	2857	4001	3275
Large	-	-	145	191	218	560	145	560	279
Recreational harvest (small salmon)[1]									
Retained	126	311	316	340	393	463	23	1547	1824
Released	-	30	103	4	47	93	4	103	55
Recreational harvest (large salmon)[2]									
Retained	0	0	0	0	0	0	0	0	0
Released	-	0	0	1	1	31	1	31	7
Other mortalities									
Small	0	0	0	0	0	0	0	0	0
Large	0	0	0	0	0	0	0	0	0
Spawners:									
Small	-	-	3675	2517	2637	2736	2517	3675	2891
Large	-	-	145	191	218	557	145	557	278
Conservation requirement % eggs met:			311	239	279	304	239	311	283
Smolt count[3]			31577	41633	39715	58369	31577	58369	42831
Sea survival[4]			7.2	6.1	7.2		6.1	7.2	6.8

[1] Min, max and mean recreational harvest for period 1974-96; other mean data for 1986-91 to coincide with the pre-moratorium period. Angling harvests are DFO statistics.

[2] Min., max. and mean for the period 1993-96.

[3] Sea survival of smolt to 1SW salmon returns. Min. and max. are for 1993-96 smolt migrations.

Data and methodology: Smolts were enumerated by a counting fence. Returning adult salmon are enumerated at a fishing counting fence with a video camera system A hook-and-release mortality of 10% was used in the calculation of spawning escapements for the years 1993-96.

State of the stock: Target requirements were met from 1993 to 1996.

Forecast: Adult returns in 1997 from the smolt migration in 1996 should be approximately 4,000 fish plus repeat spawners at average 22% survival rate thus giving an upstream migration of 5,100 fish.

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	1991	1992	1993	1994	1995	1996	MIN	MAX	MEAN
Recreational harvest (small salmon)[1]									
Retained	1180	1268	1271	2122	2598	3009	1155	4575	2459
Released			1950	448	612	1148	448	1950	1003
Recreational harvest (large salmon)									
Retained									-
Released ,			92	39	74	73	39	92	-
Conservation requirement[2]									
% eggs met	36%	118%	128%	91%	95%	124%	36%	44%	39%

[1] Recreational fishery data for retained fish are for the period 1974 to 1991 (prior to the commercial fishery moratorium). Harvests for 1992 and 1993 are retained catches to the time the SFA quota was caught. Data prior to 1992 and for 1994-96 are retained fish for the entire angling season. Data for 1987 are omitted from the calculations of min., max., and mean due to the closure of parts of the river as a result of drought conditions. Data for released fish are for the years 1993-96.

[2] Summaries (min. max., and mean) for counts and conservation requirement are for 1989-91. Percent of conservation requirement met represents the contribution of both small and large salmon.

[3] Counts for 1992 were adjusted.
Note: any changes from previous years were due to the updating of preliminary data and biological characteristics information.

Recreational catches: Catches have ranged from 1,155 to 4,575 small salmon during the period 1974-91. Catches declined during 1981-91, before the salmon moratorium. Effort has increased substantially since 1994. The number of small salmon retained in 1996 was 3009 (an increase of 16% over 1995) and the number released was 1148 compared to 612 in 1995.

Data and assessment: Complete counts of salmon were obtained at a fish counting fence during 1989-96, and have historically been counted at a fishway located on a tributary, Salmon Brook. A hook-and -release mortality of 10% was used in the calculation of spawning escapements for the years 1993-96.

State of the stock: Conservation requirement was exceeded in 1996, the third time since the start of the moratorium in 1992. The relative contribution of large salmon to total egg deposition in 1996 was 13%, which was an increase over that recorded for 1993-95 (11% each year), but represented a substantial decline from 34% observed in 1992; the average for pre-moratorium years 1989-91 was 13%. 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 1992-96 occurred in pre-salmon moratorium years. Total population sizes of small salmon and spawning escapements for pre-salmon moratorium years 1989-91 were the lowest for the period 1974-91. Counts of large salmon at Salmon Brook in 1992-96 were the highest on record. Most smolts leaving Gander River are four years old. Increased returns of adults with a smolt age of three years, the progeny of the greatly increased escapement in 1992 due to the closure of the commercial fishery, are expected in 1997. The magnitude of these returns will depend on the strength of the three-year-old smolt age component.

Forecast: Based on an analysis of the numbers of small salmon produced per spawner, returns in 1997 are anticipated to be in excess of conservation requirement. An alternate prediction based on juvenile population estimates as indices of abundance also indicates conservation requirement will be exceeded in 1997.

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	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Recreational harvest (small salmon)[1]									
Retained	278	423	299	409	402	476	165	789	461
Released			387	122	82	153	82	387	197
Recreational harvest (large salmon)									
Retained	0	0	0	0	0	0	0	0	-
Released			0	37	0	0	0	37	0
Other mortalities									
Small					3	16			
Large									
Counts[2]									
Small	562	1182	1959	1513	1139	1751	496	2414	1118
Large	14	43	87	90	168	161	13	91	34
Conservation requirement % eggs met:[3]	51%	148%	238%	174%	114%	250%	49%	131%	78%

[1]Recreational fishery data for retained fish for the period 1974 to 1991 (prior to the commercial fishery moratorium). Harvests for 1992 and 1993 are retained catches to the time the SFA quota was caught. Data prior to 1992 and for 1994-96 are retained fish for the entire angling season. The years 1979 and 1987 are omitted from calculations of min, max, and mean due to river closures resulting from drought conditions. Data for released fish are for the years 1993-96.

[2]Means for counts are from 1980 to 1991.

[3]Summary (min, max., and mean) for the conservation requirement is for 1984-91. Percent of conservation requirement met represents the contribution of both small and large salmon.

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

Recreational catches: For the period 1974-91, harvests ranged from 165 to 789 small salmon. Rod-days of effort peaked during the mid-1980s but declined substantially in recent years. A total of 476small salmon was retained in 1996 and 153 were released.

Data and assessment: Complete counts are available from a fishway located on the lower river. A hook-and-release mortality of 10% was used in the calculation of spawning escpements for the years 1993-96.

State of the stock: Conservation requirement was exceeded in 1992-96. 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 1992-96 occurred in pre-salmon moratorium years. Counts of large salmon in 1995 and 1996 were the highest recorded. Total population sizes of small salmon during the moratorium years were substantially lower than in the late 1970s and early 1980s.

Forecast: Based on an analysis of the numbers of small salmon produced per spawner, returns in 1997 are anticipated to be in excess of conservation requirement.

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	1991	1992	1993	1994	1995	1996	MIN	MAX	MEAN
Recreational harvest (small salmon)[1]									
Retained	448	409	484	822	696	896	243	850	559
Released			569	178	132	260	132	569	293
Recreational harvest (large salmon)									
Retained	0	0	0	0	0	0	0	0	-
Released			62	44	72	113	44	113	-
Broodstock									
Small				64	222	225			
Large				9	44	32			
Counts[2]									
Small	873	1443	2713	1571	2258	2005	569	1737	1087
Large	114	270	470	242	634	464	19	206	101
Conservation requirement % eggs met:[3]	15%	28%	53%	26%	45%	36%	14%	28%	19%

[1]Recreational fishery data for retained fish are for the period 1974 to 1991 (prior to the commercial fishery moratorium). Harvests for 1992 and 1993 are retained catches to the time the SFA quota was caught. Data prior to 1992 and for 1994-96 are retained fish for the entire angling season. Data for released fish are for the years 1993-96.
[2]Means for counts are from 1979 to 1991.
[3]Summary (min., max., and mean) for the conservation requirement is for 1984-91. Percent of conservation requirement met represents the contribution of both small and large salmon.
Note: any changes from previous years were due to the updating of preliminary data and biological characteristics information.

Recreational catches: For the period 1974-91, harvests ranged from 243 to 850 small salmon. 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 1993-96. A total of 896 small salmon was retained in 1996 and 260 were released.

Data and assessment: Counts are available from a fishway located on the lower river. In 1994-96, 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. A hook-and-release mortality of 10% was used in the calculation of spawning escapements for the years 1993-96.

State of the stock: The proportion of conservation requirement achieved in 1996 was 36%, the third highest on record. Although this river has never achieved conservation requirement, egg depositions during the moratorium years 1992-96 were generally higher than in pre-moratorium years.

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	1991	1992	1993	1994	1995	1996	MIN	MAX	MEAN
Recreational harvest (small salmon)[1]									
Retained	30	139	133	164	97		30	336	182
Released			73	1	0	7	0	73	25
Recreational harvest (large salmon)[1]									
Retained	0	0	0	0	0	0	0	0	-
Released			0	3	0	0	0	3	-
Counts									
Small					498	593			
Large					135	203			
Conservation requirement									
% eggs met:					40%	55%			

[1]Recreational fishery data for retained fish are for the period 1974 to 1991 (prior to the commercial fishery moratorium). Harvests for 1992 and 1993 are retained catches to the time the SFA quota was caught. Data prior to 1992 and for 1994-96 are retained fish for the entire angling season. The years 1979, 1987, and 1989 are omitted from calculations of min., max., and mean due to the closure of the river as a result of drought conditions. Data for released fish are for the years 1993-96.

Recreational catches: For the period 1974-91, harvests ranged from 30 to 336 small salmon. Rod-days of effort 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 of park boundaries, the river was managed according to regulations in place for the remaining 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. A subsequent in-season review projected that the river would receive in excess of 50% of conservation requirement and 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.

Data and assessment: A count was obtained at a counting fence installed in the lower river in 1995 and 1996. The fence was operated by Terra Nova National Park personnel.

State of the stock: The river received 40% of conservation requirement in 1995 and 55% in 1996.

TOCK: Biscay Bay River (SFA 9) **Drainage area:** 239 km²

CONSERVATION REQUIREMENT: 2.9 million eggs (~1,134 small salmon) calculated as fluvial area x 2.4 eggs/m² and lacustrine area x 368 eggs/ha.

Year	1991	1992	1993	1994	1995	1996	MIN	MAX	MEAN
Recreational harvest (small salmon)[1]									
Retained	10	75	299	214	386	238	10	424	234
Released			38	43	112	50	38	112	64
Recreational harvest (large salmon)[1]									
Retained	0	0	0	0	0	0	0	0	-
Released			0	0	0	0	0	0	-
Counts[2]									
Small	394	1442	1107	1592	1071	1182	394	2516	1656
Large	35	51	120	68	56	149	35	101	75
Conservation requirement[2] % eggs met	38%	141%	97%	143%	77%	117%	38%	230%	124%

[1]Recreational fishery data for retained fish are for the period 1974 to 1991 (prior to the commercial fishery moratorium). Harvests for 1992 and 1993 are retained catches to the time the SFA quota was caught. Data prior to 1992 and for 1994-96 are retained fish for the entire angling season. Data for 1987 are omitted from the calculation of the mean due to the closure of the river as a result of drought conditions. Data for released fish are for the years 1993-96.

[2] Summary (min., max., and mean) for counts is for 1983 -91 and for percent of conservation requirement for 1984-91. Percentage conservation requirement met since 1984 reflects the contribution of both small and large salmon. Counts for 1985, 1989, 1992, and 1993 were adjusted to total counts.

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

Recreational catches: For the period 1974-91, harvests have ranged from 10 to 424 small salmon. Rod days of effort in 1995 and 1996 were the highest recorded since 1978. In 1996, a total of 238 small salmon was retained and 50 were released.

Data and assessment: Complete counts are available from a fish counting fence which has been in operation since 1983. A hook-and-release mortality of 10% was used in the calculation of spawning escapements for the years 1993-96.

State of the stock: Since 1984, from 38 to 230% of conservation requirements was achieved. During the commercial salmon fishery moratorium years, the requirement was exceeded in 1992, 1994, and 1996, but not in 1993 and 1995. Generally, counts of small salmon were higher in pre-salmon moratorium years than in 1992-96; the 1993 and 1995 counts of large salmon were higher than any observed previously. Total population size of small salmon during the moratorium years was substantially lower than in the early 1980s.

Forecast: Based on an analysis of the numbers of small salmon produced per spawner, returns in 1997 are anticipated to be in excess of conservation requirement.

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

CONSERVATION REQUIREMENT: 3.4 million eggs (equivalent to 881 small salmon)

Year	1990	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Total returns	418	227	283	364	177	424	401	81	418	244
Small	401	211	237	292	158	385	356	80	401	235
Large	17	16	46	72	19	39	45	1	17	10
Recreational harvest										
Small	-	-	-	-	-	-	-	-	-	-
Large	-	-	-	-	-	-	-	-	-	-
Broodstock	0	0	0	0	62	76	0	0	0	0
Conservation requirement % eggs met:	40	22	28	34	25	56	34	17	40	26
Smolt Count	8287	7732	7813	5115	9781	7786	14261	7732	8287	8010
Sea Survival	2.3	2.9	3.5	2.3	3.4	3.8		2.3	2.9	2.6

[1]Min, Max and Mean period from 1987-91.

Background: Rocky River was stocked with salmon fry from 1983 to 1987 with the first returns to the reconstructed fishway realized in 1987.

Methodologies: Fluvial habitat consists of 1.08 million m^2 and lacustrine habitat includes 2200 ha. Conservation egg requirement to come from small salmon. Biological characteristics used are those of the Rocky River stock. Previous fry releases are backcalculated to eggs for % of target egg achieved in areas stocked.

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

Data and assessment: Complete adult counts are available from a trap installed in the fishway. Smolts have been enumerated annually since 1990.

State of the stock: On average, the watershed is achieving 30% of its required conservation egg deposition.

Forecast: Based on the 1991-95 smolt-to-adult survival, between 300 and 496 maiden 1SW salmon are expected in 1997.

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

ONSERVATION 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	1991	1992	1993	1994	1995	1996	MIN	MAX	MEAN
ecreational harvest (small salmon)[1]									
Retained	19	37	132	39	127	268	19	349	168
eleased			61	5	8	7	5	61	25
Recreational harvest (large salmon)									
etained	0	0	0	0	0	0	0	0	-
Released			0	0	0	0	0	0	-
ther mortalities									
Small					25	49			
arge					5				
Counts[2]									
Small	353	921	847	677	663	1225	223	725	415
Large	8	46	65	70	74	123	0	62	29
Conservation equirement									
% eggs met:[3]	175%	555%	527%	434%	422%	736%	152%	352%	233%

[1] Recreational fishery data for retained fish for the period 1974 to 1991 (prior to the commercial fishery moratorium). Harvests for 1992 and 1993 are retained catches to the time the SFA quota was caught. Data prior to 1992 and for 1994-96 are retained fish for the entire angling season. Data for 1987 are omitted from the calculation of the mean due to the closure of the river as a result of drought conditions. Data for released fish are for the years 1993-96.

[2] Summary (Min., Max., and Mean) for counts is for the period 1976 -91.

[3] Summary (Min., Max., and Mean) for the conservation requirement is for 1984-91. Percent of conservation requirement met represents the contribution from both small and large salmon.

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

Recreational catches: For the period 1974-91, harvests have ranged from 19 to 349 small salmon. Rod-days of effort in 1996 were the highest recorded. In 1996, a total of 268 small salmon was retained and 7 were released.

ata and assessment: Counts are available from a fishway on the lower river. A hook-and-release mortality of 10% was used in the calculation of spawning escapements for the years 1993-96.

State of the stock: Conservation requirement has been exceeded every year since 1984. The counts of small and rge salmon in 1996 were the highest on record.

STOCK: Little River, SFA 11
CONSERVATION REQUIREMENT: 306 thousand eggs (equivalent to 230 small salmon)

Year	1990	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Total returns:	173	61	125	180	88	135	801	61	173	95
Small	158	55	104	169	75	118	674	55	158	89
Large	15	6	21	11	13	17	127	3	15	6
Recreational Harvest	-	-	-	-	-	-	-	-	-	-
Broodstock	82	30	97	100	0	85	119			
Conservation requirement										
% eggs met[2]:	105	47	45	82	38	21	298	29	105	54
Smolt	-	-	382	324	501	2712	4449			

[1] Min, Max, and Mean period 1987-91.
[2] Represents contribution from both small and large salmon.
+ no angling data reported.
* recreational fishery closed.

Background: The Little River is the site of an enhancement project where limited fry stocking was conducted from 1990 to 1996, except for 1995.

Methodologies: Conservation egg deposition is derived for accessible habitat (1,308 riverine units) with eggs required for conservation to come from small salmon. Biological characteristics are those of Little River and Conne River. Current fry releases are backcalculated to eggs for % of conservation egg achieved in areas stocked. Total returns to the river are based on fence counts.

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

Data and assessment: Complete counts of fish are available from a counting fence. Smolt counts are available for 1992-96.

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

Forecast: No quantitative forecast is possible for 1997.

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.

Year	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Total Returns:									
Small	2411	2523	2703	1533	3502	4440	2411	10155	6472
Large	89	159	100	100	110	179	89	516	355
First Peoples' harvest									
Small	281	483	417	0	0	0	18	948	459
Large	3	5	3	0	0	0	0	11	3
Recreational harvest									
Small (retained)	108	329	0	0	0	0	0	3302	1824
Large (retained)	0	0	0	0	0	0	0	-	-
Small (released)	-	-	-	-	-	-	-	-	-
Large (released)	-	-	-	-	-	-	-	-	-
Other Mortalities including broodstock removal									
Small	7	8	3	98	126	38	-	-	-
Large	0	2	2	1	2	0	-	-	-
Spawners:									
Small	2062	1783	2353	1435	3376	4402	2062	7823	4709
Large	87	153	97	99	108	179	87	488	345
Management target % eggs met:	51%	51%	61%	40%	81%	112%	51%	214%	131%
Smolt count[2]	74645	68208	55765	60762	62749	94088	55765	94088	68743
Sea Survival[3]	3.4%	4.0%	2.7%	5.8%	7.2%	-	2.7%	10.2%	5.8%

[1] Min, max and mean recreational harvest calculated for period 1974-91; other mean data for 1986-91 to coincide with the pre-moratorium period. Angling harvests are DFO statistics. 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 reduced to 500 fish for 1993. First Peoples fishery closed in 1994-96.

[2] Min., max. and mean for the period 1987 to 1996.

[3] Sea survival of smolt to small salmon returns. Min., max. and mean are for 1987 to 1995 smolt migrations.

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

State of the stock: The Management Target, which differs and is higher than the conservation egg requirement, was met from 1986-90 and again in 1996. Only 40-61% of the target was achieved from 1991-1994 but rose to 81% in 1995. Sea survival increased to the highest value in six years (7.2%). An enhancement project was initiated in 1994 with approximately 128 thousand fry released in 1995. Note that these fry have not been included in terms of the percentage target achieved in the above table.

Forecast: Estimated smolt output in 1996 was the highest on record: 94,088 (79,867-108,309). Given the high smolt run, a survival only 4.25% should result in 4000 adult salmon returns in 1997. With survival in 1997 similar to that for 1SW salmon in the previous year, then returns should easily exceed 4000 fish and could approach 5400 1SW salmon. In addition, other relationships between (a) median timing of the smolt run and sea survival, and (B) an index of marine thermal habitat and sea survival, both suggest high returns in 1997. In-season monitoring should be used to update managers on changing conditions as the 1997 run progresses. Over 130 thousand Saint John River origin salmon reportedly escaped in February, 1996, from an aquaculture sea cage in Bay d'Espoir. Some of these fish could begin to return to local rivers, including Conne River, as 1SW salmon in 1997.

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

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

Year	1980	1981	1982	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Total Returns:										
Small	82	127	100	137	145	172	199	82	199	137
Large	55	29	56	78	148	120	142	29	148	90
Recreational harvest[2]				CLOSED SINCE 1978						
Small (retained)										
Large (retained)										
Small (released)										
Large (released)										
Other Moralities										
Small										
Large										
Spawners:										
Small	82	127	100	137	145	172	199	82	199	137
Large	55	29	56	78	148	120	142	29	148	90
Conservation Requirement										
% eggs met	32	26	34	47	86	68	78	26	86	53
Smolt count	15130	15839	12373	9986	10503	12160	12383	9986	15839	12625
Sea Survival	1.2%			2.7%	3.0%			1.2%	3.0%	2.4%

[1] Min, Max and Mean are for 1980-82 and 1993-96.
[2] River has been closed to angling since 1978.

Data and methodology: Counts of smolt and adult salmon were obtained with a fish counting fence in 1980-82 and in 1993-96. Juvenile densities were measured at 19 stations to determine changes in juvenile salmon production. Juvenile studies at the higher egg depositions following the moratorium will give a better estimate of the potential production of different reaches and a more accurate estimation of the required egg deposition for conservation. Sea survival for year = x, is calculated by adding small salmon for year = x + 1 and large salmon for year = x + 2 divided by smolt year = x.

State of the stock: The large salmon component has recovered since the closure of the commercial fishery, and now forms 45% from the preceding smolt run, compared to only 26% of the run a decade and a half ago. Potential egg depositions are approaching the conservation requirement. Repeat spawners may now form 40% of the large salmon component.

Forecast: Given present sea-survival rates, 164 large salmon and 195 grilse are expected to return in 1997, achieving about 86% of the conservation egg requirements.

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

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

Year	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Total returns									
Small	243	682	354	774	N/A	592-844	111	1919	674
Large	32	126	34	113	N/A	144-239	15	359	138
Recreational harvest									
Small (retained)	103	263	150	174	26	N/A	47	561	235
Large (retained)[2]	0	0	0	0	0	0	14	127	81
Small (released)	-	26	0	37	5	N/A	-	-	-
Large (released)[3]	9	88	24	45	32	N/A	0	25	9
Other mortalities									
Small									
Large									
Spawners[4]									
Small	140	393	204	600	N/A	592-844	64	1355	439
Large	32	126	34	113	N/A	144-239	15	270	92
Conservation requirement									
% eggs met	7	34	13	41	N/A	44-68	3	55	21

[1] Min, max and mean are for the period 1974-91,
[2] Min, max and mean for large salmon retained is for 1974-83.
[3] Min, max and mean for salmon released is for 1984-91.
[4] Hook and release mortality is 10% of released salmon

Data and methodology: Visual counts of salmon were made by swimmers in late August, 1996. An adjustment factor was applied to the visual counts to give a maximum 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.

State of the stock: In 1996, Crabbes River achieved between 76 % and 81% of its egg deposition required for conservation. This estimate is the highest achieved since 1980. This stock has been at very low population size and has not achieved its conservation requirements in the past 15 years.

Forecast: There is no forecast of abundance for 1997.

STOCK: Middle Barachois River (SFA 13) **Drainage area:** 241 km^2

CONSERVATION REQUIREMENT: 2.1 million eggs (spawners not defined) calculated as 2.4 eggs/m^2 of fluvial parr rearing area and 368 eggs per hectare of lacustrine area.

Year	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Total returns									
Small	179	584	665	732	N/A	755-805	134	1619	675
Large	28	72	36	81	N/A	34-36	0	1159	132
Recreational harvest									
Small (retained)	68	222	230	154	53	N/A	51	526	207
Large (retained)[2]	0	0	0	0	0	0	0	117	42
Small (released)	-	0	23	25	2	N/A	-	-	-
Large (released)[3]	6	22	11	14	24	N/A	0	23	7
Other mortalities									
Small									
Large									
Spawners[4]									
Small	111	362	435	578	N/A	755-805	83	1329	468
Large	28	72	36	81	N/A	34-36	0	1057	108
Conservation requirement									
% eggs met	12	53	48	74	N/A	76-81	0	254	49

[1] Min, max, and mean are for the period 1974-91.
[2] Min, max, and mean for large salmon retained is for 1974-83.
[3] Min, max, and mean for salmon released is for 1984-91.
[4] Hook and release mortality is 10% of released salmon

Data and methodology: Visual counts of salmon were made by swimmers in late August, 1996. An adjustment factor was applied to the visual counts to give a maximum 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.

State of the stock: In 1996, Middle Barachois River achieved between 76 % and 81% of its egg deposition required for conservation.. This estimate is the highest achieved since 1980. This stock has been at very low population size and has not achieved its conservation requirements in the past 15 years.

Forecast: There is no forecast of abundance for 1997.

STOCK: Robinsons River (SFA 13) **Drainage area**: 439 km^2

CONSERVATION REQUIREMENT: 3.3 million eggs (spawners not defined) calculated as 2.4 $eggs/m^2$ of fluvial parr rearing area and 368 eggs per hectare of lacustrine area.

Year	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Total returns									
Small	415	967	531	910	N/A	659-768	274	3186	1234
Large	32	130	31	115	N/A	102-120	21	733	176
Recreational harvest									
Small (retained)	176	386	225	160	73	N/A	116	905	422
Large (retained)[2]	0	0	01	0	0	0	0	117	68
Small (released)	-	24	0	88	38	N/A	-	-	-
Large (released)[3]	10	75	18	38	23	N/A	0	37	16
Other mortalities									
Small									
Large									
Spawners[4]									
Small	239	557	306	750	N/A	659-768	158	2281	812
Large					N/A	102-120	21	604	137
Conservation requirement									
% eggs met:	13	57	23	65	N/A	57-67	9	174	50

[1] Min, max and mean are for the period 1974-91.
[2] Min, max and mean for large salmon retained is for 1974-83.
[3] Min, max and mean for salmon released is for 1984-91.
[4] Hook and release mortality is 10% of released salmon.

Data and methodology: Visual counts of salmon were made by swimmers in late August, 1996. An adjustment factor was applied to the visual counts to give a maximum 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.

State of the stock: In 1996, Robinsons River achieved between 57% and 67% of its egg deposition required for conservation. This estimate is the highest achieved since 1984. This stock has been at very low population size and has not achieved its conservation requirements in the past 15 years.

Forecast: There is no forecast of abundance for 1997.

STOCK: Flat Bay River (SFA 13) **Drainage area:** 635 km²
CONSERVATION REQUIREMENT: 3.8 million eggs

Year	1991	1992	1993	1994	1995	1996	MIN	MAX	MEAN
Total returns[1]:				470	598	1365	470	1365	811
Small				403	557	1233	403	1233	731
Large				67	41	132	41	132	80
Recreational harvest[2]									
Small (retained)[3]	251	211	173	128	0	0	72	609	287
Large (retained)									
Small (released)	N/A	12	0	8	0	0	0	12	4
Large(released)	2	20	17	32	0	0	0	32	12
				6	4	109	0.2	109	21
Other mortalities[2]									
Small				6	4	95	0	95	18
Large				0	0	14	0	14	4
Brood stock removals[1]:	-	-	-	43	83	87	43	87	71
Conservation requirement % eggs met[1]	-	-	-	27	45	65	27	65	46

[1]Min, Max period from 1994-96.
[2]Min, Max period from 1991-96.
[3]Min, Max period from 1974-96.

Methodologies: Habitat includes 1.6×10^4 units. Conservation requirements are to come from small and large salmon. Biological characteristics and fecundity used were those of Flat Bay stock. Total returns (1994-95) are based on a fence count and angling below the fence. The 1996 returns were based on a snorkelling survey conducted in late August 1996.

Broodstock requirements: 87 at present.

Recreational catches: The Flat Bay River stock has been under quota since 1986 as follows: 1986 = 400 small; 1987-88 = 300 small; and 1989-94 = 250 small. The quota has only been achieved in two years. The recreational fishery has been closed since 1995.

State of the stock: The 1996 snorkelling survey counted more fish than the fence count in 1996. This was partially due to a fence washout in mid-season.

Forecast: No quantitative forecast available at this time.

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

CONSERVATION REQUIREMENT: 7.8 million eggs (~ 4,068 small and 92 large salmon) is based on 2.4 eggs/m^2 of fluvial area and 368 eggs per ha of lacustrine area.

Year	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Returns to Pinchgut Brook fence:									
Small	.	222	576	563	752	601	222	752	528
Large	.	5	43	47	28	38	5	47	31
Angling catch above fence:									
Small (retained)	26	10	28	18	3	0	3	28	19
Small (released)	0	0	1	10	2	0			
Large (released)	.	1	0	0	0	0	0	0	0
Spawning escapement on Pinchgut Brook:									
Small	.	212	548	545	749	601	212	749	513
Large	.	5	43	47	28	38	5	47	31
Estimated spawning escapement:									
Small + Large	.	529	1441	1444	1895	1936	529	1895	1138
Conservation requirement[2]									
% eggs met									
Small + Large	.	12	37	46	48	52	12	48	32

[1]Min, Max, Mean are for 1992-95.
[2] % of conservation requirements achieved are updated from the 1995 report based on revised habitat values, biological characteristics and estimated spawning escapement on Harrys River. Conservation egg requirement is preliminary because it includes only lake areas >5 ha.

Methodology: Fluvial habitat includes 2,639,400 m^2 and lacustrine habitat includes 4,068 ha (preliminary - includes all lakes >5ha). Potential egg depositions were calculated from spawning escapements based on 1,540 eggs per kg of body weight of female salmon. The total spawning escapement on Harrys River was estimated based on the spawning escapement on Pinchgut Brook. Potential egg depositions on Harrys River by small salmon in 1992-96 were based on biological characteristics collected in the recreational fishery and at the counting fence in 1992-94. For large salmon, biological characteristics were based on samples collected on other Bay St. George rivers in 1953-94. Spawning escapement for Pinchgut Brook was derived from total returns by subtracting angling removals which include retained catches and a 10% mortality rate for released catches.

Recreational fishery: In the mid 1960s, Harrys River produced the largest recreational catches of any river in Bay St. George but catches began to decline in the 1970s and 1980s. The fishery has been controlled by a river quota of 350 small salmon since 1987 and in-season reviews in 1994-95. The retention fishery was closed in 1994-95 as a result of the in-season review and in 1992-93 due to quotas being reached (1992-zonal; 1993-river). The recreational fishery in 1996 was limited to hook-and-release angling only and angling was not permitted in the headwaters upstream from Home Pool at the outflow of Georges Lake. Recreational angling statistics were not collected in 1996.

Data and assessment: Assessment of the stocks in Harrys River in 1992-96, included the operation of a counting fence on Pinchgut Brook in 1992-96; a spawning survey in November 1995 and November 1996, and a mark-recapture experiment in July 1995. The redds counted on Pinchgut Brook in 1996 was 36% of Harrys River, 12% less than in 1995 (41%). The total spawning escapements on Harrys River in 1992-95 were estimated based on the total spawning escapement on Pinchgut Brook adjusted by the proportion of redds counted on the Pinchgut system in 1995. The total spawning escapements on Harrys River in 1996 was estimated based on the total spawning escapement on Pinchgut Brook adjusted by the proportion of redds counted on the Pinchgut system in 1996. The returns estimated in 1995 based on tagging was similar to the estimate based on the spawning survey results.

State of the stock: Spawning escapements on Harrys River appear to have increased slightly in the last five years but have been less than 50% of the spawning requirement based on this assessment.

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

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

Year	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Recreational harvests									
Small (retained)	1431	4349	4161	2523	5150	5042	1217	6147	3268
Small (released)	.	194	601	463	705	1350	.	.	.
Large (released)	11	177	112	166	233	237	10	303	100
Returns[3]:									
Small	5724	17571	18477	7995	27898	30445	4868	24588	13074
Large	401	2945	636	1030	2064	2679	341	2945	915
Estimated spawning escapement:									
Small	4293	13222	14316	5472	22748	26478	3651	18441	9805
Large	401	2945	636	1030	2064	2524	341	2945	850
Conservation requirement % eggs met:									
Small + Large	27	117	96	40	129	186[4]	24	119	63

[1] Min, Max, Mean are for 1974-91.
[2] Angling catch of small salmon in 1992-96 is estimated based on a creel survey conducted at Big Falls.
[3] Total returns for 1974-91 were estimated based on an angling exploitation rate of 25% adjusted for tag loss and reporting rate.
[4] Preliminary data based on tags returned up to January 06, 1997.

Methodology: Fluvial habitat includes 11.5 million m^2 and lacustrine habitat includes 1,751 ha (excluding Deer Lake - 5930 ha). Biological characteristics were based on samples from the recreational fishery and from the tagging trap located in the estuary of the Humber River. Returns of small salmon are currently estimated by mark-recapture method. Returns of large salmon are assumed to equal returns of small salmon multiplied by the ratio of large to small salmon in the tagging traps. Returns of small salmon in 1992 were based on an angling exploitation rate derived from tags recovered at the Big Falls section of the river by DFO creel survey personnel. The estimate of exploitation rate reported in 1992 had not been adjusted for tag loss but the current value for 1992 includes this adjustment based on a tag loss rate of 23%. Spawning escapement in 1996 was derived from total returns by subtracting angling removals which include retained catches and a 10% mortality rate for released catches.

Recreational fishery: The Humber River produces about 40% of the small salmon catch in SFA 13. Recreational catches estimated in 1992 and 1993 were among the highest on the river since the early 1980s. The recreational catch of small salmon (retained) in 1996 was similar to that of 1995.

State of the stock: The mean potential egg deposition in 1974-91 represented about 63% of the conservation requirement. The 1992-95 mean was 95% requirement. The mean potential egg deposition in 1996 represented 186% of requirement, 31% above the 1995 level. The status of the stock in 1996 was the best since the commercial salmon moratorium and since 1974. The increases in percentages of conservation requirement met

since the commercial moratorium has given a false impression that the status of stocks have improved relative to long-term abundance. Assessments of this river has shown that this is not the case.

Forecast: Assuming that the total angling exploitation on the Humber River in 1997 remains at the current level, similar to that in 1995 and 1996, the spawning escapement in 1997, based on trend analysis, is expected to exceed the conservation spawner requirement. Approximately 50% will be produced from spawners in the first year of the commercial moratorium.

STOCK: Lomond River (above the fishway) (SFA 14A) **Drainage area:** 470 km^2
CONSERVATION REQUIREMENT: 1.1 million eggs (~ 557 small salmon) is based on 2.4 eggs/m^2 of fluvial area and 368 eggs per ha of lacustrine area.

Year	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Returns to fishway:									
Small	403	435	526	701	1002	602	1	440	224
Large	20	80	34	50	95	93	0	50	19
Angling catch below fishway:									
Small (retained)	328	357	275	325	343	381	203	650	366
Small (released)	.	24	85	116	190	99	.	.	.
Large (released)	10	56	36	58	62	49	2	46	18
Approximate total returns[2]:									
Small	731	794	816	1038	1364	983	259	986	590
Large	21	86	38	56	101	98	3	75	31
Known removals above fishway:									
Small	0	16	22	0	20	0	0	0	0
Large	0	0	1	0	0	0	0	0	0
Spawning escapement above fishway:									
Small	403	419	504	701	982	602	1	440	224
Large	20	80	33	50	95	93	0	50	19
Conservation requirement % eggs met:[3]									
Small + Large	64	121	118	143	187	143	0	74	37

[1]Min, Max, Mean are for 1974-88.
[2]Approximate because of the occurrence of spawning below the fishway. Large salmon were not retained after 1984.
[3]Egg depositions in 1992 and 1993 are based on biological characteristics for 1993. Egg depositions in 1996 are based on 1992-96 mean for small salmon and 1978-96 for large salmon.

Methodology: Fluvial habitat includes 215,600 m^2 and lacustrine habitat includes 1,570 ha. Returns to the fishway in 1991 were estimated based on the average count at the fishway in the previous three years. Total returns to the river for 1962-91 were based on counts at the fishway plus angling catches below the fishway. Total returns for 1992-96 were based on counts at the fishway plus retained catches below the fishway and 10% of the released catches. Potential egg deposition was determined from counts of small and large salmon at the fishway and biological characteristics obtained from samples at the fishway and in the recreational fishery.

Recreational fishery: The recreational fishery above the fishway has been closed since 1978. The recreational fishery was managed by a river quota of 350 small salmon during 1986-94. The quota increased to 375 small salmon in 1995 and 1996. In 1996, the river was closed to retention angling when the quota was caught on August 13. Angling is currently not permitted above the fishway.

Data and assessment: Counts of salmon from the fishway are available from 1962 to 1996 with the exception of 1968-70 and 1989-91 when the fishway was not monitored.

State of the stock: The state of the stock should be assessed in terms of the whole river. The area above the fishway represents about 40% of the total river area. Potential egg depositions averaged 37% of the conservation requirement above the fishway in 1974-88 compared to 142% in 1992-95. The potential egg deposition in 1996 was 145% of requirement, 74% above the 1974-88 average, but 29% below 1995. The increases in percentages of conservation requirement met since the commercial fishery moratorium has given a false impression that the status of stocks has improved relative to long-term abundance. Assessments of this river has 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 (~ 562 small salmon is based on 2.4 eggs/m^2 of fluvial area and 105 eggs per ha of lacustrine area.

Year	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Returns to fishway:									
Small	1415	2347	4009	3592	5799	6923	38	2315	1509
Large	73	169	222	331	611	507	3	323	113
Angling catch below fishway:									
Small (retained)	150	477	179	227	331	448	0	340	118
Small (released)	.	75	266	82	369	370	.	.	.
Large (released)	1	6	15	9	36	20	0	18	3
Approximate total returns to river[2]:									
Small	1565	2832	4215	3891	6167	7371	96	3155	1626
Large	73	170	224	332	615	510	7	525	115
Total spawners above fishway:									
Small	1415	2347	4009	3592	5799	6923	138	2815	1533
Large	73	169	222	331	611	507	3	523	113
Conservation requirement									
% eggs met:									
Small + Large	176	314	538	530	1033	1279	17	360	195

[1]Min, Max and Mean are for 1974-91.
[2]Approximate because of the occurrence of spawning below the fishway.
[3]Potential egg depositions in 1990-93 were calculated based on the 1985-89 female mean wt. of 1.6 kg for small and 4.13 kg for large salmon. Egg depositions in 1996 are based on 1992-96 mean for small salmon and 1975-96 for large salmon.

Methodology: Fluvial habitat includes 516,800 m^2 and lacustrine habitat includes 2,323 ha. Potential egg depositions were determined from the spawning escapement of small and large salmon based on a fecundity of 1783 eggs per kg estimated for Western Arm Brook. Biological characteristics used to calculate the potential egg depositions in 1974-84 and 1990-93 were based on the 1985-89 mean female biological characteristics, 1994-95 egg depositions were based on individual year values, and 1996 egg depositions were based on the 1992-96 mean for small salmon and the 1975-96 mean for large salmon. Biological characteristics were from samples collected at the fishway and the recreational fishery. Total returns to the river for 1971-91 were based on counts at the fishway plus angling catches below the fishway. Total returns for 1992-96 were based on counts at the fishway plus retained catches below the fishway and 10% of the released catches.

Recreational fishery: As in 1995, the river was not open to retention catch in 1996 until a minimum spawning escapement of 750 salmon had passed through the fishway, but in 1996 the river was open for hook and release only until the 750 salmon had passed through the fishway. The minimum in 1994 and previous years was 1,000 salmon. Angling is currently not permitted above the fishway.

Data and assessment: The count of small salmon at the fishway in 1996 was the highest on record, and for large salmon, the second highest. In 1996, the count of small salmon was16% above the count of small salmon in 1995. The count of large salmon in 1996 was 20% below that of 1995.

State of the stock: It is estimated that the Torrent River stock has achieved conservation requirement above the fishway every year since 1978. The percentage of requirement achieved in 1996 was 1,279%, 20% above 1995 and 53% above the 1992-95 mean (603%) value. The increases in percentages of requirement met since the commercial moratorium has given a false impression that the status of stocks has improved relative to long-term abundance. Assessments of this river has shown that this is not the case.

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

CONSERVATION REQUIREMENT: 0.91 million eggs (~ 287 small salmon) is based on 2.4 eggs/m^2 of fluvial area and 105 eggs per ha of lacustrine area.

Year	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Returns to counting fence:									
Smolt									
Small	233	480	947	954	823	1272	120	1578	492
Large	1	8	8	31	33	52	0	4	1
Angling catch below fence:									
Small	.	.	.	.	.	.	0	171	41
Large	.	.	.	.	.	.	0	2	0
Total Returns to river:									
Small	233	480	947	954	823	1272	233	1578	533
Large	1	8	8	31	33	52	0	5	2
% Smolt survival[2]:									
	2.2	3.6	5.3	6.8	8.9	8.4	2.1	12.1	4.4
Spawning escapement above fence:									
Small	233	480	947	954	789	1230	120	1578	468
Large	1	8	8	31	30	50	0	4	1
Conservation									
requirement									
% eggs met:									
Small + Large	68	151	288	292	285	430	31	287	111

[1]Min, Max and Mean are for 1974-91.
[2]Based on smolts in year i and total returns of small salmon (adjusted for repeat spawners)in year i+1.

Methodology: Fluvial habitat includes 290,000 m^2 and lacustrine habitat includes 2,017 ha. Total returns to the river were based on counts at the fence plus angling catches below the fence in 1976-88. Potential egg depositions were calculated from the total spawning escapement of small and large salmon based on 1,783 eggs per kg of females. Potential egg depositions in 1984-93 were based on 1984-93 biological characteristics for small and large salmon combined. In 1994-95, egg depositions were based on biological characteristics for each individual year and for 1996, egg deposition was based on mean 1996 female biological characteristics for small salmon and the 1992-96 mean biological characteristics for large salmon.

Recreational fishery: The recreational fishery on this river has been closed since 1989 because of high angling exploitation below the counting fence.

Data and assessment: Complete adult and smolt counts at the counting fence are available since 1971.

State of the stock: Potential egg depositions in 1974-91 averaged 111% of the conservation requirement in 1974-91, and 254% in 1992-95. The level achieved in 1996 was 430%, 34% above the 1995 level and 74% above the average for 1974-91. The increases in percentages of target met since the commercial moratorium has given a false impression that the status of stocks has improved relative to long-term abundance. Assessments of this river has shown that this is not the case.

Forecast: The smolt count on Western Arm Brook in 1996 was 4% less than in 1995. Therefore, assuming that the smolt-adult survival rate in 1997 is similar to that in 1996, returns of 1SW salmon in 1997 are expected to be 4% less than the returns in 1996.

APPENDIX 6
Calculation of Spawner Requirements for Rivers with MSW Stocks

The heritability of the age at sexual maturity of Atlantic salmon was estimated by Gjerde (1984) to be 0.48 $\pm$ 0.20. This finding strongly indicates that age at sexual maturity is a heritable trait. Thus, it is important to determine the appropriate proportion of the conservation egg deposition requirements which should come from MSW salmon. The approach to determining the number of MSW salmon that should be in the spawning stock is complicated by the absence of knowledge of what the proportion of the historical spawning stock was MSW salmon and the lack of a good understanding of what the current population can produce. Currently most salmon populations with a MSW component are in a depressed state and spawning stocks have a lower proportion of large salmon than they did 30 years ago. A number of management measures are in place to try to restore the populations of large and small salmon to historical levels. In order to achieve this goal, sufficient numbers of large salmon spawners should be permitted to spawn to restore the population and to attain an historically small:large salmon ratio.

Several approaches were discussed for calculating the numbers of large salmon required to achieve the conservation egg deposition requirements for rivers with MSW stocks. No unanimous agreement was reached on the best approach. As a general principle, it was agreed that the eggs required for conservation should be deposited by large and small salmon in the same proportion that the eggs occurred in the total population of a stock (prior to fishing exploitation) during some earlier period, although the actual period was not defined.

An example of one method which could be used to calculation the proportion of the large and small salmon in the spawner is outlined below. This example uses the information available for the Pinware River.

Example

Method:

1. Use the angling catch data of small and large salmon for the period 1968-75. Apply a differential exploitation rate for large and small salmon to calculate the average numbers of large and small salmon in the river. The difference in exploitation rates for large salmon and small salmon is to be based on the differences observed on other rivers, i. e. Sand Hill R, Forteau R.

2. Apply a differential commercial fishery exploitation rate on large and small salmon to calculate the total numbers of large and small salmon in the population (1968-75). Exploitation rates are the mid-point of the range used in the Labrador assessments.

3. Calculate the proportion of the eggs, in the total population prior to exploitation in fisheries, which are being carried by large salmon using biological characteristics from the period (1968-75).

4. Apply the proportion of eggs from large salmon calculated in point 3 above, to the conservation egg requirements for Pinware River (11,847,390). This gives the proportion of eggs in the Conservation Requirements which should be deposited by large salmon. The remainder of the eggs should come from small salmon.

5. Calculate the number of large salmon spawners required for conservation using the number of eggs to be deposited from large salmon, from point 4 above, and applying average biological characteristics for the period 1992-96.

Results

Average angling catches 1968-73 = 757 small salmon
241 large salmon

Exploitation rate of angled salmon on Forteau River in 1996, for small salmon = 0.54 and for large salmon = 0.14 (25.9% of small salmon)

Exploitation rates in the angling fishery on Sand Hill River 1994 to 1996 are as follows:

1994	small salmon = 0.278	large salmon = 0.047
1995	small salmon = 0.225	large salmon = 0.075
1995	small salmon = 0.310	large salmon = 0.135
	average 0.271	average 0.087 (32.1% of small)

The average difference in the exploitation rate on small salmon and large salmon on Forteau and Sand Hill rivers is 29.0% ((25.9+32.1)/2)

If the exploitation rate on small salmon, 1968-73, is assumed to be 0.20, then the exploitation rate on large salmon would be 0.20 x 0.29 = 0.058

Total returns of salmon to Pinware River 1968-73 = angling catch/exploitation rate
Small salmon = 757/0.2 = 3,785
Large salmon = 241/0.058 = 4,155

Total production of salmon = Returns to river/(1-commercial exploitation rate)

Commercial exploitation rate is assumed to be the mid-point of the ranges used in (Anon 1997), which is for large salmon 0.80 and for small salmon 0.40

Total Production of small salmon = 3,785/(1-0.40) = 6,308
Total production of large salmon = 4,155/(1-0.80) = 20,775
Total 27,083

Proportion large salmon in total population = 0.767

Proportion of the total eggs in total population that is carried by large salmon

$$= \frac{PF_L * PL * RF_L * W_L}{(PF_L * PL * RF_L * W_L) + (PF_s * PS * RF_s * W_s)}$$

where:
PF_L is the proportion female large salmon = 0.714
PL is proportion large salmon in total population = 0.767
RF_L is relative Fecundity of large salmon = 1783 eggs / kg
W_L is the mean weight of large salmon = 4.65 kg
PF_S is the proportion female small salmon = 0.449
PS is proportion large salmon in total population = 0.233
RF_S is relative Fecundity of small salmon = 1783 eggs/kg
W_S is the mean weight of small salmon = 1.78 kg (
(values for PF_L, RF_L, PF_S, RF_S, W_S are from Mullins, pers comm)

Proportion of total eggs carried by large salmon

$$= \frac{0.714 * 0.767 * 1,783 * 4.65}{(0.714 * 0.767 * 1,783 * 4.65) + (0.449 * 0.233 * 1,783 * 1.78)}$$

$$= \frac{4,540.4}{4,54.4 + 332.0} = 93\%$$

Therefore 93% of eggs should come from large salmon

Total eggs required for conservation = 11,847,390

Number of eggs required from large salmon = 11,847,390 * 0.93 = 11,018,073

Number of large salmon required = 11,018,073/(1,783 * 4.65 * 0.714) = 1,**861**

Number eggs required from small salmon = 11,847,390 - 11,018,073 = 829,317

Number of small salmon required for spawning = 829,317 / (1,783 * 1.78 * 0.449) = **582**

Using similar calculations and assuming that the angling exploitation on large salmon is 50% of the exploitation on small salmon, the required number of large salmon would be **1,777** and the number of small salmon would be **931.**

Using similar calculations and assuming that the angling exploitation on large salmon is the same as the exploitation on small salmon, the required number of large salmon would be **1,621** and the number of small salmon would be **1,580.**

Recommendations:

1. A paper be prepared for next years meeting further documenting the reasons why this approach is required and the method outlined.

2. The paper should include modeling and risk assessment for the impact(s) of this on fisheries and spawners.

3. The paper should include the effect of environmental influences on age at maturity.