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Newfoundland and Labrador Region
Canadian Science Advisory Secretariat
Science Advisory Report 2006/050

STOCK ASSESSMENT OF NEWFOUNDLAND AND LABRADOR ATLANTIC SALMON - 2006

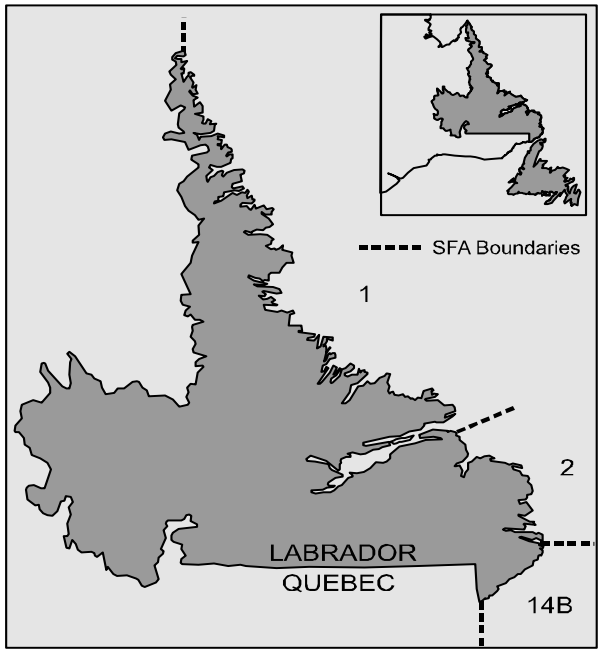

Figure 1: Labrador portion of the NL Region.

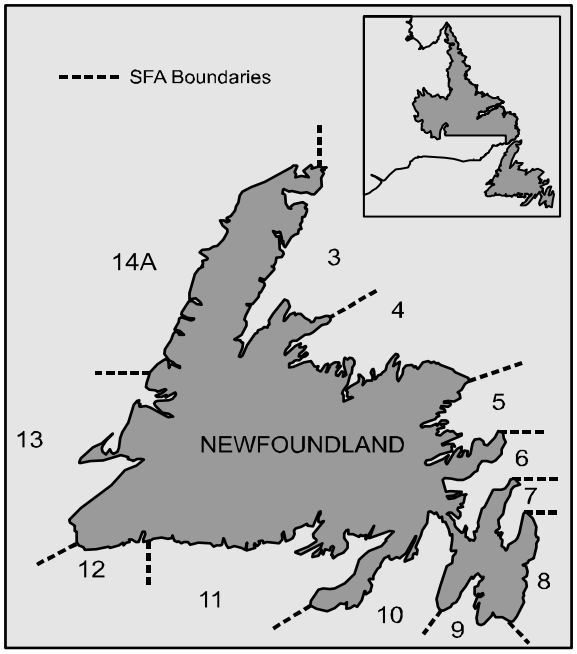

Figure 2: Newfoundland portion of the NL Region.

Context

There are 15 Atlantic salmon (Salmo salar) management areas, known as Salmon Fishing Areas (SFAs) 1-14B, in Newfoundland and Labrador (Fig. 1 and Fig. 2). Within these areas there are more than 200 rivers with reported Atlantic salmon populations characterized by differences in life history traits including freshwater residence time, age at first spawning, and the extent of ocean migrations. Spawning populations consist of varying proportions of small (fork length < 63 cm) and large (fork length ≥ 63 cm) salmon. The majority of rivers in Newfoundland contain populations of small salmon or grilse which are predominantly maiden fish (never spawned before) that have spent one year at sea before returning to spawn (one-sea-winter salmon, 1SW). In Labrador (SFAs 1, 2 & 14B), and western Newfoundland (SFAs 13 & 14A), there are important large salmon components that contain a mixture of maiden fish that have spent two (2SW) or more years (MSW) at sea before spawning and repeat spawners which are returning for a second or subsequent spawning. In other Newfoundland rivers, the large salmon component consists mainly of repeat spawners. Conservation requirements for Atlantic salmon rivers are considered to be threshold reference points. Conservation requirements have been established for individual rivers in Labrador (SFAs 1-2) based on 1.9 eggs m^2 of river rearing habitat, Straits Area of

Labrador (SFAs 14A-14B) based on 2.4 eggs per m^2 of river rearing habitat and 105 eggs per hectare of lake habitat and insular Newfoundland (SFAs 3-13) based on 2.4 eggs per m^2 of river rearing habitat and 368 eggs per hectare of lake. The status of stocks is assessed on the basis of the proportion of the conservation egg deposition achieved in a given year and the trends in abundance of various life stages. The consequences of egg depositions below conservation to the long-term sustainability of the stock are unknown but the likelihood of deleterious effects are greater when egg depositions are below conservation. There should be no human induced mortality on stocks that are below 100% of conservation.

2006 marks the final year of the five-year Atlantic salmon management program. A Regional Advisory Process meeting was held in November 2006 to primarily update those stocks/rivers considered during the last assessment meeting, with emphasis on determining the level of conservation spawning requirement achieved.

SUMMARY

Labrador (SFA 1-2 & 14B)

- In Labrador, returns of small salmon decreased in 2006 compared to 2005 at three of four counting facilities. The 2005 and 2006 index of abundance, and hence spawners, are the highest in the time series.

- Numbers of large salmon declined in 2006 compared to 2005; also returns of large salmon still appear to be lower than prior to the closure of the commercial fishery.

Labrador SFA 1

- English River has met or exceeded conservation requirements in only one of the last eight years.

Labrador SFA 2

- Sand Hill River has met or exceeded conservation requirements for the last three years of a total of 12 years (1970-73, 1994-96, and 2002-2006).

- Muddy Bay Brook has met or exceeded conservation requirements for the last four years of a total of five years.

- Southwest Brook (Paradise River) has met or exceeded conservation requirements for five out of eight years.

Newfoundland (SFAs 3-14A)

- In Newfoundland there was a general decline in returns of small salmon and a general increase in large salmon compared to 2005. Egg depositions were for the most part above the moratorium means.

- Abundance of salmon during the moratorium years continues to be lower than prior to the closure of the commercial fisheries.

- There is a concern with the viability of the salmon stock in the upper section of the Exploits River (upstream of Red Indian Lake).

- There is concern with the low level of large salmon spawners in the Bay St. George area (SFA 13).

Northeast and Eastern Newfoundland (SFAs 3-8)

- In spite of greatly increased spawning in 1992-1996, subsequent returns of small and large salmon are still low.

- Conservation requirements were achieved in two (Campbellton and Middle Brook) of six assessed rivers.

- Exploits River, Terra Nova River and Northwest River (Port Blandford) have yet to achieve conservation requirements due mainly to habitat expansion.

- Campbellton River and Middle Brook have met or exceeded conservation requirements in each year of assessment during the commercial salmon fishery moratorium.

- Gander River has met or exceeded conservation requirements in only seven of the last 15 years.

- The lower Exploits River has achieved conservation requirements ten out of 15 years. The number of spawners in the middle Exploits has increased since the moratorium whilst the number of spawners in the upper Exploits has declined since 1997.

Southern Newfoundland (SFA 9-11)

- Conservation requirements were achieved in two (Northeast and Conne River) out of the four rivers assessed. The 2006 egg deposition was equal to the 1992-2005 mean for Northeast and Rocky whilst it was below the 1992-2005 mean for Little and Conne rivers.

Southwest Newfoundland (SFA 12 -13)

- Conservation requirements were achieved on Harry's River for the first time in 2006.

- Increases in returns of small salmon were observed in the two rivers assessed: Harry's and Highlands rivers.

- Total population sizes remain low, particularly in two-sea-winter (2SW) maiden salmon.

Northwest Newfoundland (SFA 14A)

- Conservation requirements were exceeded in the two assessed rivers in 2006.

BACKGROUND

Recreational Fisheries

Labrador

In 2006, the recreational salmon fishery for all Labrador rivers opened 15 June and closed 15 September. Retention of large salmon was not permitted in SFA 14B of Labrador but was permitted on some rivers in SFA 2 and all rivers in SFA 1. In SFA 1 and some SFA 2 rivers, anglers could retain four salmon for the season, one of which could be large; other scheduled salmon rivers in SFA 2 were given a Class III designation, with a seasonal retention limit of two small salmon and no large salmon. The lower retention limit for some rivers in SFA 2 was implemented as a precautionary measure to prevent increased fishing mortality expected as a result of increased angling on rivers made easily accessible via the Trans-Labrador Highway. Rivers without direct access from the highway were left at four salmon, as was previously the case.

Angling catch data for SFA 1 were derived from records kept by the Department of Fisheries and Oceans (DFO) Conservation and Protection (C & P) staff, logbooks from outfitting camps 1974-1993 and logbooks from outfitting camps 1994 onwards. For SFA 2, C & P and logbook data were used for 1974-1993 and a combination of logbook and License Stub Return data was used for 1994-2005. For SFA 14B, C & P and logbook data were used for 1974-1993 and License Stub Return data for 1994-2005. In 2005, preliminary estimates suggest the total angling catch in SFAs 1, 2 & 14B was 9,068, the third highest on record. The total angling effort was 7,613 rod-days, a decrease over 2003 and 2004 values of 8,053 and 8,302, respectively. The catch of small salmon was 7,806 (1,824 retained and 5,982 released) and large salmon was 1,262 (292 retained and 970 released). The proportion of salmon released by anglers in Labrador, which has been increasing over time, was 77% of the total catch. In total, there were 6,952 small and large salmon estimated to be hooked and released in 2005 (Fig. 3). In SFA 1, the total catch in 2005 (small and large salmon combined) of 1,464 decreased by 21% compared to 2004. In SFA 2, the total catch (small and large salmon combined) in 2005 of 5,830 decreased by 3% compared to 2004. Also, in SFA 14B, the total catch (small and large salmon combined) in 2005 of 1,774 increased by 5% compared to 2004. Data for 2006 are currently unavailable.

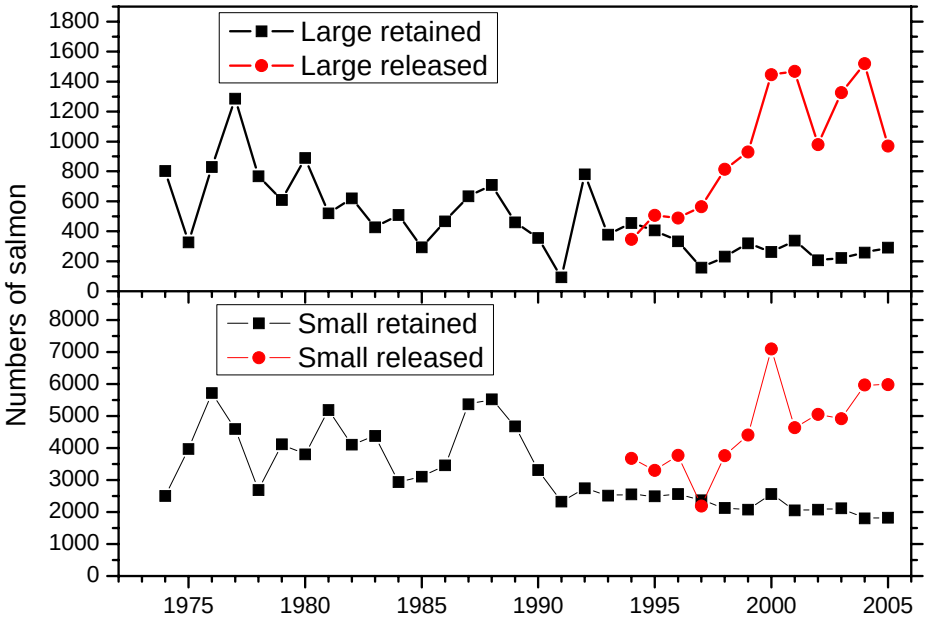

Figure 3: Angling catch statistics for Labrador SFA's 1, 2 & 14B.

Newfoundland

The recreational salmon fishery in SFAs 2-14B is managed according to the River Classification System. A five-year (2002-2006) integrated Atlantic salmon fisheries Management Plan was introduced for Newfoundland and Labrador in 2002 (DFO 2002). In the 2003 Management Plan, some rivers were reclassified as outlined in Angler's Guide for 2003 (DFO 2003).

Angling catch statistics from License Stub Returns in 2006 are not yet available. Preliminary estimates of catches are based the 2001-2005 means.

Aboriginal Fisheries

Aboriginal subsistence fisheries for salmon, charr and trout occurred in Labrador under communal license similar to 2005. An All Resident Subsistence Fishery for trout and charr permitted retention of up to four salmon as a by-catch in 2006 similar to 2005. In 2006, a Métis Subsistence Fishery was also permitted for salmon, charr and trout.

There has been no commercial salmon fishing in insular Newfoundland since 1992, the Straits area of Labrador (SFA 14B) since 1997, and the rest of Labrador (SFAs 1-2) since 1998.

Commercial salmon fishing in Greenland territorial waters was suspended in 2002. Greenlanders continued a subsistence harvest in 2002-2006 of less then 30 tonnes including estimates for unreported catches. In 2006, there was a small commercial and recreational net fishery in St. Pierre et Miquelon territorial waters. Harvests have been less than 5 tonnes annually.

Information available on Labrador subsistence fishery catches indicates that about 32 tonnes (13,253 salmon) were harvested in 2005 of which large salmon represented 34% of the catch by weight and 21% by number. Subsistence food fishery landings in 2005 were the highest on record for the 6 years that data have been kept and increased only slightly over 2004 landings of 31 tonnes (Table 1). Subsistence fishery landings from 2006 logbook returns are not yet complete.

Table 1. Subsistence salmon fisheries landings in Labrador as of 6 November 2006.

	Small salmon		Large salmon		Total	
Year	Number	Weight(kg)	Number	Weight(kg)	Number	Weight(kg)
2000	5,323	10,353	1,352	5,262	6,675	15,613
2001	4,789	9,789	1,673	6,499	6,478	16,288
2002	5,806	11,581	1,437	5,990	7,243	17,572
2003	6,477	13,196	2,175	8,912	8,653	22,108
2004	8,385	17,379	3,696	14,270	12,091	31,649
2005	10,436	21,038	2,817	10,876	13,253	31,914

Prior to the closure of the Labrador commercial salmon fishery in 1998, landings (small and large salmon combined) averaged 369 tonnes annually during the period from 1984 to 1989, and 111 tonnes per year from 1990 to 1997, the period in which quotas and allowances were in effect. Commercial salmon landings during the last year of the fishery (1997) were about 47 tonnes. By comparison, approximately 32 tonnes of salmon were harvested in subsistence fisheries in 2005.

ASSESSMENT

Conservation Requirements for Labrador Rivers

In 2006, conservation requirements for Atlantic salmon (*Salmo salar* L.) in Labrador were reviewed and updated. The current standard conservation requirement of 240 eggs per 100 m^2 of parr-rearing habitat used for some Eastern Canadian rivers was deemed questionable for Labrador because Labrador rivers are on the northern edge of the range of Atlantic salmon and have a much colder climate. As a result of the colder climate, Labrador salmon generally spend

longer in freshwater than do salmon populations to the south. Also, many Labrador rivers have abundant anadromous charr (*Salvelinus alpinus* L.) and trout (*Salvelinus fontinalis* Mitchill) which are not present in rivers to the south and may compete with salmon in freshwater for space and food. Because Labrador salmon are exploited in FSC fisheries (fisheries by aboriginal people for food, social and ceremonial purposes) in addition to angling, it requires the development of an interim value until such time that more definitive reference points can be developed. The preferred approach to defining biological reference points is through the analysis of stock and recruits relationships (SR). The collection of a sufficient SR time series requires a number of years of measured spawners and adult returns which do not exist for any Labrador river. Thus, various approaches for deriving conservation limits were reviewed. The first of these is based on a quasi-stock and recruit method and uses fishery generated SR data. The second considers measured smolt production from Sand Hill River adjusted to variable freshwater survival rates. The third converts angling catch rates and river returns from a counting fence to construct SR data from a limit of 50% of the equilibrium population. Results from the three methods show 161 (95th CL 110 to 309) eggs per 100 m^2 for the quasi-SR approach, 152 (95th CL 80 to 370) eggs per 100 m^2 based on the Sand Hill smolt production data and 187 (95th CL 153 to 201) from the SR analysis of Sand Hill River fence and angling data. Based on the data and analysis and until more information can be collected at higher escapements, it is recommended that a management target of 240 eggs per 100 m^2 and an interim conservation limit of 190 eggs per 100 m^2 be adopted for use in Labrador (SFAs 1&2).

Resource Status – Adult salmon

Labrador (SFA 1, 2, 14B)

Stock status can be tracked by examining trends of individual stocks, or in a collective manner where information from fisheries and from assessed rivers is combined to derive indices of abundance. As illustrated for small (Fig. 4) and large (Fig. 5) salmon in Labrador, despite improvements in runs to some rivers in 2006, overall abundance remains relatively low when compared with levels when commercial fishing was taking place prior to 1998. While the abundance of small salmon was similar to previous levels the large salmon index still remains relatively low. This is a very important consideration for Labrador as large salmon are primarily multi-sea-winter salmon, have a high percentage of female salmon, and thus carry a high proportion of the overall egg requirement.

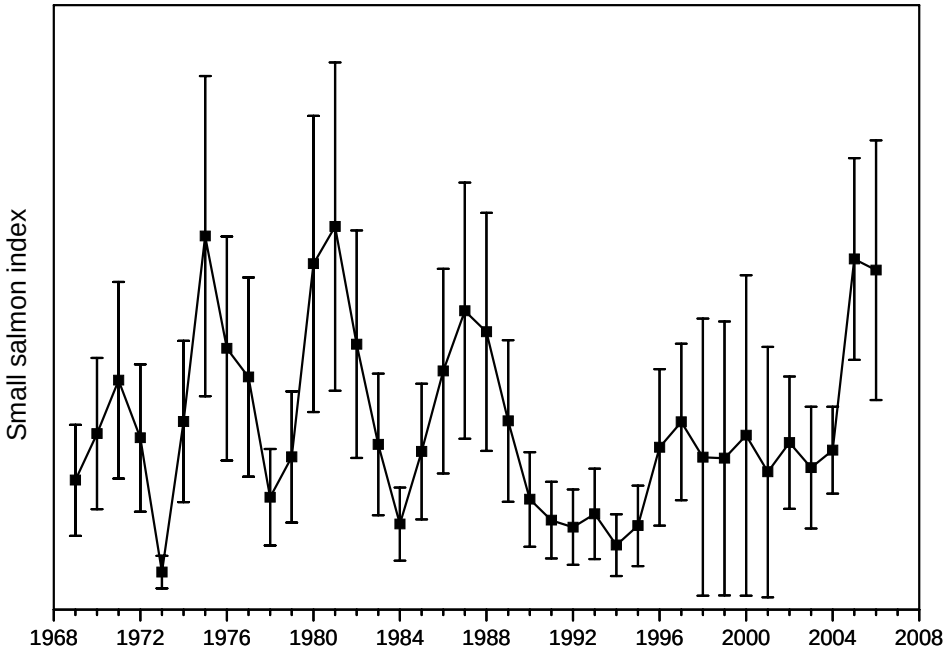

Figure 4: Trends in abundance of small Atlantic salmon in Labrador, 1969 to 2006. Returns have been corrected to account for marine exploitation. Vertical lines represent the 95th confidence intervals.

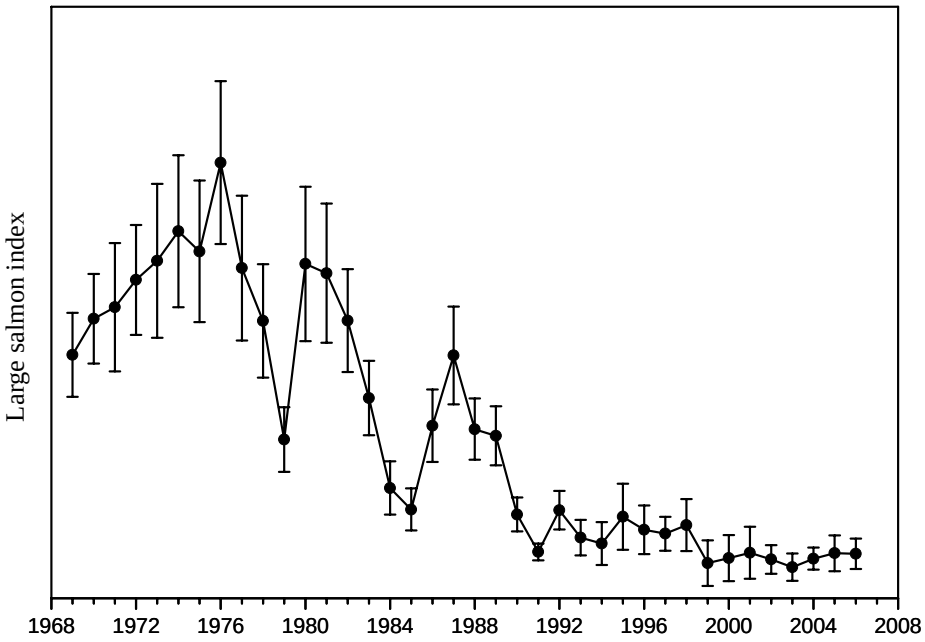

Figure 5: Trends in abundance of large Atlantic salmon in Labrador, 1969 to 2006. Returns have been corrected to account for marine exploitation. Vertical lines represent the 95th confidence intervals.

The status of English River (SFA 1), Southwest Brook (Paradise River), Muddy Bay Brook, and Sand Hill River (SFA 2) (Fig. 1) was assessed using fish counting facilities. There are no additional facilities from which to determine the status of other Labrador salmon stocks.

Returns of small salmon to English River increased in 2006 over those of 2005 by 44% and increased for large salmon by 57% (Appendix 1). Returns of small salmon to English River were the highest since assessments commenced in the late 1990s. At Southwest Brook, a tributary of Paradise River, small salmon returns decreased in 2006 by 62% while large salmon declined by 35% over values in 2005. Both small and large salmon returns in 2005 were the highest on record. Muddy Bay Brook with five years of data showed decreases of 14% for small salmon while large salmon declined by 15% over returns in 2005. Sand Hill River although broken into 3 time periods (1970-73, 1994-96 & 2002-2006) has the longest series of count information in Labrador. Returns to the river in 2006 declined by 30% for small salmon and 38% for large salmon compared to 2005, which was the highest in the time series for both small and large salmon. Removals by marine fisheries are not included in total returns to these rivers.

Interim conservation spawning requirements for Labrador rivers in SFAs 1&2 have been defined as 1.9 eggs per m² of fluvial habitat which is assumed to include pond habitat (Reddin et al. 2006). Using estimates of available parr rearing habitat in these rivers, the conservation requirements are then developed for each river. Conservation requirements for English River, Sand Hill River, Muddy Bay and Southwest brooks exceeded these levels in 2006. Southwest, Muddy Bay, English and Sand Hill rivers all showed decreases

in the percent of conservation requirements met.

Newfoundland (SFAs 3-14A)

Salmon abundance and hence stock status can be tracked by examining trends of individual stocks, or in a collective manner where information on salmon returns to all assessed rivers is combined to derive composite indices of abundance. As illustrated below for Newfoundland small salmon, despite improvements in runs to many rivers in 2003-2006, overall abundance remained relatively low when compared with pre-moratorium levels (1984-1991) that have been corrected to account for marine exploitation. Overall abundance of small salmon in 2006 fell by comparison with 2003-2005, but remains on par with the 1992-1996 and 1997-2005 means.

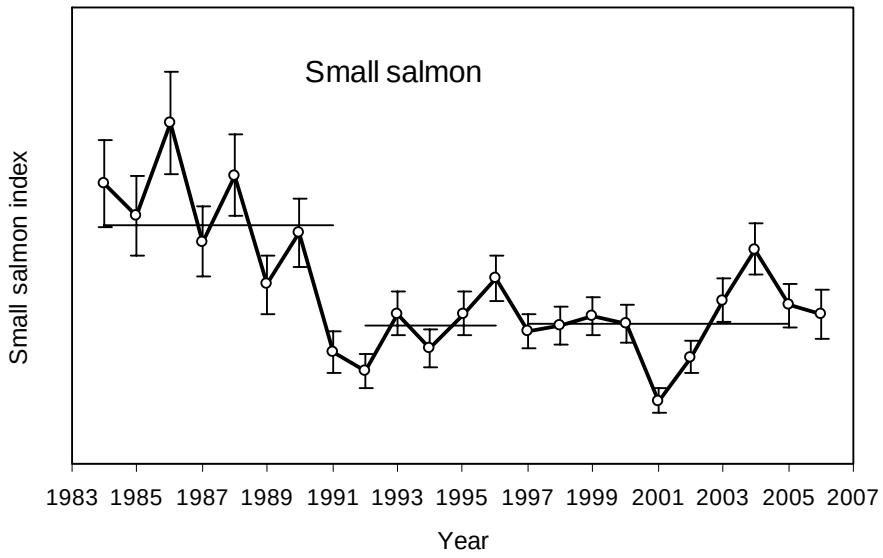

Figure 6: Trends in abundance of small Atlantic salmon in Newfoundland, 1984 to 2006. Returns from 1984 to 1991 have been corrected to account for marine exploitation. Horizontal lines illustrate the mean abundance index for the periods 1984-1991, 1992-1996, and 1997-2005. Vertical lines represent ± 1 standard error.

A somewhat similar situation exists for large salmon. There was also a precipitous decline in abundance from the mid-1980s until the early 1990s. Following the closure of the Newfoundland commercial salmon fishery in 1992, the collective abundance of large salmon increased consistently until 1998. Abundance of large salmon then fell to moderately low levels in 2001 and 2002 before increasing in recent years although overall abundance declined again in 2005 and 2006 relative to 2004 and was slightly above the 1997-2005 mean. Hence, while the overall returns and spawning escapements of salmon to rivers have increased relative to the pre-moratorium period, total stock size is still only similar to or lower than levels obtained prior to the closure of the Newfoundland commercial salmon fishery.

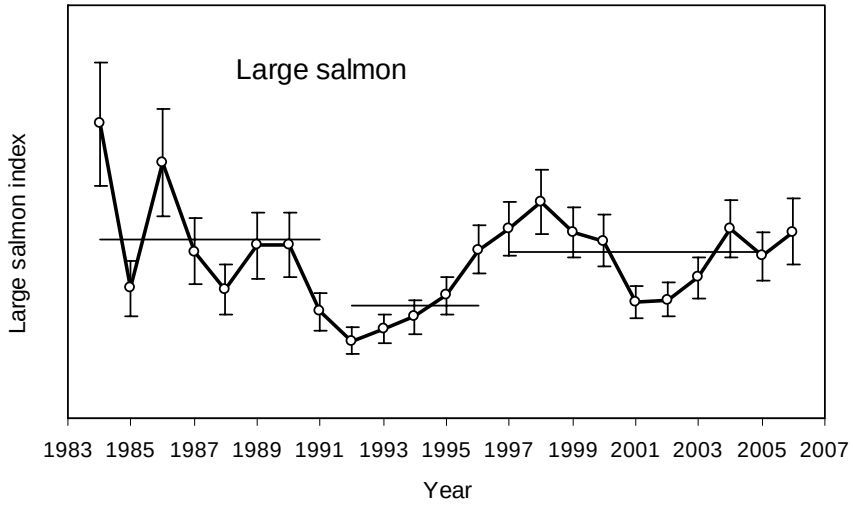

Figure 7: Trends in abundance of large Atlantic salmon in Newfoundland, 1984 to 2006. Returns from 1984 to 1991 have been corrected to account for marine exploitation. Horizontal lines illustrate the mean abundance index for the periods 1984-1991, 1992-1996, and 1997-2005. Vertical lines represent ± 1 standard error.

Northeast and Eastern Newfoundland (SFAs 3-8)

Six rivers were assessed: Exploits, Campbellton, and Gander rivers in SFA 4, and Middle Brook, Terra Nova River and Northwest River (Port Blandford) in SFA 5. With the exception of Gander River, all stocks were assessed directly from salmon returning to fish counting facilities. The status of Gander River in 2006 was inferred from salmon returning to a fishway in Salmon Brook, a tributary.

Total returns of small salmon in 2006 decreased over those of 2004 for all rivers except Terra Nova, which showed an increase. Compared to the means for 1992-2005 declines were noted for Gander, Middle Brook and Northwest rivers. Returns of large salmon in 2006 increased relative to 2005 for Middle Brook, Exploits, Campbellton and Terra Nova rivers while the remainder showed decreases.

All rivers except Middle Brook and Gander River increased relative to the 1992-2005 mean. Conservation spawning requirements were met only at Campbellton River and Middle Brook (Appendix 1). Campbellton River and Middle Brook have exceeded their conservation spawning requirements in each of the years they have been assessed during the moratorium (Appendix 1). Gander River has met or exceeded conservation requirements in only seven of 15 years. Terra Nova River, Exploits River and Northwest River (Port Blandford) have yet to achieve conservation spawning requirements.

In spite of greatly increased spawning escapements for most assessed rivers in this area in 1992-1996, which were the immediate benefits of the moratorium, there has been no corresponding increase in adult recruitment (i.e. small salmon) which should have started in 1997.

South Newfoundland (SFAs 9-11)

Specific rivers assessed in 2006 (N = 4) include: Northeast Brook (Trepassey) and Rocky River in SFA 9, Conne River and Little River in SFA 11 (Fig. 2). Northeast River (Placentia) (SFA 10) has not been assessed since 2002. Spawning escapements are evaluated using fish counting facilities while mark-recapture methods are used to survey smolt production at Conne River.

Total returns of small salmon in 2006 increased by 33% at Conne River by comparison with 2005 with returns at Northeast Brook (Trepassey) 10% more than the previous year. In contrast, returns of small salmon fell by 18% at Rocky River. Salmon enhancement activities have been taking place at Little River where returns in 2006 fell by 37% relative to 2005. Overall, salmon abundance at Little River is highly variable, in part as a result of enhancement activities whereas returns to Northeast Brook (Trepassey) vary the least among monitored south coast rivers. Regarding large salmon, abundance increased by 62% at Conne River and by 73% at Little River. Large salmon returns at Northeast Brook (Trepassey) were equal to those in 2005 whereas returns to Rocky River declined by 41% to the lowest value recorded since 1996. As noted in past years, large salmon at rivers such as Conne River are predominately alternate spawning grilse.

Conservation spawning requirements in 2006 were only achieved at Northeast Brook (Trepassey) (184%) and at Conne River (110%) while Rocky River and Little River attained 42% and 70%, respectively. Rocky River has yet to achieve conservation while Conne River has met its requirement in 10 of the past 15 years since the commercial salmon fishery moratorium began. As noted, Little River has been subject to enhancement activities but conservation requirements have generally been met in four of the past five years (99% conservation met in 2005).

Southwest Newfoundland (SFAs 12-13)

No rivers were assessed in SFA 12 in 2006.

In SFA 13, two rivers (Harry's and Highlands) were assessed by counting fences in 2006. Adult counts were taken on Harry's River at Gallants at approximately river km 25. A limited amount of snorkeling was also carried out on Harry's River below the counting fence to estimate the number of adults in the lower reaches of the river.

Total counts as well as counts of small and large salmon were the highest ever recorded for Harry's River. Also, since 2002 the total counts on Harry's River have been trending up.

On Highlands River the total number of adult salmon increased in 2006 compared with 2005. However, the number of large salmon decreased relative to 2005. It should be noted that the total population of adult salmon in Highlands River is estimated at approximately 350 and total returns have been highly variable in recent years.

The remaining rivers in SFA 13 that are normally assessed by a snorkeling survey (Crabbes, Middle Barachois, Robinsons, Fischells and Flat Bay) were not surveyed due to heavy rains that caused the cancellation of the snorkeling survey.

The conservation egg deposition requirements for Harry's River exceeded 100% in 2006 for the first time since monitoring began. Egg deposition for Highlands River decreased to 71% of conservation in 2006 compared with 75% attained in 2005.

Northwest Newfoundland (SFA 14A)

Two rivers were assessed in 2006: Torrent River and Western Arm Brook, using fish counting facilities.

On Torrent River returns of small salmon decreased slightly in 2006 (4048 salmon) compared to 2005 (4065 salmon). However, counts of large salmon increased significantly to 1429 which is the highest on record.

At Western Arm Brook the number of small fish increased in 2006 compared with 2005 but the number of large fish remained the same.

Egg deposition on these two rivers consistently exceeds the conservation requirement. Torrent River was estimated at 844 % conservation met and Western Arm Brook was at 446 % conservation met.

Smolt Production and Marine Survival

In Newfoundland, information on both smolt and adult salmon counts is available from five rivers: Campbellton River (SFA 4); Northeast Brook (Trepassey) (SFA 9); Rocky River (SFA 9); Conne River (SFA 11); and Western Arm Brook (SFA 14A). Thus, estimates of marine survival from smolts to adult small salmon can be derived and examined in relation to trends over time or in view of changes in management plans. The data series ranges from over 35 years at Western Arm Brook to 14 years at Campbellton River. Smolt monitoring at Highlands River (SFA 13) ended in 2000.

Smolt production

Smolt production in 2006 decreased in two of five stocks by comparison with 2005. Decreases ranged from 17% at Rocky River to 46% at Conne River where the number of smolts estimated was the lowest recorded (Fig. 8). However, mild weather coupled with high water events in early April may have contributed to an earlier sea migration and hence an underestimate of the actual number of migrating smolts at Conne. Smolt production at Western Arm Brook more than doubled from the low numbers reported in 2005 to the second highest value on record. At Campbellton River, numbers of smolts increased by 11% over 2005, but values are still low by comparison with earlier years. Where smolt production declined in 2006, returns of small salmon in 2007 are expected to be lower unless there is a compensatory increase in marine survival.

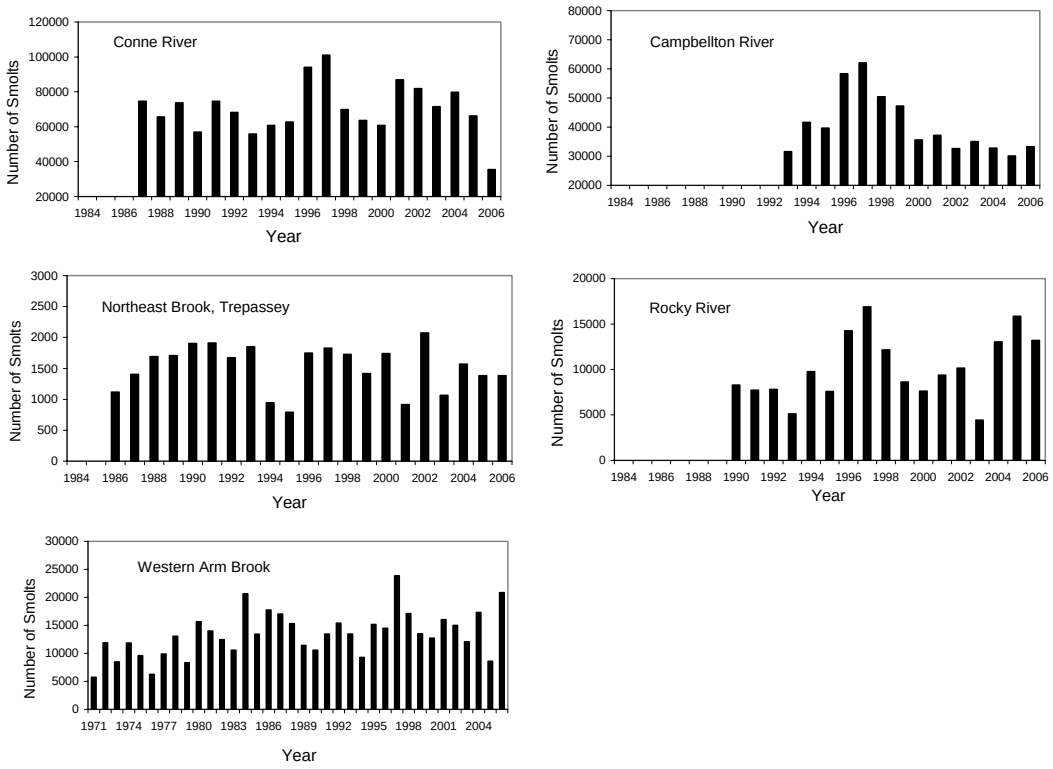

Figure 8: Trends in smolt production from various Newfoundland Atlantic salmon rivers.

Marine survival

Marine survival, corresponding to adult small salmon returns in 2006, averaged 7.2% across all five rivers, ranging from a high of 15.1% at Western Arm Brook to a low of 2.2% at Rocky River (Fig. 9). Survival increased at two south coast rivers (Conne and Northeast Brook (Trepassey)) but declined at Rocky River to the lowest value on record (2.2%). In contrast, the anomalously high survival at Western Arm Brook is strongly influenced by exceptionally low numbers of smolts recorded in 2005. At Campbellton River, survival to adult returns in 2006 (9.2%) was lower than the previous year (11.4%) but remains moderately high by comparison with other monitored rivers.

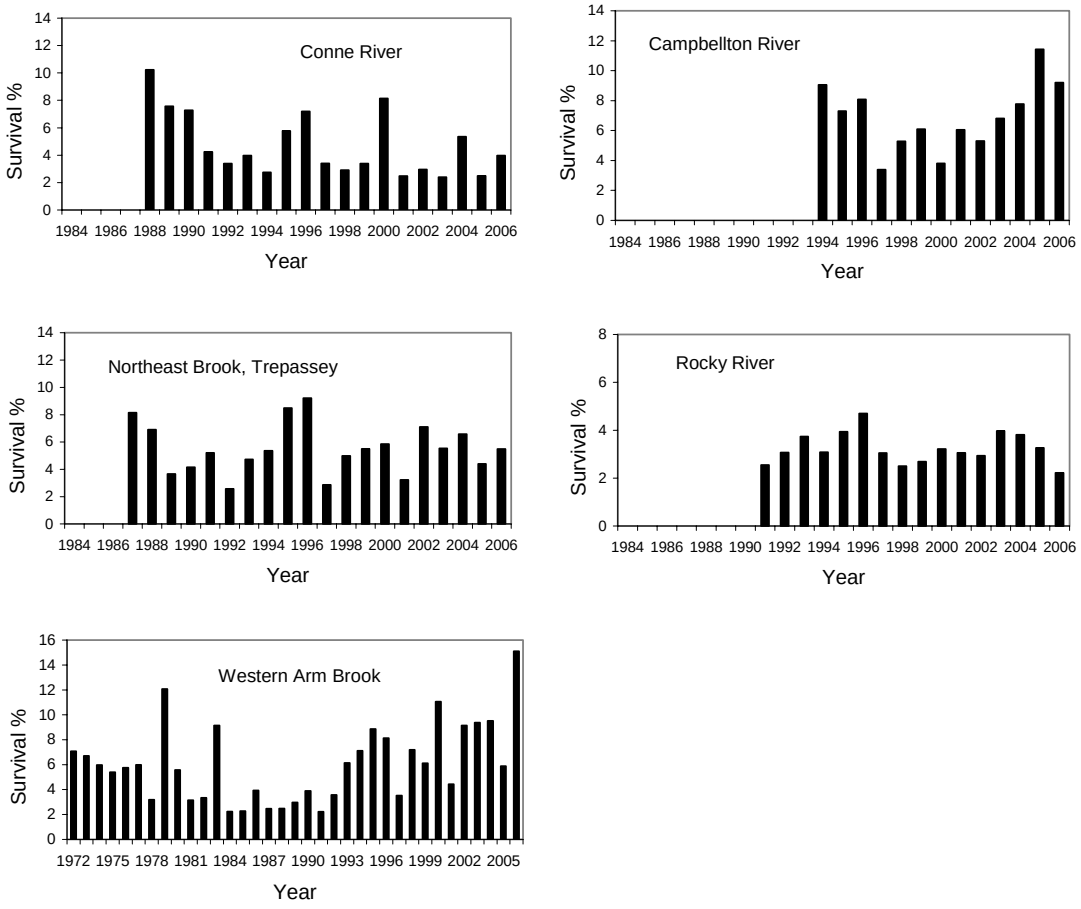

Figure 9: Marine survival rates for adult small salmon at various Newfoundland rivers. Survival rates have not been adjusted for marine exploitation in years prior to 1992 when commercial fisheries for salmon occurred. Thus, values represent survival of salmon back to the river.

Sources of Uncertainty

Unrecorded removals need to be quantified as there is some evidence that these removals could be higher than the recorded fishing mortality on some stocks. High unrecorded mortality is of particular concern at present stock levels.

Gander River met conservation requirements for the first time in five years in 2004 and again in 2005; it has achieved its requirements in only seven of 15 years. There is some uncertainty around estimates of returns from year 2000 onwards (O'Connell 2003). Observations by some anglers suggest returns were better than estimates extrapolated from Salmon Brook in certain years.

Other sources of uncertainty include current rates of egg production (fecundity) versus historical information from individual stocks, annual changes in sex ratios and variation in biological characteristics that could, collectively, impact on the reproductive potential of stocks.

Anomalously low smolt production at Western Arm Brook in 2005 and Conne River in 2006 cannot be fully reconciled based on observations over the past decade. Consequently, the highest survival ever recorded at Western Arm Brook may be an artifact of incomplete smolt

monitoring in 2005. It remains to be seen whether a similar situation will occur at Conne River pending adult salmon returns in 2007.

CONCLUSIONS AND ADVICE

Management Advice

Provision of advice on the status of salmon stocks is constrained by our inability to understand the causes of the low survival of salmon at sea.

Marine survival of Atlantic salmon stocks remains low throughout Newfoundland and Labrador even with the reductions in directed marine fisheries since 1992.

Illegal removals near-shore and in-rivers appear high in some areas. These removals should be minimized.

In **Labrador** (SFAs 1-2) concern is expressed for the apparent low abundance of larger salmon (maiden 2SW salmon).

Increased access provided by the Trans-Labrador Highway has the potential to increase angling exploitation rates on fishery resources. Careful monitoring of stock status and the compilation of accurate catch statistics are essential to ensure the long-term sustainability of the resource. In the absence of resource monitoring coupled with harvest adjustments, sustainability could be jeopardized. All sources of mortality should be examined as well as potential habitat effects.

There is no information available to ascertain whether or not the returns to English River are indicative of returns to other rivers in SFA 1. However, returns to Big Brook also in SFA 1 when last measured in 2000 were low. Caution is advised when setting the level of fishing mortality in SFA 1.

In **Northeast and Eastern Newfoundland** (SFAs 3-8), the improvement in the status of salmon in Northwest River (Port Blandford) in 2003 - 2006 appears to be attributed in part to conservation/recovery plan established for the resource since 2002.

The Exploits River watershed is managed in three sections – lower, middle and upper, which have all undergone enhancement activities ranging from fishway construction to adult and fry stockings. The lower section of the Exploits (downstream of Grand falls fishway) has achieved conservation requirements eight of the last 12 years. The middle Exploits (Grand Falls fishway to Red Indian Lake fishway) continues to improve with spawning escapements averaging over 9,000 fish since 1993. The upper Exploits (area above Red Indian lake fishway) continues to be an area of concern with respect to spawners and consideration should be given to reducing mortality to ensure that the stock in the upper section of the Exploits River is not compromised.

In **Southern Newfoundland** (SFAs 9-11), some rivers (e.g. Northeast Brook (Trepassey) and Conne River) had average returns of small salmon in 1992-2003 that were lower than returns prior to the commercial salmon moratorium. In general, stocks continue to under perform.

Specific management measures are in effect for Conne River including the requirement for an in season review.

Southwest Newfoundland (SFAs 12-13): No information is available on the salmon stocks in SFA 12. In SFA 13, particular consideration should be given to the conservation of salmon stocks in Bay St. George. Although there has been some improvement in most of these stocks recently, the sizes of the stocks are still low, particularly the important large salmon components, many of which are 2-sea-winter salmon. Concern for these stocks has been registered for more than two decades.

The low egg depositions experienced in some rivers in 2001 and 2002 could result in decreased returns in 2007 unless there is compensatory survival. Rivers in Bay St. George experience dramatic fluctuations in salmon abundance. Some, but not all, of these fluctuations may be attributed to the frequent extremes in river discharge. Poaching in some Bay St. George rivers is also believed to be a long-standing problem hampering stock recovery.

The increased management efforts with respect to conservation/recovery plans and enforcement appear to have been successful on Bay St. George Rivers. DFO should continue to support the stewardship initiatives and implement management options that will maximise the spawning population.

A concerted effort should be made to improve the number of spawners in all Bay St. George Rivers in 2007.

Conservation/Stock Recovery Strategies (Stewardship program) appear to have contributed to increased spawning stocks in targeted rivers. These strategies include directed fishing mortality when stocks are below their conservation requirements. Science only supports such directed fisheries in cases where annual in-season resource monitoring is conducted to determine whether or not the fishery is having a negative impact on the spawning stock. Also this approach enables immediate management adjustments.

Research Recommendations

Owing to the general lack of response of monitored south coast salmon rivers to the commercial salmon fishery moratorium, by comparison with other areas in Newfoundland and Labrador, it is imperative that salmon abundance monitoring be expanded to determine if other south coast stocks are similarly under-producing with respect to adult salmon abundance. Thus, efforts should be made to resume salmon counting operations at Northeast River, Placentia, and Biscay Bay River where historic information exists. In addition, with the proposed expansion of salmon aquaculture operations in Fortune Bay, salmon abundance monitoring and biological sampling should be initiated in several rivers in this area. Finally, there are no data from which to determine the conservation status of salmon in rivers along the entire south coast in the area west of Conne River.

Priority research is required to address the lack of understanding of factors contributing to low survival of salmon at sea. There is some indication that in some years higher mortality may occur near-shore. There is also a lack of understanding of factors responsible for variation in freshwater (egg-to-smolt) survival which can be similar to or even higher than the variation observed in marine survival.

In spite of recommendations on interim reference egg deposition levels for Labrador salmon rivers, it is still crucial that stock and recruit data along with smolt production be collected on at

least one Labrador river. This information could be used to confirm the recommended level of 1.9 eggs per m^2 and adjust egg requirements accordingly.

More research information is required to provide return information for other rivers in SFA 1 to determine if fluctuations in returns to English River are also occurring in other SFA 1 rivers.

OTHER CONSIDERATIONS

Environmental Conditions

Marine Environment

The North Atlantic Oscillation (NAO) index for 2006 was below normal indicating widespread warming throughout the Northwest Atlantic. Spring air temperatures were at an all time record of >4°C above average on the Labrador Coast at Cartwright and the third highest on record at St. John's where June temperatures were 3.5°C above average. Sea-ice extent during 2006 was below the long-term average for the twelfth consecutive year, the longest period of lighter-than-normal sea-ice conditions since record keeping began in the early 1960s.

Ocean surface temperatures off Cape Spear during 2005 remained at the 60-year record high of 1°C above normal set in 2004. These warmer-than-normal values continued in 2006 with values reaching 2°C above normal in early July. Oceanographic data collected during the spring and summer of 2006 on the Newfoundland and Labrador Shelf generally showed above normal temperatures with the area of the cold intermediate layer (CIL <0°C) shelf water below normal for the 12th consecutive year off Cape Bonavista.

Preliminary analyses have shown strong associations between marine environmental conditions and marine survival of salmon, adult salmon run timing and abundance of both large and small salmon. For example, salmon run-times are significantly correlated with both sea-surface temperature in eastern Newfoundland waters and spring sea-ice cover with later run-times associate with cold conditions and extensive ice cover. There is insufficient information at present to quantify these relationships. However, based on historical data the current marine environment in Newfoundland and Labrador waters is favorable for survival of Atlantic salmon.

Freshwater Environment

In past years, freshwater environmental conditions have been inferred by examining the frequency and extent that scheduled salmon rivers were closed for environmental reasons, specifically, low water levels and water temperatures. During the 2006 angling season 29 out of 158 (18.4%) scheduled rivers in insular Newfoundland were closed for varying periods of time. Most of the closures occurred in SFA 14A from mid-July to mid-August. This equates to 3.5% of the potential fishing days being unavailable, down slightly from 2005 when 5.2% of the days were affected by environmental closures. This contrasts with 2003 and 2004 when 93 and 112 rivers, respectively, were closed resulting in 15 to 20% of the angling days being affected.

Labrador rivers, in the past, had rarely if at all been closed due to low water levels and high temperatures because of the cooler climate there. This changed in 2006 when 14 out of 16 (88%) scheduled rivers were closed during the angling season. The rivers closed were all in SFA2. The closures were in the later part of July extending into most of August and part of September. In the rivers affected, there were a total of 103 fishing days lost which represents about 30% of the fishing season. Mortalities of parr and adult salmon were noted in some rivers in particular at Sand Hill and Shinneys rivers. At Shinneys, about 300 salmon and 1350 charr were physically moved in September over a barrier created by the low water.

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Appendix 1. Summary of Atlantic salmon stock status in the Newfoundland and Labrador. Conservation met refers to the actual percentage of the conservation spawning requirement achieved. Refer to footnotes for definition of characters and abbreviations.

Region			Total Returns						Conservation met (%)				Status in 2006					
			2006		2005		1992-05						Smolts Relative to:		Marine Survival Relative to:		Egg Deposition Relative to:	
River	SFA	Method	Small	Large	Small	Large	Small	Large	2006	2005	1992-05	1992-06	2005	1992-05	2005	1992-05	2005	1992-05
LABRADOR																		
Sand Hill River	2	Fe	4872	543	7007	875	3660	624	115	168	92	3 of 8 yrs					⇩	⇧
Muddy Bay Brook	2	Fe	445	17	520	20	369	23	161	190	140	4 of 5 yrs					⇩	⇧
Southwest Bk. (Paradise River)	2	Fe	326	35	858	54	376	34	110	267	127	5 of 8 yrs					⇩	⇩
English River	1	Fe	484	44	337	28	192	30	115	80	51	1 of 8 yrs					⇧	⇧
INSULAR NEWFOUNDLAND																		
Northeast Coast																		
Exploits River	4	Fw	25009	3365	27912	1966	21607	1222	48	51	40	0 of 15 yrs					⇔	⇧
Campbellton River	4	Fe	2769	328	3746	276	2772	259	270	324	237	14 of 14 yrs	⇧	⇩	⇩	⇧	⇩	⇧
Gander River *	4	EFw	13959	1927	17828	2461	17713	2335	81	111	103	7 of 15 yrs					⇩	⇩
Middle Brook	5	Fw	1153	115	1516	62	1666	120	134	163	183	15 of 15 yrs					⇩	⇩
Terra Nova River	5	Fw	2536	426	2372	313	2134	373	48	42	37	0 of 15 yrs					⇧	⇧
Northwest River (Port Blandford)	5	Fe	783	197	1210	305	605	166	58	93	50	0 of 12 yrs					⇩	⇧
South Coast																		
Northeast Brook (Trepassey)	9	Fe	76	5	69	5	77	11	184	168	199	15 of 15 yrs	⇔	⇔	⇧	⇔	⇔	⇔
Rocky River	9	Fe	352	56	427	95	314	83	42	55	42	0 of 15 yrs	⇩	⇧	⇩	⇩	⇩	⇔
Little River	11	Fe	136	26	216	15	320	39	70	99	148	7 of 15 yrs					⇩	⇩
Conne River	11	Fe	2623	170	1978	105	2871	159	110	91	124	10 of 15 yrs	⇩	⇩	⇧	⇔	⇧	⇩
Southwest Coast																		
Highlands River	13	Fe	233	114	101	153	192	126	71	75	72	2 of 14 yrs					⇔	⇔
Harry's River	13	Fe	2905	676	2495	453	1801	205	118	92	53	1 of 15 yrs					⇧	⇧
Northwest Coast																		
Torrent River	14A	Fw	4048	1429	4065	777	4556	490	844	675	686	15 of 15 yrs					⇧	⇧
Western Arm Bk	14A	Fe	1300	44	1019	43	1057	48	446	351	367	15 of 15 yrs	⇧	⇧	⇧	⇧	⇧	⇧

Assessment Methods:
Fe = counting fence
Fw = fishway count
EFw = estimated from tributary fishway count

Trend symbols:
⇩ > 10% decrease
⇧ > 10% increase
⇔ no change = ± 10%

Footnotes:
Marine survival is from smolts in year i to small salmon in year i + 1.
190 eggs/100 m2 was used to determine the conservation levels for Labrador rivers.
In some cases fewer years are included in the 1992-2005 mean for some rivers.
* Gander River was assessed using a fish counting fence from 1989 to 1999.