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Newfoundland and Labrador Region
Canadian Science Advisory Secretariat
Science Advisory Report 2007/055

STOCK ASSESSMENT OF NEWFOUNDLAND AND LABRADOR ATLANTIC SALMON - 2007

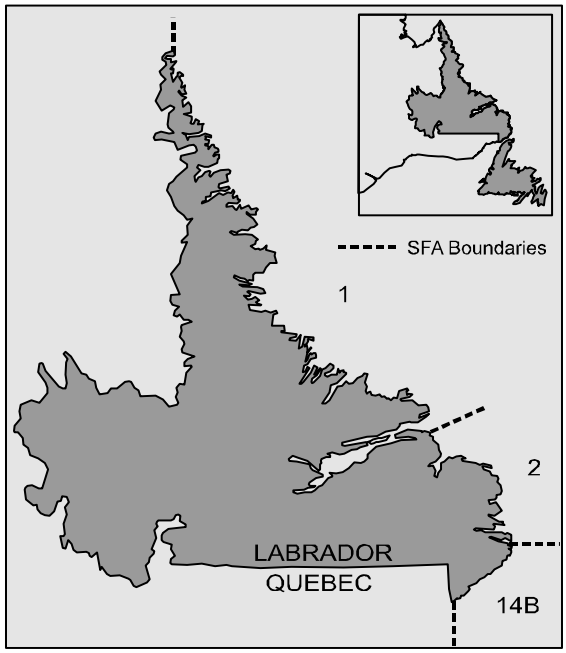

Figure 1: Labrador portion of the NL Region.

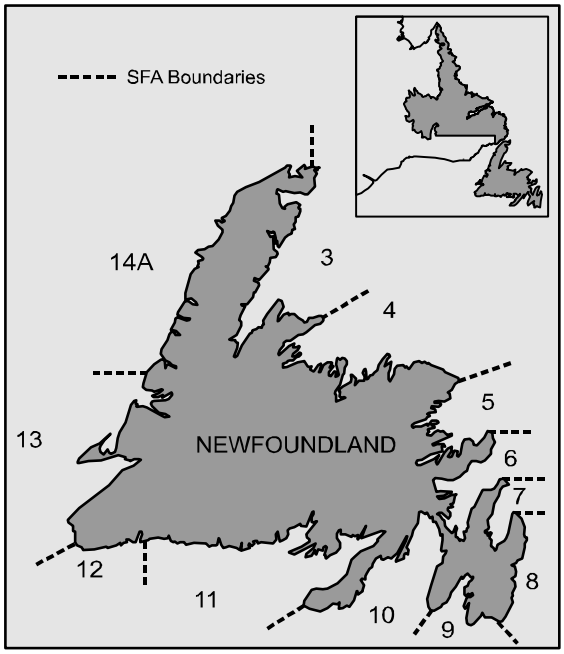

Figure 2: Newfoundland portion of the NL Region.

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.

A Regional Advisory Process (RAP) meeting was held in November 2007 in St. John's, NL to update those stocks/rivers considered during the last assessment meeting. 2007 marks the first year of a five-year Atlantic salmon management program. This resource is assessed on an annual basis.

SUMMARY

Newfoundland and Labrador Region (SFAs 1-14B)

- Low marine survival since the late 1980's continues to be the major factor affecting abundance of Atlantic salmon within the region.

- Within insular Newfoundland particularly low abundance of small salmon was noted in 2007 and 2001 however for large salmon particularly low abundance was noted in 2007 and the early 1990's.

- Within Labrador abundance of small salmon has increased since 2004 but overall abundance of large salmon has remained particularly low since the late 1980's.

Labrador (SFA 1-2 & 14B)

- In Labrador, returns of small salmon decreased or remained unchanged in 2007 compared to 2006 at all four counting facilities. The 2006 and 2007 index of abundance is below the 2005 level but above the moratorium mean.

- Numbers of large salmon declined for two rivers assessed and remained unchanged for two rivers in 2007 compared to 2006; also returns of large salmon are lower than prior to the closure of the commercial fishery. There is a concern with the low level of large salmon spawners in Labrador.

- Conservation requirements were met on 2 of 4 assessed rivers.

- In 2007, there was no change in returns (<10%) of small salmon in SFA 1 compared to 2006. However, small salmon returns increased over the previous 7 year mean. There was a decrease in returns of small salmon in SFA 2 compared to 2006 and when compared to previous year means at all three counting fences. (See Table 1)

- There were no changes in returns (<10%) of large salmon in SFA 1 compared to 2006. However, when compared to the previous 7 year mean, large salmon returns decreased. There was a decrease in returns of large salmon in SFA 2 compared to 2006 at two counting fences and no change in returns (<10%) at another counting fence. When compared to previous year means large salmon returns decreased at two counting fences and did not change (<10%) at another counting fence. Returns of large salmon still appear to be lower than prior to the closure of the commercial fishery. (See Table 1)

- Conservation spawning requirements for Labrador rivers have been defined as 190 eggs per 100 m² of fluvial habitat which is assumed to include pond habitat (Reddin et al. 2006).

Labrador SFA 1

- English River met conservation requirements for a second consecutive year.
- English River has met or exceeded conservation requirements for a second consecutive year of the nine years.

Labrador SFA 2

- Sand Hill River did not meet the conservation requirements in 2007 although it did in the previous three years out of a total of 13 years (1970-73, 1994-96, and 2002-2007).
- Muddy Bay Brook did not meet conservation requirements in 2007 although it did in the previous four years of a total of six years.
- Southwest Brook (Paradise River) has met conservation requirements for six out of nine years including 2007.
- Sand Hill River did not meet conservation requirements in 2007.
- Muddy Bay Brook did not meet conservation requirements in 2007.
- Southwest Brook (Paradise River) met conservation requirements in 2007.

Newfoundland (SFAs 3-14A)

- In Newfoundland there was a decline in returns of small and large salmon compared to 2006 and to the 1992-2006 mean. Egg depositions were for the most part below the moratorium means.
- Marine survival of smolts declined in all five monitored rivers compared to 2006 (mean 3.3%) and is the lowest overall survival recorded since the moratorium.
- Conservation requirements were met on 4 of the 13 assessed rivers.
- 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 (2SW) 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.
- Egg deposition declined or remained unchanged in all assessed rivers compared to 2006 and the 1992-2006 mean.
- 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 providing access to new habitat).
- The number of spawners in the upper Exploits has declined since 1997.

Southern Newfoundland (SFAs 9-11)

- Conservation requirements were not achieved in any of the four rivers assessed.
- Returns of small and large salmon and egg deposition declined in 2007 compared to 2006, and as compared to the 1992-2006 mean and three of four rivers set record low levels for returns of small salmon.

Southwest Newfoundland (SFAs 12 -13)

- Conservation requirements were not achieved on Harry's River in 2007.
- Returns of small and large salmon declined from 2006 with returns of small salmon being below the 1992-2006 mean. The egg deposition declined from 2006 and the 1992-2006 mean.
- 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 2007.
- Returns of small and large salmon and egg deposition declined in 2007 compared to 2006 and the 1992-2006 mean.

BACKGROUND

Recreational Fisheries

Labrador

In 2007, 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 1994-2007. For SFA 14B, C & P and logbook data were used for 1974-1993 and License Stub Return data for 1994-2007. However, the recreational data in SFAs 1, 2 & 14B for 2006 has been updated. The total angling catch for Labrador was 8282. The total angling effort was 6868 rod-days, a decrease over 2004 and 2005 values of 8302 and 8499, respectively. The catch of small salmon was 7019 (1530 retained and 5489 released) and large salmon was 1263 (213 retained and 1050 released). The proportion of salmon released by anglers in Labrador, which has been increasing over time, was 79% of the total catch. In total, there were 6539 small and large salmon estimated to be hooked and released in 2006 (Fig. 3). In SFA 1, the total catch in 2006 (small and large salmon combined) of 1711 increased by 17% compared to 2005. In SFA 2, the total catch (small and large salmon combined) in 2006 of 4516 decreased by 30% compared to 2005. Also, in SFA 14B, the total catch (small and large salmon combined) in 2006 of 2055 decreased by 25% compared to 2005. Data for 2007 are currently unavailable.

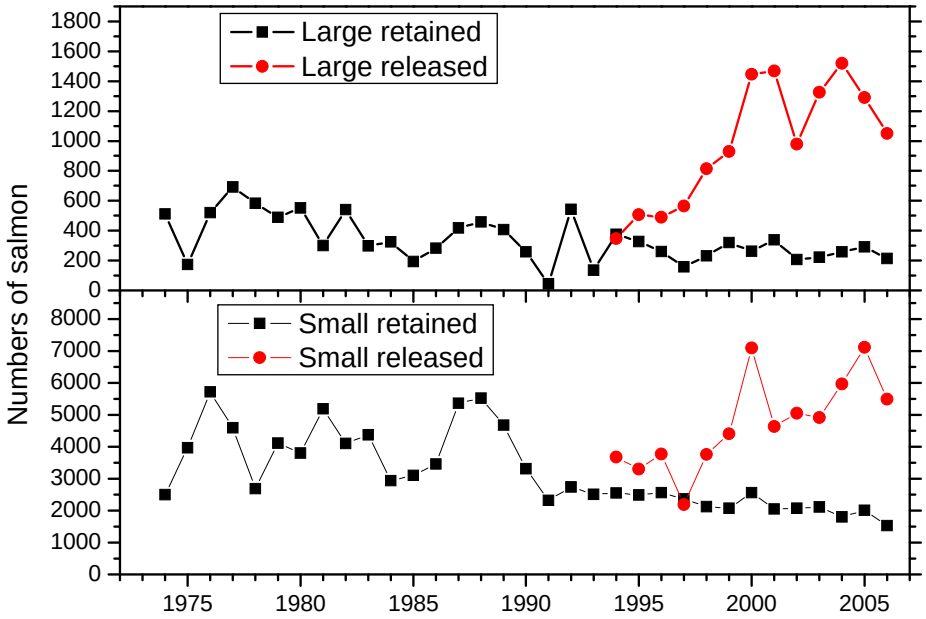

Figure 3: Angling catch statistics for Labrador SFAs 1, 2 & 14B.

Newfoundland

The recreational salmon fishery in SFAs 2-14B is managed according to the River Classification System. Five-year integrated Atlantic salmon fisheries Management Plans were introduced for Newfoundland and Labrador in 2002 and 2007 (DFO 2002 &2007). In the 2003 some rivers were reclassified as outlined in Angler's Guide for 2003 (DFO 2003).

Angling catch statistics from License Stub Returns in 2007 are not yet available. Preliminary estimates of catches are based the 2002-2006 means.

Aboriginal Fisheries

Aboriginal subsistence fisheries for salmon, Arctic charr and brook trout occurred in Labrador under communal license similar to 2006. An All Resident Subsistence Fishery for trout and charr permitted retention of up to four salmon as a by-catch in 2007 similar to 2006.

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 t 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 t annually.

Information available on Labrador subsistence fishery catches indicates that about 32 t (13,024 salmon) were harvested in 2006 of which large salmon represented 35% of the catch by weight and 22% by number. Subsistence food fishery landings in 2006 were similar to the 2005 landings of 32 t (Table 1).

Table 1. Subsistence salmon fisheries landings in Labrador as of November, 2007

	Small salmon		Large salmon		Total	
Year	Number	Weight(kg)	Number	Weight(kg)	Number	Weight(kg)
2000	5323	10,353	1352	5262	6675	15,613
2001	4789	9789	1673	6499	6478	16,288
2002	5806	11,581	1437	5990	7243	17,572
2003	6477	13,196	2175	8912	8653	22,108
2004	8385	17,379	3696	14,270	12,091	31,649
2005	10,436	21,038	2817	10,876	13,253	31,914
2006	10,057	20,575	2967	11,025	13,024	31,600

Prior to the closure of the Labrador commercial salmon fishery in 1998, landings (small and large salmon combined) averaged 369 t annually during the period from 1984 to 1989, and 111 t 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 t. By comparison, approximately 32 t of salmon were harvested in subsistence fisheries in 2006.

ASSESSMENT

Conservation Requirements for Labrador Rivers

In 2007, conservation requirements for Atlantic salmon in Labrador were discussed in detail by Reddin et al. 2006. In 2007, the interim conservation limit of 190 eggs per 100 m^2 was used in Labrador (SFAs 1&2).

Resource Status – Adult salmon

Labrador (SFA's 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 recent years, overall abundance remains relatively low when compared with levels when commercial fishing was taking place prior to 1998. The abundance of small salmon while relatively high has declined in each of the last two years. 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.

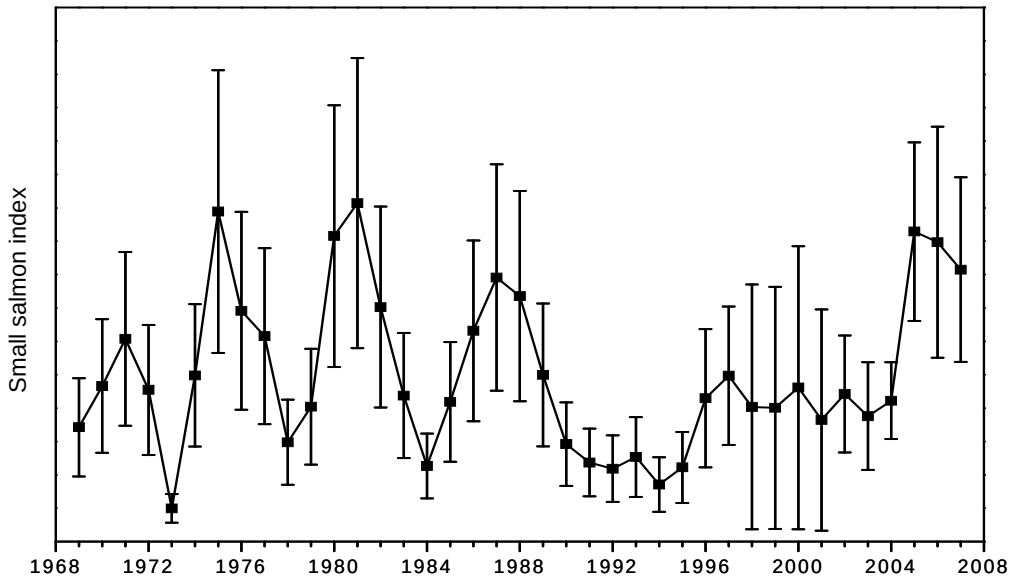

Figure 4: Trends in abundance of small Atlantic salmon in Labrador, 1969-2007. Returns have been corrected to account for marine exploitation. Vertical lines represent the 95th confidence intervals.

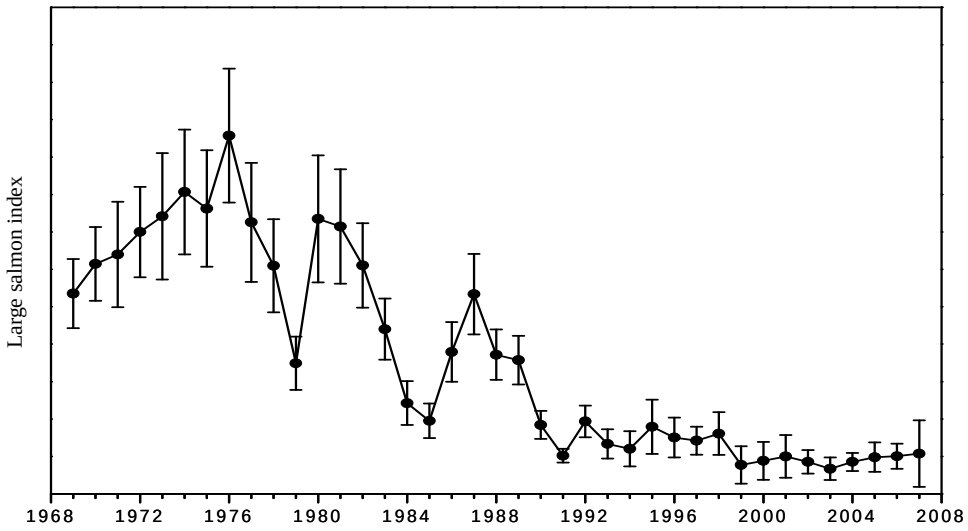

Figure 5: Trends in abundance of large Atlantic salmon in Labrador, 1969-2007. Returns have been corrected to account for marine exploitation. Vertical lines represent the 95th confidence intervals.

Northern Labrador & Lake Melville (SFA 1)

One river was assessed in SFA 1. Salmon and charr stocks were assessed from returns to the fish counting facility at English River near Postville. In 2007, there was no change in returns (<10%) of small salmon compared to 2006. However, small salmon returns increased considerably over the long-term mean. In 2007, there were no changes in returns (<10%) of large salmon compared to 2006. However, when compared to the long-term mean, large salmon returns increased.

Conservation spawning requirements for Labrador rivers have been defined as 190 eggs per 100 m^2 of fluvial habitat which is assumed to include pond habitat (Reddin et al. 2006). English River has met or exceeded conservation requirements for a second consecutive year of the nine years.

In 2007, the egg deposition relative to 2006 did not change (<10%) and when compared to the long-term mean the egg deposition had increased.

Southern Labrador (SFA 2)

Three rivers were assessed in SFA 1: Sand Hill River, Muddy Bay Brook, and Southwest Brook (tributary of Paradise River). There was a decrease in returns of small salmon compared to 2006 returns and also when compared to long-term means at all three counting fences. There was an increase in returns of large salmon compared to 2006 at Sand Hill River, a decrease at Muddy Bay Brook and no change in returns (<10%) at Southwest Brook (Paradise River). When 2007 returns are compared to long-term means large salmon returns increased at Sand Hill River, decreased at Muddy Bay Brook, and did not change (<10%) at Southwest Brook (Paradise River).

Southwest Brook (Paradise River) has met conservation requirements for six out of nine years including 2007. Muddy Bay Brook has not met conservation requirements for 2007 although it did in the previous four years out of a total of six years. Sand Hill River has not met the conservation requirements although it did in the previous three years out of a total of 13 years (1970-73, 1994-96, and 2002-2007). Conservation spawning requirements for Labrador rivers have been defined as 190 eggs per 100 m^2 of fluvial habitat which is assumed to include pond habitat (Reddin et al. 2006).

In 2007, the egg deposition relative to 2006 decreased at Sand Hill River and Muddy Bay Brook and did not change (<10%) at Southwest Brook (Paradise River). When compared to the long-term mean the egg deposition had not changed (<10%) at Sand Hill River and there was a decrease at Muddy Bay Brook and Southwest Brook (Paradise River).

Labrador Straits (SFA 14b)

No rivers were assessed in SFA 14b in 2007.

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. In the latter case,

the variability inherent in each individual river is accounted for in the modelling process. As illustrated below for Newfoundland small salmon, despite improvements in runs to many rivers in 2003 and 2004, overall abundance remains relatively low when compared with pre-moratorium levels (1984-1991) that have been corrected to account for marine exploitation. Collectively over all monitored rivers, abundance of small salmon has fallen since 2004 and is now below long term means with 2001 and 2007 anomalously low. Several rivers had record lows in 2007, with others achieving among their lowest returns since the early 1990s.

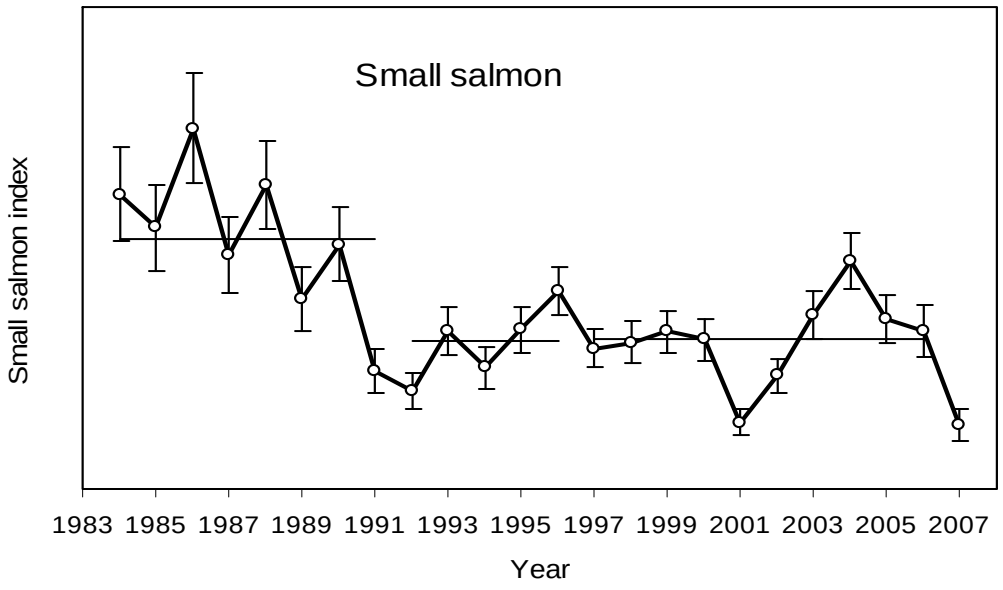

Figure 6: Trends in abundance of small Atlantic salmon in Newfoundland, 1984-2007. Returns from 1984-1991 have been corrected to account for marine exploitation. Horizontal lines illustrate the mean abundance index for the periods 1984-1991, 1992-1996, and 1997-2006. Vertical lines represent $\pm$1 standard 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 fell to moderately low levels in 2001 and 2002 then rising again from 2004 to 2006. However, large salmon abundance in 2007 fell to levels not observed since the early 1990s and was below the 1997-2006 average. Nine of 12 monitored stocks experienced declines in abundance relative to 2006. 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. As stated above these values reflect the overall pattern of abundance as determined from all monitored rivers.

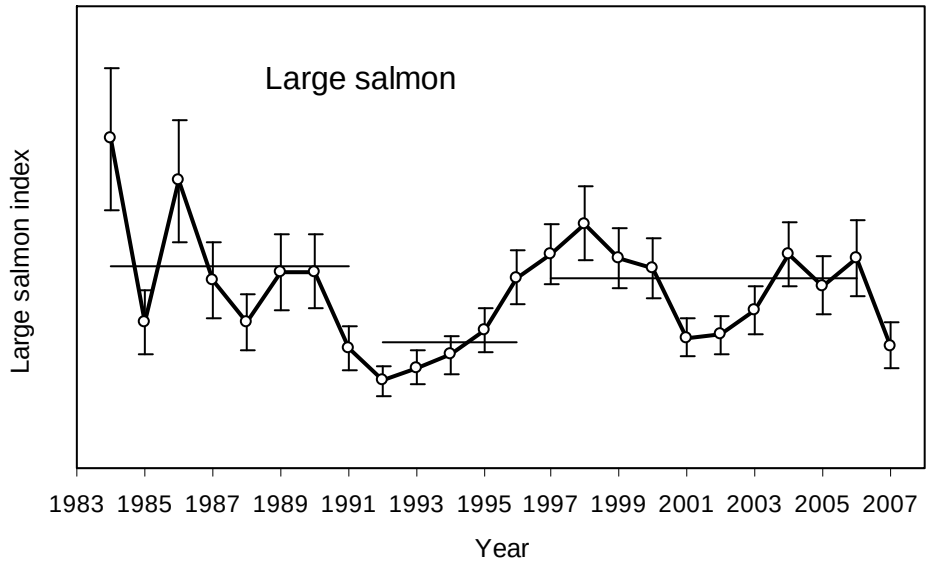

Figure 7: Trends in abundance of large Atlantic salmon in Newfoundland, 1984-2007. Returns from 1984-1991 have been corrected to account for marine exploitation. Horizontal lines illustrate the mean abundance index for the periods 1984-1991, 1992-1996, and 1997-2006. Vertical lines represent $\pm$1 standard 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 2007 was inferred from salmon returning to a fishway in Salmon Brook, a tributary.

Total returns of small salmon in 2007 decreased from those of 2006 for all rivers. Compared to the means for 1992-2006 declines were noted for Campbellton River, Gander River, Middle Brook and Terra Nova River. Returns of large salmon in 2007 declined relative to 2006 for, Gander, Terra Nova and Northwest (Port Blandford) rivers while the remainder showed increases.

Egg deposition declined on all rivers except Exploits relative to the 1992-2006 mean. Conservation spawning requirements were met only at Campbellton River and Middle Brook (Table 2). Campbellton River and Middle Brook have exceeded their conservation spawning requirements in each of the years they have been assessed during the moratorium (Table 2). Gander River has met or exceeded conservation requirements in only seven of 16 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 2007 (N = 4) include: Northeast Brook (Trepassey) and Rocky River in SFA 9, Conne River and Little River in SFA 11. 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 2007 decreased 55% at Conne River by comparison with 2006 and were the lowest recorded since monitoring began in 1986. Owing to the anomalously low smolt run at Conne River in 2006, adult returns in 2007 were expected to be low, but not necessarily at record low levels. At Northeast Brook (Trepassey) and Little River, returns in 2007 were also the lowest recorded falling 51% and 71% respectively, by comparison with 2006. Small salmon returns also declined by 51% at Rocky River to the third lowest since the moratorium began in 1992.

Regarding large salmon, abundance was also low dropping by about 40% at Northeast Brook, Trepassey and at Rocky River, while at Conne River and Little River returns of large salmon were about 70% less than 2006. Large salmon returns at Conne River were also the lowest recorded. As noted in past years, large salmon at rivers such as Conne River, are predominately alternate spawning grilse.

Conservation spawning requirements in 2007 were not achieved at any of the four monitored stocks. At Northeast Brook (Trepassey) conservation requirements were not met for the first time with only 92% attained. At Conne River 55% of conservation requirement was met while Rocky River and Little River attained 22% and 20%, respectively. Rocky River has yet to achieve conservation while Conne River has met its requirement in 10 of the past 16 years since the commercial salmon fishery moratorium began. As noted, Little River has been subject to enhancement activities but conservation requirements have been met in four of the past six years.

Southwest Newfoundland (SFAs 12-13)

No rivers were assessed in SFA 12 in 2007.

In SFA 13, Harry's River was assessed by a counting fence in 2007. Adult counts were taken at Gallants at approximately river km 25. A snorkel survey 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 on Harry's River dropped by more than 50% compared to 2006. Further, the counts also dropped compared to the commercial salmon fishing moratorium (1992-2006) mean.

No counting fence was operated on Highlands River in 2007.

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 requirement for Harry's River decreased and is estimated at only 55%.

Northwest Newfoundland (SFA 14A)

Two rivers were assessed in 2007: Torrent River and Western Arm Brook, using fish counting facilities.

On Torrent River returns of small salmon decreased slightly in 2007 compared to 2006 but counts of large salmon decreased by 63%. Also, both large and small returns decreased relative to the moratorium mean.

At Western Arm Brook the number of small fish decreased by 39% and the number of large fish decreased by 61% in 2007 compared with 2006. As well, the number of small and large fish decreased relative to the moratorium mean.

It should be noted that for Western Arm Brook and Torrent River, large fish are repeat spawners.

Egg deposition on these two rivers consistently exceeds the conservation requirement. Torrent River was estimated at 458% conservation met and Western Arm Brook was at 260% 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 15 years at Campbellton River. Smolt monitoring at Highlands River (SFA 13) ended in 2000.

Smolt production

Smolt production in 2007 increased in three of five stocks by comparison with 2006. Increases ranged from a high of 80% more smolts at Conne to a 7% increase at Campbellton River. Decreases occurred at Rocky River and Western Arm Brook where numbers of smolts fell by 6% and 21%, respectively (Fig. 8). At Campbellton River, numbers of smolts are still low by comparison with earlier years. Where smolt production declined in 2007, returns of small salmon in 2008 are expected to be lower unless there is a compensatory increase in marine survival.

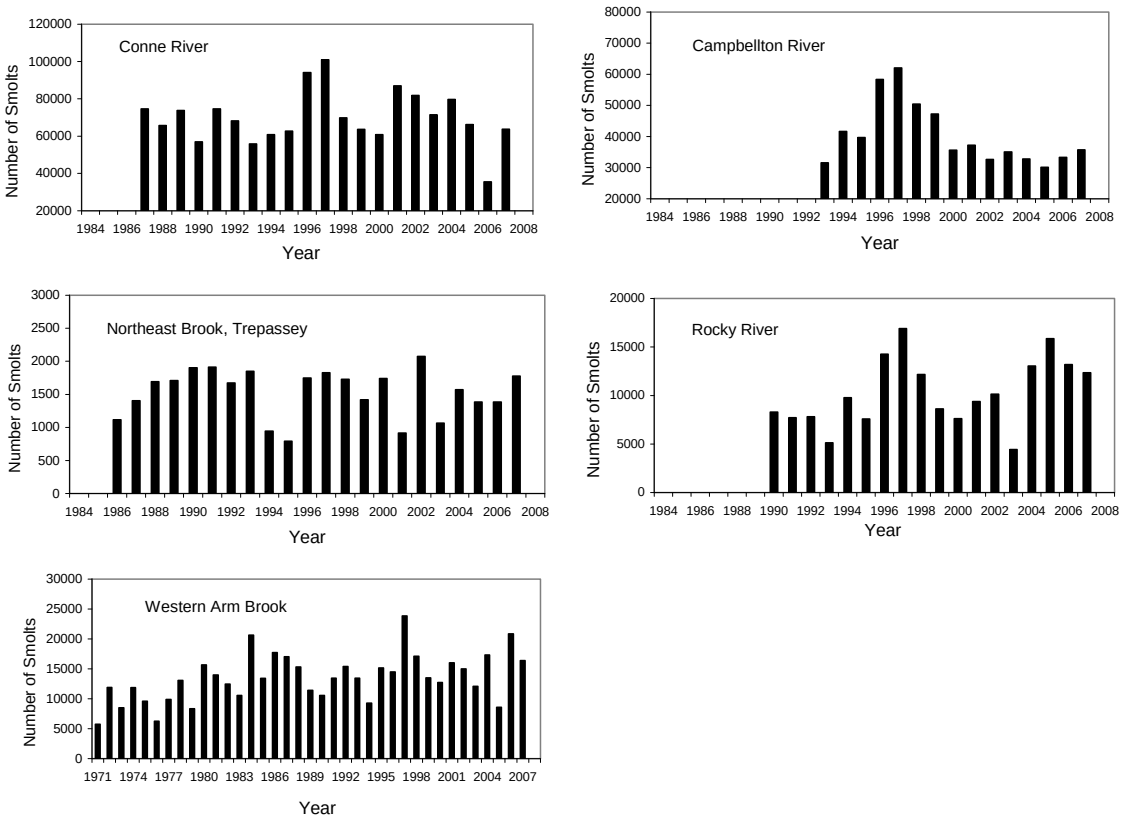

Figure 8: Trends in smolt production from various Newfoundland Atlantic salmon rivers.

Marine survival

Marine survival, corresponding to adult small salmon returns in 2007, averaged 3.3% across all five rivers, ranging from a high of 5.6% at Campbellton River to a low of only 1.3% at Rocky River (Fig. 9). In all cases, survival was lower than the previous year declining by 75% at Western Arm Brook with values 40 to 50% lower at Rocky, Campbellton, Northeast Brook, and Trepassey, relative to 2006. Survival of salmon returning to Rocky River was the lowest ever recorded while at Northeast Brook, Trepassey, marine survival was the second lowest ever. With a few exceptions, the marine survival rates have been declining in recent years (Fig. 9).

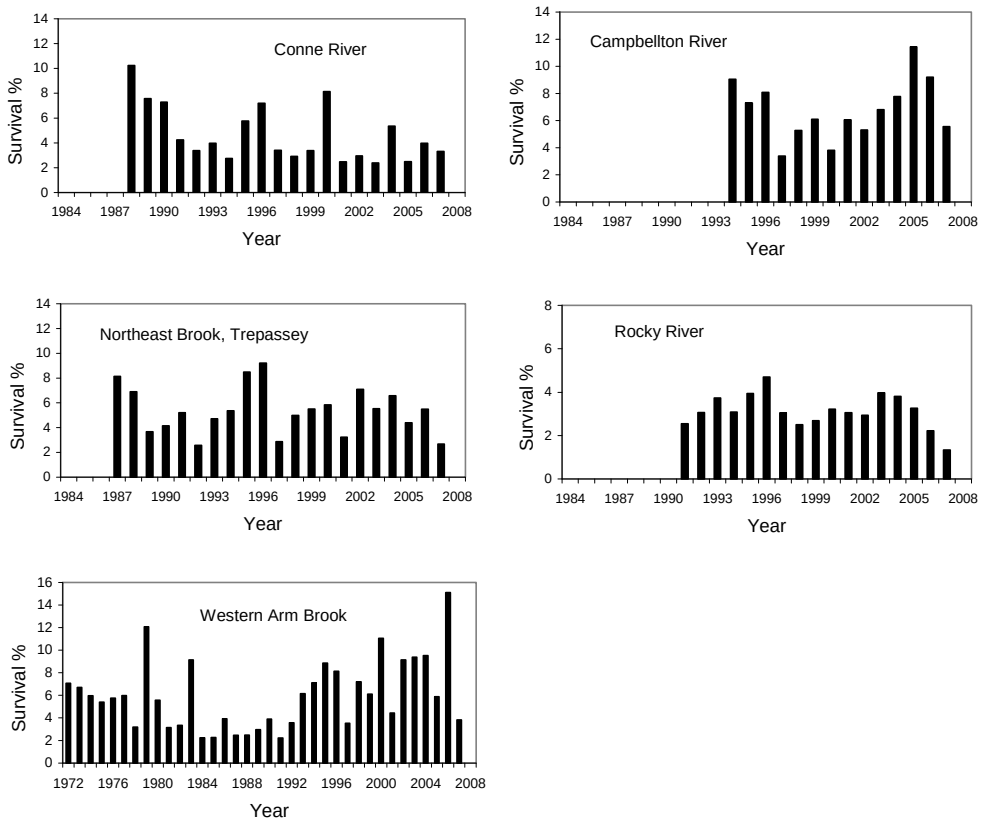

Figure 9: Marine survival rates for adult small salmon at various Newfoundland rivers. Survival rates have not been adjusted for marine exploitation in years prior to 1992 when commercial fisheries for salmon occurred. Thus, values represent survival of salmon back to the river.

A composite index of marine survival rates derived from all rivers is shown below. Here, standardized mean annual rates of survival of smolts to adult small salmon are illustrated for the period 1971 to 2006, where year represents the year of smolt migration. As observed, the standardized index of smolt survival fell dramatically for smolts that went to sea in 2006 such that it is the lowest value since the early 1980s.

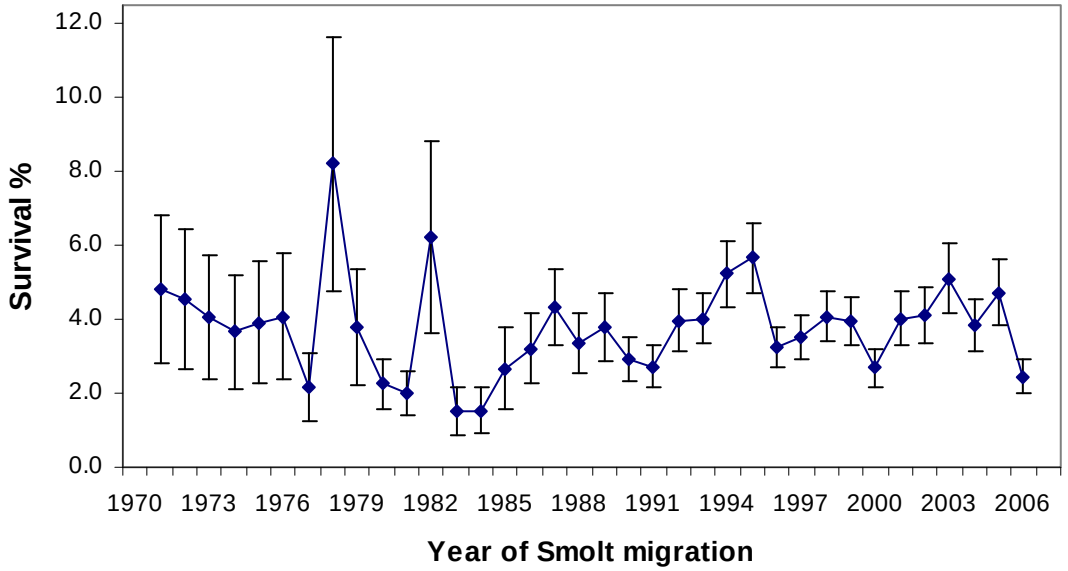

Figure 10: Standardized mean survival of smolts to adult small salmon derived from a general linear model analysis of monitored Newfoundland rivers. Year represents the year of smolt migration. Vertical lines represent one standard error about the mean. Data have not been adjusted for marine exploitation.

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 16 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.

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 & 14B) concern is expressed for the apparent low abundance of larger salmon (maiden 2SW salmon). Declines in large salmon in Labrador are similar to those experienced in other areas of Eastern Canada and Europe.

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. The returns of large salmon to English River have been consistently low over the period of time the fence has been operated. Furthermore, recent scale analysis has indicated that large salmon at English River consist of a high proportion of grilse repeat spawners. It is unknown if the few large salmon and in particular those that are MSW salmon are indicative of MSW 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 SFA 2, except for large salmon returns to Sand Hill River, returns to counting facilities have declined for the third year in a row and are now below average values recorded in 2002-2006. Egg deposition has also declined in two out of three facilities and are below the 2002-2006 means. As conservation requirements were not achieved in two out of three facilities and since returns of small salmon declined at all three facilities and large salmon at two, consideration should be given to reducing mortality.

There are no counting facilities in Lake Melville and SFA 14B with which to determine stock status. Mortality levels from the food fishery in Lake Melville including Resident, and Food Social and Ceremonials (FSCs) is considered to be high given the level of recorded landings, managers should exercise caution when setting harvest levels for 2008.

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 9000 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 and 2007 that were lower than returns prior to the commercial salmon moratorium. In general, stocks continue to under perform and three of four stocks attained record low levels of returns in 2007.

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, the sudden drop in returns is disconcerting. A continuation of this trend in 2008 could put this stock in serious trouble. The best indicator of expected returns is the run timing. A late start to the 2008 run should be a cause for concern and the Department should be ready to act if indications suggest that returns will be low again in 2008. Although there was some improvement in most of these stocks recently (2007 being the exception), 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 have contributed to the decreased returns in 2007. 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, again with 2007 being the exception. 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 2008.

Conservation/Stock Recovery Strategies (Stewardship programs) 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.

Northwest Newfoundland (SFA 14A): Western Arm Brook and Torrent River consistently exceed spawning requirements, suggesting both stocks are quite healthy. However, the total population of adult salmon in Western Arm Brook is now just over 800. Given that Western Arm Brook is still at 260% conservation caution should be used before allowing this population to be reduced to 100% conservation which translates into a population of approximately 350.

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 regions 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 2007 was above normal indicating an increase in arctic outflow in the Northwest Atlantic. Air temperatures on the Labrador Coast however remained above normal in January and February but decreased to below normal values during March, reaching a minimum of 1.5^{o}C below normal by May. The annual sea-ice extent on the Newfoundland and Labrador Shelf during 2007 was below the long-term average for the 13th consecutive year; however it increased over 2006 conditions and was the most extensive since 2003 with late spring (May and June) conditions the most extensive since 1994.

Surface water temperatures at Station 27 off St. John's Newfoundland remained above normal during January and February, were about normal in March but decreased to below normal values during spring, reaching a minimum value of 0.6^{o}C below normal in June. While summer values warmed to about 0.5^{o}C above normal, they were significantly below the near-record values observed in 2006. Oceanographic data collected during the spring on oceanographic and multi-species research surveys generally showed below normal upper water column temperatures along the east and south coast of Newfoundland. Observations from a mid-summer oceanographic survey indicated that the area of the cold-intermediate-layer (CIL <0°C) shelf water increased over 2006 but was below normal for the 13th consecutive year off Cape Bonavista. In general, sea-surface temperatures on the Newfoundland and Labrador Shelf remained above normal during the winter of 2007 (December-February), cooled to below normal values in spring but warmed to slightly above normal during the summer months.

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 (r^2=0.67) in eastern Newfoundland waters and spring sea-ice cover (r^2=0.50) with later run-times associates with cold conditions and extensive ice

cover. More research is required to quantify these relationships. However, based on historical data the marine environment in Newfoundland and Labrador waters during 2006 were favourable for survival of Atlantic salmon while the cold conditions during the spring of 2007 may have negatively impacted Atlantic salmon in this region.

Freshwater Environment

In past years, freshwater environmental conditions have been inferred by examining the frequency and extent that scheduled salmon rivers in were closed for environmental reasons, specifically, low water levels and water temperatures. During the 2007 angling season only 2 out of 158 (1.3%) scheduled rivers in insular Newfoundland were closed, the least number of rivers affected since 1993. The rivers that were closed were both in SFA 5: Salmon Brook, Port Blandford and Southwest Brook, Port Blandford. This equates to 0.1% of the potential fishing days being unavailable, down from 2006 when 3.5% of the days were affected by environmental closures and 5.2% in 2005. 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.

SOURCES OF INFORMATION

Dempson, J. B., M. F. O'Connell, D. G. Reddin, and N. M. Cochrane. 2006. Stock status summary for Atlantic salmon from Newfoundland and Labrador. DFO Can. Sci. Advis. Sec. Res. Doc. 2006/028. 39 p.

Dempson, J. B., M. F. O'Connell, and C. J. Schwarz. 2004. Spatial and temporal trends in abundance of Atlantic salmon, *Salmo salar*, in Newfoundland with emphasis on impacts of the 1992 closure of the commercial fishery. Fisheries Management and Ecology 11: 387-402.

DFO 2002. 2002-2006 Atlantic salmon integrated management plan Newfoundland and Labrador. Fisheries Management Branch, Newfoundland Region. St. John's, NL.

DFO 2003. Angler's Guide, 2003. Newfoundland and Labrador. Fisheries Management Branch, Newfoundland Region. St. John's, NL.

DFO 2002. Newfoundland and Labrador Atlantic Salmon 2002 Stock Status Update. DFO Science Stock Status Update D2-01 (2002), 20p.

DFO 2007. 2007-2011 Atlantic salmon integrated management plan Newfoundland and Labrador. Fisheries Management Branch, Newfoundland Region. St. John's, NL.

O'Connell, M. F. 2003. Uncertainty about estimating total returns of Atlantic salmon, *Salmo salar* to Gander River, Newfoundland, Canada, evaluated using a fish counting fence. Fisheries Management and Ecology 10: 23-29.

O'Connell, M. F., J. B. Dempson, D. G. Reddin, C. E. Bourgeois, T. R. Porter, N. M. Cochrane, and D. Caines. 2005. Status of Atlantic salmon (*Salmo salar* L.) stocks of insular Newfoundland (SFAs 3-14A), 2005. DFO Can. Sci. Advis. Sec. Res. Doc. 2006/058.

Reddin, D. G., J. B. Dempson, and P. G. Amiro. 2006. Conservation requirements for Atlantic salmon (*Salmo salar* L.) in Labrador rivers. DFO Can. Sci. Advis. Sec. Res. Doc. 2006/071, 29 p.

Table 2. 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 2007					
			2007		2006		1992-06						Smolts		Marine Survival		Egg Deposition	
													Relative to:		Relative to:		Relative to:	
River	SFA	Method	Small	Large	Small	Large	Small	Large	2007	2006	1992-06	1992-06	2006	1992-06	2006	1992-06	2006	1992-06
LABRADOR																		
English River	1	Fe	498	42	484	44	228	31	115	115	59	2 of 9 yrs					⇔	⇧
Sand Hill River	2	Fe	3222	693	4967	568	3824	617	89	118	95	3 of 9 yrs					↓	⇔
Muddy Bay Brook	2	Fe	240	14	445	17	384	21	90	161	144	4 of 6 yrs					↓	↓
Southwest Bk. (Paradise River)	2	Fe	303	32	326	35	370	34	102	110	125	6 of 9 yrs					⇔	↓
INSULAR NEWFOUNDLAND																		
Northeast Coast																		
Exploits River	4	Fw	21810	3856	24860	3365	21833	1365	42	49	40	0 of 16 yrs					↓	⇔
Campbellton River	4	Fe	1849	487	2768	328	2772	264	212	270	239	15 of 15 yrs	⇔	↓	↓	↓	↓	↓
Gander River *	4	EFw	11571	1243	13959	1927	17463	2308	65	82	102	7 of 16 yrs					↓	↓
Middle Brook	5	Fw	1042	141	1138	115	1633	120	127	134	180	16 of 16 yrs					⇔	↓
Terra Nova River	5	Fw	1654	240	2525	426	2163	377	29	48	37	0 of 16 yrs					↓	↓
Northwest River (Port Blandford)	5	Fe	675	94	783	197	620	169	50	58	51	0 of 13 yrs					↓	⇔
South Coast																		
Northeast Brook (Trepassey)	9	Fe	37	3	76	5	77	11	92	184	198	15 of 16 yrs	⇧	⇧	↓	↓	↓	↓
Rocky River	9	Fe	174	35	352	56	317	81	22	42	42	0 of 16 yrs	⇔	⇧	↓	↓	↓	↓
Little River	11	Fe	39	8	136	26	308	39	20	69	142	7 of 16 yrs					↓	↓
Conne River	11	Fe	1174	49	2623	170	2854	159	55	110	123	10 of 16 yrs	⇧	⇔	↓	↓	↓	↓
Southwest Coast																		
Harry's River	13	Fe	1433	293	2929	676	1876	237	55	126	62	1 of 16 yrs					↓	↓
Northwest Coast																		
Torrent River	14A	Fw	3246	524	3887	1430	4530	553	458	844	697	16 of 16 yrs					↓	↓
Western Arm Bk	14A	Fe	797	17	1300	44	1074	48	260	446	373	16 of 16 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 1992-2006 mean for some rivers.
* Gander River was assessed using a fish counting fence from 1989 to 1999.

FOR MORE INFORMATION

Contact: Chuck Bourgeois
Fisheries and Oceans Canada
PO Box 5667
St. John's, NL
A1C 5X1
Tel: (709) 772-2128
Fax: (709) 772-3578
E-Mail: bourgeoisc@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice
Newfoundland and Labrador Region
Fisheries and Oceans Canada
PO Box 5667
St. John's, NL
A1C 5X1

Telephone: (709) 772-2302/8892
Fax: (709) 772-6100
E-Mail: dale.e.richards@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

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