Fisheries and Oceans Pêches et Océans

Newfoundland Region

DFO Science

Stock Status Report D2-01(2002)

Newfoundland & Labrador Atlantic Salmon Stock Status for 2001

Background

There are 15 Atlantic salmon (Salmo salar) management areas, known as Salmon Fishing Areas (SFAs) 1-14B, in Newfoundland and Labrador (Figs. 1-2). 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. 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. Conservation requirements are established for individual rivers in insular Newfoundland (SFAs 3-14A) and Labrador Straits (SFA 14B) based on 2.4 eggs per m^2 of river rearing habitat and 368 or 105 eggs per hectare of lake habitat, depending on the river system. Conservation requirements have been established for only a few SFA 1 & 2 rivers. 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. ***Science recommends there be no fishing mortality on stocks that are below 100% of conservation.***

Summary

- Limited information from **Labrador** (Fig. 1) indicated that returns of small (< 63 cm) salmon in SFA 1 decreased while large (≥ 63 cm) salmon runs increased relative to 2000. For SFA 2, returns of small salmon were similar to 1999 runs, while large salmon increased. Overall, salmon abundance appears to be low, as evidenced by returns to two counting facilities when compared with rivers assessed in insular Newfoundland.

- In **insular Newfoundland** (Fig. 2), 21 rivers were assessed relative to conservation. Of these, 7 stocks met or exceeded spawning requirements, four rivers were between 53 and 88%, while 8 rivers achieved less than 40% of their spawning requirements. Of the latter rivers, three were located in Bay St. George (SFA 13) (Highlands, Harry's and Fischells rivers), while three others (Exploits, Terra Nova, and Rocky rivers) were enhanced stocks that have been, or are undergoing colonization programs. In general, most monitored

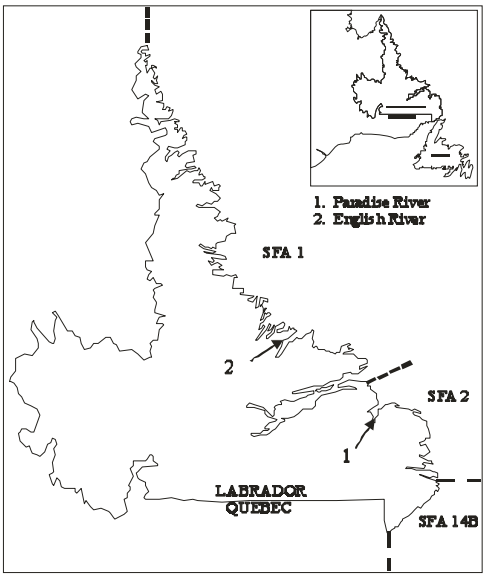

Figure 1. Map illustrating the location of Salmon Fishing Areas of Labrador, along with salmon rivers assessed in 2001. English River and Southwest Brook (Paradise River) were not assessed relative to conservation requirements.

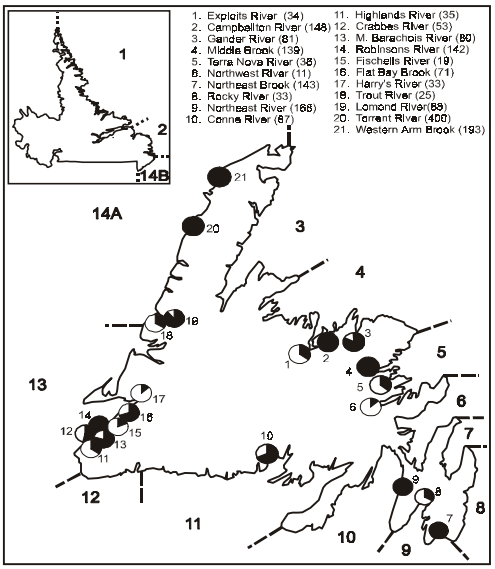

Figure 2. Map illustrating the location of the Salmon Fishing Areas of Newfoundland, along with the various salmon rivers assessed relative to conservation. The black portion of the circle and the numbers in parentheses indicate the percentage of the conservation requirement achieved for each river in 2001.

stocks declined, many dramatically, from 2000 levels and in some cases represents the third year of low returns since 1997.

- In **insular Newfoundland**, smolt production in 2001 increased from 4 to 43% at four of the five monitored stocks while declining by almost 50% at Northeast Brook (Trepassey) compared with 2000. When smolt production declines, returns of small salmon are expected to be lower unless there are corresponding increases in marine survival to compensate for the reduction in smolt numbers.

- In **Northeast and eastern Newfoundland** (SFAs 4 - 5), total returns of small salmon in 2001 were mixed: three of six monitored rivers had returns increasing by 20% (Campbellton River) to 60% (Exploits River) over the previous year, while three other stocks declined from 11% (Gander River) to 62% (Northwest River, Port Blandford) relative to 2000. All but one stock (Terra Nova) had returns lower than the 1992-2000 average. Returns of large salmon were also variable. Two stocks (Exploits, Terra Nova) increased substantially over 2000 while in the remaining rivers returns of large salmon declined from 13 to 67% with all but one (Exploits) having returns less than the 1992-2000 mean. Two of six stocks assessed met their conservation requirements in 2001. Particular concern is warranted for Northwest River that fell to 11% of conservation in 2001. Marine survival of smolts to returns of small salmon at Campbellton River increased from 3.8% in 2000 to 6.0% in 2001, similar to the average of 6.1% for the previous seven years.

- In **Southern Newfoundland** (SFAs 9 - 11), total returns of both small and large salmon in 2001 decreased over the previous year, with declines in some instances ranging from 40 to 75%. All monitored stocks had returns less than the 1992-2000 means, with the greatest declines in small salmon occurring at Northeast River (Placentia) and Conne River. Con-

servation requirements were attained only at Northeast Brook (Trepassey) and Northeast River (Placentia). Marine survival at Conne River fell to the lowest value recorded (2.5%), and was the third lowest (3.2%) in 15 years at Northeast Brook (Trepassey). In contrast, survival at Rocky River (3.1%) was similar to the previous year. Marine survival remains anomalously low given the reductions in directed marine fisheries for salmon during the past decade.

- In **Southwest Newfoundland** (SFAs 12 - 13), total returns of small salmon declined from 18 to 88% in five of seven monitored rivers with increases occurring only at Highlands and Robinsons rivers by comparison with 2000. Only one stock (Robinsons River) showed any marked improvement relative to the 1992-2000 average. Relative to 2000, total returns of large salmon similarly decreased from 3 to 84% in all but two stocks (Crabbes and Harry's Rivers) where returns were higher than the previous year. With the exception of Middle Barachois River, returns of large salmon were either similar to (Robinsons River), or well below the 1992-2000 average. Conservation spawning requirements were attained in only one of the seven stocks assessed (Robinsons River); Fischells River attained less than 20% of conservation. Marine survival of smolts to small salmon returns at Highlands River was similar to the previous year (0.6%) which had been the lowest recorded. Survival to 2SW salmon fell from 0.7% to 0.4%, the lowest value obtained since the moratorium began in 1992. Note, for rivers other than Highlands, estimates of total returns and percent conservation requirements achieved in 2001 are minimum estimates since there was evidence of an unusual late run of salmon to these rivers.

- In **Northwest Newfoundland** (SFA 14A), total returns of both small and large salmon in 2001 decreased over the previous year, with declines in some instances of more than 60%. Returns of small salmon were either the lowest (Lomond and Torrent rivers) or second lowest (Western Arm Brook) obtained since the moratorium began. All monitored stocks had returns of both small and large salmon less than the 1992-2000 means, with the greatest decline in small salmon occurring at Western Arm Brook. Conservation spawning requirements were not met at Lomond River nor Trout River. Marine survival of smolts to small salmon returns at Western Arm Brook decreased from 11.1% in 2000 to 4.4% in 2001.

Environmental Conditions

Variability in ocean conditions can influence both the survival and growth of salmon as well as the timing and location of their migrations. Similarly, conditions in freshwater influence growth, survival, length of residence in freshwater, and timing of exit to the sea. On return as adult salmon, migration and speed of upstream ascent are also influenced by water levels and temperatures. Freshwater environmental conditions can affect exploitation rates on returning adult salmon, and determine whether or not additional conservation measures are required when low water levels and warm water temperatures prevail.

A surrogate of freshwater environmental conditions can be inferred by examining the frequency and extent that salmon rivers were closed for environmental reasons. During 2001, 114 out of 158 scheduled rivers on the island (72%) were closed for varying periods of time during the summer because of low water levels and warm water temperatures, resulting in 18.2% of the potential number of fishing days available being lost.

This contrasts with 2000 when only 5.9% of the available fishing days were affected.

Meteorological and Marine Environmental Summary for 2001

Annual air temperatures throughout most of the Newfoundland and Labrador Region were above normal during 2001. Annual mean air temperatures at Cartwright for example, on the southern Labrador Shelf, warmed slightly over 2000 values to 1.4°C above normal. Air temperatures at both Goose Bay and St. John's were above normal for 8 out of 12 months by 1.35°C and 0.53°C, respectively. The North Atlantic Oscillation (NAO) index for 2001 was below normal indicating a reduced Arctic outflow to the Northwest Atlantic during the winter months. The spatial extent of the NAO atmospheric sea-level pressure fields during the winter months returned to normal, ending the anomalous eastward shift that occurred during 1999 and 2000. The index during 1999 and 2000 was similar to levels obtained during the cold early 1990s; however, the colder-than-normal environmental conditions usually associated with a high NAO index did not influence the northwestern side of the Atlantic. Sea ice on the southern Labrador and Newfoundland Shelves generally appeared late and left early, resulting in a shorter duration on the Newfoundland Shelf than usual. The total sea ice coverage in these areas during 2001 decreased slightly over conditions in 2000, remaining below average during both winter and spring.

The annual water column average temperature at Station 27 off St. John's, Newfoundland, for 2001, warmed slightly over 2000 values, remaining above the long-term mean for the third consecutive year. Surface temperatures were above normal for 9 out of 12 months, with anomalies reaching a maximum of near 1.8°C during October, with an annual value of about 0.5°C above normal (Fig. 3). The March, April and May surface values were below normal. Bottom temperatures at Station 27 were above normal (by about 0.5°C) during all 12 months of 2001. The vertically averaged salinity for the summer months at Station 27 decreased over 2000 values to fresher than normal conditions. Annual temperature anomalies at 10-m depth in the inshore regions along the east and northeast coast of Newfoundland during 2001 were slightly cooler than 2000 values but remained above normal by between 0.5°-0.8°C. Temperatures on the south coast of Newfoundland however decreased to below normal values during 2001 compared to the above normal trend experienced from 1998 to 2000. The areas of the summer cold intermediate layer (CIL) of water <0°C on the eastern Newfoundland Shelf decreased over 2000 values to the lowest observed in 23 years.

In general, the below normal trends in temperature and salinity, established in the late 1980s on the Newfoundland Shelf reached minima in the early 1990s. This cold trend began to moderate during the mid 1990s and by 1996 temperature conditions were above normal over most regions. During 1997 to 1999 ocean temperatures continued above normal over most areas with 1999 being one of the warmest years in the past couple of decades. In general, during 2000 and 2001, ocean temperatures decreased over 1999 values, but remained above normal over most areas, continuing the warm trend. Ocean salinity however, on the inner Newfoundland Shelf during most of the 1990s, continued to be slightly below the long-term average during most years. An examination of the survival of salmon returning to several rivers in the Newfoundland Region were found to be significantly correlated with upper layer ocean temperatures at a time lag of one year, indicating a possible environmental effect on the marine survival of smolts.

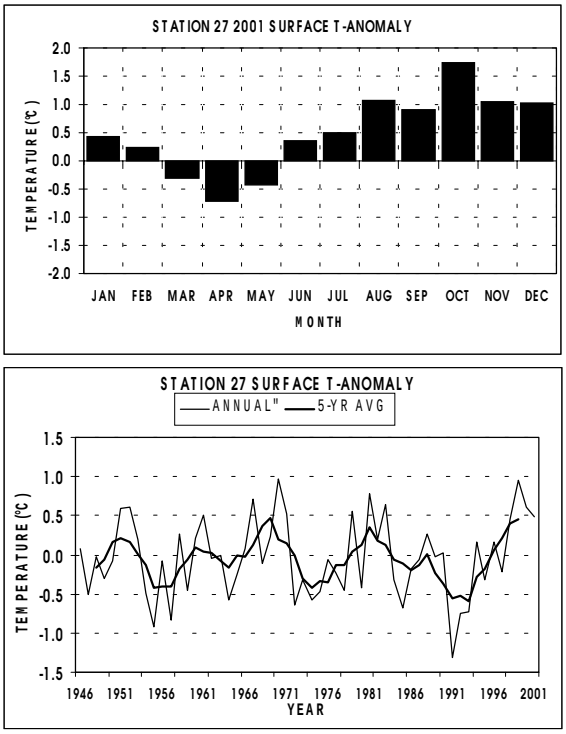

Fig. 3. Monthly surface temperature anomalies at Station 27 during 2001 (top) and the annual surface temperature anomalies and their 5-year running means (bottom).

The Fishery

Atlantic salmon were harvested by Aboriginal peoples, and recreational fishers including commercial outfitters. Also, DFO allowed a food fishery for residents in Lake Melville and coastal southern Labrador. Aboriginal salmon fisheries occurred in Labrador (Fig. 1) under communal licence with the Labrador Inuit Association, and by an agreed quota with the Innu Nation for the Lake Melville and Davis Inlet areas. The moratorium on commercial Atlantic salmon fishing, which began in 1992 in Newfoundland (Fig. 2), the Straits area of Labrador in 1997 (SFA 14B) and extended to all of Labrador (SFAs 1 – 2) in 1998, continued in 2001.

The three-year integrated salmon management program introduced in 1999 continued in its final year, 2001. This management strategy introduced a river classification system to insular Newfoundland and the straits area of Labrador that provided for different retention levels based upon the actual or perceived status of individual stocks. Retention levels ranged from a seasonal limit of 6 fish on Class I rivers, to no retention and catch-and-release only on Class IV rivers. Some rivers were closed to all angling and were not assigned a class number. Further details of the management plan can be found in Anon. (1999).

In 2001, approximately 14,400 salmon angling licences were sold (preliminary figure). Although nine rivers were closed to angling for conservation reasons in 2001, the potential number of fishing days available in insular Newfoundland was the highest since 1977.

Labrador

The salmon angling fishery in Labrador mainly occurs on rivers in coastal areas draining into the Labrador Sea and is pursued by guests at outfitting camps, both private and commercial, as well as by non-camp recreational fishers. Angling catch data for SFAs 1 and 2 are derived, as in previous years, from records kept by DFO River Guardians and log books from outfitting camps. For SFA 14B rivers, catch statistics for 1996 - 2001 were derived from the License Stub Return System (2001 data are preliminary). The 2001 salmon angling fishery for all Labrador rivers opened on 15 June and closed on 15 September. Although retention of one large salmon was allowed in all rivers in SFA 1 and some in SFA 2, there was no retention of large salmon allowed for the entire season in SFA 14B. In SFA 1, anglers could retain four salmon for the season, one of which could be large, while rivers in SFA 14B and some rivers in SFA 2 were included in the

river classification system with a seasonal retention limit of two small salmon. The change in retention in SFA 2 was made for those rivers crossed by the new Trans Labrador Highway which opened rivers to access by vehicle from the Island of Newfoundland. Rivers without direct access from the highway were left at four salmon as was previously the case.

In 2001, the total Labrador angling catch was 9,222 Atlantic salmon, considerably higher than levels experienced in other years, other than 2000 which was higher. The catch of small salmon was 7,330 (1,929 retained and 5,401 released) and large salmon was 1,892 (326 retained and 1,566 released) (Fig. 4). In SFA 1, the total catch (small and large salmon combined) of 1,238 decreased 16% over 2000. In SFA 2, the total catch of 4,715 was 22% lower than in 2000. The total catch of 3,269 salmon in SFA 14B was 3% lower than in 2000. The proportion of salmon released by anglers in Labrador, which has been increasing over time, was 76% of the total catch, and was the highest value reported to date. In total, there were 6,967 small and large salmon reported to have been hooked and released in 2001. Information available on food fishery catches indicates that about 19 tonnes (7,100 salmon) of salmon were harvested in 2001, of which large salmon represented 49% of the catch by weight and 33% by number.

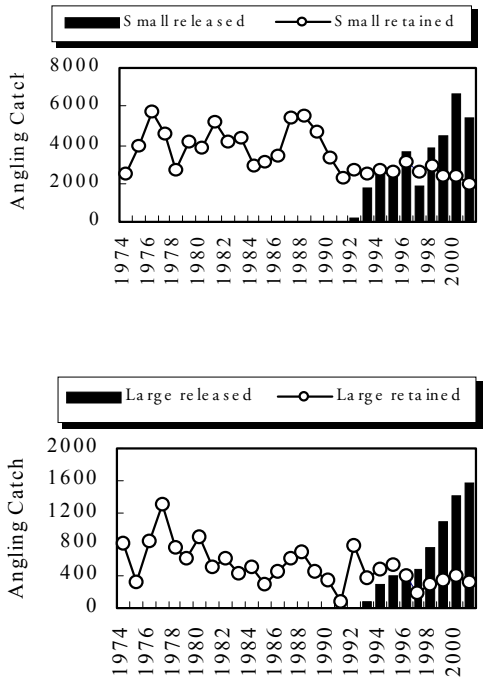

Figure 4. Angling catch statistics of small and large Salmon in Labrador SFAs 1, 2, and 14B, 1974-2001. Data for 1996-2001 are from the Licence Stub Return System for SFA 14B (data for 2001 are preliminary) and DFO statistics for SFAs 1 and 2, 1974-2001.

Newfoundland

A preliminary estimate of 33,860 small salmon (18,606 retained and 15,252 released) were angled in insular Newfoundland SFAs 3-14A in 2001, a decline of 19% from 2000 and 16% from the 1992-1996 mean, among the lowest in recent years (Fig. 5). An estimated 2,903 large salmon were released, 7% less than in 2000 but 46% higher than the mean for 1992-1996. The proportion of hooked-and-released salmon has increased in recent years (range of 0.41 to 0.52 since 1997). The number of small salmon retained in 2001 decreased by 9% from 2000 and by 35% from the mean for 1992-1996, one of the lowest catches in recent years.

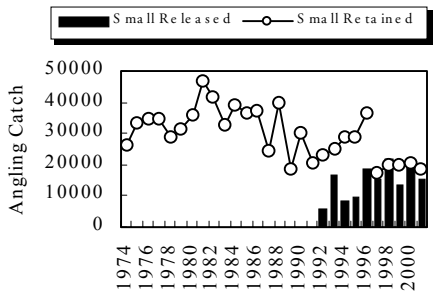

Figure 5. Angling catches of small salmon in Newfoundland SFAs 3 – 14A, 1974 – 2001. Data for 1997 – 2000 are from the Licence Stub Return System and information for 2001 is preliminary.

Resource Description

The status of Atlantic salmon stocks is determined from the annual returns to rivers and spawning escapements relative to conservation requirements, abundance of smolts, and trends in marine survival. During the commercial salmon fishery moratorium (1992 - 2001), the numbers of small and large salmon returning to rivers in insular Newfoundland are considered to be the total numbers of salmon produced. Spawning escapements are determined by accounting for known removals of salmon, including recreational harvests, broodstock collections, in-river mortalities, or scientific samples. The status of stocks is assessed on the basis of the proportion of the conservation egg deposition achieved in a given year. For Atlantic salmon rivers, conservation requirements are based on 2.4 eggs per m^2 of river rearing habitat, and 368 or 105 eggs per hectare of lake habitat, depending on the river system (105 eggs per hectare is used for some northwest coast and some Labrador rivers). The conservation requirements are considered to be threshold reference points, but may not be appropriate for Labrador salmon stocks. In 2001, 23 rivers were assessed (Table 1).

Counts of smolts and small salmon enable estimates of marine survival to be derived. Examination of survival trends over time can provide insight into the effects of management measures designed to reduce marine exploitation, or, alternatively in the absence of fisheries, allow estimates of natural survival to be calculated. Counts of smolts also provide a direct measure of freshwater production, and in some cases, allow estimates of egg-to-smolt survival to be derived and evaluated in relation to current conservation requirements. In Newfoundland, information on smolts and adult salmon counts has been available from six rivers: Campbellton River (SFA 4); Northeast Brook (Trepassey) (SFA 9); Rocky River (SFA 9); Conne River (SFA 11); Highlands River (SFA 13); Western Arm Brook (SFA 14A) (Figs. 6 and 7), although smolts were not monitored at Highlands River in 2001. Smolts were also monitored for a single year (2000) at Northwest River (Port Blandford). With the exception of Highlands River, information on marine survival pertains to returns of small salmon only. Small salmon are predominantly maiden 1SW fish, but could also include some repeat spawners and possibly some 2SW salmon.

Resource Status

Labrador (SFAs 1-2, 14B)

There are now 28 scheduled salmon rivers in SFAs 1 – 2 and 14B, although many other rivers contain populations of Atlantic salmon. 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 commercial fishery (1997) were about

47 t. By comparison, approximately 19 t of salmon were harvested in food fisheries in 2001. The status of English River (SFA 1) and Southwest Brook (Paradise 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.

Status

Returns of small salmon to English River in 2001 decreased over 2000, totalling 224 versus 367 the previous year. In contrast, returns of large salmon rose from 15 to 41. For Southwest Brook, a tributary of Paradise River, returns of 323 small salmon were similar to the 331 salmon counted in 1999, while for large salmon returns declined from 43 in 1999 to 32 in 2001. It should be kept in mind that there was a food fishery by resident fishers in 2001 that did not exist in 1999. The fishery would have harvested salmon outside of the river and these fish are not included in the returns.

Conservation spawning requirements for Labrador rivers have not been defined and the use of 2.4 eggs per m^2 of fluvial habitat and 105 eggs per hectare of pond habitat may not be appropriate. In the absence of suitable conservation requirements, an alternate means by which comparisons of salmon abundance can be made is to scale numbers of salmon returning to the river relative to the watershed drainage area. In doing this, Big Brook has a value of 1.43 salmon per km^2 in 2000 compared with 1.96 for English River in 2001. By comparison, Sand Hill River, SFA 2, assessed from 1994 to 1996, has a value of 2.6 salmon per km^2. In contrast, two rivers on the northern peninsula of Newfoundland in SFA 14A (Torrent River, Western Arm Brook) have corresponding conservation requirements in the range of 1.1 to 2.0 salmon per km^2 of drainage, but with actual returns that are far in excess of conservation, now ranging between 8 and 10 salmon per km^2. Clearly, efforts are needed to derive acceptable reference or conservation levels for Labrador rivers as there is uncertainty in reconciling and comparing different reference criteria from these approaches.

There is no information available to assess salmon stocks in SFA 14B.

Management concerns

Despite the potential production of salmon from the vast amount of habitat available in Labrador, relatively little information is available on the status of individual stocks. Information on salmon abundance in 2001, obtained from two rivers in Labrador suggests Labrador stocks are low by comparison with some rivers assessed in Newfoundland. It is also noted that salmon returns to Labrador rivers are not reflective of total production since salmon are harvested in various marine food fisheries.

The Trans Labrador Highway has the potential to increase exploitation substantially on southern Labrador salmonid stocks by providing anglers easier access to rivers. Restrictions to angling imposed by the classification system are good and efforts should continue to put regulations in place to prevent excessive fishing mortality on salmon populations.

Collectively, harvests in the Labrador Inuit Association and Innu food fisheries, along with those in the resident food fishery in Lake Melville and southern Labrador, plus the angling fishery throughout Labrador have the potential to increase exploitation rates. 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, sustainability could be jeopardized as the status of the resource cannot be determined.

Northeast and eastern Newfoundland (SFAs 3 – 8)

There are 60 scheduled rivers in SFAs 3 – 8. Prior to the closure of the Newfoundland commercial salmon fishery, landings (small and large salmon combined) averaged 422 t annually during the period from 1984 to 1991. The largest (Exploits) and third largest (Gander) rivers in Newfoundland occur in the area. Specific rivers assessed (N = 6) include: Exploits, Campbellton, and Gander rivers in SFA 4, and Middle Brook, Terra Nova River and Northwest River (Port Blandford), in SFA 5 (Fig. 2). With the exception of Gander River, all stocks were assessed directly from salmon returning to fish counting facilities. The status of Gander River in 2001 was inferred from salmon returning to a fishway on Salmon Brook, a tributary of Gander River system.

In 2001, a water quality study was done at Campbellton River in relation to the presence of the smolt and adult counting fences near to the water supply for the Town of Campbellton. The results of analysis of samples collected from above and below the fences, prior to fence installation and from previous years indicated that the counting fences made no difference to the water quality in Campbellton River.

Status

Total returns of small salmon in 2001 were mixed: three of six monitored rivers had returns increasing by 20% (Campbellton River) to 60% (Exploits River) over the previous year, while three other stocks showed declines ranging from 11% (Gander River) to 62% (Northwest River) relative to 2000. All but one stock had returns lower than the 1992-2000 average. Returns of large salmon were also variable. Two stocks (Exploits, Terra Nova) increased substantially over 2000, while in the remaining rivers, returns of large salmon declined from 13 to 67% with all but one stock having returns less than the 1992-2000 mean. Conservation spawning requirements were met at Campbellton River and Middle Brook (Fig. 2, Table 1). Terra Nova River is still in a colonization phase as additional habitat was opened up in 1985 effectively doubling the amount of accessible rearing area on this system. Most of the habitat in Northwest River (Port Blandford) was opened to anadromous salmon in the late 1940s and enhancement programs (colonization) have been carried out on the Exploits River since the late 1950s.

Campbellton River and Middle Brook have exceeded their conservation spawning requirements in each of the years that the rivers have been assessed during the moratorium (Table 1). Gander River has met or exceed conservation in 5 of 10 years, while Terra Nova River, Exploits River and Northwest River (Port Blandford) have yet to achieve conservation. Particular concern is warranted for Northwest River where the percent of conservation requirements achieved fell to 11% in 2001.

Marine survival

At Campbellton River (SFA 4), estimates of marine survival are available since the 1993 smolt class. During the period 1993 - 1995, survival to subsequent small salmon returns averaged 8.1%. This fell to 3.4% with adult returns in 1997. Marine survival increased from 3.8 in 2000 to 6.0% in 2001 (Fig. 6). The single estimate of survival at Northwest River (Port Blandford), obtained from smolts monitored in 2000 with adult small salmon returns in 2001, was only 1.3%.

Smolt production

Smolts produced in Campbellton River have ranged from a high of 62,050 in 1997 to a low of 31,577 in 1993. Smolt production in 2001 (37,170) increased marginally (4.4%) over 2000, but is still 21% less than the 1993 to 1999 mean ($\bar{x}$ = 47,292), and 40% lower than the peak production in 1997 (Fig. 7). Returns of adult small salmon in 2002 could be similar to that of 2001 if marine survival remains the same.

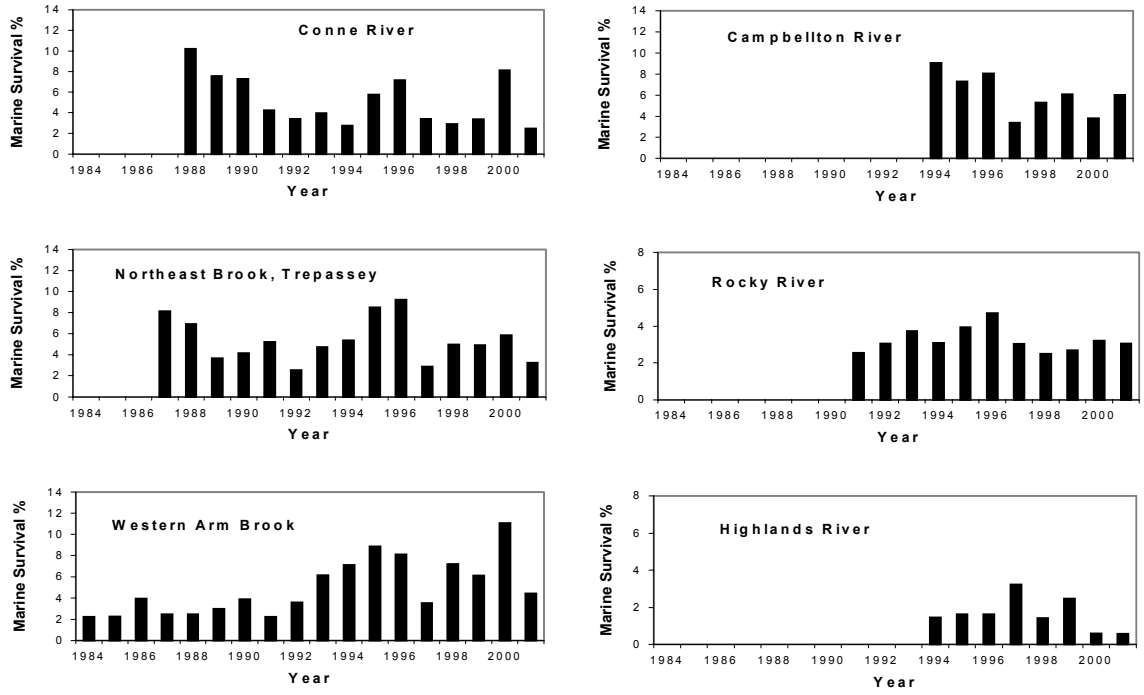

Figure 6. Marine survival rates for small salmon at various Newfoundland rivers. Survival rates have not been adjusted for marine exploitation in years prior to 1992 when commercial fisheries for salmon occurred.

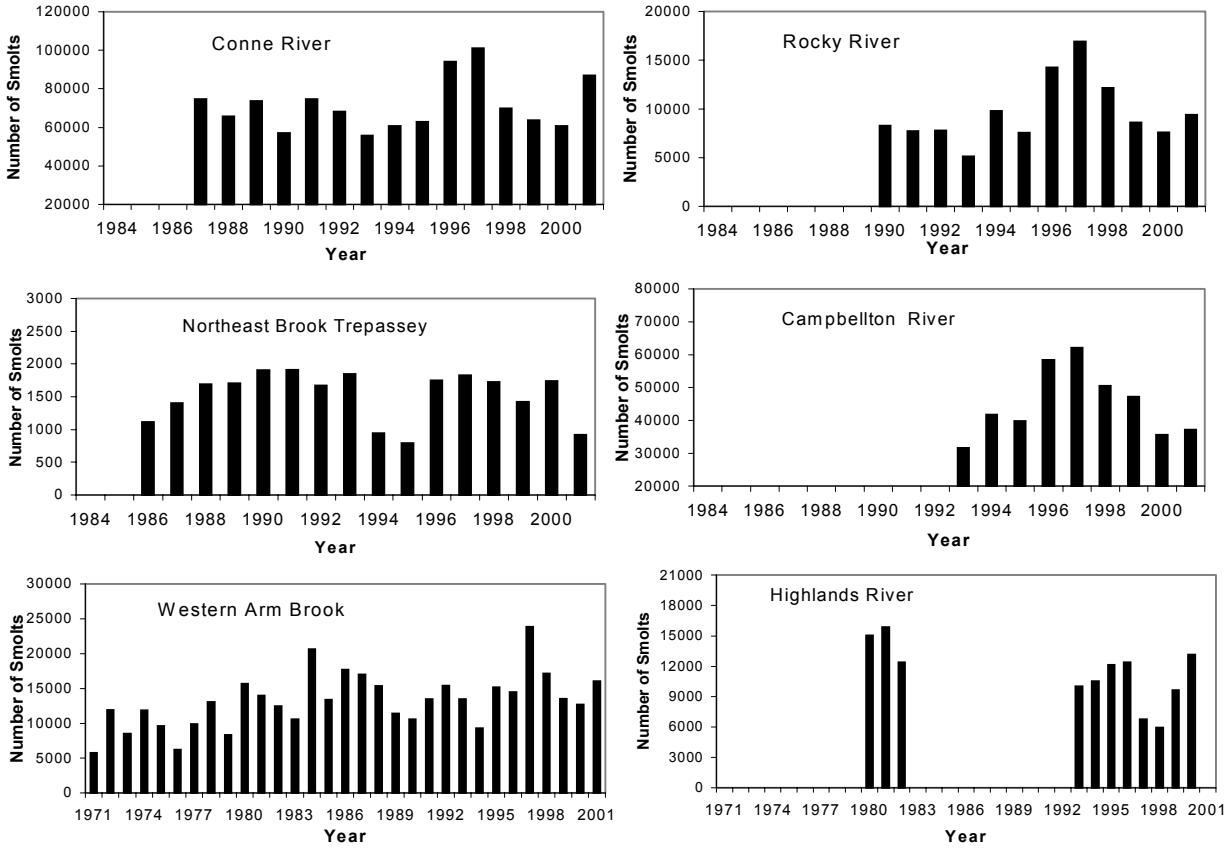

Figure 7. Trends in smolt production from various Newfoundland rivers.

Management concerns

Salmon returns to Northwest River (Port Blandford) have fallen dramatically and are now critically low, and if this level is maintained, genetic diversity of the stock could be affected. Only 11% of the conservation spawning requirement was achieved in 2001. It is recommended that there be no mortality on stocks that are below 100% of their conservation requirements. Marine survival is monitored at Campbellton River only, and survival rates, while higher than in the previous year, still remain low. The decline in returns to some monitored rivers in 2001 represents the third time in five years where abundance has been anomalously low, given the reductions in directed marine fisheries for Atlantic salmon.

South Newfoundland (SFAs 9 - 11)

There are 50 scheduled rivers in SFAs 9 - 11. Prior to the closure of the Newfoundland commercial salmon fishery, landings (small and large salmon combined) averaged 87 t annually during the period from 1984 to 1991. Owing to the proximity of the populated St. John's and Mount Pearl areas, some rivers in SFA 9 are often subject to substantial angling pressure.

Specific rivers assessed (N=4) include: Northeast Brook (Trepassey) and Rocky River in SFA 9, Northeast River (Placentia) in SFA 10, and Conne River in SFA 11 (Fig. 2). Spawning escapements of the above stocks are assessed using fish counting facilities while mark-recapture methods are used to survey smolt production at Conne River.

Status

Total returns of both small and large salmon in 2001 decreased over the previous year, with declines in some instances ranging from 40 to 75%. All monitored stocks had returns less than the 1992-2000 means, with the greatest decline in returns of small salmon occurring at Northeast River (Placentia) and Conne River.

Conservation spawning requirements in 2001 were attained only at Northeast Brook (Trepassey) and Northeast River (Placentia) (Fig. 2), with these rivers exceeding their requirements in each year during the moratorium. At Conne River, percent of conservation requirements attained fell to 67%, but this stock has met its requirement in 7 of the past 10 years, while Rocky River has yet to achieve conservation. Enhancement initiatives (colonization) have been in progress on Rocky River since the 1980's. Some south coast rivers (e.g. Northeast Brook (Trepassey), and Conne River) had average returns of small salmon during 1992 - 2001 that were lower than returns prior to the closure of the commercial salmon fishery.

Marine survival

For Northeast Brook (Trepassey) (SFA 9), a late run river, marine survival has varied among years (Fig. 6). Peak survivals from the 1994 and 1995 smolt classes were in excess of 8 and 9%, respectively. Marine survival declined to 2.9% in 1997, similar to that obtained in 2001 (3.2%).

Rocky River (SFA 9) is a recently colonized river. Fry stocking occurred from 1984 to 1987, and again in 1995 and 1996. In 1987, 140 adult salmon were also stocked. Marine survival averaged 3.5% from the 1990 to 1995 smolt classes, about 23% lower than that reported for Conne River. Marine survival has remained low, with values no higher than 3.2% during the past five years (Fig. 6).

For Conne River (SFA 11), survival also varies widely among years (Fig. 6). Prior to 2000, the highest survivals occurred with the 1987 to 1989 smolt classes (7-10%), and again with the 1995 smolt class (7.2%). Following a period of abnormally low survivals, survival increased to the second highest value recorded (8.1%) with adult returns in 2000, but fell dramatically to 2.5%, the lowest recorded, in 2001.

Smolt production

Smolt production in 2001 increased at both Rocky and Conne rivers in 2001 while falling by 47% at Northeast Brook (Trepassey). The increased smolt production at two rivers could translate into higher adult returns in 2002 even if survival remains at the same level as the previous year. In contrast, a corresponding increase in marine survival will be required in order for adult small salmon returns in 2002 to meet or exceed the 2001 value at Northeast Brook (Trepassey). There is evidence from two rivers that increased egg depositions do not necessarily result in increased smolt production.

Management concerns

Some south coast rivers had average returns of small salmon during 1992 - 2001 that were lower than returns prior to the closure on the commercial salmon fishery. Marine survival remains low given the reductions in directed marine fisheries. Consideration could again be given to opening Conne River to angling in 2002 as the conservation requirement, while dropping in 2001, has been achieved in six year of the past seven years. Total returns, however, are still low by comparison with the 1986 to 1989 period.

Southwest Newfoundland (SFAs 12 - 13)

There are 26 scheduled rivers in SFAs 12 and 13. SFA 12 was closed to commercial fishing in 1984. Prior to the closure of the Newfoundland commercial salmon fishery in 1992, landings (small and large salmon combined) in SFA 13 averaged 52 t annually, during the period from 1984 to 1991. Humber River, the second largest river in Newfoundland, and several rivers in Bay St. George, produce significant numbers of large salmon, many of which are maiden multi-sea-winter fish. Historically, rivers in Bay St. George produced among the highest recreational catches of salmon in insular Newfoundland, although in recent years, a number of these stocks remain at low levels of abundance. Highlands River and Cooks Brook remained closed to recreational fishing in 2001.

Specific rivers assessed (N=7) include: Highlands River, Harry's (Pinchgut) River, Crabbes River, Middle Barachois Brook, Fischells Brook, Robinsons River, and Flat Bay Brook (Fig. 2). Crabbes, Fischells, Robinsons, Middle Barachois and Flat Bay rivers were assessed by snorkelling surveys, Highlands River by a fish counting facility, while the status of Harry's River was inferred from salmon returning to a counting fence on Pinchgut Brook, a tributary of Harry's River.

Status

With the exception of Highlands and Robinsons rivers, total returns of small salmon in 2001 declined anywhere from 18% (Middle Barachois) to almost 90% (Fischells River) relative to 2001. Only Robinsons River had returns that were substantially higher than the 1992-2000 means. Total returns of large salmon were also generally low falling 3% at Highlands River to 80% or more at Fischells and Pinchgut brooks. In contrast, returns of large salmon at Crabbes and Harry's Rivers improved over those in 2000. Unusually late returns of salmon such as occurred at Highlands River, may also have occurred in other Bay St. George rivers. Thus, estimates of total returns obtained from surveys carried out in mid-August are likely minimum values. Conservation requirements were achieved at only Robinsons River with 35% of the requirement or less attained at Highlands, Fischells and Harry's rivers (Fig. 2, Table 1). Since 1992, the levels of conservation requirements attained at Harry's River have not exceeded 52%. Similarly, Crabbes and Middle Barachois rivers have yet to attain conservation requirements since the moratorium began in 1992.

Marine survival

For Highlands River, counts of smolts and adult salmon are available from two time periods: 1980 - 1982 and 1993 – 2000; monitoring was discontinued in 2001. Highlands River is characterized by a run of two-sea-winter (2SW) salmon as well as a few 3SW fish. Marine survival from smolts to small salmon returns was less than 1% in the early 1980's, but increased to 1.6% from the 1993 - 1995 smolt classes reaching a high of 3.2% for 1997 returns (Fig. 6). Returns of small salmon in 2000 and 2001 coincided with the lowest marine survival rates obtained (0.6%). Survival to 2SW salmon fell from 0.7% to 0.4%, the lowest value obtained since the moratorium began in 1992.

Management concerns

Particular consideration should be given to the conservation needs of salmon populations in SFA 13. Concern about the status of these stocks has been registered for more than two decades. With few exceptions, spawning populations in Bay St. George rivers still remain low, particularly Highlands, Harry's, Middle Barachois, and Crabbes rivers with Fischells River showing dramatic fluctuations varying from well above conservation requirements (2000) to levels approximating only 20% in 2001.

Poaching on some rivers in Bay St. George is believed to be a long-standing problem hampering stock recovery.

Highlands River has been closed to angling since 1978 and, with the exception of returns in 1997, there has been little sign of recovery as the level of conservation attained in 2000 and 2001 were among the lowest recorded.

Northwest Newfoundland (SFA 14A)

There are 22 scheduled rivers in SFA 14A. Prior to the closure of the Newfoundland commercial salmon fishery, landings (small and large salmon combined) averaged 37 t annually during the period 1984 - 1991. Compared with rivers in other SFAs in Newfoundland, salmon returns and spawning escapements in SFA 14A have improved the greatest since 1992.

Specific rivers assessed (N=4) include: Trout River, Lomond River, Torrent River, and Western Arm Brook (Fig. 2). All stocks are assessed using fish counting facilities.

Status

Total returns of both small and large salmon in 2001 at Western Arm Brook, Torrent and Lomond rivers decreased over the previous year, with declines in some instances exceeding 60%. Returns of small salmon were either the lowest (Lomond and Torrent rivers) or second lowest (Western Arm Brook) obtained since the moratorium began. All monitored stocks had returns of both small and large salmon less than the 1992-2000 means, with the greatest declines in small and large salmon occurring at Western Arm Brook. Conservation spawning requirements were not met at Lomond River (88% achieved) for the first time since the moratorium began.

With the exception of Lomond River in 2001, spawning escapements continue to exceed conservation requirements at these rivers and have done so in all years since the closure of the commercial salmon fishery (Fig. 2, Table 1). Lomond and Torrent rivers are enhanced (colonized) stocks. Trout River, assessed for the first time in 2001, attained only 25% of its conservation requirement.

Marine survival

Estimates of marine survival are available for 29 years at Western Arm Brook (SFA 14A). Survival has ranged from a low of 2.2% for small salmon returns in 1984 and 1991, to a high of 12.1% in 1979. In general, higher marine survivals occurred subsequent to the closure of the commercial fishery in 1992, but similar or even higher values were ob-

tained in some years prior to the closure of fisheries. Marine survival was 11.1% for small salmon returns in 2000, the second highest value reported (Fig. 6) but fell dramatically to 4.4% in 2001.

Smolt production

Since the moratorium began in 1992, numbers of smolts produced at Western Arm Brook have ranged from a high of 23,845 (1997) to a low of 9,283 (1994) (Fig. 7). Smolt production in 2001 increased 26% from 2000, but was still 33% lower than the peak run in 1997. Owing to the higher smolt production in 2001, returns of adult small salmon in 2002 could increase even if marine survival remains the same low level. There is evidence from one river that increased egg depositions do not necessarily result in increased smolt production.

Management concerns

Despite lower salmon abundance in 2001, some rivers in SFA 14A have returns that still greatly exceed their conservation requirements, thus there is opportunity for increased harvest. Consideration could be given to changing the classification of some additional rivers.

Salmon by-catch in bait nets

Salmon by-catch in bait nets was examined by various means in 2001 including the determination of the number of licenced fishers (3600), a phone survey to determine how many actively fished (46%, with herring used primarily for the lobster fishery followed by crab and cod) and the level of by-catch experienced, fishing experimentally with bait nets and traditional herring nets, surveying catches in bait nets by DFO Enforcement Staff and studying tag returns of repeat spawners from Campbellton River.

Experimental fishing was carried out in three locations and a total of six salmon, one sea trout and one post-smolt salmon were caught. Seven of the salmonids were caught in nets set perpendicular to shore and one in a nets set parallel to the shoreline. Numbers of salmon found during patrols in pelagic nets by DFO Enforcement Staff and the numbers of salmon reported during a herring index fishery were very low. The overall conclusion, based upon information presented, was that low numbers of salmon were caught in the legal bait-nets set for herring. However, with salmon stocks currently at low abundance, it is important that by-catch of salmon be minimized where practical. It is recommended that bait nets be permitted at sites where salmon are not abundant, nets should be set at least one fathom below the surface and parallel to shore where possible, with consideration given for removing gear in mid-June in areas where no bait requirement exists. It should be noted that setting of nets parallel to shore may increase the by-catch of pollock in south coast areas while reducing the catch of herring.

Sources of Uncertainty

Unlike the situation for many marine species, the status of Atlantic salmon stocks is, for the most part, based on near-to-absolute counts of salmon returning to freshwater, which reduces uncertainty as to the abundance of the resource. In a few cases, abundance is estimated using mark-recapture techniques or by inference from salmon returning to a tributary of a major river (Gander and Harry's rivers). Marine survival of smolts to adult salmon is highly variable making predictions of subsequent abundance difficult.

As noted in past years, **losses, both in legal (e.g. bait nets, sentinel fisheries etc.) and illegal fisheries have not been quantified and may be significant in some areas.** In order to address part of this issue, the effect of the bait fishery on returning Atlantic salmon in inshore Newfoundland was investigated in 2001, as noted above.

There is also a lack of current data on sex ratios, sizes and fecundity of large salmon in spawning es-

capements in Newfoundland and Labrador. Although the majority of spawners are small salmon, for which adequate data are available, updating and improving biological characteristic data for large salmon would reduce uncertainty with respect to egg deposition contributions from this component.

In recent years, the License Stub Return System has become the main source of angling data for stock assessment purposes. This system is still evolving and relies heavily on the co-operation of anglers to maximize the precision of estimates of catch and effort. **Currently, the return rate of angling logs is around 40%, far short of the desired 90%.**

Even though angling catch rates are often used as indices of salmon abundance, analyses for most rivers with counting facilities have shown no meaningful relationships between catch rate and abundance. Uncertainty exists between the comparability of the current Licence Stub Return System information and the historic data collected through the River Guardian System. It is important that efforts continue to improve the return rate of licence stubs and to validate the information from the stubs through creel surveys. Estimates of total returns of salmon to monitored rivers require the annual collection of angling data below fish counting facilities.

Rainbow trout escapees

Concern over the potential interactions of escaped farmed salmonids with wild stocks has been raised internationally, nationally, and regionally (see DFO 1999). In Newfoundland, Bay d'Espoir (SFA 11) is the site of an aquaculture industry utilizing rainbow (steelhead) trout, Atlantic salmon, and at times brook trout. Numbers of each of these species have escaped sea cages and entered rivers such as Conne River in Bay d'Espoir. Rainbow trout have also been confirmed in Biscay Bay River and Holyrood Pond (SFA 9), Long Harbour River, Grand Bank Brook, Little River, Grey River and Grandy's Brook in SFA 11.

In recent years, rainbow trout, presumably aquaculture escapees, have also been observed or angled in other parts of Newfoundland including: LaPoile River and Garia Brook (SFA 12), Crabbes River, Flat Bay Brook, Robinsons River and Humber River (SFA 13), Parsons Pond and Portland Creek (SFA 14A). In 2001, a spawning population was confirmed on Trout River (SFA 14A), however, the origin or length of time they have been established is unknown at this time. While evidence exists of escaped farmed salmonids entering rivers, impacts on wild salmon stocks have not been examined, and although suspected, the lack of directed research in Atlantic Canada has prevented definitive conclusions (DFO 1999).

Outlook

Short-term

Stock-specific quantitative forecasts for salmon returns in the year 2002 were not made. With the exception of Northeast Brook (Trepassey), smolt output from all other monitored rivers increased in 2001. Thus, if there is no decrease in marine survival rates, returns of small salmon in 2002 could be somewhat improved.

Long-term

In insular Newfoundland, the number of spawners in certain areas has, in general, been relatively high in recent years due to the closure of the commercial fishery. Natural mortality rates in the freshwater and marine environments will continue to play a major role in determining population sizes but events similar to those experienced in 2001 could be repeated. Without an increase in freshwater and/or marine survival rates, adult salmon populations will not increase. As such, if the frequency of years with anomalously low numbers of returning spawn-

ers increases, the long-term conservation of stocks could be of severe concern. Rivers of particular concern are those along the south coast of Newfoundland (SFAs 9 – 11), Bay St. George (SFA 13) and Northwest River (Port Blandford, SFA 5).

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Table 1. Summary of Atlantic salmon stock status in the Newfoundland Region. Conservation met refers to the actual percentage of the conservation spawning requirement achieved, but is intended as a reference level only for Labrador stocks, when reported. Refer to footnotes for definition of characters and abbreviations.

Region / River	SFA	Map Index	Method	Total Returns in 2001 Small	Total Returns in 2001 Large	Conservation met (%) 1997	1998	1999	2000	2001	1992 - 2001	Status in 2001: Smolts Relative to 2000	Smolts Relative to 1992 - 00	Marine Survival Relative to 2000	Marine Survival Relative to 1992 - 00	Egg Deposition Relative to 2000	Egg Deposition Relative to 1992 - 00
Labrador																	
English River	1	1	Fe	224	41												
Southwest Brook (Paradise River)	2	2	Fe	323	32												
Newfoundland																	
Northeast Coast																	
Exploits River	4	1	Fw	19665	1347	24	49	47	22	34	0 of 10 yrs					⇧	⬇
Lower	4		Fw			72	146	134	64	98	7 of 10 yrs					⇧	⬇
Middle	4		Fw			15	35	35	16	27	0 of 10 yrs					⇧	⇔
Upper	4		Fw			10	6	7	2	5	0 of 10 yrs					⇧	⬇
Campbellton River	4	2	Fe	2151	119	187	311	326	153	148	9 of 9 yrs	⇔	⬇	⇧	⇔	⇔	⬇
Gander River **	4	3	EFw	12517	1682	62	110	119	86	81	5 of 10 yrs					⇔	⬇
Middle Brook	5	4	Fw	1285	62	196	301	222	218	139	10 of 10 yrs					⬇	⬇
Terra Nova	5	5	Fw	2230	331	32	32	33	27	36	0 of 10 yrs					⇧	⇔
Northwest River (Port Blandford)	5	6	Fe	102	50	46	42	28	27	11	0 of 7 yrs					⬇	⬇

Assessment methods: Fe = counting fence; Fw = fishway count; Sc = snorkel count; MR = mark-recapture; EFw = estimated from tributary fishway count in 2001

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

Map index numbers refer to text figure and legend

Marine survival is from smolts in year i to small salmon in year i + 1

* Use of 240 eggs/100 m2 as a conservation requirement for Labrador rivers may not be appropriate, and is used here only as a reference level

** Gander River was assessed using a fish counting fence from 1989 to 1999.

Table 1. Continued. Summary of Atlantic salmon stock status in the Newfoundland Region. Conservation met refers to the actual percentage of the conservation spawning requirement achieved, but is intended as a reference level only for Labrador stocks, when reported. Refer to footnotes for definition of characters and abbreviations.

Region / River	SFA	Map Index	Method	Total Returns in 2001 Small	Total Returns in 2001 Large	Conservation met (%) 1997	1998	1999	2000	2001	1992 - 2001	Status in 2001: Smolts Relative to 2000	Smolts Relative to 1992 - 00	Marine Survival Relative to 2000	Marine Survival Relative to 1992 - 00	Egg Deposition Relative to 2000	Egg Deposition Relative to 1992 - 00
Newfoundland																	
South Coast																	
Northeast Brook (Trepassey)	9	7	Fe	56	8	135	256	248	216	143	10 of 10 yrs	⬇	⬇	⬇	⬇	⬇	⬇
Rocky River	9	8	Fe	233	60	56	54	39	34	33	0 of 10 yrs	⇧	⇔	⇔	⇔	⇔	⬇
Northeast River (Placentia)	10	9	Fw	313	65	486	484	260	449	168	10 of 10 yrs					⬇	⬇
Conne River	11	10	Fe	1503	140	125	150	122	210	67	7 of 10 yrs	⇧	⇧	⬇	⬇	⬇	⬇
Southwest Coast																	
Highlands River	13	11	Fe	75	65	105	59	49	34	35	1 of 9 yrs			⇔	⬇	⇔	⬇
Crabbes River	13	12	Sc	687	180	95	53	66	63	53	0 of 6 yrs					⬇	⬇
Middle Barachois Bk	13	13	Sc	934	141	95		43	95	80	0 of 5 yrs					⬇	⇧
Robinsons River	13	14	Sc	1972	223	91		118	135	142	3 of 5 yrs					⇔	⇧
Fischells Brook	13	15	Sc	214	44	44	23	110	142	19	2 of 5 yrs					⬇	⬇
Flat Bay Brook	13	16	Sc	1134	199	89		149	167	71	2 of 5 yrs					⬇	⬇
Harry's River	13	17	Fe	1007	30	50	49	49	29	33	0 of 10 yrs					⇧	⬇
Northwest Coast																	
Trout River	14A	18	Fe	36	15					25	0 of 1 yrs						
Lomond River	14A	19	Fw	660	77	161	151	181	140	88	9 of 10 yrs					⬇	⬇
Torrent River	14A	20	Fw	2633	445	797	924	680	657	400	10 of 10 yrs					⬇	⬇
Western Arm Brook	14A	21	Fe	563	28	200	625	370	567	193	10 of 10 yrs	⇧	⇔	⬇	⬇	⬇	⬇

Assessment methods: Fe = counting fence; Fw = fishway count; Sc = snorkel count; MR = mark-recapture; EFw = estimated from tributary fishway count in 2000

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

Map index numbers refer to text figure and legend

Marine survival is from smolts in year i to small salmon in year i + 1

* Use of 240 eggs/100 m2 as a conservation requirement for Labrador rivers may not be appropriate, and is used here only as a reference level