Fisheries and Oceans Pêches et Océans

Newfoundland Region

DFO Science

Stock Status Report D2-01(2001)

Newfoundland & Labrador Atlantic Salmon Stock Status for 2000

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 the rivers of 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. The 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. No habitat based conservation requirements have been established for SFAs 1 & 2. 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 mortality on stocks that are below 100% of conservation requirements.

Summary

- Limited information from **Labrador** (SFA 1) indicated that returns of small salmon increased while large salmon runs declined relative to 1999. Overall, salmon runs appear to be low, as evidenced by returns to two counting facilities when compared with rivers assessed in insular Newfoundland.

- In **insular Newfoundland**, 20 rivers were assessed relative to conservation. Of these, 12 stocks met or exceeded their requirements, three rivers were between 63 and 95% of conservation, while five rivers achieved less than 40% of their spawning requirements. Of the latter rivers, two were located in Bay St. George (SFA 13) (Highlands River and Harry's River), while three others were enhanced stocks that have been, or are undergoing colonization programs.

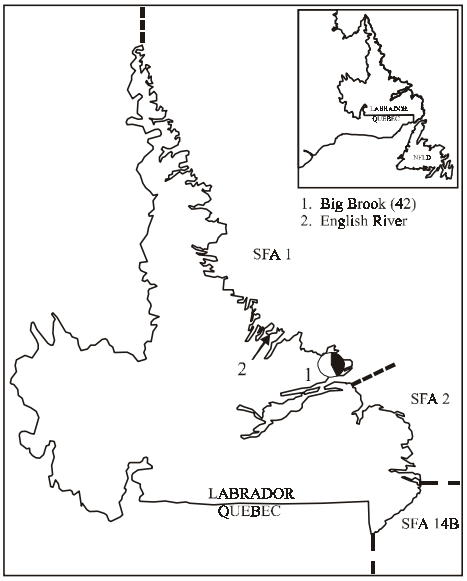


Figure 1. Map illustrating the location of the Salmon Fishing Areas of Labrador, along with salmon rivers assessed in 2000. The black portion of the circle and the numbers in parentheses indicate the percentage of the conservation reference level achieved in 2000. English River was not assessed relative to conservation requirements.

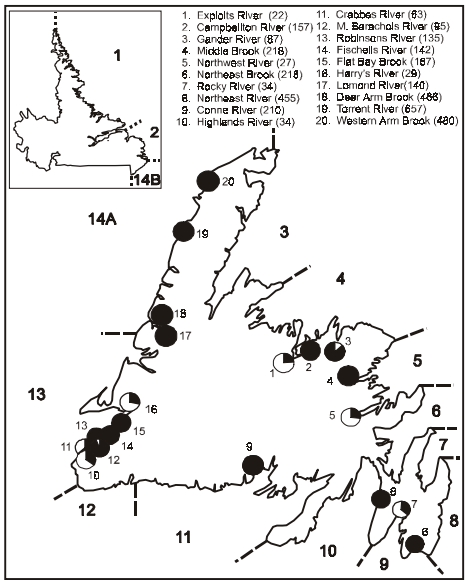


Figure 2. Map illustrating the location of the Salmon Fishing Areas of Newfoundland, along with the various salmon rivers assessed relative to conservation. The black portion of the circle and the numbers in parentheses indicate the percentage of the conservation requirement achieved for each river in 2000.

- In **insular Newfoundland**, smolt production in 2000 decreased from 5 to 25% at four of the six monitored stocks compared with 1999. Smolt production has declined consistently each year since 1997 on these rivers, which may be indicative of other rivers in Newfoundland. Where smolt production has fallen, returns of small salmon are expected to decline from 2000 levels 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 (< 63 cm) salmon declined from 11% (Middle Brook) to 58% (Exploits River) relative to 1999, with all five stocks having returns lower than the 1992-1999 average. Returns of large (> 63 cm) salmon were mixed: three stocks declined by more than 50% from previous year while returns increased at two other rivers. Two of the five stocks assessed met their conservation requirements in 2000. Marine survival of smolts to returns of small salmon at Campbellton River decreased from 6.1% in 1999 to 3.8% in 2000, and was well below the average of 6.5% for the previous six years.

- In **Southern Newfoundland** (SFAs 9 - 11), total returns of small salmon in 2000 increased substantially in two rivers relative to 1999 but declined in two other stocks. Returns of large salmon varied with increases at Northeast River (Placentia) and Rocky River but decreases at Northeast Brook (Trepassey) and Conne River. At all monitored rivers, returns of large salmon in 2000 were higher than the 1992-1999 means. With the exception of Rocky River, the three other monitored stocks met or exceeded their conservation spawning requirements. Marine survival at Conne River increased to the second highest value recorded (8.1%), while showing small increases at Northeast Brook (Trepassey), and Rocky River. However, marine survival is still anomalously low given the reductions in directed ma-

rine fisheries for salmon during the past decade. Smolt production decreased in two of the monitored rivers in 2000.

- In **Southwest Newfoundland** (SFAs 12 - 13), total returns of small salmon showed marked improvements over 1999 at three rivers (Crabbes, Middle Barachois, and Fischells), were similar to the previous year at Robinsons and Flat Bay, but declined substantially at Highlands River and Harry's River, with Highlands having the lowest return on record. Relative to 1999, total returns of large salmon decreased at Crabbes, Harry's and Highlands rivers, but increased in the other assessed stocks. Conservation spawning requirements were attained in three of the seven stocks assessed. Marine survival of smolts to small salmon returns at Highlands River decreased from 2.5% in 1999 to 0.6% in 2000, the lowest value recorded. Survival to 2SW salmon increased from 0.5% in 1999 to 0.7%.

- In **Northwest Newfoundland** (SFA 14A), total returns of small salmon varied, with higher returns at Western Arm Brook compared with 1999, but lower returns at Torrent River and Lomond River. In contrast, returns of large salmon declined only at Lomond River while showing substantive increases at Torrent River and Western Arm Brook. Conservation spawning requirements were exceeded at each of these rivers, continuing the trend that began with the commercial salmon fishery moratorium in 1992. Marine survival of smolts to small salmon returns at Western Arm Brook increased from 6.1% in 1999 to 11.0% in 2000, the highest value recorded in over 20 years.

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.

Freshwater

Water conditions are summarized from monthly averages recorded at gauging stations at Eagle, Gander, Isle aux Morts, Rocky and Humber rivers. In Labrador, water flows that were much higher than normal in June and July, dropped to below normal values in August, and continued below normal into the fall raising concerns for spawning success. For insular Newfoundland, water levels on the above referenced monitored rivers were at or below average in May and June. In July only Rocky River remained below average while the other three rivers were above average. Gander and Rocky rivers were above average in August while both Isle aux Morts and Humber rivers fell below average with all four rivers having water levels below average during September.

While 100 out of 158 scheduled rivers on the island were closed for some period of time during the summer of 2000 because of low water levels and warm water temperatures, closures were generally of short duration resulting in only 5.9% of the potential number of fishing days available being lost. This contrasts with the 1997 to 1999 period when 13.7 to 15.8% of the avail-

Number of days from June through August when maximum water temperatures exceeded 22 °C

Year	Campbellton River	NE Brook Trepassey	Conne River	Highlands River	Western Arm Brook
1996	22	5	20	27	3
1997	21	14	13	14	3
1998	36	14	30	30	9
1999	42	14	34	34	12
2000	30	4	27	36	20

able fishing days were affected. An indicator of water temperature conditions is provided above where the number of days on which maximum water temperatures exceeded 22 ° C are summarized for various rivers where both smolts and adult salmon migrations are monitored.

Meteorological and Marine

Annual air temperatures throughout much of the Newfoundland and Labrador Region were above normal during 2000. Annual mean air temperatures at Cartwright for example, on the southern Labrador Shelf, cooled slightly from the record high set in 1999, but were still above their long-term means by over 1°C. Air temperatures at Goose Bay were above normal for 10 out of 12 months and at St. John's they were above normal for 11 out of 12 months. The North Atlantic Oscillation (NAO) index value for 2000 was similar to that of 1999, which was well above normal, reversing the trend of below and near normal values of the previous three years. 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 during the past two years. This was due to an eastward shift in the anomalous air pressure fields resulting in milder-than-normal conditions in the region.

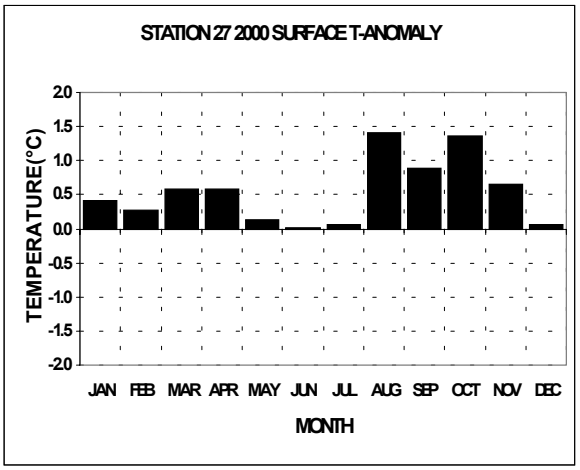
Sea ice on the southern Labrador and Newfoundland shelves generally appeared on schedule during 2000 but left early, resulting in a shorter duration of ice than usual. The total ice coverage in these areas during 2000 was lower than average but increased slightly over conditions in 1999 during both winter and spring.

The annual water column integrated temperature at Station 27 for 2000 cooled slightly compared to 1999 but remained above the long-term mean. Surface temperatures were above normal for 9 out of 12 months with anomalies reaching a maximum of near 1.5°C during August (Fig. 3). The June, July and December values were about normal. Bottom temperatures at Station 27 were above normal (by >0.5°C) during the first 6 months of the year and about normal during the remainder.

Salinities at Station 27 were below normal during the winter months and near normal during the rest of the year. The vertically integrated salinity for the summer months was about normal. Similar trends in temperatures and salinity were observed on the Flemish Cap and on Hamilton Bank during 2000. Temperatures at 10-m depth in the inshore regions along the east coast of Newfoundland during 2000 were above normal by up to 3°C during the summer months.

In general, the below normal trends in temperature and salinity, established in the late 1980s reached a peak in 1991. This cold trend continued into 1993 but started to moderate during 1994 and 1995. During 1996, temperature conditions were above normal over most regions; however, sum-

mer salinity values continue to be slightly below the long-term normal. During 1997 – 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 ocean temperatures were cooler than 1999 values, but remained above normal over most areas continuing the trend established in 1996. Salinities during 2000 were similar to 1999 values, generally fresher than normal throughout most regions, which is a continuation of the trend observed during most of the 1990s.



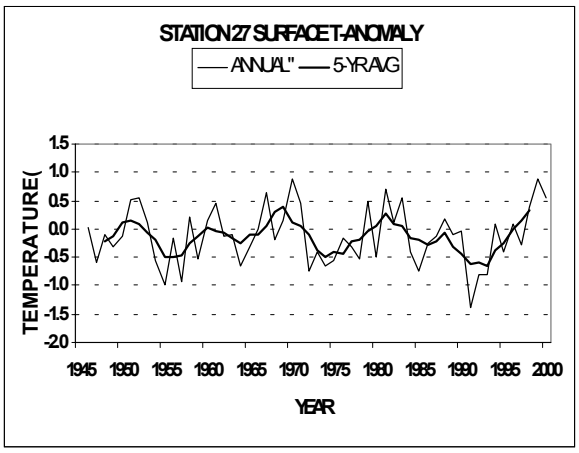


Fig. 3. Monthly surface temperature anomalies at Station 27 during 2000 (top) and the annual surface temperature anomalies and their 5-year running means (bottom).

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. While there was no exclusive Aboriginal food fishery at Conne River in 2000, 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 2000.

The three-year integrated salmon management program introduced in 1999 continued in 2000. 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 2000, approximately 16,400 salmon angling licences were sold (preliminary figure). Although ten (10) rivers were closed to angling for conservation reasons in 2000, 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 - 2000 were derived from the Licence Stub Return System (2000 data are preliminary). The 2000 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 SFAs 1 and 2, there was no retention of large salmon allowed for the entire season in SFA 14B. In SFAs 1 and 2, anglers could retain four salmon for the season, one of which could be large, while rivers in SFA 14B were included in the river classification system with a seasonal retention limit of two small salmon.

In 2000, the total Labrador angling catch was 9,875 Atlantic salmon, considerably higher than levels experienced in other years. The catch of small salmon was 8,337 (2,251 retained and 6,086 released) and large salmon was 1,538 (412 retained and 1,126 released) (Fig. 4). In SFA 1, the total catch (small and large salmon combined) of 1,475 increased 62% over 1999. In SFA 2, the total catch of 6,009 was 20% higher than in 1999. The total catch of 2,391 salmon in SFA 14B was slightly higher than the previous year. The proportion of salmon released by anglers in Labrador, which has been increasing over time, was 73% of the total catch, and was the highest value reported to date. In total, there were 7,212 small and large salmon reported to have been hooked and released in 2000. Information available on food fishery catches indicates that about 18 tonnes (7,400 salmon) of salmon were harvested in 2000, of which large salmon represented 34% of the catch by weight and 21% by number.

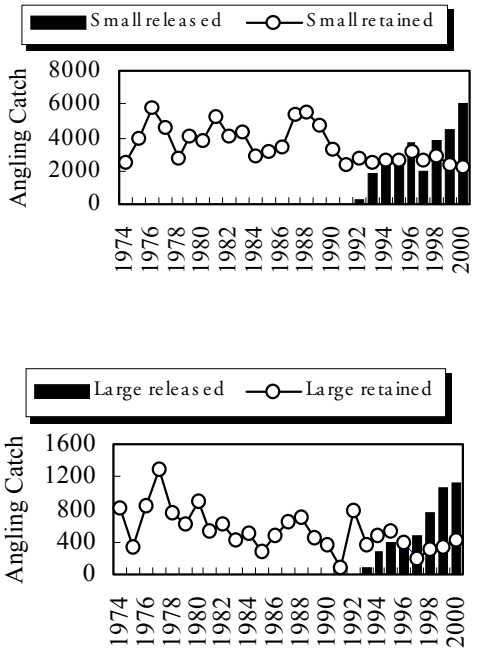


Figure 4. Angling catch statistics of small and large Salmon in Labrador SFAs 1, 2, and 14B, 1974-2000. Data for 1996-2000 are from the Licence Stub Return System for SFA 14B (data for 2000 are preliminary) and DFO statistics for SFAs 1 and 2, 1974-2000.

Newfoundland

A preliminary estimate of 26,883 small salmon (14,709 retained and 12,174 released) were angled in insular Newfoundland SFAs 3 - 14A in 2000, a decline of 20% from 1999 and 33% from the 1992-1996 mean, the lowest in recent years (Fig. 5). An estimated 2,250 large salmon were released, 35% less than in 1999 but 13% higher than the mean for 1992-1996. The proportion of hooked-and-released small salmon increased steadily during the period 1994-1996 (0.22 - 0.52); proportions for 1999 and 2000 were 0.42 and 0.45. The number of small salmon retained in 2000 decreased by 26% from 1999 and by 48% from the mean for 1992 - 1996, the lowest in recent years.

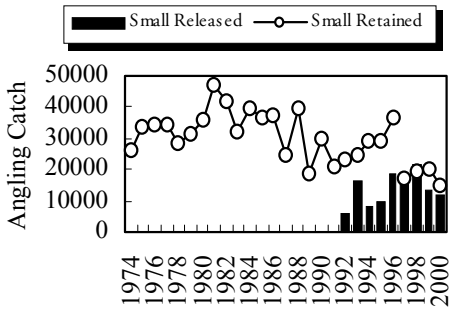


Figure 5. Angling catches of small salmon in Newfoundland SFAs 3 – 14A, 1974 – 2000. Data for 1997 – 2000 are from the Licence Stub Return System and information for 2000 is preliminary.

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 - 2000), 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 2000, 22 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 is 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). While the time series of available data varies among rivers, each of the above has information that allows direct comparisons back to the 1993 smolt class. In the following discussions, 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 19 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 18 t of salmon were harvested in food fisheries in 2000. The status of English River and Big Brook (Michaels River) (SFA 1) (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 2000 increased substantially over 1999 totalling 367 versus 59 the previous year. In contrast, returns of large salmon fell from 48 to 15. A similar pattern was observed at Big Brook where total returns of small salmon (N = 982) increased by 24% from 1999 but large salmon returns (N = 151) fell by 22%. Overall, however, more salmon (large and small combined) returned in 2000 than in either of the two previous years that Big Brook was assessed (1997, 1999), and this is consistent with reports from users suggesting stocks were higher in 2000.

Conservation spawning requirements for Labrador rivers have not been defined and the use of 2.4 eggs per m² of fluvial habitat and 105 eggs per hectare of pond habitat may not be appropriate. However, using the fluvial egg deposition rate as a reference level only, Big Brook would have achieved 42% similar to that of 1999 (41%). The habitat area of English River is not currently defined to allow for a similar comparison; however, the number of spawners still seems low considering the river has a drainage area of about 300 square kilometres.

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 km² compared with 1.17 for English River. By comparison, Sand Hill River, SFA 2, assessed from 1994 to 1996, has a value of 2.6 salmon per km². 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 km² of drainage, but with actual returns that are far in excess of conservation, now ranging between 8 and 10 salmon per km². 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 2000, obtained from two rivers in SFA 1, suggests Labrador stocks are low, English River in particular, by comparison with 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. Mechanisms should be put in place to prevent excessive fishing mortality on salmonid populations.

Collectively, harvests in the Labrador Inuit Association and Innu food fisheries, along with those in the new resident food fishery in Lake Melville and southern Labrador, plus the angling fishery throughout Labrador have the potential to increase exploitation rates substantially. 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 in this area include: Exploits, Campbellton, and Gander rivers in SFA 4, and Middle Brook 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 2000 was inferred from salmon returning to a fishway on Salmon Brook, a tributary of Gander River system.

Status

Total returns of small salmon in 2000 were 11 to 58% lower than returns in 1999. Only Middle Brook had returns that were similar to the 1992 – 1999 mean. Returns of large salmon declined by more than 50% in SFA 4 rivers (Exploits, Gander, and Campbellton) while increasing, relative to 1999, in SFA 5 (Middle Brook and Northwest River). However, in four of five rivers assessed, returns of large salmon were substantially less than the 1992 – 1999 means. Conservation spawning requirements were met at Campbellton River and Middle Brook (Fig. 2, Table 1). Although not directly assessed, it is expected on the basis of counts at the upper fishway on Terra Nova River, that this stock did not achieve conservation in 2000 and returns may very well have been lower than in 1999. The opening up of additional habitat in 1985, as part of ongoing enhancement initiatives since the late 1980's, has more than doubled the amount of accessible rearing area on Terra Nova River and the river is essentially still in a colonization phase. 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 requirements in each of the years they have been assessed during the moratorium (Table 1). Gander River has met or exceed conservation in 5 of 9 years, while Terra Nova River, Exploits River and Northwest River (Port Blandford) have yet to achieve conservation requirements.

Marine survival

At Campbellton River (SFA 4), estimates of marine survival are available since the 1993 smolt class. During the 1993 - 1995 period, survival to subsequent small salmon returns averaged 8.1%. This fell to 3.4% with adult returns in 1997. Since then, survival has remained relatively low at 5.3%, 6.1% and 3.8% for small salmon returns in 1998, 1999, and 2000, respectively (Fig. 6).

Evidence from fish counting fence data and tagging studies at Campbellton River indicates that mortality occurred inshore on returning adults and based upon limited observations may also be due, in part, to predation.

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 2000 declined 25% from 1999 and the 1993 to 1999 mean (47,292), and was 43% lower than the peak production in 1997 (Fig. 7). Returns of adult small salmon in 2001 will be below that of 2000 unless there is an increase in marine survival that compensates for the decrease in smolt production.

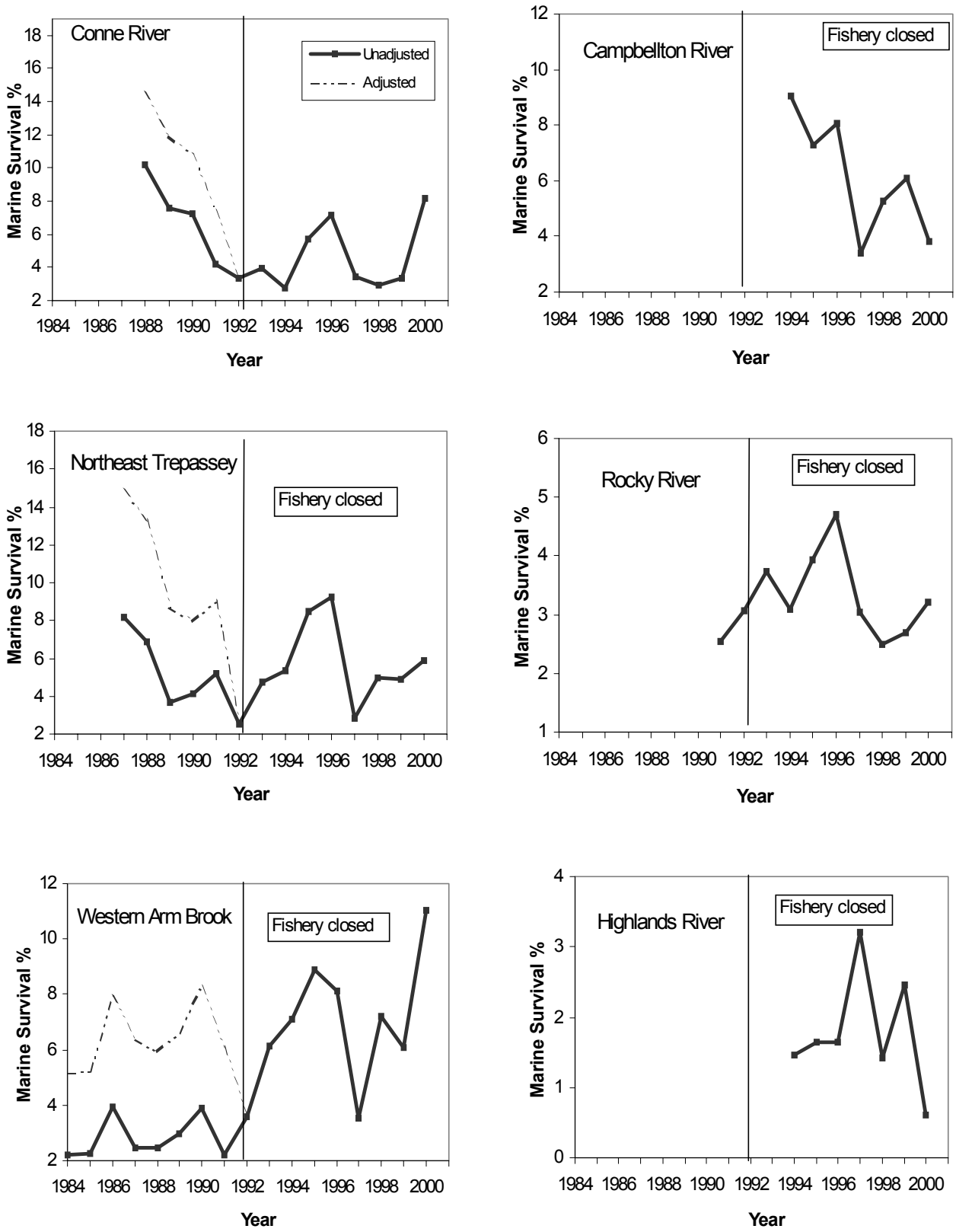


Figure 6. Marine survival rates for small salmon at various Newfoundland rivers. Dashed lines illustrate survival rates adjusted for average marine exploitation.

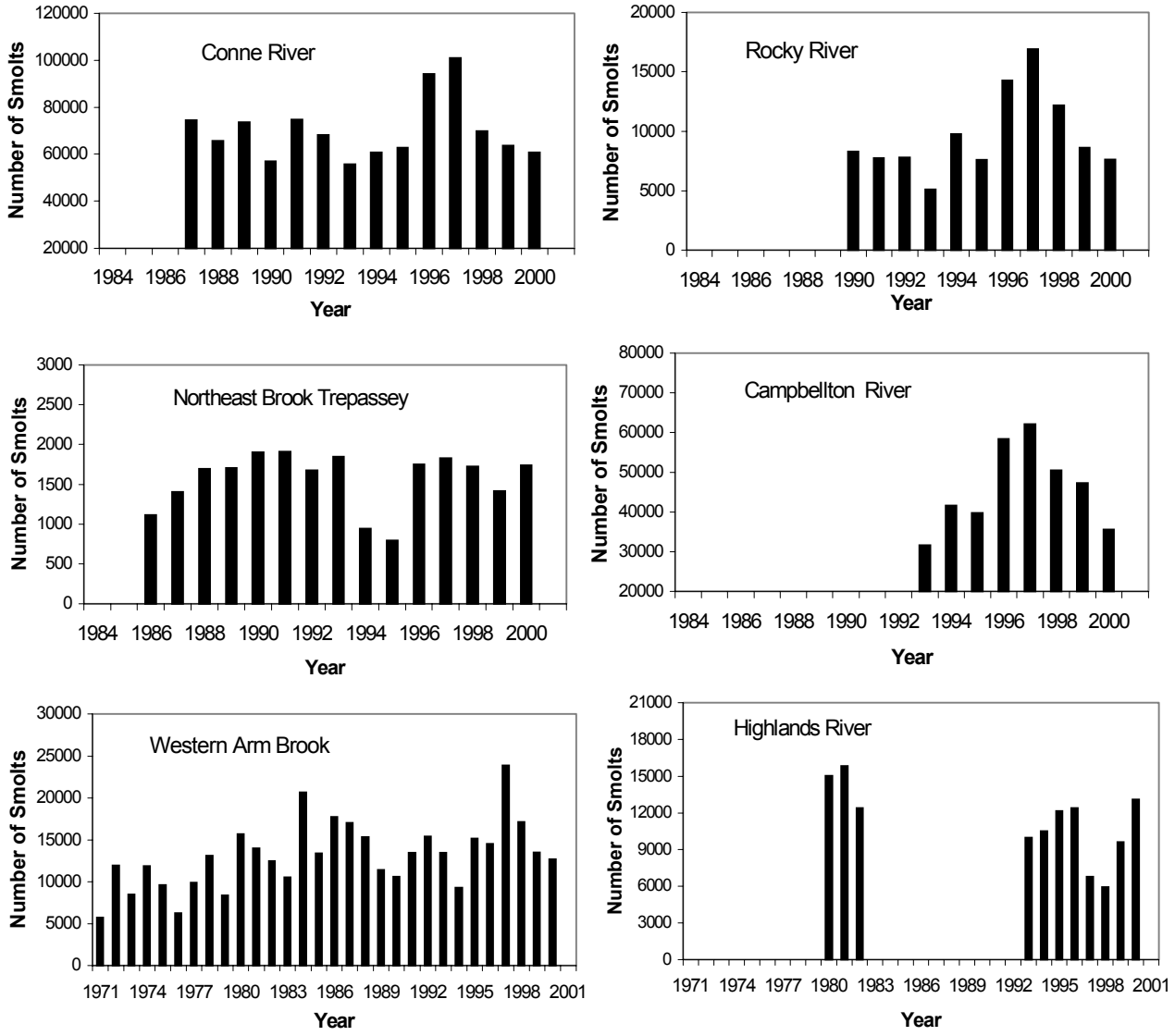


Figure 7. Trends in smolt production from various Newfoundland rivers.

Management concerns

Salmon returns to Northwest River (Port Blandford) remain low and in 2000 were less than the average of earlier years. Only 27% of the conservation spawning requirement was achieved in 2000. The management target for the Exploits River should be adjusted to ensure that conservation requirements for the Lower Exploits are achieved. Marine survival is monitored at Campbellton River only, and survival rates remain low.

If the smolt production in other SFA 4 and 5 rivers decreased as it did in Campbellton River, then salmon returns to some rivers in 2001 could be less than in 2000 unless marine survival of smolts increases.

The low returns to monitored rivers in 2000 represent the second time in four years where abundance has been low following the closure of the commercial salmon fishery.

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 St. John's and Mount Pearl areas, some rivers in SFA 9 are often subject to substantial angling pressure.

Specific rivers assessed in this area include Northeast Brook (Trepassey) and Rocky River in SFA 9, Northeast River (Placentia) in SFA 10, and Conne River in SFA 11 (Fig. 2). Conne River has both a conservation spawning requirement and a management target. 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 small salmon in 2000 declined relative to 1999 at both SFA 9 rivers but increased substantially at Northeast River (Placentia) and Conne River. Large salmon returns declined at Northeast Brook (Trepassey) and Conne River while increased returns occurred at Rocky River and Northeast River (Placentia). At all monitored rivers, returns of large salmon in 2000 were higher than the 1992-99 mean values. All monitored rivers, with the exception of Rocky River, met or exceed their conservation spawning requirements in 2000 (Fig. 2), with the management target also exceeded at Conne River. Northeast Brook (Trepassey) and Northeast River (Placentia) have exceeded their conservation spawning requirements in each year during the moratorium (Table 1). Conne River has met its conservation requirement in 7 of 9 years, while Rocky River has yet to achieve conservation requirements. Enhancement initiatives (colonization) have been in progress on Rocky River since the 1980's. Despite the positive returns in some rivers during 2000, some south coast rivers (e.g. Northeast Brook (Trepassey), and Conne River) had average returns of small salmon during 1992 - 2000 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 3% in 1997, and has remained at around 5 to 6% for adult small salmon since 1998 to 2000.

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 four years (Fig. 6).

For Conne River (SFA 11), estimates of marine survival have also varied 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 survival recorded (8.1%) with adult returns in 2000.

Smolt production

Smolt production in 2000 declined relative to 1999 and the 1992 - 1999 mean at Rocky and Conne rivers while increasing at Northeast Brook (Trepassey). Smolt production has fallen in each of the past three years at Rocky and Conne rivers. Corresponding increases in marine survival will be required in order for adult small salmon returns in 2001 to meet or exceed 2000 values.

There is evidence from two rivers (Conne River and Northeast Brook, Trepassey) 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 - 2000 that were lower than returns prior to the closure on the commercial salmon fishery. Despite improvements in marine survival at Conne River, survival remains low given the reductions in directed marine fisheries. Unless survival increases, salmon returns to some rivers in 2001 will be less than in 2000 owing to the decline in smolt production. Consideration could again be given to opening Conne River to angling as the conservation requirement has been achieved in each of the past six 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, Fischells Brook, and Cooks Brook were closed to recreational fishing in 2000.

Specific rivers assessed in this area 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

Total returns of small salmon showed marked improvements at three rivers (Crabbes, Middle Barachois, Fischells) relative to recent years, with returns similar to 1999 at Robinsons River and Flat Bay Brook. In contrast, returns of small salmon declined at Pinchgut Brook, a tributary of Harry's River and Highlands River. Total returns of large salmon varied; returns declined at Crabbes, Harry's and Highlands rivers, but increased at Middle Barachois, Robinsons, Fischells, and Flat Bay brooks. Conservation requirements were achieved at Robinsons, Fischells, and Flat Bay brooks only, with less than 35% of the requirement attained at Highlands and Harry's rivers (Fig. 2, Table 1). Since the moratorium began in 1992, Crabbes, Middle Barachois and Harry's rivers have not attained conservation requirements.

Marine survival

For Highlands River, counts of smolts and adult salmon are available from two time periods: 1980 - 1982 and 1993 - 2000. 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 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 small salmon returns (Fig. 6). Returns of small salmon in 2000 coincided with the lowest marine survival rate obtained (0.6%). Survival to 2SW salmon returns in 2000 improved over the previous year but remains at rates less than 1%.

Smolt production

Smolt production at Highlands River increased by 36% over the previous year to the highest value obtained during the 1993 to 2000 period (Fig. 7). During 1997 and 1998, smolt numbers at Highlands River fell dramatically as a result of an extreme winter flood in February 1996. Higher numbers of smolts are expected in 2001 owing to the high egg deposition rate attained from the 1997 spawners.

Management concerns

Particular consideration should be given to the conservation needs of salmon populations in SFA 13. With few exceptions, spawning populations in Bay St. George rivers still appear to be low, particularly, for Highlands, Harry's, Middle Barachois, and Crabbes rivers.

These stocks can afford no mortalities from any source and the management plan for these rivers should be reconsidered. 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 consistent sign of recovery as the level of conservation requirement attained in 2000 was the second lowest recorded. The improved numbers of spawners in Robinsons, Flat Bay and Fischells brooks could allow for limited harvests in 2001.

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 in this area include Deer Arm Brook, Lomond River, Torrent River, and Western Arm Brook (Fig. 2). All of these stocks are assessed using fish counting facilities.

Status

Total returns of small salmon were variable, with returns at Western Arm Brook increasing substantially over 1999, but with declines at Torrent River and Lomond River. Returns of large salmon also declined at Lomond River but were above the returns in 1999 and the 1992 - 2000 means at Torrent River and Western Arm Brook. Spawning escapements continue to exceed conservation requirements at each of 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. Deer Arm Brook, assessed for the first time in 2000, greatly exceeded 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 obtained 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). Note that the above-referenced estimates of marine survival shown for years prior to 1992 have not been corrected for commercial exploitation.

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 2000 fell 6% from 1999, and was 47% lower than the peak run in 1997. The decline in smolt production occurred despite the high spawning escapements observed during the moratorium. Returns of adult small salmon in 2001 may be less than in 2000 unless there is an increase in marine survival to compensate for the decrease in smolt production. There is evidence from Western Arm Brook that increased egg depositions do not necessarily result in increased smolt production.

Management concerns

Some rivers in SFA 14A have returns that greatly exceed their conservation requirements, thus there is opportunity for increased harvest.

Consideration could be given to changing the classification of some additional rivers.

Impact of retaining large salmon in angling fisheries

The impact of retaining large salmon in angling fisheries on rivers where salmon populations are considered to be grilse by virtue of their dominant life history stage, was evaluated using information from 9 monitored rivers in insular Newfoundland. Large salmon (≥ 63 cm) in these populations consist primarily of consecutive and alternate repeat spawning grilse. Some monitored rivers on the West Coast (SFAs 13 – 14A) have a higher proportion of virgin 2SW salmon than most other rivers in Newfoundland. Large salmon repeat spawners have previously spawned one to five times. Thus, the spawning stock could consist of more than five year classes, given consideration to the distribution of river-ages and frequency of spawning. This range in year classes in the spawning stock maintains genetic diversity and spreads the reproductive potential over several years providing a safety margin and "bet-hedges" against variations in survival rates. On the Campbellton and Gander rivers, one large salmon has an egg deposition equivalence of two small salmon, considering differences in mean size and sex ratio.

Run timing of large salmon is variable and spans the duration of the small salmon run. Evidence from Conne River suggests that virgin 2SW (although few in number) and alternate spawners tend to enter the river before consecutive spawners. In some years and on some rivers, the run of the large salmon peaks at the same time as small salmon, but in other years and rivers the peak of large salmon is later than that of small salmon. Therefore, it would not be possible to select a time period that would consistently coincide with the peak run of large salmon during all years or for all rivers and it would be difficult to target a recreational fishery on a specific component of the run.

For the 9 "grilse populations" examined, large salmon contributed an average of 8 % to 23 % of the total egg deposition during 1992 - 2000. However, annual variation in egg deposition contributed by large salmon ranges from 1 % to 48 %, depending on the river. Thus in some years and for some rivers, the egg deposition by large salmon is quite important for the sustainability of the population.

The effect that a retention-angling fishery would have on the average percentage egg deposition (1992 - 2000) for the 9 "grilse populations" rivers examined using the average contribution by large salmon is shown for exploitation rates of 10%, 20 %, and 30%. Also shown is the maximum reduction in percentage egg deposition. The range shows the variation among rivers. Note that these reductions assume no change in the current level of hook-and-release mortality, which results in <1% to about 4% of the large salmon being killed depending on river and year.

Exploitation	Average reduction in percentage egg deposition	Maximum reduction in *percentage egg deposition*
10 %	< 1% – 2%	2% - 5%
20 %	< 1% - 5%	3 % - 10%
30 %	1% - 7%	5% - 14%

It is concluded that a retention-angling fishery with a low exploitation rate on large repeat spawning grilse would have minimal effects on the egg deposition in most years, although the effect will vary among rivers and years.

Consideration for such a fishery should be done on a river specific basis and only where there is a low risk that the egg deposition will not fall below the conservation requirements for the river.

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, 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.

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.

There is also a lack of current data on sex ratios, sizes and fecundity of large salmon in spawning escapements in Newfoundland and Labrador. Although the majority of spawners are small salmon, for which good 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 and Grey River in SFA 11. A ripe male rainbow trout was recorded

from Grandy's Brook (SFA 11) in 2000, but is unlikely to have originated from the aquaculture operations in Bay d'Espoir.

In recent years, rainbow trout, presumably aquaculture escapees, have also been observed or angled in other parts of Newfoundland including: La Poile River and Garia Brook (SFA 12), Crabbes River, Flat Bay Brook, Robinsons River and Humber River (SFA 13), Trout River, Parsons Pond, and Portland Creek (SFA 14A). In addition, a spent female rainbow trout was angled on River of Ponds (SFA 14A), in 2000. While evidence exists of escaped farmed salmonids entering rivers, impacts on wild 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 2001 were not made. With the exception of Highlands River in Bay St. George, and Northeast Brook (Trepassey) smolt output from all other monitored rivers has declined in each of the past three years. Thus, in the absence of any improvement in marine survival rates, returns of small salmon in 2001 could be lower. With respect to Labrador, salmon returns in the year 2001 will be from higher numbers of spawners than were the returns in recent years.

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. Without an increase in freshwater and/or marine survival rates, adult salmon populations will not increase.

Owing to a lack of long-term salmon monitoring facilities in Labrador, there is no information from which to comment beyond the year 2001.

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ISSN 1480-4913 (for English series)

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. Refer to footnotes for definition of characters and abbreviations.

Region / River	SFA	Map Index	Method	Total Returns in 2000 Small	Total Returns in 2000 Large	Conservation met (%) 1996	1997	1998	1999	2000	1992 - 2000	Status in 2000: Smolts Relative to 1999	Smolts Relative to 1992 - 99	Marine Survival Relative to 1999	Marine Survival Relative to 1992 - 99	Egg Deposition Relative to 1999	Egg Deposition Relative to 1992 - 99
Labrador																	
Big Brook *	1	1	Fe	982	151		24		41	42	0 of 3 yrs					⇔	⇧
English River	1	2	Fe	367	15												
Newfoundland																	
Northeast Coast																	
Exploits River	4	1	Fw	12152	683	69	24	49	47	22	0 of 9 yrs					⬇	⬇
Lower	4		Fw			210	72	146	134	64	7 of 9 yrs					⬇	⬇
Middle	4		Fw			43	15	35	35	16	0 of 9 yrs					⬇	⬇
Upper	4		Fw			26	10	6	7	2	0 of 9 yrs					⬇	⬇
Campbellton River	4	2	Fe	1798	208	329	187	311	326	157	8 of 8 yrs	⬇	⬇	⬇	⬇	⬇	⬇
Gander River **	4	3	EFw	14041	2034	124	62	110	119	87	5 of 9 yrs					⬇	⬇
Middle Brook	5	4	Fw	1738	189	250	196	301	222	218	9 of 9 yrs					⇔	⇔
Northwest Brook (Port Blandford)	5	5	Fe	270	106	55	46	42	28	27	0 of 6 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

** 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. Refer to footnotes for definition of characters and abbreviations.

Region / River	SFA	Map Index	Method	Total Returns in 2000 Small	Total Returns in 2000 Large	Conservation met (%) 1996	1997	1998	1999	2000	1992 - 2000	Status in 2000: Smolts Relative to 1999	Smolts Relative to 1992 - 99	Marine Survival Relative to 1999	Marine Survival Relative to 1992 - 99	Egg Deposition Relative to 1999	Egg Deposition Relative to 1992 - 99
Newfoundland																	
South Coast																	
Northeast Brook (Trepassey)	9	6	Fe	83	14	196	135	256	248	216	9 of 9 yrs	⇧	⇧	⇔	⇔	⬇	⇔
Rocky River	9	7	Fe	277	104	34	56	54	39	34	0 of 9 yrs	⬇	⬇	⇧	⇔	⬇	⬇
Northeast River (Placentia)	10	8	Fw	571	258	736	486	484	260	455	9 of 9 yrs					⇧	⇔
Conne River	11	9	Fe	5177	216	204	125	150	122	210	7 of 9 yrs	⇔	⬇	⇧	⇧	⇧	⇧
Southwest Coast																	
Highlands River	13	10	Fe	58	67	79	105	59	49	34	1 of 8 yrs	⇧	⇧	⬇	⬇	⬇	⬇
Crabbes River	13	11	Sc	1026	155	68	95	44	65	63	0 of 5 yrs					⇔	⇔
Middle Barachois Bk	13	12	Sc	1142	155	52	95		44	95	0 of 4yrs					⇧	⇧
Robinsons River	13	13	Sc	1425	322	67	91		117	135	2 of 4 yrs					⇧	⇧
Fischells Brook	13	14	Sc	1800	277		44	23	110	142	2 of 4 yrs					⇧	⇧
Flat Bay Brook	13	15	Sc	2308	477	85	89		149	167	2 of 4 yrs					⇧	⇧
Harry's River	13	16	Fe	1198	43	52	50	49	49	29	0 of 9 yrs					⬇	⬇
Northwest Coast																	
Lomond River	14A	17	Fw	927	82	143	161	151	181	140	9 of 9 yrs					⬇	⇔
Deer Arm Brook	14A	18	Fe	755	80					466	1 of 1 yrs						
Torrent River	14A	19	Fw	4105	593	1279	797	924	680	657	9 of 9 yrs					⇔	⬇
Western Arm B rook	14A	20	Fe	1492	120	415	200	625	370	480	9 of 9 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

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