Department of Fisheries and Oceans
Canadian Stock Assessment Secretariat
Research Document 97/117

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Ministère des pêches et océans
Secrétariat canadien pour l'évaluation des stocks
Document de recherche 97/117

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Trends in Atlantic salmon abundance illustrated using a scaled index of returns, and estimates of marine exploitation prior to the closure of the Newfoundland commercial fishery

by

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Abstract

A simple index of salmon returns is used to illustrate the impact of the commercial Atlantic salmon fishery moratorium on Newfoundland stocks. The index is easy to calculate and understand, and is scaled to a common meaningful value for ease of comparisons among rivers. It can be used to examine the impact of the moratorium within an individual river (stock), or across rivers for specific zones (e.g. northeast, south and west coasts). The index is not related to conservation level requirements and the basic data used to derive the index can be used to infer past average levels of marine exploitation. Results indicate that salmon returns to rivers along the northeast and west coasts have increased substantially during the moratorium period (1992-1996) relative to pre-moratorium levels (1984-1991). This was not the case for returns to south coast rivers, some of which have decreased on average by as much as 50% or more. Many stocks reached their lowest or second lowest level of abundance in 1991. Several Newfoundland salmon stocks, for both small and large salmon components, were declining in abundance throughout the mid-to late 1980s and into 1991. Estimates of marine exploitation rates were 44.0% (± 9%) on small salmon and 74.9% (± 7.6%) on large fish. These estimates are considered minimum values. This is because there is evidence to suggest that overall natural survival, for some stocks, has been declining over time and was actually lower during the moratorium years than it was prior to the commercial salmon fishery moratorium.

Résumé

Un indice simple des remontées de saumons est utilisé pour illustrer l'incidence du moratoire de la pêche commerciale du saumon de l'Atlantique sur les stocks de Terre-Neuve. L'indice est facile à déterminer et à comprendre et son échelle est réduite à une valeur utile commune facilitant les comparaisons entre les rivières. Il peut être appliqué à l'examen de l'incidence du moratoire au sein de mêmes rivières (stocks) ou entre rivières de mêmes zones (p. ex. les côtes nord-est, sud ou ouest). L'indice n'est pas lié aux niveaux de conservation et les données de base utilisées pour l'obtenir peuvent servir à la déduction des niveaux d'exploitation en mer moyens antérieurs. Les résultats obtenus montrent que les remontées de saumons des rivières des côtes nord-est et ouest ont augmenté de façon appréciable pendant le moratoire (1992-1996) comparativement à la période antérieure (1984-1991). Cela ne s'est cependant pas avéré vrai pour les remontées des rivières de la côte sud, dont on a noté, pour certaines, une baisse par rapport à la moyenne atteignant ou dépassant même 50%. Pour bon nombre de stocks, le niveau d'abondance le plus faible, ou le deuxième plus faible, a été atteint en 1991. Plusieurs stocks de saumon de Terre-Neuve, à composantes de petits et de gros saumons, ont vu leur abondance décliner à partir du début ou de la fin des années 1980 jusqu'en 1991. Les taux d'exploitation en mer estimés étaient de 44,0 % (± 9%) pour les petits saumons et de 74,9% (± 7,6%) pour les gros poissons. Ces estimations sont jugées être des valeurs minimales. En effet, certains indices portent à croire que le taux de survie naturel général, de certains stocks, diminue depuis un certain temps et qu'il était même inférieur pendant le moratoire à ce qu'il était avant l'imposition de ce dernier à la pêche commerciale.

Introduction

Concern over the health of Newfoundland Atlantic salmon stocks, and management programs instituted to assist in rebuilding depressed stocks, have a long history. In 1972, drift-net fisheries off the south coast of Newfoundland were closed (Chadwick 1993; May 1993). Further restrictions affecting angling and commercial fishing seasons were placed on Newfoundland stocks in 1978 (Chadwick et al. 1978b; May 1993). The next major initiative was the 1984 salmon management plan. It was implemented primarily to rebuild depressed stocks in mainland Canada and southwestern Newfoundland by reducing the interception and exploitation of large, mainly multi-sea-winter (MSW) salmon (O'Connell et al. 1992). The 1984 management plan was not specifically designed to assist in rebuilding Newfoundland grilse populations, although it was expected that some improvements would result. Cautions expressed concerning the declining abundance of Newfoundland stocks resulted in the introduction of quotas in 1990, followed by a moratorium on the Newfoundland commercial salmon fishery in 1992 (O'Connell et al. MS 1993). A small commercial fishery was maintained in Labrador.

An evaluation of the impacts of the first year of the moratorium on Newfoundland salmon stocks addressed various issues and highlighted certain expectations regarding changes in salmon stock characteristics (Dempson and O'Connell MS 1993). Some of these expectations concerned changes to juvenile production levels, and changes in the biological characteristics of stocks. Other expectations related directly to measurable changes in salmon stock abundance.

In this paper, a simple index of salmon returns is used to illustrate the impact of the moratorium on various Newfoundland salmon stocks. The index has the following attributes: it is easy to calculate, understand and explain; the index is scaled to a common meaningful value for ease of comparisons among rivers; it can be used to examine the impact of the moratorium within an individual river (stock), or across rivers for certain zones (e.g. northeast, south and west coasts); the index is not related to conservation requirements (formerly called 'targets'). We also derive estimates of river-specific average marine exploitation rates from the basic information used to construct the above index, namely, from the total returns of salmon to rivers. We designate this as a 'marine' rather than 'commercial' exploitation rate as it incorporates losses in other legal (by-catch) and illegal (poaching) ocean fisheries. Finally, we show that natural survival of smolts during the moratorium years has actually declined relative to pre-moratorium years when the latter period is corrected for marine exploitation.

Methods

The index requires estimates of the total numbers of small and large salmon that returned to various rivers for a series of years prior to, and during the commercial salmon fishery moratorium. In this paper, the pre-moratorium period covers the eight year interval 1984 to 1991, coincident with the 1984 management plan, while the moratorium period runs from 1992 to 1996. Counts of salmon from fishways and counting fences form the basis for most of these returns. These data are summarized in O'Connell et al. (MS 1996, MS 1997). To derive total returns (TR), however, salmon losses below these counting facilities have to be added to these counts. This would apply to any river where angling is allowed downstream of the counting facility (e.g. Gander River), where observed mortalities are recorded, or, in the case of Conne River, where an aboriginal food fishery takes place in the estuary. Thus, total returns were derived as follows:

$$TR = Rc + C + M$$

where,

Rc = recreational catch below counting fence or fishway,
C = count of fish at fish counting fence or fishway,
M = mortalities below counting fence or fishway (for Conne River this includes the Aboriginal food fishery harvest of Conne River origin salmon).

We note that Humber River data were derived from mark-recapture surveys (1990 to 1996) (O'Connell et al. MS 1997), with the 1984-89 information estimated using angling exploitation rates (Mullins and Reddin MS 1996). Total return information is summarized in Appendix 1.

Given that 1992 was the first year of the commercial salmon fishery moratorium, and for the most part, it was the first year for which some level of change in total salmon returns to rivers should have been apparent, it was designated as the 'base' or reference year for each river in all subsequent comparisons. As such, the total return of salmon in the reference year divided by itself then receives the value of unity (1). Returns for all other years are normalized to the 1992 reference year by dividing respective total returns by the reference year returns. This produces a series of numbers relative to the unity value of the base reference year. A number less than unity (< 1) will indicate the actual proportion that the year in question was below or less than the reference year. Similarly, a number greater than unity (> 1) will indicate the proportion that the particular year was greater than the reference year. For example, the index value for the total return of small salmon to the Exploits River in 1991 was 0.42. That is, the total return in 1991 was only 42% of the 1992

reference year (or 58% less). In contrast, the index value for 1993 was 1.64, indicating that the return of small salmon was 64% higher than the previous year.

Given the closure of the commercial salmon fishery in 1992, coupled with the moratoria imposed on the northern cod fishery beginning in July 1992 and on cod fishing in SFAs 11-14A in August 1993 that would largely alleviate any by-catch of salmon in cod fishing gear (O'Connell et al. MS 1995), it would be expected that with similar production and survival occurring, the value of the index during the moratorium period would be greater than it was prior to closure of the commercial fisheries.

Yearly indices were calculated for each of 14 different rivers with salmon enumeration facilities, representing 13 separate salmon populations from the northeast, south and west coasts of Newfoundland. Salmon Brook is a tributary of the Gander River. Changes in salmon abundance at the regional level were derived by simply averaging index values across rivers for the northeast, south and west coast areas. In this way each river is given equal weight and illustrates the average proportional changes in returns.

Estimates of marine exploitation (ME) were derived for various stocks separately for small and large salmon. Here, the annual total returns to various reference rivers were averaged for both the pre-moratorium and moratorium periods. The percentage difference between the two periods relative to the moratorium years provides an overall average marine exploitation rate, provided that natural mortality at sea remains constant or nearly so:

$$ME = \frac{\overline{Rm} - \overline{Rpm}}{\overline{Rm}} \times 100$$

where,

$\overline{Rm}$ = average total returns during the moratorium

$\overline{Rpm}$ = average total returns prior to the moratorium

This approach is appropriate where the average total returns for the moratorium period are higher than that for the pre-moratorium period. Overall rates of marine exploitation for small and large salmon can then be derived by averaging the individual river values. These values can then be compared with historic estimates of commercial exploitation derived largely from tagging studies.

Total stock production levels and natural mortality rates for the two periods are assumed to be constant. With respect to smolt production, the coefficient of variation around individual river values has been between 11-27% for Northeast Trepassey, Rocky

River, Conne River and Western Arm Brook (data from O'Connell et al. MS 1997) using data since 1984 through to 1995 (1995 smolts would produce most of the adult small salmon returns in 1996). If total adult stock production levels were consistently higher during the moratorium period, then exploitation rates would be overestimated. In contrast, if overall adult salmon production levels were actually lower during the moratorium period, then exploitation rates would reflect minimum values. Similarly, if natural mortality has increased over time, the exploitation rates would also reflect minimum values.

Information on marine survival from smolts to adult small salmon in the following year is available from three rivers where sufficient information exists both before and during the commercial salmon fishery moratorium: Northeast Trepassey in Salmon Fishing Area (SFA) 9, 1986-1996; Conne River (SFA 11), 1987-1996; and Western Arm Brook (SFA 14A), 1971-1996.

Results

Small salmon

In general, rivers along the northeast coast of Newfoundland showed substantial increases in total returns of small salmon during the commercial salmon fishery moratorium (Fig. 1). In virtually all rivers, however, there were some years during the pre-moratorium period that were as high or higher than the 1992 reference year. Similar patterns of increased returns were observed in west coast Newfoundland rivers (Fig. 1). The exception to the improvements are found in south coast stocks. Here, Biscay Bay River, Northeast Trepassey, and Conne River had average index values during the moratorium that were lower than the pre-moratorium period (Fig. 1). At Northeast Placentia River, only the 1996 returns were substantially higher than those of the 1992 reference year. This would suggest that overall adult stock production levels for south coast rivers were substantially lower during the moratorium period likely due to decreased marine survival.

It is interesting to note that of the 14 rivers considered, 11 had either the lowest (Exploits River, Salmon Brook, Gander River, Terra Nova River, Biscay Bay River, Western Arm Brook) or second lowest (Middle Brook, Northeast Placentia River, Conne River, Humber River, Torrent River) index values recorded during the 1991 return year (Fig. 1). In addition, we note that Exploits River, Middle Brook, Biscay Bay River, and Conne River had significant declines in small salmon returns through until the 1991 period (see Fig. 1).

Overall regional perspectives for small salmon returns are illustrated in Fig. 2. Again, total returns to both the northeast and west coasts have shown improvements during the moratorium period whereas south coast rivers, as a whole, have fallen below the

pre-moratorium level. There is, however, some suggestion for improvement during the past few years (Fig. 2). The 1991 year was the lowest overall for each of the three regional groupings (Fig. 2).

Large salmon

Rivers along the northeast coast of Newfoundland also showed substantive increases in large salmon returns during the commercial salmon fishery moratorium (Fig. 3). In only two cases, Exploits River and Middle Brook, were there any pre-moratorium years that had large salmon returns as high or higher than the 1992 reference year. While Salmon Brook, a tributary of the Gander River, has shown consistent improvements in large salmon returns, the same cannot be said for the overall Gander River itself (Fig. 3). Large salmon returns peaked in 1992 and have since remained at less than 50% of the 1992 reference year.

Large salmon returns at Torrent River and Western Arm Brook on the west coast have also improved dramatically (Fig. 3). Humber River large salmon returns peaked in 1992 but were followed by a sharp decline in 1993. Since then, returns have steadily improved so that 1996 achieved 91% of the reference year value.

With respect to south coast stocks, only at Northeast Placentia River was there consistent improvement in large salmon returns during the moratorium period (Fig. 3). Dramatic declines were experienced at Northeast Trepassey and Conne rivers (Fig. 3).

Returns of large salmon were again among the lowest or second lowest for many rivers in 1991 (Fig. 3). Exploits River, Salmon Brook, Middle Brook, Northeast Trepassey River and Conne River all had significant declines in large salmon returns through to the 1991 (see Fig. 3).

Overall regional perspectives for large salmon returns are summarized in Fig. 4. Again, both the northeast and west coast have shown substantive improvements whereas south coast rivers, on average, have fallen below the pre-moratorium level. As observed with the regional grouping of small salmon returns, 1991 was again the lowest overall (Fig. 4).

Exploitation rates

Estimates of marine exploitation rate on small salmon ranged from a low of 28% based on Lomond River fishway data to 66% using the total returns to the Gander River fish counting fence (Table 1). Gander River fence data, however, began in 1989 so there

are only three years of pre-moratorium information. If the same series of years were used for Salmon Brook (a tributary of Gander River), then the two exploitation rates are similar with Salmon Brook now at 68.3%. An estimate of the overall exploitation on small salmon was 44.0% (95% C.I. = 35.0 - 53.1%) (using lower value for Salmon Brook).

Commercial exploitation on large salmon ranged from 59.6% for Lomond River to 97.5% for Western Arm Brook. Estimates for Salmon Brook and the Gander River itself were more comparable with each other (Table 1). However, if the same series of pre-moratorium data were again used for Salmon Brook as were available from the Gander River counting fence (1989-1991), then the estimate for Salmon Brook would increase to 88.8%. As observed in Figure 3, there are obvious differences in returns of large salmon to Salmon Brook versus the Gander River itself during the moratorium period. This could suggest a disproportionate movement of large salmon returns into the Salmon Brook tributary versus other tributaries to the Gander River. Angling occurs at the mouth of Salmon Brook which selectively removes small salmon from the run, especially during periods of low flow. This differential exploitation could contribute to the discrepancy. Alternatively, it could also suggest substantial differences in the categorization of what constitutes a 'large' salmon between the two counting facilities although this seems unlikely. An estimate of the overall exploitation on large salmon was 74.9% (95% C.I. = 67.4 - 82.5%).

As indicated in the Methods section, this approach to infer minimum average marine exploitation rates was appropriate only where the average total returns during the moratorium period was higher than the pre-moratorium years. Thus, it is not applicable for most south coast stocks, including Biscay Bay River, Northeast Trepassey River, and Conne River. Rocky River is omitted as it was an enhanced stock. However, by using the range in exploitation rates derived from other stocks, we can estimate the extent by which total stock size for the above rivers has decreased over the two periods.

For each of the three rivers, we applied the average exploitation rate along with the upper and lower confidence intervals (35.0 - 53.1%). We also arbitrarily chose a moderately low value of marine exploitation, 15%, but also considered the unlikely event that there was 0% marine exploitation on these populations.

Results for Biscay Bay River indicated that the stock size decreased from 48.8-63.1%, using the upper and lower confidence interval values (Table 2). Even with either 0% or 15% exploitation, the stock has declined by 21.2-33.0% (Table 2). A similar scenario resulted for Northeast Trepassey River (Table 2). The greatest decline in stock size has occurred on Conne River. This stock has decreased by 70.5-78.7% under the calculated range of exploitation rates, but even at 0% or little exploitation (15%), the stock has fallen by 54.6-61.4% (Table 2).

Natural marine survival

During the period of the commercial salmon fishery moratorium, estimates of marine survival from smolts to adult small salmon returns to rivers in the following year are believed to represent natural survival rates. This is because all directed marine fisheries for salmon in Newfoundland were closed, and small salmon (virgin spawners) do not migrate to nor are subjected to exploitation off west Greenland (Ruggles and Ritter 1980).

Both Conne River and Northeast Trepassey have had marine survival rates in some pre-moratorium years that were higher than rates experienced during the moratorium (Fig. 5). This also applies to Western Arm Brook if data prior to 1984 are examined (O'Connell et al. MS 1997; also see below). The lowest marine survivals recorded for both rivers has occurred during the period when the Newfoundland commercial fishery has been closed; Conne River for the 1993 smolt class (adult small salmon returns in 1994) and Northeast Trepassey for the 1991 smolt class (adult small salmon returns in 1992). Adjusting pre-moratorium survival rates to account for exploitation fisheries highlights the difference between the two periods even more. Conne River is an early run stock, thus the lower 95% confidence interval value (35%) was used to adjust pre-moratorium survivals. For Northeast Trepassey, the overall mean exploitation rate presented in Table 1 was used (44%). Ocean survival for both these south coast stocks was falling throughout the late 1980's and early 1990's (Fig. 5). However, an increase in survival has been noted in recent years.

A somewhat different result is obtained by looking at a northwest coast stock, Western Arm Brook (Fig. 5). Here, there has been a substantial increase in survival during the period of the salmon fishery moratorium. However, a comparison of the pre-moratorium period adjusted for marine exploitation shows that there has been little or no change in the overall average natural marine survival for the period under consideration (Fig. 5). The adjustment for Western Arm Brook used the calculated marine exploitation value of 56.8% shown in Table 1.

Discussion

Use of a scaled index has merit for examining overall trends in salmon returns in the current case, relative to major management measures. All rivers can be evaluated relative to a common meaningful scale. Yet, the differing magnitudes in salmon runs among rivers are still maintained. The approach is simple, but depends entirely of having accurate information on actual salmon escapements.

Results from this paper show that northeast coast and west coast salmon rivers have responded as expected given the commercial salmon fishery moratorium. In contrast, south coast rivers have not. It also highlights the reality that some Newfoundland salmon populations, for both small and large salmon components, were declining in abundance since the mid-to-late 1980's (for example, see Fig. 1 - Exploits River; Middle Brook; Biscay Bay River; Northeast Trepassey; Conne River). Stocks were in dire need of drastic management measures if serious stock rebuilding was truly a priority. While some benefits were accrued as a result of the 1984 management plan (O'Connell et al. 1992), continuation of a similar management strategy could have resulted in the total collapse of some Newfoundland stocks. The continual decline or lack of improvement in most south coast Newfoundland salmon populations well into the moratorium period is suggestive of other, perhaps environmental causes that affected adult salmon abundance. This was occurring at a time when freshwater production of smolts in some rivers was being maintained at relatively consistent levels.

Estimates of commercial exploitation rates, 44% for small and 74.9% for large salmon, were generally consistent with prior beliefs or estimates. Murray (1968) estimated that the commercial fishery took 48% of the 1SW salmon and 75% of the 2SW salmon component for a southwest coast Newfoundland stock. Reddin (MS 1981) obtained mean exploitation rates of 36% and 92% for 1SW and 2SW Sand Hill River, Labrador, stocks respectively, while an average exploitation rate for Western Arm Brook small salmon was reported to be 62%. Pippy (1982) assumed commercial exploitation rates of 55% for small salmon and 85% for large salmon in the Newfoundland fishery. Chadwick et al. (MS 1985) calculated an exploitation rate of 65% on Western Arm Brook salmon that reflected both distant and homewater exploitation. According to Chadwick (1993), all accepted methods for estimating fishing mortality of salmon required tagging information. Our estimates were derived using actual returns to rivers that are not confounded by the various assumptions required in most tag related studies (e.g. estimates of tag loss, tag induced mortality, tag reporting rates, etc.). The assumptions that are pertinent here relate to relatively stable natural survival rates and adult production levels.

In all likelihood, our estimates of marine exploitation reflect *minimum* values. This is because we have evidence that suggests for some stocks there has been an overall decline in natural marine survival, particularly for south coast Newfoundland stocks. Thus, the assumption indicated above of constant natural marine survival is violated. The same may apply to other stocks as well. Smolt to adult survival rates for Western Arm Brook exist back to 1971 (Chadwick et al. 1978a; O'Connell et al. MS 1997). Unadjusted survival from the 1971 to 1979 smolt classes averaged 6.4% with over 12% survival obtained in one year. If the average exploitation calculated for the 1984-91 period were applied to the 1971-79 survival rates back to the river, then the unadjusted estimates of marine survival would approximate 15%. We note that a marine survival rate of 10% has yet to be obtained in any river where smolt monitoring is conducted since the commercial salmon moratorium has been in effect (O'Connell et al. MS 1997).

Increased marine survival in recent years relative to the early 1990's should contribute to continued improvement in south coast rivers if this pattern continues. In 1997, increases in adult salmon production resulting from substantially higher spawning escapements in northeast and west coast rivers that began in 1992, should materialize. However, this again assumes that ocean survival rates remain as they were in 1995-96 or are higher. But, as Noakes et al. (1990) have stated for Pacific salmon populations, it is common for the number of adults in a stock to vary by more than an order of magnitude from one year to the next. The value of maintaining as many index river salmon counting facilities as possible cannot be underestimated, especially those that include estimates of smolt production. With the aspirations of some to consider reopening a limited commercial fishery, these facilities are crucial. They would ensure that any management decisions either to reopen a fishery or extend the moratorium could be made on the basis of sound scientific evidence.

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Table 1. Estimates of average marine exploitation rates on small and large salmon for various rivers in Newfoundland, 1984-1991.

		Small salmon	Large salmon
SFA	River	Exploitation rate	Exploitation rate
4	Exploits River	46.0	76.4
4	Gander River		
	Salmon Brook	29.4	82.4
	* Main River	66.0	72.1
5	Middle Brook	36.6	79.8
5	Terra Nova River	35.1	69.6
10	Northeast Placentia River	39.1	73.9
13	Humber River	47.3	59.6
14A	Lomond River	28.0	62.9
14A	Torrent River	56.0	75.1
14A	Western Arm Brook	56.8	97.6
Average exploitation for all rivers		44.0	74.9
	Minimum : Maximum	28.0 - 66.0	59.6 - 97.6

* Main stem Gander River is for the period 1989-1991.

Table 2. Estimates of the decline in total stock size for three south coast Newfoundland Atlantic salmon populations during the period of the commercial salmon fishery moratorium.

	Percentage decline in total stock size		
	Stock		
Exploitation rate %	Biscay Bay	Northeast Trepassey	Conne
53.1	63.1	64.0	78.7
44.0	55.9	57.0	74.6
35.0	48.8	50.0	70.5
15.0	33.0	34.7	61.4
0	21.2	23.1	54.6

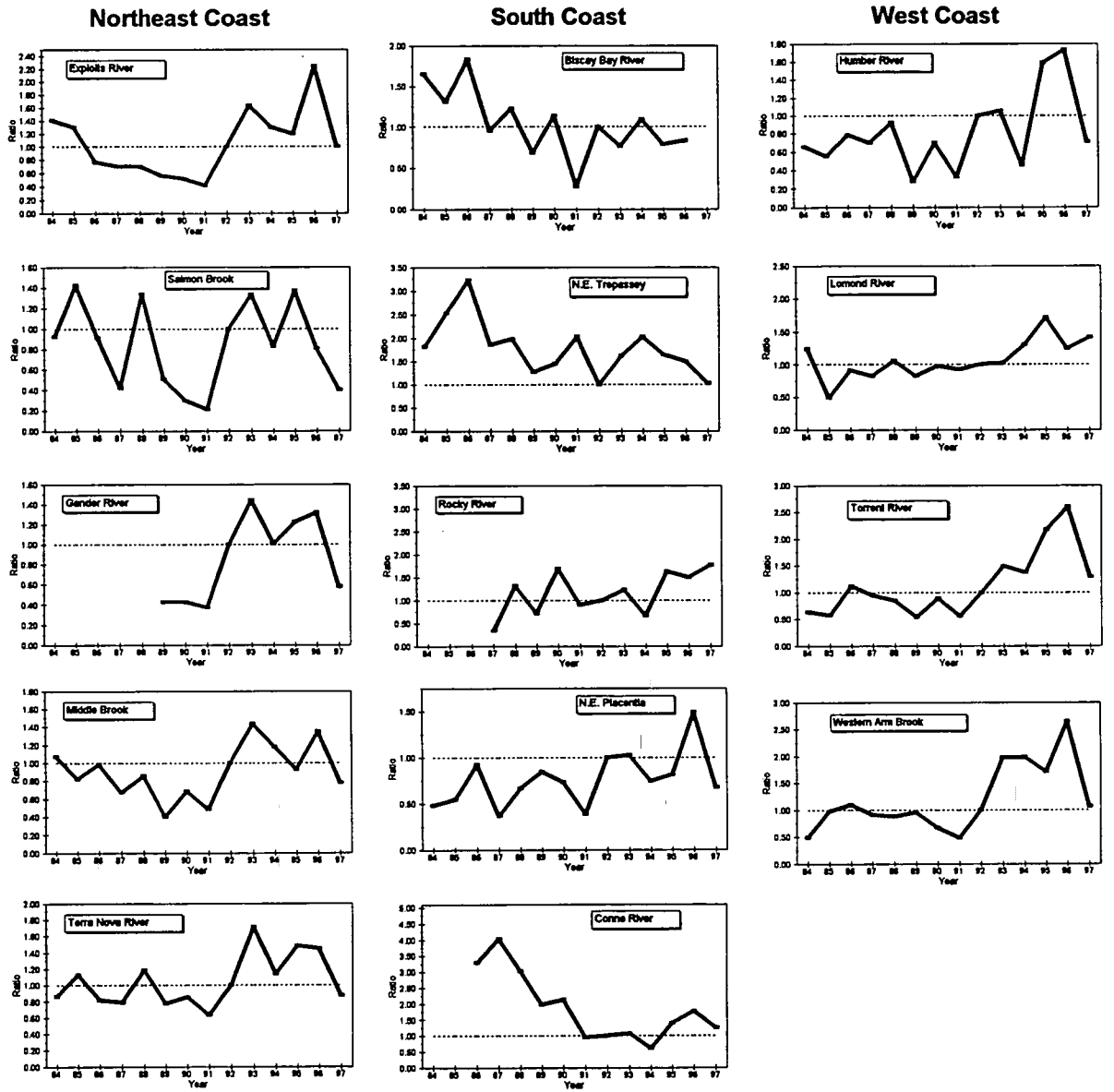

Figure 1. Ratio of the total estimated returns of small salmon to various rivers relative to the 1992 reference index year for various Northeast, South, and West coast Newfoundland, Atlantic salmon rivers. Horizontal dashed line represents the 1992 reference year: the first year of the commercial salmon fishery moratorium. Humber River returns for 1984-91 estimated using angling exploitation rates, with other years derived from mark-recapture studies.

Small Salmon

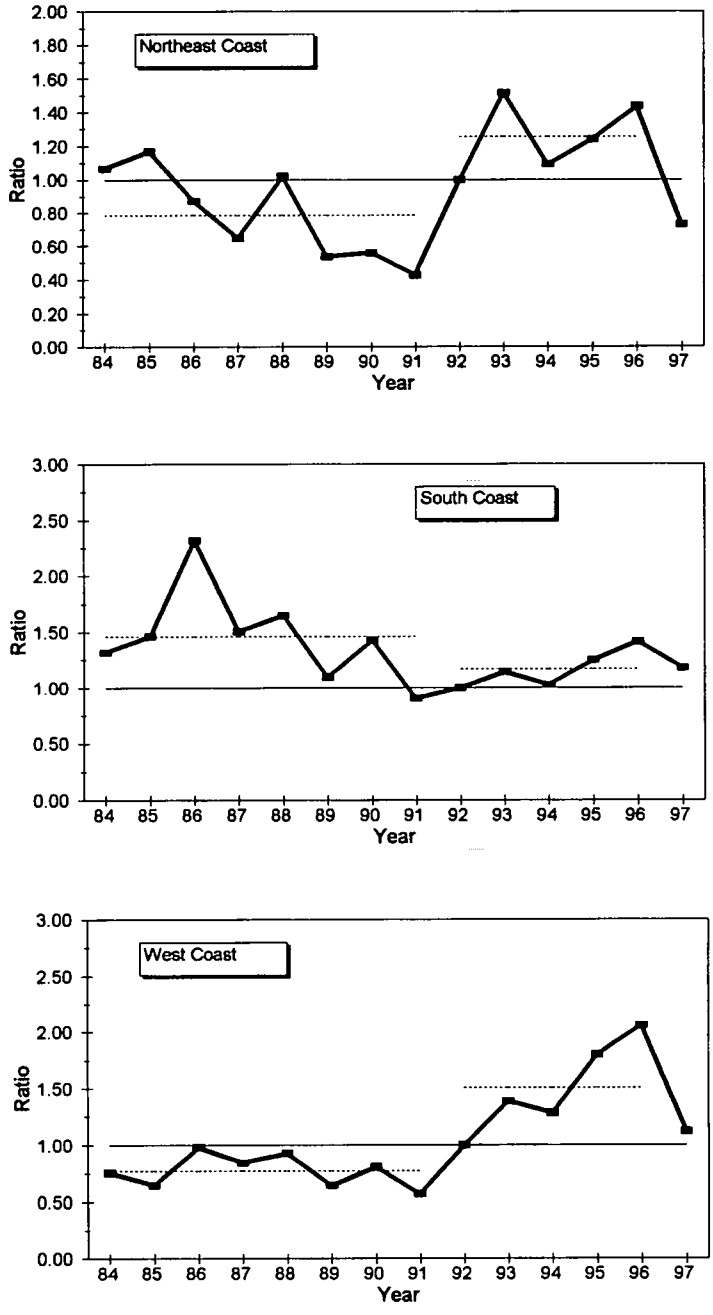

Figure 2. Ratio of the estimated returns of small salmon relative to the 1992 reference index year for various Northeast, South, and West Coast Newfoundland, Atlantic salmon rivers combined. Solid horizontal line represents the 1992 reference year while the two dashed lines indicate the average for the 1984-1991 pre-moratorium or 1992-1996 moratorium years.

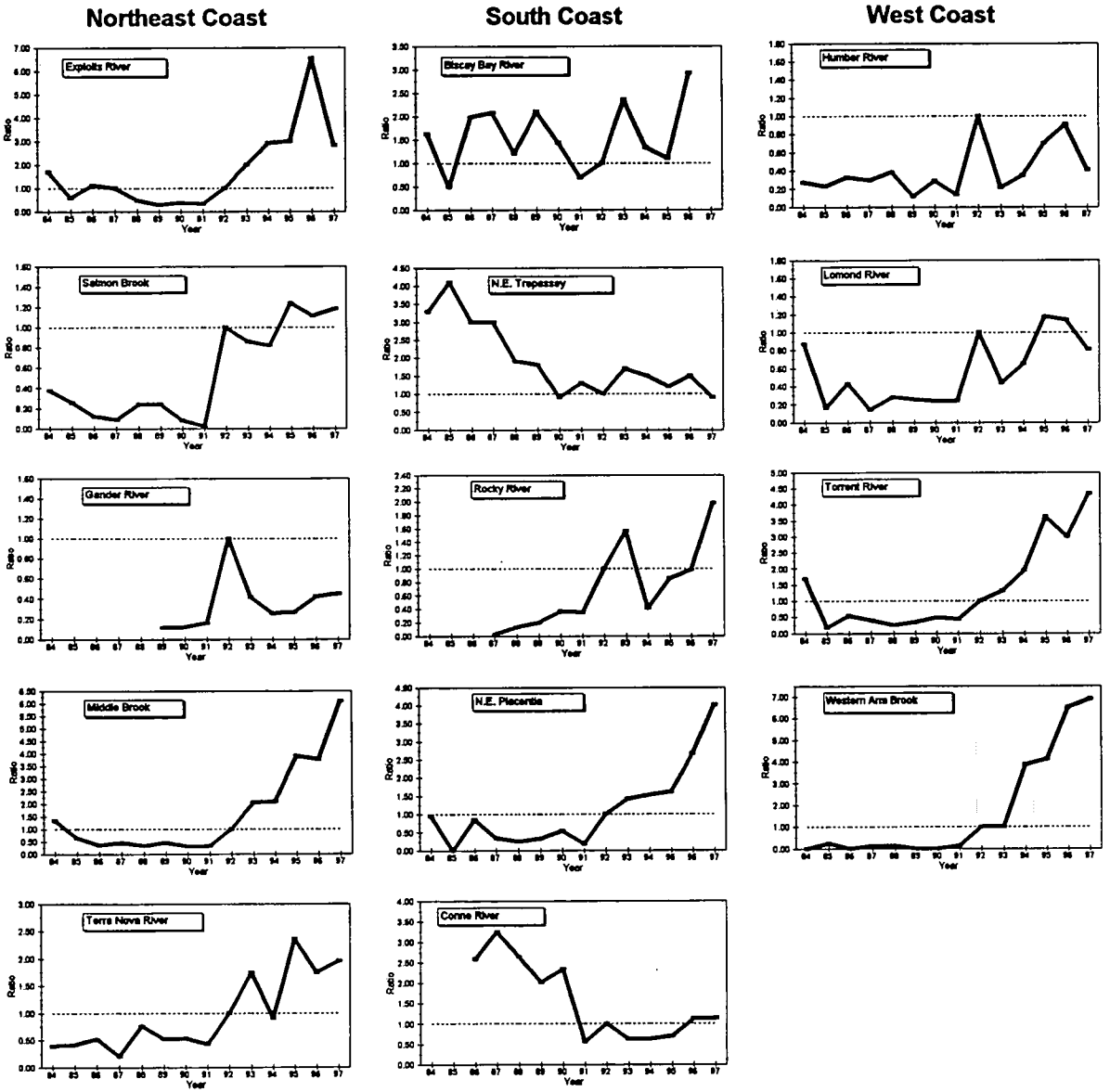

Figure 3. Ratio of the total estimated returns of large salmon to various rivers relative to the 1992 reference index year for various Northeast, South, and West coast Newfoundland, Atlantic salmon rivers. Horizontal dashed line represents the 1992 reference year: the first year of the commercial salmon fishery moratorium. Humber River returns from 1984-91 were estimated using an angling exploitation rate. Other years were derived from mark-recapture studies.

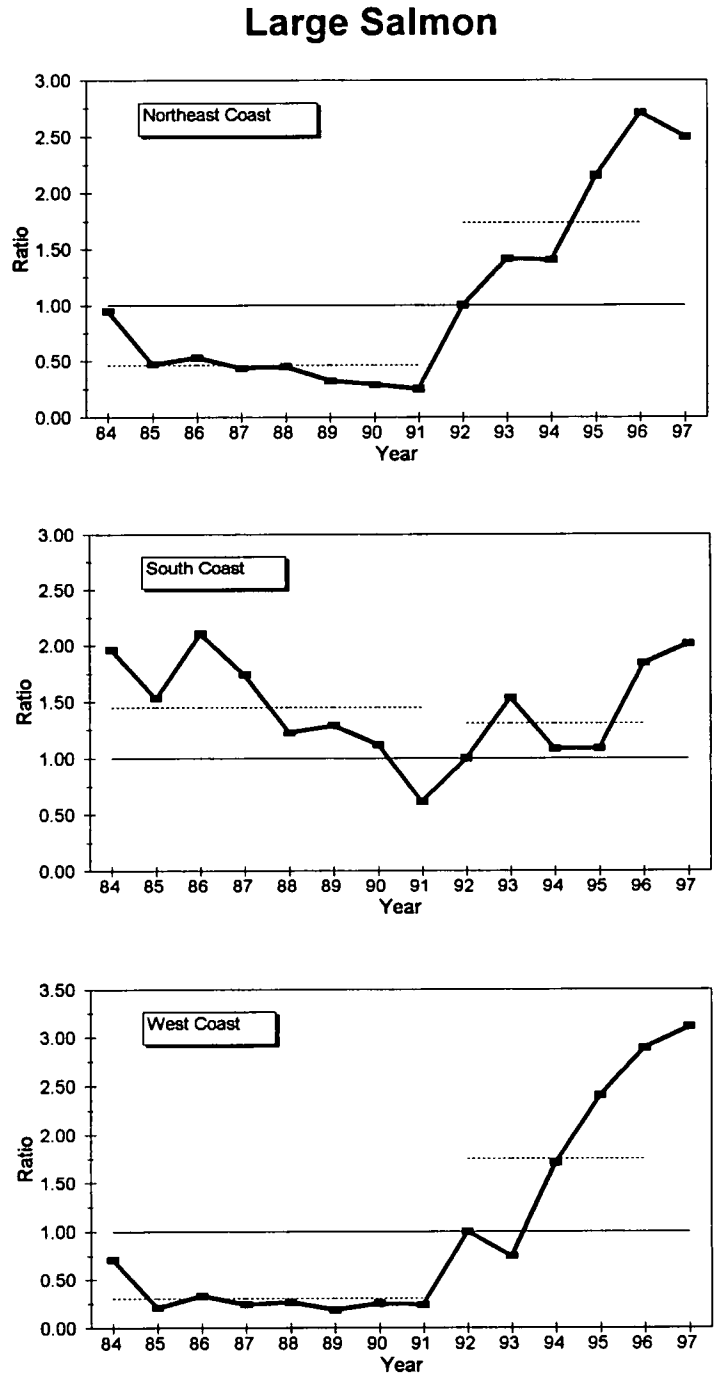

Figure 4. Ratio of the estimated returns of large salmon relative to the 1992 reference index year for various Northeast, South, and West Coast Newfoundland, Atlantic salmon rivers combined. Solid horizontal line represents the 1992 reference year while the two dashed lines indicate the average for the 1984-1991 pre-moratorium or 1992-1996 moratorium years.

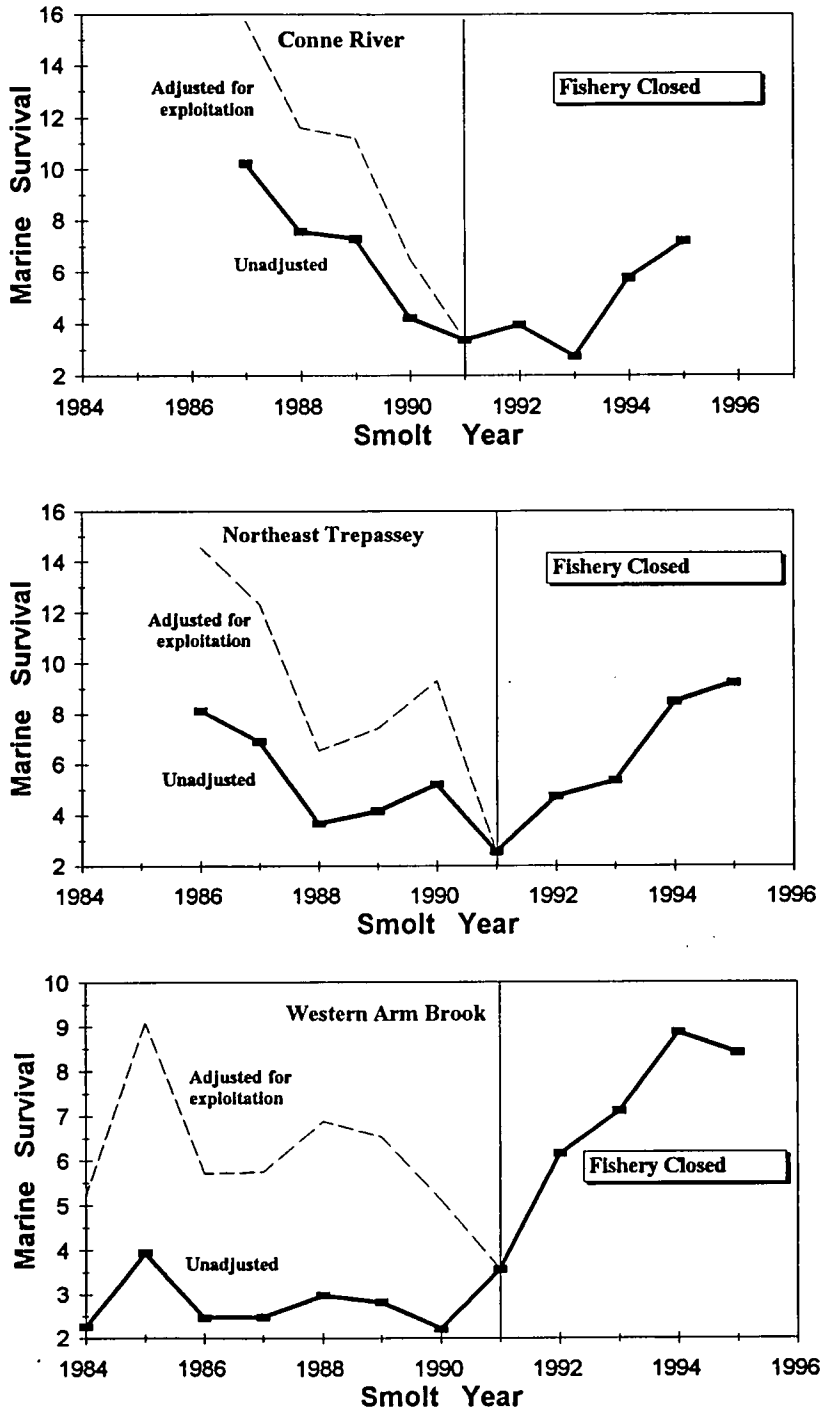

Figure 5. Estimates of marine survival from smolts in year i to adult small salmon in year i+1. Dashed line represents the marine survival adjusted for average marine exploitation rate.

Appendix 1. Total returns of small and large Atlantic salmon to various Newfoundland rivers.

Small salmon

	Northeast Coast					South Coast					West Coast			
Year	Exploits	Salmon Bk.	Gander	Middle Bk.	Terra Nova	Biscay Bay	Northeast Trepassey	Rocky	Northeast Placentia	Conne	Humber	Lomond	Torrent	Western Arm Bk.
1984	19028	1081		1675	1534	2430	89		459		11488	986	1805	235
1985	17555	1663		1283	2012	1926	124		519		9720	393	1623	466
1986	10343	1064		1547	1459	2688	158		879	8302	13824	725	3155	527
1987	9481	493		1053	1404	1393	91	80	350	10155	12296	652	2670	437
1988	9496	1562		1337	2114	1802	97	313	637	7627	16168	841	2388	422
1989	7577	596	7743	626	1377	1004	62	168	809	4968	4868	652	1512	455
1990	6995	345	7740	1070	1518	1670	71	401	699	5368	12216	777	2518	322
1991	5659	245	6745	763	1127	394	99	211	368	2411	5724	731	1565	233
1992	13504	1168	18179	1563	1780	1467	49	237	956	2523	17571	794	2832	480
1993	22150	1560	26205	2247	3050	1117	79	292	980	2703	18477	816	4215	947
1994	17556	968	18273	1844	2035	1600	99	158	710	1533	7995	1038	3891	954
1995	16149	1600	22266	1448	2638	1151	80	385	774	3502	27898	1364	6167	823
1996	30316	946	23946	2112	2575	1217	73	356	1420	4440	30445	983	7371	1272

Large salmon

	Northeast Coast					South Coast					West Coast			
Year	Exploits	Salmon Bk.	Gander	Middle Bk.	Terra Nova	Biscay Bay	Northeast Trepassey	Rocky	Northeast Placentia	Conne	Humber	Lomond	Torrent	Western Arm Bk.
1984	529	38		57	107	83	33		44		804	75	288	0
1985	183	26		27	112	25	41		0		680	14	30	2
1986	355	12		15	140	101	30		39	412	968	37	93	0
1987	310	9		19	56	106	30	1	16	516	861	12	68	1
1988	147	24		14	206	61	19	6	11	420	1132	24	44	1
1989	89	24	473	19	142	107	18	9	15	320	341	22	60	0
1990	122	8	508	13	144	73	9	17	25	372	855	20	82	0
1991	99	2	670	14	114	35	13	16	8	89	401	21	73	1
1992	314	101	4180	43	270	51	10	46	46	159	2945	86	170	8
1993	627	87	1734	88	472	120	17	72	65	100	636	38	224	8
1994	916	83	1072	90	246	68	15	19	70	100	1030	56	332	31
1995	941	125	1121	168	638	56	12	39	74	110	2064	101	615	33
1996	2053	112	1753	161	472	149	15	45	123	179	2679	98	510	52