Fisheries and Oceans / Pêches et Océans

Canadian Stock Assessment Secretariat
Research Document 98/118

Not to be cited without
permission of the authors[1]

Secrétariat canadien pour l'évaluation des stocks
Document de recherche 98/118

Ne pas citer sans
autorisation des auteurs[1]

Status of Atlantic salmon (*Salmo salar* L.) Stocks in Labrador, 1997

by

D. G. Reddin, C. C. Mullins, M. F. O'Connell and N. M. Cochrane
Science Branch
Department of Fisheries and Oceans
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1

[1] This series documents the scientific basis for the evaluation of fisheries resources in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research documents are produced in the official language in which they are provided to the Secretariat.

[1] La présente série documente les bases scientifiques des évaluations des ressources halieutiques du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Les documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au secrétariat.

ISSN 1480-4883
Ottawa, 1998

Canada

Abstract

There were further reductions in commercial quotas in Labrador in 1997 with the complete closure of SFA 14B. In SFAs 1 & 2, the fishing season opened on 20 June similar to 1996 and quotas remained unchanged. The quota was caught only in SFA 2 in 1997. Labrador total number of recruits, particularly the large salmon component, continued to be low compared to the 1970s while the small component increased slightly over those of 1996. Management measures in recent years; however, have resulted in improved spawning escapements, with the potential for increased returns beginning in the year 1999. An analysis of salmon abundance based on sales slips indicated that salmon abundance did not decline substantially in Labrador in 1997 as it did in other areas of Atlantic Canada. It is recommended that fishing mortality not increase at this time. In spite of the commercial fishery closure in 1997 and the restrictions on retention of large salmon, the estimated spawning escapements of small and large salmon in SFA 14B were probably at or near their lowest level ever. A summary of the seal and salmon fishery questionnaire is provided. Fishers reported that seals remove many salmon from their nets and damage others which reduces their incomes and spawners returning to rivers.

Résumé

La fermeture complète de la ZPS 14B en 1997 a donné lieu à une autre réduction des quotas commerciaux au Labrador. Dans les ZPS 1 et 2, la saison a débuté le 20 juin, comme en 1996, et les quotas sont demeurés inchangés. Le quota n'a été atteint que dans la ZPS 2 en 1997. Le nombre total de recrues au Labrador, surtout celui de la composante des grands saumons, a continué d'être faible comparativement aux valeurs des années 1970, mais celui de la composante des petits saumons a été légèrement supérieur à celui de 1996. Les mesures de gestion adoptées ces dernières années ont cependant permis d'accroître les échappées de géniteurs et les résultats de ces interventions devraient être visibles au début de 1999. Une analyse de l'abondance du saumon fondée sur les bordereaux de vente montre qu'elle n'a pas décliné de façon appréciable au Labrador en 1997, comme cela a été le cas dans d'autres zones du Canada atlantique. Il est recommandé de ne pas accroître la mortalité par pêche. En dépit de la fermeture de la pêche commerciale en 1997 et de restrictions quant au nombre de grands saumons pouvant être conservés, les échappées estimées de grands et de petits saumons dans la ZPS 14B ont sans doute été les plus faibles jamais notées. Un sommaire des résultats du questionnaire sur le phoque et le saumon est présenté. Les pêcheurs ont signalé que les phoques prélevaient beaucoup de saumons des filets et qu'ils en endommageaient d'autres, ce qui avait pour effet de réduire leurs revenus de même que le nombre de géniteurs revenant aux rivières.

Introduction

Labrador forms the northeastern edge of the North American continent and, covering an area of 293,000 km^2, it comprises 3% of Canada's total landmass. The linear distance from the Quebec border at Blanc Sablon to the northernmost point at Cape Chidley is 1,125 km (Fig. 1). Labrador contains vast areas of freshwater found in the many streams, rivers and lakes dotting the landscape. While only 19 rivers in Labrador are 'scheduled' for salmon angling, meaning that anglers must have a license and can angle only with artificial flies, there are a further 60 or so rivers with Atlantic salmon populations. The most northerly river with a substantial salmon population is generally considered to be Flowers River just to the north of the community of Hopedale on the coast. Many commercial and private fishing camps are operated annually and accommodate anglers from insular Newfoundland, other provinces of Canada, and from around the world. The commercial fishery along the coast is an important source of income for coastal residents and harvests salmon that originate mainly in Labrador rivers.

This paper presents the general status of Atlantic salmon stocks in Labrador in 1997. Catch and effort data for the commercial fishery in Labrador and angling fisheries and counts of Atlantic salmon at fishways and counting fences are examined in relation to historic data and management measures in effect in 1997. Assessments for individual stocks are presented in separate documents and include information collected for Big Brook (SFA 1) and Pinware and Forteau rivers (SFA 14B).

MANAGEMENT MEASURES

A five-year moratorium was placed on the commercial Atlantic salmon fishery in insular Newfoundland in 1992, while in Labrador commercial fishing continued under quotas or allowance catches. In addition, a commercial license retirement program went into effect on a voluntary basis in Labrador, which has substantially reduced fishing effort. These regulations continue a long-standing history of implementation of management programs to prevent stock declines and allow populations to rebuild (May 1993). Some of these management policies were still in effect in 1997. The angling fishery in Labrador has been controlled by reductions in season bag limits and retention limits for large salmon.

Commercial fishery

The aboriginal people of Labrador have utilized salmon for food since the beginning of time. Although fish populations in Labrador were possibly exploited by early Viking explorers and Basque fishermen who came to Labrador to hunt whales; the commercial exploitation of salmon by Europeans began in the latter part of the 18th century (Taylor 1985). Early exploitation involved placing weirs across the mouths of rivers. The present commercial salmon fishery in coastal Labrador is a mixed-stock fishery harvesting salmon from a variety of rivers in North America; although tagging studies and analysis of age

composition of catch samples (Reddin & Dempson 1986) show that the majority of salmon harvested originate in Labrador rivers (Pippy 1982). The fishing gear in current use is gillnets constructed of multi-filament twine with a minimum opening of 127 mm-stretched measure. Labrador origin salmon were harvested in the commercial fishery in Newfoundland until the moratorium in 1992 and are still harvested at west Greenland and possibly to a minor extent in the north shore area of Quebec adjacent to the straits shore region of Labrador.

Quotas (t) for Labrador Salmon Fishing Areas (SFA) 1, 2, and 14B in 1997 and since they were first introduced in 1990 were as follows:

Year	Salmon Fishing Areas		
	1*	2	14B
1990	80	200	50+10**
1991	80	200	15
1992	80	180	13
1993	80	90	8
1994	24	60	8
1995	19	48	6.5
1996	14.5	35.5	5
1997	14.5	35.5	Closed

*Allowance catch up to 1993.

**The 1990 quota of 50 t was for all of SFA 14; there was also a supplementary quota of 10 t for SFA 14B.

Angling fishery

The angling season for retention in scheduled rivers in SFAs 1, 2, & 14B opened on June 21 and closed on September 14. The season limit in SFAs 1 & 2 was six salmon only one of which could be a large salmon. In SFA 14B, the season limit was 6 salmon, none of which could be a large salmon. In SFA 14B, anglers were restricted to three salmon prior to July 31 and three salmon after July 31. Daily bag limits were two salmon retained and four caught and released per day. There were no closures in Labrador due to low water/high temperatures in 1997. In SFA 14B, the Pinware River angling fishery closed to retention on August 14 permitting only hook and release and Forteau and Lance aux Loup brooks were closed to all angling on August 14 due to low returns. After August 14, anglers could no longer retain any salmon caught in non-scheduled waters anywhere in the province (including coastal waters). These additional restrictions meant that after Thursday, August 14, anglers could retain salmon only in scheduled salmon rivers in SFAs 1 & 2. There are 19 scheduled rivers in Labrador: Forteau Brook, Lance au Loup Brook, and Pinware River in SFA 14B, St. Mary's River, Shinneys River, Reids Pond River and Reids Pond, Hawke River, Gilbert River,

Sand Hill River, and Eagle River in SFA 2, Double Mer, Tom Luscombe River, Big Brook (Michaels River), Big River, Little Bay River, Ujutok & Adlatok River, Hunt River, and Flowers River in SFA 1.

ENVIRONMENTAL CONDITIONS IN 1997

Freshwater environment

Water conditions in Labrador during June, July and August in 1997 were measured at Department of Environment climatological stations at Eagle and Alexis River in SFA 2. A new station has also become operational on Reid Brook, Voiseys Bay. Atmospheric climatology data is also collected at Cartwright and Rigolet. The following interpretations were based on monthly averages. Stream flows as measured at Eagle River were 85% of median mean flows for the month of June, 171% for July, and 183% for August. Additional reports from Fisheries Officers along the coast were that water conditions were very high in July and August. High water conditions will typically reduce the catchability of salmon in the angling fishery reducing quality of catch rate as an index of abundance.

Marine environment

During January of 1997, positive air temperature anomalies covered most of northern Labrador and the Canadian Arctic with values reaching 4°C in Baffin Bay in the Davis Strait. Air temperature anomalies on the northern Labrador Shelf exceeded 1°C. Rapid cooling during February resulted in very cold air temperatures over the Labrador Sea with anomalies exceeding -3°C. The colder than normal air temperatures continued into May. In June, the Labrador Sea was covered by air that was above normal temperatures. During the summer months, air temperatures varied about their normal levels both spatially and from month to month.

During winter of 1997, sea ice along the Labrador coast was at near normal to high levels of concentration and thickness. In May, strong northeasterly winds over southern Labrador packed ice inshore along the Labrador coast. Retreat of ice proceeded rapidly during May resulting in ice extent and coverage that was well north of its normal position by 1 June. Ice remained off the mouth of Hamilton Inlet through June and was still there on 1 July. By 10 July, all traces of ice had disappeared from southern Labrador. Ice continued to retreat northwards so that by mid-July most of the northern Labrador coast was also clear of ice. This is early for northern Labrador and contrasts with conditions in recent years which saw large amounts of ice present for most of the summer from Hamilton Inlet north. In summary, 1997 was an average to lighter-than-average ice year on the Labrador coast and in the Labrador Sea.

Sea surface temperatures were average to above average for most areas of coastal Labrador during spring of 1996 to early summer of 1997.

LABRADOR SALMON STOCKS

Anderson (1985) lists about 80 rivers in Labrador with salmon populations along with substantial numbers of Arctic charr and sea-run brook trout. Labrador salmon rivers have always been renowned for their high proportion of large MSW salmon, particularly favoured by both anglers and commercial fishers. Because of the pristine nature of the environment in Labrador, yet to be spoiled by dams for hydroelectric development or water abstraction, Labrador remains one of the only areas of North America with habitat for fish stocks in a near-to original state.

Methods

SOURCES OF DATA

Commercial and recreational fishery catch and effort data and fishway and counting fence data were added to that presented in O'Connell et al. (MS 1997a). For the Labrador commercial fishery, data were compiled by the Statistics and Informatics Branch of the Department of Fisheries and Oceans (DFO) in the manner described by Ash and O'Connell (1987a,b). This includes estimates of salmon sold locally or consumed locally by the Fisheries Officers for each community. Beginning in 1993, each sales slip also included the PFV (Personal Fishing Vessel), number which identifies an individual fisherman as well as the amount of salmon purchased, date and location. Because of the introduction of quotas followed subsequently by their reduction and substantial reduction in licenced effort through voluntary buy-backs; the sales-slip database is the only continuous data that can be used to examine abundance of Labrador salmon stocks. The landings recorded on sales slips were adjusted for local sales, only the records of fishermen who were active in 1997, and landings occurring within the 1997 fishing dates of 20 June - 15 October (SFA 1) and 20 June - 15 July (SFA 2). An analysis of variance model (PROC GLM) was used to compare landings from 1993-97. Landings were logged.

Angling fishery data were compiled by DFO as described by Ash and O'Connell (1987a,b) and Mullins and Claytor (1989). Catch statistics for both retained and released small salmon were used in 1992-97. Catch information for released large salmon has been available since 1985 for SFA 14B but the data series is incomplete for 1996. Angling fishing effort was presented as rod days, defined as any day or part of a day during which an angler fished.

Beginning for 1994, a new angling statistics system, the License Stub Return System (LSRS) has come into general use. Specifically, a stub is attached to each license for anglers to record his/her catch and release information for the year. The completed license stubs returned to DFO by each angler in conjunction with a record of license sales are used to estimate catches and effort for each river in the province. Details on the License Stub Return System and its potential usefulness are given in O'Connell et

al. (1998). Basically, for SFAs 1 and 2, it was decided to continue utilizing the DFO catch time series; however, for SFA 14B it was recommended that data from the License Stub Return System be used.

Commercial salmon fishers were surveyed to learn more about seals interacting with salmon gear and to determine the level of non-catch fishing mortality caused by seals. The survey was conducted in January-February of 1998. The survey questions are shown in Appendix 1. The survey was designed with the assistance of Dr. L. Felt, Memorial University of Newfoundland. The surveys were sent out from the area office in Goose Bay, Labrador to be returned by mid-February.

IMPACTS OF MANAGEMENT MEASURES, LABRADOR

The effects of management measures taken in the coastal waters of Labrador were evaluated by:

- Comparing weekly distribution of catches in the former fishing season and the current reduced season; and,
- Exploitation rates from tagging studies for Sand Hill River, 1969-73 and reductions in the number of licensed salmon fishers.

Reduction in commercial salmon fishing season in 1997

The commercial fishing season opened on 20 June in 1997 similar to that of 1996. Beginning in 1995, opening dates were changed from 15 May to 5 June in Labrador. The impact of the earlier season and reductions due to quotas being attained in SFA 2 on numbers of Atlantic salmon landed in 1997, was examined using weekly landings from 1974-89 in SFAs 1 and 2. Landings for 1974-89 were used as a basis due to the lack of ice and earlier run timing experienced in those years, similar to conditions and run timing in 1997. The percentage of landings that would have occurred in the shorter season was calculated as the quotient of summed landings during the weeks of the 1997 season and landings actually made for that year in a full fishing season.

Effort changes

Losses or gains in landings due to effort reductions since 1991 were evaluated using the method of Anon. (MS 1995). Assumed base exploitation rates (F) in the commercial fishery (0.7-0.9 for large salmon; 0.3-0.5 for small salmon) (Anon. MS 1995) were adjusted using changes in licensed effort since 1991 and the following equations:

$$U = 1-e^{-aF} \qquad (1)$$

Where U = adjusted exploitation rate, a = the fraction of the 1991 licensed effort remaining in 1992-97, and F = fishing mortality. An assumption of this method is that each fishermen fishes the four nets allowed by their license.

ESTIMATES OF TOTAL POPULATION SIZE

The total population sizes of small and large salmon prior to the commercial fishery in SFAs 1, 2 and 14B of Labrador were estimated by the technique of Rago *et al.* (MS 1993a,b), updated to include 1997 values. For SFA 14B, where the fishery was closed in 1997, population estimates from studies on Forteau Brook and Pinware River adjusted to drainage areas for the entire zone were used instead. Parameters used to estimate total populations of small and large salmon were commercial catches, exploitation rates adjusted for fishing effort and reduced season, proportion Labrador origin salmon in commercial catches, and proportions of various sea age classes. Confidence intervals for the population sizes of small and large salmon were simulated using Monte Carlo techniques.

RECRUITMENT OVERFISHING

A definition of recruitment overfishing is the level of fishing mortality that reduces the ability of a population to persist; more specifically, it is the failure of a cohort of spawners to replace itself at the same time as fishing occurs. If returning spawners are not replacing the spawners that produced them, and if this situation continues over a series of years, then the total population will decline. One way to evaluate salmon stocks for recruitment overfishing is through the examination of spawner-to-spawner relationships. Estimated numbers of spawners obtained from parental cohorts of small and large (2SW) salmon were traced backward, beginning with the estimate of the number of spawners for the current year. Data sets of the relevant information were examined to see if numbers of spawners, made up of a range of chronological ages, were sufficient to replace the weighted sum of spawning parents of the same sea age. The appropriate weighting for historical spawners was determined from the average smolt-age distribution of samples collected from anglers and sampled at counting fences in Labrador rivers.

The relative importance of the cohorts that produced the returns in any given year can be expressed as a weighted average of the appropriately lagged spawners. For example, let β_{ijk} equal the expected frequency of size class i, river age j smolts for stock (or region) k, where i=1, 2 size classes, j=1,2,....,6 smolt ages and k=1,2,...,5 stocks (or regions). The number of spawners (SP) in year t can be written as:

$$SP_{i,k}(t) = \alpha_{t,k} \sum_{i+2}^{i+7} \beta_{j-i-1,k} \; SP_{i,k}(t-j) \qquad (2)$$

where $\alpha_k = 1$ is the stock at replacement level, $\alpha_k > 1$ implies population growth, and $\alpha_k < 1$ implies that the population is shrinking. Thus, α provides a measure of recruitment overfishing, i.e. recruitment falling below replacement. Because of the long life history of salmon in Newfoundland and Labrador, the lags can be difficult to determine. For example, when 6-year-old smolts contribute to the 2SW spawners, the analysis is restricted to the return year period of 1978-1997. Also note that this treats the large salmon category as if they were all 2SW spawners (either virgin or repeat spawners). The commercial fishing moratorium in Newfoundland is allowing a much higher number of repeat spawners to return to freshwater for some stocks and if this occurs in Labrador it will become necessary to alter Equation 2 to account for repeat spawners.

A second definition of recruitment overfishing is defined with reference to the target spawners for a given river system. Since the target spawners can be expressed for each river system as a product of the biological reference level and available rearing habitat for pond and riverine habitats, the percent of conservation spawning requirement achieved provides a useful measure of recruitment overfishing. Recruitment overfishing would be deemed to have occurred if the percent of conservation requirement achieved is less than 100%. More problematic for the survival of a stock would be the situation where both definitions of recruitment overfishing occur simultaneously. The methodology used to derive the conservation spawning requirements for Labrador is described in O'Connell *et al.* (MS 1997b).

Results & Discussion

THE LABRADOR COMMERCIAL FISHERY, 1997

The percentages of quota caught and quotas in tonnes (in parentheses) in 1990-97 were as follows:

Year	SFA 1	SFA 2	SFA 14B	SFAs 1, 2,& 14B
1990	65 (80)	64 (200)	38 (60)	59 (340)
1991	13 (80)	38 (200)	227 (15)	41 (295)
1992	83 (80)	67 (180)	131 (13)	75 (273)
1993	31 (80)	76 (90)	238 (8)	63 (178)
1994	96 (24)	107 (60)	75 (8)	101 (92)
1995	79 (19)	79 (48)	31 (6.5)	76 (73.5)
1996	62 (14.5)	99 (35.5)	80 (5)	87 (55)
1997	60 (14.5)	108 (35.5)	**CLOSED**	94 (50)

In 1997, the quota was caught in SFA 2 but not in SFA 1. It should be noted that quotas in 1993 (except for SFA 1), 1994, 1995, and 1996 (the lowest yet) were substantially lower than in years prior to 1993. This general lowering of the quota makes comparison of current catches to those of previous years as an index of abundance inappropriate without adjustment for changing management regimes.

The commercial catch of small salmon (3,526 kg) in SFA 1 in 1997 (Table 1 and Fig. 2a) increased from 1996 (10%) and decreased from the 1984-89 (-88%), 1986-91 (-86%), and 1992-96 (-59%) means. The catch of large salmon in 1997 (5,165 kg) also decreased from 1996 (-7%) and the means (-93, -91, and -73%, respectively) (Table 1 and Fig. 2b). The 1997 catch of small salmon in SFA 2 (18,003) (Table 2 and Fig. 2a) was considerably above that of 1996 (75%) but below the means of 1984-89 (-77%) and 1986-91 (-77%), and slightly above that of 1992-96 (15%). The catch of large salmon (20,265 kg) was below 1996 and the means (-19, -86, -85, and -60%, respectively) (Table 2 and Fig. 2b). The commercial salmon fishery was closed in SFA 14B in 1997 (Table 3). Previous catches are shown in Table 3 and Figures 2a & 2b for general information. For all SFAs in Labrador combined (Table 4 and Fig. 2a), the catch of small salmon (21,529 kg) in 1997 increased from 1996 (42%) and decreased from the means (-82, -82, and -17%, respectively). The catch of large salmon (25,430 kg) in 1997 declined from 1996 and the means (-22, -90, -89, and -67%, respectively) (Table 4 and Fig. 2b).

Total commercial catch (8,691 kg) in SFA 1 in 1997 declined from 1996 (-1%) and from the 1984-89 (-91%), 1986-91 (-90%), and 1992-96 (-69%) means (Table 1 and Fig. 2c). Likewise, for SFA 2, the catch in 1997 (38,268 kg) increased from 1996 but declined from the means (8, -83, -82, and -42%, respectively) (Table 2 and Fig. 2c). The commercial salmon fishery in SFA 14B was closed in 1997. For all of Labrador, the total catch (46,959 kg) in 1997 decreased from 1996 by 2% and from the means by

-87% (1984-89), -86% (1986-91), and -55% (1992-96) (Table 4 and Fig. 2c). Total catches in the Labrador commercial salmon fishery in 1997 in SFAs 1 & 2 increased slightly from those of 1996, which were the lowest recorded.

In order to ensure a complete record of mortalities, the amount of salmon consumed locally is estimated by local Fisheries Officers and included as part of the catch statistics. In SFA 1, local sales have varied annually in absolute terms and as a proportion of the catch (Fig. 3). In SFA 1, local sales have ranged from 1,400 kg to 24,000 kg and as a percent of total landings have ranged from 10% to 40%. In SFA 2, local sales have ranged from 6,400 kg to 20,100 kg and as a percent of total landings have ranged from 6% to 22%. Any comparison of landings must take into account local sales and its variability.

The results of the seals and the commercial salmon fishery survey are given in Appendix 1. For assessment purposes, it is important to know how many salmon are killed as a result of fishing either directly as catch or indirectly as non-catch fishing mortalities (Ricker 1975). Mortalities due to fishing but not recorded as part of the catch statistics have been defined as non-catch fishing mortalities and include those fish killed due to both illegal and legal fishing activities (Ricker 1976). One type of non-catch fishing mortality is salmon removed from nets by seals. The information supplied by commercial fishermen indicated that their catches would be about 60% higher if seals did not remove salmon from them (Mean = 6.2 salmon per 10 caught, mode=0, median=3, minimum=0, maximum=40). However, the range of values presented by individual fishermen is very high with coefficients of variation about 125%. Also many fishermen said that they simply did not know the magnitude of seal removals; although they thought it was substantial which adds to the uncertainty. Most fishermen reported that seal problems worsened circa the late 1980s. The effect of non-catch fishing mortalities if included in population estimates would be to increase the population size although the overall trends in population sizes would remain similar to those when seal removals were not included in population estimates. It is recommended that experiments/logbooks be kept in 1998 by selected fishermen to further quantify losses.

The survey information indicates that removals of salmon by seals and other predators do cause problems for the commercial fishers during the salmon season. Damage to gear is sometimes extensive and the damaged salmon in nets are unmarketable thus reducing fisher incomes. Some fishers also expressed concern about mortalities of salmon and other fish species aside from removals from nets during the salmon fishery. These mortalities could take place at sea or in rivers, which are known to have seals, mainly harbour seals, during the entire year. While there is no doubt from the observations by commercial fishers that these events are taking place; there is a requirement to quantify the impact that can only be done by a detailed study.

THE LABRADOR ANGLING SALMON FISHERY, 1997

Recreational catches of small and large salmon, effort, and catch per unit of effort (CPUE) for Labrador (SFAs 1, 2, and 14B, combined) are presented in tables 5, 6, 7 and 8 and in figures 4(a), 4(b), and 4(c). It is not possible to meaningfully compare catches, effort, and CPUE in 1996 and 1997 to other years or series of years combined as means for all of Labrador because of the switch from DFO angling data to License Stub Return System data for SFA 14B in 1996-97. In 1996-97, angling data used for SFAs 1 and 2 was collected by angling camps and fisheries officers similar to previous years. Angling catch data is more comparable within SFAs but still is not without problems due to low exploitation, variable camp opening dates, and changes in regulations governing retention of salmon, in particular large salmon.

SFA 1: Total catches of small and large salmon (retained plus released fish) in 1997 increased markedly from 1996; although remaining below the 1984-89, 1986-91 and 1992-96 means. Effort increased substantially over that of 1996 and increased from the 1984-89, 1986-91 and 1992-96 means. CPUE decreased slightly from 1996 and remained well below the 1984-89, 1986-91, and 1992-96 means (Table 6, Fig. 4(a)).

The numbers of small salmon retained in 1997 were slightly higher than in 1996 but substantially lower than the 1984-89, 1986-91 and 1992-96 means and large salmon were similar to those in 1996 but lower than the 1984-89, 1986-91 and 1992-96 means. The numbers of small salmon released in 1997 increased from 1996 but declined from the 1992-96 mean. The number of large salmon released increased from 1996 but was lower than the 1992-96 mean (Table 6, Fig. 4(a)).

SFA 2: Total catches of small and large salmon (retained plus released fish) in 1997 declined substantially from 1996 but increased over the 1984-89 and 1986-91 means; although slightly lower than the 1992-96 mean. Effort decreased compared to 1996 and the 1984-89, 1986-91 and 1992-96 means. CPUE showed an overall decrease from that of 1996 and the 1984-89, 1986-91, and 1992-96 means (Table 7, Fig. 4(b)).

The numbers of small and large salmon retained in 1997 declined substantially from 1996 and from the 1984-89, 1986-91 and 1992-96 means; only those for small salmon increased over the 1992-96 mean. The numbers of small and large salmon released in 1997 declined substantially from 1996 and the 1992-96 mean (Table 7, Fig. 4(b)).

SFA 14B: Total catches of small and large salmon (retained plus released fish) in 1997, although considerably lower than in 1996, were similar to 1995 and the 1984-89, 1986-91 and 1992-96 means. There are no angling effort data available for SFA 14B for 1996 and 1997 and hence no comparisons could be made (Table 8, Fig. 4(c)).

The numbers of small salmon retained in 1997 declined substantially from 1996 and from the 1984-89, 1986-91 and 1992-96 means. It was illegal to retain large salmon in SFA 14B in 1997 and no comparison to other years is possible. The total numbers of

small and large salmon released in 1997 decreased from 1996 but was much higher than the 1992-96 mean. The number of small salmon released declined substantially from 1996 and was higher the 1992-96 mean. The number of large salmon released increased from 1996 and the 1992-96 mean (Table 8, Fig. 4(c)).

COUNTING FACILITIES, LABRADOR, 1997

SFA 1: A counting fence was operated in Big Brook, Labrador in 1997, the first counting fence in SFA 1 in recent years. The total returns of small salmon in 1997 were 530 and large were 104 (Reddin et al. 1998). The number of small salmon spawners were 454 and large 102 which is considerably below conservation requirements. Both the total returns and spawners are considered to be quite low compared to Sand Hill River and the production potential of Big Brook (Anderson 1985).

SFA 2: There were no counting facilities operated in SFA 2 in 1997.

SFA 14B: There were two assessment projects operating in SFA 14B in 1997; a counting fence on Forteau Brook and a mark-recapture experiment on Pinware River.

Forteau River

Counts of small and large salmon at the counting fence on Forteau River in 1997 indicated that the population was at an extremely low level. However, based on the daily counts and run timing in previous years it is possible that salmon could have entered the river before the counting fence was completely installed. The following text table summaries information for Forteau River:

	Fence Count		Returns					
Year	Small	Large	Small	Large	Total	Prop. Small	Small Ret. & Rel.	Angling ER for Small
1994	228	74	458	77	535	0.8561	327	
1995	315	136	461	147	608	0.7582	281	0.6095
1996	74 (p)							
1997	50 (p)	21	**223**	**56**	**279**		**136**	

Note: Conservation Requirement: 361 small and 140 large.

The total returns to the river in 1997 were also estimated based on the angling catch. The estimated total retained and released catch of small salmon in 1997 was approximately 136 fish. Based on an angling exploitation rate of 0.6095 for retained and released small salmon observed in 1995 when the counting fence was in the same

location as in 1997 (Lowe and Mullins, 1996), the total return of small salmon in 1997 was 223 fish. Based on the proportion of small (0.80) observed in 1994-95, the return of large salmon in 1997 was 56 fish. Given that the conservation requirement on the Forteau River is 361 small and 140 large this stock was at an extremely low level in 1997.

Pinware River

A mark-recapture estimate of the run size indicated that only 16% of the conservation egg deposition was achieved in 1997 (Mullins and Caines 1998). There is always some uncertainty in estimating population size based on the mark and recapture technique, especially when the numbers of tagged and recaptured are low. However, given the number of tags applied in 1997 and the number of recaptures observed in the recreational fishery and in the recapture trap, it is highly unlikely that the total population size was high enough to achieve the conservation egg deposition requirement in 1997.

The proportion of large salmon observed in 1997 was 40% higher than observed in the tagging and recapture traps operated in 1996, possibly due to the commercial fishery closure.

Thus, the total returns and recruits for SFA 14B including an adjustment for Lanse aux Loup Brook are 1,104 small salmon (663-1,545) and 237 large salmon (146-327). The prospects for 1998 are not good given that the stock has been experiencing a declining trend resulting from low spawning escapements in previous years. However, provided marine survival does not decline further and provided the current restrictions on recreational harvests are not relaxed, the contribution of the predominantly female large salmon to the total egg deposition should help the stock improve in the long term. In spite of the commercial fishery closure in 1997 and the restrictions on retention of large salmon, the estimated spawning escapements of small and large salmon in SFA 14B were probably at or near their lowest level ever.

IMPACTS OF MANAGEMENT MEASURES, LABRADOR COMMERCIAL FISHERY

Losses in landings due to reduced season

The presence of ice on the Labrador coast is an annual event that has an important influence on sea temperature and timing for setting out of commercial salmon nets. Several authors have noted the relationship between sea temperature and salmon migration with run timing generally being delayed in colder water (Reddin and Shearer 1987; Reddin and Friedland 1993; Narayanan *et al.* 1995). Since ice also can hinder the setting of salmon gear, its presence or absence delays or extends the actual fishing season considerably from year to year (Reddin and Day 1980). A portion of the variability in landings from year to year can be ascribed to ice conditions and sea surface temperature. Fishers in southern Labrador reported that 1997 was not as early a year in terms of ice

conditions and run timing as had been 1996 when salmon were available for capture in SFAs 2 and 14B immediately on the opening of the season on June 20. Ice conditions in 1997, were similar to those of 1974-89 which were years of average ice conditions. Thus, the proportionate distribution of the landings in 1997 may have been similar to those of 1974-89. In northern Labrador, ice conditions were unusually good with coastal ice retreating northward quickly and earlier than normal.

The results of adjusting catches for ice conditions show varying percentages of reductions in landings among SFAs, size classes, and years (Fig. 5). Average small salmon landings in the 1997 season (using as a base catches in 1974-89) would have been 100.0% of the landings in SFA 1 and 46.8% in SFA 2 with a full fishing season. Thus, small salmon landings in 1997 may have been reduced due to the shortened season by 0 kg in SFA 1 and 20,498 kg in SFA 2, based on the average reduction in landings from 1974 to 1989. Average large salmon landings in the reduced season would have been 100.0% of the actual landings in SFA 1 and 64.4% in SFA 2. Thus, large salmon landings in 1997 may have been reduced by 0 kg in SFA 1 and 11,207 kg in SFA 2, based on the average reduction in landings from previous years. Therefore, total Atlantic salmon landings in 1997 may have been reduced by 0 kg in SFA 1 and 31,705 kg in SFA 2, based on the sum of average reductions in small and large landings of previous years. In general, small salmon landings were reduced more than those of large salmon and reduction in landings in the shorter season were higher in SFA 2 than in SFA 1. The shorter 1997 commercial salmon fishing season in Labrador may have resulted in a loss in landings of 32 t.

Losses in landings due to effort reductions

The number of licenced and active commercial salmon fishermen in Labrador is shown in the text table below:

Fisher type	1991	1992	1993	1994	1995	1996	1997
Licenced	570	495	288	218	218	218	205
Active	513	446	262	194	153	127	138

Both the number of active and inactive licensed fishermen have declined annually from 1991 to 1997. There was a slight decline in licensed fishermen in 1997 due to the closure of SFA 14B commercial fishery; however, overall the number of active fishermen increased in 1997 over 1996 in spite of the SFA 14B closure. This may have been due to the late start of the crab fishery in 1997 over 1996.

Licensed effort in 1997 for all of Labrador was 36% of the 1991 level, which should have reduced commercial exploitation on Labrador stocks from what it would have been at the 1991 level. Estimates of active licenses based on fish plant sales slips suggested that 138 of the 205 licenses extant in 1997 were active. The adjusted estimates for exploitation rates in the commercial fishery in 1997 were for small salmon: 7-14% in SFA 1 and 4-8%

in SFA 2. For large salmon, adjusted exploitation rates were: 22-40% in SFA 1 and 16-28% in SFA 2. Thus, reductions in commercial licensed effort may have doubled the returns of large salmon to rivers in the three SFAs over that which would have occurred if licensed effort had remained at 1991 levels. A similar effect would be expected for small salmon. The combined effects of the reduction in licensed effort in Labrador, the commercial fishery moratorium in insular Newfoundland, and the 1997 quotas which considerably shortened the fishing season, may have resulted in a tripling of returns to freshwater over what they would have been had no changes been made.

SALMON ABUNDANCE

Population trends from sales slip data

The results of modeling landings of salmon by fishers indicateed that landings vary significantly by year, SFA, and fishers (CFV in table)(Table 9, Fig. 6). Subsequent analyses to compare annual salmon abundance were executed separately for SFAs 1 and 2. For SFA 1, logged catch per purchase slip was compared among fishers and years. The overall model was significant at less than 1% ($F=17.6$, $P<0.0001$); although a relatively small proportion of the total variance was explained ($R^2=0.33$). Type III sum of squares indicated that fishers and year were significantly related to catch ($F=13.7$, $P<0.0001$; $F=17.0$, $P<0.0001$, respectively). The catch per purchase slip increased in 1994 over 1993 and then declined steadily to its lowest value in 1997 (Table 10a, Fig. 7). For SFA 2, logged catch per purchase slip was compared among fishers and years. The overall the model was significant at less than 1% ($F=7.7$, $P<0.0001$); although a relatively small proportion of the variance was explained (($R^2=0.29$). Type III sum of squares indicated that fishers and year were significantly related to catch ($F=8.23$, $P<0.0001$; $F=7.73$, $P<0.0001$). In SFA 2, the catch per purchase slip increased from 1993 to 1995 and then declined in 1996 and 1997 (Table 10b, Fig. 7).

The LS (least square) means of catch per purchase slip adjusted for fishing season and local sales indicated that over the period of 1993 to 1997, the salmon population has declined in SFA 1. Comparison of the LS means indicated that catch per fishermen was significantly lower in 1997 than it was in 1993; however, comparison of the LS means between 1996 and 1997 indicated that although lower in 1997 catch per fisher was not statistically significantly different in 1997 from 1996. For SFA 2, catch per purchase slip (LS mean) adjusted for fishing season and local sales indicated that over the period of 1993 to 1997, the salmon population increased 1993 to 1995 and then declined in 1996 and 1997. However, salmon population in 1997 was about the same size as it was in 1993. The decline in 1997 from 1996 was about 12% in SFA 1 and about 20% in SFA 2 (Tables 10a & 10b). Therefore, while declines in salmon populations are evident in Labrador SFAs 1 & 2 between 1996 and 1997, the rate of change is not unusual and similar changes have been noted for other years. Also, declines in population size were expected for Labrador based on the spawners contributing to the 1997 population. Trends in salmon populations in other areas of

Eastern Canada in 1997 indicated substantial declines in salmon populations. Declines of a similar magnitude did not seem to have occurred in Labrador, at least as shown by the analysis of catch per fisher data from the purchase slips.

Population trends from estimates of total recruits & spawners

Parameter values for modeling salmon population trends in Labrador were separated by SFA. For SFA 1 small salmon: exploitation rates of 0.07-0.14, proportion Labrador origin of 0.36-0.42, proportion non-maturing of 0.8-0.9. For SFA 2 small salmon: exploitation rates of 0.04-0.07, proportion Labrador origin of 0.75-0.85, proportion non-maturing of 0.8-0.9. For SFA 1 large salmon: exploitation rates of 0.22-0.40, proportion Labrador origin of 0.64-0.72, and proportion of large component that is 2SW 0.7-0.9. For SFA 2 large salmon: exploitation rates of 0.16-0.28, proportion Labrador origin of 0.88-0.95, and proportion of large component that is 2SW 0.6-0.8. Total recruits for salmon in SFA 14B because there was no commercial fishery in 1997 were generated randomly from the range of salmon returning to freshwater reported herein. For small salmon, the estimated numbers returning to freshwater were 663 to 1545 and 146 to 327 for large salmon. Spawners were estimated by subtracting commercial catches and angling catches plus hook and release mortalities from number of recruits.

Estimated numbers of small and large salmon recruits (total population in Labrador, Greenland, and Newfoundland before commercial fisheries) and spawners (after the angling fishery and including a mortality rate of 0.1 for hook-and-release fish) for Labrador during the period 1974-97 are shown in Fig. 8. The total population of small salmon increased in 1997 over 1996 and the numbers, while high, are similar to those frequently observed in the past. The total population of large salmon decreased somewhat from that of 1996 and remained substantially lower than in most years during the period 1974-89. The number of small salmon spawners in 1997 was above the conservation requirement of 48,200. Numbers of large salmon spawners observed since 1993 were comparable to or higher than those of previous years. While the number of large spawners for 1997 was lower than the record high observed in 1995, this level is still below the conservation requirement (42,800). The continuing decline in large salmon is of particular concern in Labrador as much of the egg deposition comes from large salmon spawners.

RECRUITMENT OVERFISHING, LABRADOR STOCKS

In 1997, the number of small and large salmon spawners if summed was considerably above conservation requirement and the spawning population replaced itself if small and large spawners are considered together (Fig. 9). The achievement of conservation requirement levels in 1995 and 1996 and replacement of the spawning population was partly due to increased population sizes in those years; especially of small salmon. However, the main causative factor for the increased spawner levels has been the management plans, which have reduced commercial exploitation substantially. While numbers of small salmon increased considerably in 1997, the low overall number of 2SW

and large salmon is still of serious concern. In Labrador, large salmon spawners are mainly female while small salmon spawners are mainly male. Thus, any decline in large salmon if not balanced by an increase in small female salmon will ultimately lead to lowered egg deposition and lower future adult returns.

Estimates of small and large salmon spawners producing returns in 1998 declined from 1997 (Fig. 10). Thus, it is expected that returns in 1998 will also decline. However, beginning in 1999, the number of large salmon spawners producing returns begins to increase and baring a decline in sea survival so should adult returns.

RECOMMENDATIONS AND CONCLUSIONS

Recent management changes in the angling fishery, specifically the retention limit of one large salmon in SFAs 1 & 2 and 0 large salmon retention for SFA 14B, along with hook-and-release fishing, and lower daily and seasonal bag limits, has seriously compromised the usefulness of angling data in terms of comparability with past records, especially when used as an index of abundance. Adding hook-and-release fish to retained fish, and comparing this total to retained fish for years prior to 1992, assumes that the amount of effort expended applies equally to hook-and-release and retained fish. The non-comparability of annual angling catch statistics is further complicated by the introduction of License Stub Return System in 1996 for SFA 14B; although in the long-term the licence stub system should result in an overall improvement in angling statistics. For Labrador, an additional benefit from the stub return system will be the data obtained for rivers with no angling camps that was hitherto unknown. The implementation and then reduction in quotas in the commercial fishery along with licensed buyouts further complicates the use of angling catch rate as an index of abundance.

In Labrador, camp operations frequently vary from year to year in quantity and timing of guests and hence fishing effort can be quite variable which will be reflected in the angling statistics. A shortened angling season due to a lack of camp guests can then result in the catch and catch rates not being indicative of salmon abundance. Thus, the interpretation of trends and drawing of conclusions with respect to abundance based on angling fishery data should be verified with other abundance indicators such as counting facilities. In Labrador, there are too few counting facilities to do an adequate job of assessing status of stocks, e.g. in 1997 in SFA 2 there were none. Also, in Labrador, angling catches have historically constituted only a small proportion of the total catches (angling plus commercial) and therefore a cautious approach must be taken in the interpretation of catch trends as they may not be representative of abundance and hence trends in abundance.

In 1997, the quota for the commercial fishery in Labrador was the lowest since the inception of quotas in 1990. The commercial fishery opened approximately two weeks earlier in 1996 and 1997 than in 1995 when the season was delayed by approximately one month to July 3 from the usual opening date of June 5. The delayed opening in 1995-97 was designed to allow a greater escapement of large salmon into freshwater. The quota

for 1995 was not caught in either of the SFAs and in 1996 was reached only in SFA 2. In 1997, the quota was caught in SFA 2 but not in SFA 1. In SFA 1, the non-attainment of the quota was due to declines in fishing effort and salmon abundance. The fact that commercial landings did not increase substantially in 1997 indicates that the Labrador commercial fishery was not the cause of low returns to rivers in other areas of Atlantic Canada (Anon. 1998).

Catches of small and large salmon (retained & released) in the angling fishery in SFA 1 in 1997 improved over 1996 while the reverse was true for rivers in SFA 2. Angling catches for small salmon declined in SFA 14B in 1997 over 1996 and for large salmon (released only) increased. The decreased catches in SFA 2 could be attributed to the apparent substantial decrease in effort. The higher catches in SFA 1 might have been due to the lack of ice along this part of the Labrador coast which caused an earlier entry of salmon into freshwater over those years with ice. Catches were lower in Labrador in 1991 when severe ice conditions persisted throughout most of the summer. Also, water levels in 1997 were much higher than in 1996.

The low total population size of the large salmon component compared to earlier years is still of serious concern. Overall conclusions, based on the results of the exploitation model are: while stocks continue to be low in Labrador relative to the 1970s, they have increased in recent years. Management measures in recent years, have dramatically improved spawning escapements, with the potential for increased returns after 1998. The information gathered from commercial fishermen on seals removing salmon from their nets indicates that the stock size prior to commercial fishing may have been underestimated. However, fishermen also consistently indicated that seals are having a big impact on their fishery by removing salmon and damaging gear. Perhaps a consideration would be to have a fall seal fishery for Labrador.

It is recommended that fishing mortality on stocks in SFA 2 and 14B not be allowed to increase at this time. Furthermore, it is recommended that fishing mortality be reduced in SFA 1. The absence of adequate stock assessment projects in Labrador results in considerable uncertainty in the estimates of salmon abundance and spawners. In spite of the commercial fishery closure in 1997 and the restrictions on retention of large salmon, the estimated spawning escapements of small and large salmon in SFA 14B were probably at or near their lowest level ever.

Acknowledgements

The assistance of the staff at the Area Office in Goose Bay is gratefully acknowledged for data collection. The commercial salmon fishers of Labrador are acknowledged for their outstanding contribution to the seal survey. The high number of returns from a survey of this type indicates the concern that fishers have for salmon stocks and possible interactions with seal populations.

References

Anderson, T. C. 1985. The Rivers of Labrador. Can. Spec. Publ. Fish. Aquat. Sci. 81: 389p.

Anon. MS 1995. Report of the Working Group on North Atlantic Salmon. Int. Counc. Explor. Mer, CM 1995/Assess: 14, 181 p.

Anon. MS 1998. Atlantic salmon abundance overview for 1997. DFO Science stock Status Report D0-02 (1998).

Ash, E.G.M., and M. F. O'Connell. 1987a. Atlantic salmon fishery in Newfoundland and Labrador, commercial and recreational, 1984. Can. Data Rep. Fish. Aquat. Sci. 658: v + 294 p.

Ash, E.G.M., and M. F. O'Connell. 1987b. Atlantic salmon fishery in Newfoundland and Labrador, commercial and recreational, 1985. Can. Data Rep. Fish. Aquat. Sci. 672: v + 284 p.

Lowe, S. L. and C. C. Mullins. 1996. Status of the Atlantic salmon (Salmo salar L.) stock of Forteau Brook, Labrador, 1995. DFO, CSAS Res. Doc. 96/87, 31 p.

May, A. W. 1993. A review of management and allocation of the Atlantic salmon resource in Atlantic Canada. p. 220-232. *In*: Mills, D. [ed.] Salmon in the sea and new enhancement strategies. Fishing News Books. 424 p.

Mullins, C. C., and R. R. Claytor. 1989. Recreational Atlantic salmon catch, 1987 and 1988, and annual summaries, 1973-1988, for west Newfoundland and south Labrador, Gulf Region. Can. Data Rep. Fish. Aquat. Sci. No. 748. vi + 192 p.

Mullins, C. C., and D. Caines. 1998. Status of the Atlantic salmon (Salmo salar L.) stock of Pinware River, Labrador, 1997. DFO, CSAS Res. Doc. 98/116.

Narayanan, S., J. Carscadden, J. B. Dempson, M. F. O'Connell, S. Prinsenberg, D. G. Reddin, & N. Shackell. 1995. Marine climate off Newfoundland and its influence on salmon (*Salmo salar*) and capelin (*Mallotus villosus*), p. 461-474. *In* R.J. Beamish [ed.] Climate change and northern fish populations. Can. Spec. Publ. Fish. Aquat. Sci. 121.

O'Connell, M. F., J. B. Dempson, T. R. Porter, D. G. Reddin, E.G.M. Ash, and N. M. Cochrane. MS 1997a. Status of Atlantic salmon (*Salmo salar* L.) stocks of the Newfoundland Region, 1996. CAFSAC Res. Doc. 97/42. 104 p.

O'Connell, M. F., D. G. Reddin, P. G. Amiro, F. Caron, T. L. Marshall, G. Chaput, C. C. Mullins, A. Locke, S. F. O'Neil, and D. K. Cairns. MS 1997b. Estimates of conservation spawning requirements for Atlantic salmon (*Salmo salar* L.) for Canada. DFO, CSAS Res. Doc. 97/100, 58 p.

O'Connell, M. F., N. M. Cochrane, E. G. M. Ash and C. C. Mullins. 1998. An analysis of the results of the License Stub Return System in the Newfoundland Region, 1994-97. DFO, CSAS Res. Doc. 98/111.

Pippy, J. [Chairman] 1982. Report of the Working Group on the Interception of Mainland Salmon in Newfoundland. Can. MS Rep. Fish. Aquat. Sci. 1654: x + 196 p.

Rago, P. J., D.G. Reddin, T. R. Porter, D. J. Meerburg, K. D. Friedland, and E. C. E. Potter. MS 1993a. A continental run reconstruction model for the non-maturing component analysis of North American Atlantic salmon: Analysis of fisheries in Greenland and Newfoundland-Labrador, 1974-91. Cons. Int. Explor. Mer C. M. 1993/M:25, 33 p.

Rago, P. J., D. J. Meerburg, D.G. Reddin, G. J. Chaput, T. L. Marshall, J.B. Dempson, F. Caron, T. R. Porter, K. D. Friedland, and E. T. Baum. MS 1993b. Estimation and analysis of pre-fishery abundance of the two-sea winter population of North American Atlantic salmon (*Salmo salar*). Cons. Int. Explor. Mer C. M. 1993/M:24, 28p.

Reddin, D.G., and F.A. Day. 1980. 1969-72 Newfoundland and Labrador Atlantic salmon (*Salmo salar* L.) commercial catch data. Canadian Data Report of Fisheries and Aquatic Sciences 220.

Reddin, D. G., and J. B. Dempson. 1986. Origin of Atlantic salmon (Salmo salar L.) caught at sea near Nain, Labrador. Le Naturaliste Canadien 113: 211-218.

Reddin, D. G., and W. M. Shearer. 1987. Sea-surface temperature and distribution of Atlantic salmon in the Northwest Atlantic Ocean. For: American Fisheries Society Symposium on Common Strategies in Anadromous/Catadromous Fishes 1: 262-275.

Reddin, D.G., and K. D. Friedland. 1993. Marine environmental factors influencing the movement and survival of Atlantic salmon. *Ch. 4: pp. 107-103. In* Derek Mills [ed.] Salmon in the sea and new enhancement strategies. Fishing News Books. 424 p.

Reddin, D. G., P. B. Short and R. W. Johnson. 1998. The stock status of Atlantic (Salmo salar L.) of Big Brook (Michaels River), Labrador in 1997. DFO, CSAS Res. Doc. 98/119.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Fish. Marine Serv. Bull. 191, 382 p.

Ricker, W. E. 1976. Review of the rate of growth and mortality of Pacific salmon in salt water and non-catch mortality caused by fishing. J. Fish. Res. Bd Canada 33: 1483-1524.

Taylor, V.R. 1985. The early Atlantic salmon fishery in Newfoundland and Labrador. Can. Spec. Publ. Fish. Aquat. Sci. 76: 71 p.

Table 1. Summary of Atlantic salmon commercial catch data for Salmon Fishing Area 1, 1974-97. Weight in kilograms. Also shown is percentage change for 1997 in relation to 1996 and the 1984-89, 1986-91 and 1992-96 means.

SALMON FISHING AREA 1

YEAR	SMALL WEIGHT	SMALL NUMBER	LARGE WEIGHT	LARGE NUMBER	TOTAL WEIGHT	TOTAL NUMBER	QUOTA WEIGHT
1974	19694	9848	67944	13866	87637	23714	
1975	66384	34937	123025	28601	189409	63538	
1976	36944	17589	173514	38555	210458	56144	
1977	35564	17796	137989	28158	173553	45954	
1978	32481	17095	144887	30824	177369	47919	
1979	20413	9712	93700	21291	114113	31003	
1980	49516	22501	143557	28750	193073	51251	
1981	45428	21596	182169	36147	227597	57743	
1982	36805	18478	112969	24192	149775	42670	
1983	30676	15964	85699	19403	116375	35367	
1984	24073	11474	54949	11726	79022	23200	
1985	29138	15400	59705	13252	88843	28652	
1986	35527	17779	97649	19152	133176	36931	
1987	27431	13714	86882	18257	114313	31971	
1988	37331	19641	59391	12621	96721	32262	
1989	26458	13233	69194	16261	99651	29494	
1990	17370	8736	35498	7313	52868	16049	80,000**
1991	2843	1410	6520	1369	9362	2779	80,000**
1992	18431	9588	47416	9981	65847	19569	80,000**
1993	7266	3893	17287	3825	24553	7718	80,000**
1994	6948	3303	16100	3464	23048	6767	24,000
1995	6715	3202	10317	2150	17031	5352	19,000
1996	3213	1676	5554	1375	8767	3051	14,500
1997*	3526	1774	5165	1347	8691	3121	14,500
$\bar{X}$ 84-89	29993.0	15207	71295.0	15212	101954.3	30418	
S.D.	5278.4	3045	17234.4	3118	19277.0	4567	
95% LCL	24452.7	12010	53205.6	11939	81721.0	25624	
95% UCL	35533.3	18403	89384.4	18484	122187.6	35212	
$\bar{X}$ 86-91	24493.3	12419	59189.0	12496	84348.5	24914	
S.D.	12794.7	6603	33709.1	6962	45350.3	12944	
95% LCL	11064.0	5488	23807.8	5188	36748.6	11328	
95% UCL	37922.7	19349	94570.2	19803	131948.4	38500	
$\bar{X}$ 92-96	8514.6	4332	19334.8	4159	27849.2	8491	
S.D.	5781.3	3050	16389.3	3401	22129.8	6437	
95% LCL	-683.4	-520	-6740.6	-1253	-7359.3	-1750	
95% UCL	17712.6	9185	45410.2	9571	63057.7	18733	
%Change, 1997 vs:							
1996	10	6	-7	-2	-1	2	
$\bar{X}$ 84-89	-88	-88	-93	-91	-91	-90	
$\bar{X}$ 86-91	-86	-86	-91	-89	-90	-87	
$\bar{X}$ 92-96	-59	-59	-73	-68	-69	-63	

* Preliminary data.
**Allowance catch

Table 2. Summary of Atlantic salmon commercial catch data for Salmon Fishing Area 2, 1974-97. Weight in kilograms. Also shown is percentage change for 1997 in relation to 1996 and the 1984-89, 1986-91 and 1992-96 means.

SALMON FISHING AREA 2

YEAR	SMALL WEIGHT	SMALL NUMBER	LARGE WEIGHT	LARGE NUMBER	TOTAL WEIGHT	TOTAL NUMBER	QUOTA WEIGHT
1974	74254	37145	455894	93036	530148	130181	
1975	109380	57560	306030	71168	415410	128728	
1976	99694	47468	350068	77796	449761	125264	
1977	81072	40539	343871	70158	424941	110697	
1978	23832	12535	230028	48934	253860	61469	
1979	60516	28808	119179	27073	179695	55881	
1980	159171	72485	435314	87067	594483	159552	
1981	179274	86426	355534	68581	534808	155007	
1982	107042	53592	249103	53085	356145	106677	
1983	59603	30185	153694	33320	213295	63505	
1984	23347	11695	114883	25258	138228	36953	
1985	46656	24499	76967	16789	122622	41288	
1986	90207	45321	174123	34071	264329	79392	
1987	127564	64351	239726	49799	367289	114150	
1988	107447	56381	152282	32386	259726	88767	
1989	68520	34200	124885	26836	189404	61036	
1990	41562	20699	86296	17316	127856	38015	200,000
1991	39760	20055	36267	7679	76027	27734	200,000
1992	25412	13336	96023	19608	121434	32944	180,000
1993	22852	12037	45572	9651	68423	21688	90,000
1994	9548	4535	54672	11056	64220	15591	60,000
1995	10043	4561	32239	8714	42282	13275	48,000
1996	10286	5308	25148	5479	35434	10787	35,500
1997*	18003	8633	20265	4942	38268	13575	35,500
$\bar{X}$ 84-89	77290.2	39408	147144.3	30857	223599.7	70264	
S.D.	38804.6	19812	56190.3	11108	91939.9	29618	
95% LCL	36560.7	18613	88166.7	19198	127098.9	39177	
95% UCL	118019.7	60203	206122.0	42515	320100.4	101351	
$\bar{X}$ 86-91	79176.7	40168	135596.5	28015	214105.2	68182	
S.D.	35621.1	18403	70735.1	14558	105055.8	32433	
95% LCL	41788.5	20852	61352.5	12734	103837.9	34140	
95% UCL	116564.8	59484	209840.5	43295	324372.4	102225	
$\bar{X}$ 92-96	15628.2	7955.4	50730.8	10901.6	66358.6	18857.0	
S.D.	7820.0	4354.3	27793.7	5281.6	33831.0	8851.7	
95% LCL	3186.6	1028	6511.0	2499	12533.5	4774	
95% UCL	28069.8	14883	94950.6	19305	120183.7	32940	
%Change, 1997 vs:							
1996	75	63	-19	-10	8	26	
$\bar{X}$ 84-89	-77	-78	-86	-84	-83	-81	
$\bar{X}$ 86-91	-77	-79	-85	-82	-82	-80	
$\bar{X}$ 92-96	15	9	-60	-55	-42	-28	

* Preliminary data.

Table 3. Summary of Atlantic salmon commercial catch data for Salmon Fishing Area 14B, 1974-96. Weight in kilograms. Also shown is percentage change for 1996 in relation to 1995 and the 1984-89, 1986-91 and 1992-95 means.

SALMON FISHING AREA 14B

YEAR	SMALL WEIGHT	SMALL NUMBER	LARGE WEIGHT	LARGE NUMBER	TOTAL WEIGHT	TOTAL NUMBER	QUOTA WEIGHT
1974	18655	9328	77743	15863	96398	25191	
1975	36670	19294	63414	14752	100084	34046	
1976	27635	13152	68416	15189	96051	28341	
1977	22521	11267	91433	18664	113954	29931	
1978	7649	4026	55071	11715	62720	15741	
1979	15096	7194	17032	3874	32128	11068	
1980	18877	8493	46168	9138	65045	17631	
1981	13681	6658	38485	7606	52166	14264	
1982	14535	7379	27195	5966	41730	13345	
1983	6580	3292	33265	7489	39845	10781	
1984	4841	2421	29844	6218	34685	8639	
1985	11099	7460	15916	3954	27015	11414	
1986	14602	8296	26203	5342	40805	13638	
1987	22987	11389	58170	11114	81157	22503	
1988	15155	7087	22615	4591	37770	11678	
1989	19291	9053	22036	4646	41327	13699	
1990	7735	3592	15335	2858	23070	6450	60,000
1991	11391	5303	22616	4417	34007	9720	15,000
1992	2819	1325	14401	2752	17221	4077	13,000
1993	2207	1144	17103	3620	19309	4764	8,000
1994	1692	802	4190	857	5882	1659	8,000
1995	478	217	1192	312	1670	529	6,500
1996	1642	865	1888	418	3530	1283	5,000
1997*			**CLOSED IN 1997**				
$\bar{X}$ 84-89	14662.5	7618	29130.7	5978	43793.2	13595	
S.D.	6326.6	2968	14965.2	2632	19035.8	4740	
95% LCL	8022.1	4502	13423.2	3215	23813.1	8620	
95% UCL	21302.9	10733	44838.2	8740	63773.3	18571	
$\bar{X}$ 86-91	15193.5	7453	27829.2	5495	43022.7	12948	
S.D.	5440.0	2772	15279.0	2872	19844.4	5415	
95% LCL	9483.6	4544	11792.2	2480	22193.9	7265	
95% UCL	20903.4	10363	43866.1	8509	63851.5	18631	
$\bar{X}$ 92-95	1799.0	872	9221.5	1885	11020.5	2757	
S.D.	993.9	488	7718.7	1559	8582.6	1995	
95% LCL	217.7	96	-3058.9	-595	-2634.4	-417	
95% UCL	3380.3	1648	21501.9	4366	24675.4	5931	
%Change, 1996 vs:							
1995	244	299	58	34	111	143	
$\bar{X}$ 84-89	-89	-89	-94	-93	-92	-91	
$\bar{X}$ 86-91	-89	-88	-93	-92	-92	-90	
$\bar{X}$ 92-95	-9	-1	-80	-78	-68	-53	

* Preliminary data.

Table 4. Summary of Atlantic salmon commercial catch data for Labrador (Salmon Fishing Areas 1, 2, & 14B), 1974-97. Weight in kilograms. Also shown is percentage change for 1997 in relation to 1996 and the 1984-89, 1986-91 and 1992-96 means.

LABRADOR (SFAs 1, 2 & 14B)

YEAR	SMALL WEIGHT	SMALL NUMBER	LARGE WEIGHT	LARGE NUMBER	TOTAL WEIGHT	TOTAL NUMBER	QUOTA WEIGHT
1974	112603	56321	601581	122765	714183	179086	
1975	212434	111791	492469	114521	704903	226312	
1976	164273	78209	591998	131540	756270	209749	
1977	139157	69602	573293	116980	712448	186582	
1978	63962	33656	429986	91473	493949	125129	
1979	96025	45714	229911	52238	325936	97952	
1980	227564	103479	625039	124955	852601	228434	
1981	238383	114680	576188	112334	814571	227014	
1982	158382	79449	389267	83243	547650	162692	
1983	96859	49441	272658	60212	369515	109653	
1984	52261	25590	199676	43202	251935	68792	
1985	86893	47359	152588	33995	238480	81354	
1986	140336	71396	297975	58565	438310	129961	
1987	177982	89454	384778	79170	562759	168624	
1988	159933	83109	234288	49598	394217	132707	
1989	114269	56486	216115	47743	330382	104229	
1990	66667	33027	137129	27487	203794	60514	260,000
1991	53994	26768	65403	13465	119396	40233	295,000
1992	46662	24249	157840	32341	204502	56590	273,000
1993	32325	17074	79962	17096	112285	34170	178,000
1994	18188	8640	74962	15377	93150	24017	92,000
1995	17236	7980	43748	11176	60983	19156	73,500
1996	15141	7849	32590	7272	47730	15121	55,000
1997*	21529	10407	25430	6289	46959	16696	50,000
$\bar{X}$ 84-89	121945.7	62232	247570.0	52046	369347.2	114278	
S.D.	47042.3	23907	82277.5	15536	122648.0	36859	
95% LCL	72569.8	37139	161211.0	35739	240615.1	75590	
95% UCL	171321.6	87325	333929.0	68352	498079.3	152966	
$\bar{X}$ 86-91	118863.5	60040	222614.7	46005	341476.3	106045	
S.D.	50192.4	25983	113294.3	23132	160949.4	48180	
95% LCL	66181.2	32768	103700.3	21726	172542.8	55475	
95% UCL	171545.8	87312	341529.0	70284	510409.8	156615	
$\bar{X}$ 92-96	25910.4	13158.4	77820.4	16652.4	103730.0	29810.8	
S.D.	13441.0	7310.2	49047.5	9564.8	61853.5	16575.7	
95% LCL	4525.8	1528	-214.1	1435	5321.1	3439	
95% UCL	47295.0	24789	155854.9	31870	202138.9	56183	
%Change, 1997 vs:							
1996	42	33	-22	-14	-2	10	
$\bar{X}$ 84-89	-82	-83	-90	-88	-87	-85	
$\bar{X}$ 86-91	-82	-83	-89	-86	-86	-84	
$\bar{X}$ 92-96	-17	-21	-67	-62	-55	-44	

* Preliminary data.

Table 5. Atlantic salmon recreational fishery catch and effort data for Newfoundland and Labrador combined (SFAs 1, 2 & 14B), 1974-97. Ret. = retained fish; Rel. = released fish. The 1997 data were obtained from the licence stub return for SFA 14B only.

Year	Effort Rod Days	Small (<63 cm) Ret.	Rel.	Tot.	Large (>=63 cm) Ret.	Rel.	Tot.	Total (Small + Large) Ret.	Rel.	Tot.	CPUE
1974	5492	2501	.	2501	803	.	803	3304	.	3304	0.60
1975	4209	3972	.	3972	327	.	327	4299	.	4299	1.02
1976	7155	5726	.	5726	830	.	830	6556	.	6556	0.92
1977	7234	4594	.	4594	1286	.	1286	5880	.	5880	0.81
1978	6248	2691	.	2691	767	.	767	3458	.	3458	0.55
1979	5333	4118	.	4118	609	.	609	4727	.	4727	0.89
1980	4948	3800	.	3800	889	.	889	4689	.	4689	0.95
1981	5198	5191	.	5191	520	.	520	5711	.	5711	1.10
1982	6400	4104	.	4104	621	.	621	4725	.	4725	0.74
1983	6657	4372	.	4372	428	.	428	4800	.	4800	0.72
1984	7128	2935	.	2935	510	.	510	3445	.	3445	0.48
1985	6366	3101	.	3101	294	.	294	3395	.	3395	0.53
1986	7694	3464	.	3464	467	.	467	3931	.	3931	0.51
1987	8754	5366	.	5366	633	.	633	5999	.	5999	0.69
1988	10211	5523	.	5523	710	.	710	6233	.	6233	0.61
1989	9177	4684	.	4684	461	.	461	5145	.	5145	0.56
1990	8927	3309	.	3309	357	.	357	3666	.	3666	0.41
1991	7500	2323	.	2323	93	.	93	2416	.	2416	0.32
1992	8342	2738	251	2989	781	10	791	3519	261	3780	0.45
1993	9318	2508	1793	4301	378	91	469	2886	1884	4770	0.51
1994	10297	2657	2735	5392	474	291	765	3131	3026	6157	0.60
1995	9846	2597	2808	5405	546	400	946	3143	3208	6351	0.65
1996	.	3142	3624	6766	404	453	857	3546	4077	7623	.
1997*	.	2572	1907	4479	198	469	667	2770	2376	5146	.
84-89 $\bar{X}$	8115.2	3941.4	.	3941.4	488.4	0.0	488.4	4429.8	0.0	4429.8	0.55
95% CL	1936.4	1388.0	.	1388.0	184.7	0.0	184.7	1527.1	0.0	1527.1	0.00
N	5	5	0	5	5	4	5	5	4	5	5
86-91 $\bar{X}$	8701.8	3860.6	.	3860.6	417.6	0.0	417.6	4278.2	0.0	4278.2	0.49
95% CL	1390.0	1554.0	.	1554.0	276.8	0.0	276.8	1813.5	0.0	1813.5	0.00
N	5	5	0	5	5	5	5	5	5	5	5
92-96 $\bar{X}$	7560.6	2728.4	2242.2	4970.6	516.6	249.0	765.6	3245.0	2491.2	5736.2	0.76
95% CL	5324.3	305.4	1599.4	1751.8	200.6	239.0	223.4	350.0	1826.4	1849.3	0.00
N	5	5	5	5	5	5	5	5	5	5	5

1987 DATA NOT INCLUDED IN MEAN

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992-97 AND ON RETAINED FISH ONLY PRIOR TO 1992.

*Data for SFAs 1 & 2 are DFO

Table 6. Atlantic salmon recreational fishery catch and effort data for Salmon Fishing Area 1, Labrador, 1974-97.
Ret. = retained fish; Rel. = released fish.

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	801	347	.	347	311	.	311	658	.	658	0.82
1975	245	379	.	379	117	.	117	496	.	496	2.02
1976	928	891	.	891	368	.	368	1259	.	1259	1.36
1977	809	688	.	688	533	.	533	1221	.	1221	1.51
1978	704	875	.	875	432	.	432	1307	.	1307	1.86
1979	1367	905	.	905	430	.	430	1335	.	1335	0.98
1980	780	704	.	704	232	.	232	936	.	936	1.20
1981	422	669	.	669	195	.	195	864	.	864	2.05
1982	831	834	.	834	379	.	379	1213	.	1213	1.46
1983	834	488	.	488	137	.	137	625	.	625	0.75
1984	1074	702	.	702	222	.	222	924	.	924	0.86
1985	946	642	.	642	135	.	135	777	.	777	0.82
1986	741	421	.	421	129	.	129	550	.	550	0.74
1987	1011	854	.	854	141	.	141	995	.	995	0.98
1988	1629	1278	.	1278	171	.	171	1449	.	1449	0.89
1989	1296	1269	.	1269	144	.	144	1413	.	1413	1.09
1990	1245	563	.	563	115	.	115	678	.	678	0.54
1991	1056	130	.	130	8	.	8	138	.	138	0.13
1992	899	283	29	312	335	0	335	618	29	647	0.72
1993	422	121	124	245	22	25	47	143	149	292	0.69
1994	1036	453	933	1386	114	96	210	567	1029	1596	1.54
1995	880	500	854	1354	92	97	189	592	951	1543	1.75
1996	879	260	62	322	50	17	67	310	79	389	0.44
1997*	1266	300	133	433	46	25	71	346	158	504	0.40
84-89 $\bar{X}$	1116.2	861.0	.	861.0	157.0	.	157.0	1018.0	.	1018.0	0.91
95% CL	324.5	365.8	.	365.8	36.7	.	36.7	372.1	.	372.1	0.12
N	6	6	0	6	6	0	6	6	0	6	6
86-91 $\bar{X}$	1163.0	752.5	.	752.5	118.0	.	118.0	870.5	.	870.5	0.75
95% CL	316.4	489.3	.	489.3	59.8	.	59.8	539.5	.	539.5	0.36
N	6	6	0	6	6	0	6	6	0	6	6
92-96 $\bar{X}$	823.2	323.4	400.4	723.8	122.6	47.0	169.6	446.0	447.4	893.4	1.09
95% CL	290.0	190.9	561.5	733.4	154.0	57.2	145.5	260.3	618.1	783.3	0.76
N	5	5	5	5	5	5	5	5	5	5	5

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992-97 AND ON RETAINED FISH ONLY PRIOR TO 1992.

*1997 - DFO data and is preliminary

Table 7. Atlantic salmon recreational fishery catch and effort data for Salmon Fishing Area 2, Labrador, 1974-97. Ret. = retained fish; Rel. = released fish.

	Effort	Small (<63 cm)			Large (>= 63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	1978	1414	.	1414	201	.	201	1615	.	1615	0.82
1975	1784	2524	.	2524	56	.	56	2580	.	2580	1.45
1976	2331	2337	.	2337	152	.	152	2489	.	2489	1.07
1977	2507	2244	.	2244	160	.	160	2404	.	2404	0.96
1978	3131	1243	.	1243	152	.	152	1395	.	1395	0.45
1979	1817	2312	.	2312	60	.	60	2372	.	2372	1.31
1980	1692	2158	.	2158	320	.	320	2478	.	2478	1.46
1981	1423	2824	.	2824	105	.	105	2929	.	2929	2.06
1982	2290	1999	.	1999	162	.	162	2161	.	2161	0.94
1983	2294	1884	.	1884	161	.	161	2045	.	2045	0.89
1984	2057	1246	.	1246	103	.	103	1349	.	1349	0.66
1985	1756	1367	.	1367	59	.	59	1426	.	1426	0.81
1986	2310	1972	.	1972	154	.	154	2126	.	2126	0.92
1987	2750	2625	.	2625	277	.	277	2902	.	2902	1.06
1988	2875	2653	.	2653	288	.	288	2941	.	2941	1.02
1989	2986	2242	.	2242	264	.	264	2506	.	2506	0.84
1990	2607	1680	.	1680	144	.	144	1824	.	1824	0.70
1991	2427	1041	.	1041	36	.	36	1077	.	1077	0.44
1992	2813	1599	158	1757	208	10	218	1807	168	1975	0.70
1993	3600	1340	1255	2595	114	36	150	1454	1291	2745	0.76
1994	3352	1511	1716	3227	259	184	443	1770	1900	3670	1.09
1995	3544	1280	1727	3007	246	219	465	1526	1946	3472	0.98
1996	6271	1991	2610	4601	255	296	551	2246	2906	5152	0.82
1997*	5256	1729	1264	2993	152	118	270	1881	1382	3263	0.62
84-89 $\bar{X}$	2455.7	2017.5	.	2017.5	190.8	.	190.8	2208.3	.	2208.3	0.90
95% CL	517.1	637.4	.	637.4	103.6	.	103.6	736.8	.	736.8	0.15
N	6	6	0	6	6	0	6	6	0	6	6
86-91 $\bar{X}$	2659.2	2035.5	.	2035.5	193.8	.	193.8	2229.3	.	2229.3	0.84
95% CL	273.8	645.5	.	645.5	104.6	.	104.6	747.9	.	747.9	0.23
N	6	6	0	6	6	0	6	6	0	6	6
92-96 $\bar{X}$	3916.0	1544.2	1493.2	3037.4	216.4	149.0	365.4	1760.6	1642.2	3402.8	0.87
95% CL	1679.3	348.5	1108.8	1289.7	75.4	151.8	213.7	386.1	1249.6	1469.9	0.17
N	5	5	5	5	5	5	5	5	5	5	5

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992-97 AND ON RETAINED FISH ONLY PRIOR TO 1992.

*1997 - DFO data and are preliminary

Table 8. Atlantic salmon recreational fishery catch and effort data for Salmon Fishing Area 14B, Labrador, 1974-97. Ret. = retained fish; Rel. = released fish. The 1996-97 data, obtained from the License Stub Return System, are preliminary.

	Effort	Small (<63 cm)			Large (>= 63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	2713	740	.	740	291	.	291	1031	.	1031	0.38
1975	2180	1069	.	1069	154	.	154	1223	.	1223	0.56
1976	3896	2498	.	2498	310	.	310	2808	.	2808	0.72
1977	3918	1662	.	1662	593	.	593	2255	.	2255	0.58
1978	2413	573	.	573	183	.	183	756	.	756	0.31
1979	2149	901	.	901	119	.	119	1020	.	1020	0.47
1980	2476	938	.	938	337	.	337	1275	.	1275	0.51
1981	3353	1698	.	1698	220	.	220	1918	.	1918	0.57
1982	3279	1271	.	1271	80	.	80	1351	.	1351	0.41
1983	3529	2000	.	2000	130	.	130	2130	.	2130	0.60
1984	3997	987	.	987	185	.	185	1172	.	1172	0.29
1985	3664	1092	.	1092	100	.	100	1192	.	1192	0.33
1986	4643	1071	.	1071	184	.	184	1255	.	1255	0.27
1987	4993	1887	.	1887	215	.	215	2102	.	2102	0.42
1988	5707	1592	.	1592	251	.	251	1843	.	1843	0.32
1989	4895	1173	.	1173	53	.	53	1226	.	1226	0.25
1990	5075	1066	.	1066	98	.	98	1164	.	1164	0.23
1991	4017	1152	.	1152	49	.	49	1201	.	1201	0.30
1992	4630	856	64	920	238	0	238	1094	64	1158	0.25
1993	5296	1047	414	1461	242	30	272	1289	444	1733	0.33
1994	5909	693	86	779	101	11	112	794	97	891	0.15
1995	5422	817	227	1044	208	84	292	1025	311	1336	0.25
1996	.	891	952	1843	99	140	239	990	1092	2082	.
1997	.	543	510	1053	*	326	326	543	836	1379	.
84-89 $\bar{X}$	4649.8	1300.3	.	1300.3	164.7	.	164.7	1465.0	.	1465.0	0.32
95% CL	770.4	375.4	.	375.4	77.7	.	77.7	422.5	.	422.5	0.07
N	6	6	0	6	6	0	6	6	0	6	6
86-91 $\bar{X}$	4888.3	1323.5	.	1323.5	141.7	.	141.7	1465.2	.	1465.2	0.30
95% CL	581.7	354.9	.	354.9	90.9	.	90.9	422.5	.	422.5	0.07
N	6	6	0	6	6	0	6	6	0	6	6
92-96 $\bar{X}$	5314.3	853.3	197.8	1051.0	197.3	31.3	228.5	1050.5	229.0	1279.5	0.24
95% CL	838.8	233.4	256.5	467.7	104.9	59.3	128.6	325.0	287.0	562.2	0.12
N	4	4	4	4	4	4	4	4	4	4	4

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992-97 AND ON RETAINED FISH ONLY PRIOR TO 1992.

*NOT ALLOWED TO RETAIN LARGE SALMON IN SFA 14B, 1997.

Table 9. Full model with no correction for season and local sales.

Dependent Variable: LN_CAT

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	329	3191.2268182	9.6997776	11.23	0.0001
Error	5408	4670.0812512	0.8635505		
Corrected Total	5737	7861.3080694			

R-Square	C.V.	Root MSE	LN_CAT Mean
0.405941	28.30753	0.9292742	3.2827805

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	4	90.6773440	22.6693360	26.25	0.0001
SFA	1	1135.1855665	1135.1855665	1314.56	0.0001
CFV	324	1965.3639077	6.0659380	7.02	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	4	57.8577176	14.4644294	16.75	0.0001
SFA	1	19.6146520	19.6146520	22.71	0.0001
CFV	324	1965.3639077	6.0659380	7.02	0.0001

Table 10a. General linear models for Salmon Fishing Area 1 corrected for effects of season and local sales.

General Linear Models Procedure

Dependent Variable: LN_CAT

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	42	597.36959315	14.22308555	17.61	0.0001
Error	1530	1235.85083688	0.80774565		
Corrected Total	1572	1833.22043003			

R-Square	C.V.	Root MSE	LN_CAT Mean
0.325858	30.67069	0.8987467	2.9303113

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	4	75.99849344	18.99962336	23.52	0.0001
CFV	38	521.37109971	13.72029210	16.99	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	4	44.22219363	11.05554841	13.69	0.0001
CFV	38	521.37109971	13.72029210	16.99	0.0001

Comparison of annual catch per fishermen

YEAR	LN_CAT LSMEAN	Std Err LSMEAN	Pr > |T| HO:LSMEAN=0	LSMEAN Number
93	3.08613600	0.07913291	0.0001	1
94	3.22730488	0.07216178	0.0001	2
95	2.97369470	0.06747947	0.0001	3
96	2.83052208	0.07361558	0.0001	4
97	2.69984550	0.06309720	0.0001	5

Pr > |T| HO: LSMEAN(i)=LSMEAN(j)

i/j	1	2	3	4	5
1	.	0.0826	0.1497	0.0030	0.0001
2	0.0826	.	0.0003	0.0001	0.0001
3	0.1497	0.0003	.	0.0583	0.0001
4	0.0030	0.0001	0.0583	.	0.0797
5	0.0001	0.0001	0.0001	0.0797	.

Table 10b. General linear models for Salmon Fishing Area 2 corrected for effects of season and local sales.

General Linear Models Procedure

Dependent Variable: LN_CAT

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	102	634.63241409	6.22188641	7.74	0.0001
Error	1970	1583.52540534	0.80382000		
Corrected Total	2072	2218.15781943			

R-Square	C.V.	Root MSE	LN_CAT Mean
0.286108	22.68263	0.8965601	3.9526276

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	4	25.67725707	6.41931427	7.99	0.0001
CFV	98	608.95515702	6.21382813	7.73	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	4	26.45028635	6.61257159	8.23	0.0001
CFV	98	608.95515702	6.21382813	7.73	0.0001

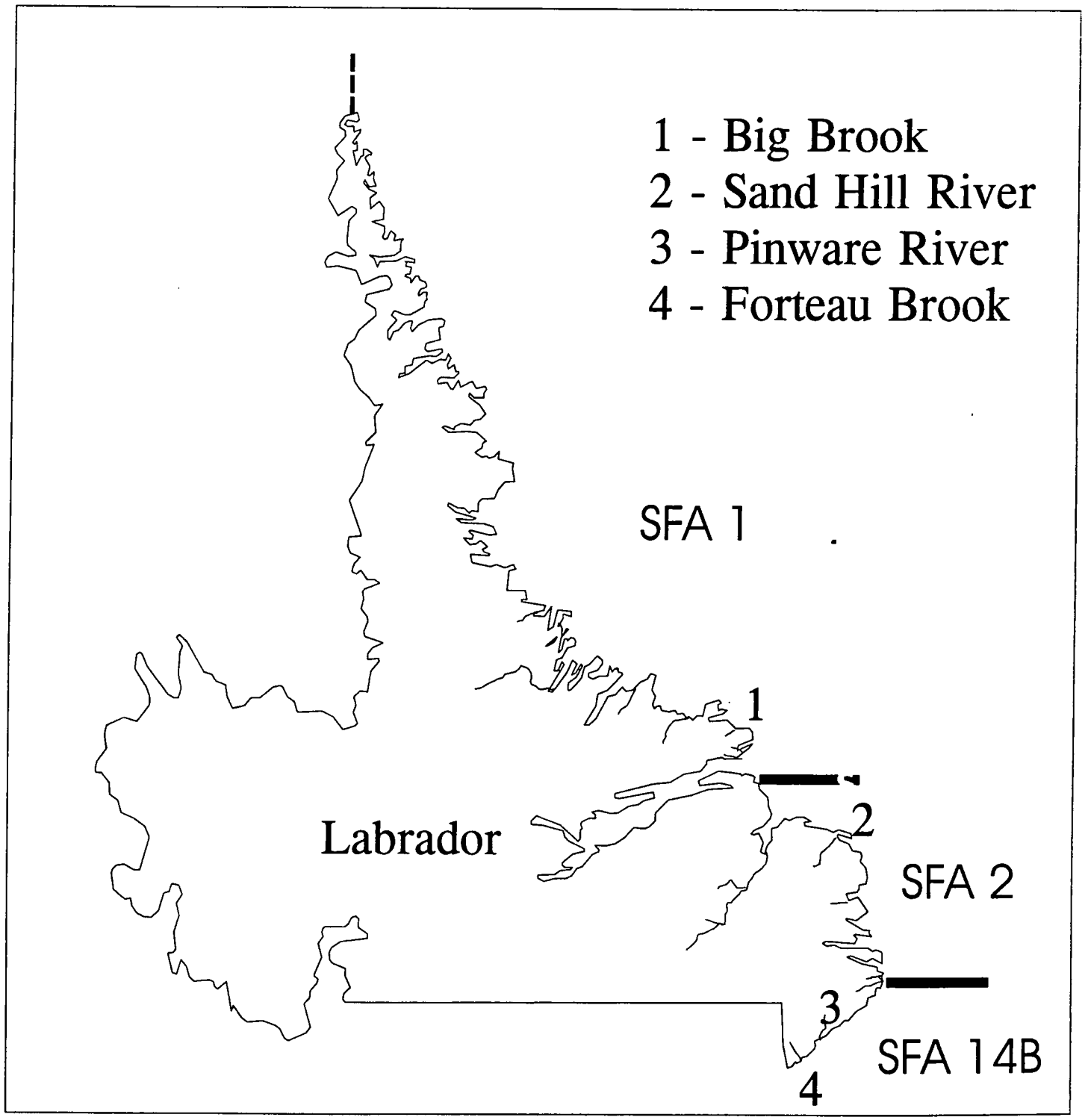
General Linear Models Procedure
Least Squares Means

YEAR	LN_CAT LSMEAN	Std Err LSMEAN	Pr > |T| HO:LSMEAN=0	LSMEAN Number
93	3.89740084	0.04988201	0.0001	1
94	4.01187859	0.05047332	0.0001	2
95	4.23350573	0.06306857	0.0001	3
96	4.11754948	0.05703315	0.0001	4
97	3.89583877	0.04530863	0.0001	5

Pr > |T| HO: LSMEAN(i)=LSMEAN(j)

i/j	1	2	3	4	5
1	.	0.0599	0.0001	0.0014	0.9799
2	0.0599	.	0.0019	0.1220	0.0582
3	0.0001	0.0019	.	0.1273	0.0001
4	0.0014	0.1220	0.1273	.	0.0009
5	0.9799	0.0582	0.0001	0.0009	.

Fig. 1. Labrador with location of Salmon Fishing Areas and location of rivers mentioned in the text.



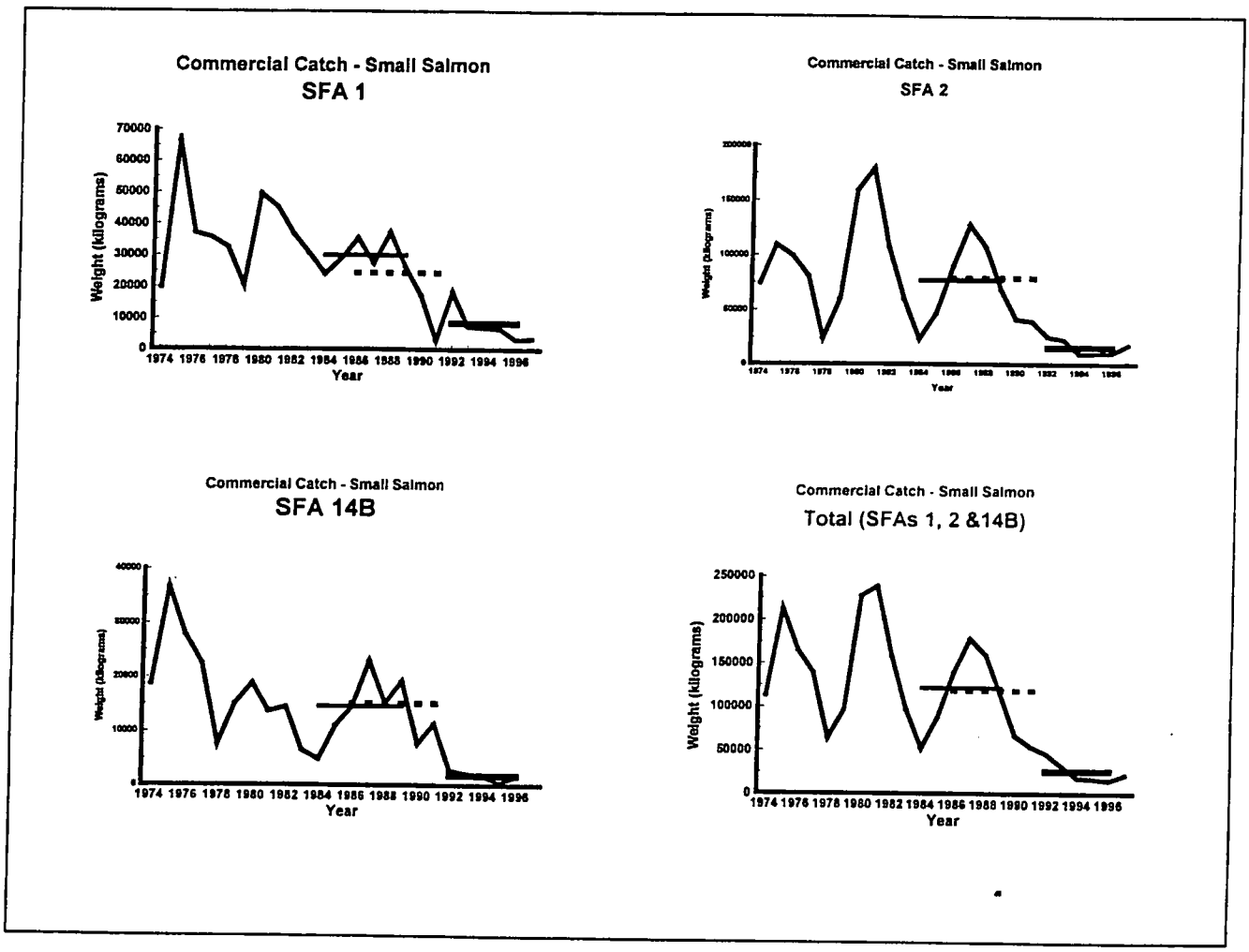


Fig. 2a. Commercial catch of small salmon (kilograms) for SFAs 1, 2, and 14B separately and combined, Labrador, 1974-97. The thin solid horizontal line represents the 1984-89 mean, the broken line the 1986-91 mean and the thick solid line the 1992-96 mean.

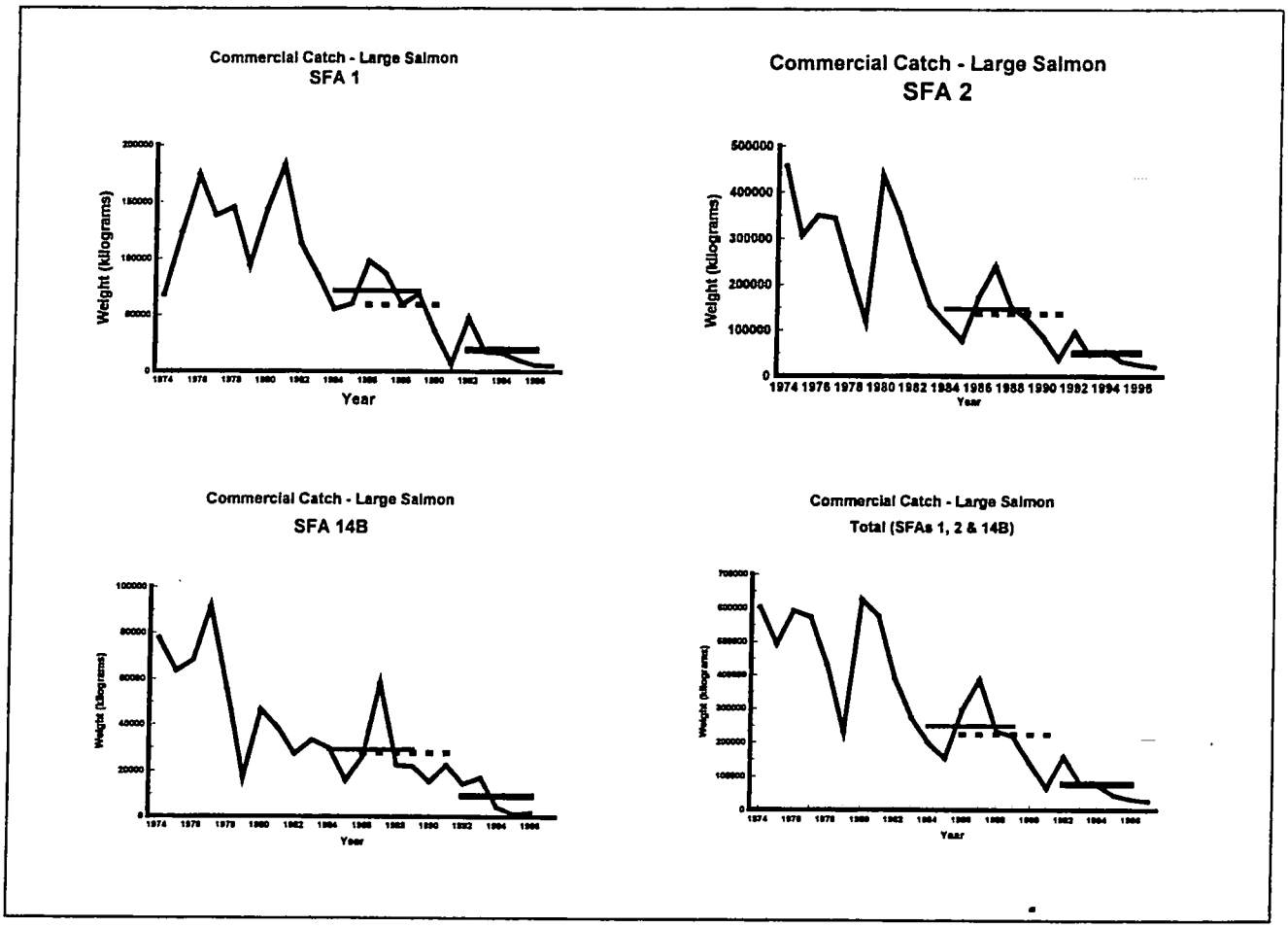


Fig. 2b. Commercial catch of large salmon (kilograms) for SFAs 1, 2, and 14B separately and combined, Labrador, 1974-97. The thin solid horizontal line represents the 1984-89 mean, the broken line the 1986-91 mean and the thick solid line the 1992-96 mean.

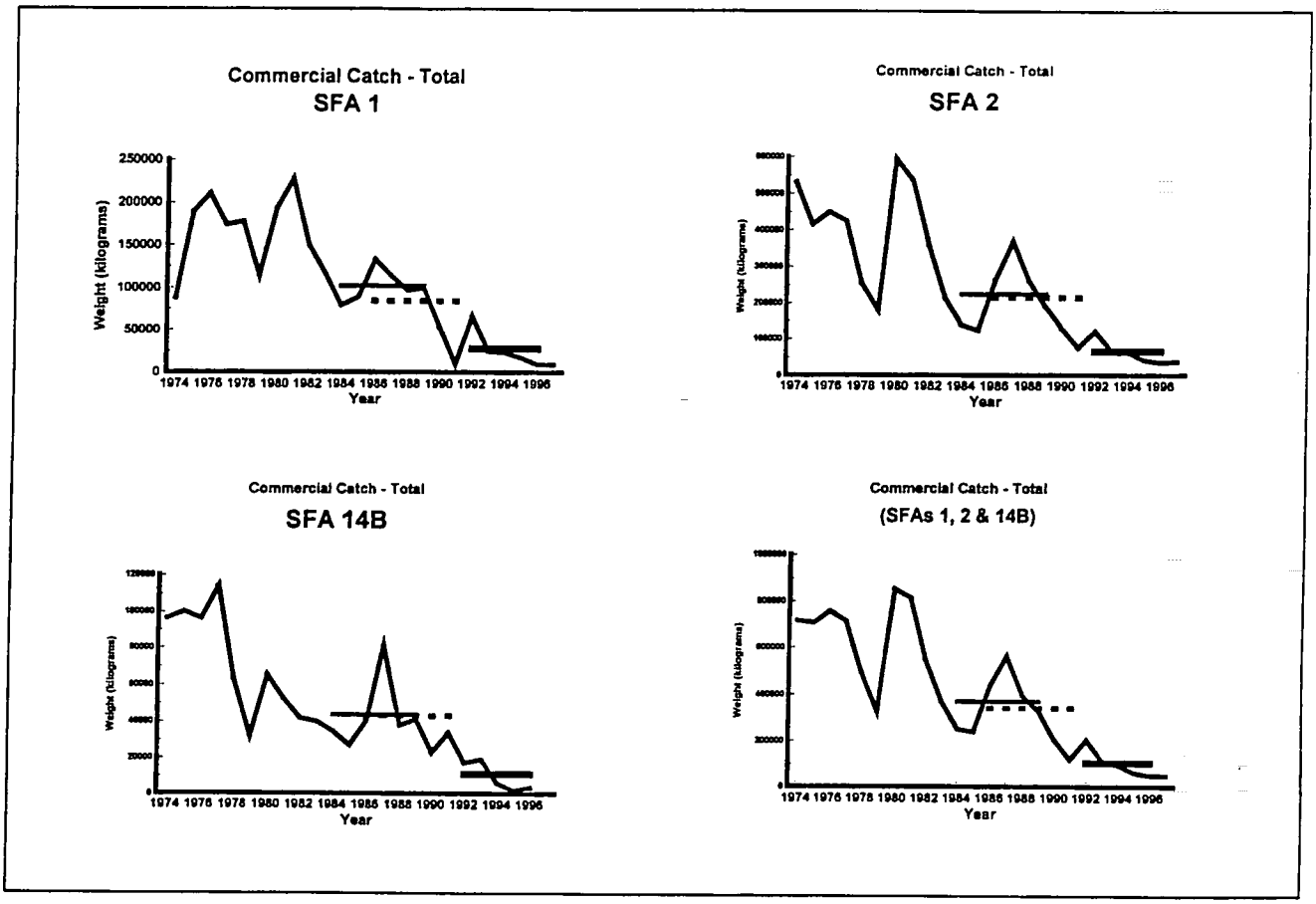
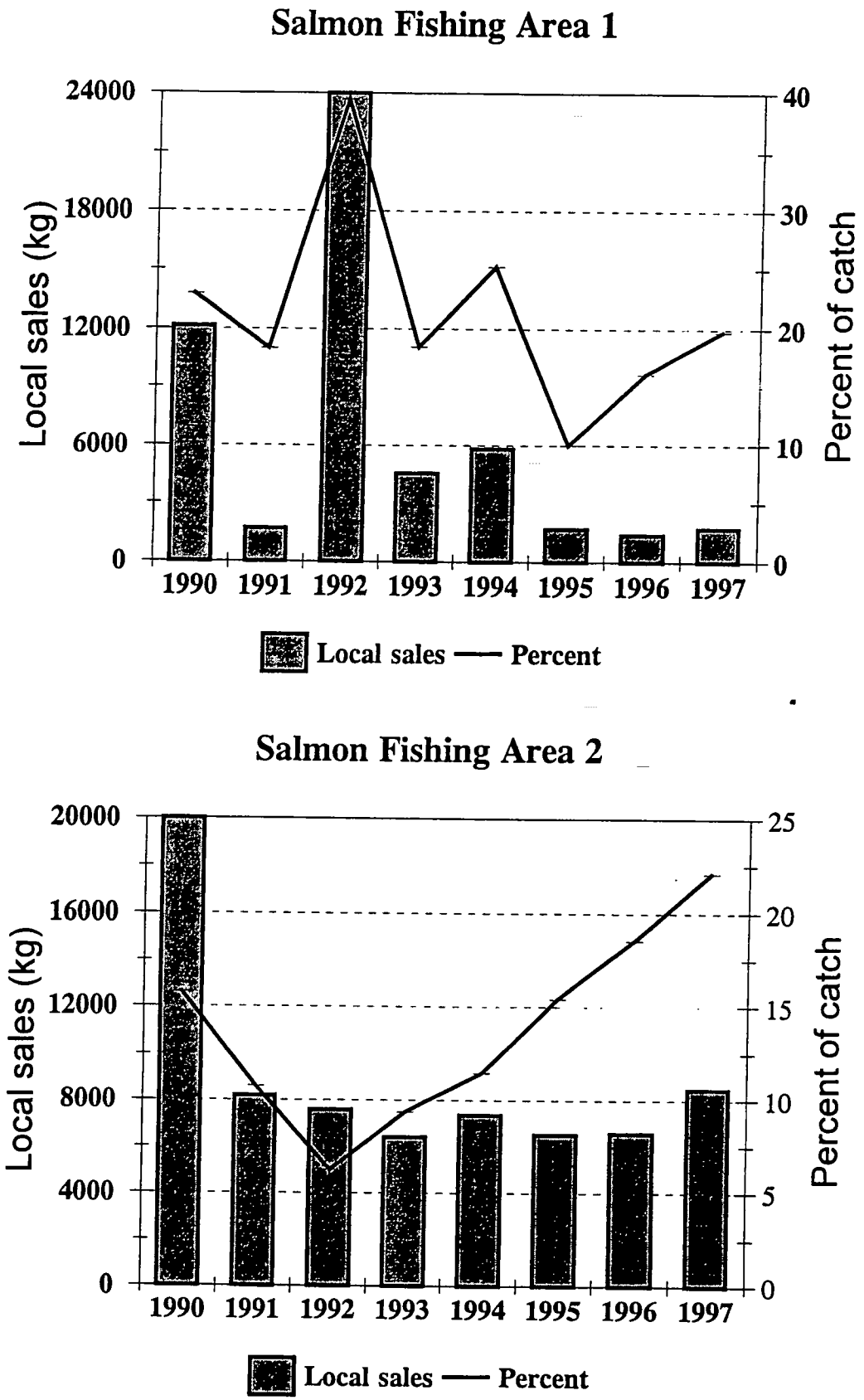


Fig. 2c. Total commercial catch (kilograms) for SFAs 1, 2, and 14B separately and combined, Labrador, 1974-97. The thin solid horizontal line represents the 1984-89 mean, the broken line the 1986-91 mean and the thick solid line the 1992-96 mean.

Fig. 3. Local sales estimates for Labrador, 1990-97.



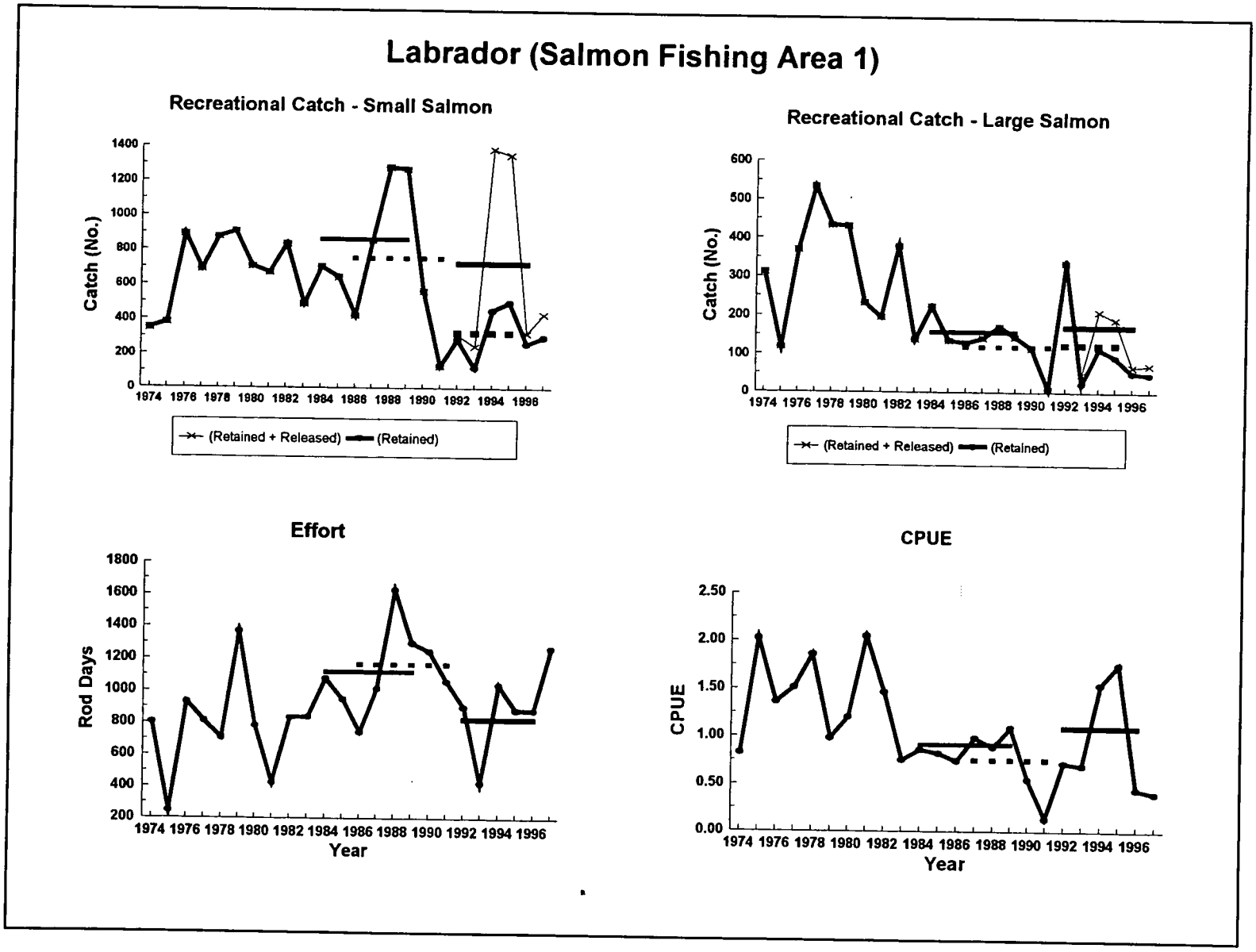


Fig. 4a. Recreational catch of small and large salmon (retained, 1974-97; retained plus released, 1992-97), effort, and catch per unit of effort (CPUE), 1974-97 for Labrador (SFA 1). The thin solid horizontal line represents the 1984-89 mean, the thin broken horizontal line the 1986-91 mean, the thick solid line the 1992-96 mean (retained + released) and the thick broken line the 1992-96 mean (retained only).

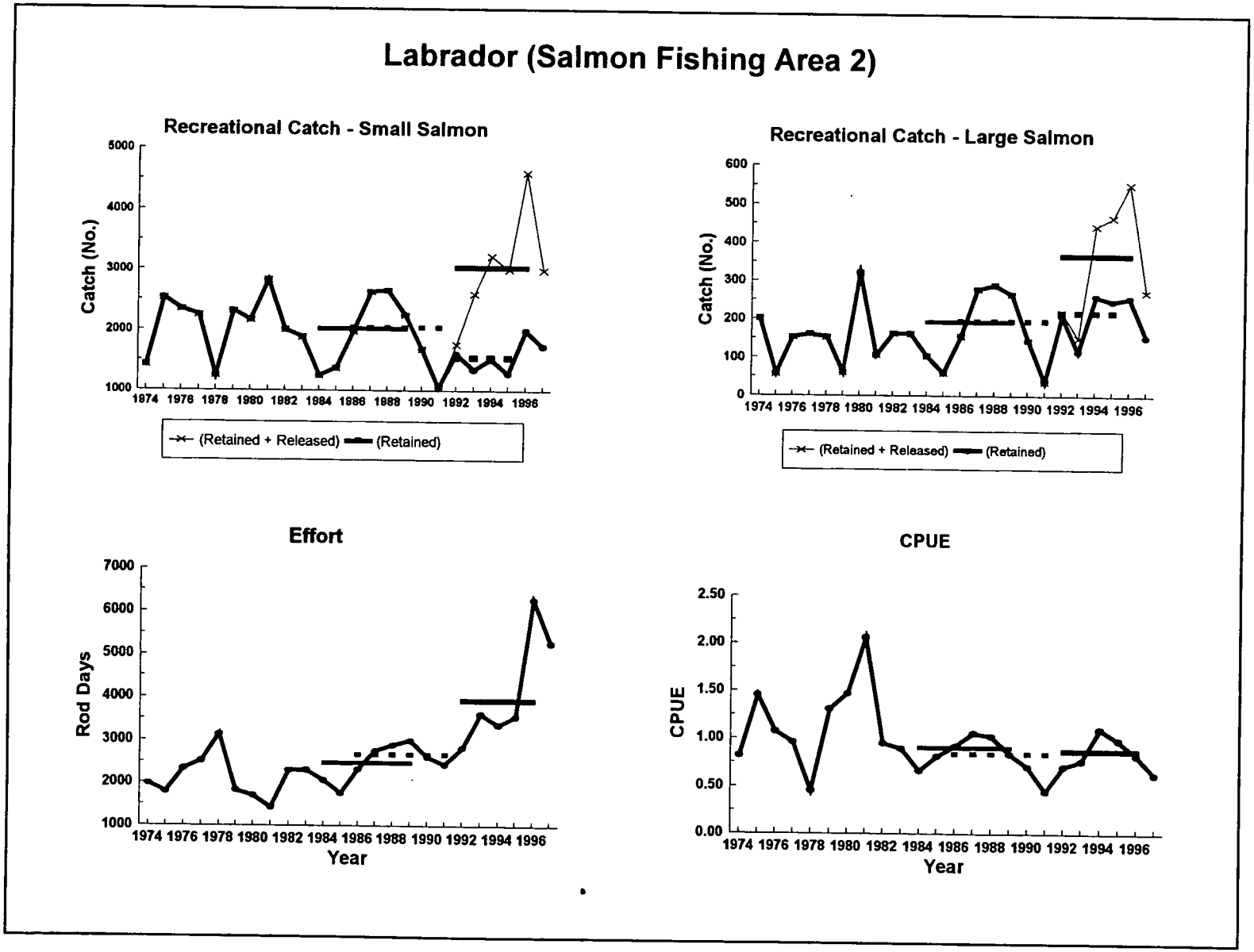


Fig. 4b. Recreational catch of small and large salmon (retained, 1974-97; retained plus released, 1992-97), effort, and catch per unit of effort (CPUE), 1974-97 for Labrador (SFA 2). The thin solid horizontal line represents the 1984-89 mean, the thin broken horizontal line the 1986-91 mean, the thick solid line the 1992-96 mean (retained + released) and the thick broken line the 1992-96 mean (retained only).

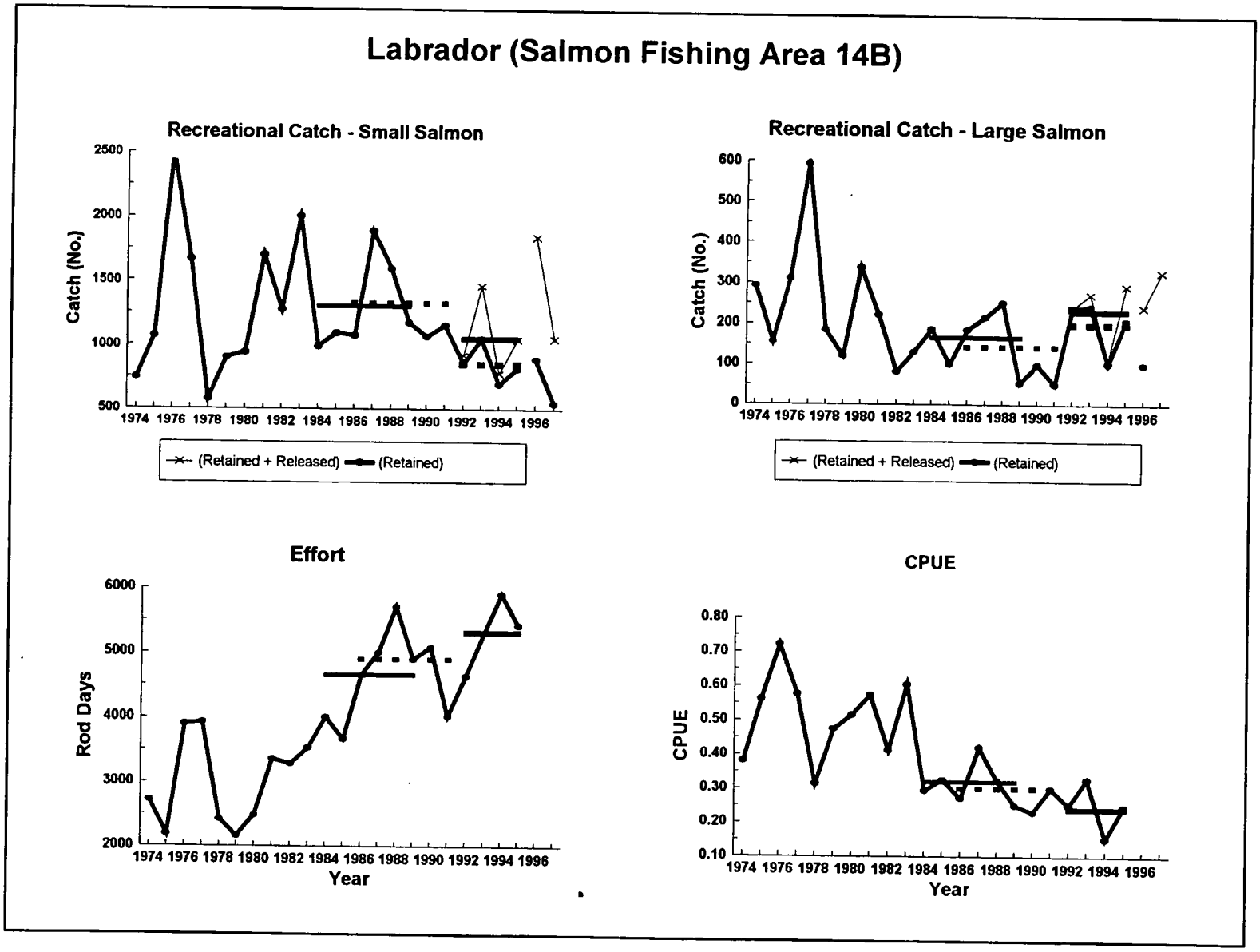


Fig. 4c. Recreational catch of small and large salmon (retained, 1974-97; retained plus released, 1992-97), effort, and catch per unit of effort (CPUE), 1974-95 for Labrador (SFA 14B). The thin solid horizontal line represents the 1984-89 mean, the thin broken horizontal line the 1986-91 mean, the thick solid line the 1992-95 mean (retained + released) and the thick broken line the 1992-95 mean (retained only). The 1996 and 1997 data, obtained from the license stub return, are represented by a non-continuous line. There are no effort data available for 1996 and 1997.

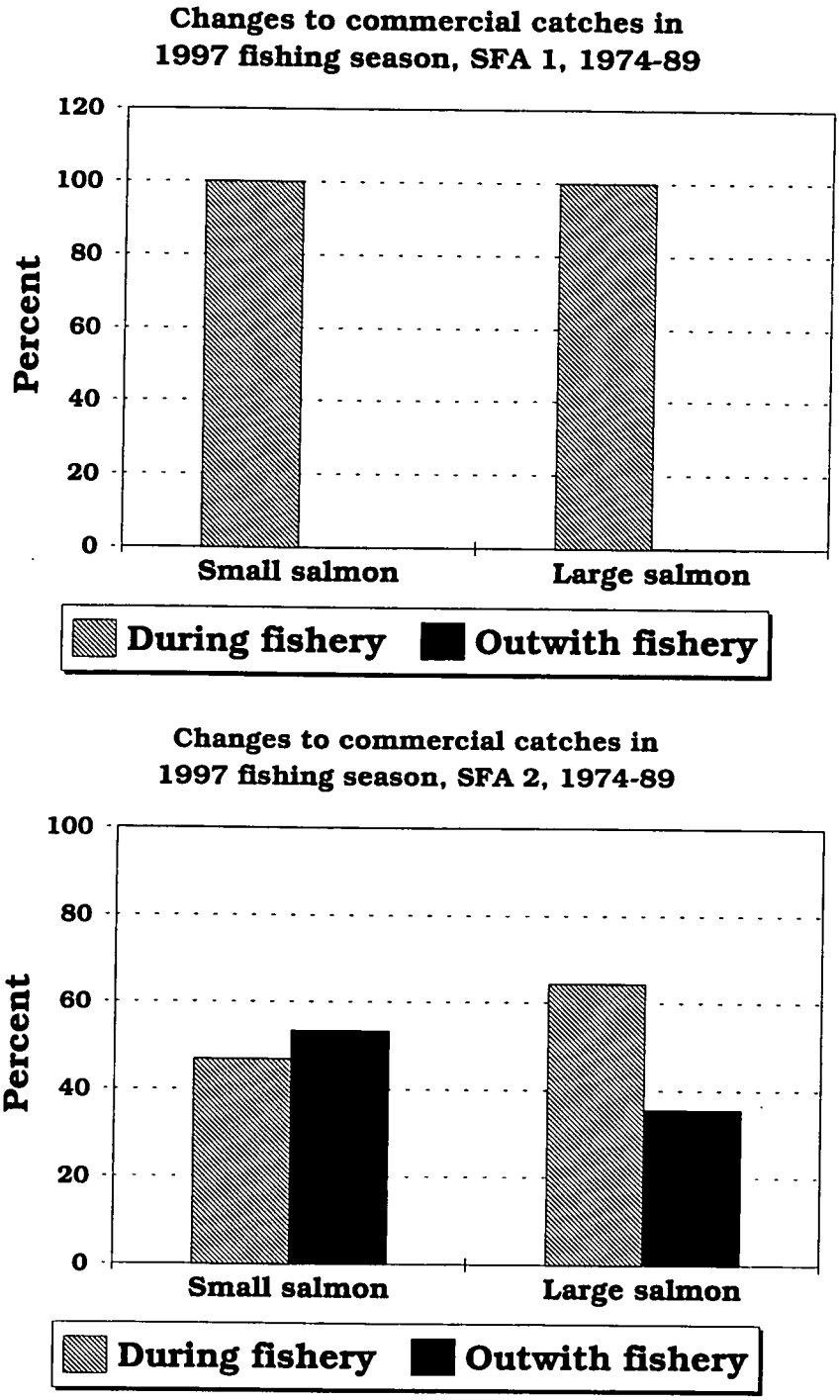


Fig. 5. Effects of the 1997 reduced fishing season on commercial landings in Labrador imputed by applying the June 20 opening date and October 14 (SFA 1) & mid-July (SFA 2) closing dates to landings in years 1974-89.

Fig. 6. Catch per fisherman adjusted for local sales and time period, 1993-97.

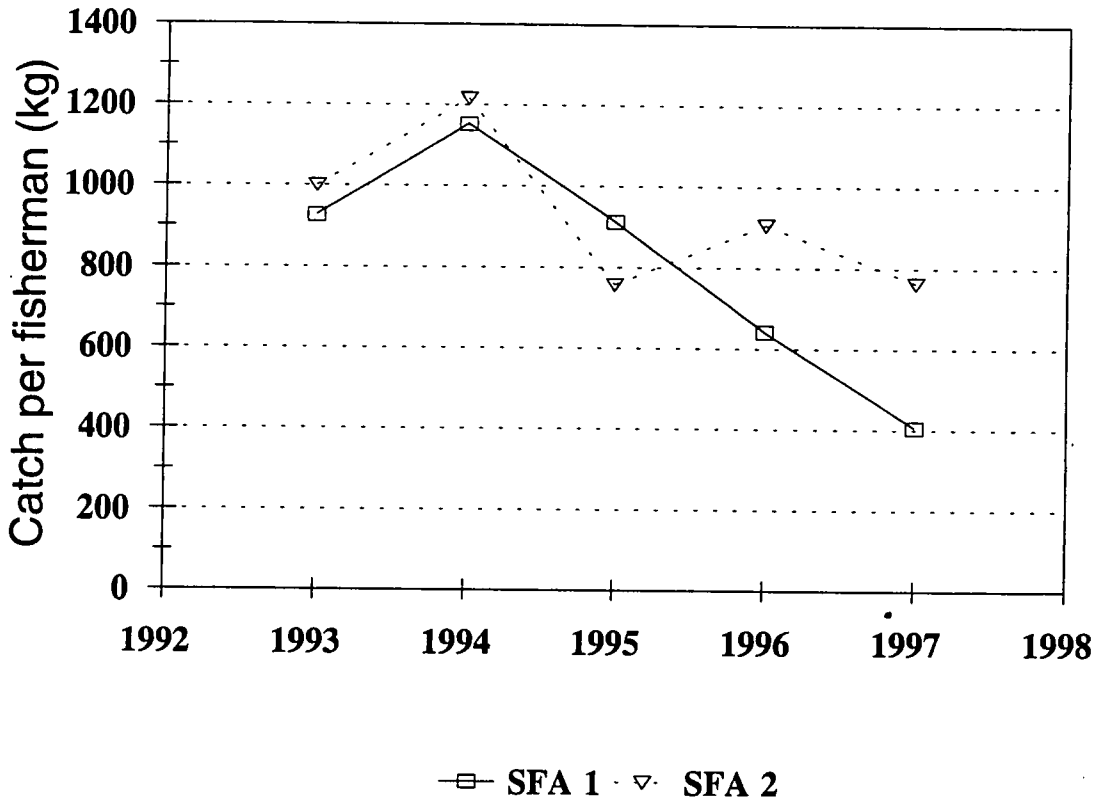


Fig. 7. Catch (kg) per purchase slip, 1993-97 for selected fishermen in SFA 1.

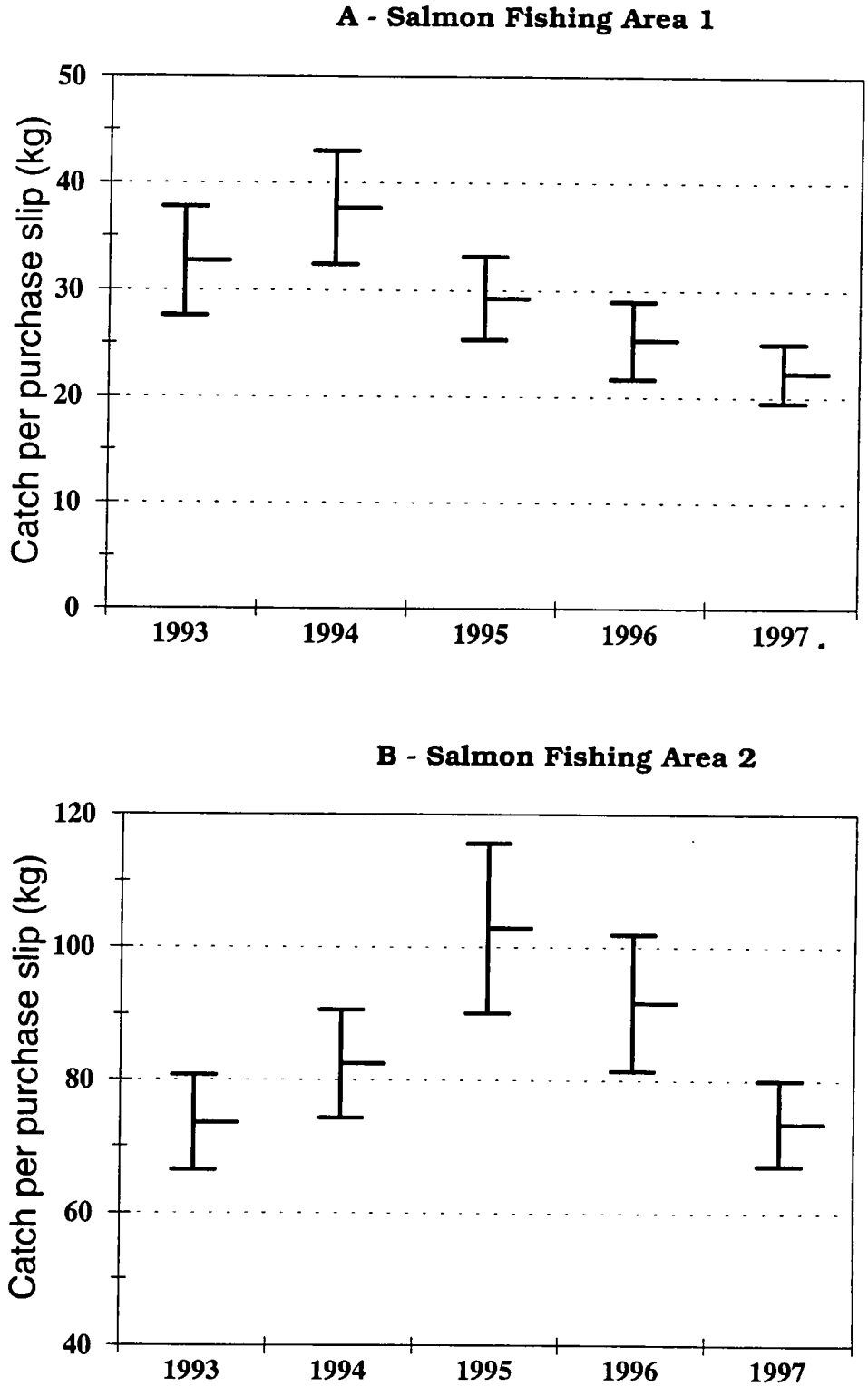
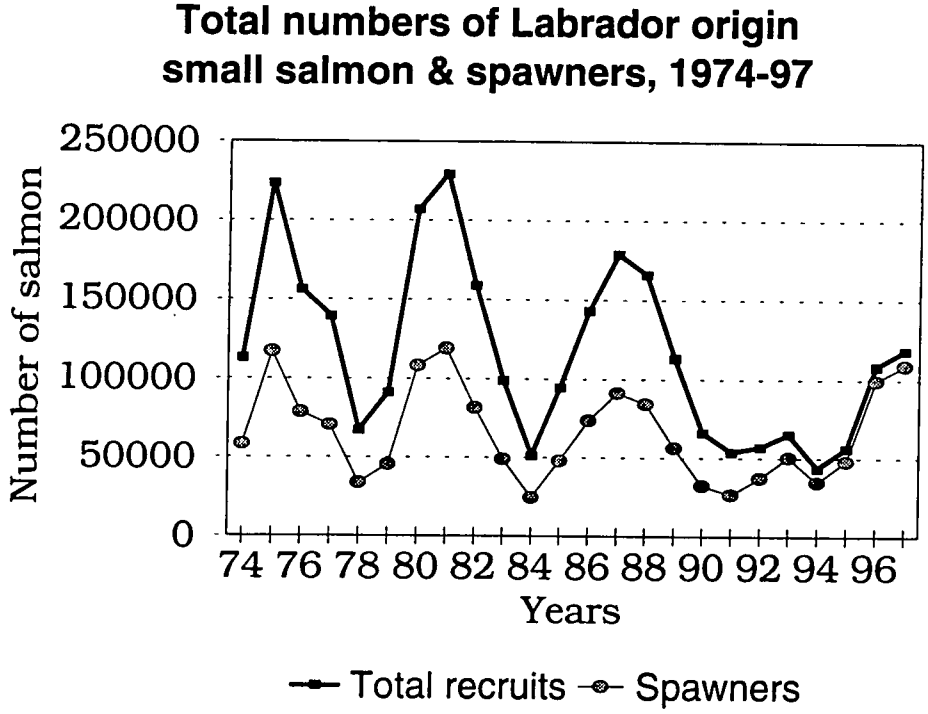


Fig. 8. Estimated numbers of small and large salmon recruits (prior to commercial fishery) and spawners for SFAs 1, 2, and 14B, Labrador, 1974-96.



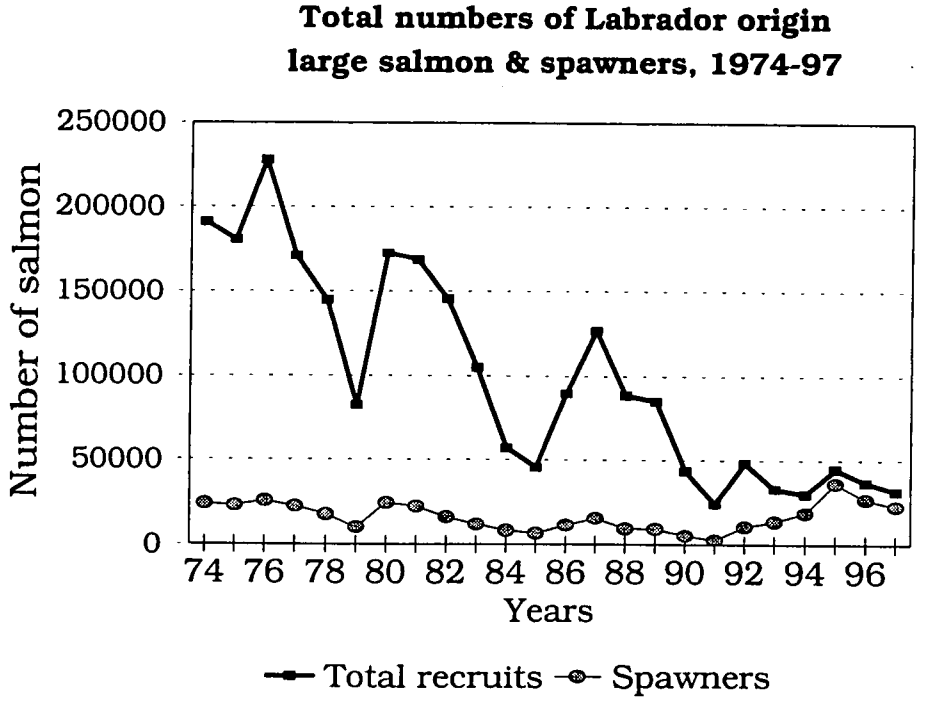


Fig. 9. The relationship between small and large salmon parents and spawners, the replacement line (diagonal), and conservation spawning requirements (horizontal line) for SFAs 1, 2, and 14B, Labrador, 1983-97.

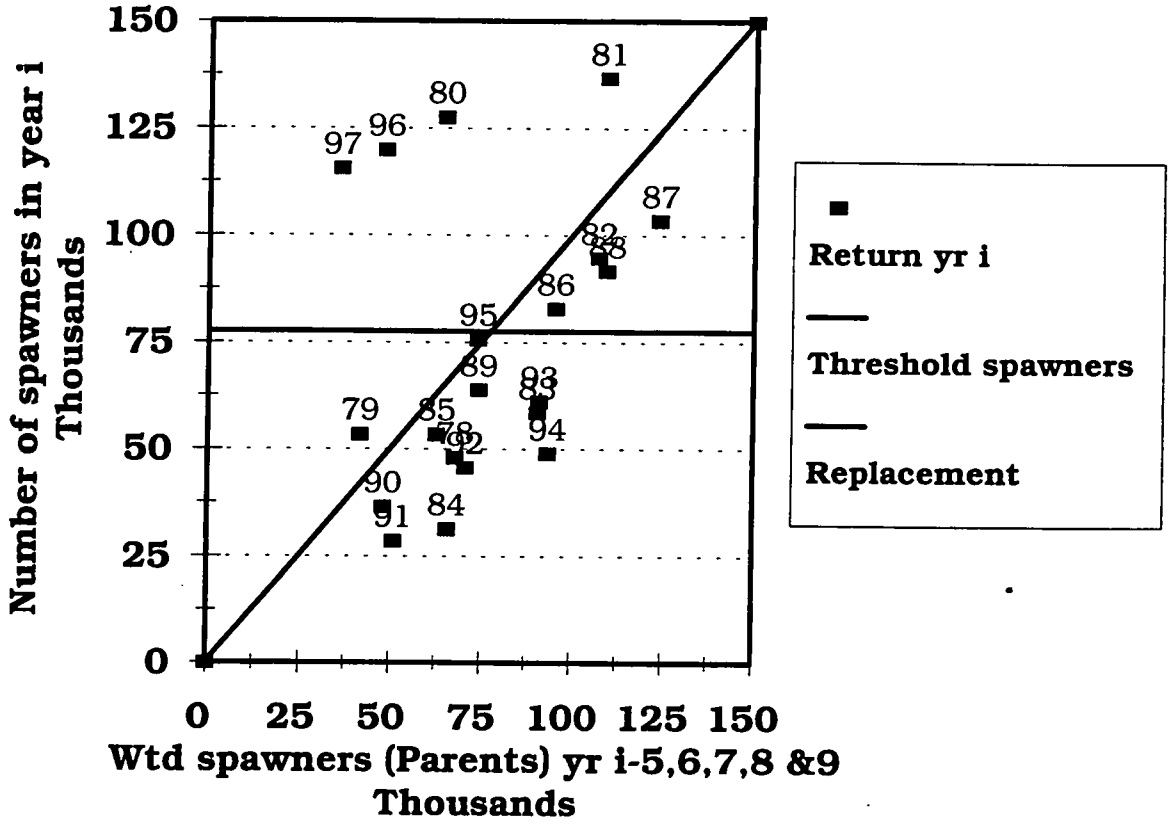
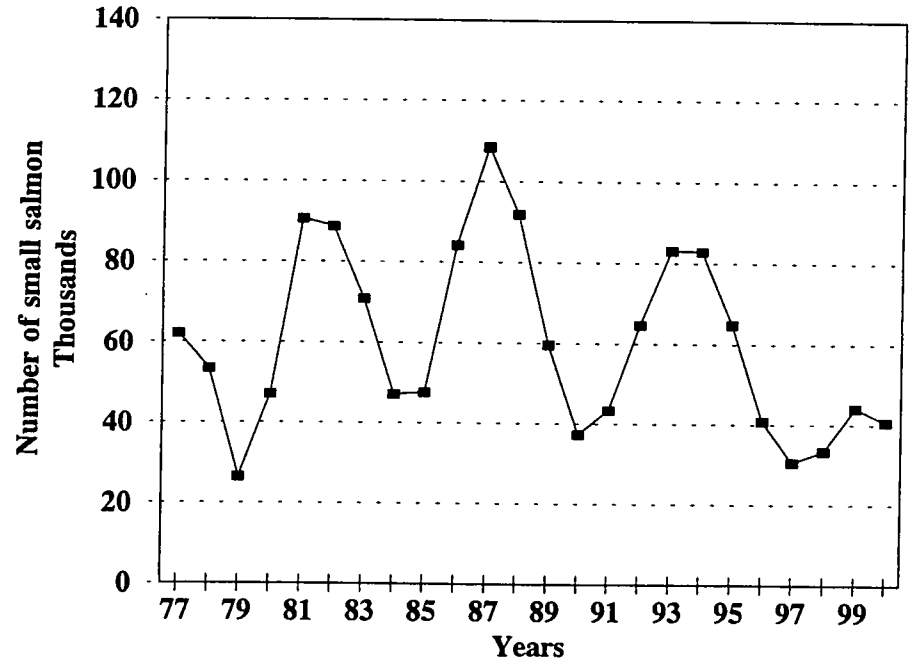
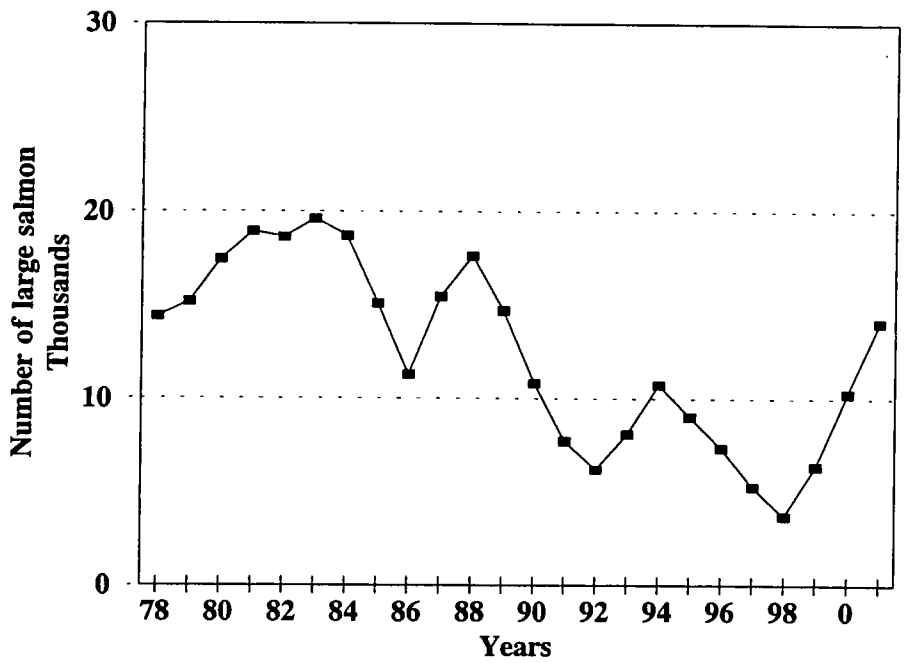


Fig. 10. Estimates of small and large spawners producing returns in 1977-2001.





Appendix 1

Results of salmon and seals survey for Labrador

By

D. G. Reddin and L. Felt[1]

Survey design

Commercial salmon fishers were surveyed for their opinions on seals and their interactions with salmon gear and the numbers of salmon removed by seals and other predators from fishing gear (non-catch fishing mortality). The survey was conducted in January-February of 1998. A copy of the survey is attached to this document. The survey was designed with the assistance of Dr. L. Felt, Sociology Department, Memorial University of Newfoundland. The surveys were sent out from the Goose Bay DFO office and returns from fishers were requested by mid-February. The responses to as many of the questions as possible have been summarized in tabular format. Those questions that asked for a written response that could not be summarized in tabular format, i.e. questions 10, part of 13, 14, 15 and 16, have been summarized in a descriptive format.

Seal survey results

At the time of this analysis (Feb. 28/98), there were 89 responses from fishers to the questionnaire for a response rate of 64% of active fishers and 43% of licenced fishers (Table 1). In general, the effort that fishers put into their replies was quite impressive and included many detailed responses and comments. This high response rate is indicative of how serious fishers take the seal issue and their fishery. A summary of responses follows:

1. Community where you fish?

There were replies from most of the communities along the Labrador Coast (Table 1). Because of the wide distribution of replies we conclude that the questionnaire results are applicable to the commercial salmon fishery.

2. Did you fish salmon commercially in 1997?

Of the 89 responding fishers, 82 of them or 92% fished in 1997 (Table 1). Thus, the information in the responses from fishers is current.

[1] Sociology Dept., Memorial University of Newfoundland, St. John's, Newfoundland

3. If so then how much salmon did you catch?

In SFA 1, there was an average of 647 lbs of salmon caught per fisher while in SFA 2, it was 947 lbs per fisher (Table 1). The total catch in SFAs 1&2 with 138 active fishers would approximate the actual landings recorded by DFO staff through local sales and fish plant purchase slips.

4. What causes you the most trouble during the salmon fishery?

Of the total responding fishers, 37% thought that seals removing salmon from their nets caused them the most trouble during the commercial salmon fishery (Table 2). However, there were some fishers who thought that other issues were important as well. The other issues were weather - 6%, gulls - 12%, ice - 13%, and dirty water - 19%. The only location that had no problem with seals was Spear Harbour and some fishers in the Makkovik area thought that gulls were more of a problem than seals. But by and large, the majority of salmon fishers certainly think that seals are current and an ever-increasing problem for the commercial salmon fishery and salmon stocks. Also, several fishers mentioned the impact that seals and other predators could have on hook and released salmon in rivers. They suggested that released salmon might be more susceptible to predation during recovery from hook-and-release angling. This is a valid concern as seals have been observed in many if not most Labrador rivers during salmon runs and it is known that salmon that have been physically stressed require time to recover. Overall, the dominant issue for fishers during the salmon fishery was seals and, of course, low quotas.

5. Do seals take salmon from your salmon nets during the salmon season?

Of the total responding fishers, 88% thought that seals remove salmon from their nets during the commercial salmon fishery (Table 1). Alternately, 12% of fishers felt that seals did not remove any salmon from their nets.

6. What other animals take salmon from your salmon nets during the salmon season?

Fishers listed polar bears, gulls, otters, humans, whales, sharks and mink in response to this question. Of these, the most numerous mentioned animal was gulls with 74% of fishers responding that gulls were a problem for them by removing salmon from their nets and by partial consumption of the salmon in the net rendering the fish unmarketable (Table 3).

7. How often do you see seals around your nets during the salmon season?

Of the total responding fishers, 67% reported seeing salmon around their nets during the commercial fishing season (Table 1). Furthermore, 16% reported seeing seals once or twice per week. In total, 17% thought it was rare to see seals around their nets;

even though it was rare for them to actually see seals, several of these fishers still thought that seals were a problem.

8. When are seals more common around your nets during the season?

Seals were more commonly seen around nets during the middle of the fishing season then at the beginning or end (Table 1). Several fishers reported that the number of seals around their nets was lower at the beginning then in mid to late season. The differences between the three groups were small.

9a. Over the duration of the salmon season, for every 10 salmon that you catch in your net, how many salmon do you know that seals took from your net?

In total, there were 20 (22%) of fishers who either did not or said they could not answer this question (Table 1). Many of the fishers who said they could not quantify the number of salmon that seals removed still thought it was important. Overall, for those fishers who did answer the question, the average number of salmon removed by seals was 6.2 per 10 salmon caught (Variance=7.58, coefficient of variation=123%, range=0 to 30, mode=0, & median=3). The most common response to this question was either unknown or the 2 to 4 salmon category (Fig. 1). There was also a geographic difference in response to this question for SFA 1 fishers who thought that 3.5 salmon were removed per every 10 caught compared to 7.0 salmon reported by fishers in SFA 2 (Table 1).

9b. How many additional salmon do you think might have been taken from your net that you did not observe?

In total, there were 37 (42%) of fishers who either did not or said they could not answer this question (Table 1). This is a substantial increase over the number of fishers who said they could not answer question 9a and reflects the difficulty in quantifying the impact of seals on the salmon fishery where much of the seal activity is thought to take place when fishers are not present. Overall, for those fishers who did answer the question, the average number of salmon removed by seals was 7.9 per 10 salmon caught (Variance=13.1, coefficient of variation=165%, range=0 to 60, mode=0, median=4). The most common response to this question was that an unknown number of salmon were removed (Fig. 1). There was also a difference in response to this question for SFA 1 fishers who thought that 4.1 salmon were removed compared to 8.8 salmon for SFA 2 (Table 1).

The wide-range in responses to questions 9a and 9b reflected in the high coefficient of variation indicate the potential magnitude of the problem and the difficulty in quantifying what it actually is. From the information provided it should be fairly obvious that seals are an important problem for the commercial salmon fishery.

10. What have you seen to show this?

This question was directed at what types of evidence were fishers using to determine the impact of seals on their fishery. There were 60 responses to this question with some fishers responding with several sources of evidence. There were 60 responses to partly eaten salmon found in nets, 76 to salmon heads left in nets, 73 to seals seen around nets, and 33 to other indirect evidence. This indirect evidence included holes in nets 33, seals seen eating salmon 8, seals caught in nets 8, salmon observed on sea floor below net 2, and one fisher who had observed seals around nets at night and another who had caught salmon scarred by seals. The evidence provided by fishers indicates that seals are removing some salmon from nets.

11. What kind of seal causes you the most trouble?

Fishers reported that ranger (harbour), gray, and harp seals were causing the most problems (Table 1). The bearded and hood seals were the least likely to be a problem. Many fishers also commented that harp seals removing salmon from nets was a recent problem while ranger and gray seals had always been a problem although worsening in recent years in relation to their increasing abundance.

12. Have you noticed any change in the number of seals in the area where you fish compared to 10 years ago?

Fisher responses indicates that 91% thought the number of seals and incidences of salmon removals from nets had increased compared to 10 years ago (Table 1). Only 9% of fishers thought that there was no change in the number of seals and magnitude of their interactions with the salmon fishery. This is entirely consistent with what we know about seal population dynamics as it is known that the numbers of most species of seals have been increasing in recent years (Dempson et al. 1998).

13. Do seals behave differently now than 10 years ago?

Most common response to this question was that seals were more frequently seen around nets and removing salmon from nets than in the past (Table 1). The reason stated for the change in behaviour was that there were more seals than ever before, seal behaviour had changed bringing them closer to the coast and in many cases into rivers. Some fishers thought the reason for the behaviour changes was that there was not enough food for the seals and they resorted to removing salmon from nets to survive. The species of seals causing problems have changed as well in that it used to be only rangers and grey seals whereas recently harp seals are being reported as an increasing problem. Fishers also thought that with fewer and fewer fishers due to license buybacks, seals were more concentrated on the nets that were left, thus increasing the potential problem. Seals were observed on land as well as in rivers where they are assumed to be feeding on salmon, trout and other freshwater fish species.

14. How would you deal with seals and salmon gear?

Fishers noted that this issue will be very hard to deal with as seals do most damage at night when fishers cannot tend their nets. The most common reported solution was to kill the seals causing problems. Many fishers wanted a seal fishery on the Labrador coast during fall for meat and pelts, which would also reduce the number of seals. Fishers felt that there should be a bounty on seals and fishers should be encouraged and allowed to fish with nets for seals (14" mesh size was suggested). Fishers pointed out that scaring seals does not work as the seals simply return the next day or come during the night. The season for commercial salmon should open when salmon are most plentiful so the season would be as short as possible providing a narrower opportunity for seals to cause problems. One fisher suggested reducing the impact of seals by having as quick a fishery as possible. This could be accomplished by using drift gillnets which would have to be constantly tended and taken up at night. A quick fishery could be achieved by opening the fishery in each area when salmon were most abundant and permitting higher amounts of gear to be fished. Another solution suggested by one fisher was to close the salmon fishery altogether.

15. Would you be willing to keep a logbook of seal sightings/incidents with salmon gear in 1998?

A number of salmon fishers volunteered to keep logbooks in 1998. The level of interest in the seal issue suggests that the issue is an important one and that a logbook would be a good way of collecting more detailed information while it is still fresh in fishers minds.

16. Please feel free to comment on any aspect of salmon and seals.

General comments on seals and salmon

- In general, fishers think that the number of salmon in freshwater have increased in recent years sufficient for the commercial fishery to continue.
- Others attributed declining salmon to seals which, they report "are so numerous now and so bold that they are destroying salmon, trout, and charr stocks and if not dealt with by shooting, poison or otherwise killing them there will be no fish left";
- Fishers felt that if the seal lobby does not want seals killed then they should have to compensate fishers for lost income and damaged nets; and,
- Fishers also noted that seals can take salmon in rivers making salmon recovering from hook and release more vulnerable.

Fisheries management

- One fisherman stated that "There needs to be more consultation between commercial fishermen, scientists, outfitters, and recreational fishermen in a

single meeting place to come up with practical and viable solutions rather than having one user group blaming another";

- Nobody from Lake Melville is on the Advisory Board and they knew nothing about it;
- A number of fishers wanted a buyback program;
- Other fishers wanted the fishery to continue as it is an important source of livelihood and part of their social and cultural history that should not be allowed to die out;
- Several thought that there should be a boat quota to replace the area quotas;
- Many fishers wanted to have the quotas increased;
- Trout nets were mentioned several times as a problem for the commercial salmon fishery as they are constructed of small mesh and catch a lot of small salmon;
- DFO should listen to fishers rather than scientists. If scientists do not know now what the problem is they should be retrained;
- One fisher felt that there are lots of salmon for both anglers and commercial fishers. Problem is the anglers want them all for themselves; and,
- Angling fishery has not been limited like the commercial fishery, viz. there is no restrictions on the number of licenses like there is for commercial licenses and there should be.

Salmon stock status

- A lot of fishers commented on how low the salmon stocks were particularly in SFA 1 with few if any fishermen saying stocks were good;
- In SFA 2, there were mixed views expressed on health of salmon stocks with some fishers thinking that they were low and others high although lower than what they were 35 years ago. Some fishers from the same community had different opinions on stock sizes, viz. low versus high;
- Declines noted in large salmon compared to grilse, which are becoming more numerous; and,
- Many commented on the high numbers of salmon in freshwater and improvement in spawners.

Other problems with the salmon fishery are:

- Ghost nets outside 200 mile limit
- Greenland
- Trout nets
- Seals & gulls
- Poachers
- Hook & release angling
- Anglers cheating on bag limits
- Cod traps

What do the fishers with many years spent in the commercial fishery have to say?

There were a couple of fishers responding to the survey that said that they had been fishing salmon in Labrador for more than 35 years. Observations from these fishers are particularly valuable as they can provide views on salmon trends over many years. Here is what they had to say:

- A fisherman who had fished for 63 years both on the coast and near to a river stated that seals were not a problem when he first began fishing. Seals started becoming a problem in the late 1970s and 80s and had been gradually getting worse each year.

- Another fisherman had fished salmon in Labrador since 1960. He reported that salmon numbers were fair to good in 1960-80s but started to decline for the last several years to very low. Seals were not a problem years ago.

- Another salmon fisherman thinks that seals are not the problem with decreasing salmon stocks. He has looked in many seal stomachs and has seen no evidence of salmon or trout. Seals were around years ago so why are they a problem now.

General discussion and recommendations

There is no doubt from the information supplied by salmon fishers through the seal questionnaire that seals have an impact on the commercial salmon fishery by removing salmon from nets and damaging fishing gear. Since a quota controls the commercial salmon fishery, any salmon removed from nets by seals are not included in recorded landings and become part of the 'natural mortality' component of salmon life history. These salmon, of course, will not contribute to the spawning escapement and because they are removed prior to entry to freshwater reduce the number of salmon accessible to anglers. The magnitude of these losses have been estimated by fishers to be about 3 per 10 salmon landed at the median value; although the high variability and number reported as unknown by fishers suggest that the real losses could be different than the reported values. In order to better quantify losses by seals, a series of experiments should be conducted involving commercial salmon fishers. Also, there should be a log book survey in 1998 involving commercial fishers to collect data on seal siting and salmon losses.

While a lot is known about harp, hood, and grey seals; there is less information available for harbour, ring and bearded seals (Dempson et al. 1998). However, the information provided by salmon fishers is consistent with published information on seal life history. For example, fishers reported that bearded seals were much less of a problem than some other species. It is known that bearded seals are low in overall numbers and studies on diet have shown they mainly consume benthic invertebrates and

not fish. For the other species, it is known that the number of grey, harp, and harbour seals are increasing; especially for grey and harbour seals that are not hunted commercially and in some cases are protected as a threatened species (Stenson et al. 1996, Stenson et al. 1997; Zwanenburg 1990). Thus, dealing with the problem of seals interacting with salmon fishing is going to be difficult. A way of reducing seal numbers would be to have a fall commercial seal harvest. In this way, salmon fishers and other coastal residents would benefit and the number of seals would be reduced. Coastal Labradorians have not been able to become involved in the spring seal hunt because of abundant spring ice that keeps their harbours locked in until late spring or early summer. A fall hunt would take place when harbours are ice free, would reduce seal numbers, and provide an income for fishers involved.

A broader issue mentioned by fishers is the possible consumption of salmon and trout by seals in freshwater; especially those that were hooked-and-released. Seals are known to frequent rivers in Labrador sometimes being found far upstream (Anderson 1985). Their frequent presence at partial obstacles to salmon migration suggest a diet of salmon is possible. Also, seals have been observed at the mouth of White Bear River feeding on salmon (H. Hurd, personal communication). Seals in salmon rivers has undoubtedly been occurring for quite sometime as it has been variously mentioned by early settlers in their journals. What is of concern here, is the reports of increasing numbers of seals in freshwater at a time when salmon populations are low. A possible experiment would be to determine the salmon and seal populations and confirm the diet of the latter.

References

Dempson, J. B., D. G. Reddin, M. F. O'Connell, J. Helbig, C. E. Bourgeois, C. Mullins, T. R. Porter, G. Lilly, J. Carscadden, G. B. Stenson, and D. Kulka. 1998. Spatial and temporal variation in Atlantic salmon abundance in the Newfoundland-Labrador region with emphasis on factors that may have contributed to low returns in 1997. DFO CSAS Res. Doc. 114, 161 p.

Hammill, M. O., and G. B. Stenson. 1998. Estimated prey consumption by harp seals (Phoca groenlandica), grey seals (Halichoerus grypus), harbour seals (Phoca vitulina) and hooded seals (Cystophora cristata) in the Northwest Atlantic NAFO Sci. Council Res. Doc. 97/40. 37 p.

Stenson, G. B., M.O. Hammill, M. C. S. Kingsley, B. Sjare, W. G. Warren, and R. A. Myers. 1996. 1994 Pup production of northwest Atlantic harp seals, Phoca groenlandica. NAFO Sci. Coun. Stud. 26:47-62 (NAFO SCR Doc. 95/17, Serial No. N2524).

Stenson, G. B., R. A. Myers, I-H. Ni, and W. G. Warren. 1997. Pup production and population growth of hooded seals (Cystophora cristata) near Newfoundland, Canada. Can. J. Fish. Aquat. Sci 54: 209-216.

Zwanenburg, K. C. T., and W. D. Bowen. 1990. Population trends of the grey seal (Halichoerus grypus) in eastern Canada. P. 185-197. *In* W. D. Bowen [ed.] Population biology of sealworm (Pseudoterranova decipiens) in relation to its intermediate and seal hosts. Can. Bull. Fish. Aquat. Sci. 222: 306 p.

QUESTIONNAIRE
On the salmon fishery

1. Community where you fish:

2. Did you fish salmon commercially in 1997.

   YES ☐ NO ☐

3. If so then how much salmon did you catch? _____Lbs. Numbers of salmon _____

4. What causes you the most trouble during the salmon fishery?

_____

_____

_____

5. Do seals take salmon from your salmon nets during the salmon season?

   YES ☐ NO ☐

6. What other animals take salmon from your salmon nets?

7. How often do you see seals around your nets during the salmon season?

   Every day ☐ Once or twice per week ☐ Rarely ☐

8. When are seals more common around your nets during the season?

   Beginning ☐ Mid-season ☐ End ☐

9. Over the duration of the salmon season, for every 10 salmon that you catch in your net, how many salmon do you know that seals took from your net?

   Number: _____

   How many additional salmon do you think might have been taken from your net that you did not observe?

   Number: _____

10. What have you seen to show this?

Partially eaten salmon observed ☐

Heads left in nets ☐

Seals seen around nets ☐

Other evidence_____

_____

_____

_____

11. What kind of seal causes you the most trouble?

Gray/Uppa/Hupper ☐ Ranger/Doder/Doter ☐ Dog hood ☐

Harp/Bedlamer ☐ Jar ☐ Lazzie/Mozzie/Square flipper ☐

Other kinds of seals if not listed:

12. Have you noticed any change in the number of seals in the area where you fish compared to 10 years ago?

No change ☐ Lower ☐ Higher ☐

13. Do seals behave differently now than 10 years ago?

YES ☐ NO ☐

In what way:

_____

_____

14. How would you deal with seals and salmon gear?

_____

_____

_____

_____

15. Would you be willing to keep a logbook of seal sightings/incidents with salmon gear in 1998?

    If YES then please write your name:

16. Please feel free to comment on any aspect of salmon and seals

_____
_____
_____
_____
_____

Table 1. Summary of fisher responses to questions 1 - 3, 5, 7-9, & 11-13 from the salmon fishery and seal questionnaire.

Questions

1 Community Name	Number of fishers	2		Mean catch per fisher 3		5		7			8			FOR EVERY 10 SALMON SEALS TAKE 9a - Know		9b - Quess		Gray	Ranger	Hood	Harp	Ring	Bearded	11						12			13	
		Yes	No	lbs.	No. fish	Yes	No	Evday	1 to 2	Rare	B	M	E	No response	No.	No response	No.	1	2	3	4	5	6	NC	Low	Hi	Yes	No
Nain	1	1	0	500	125	1	0	0	1	0	0	1	0	0	2.5	0	0.0	0	0	0	1	0	0	0	0	1	1	0
Postville	2	2	0	704	115	2	0	0	2	0	2	0	1	0	2.0	0	2.5	0	1	0	2	2	0	0	0	2	2	0
Makkovik	7	6	1	752	91	5	2	4	0	3	1	4	3	0	2.1	3	2.6	5	4	1	0	1	1	2	0	5	5	2
Rigolet	9	9	0	633	128	9	0	7	1	1	5	6	2	4	6.4	5	7.4	9	9	1	4	0	0	0	0	9	7	1
SFA 1 total	19	18	1	647	115	17	2	11	4	4	8	11	6	4	3.5	8	4.1	14	14	2	7	3	1	2	0	17	15	3
Eagle	1	1	0	700	100	1	0	1	0	0	1	0	0	0	10.0	0	10.0	1	1	0	0	0	0	0	0	1	1	0
Paradise R	3	3	0	431	77	2	1	2	0	1	2	1	2	1	18.8	1	27.8	1	2	1	1	2	0	1	0	2	2	0
Cartwright	11	10	1	968	179	11	0	11	0	0	7	9	9	1	9.0	3	5.3	10	8	1	6	5	1	0	0	11	10	1
Grady	2	2	0	1350	200	2	0	2	0	0	0	2	1	0	13.3	1	12.5	2	1	0	1	0	0	0	0	2	2	0
Black Tickle	4	4	0	298	41	3	1	1	1	2	2	3	3	3	0.0	4	.	0	0	0	4	0	0	1	0	3	1	3
Punch Bowl	1	0	1	4500	1000	1	0	1	0	0	1	1	1	0	25.0	0	20.0	1	1	0	1	1	0	0	0	1	1	0
Seal Is	2	2	0	1500	400	2	0	1	0	1	1	1	1	1	0.0	1	12.0	1	2	0	2	0	0	0	0	2	2	0
Five Is	1	0	1	.	.	1	0	0	1	0	1	1	1	0	2.5	0	1.5	1	0	0	0	1	0	0	0	1	1	0
Dead Is	1	1	0	800	100	0	1	0	0	1	.	.	.	1	.	0	0.0	.	.	.	.	.	.	.	.	.	.	.
Bolsters Rock	1	0	1	.	.	1	0	1	0	0	1	1	1	0	3.0	0	5.0	1	1	0	1	1	0	0	0	1	1	0
Caplin Bay	1	1	0	500	120	1	0	1	0	0	1	1	1	0	2.5	0	.	1	1	1	1	1	1	0	0	1	1	0
Hawk Hr	2	2	0	475	70	2	0	1	1	0	2	2	1	0	1.5	0	2.5	0	0	0	2	2	0	0	0	2	2	0
Snug Hr	1	1	0	600	.	1	0	1	0	0	0	1	1	0	25.0	0	55.0	1	1	0	1	0	0	0	0	1	1	0
St. Lewis	3	3	0	393	82	3	0	3	0	0	2	1	1	0	4.0	0	9.7	2	2	0	3	3	1	0	0	3	3	0
Charlottetown	1	1	0	1000	160	1	0	1	0	0	1	1	0	0	10.0	1	.	1	0	0	1	0	0	0	0	1	1	0
Triangle Hr	2	2	0	1100	.	2	0	2	0	0	1	2	1	1	2.0	2	.	1	1	1	2	0	0	0	0	2	2	0
Sandy Hook	2	2	0	1250	251	1	1	1	0	1	1	1	1	0	2.5	1	0.0	1	1	0	1	1	0	1	0	1	1	1
Williams Hr	1	1	0	1207	213	1	0	0	1	0	1	0	1	0	2.5	1	.	1	0	0	0	1	0	0	0	1	1	0
Spear Hr	3	3	0	713	120	0	3	0	0	3	0	1	0	0	0.0	0	0.0	0	0	0	0	0	0	2	0	1	2	0
Penneys Hr	2	2	0	1500	400	2	0	2	0	0	0	2	1	1	4.0	1	4.0	2	1	0	2	1	0	0	0	2	2	0
Battle hr	3	3	0	362	80	3	0	1	1	1	1	2	2	0	1.1	0	1.1	1	0	0	3	1	0	0	0	3	3	0
Marys Hr	2	2	0	1700	.	2	0	1	1	0	1	2	1	1	5.0	1	7.5	2	1	0	1	0	1	0	0	2	2	0
Cape St. Charles	8	7	1	596	93	7	1	4	4	0	7	5	2	3	6.6	6	2.3	3	2	1	8	1	0	0	0	8	7	1
Camp Is.	3	3	0	1133	188	3	0	2	0	0	1	2	2	1	3.5	3	.	3	1	1	3	1	0	0	0	3	3	0
Carrol Hr	2	2	0	314	40	2	0	2	0	0	1	1	0	0	16.0	1	1.5	0	0	0	2	1	0	0	0	2	2	0
Matthews Cove	1	1	0	100	.	1	0	1	0	0	0	1	0	1	.	1	.	1	0	0	1	0	0	0	0	1	1	0
Unknown	6	5	1	57	8	5	1	5	0	1	5	2	2	1	7.8	1	18.4	3	2	0	2	1	1	1	0	5	4	2
SFA 2 total	70	64	6	942	187	61	9	48	10	11	41	46	36	16	7.0	29	8.8	41	29	6	49	24	5	6	0	63	59	8
Overall totals	89	82	7			78	11	59	14	15	49	57	42	20	6.2	37	7.9	55	43	8	56	27	6	8	0	80	74	11
Percentages		92%	8%			88%	12%	67%	16%	17%	33%	39%	28%	22%		42%		28%	22%	4%	29%	14%	3%	9%	0%	91%	87%	13%

Table 2. Fisher responses to *question 4. What causes you the most trouble during the fishing season?*.

Community Name	Polar bears	Seals	Weather	Gulls	Food fishery	Lack of Salmon	Ice	Dirty or slubby water	Seaweed	Anglers	Fisheries Officers	DFO	Length/lateness fishing season	Quota	Whales	Otters
Nain	1	1														
Postville		1	1	1	1											
Makkovik		4		1		1	2	4								
Rigolet		8	2	5				1	1							
SFA 1 totals	1	14	3	7	1	1	2	5	1							
SFA 1 %	3%	40%	9%	20%	3%	3%	6%	14%	3%							
Eagle		1														
Paradise R		2								1	1					
Cartwright		10					1	1				1				
Grady		2					1									
Black Tickle		2		2			2									
Punch Bowl		1		1			1	1								
Seal Is		1					2	1								
Five Is		1					1	1								
Dead Is								1								
Bolsters Rock		1														
Caplin Bay		1	1	1			1									
Hawk Hr		2		1			1									
Snug Hr								1					1			
St. Lewis		2					2	2						1		
Charlottetown		1						1							1	
Triangle Hr		2						1					1			
Sandy Hook		1		1			1	1						1		
Williams Hr		1													1	
Spear Hr			2	1				2								
Penneys Hr		2	2					2							1	
Battle Hr		2				1	1	1					1			
Marys Hr		2		1			2									
Cape St. Charles		4	3	2			1	8					2			
Camp Is.		2		1			1	3					1			
Carrols Hr		1		2			2									
Matthews Cove		1											1			
Unknown		4		1				1								1
SFA 2 sums		49	8	14		1	20	28		1	1	1	7	2	3	1
SFA 2 %		36%	6%	10%		1%	15%	21%		1%	1%	1%	5%	1%	2%	1%
Overall total	1	63	11	21	1	2	22	33	1	1	1	1	7	2	3	1
Overall %	1%	37%	6%	12%	1%	1%	13%	19%	1%	1%	1%	1%	4%	1%	2%	1%

Table 3. Fishermen responses to ***6. What other animals take salmon from your salmon nets during the salmon season?*** .

Community Name	Polar bears	Sea gulls	Otters	Humans	Whales	Sharks	Mink
Nain	1	1					
Postville			1				1
Makkovik		2	1	1			2
Rigolet		6	1	1			2
SFA 1 sums	1	9	3	2			5
SFA 1 %	5%	45%	15%	10%			25%
Eagle							
Paradise R							
Cartwright		4	1				
Grady		1					
Black Tickle		4					
Punch Bowl					1		
Seal Is		1					
Five Is		1					
Dead Is							
Bolsters Rock		1					
Caplin Bay		1	1				
Hawk Hr		1					
Snug Hr		1					
St. Lewis		3					
Charlottetown		1					
Triangle Hr		2					
Sandy Hook		2					
Williams Hr							
Spear Hr		2					
Penneys Hr		1					
Battle hr		3					
Marys Hr		2					
Cape St. Charles		4					
Camp Is.		2				1	
Carrol Hr		2					
Matthews Cove							
Unknown			1				1
SFA 2 sums		39	3		1	1	1
SFA 2 %		87%	7%		2%	2%	2%
Overall total	1	48	6	2	1	1	6
Overall %	2%	74%	9%	3%	2%	2%	9%

Fig. 1. The distribution of responses to the number of salmon removed by seals from nets during the commercial salmon fishery.