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Newfoundland East and Southeast Coast Herring - An Assessment of Stocks to the Spring of 1994

by

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Abstract

Results of the analysis of data from 1993 to the spring of 1994 are presented for the five herring stock complexes assessed within the Newfoundland region. Commercial landings decreased from 11300 t in 1992 to 5500 t in 1993. The 1987 yearclass of spring spawners continued as the dominant yearclass in the commercial fishery. In this assessment, yearclass strengths were estimated from research gillnet catch rate indices and acoustic survey estimates using a multiplicative model and from research gillnet catch at age data using a modified Leslie-DeLury depletion approach. Stock abundances were estimated using an extended survivors analysis. It was concluded that although east and southeast Newfoundland herring stocks rebuilt through the 1980's with the recruitment of a moderately sized 1982 yearclass and a smaller 1987 yearclass, stock sizes did not increase to levels observed during the 1970's. As these yearclasses have passed the point of maximum yield per recruit, stock sizes have declined and are presently less than 15% of maximum observed levels. As recruitment of recent yearclasses does not appear to be strong, from a biological viewpoint, consideration should be given to closing these herring fisheries.

Résumé

Les résultats de l'analyse des données de la période s'étendant de 1993 au printemps de 1994 sont présentés pour les cinq complexes de stocks de hareng examinés dans la région de Terre-Neuve. Les débarquements commerciaux ont diminué pour passer de 11 300 t, en 1992, à 5 500 t, en 1993. Les géniteurs de printemps de la classe d'âge de 1987 ont continué de dominer les prises commerciales. L'importance des classes d'âge a été évaluée à partir des indices des taux de capture des relevés de recherche au filet maillant et des estimations des relevés acoustiques, à l'aide d'un modèle multiplicatif, et à partir des données des prises selon l'âge d'un relevé de recherche au filet maillant, par approche d'épuisement de Leslie-DeLury. L'abondance des stocks a été estimée par analyse étendue des survivants. En dépit du rétablissement, au cours des années 1980, des stocks de hareng de l'est et du sud-est de Terre-Neuve, de par le recrutement d'une classe d'âge moyenne (1982) et d'une classe d'âge plus petite (1987), l'effectif des stocks n'a pas atteint celui des années 1970. À mesure que ces classes d'âge ont dépassé le point de rendement maximum par recrue, l'effectif des stocks a diminué et correspond actuellement à 15 % de la valeur maximale observée. Le recrutement des classes d'âge des dernières années n'étant pas important, du point de vue biologique, il serait bon d'examiner la possibilité d'interdire ces pêches.

Introduction

This report contains an assessment of Atlantic herring stocks along the east and southeast coasts of Newfoundland, including the areas White Bay - Notre Dame Bay (WB-NDB), Bonavista Bay - Trinity Bay (BB-TB), Conception Bay - Southern Shore (CB-SS), St. Mary's Bay - Placentia Bay (SMB-PB), and Fortune Bay (FB) (Fig.1). Emphasis was placed on assessing the three stocks upon which there have been commercial fisheries in recent years, White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, and St. Mary's Bay - Placentia Bay.

Until this year, assessments of these stocks have been reviewed annually by the Pelagic Committee, formally a subcommittee of CAFSAC. As part of the "Renewed Process for the Assessment of Atlantic Stocks", this current review was conducted regionally in St. John's by personnel from the Department of Fisheries and Oceans and the Department of Fisheries, Food and Agriculture, Government of Newfoundland. The review was conducted during four meetings in October and November, 1994 so that the most current information on the status of these stocks could be included in the Newfoundland Herring Management Plan for 1995.

In recent years, there have been three primary data sources used in the assessment of these stocks: age distributions and catch rates at age from a research gillnet program, biomass estimates from acoustic surveys, and commercial catch at age data. This year, there was also consideration given to the interaction between species in the environment, specifically to the impact of seal predation on herring. The effect of environmental conditions was also considered, in particular the effect that overwintering temperatures and salinities have on the successful survival of herring yearclasses.

Until this year, biomass estimates from acoustic surveys and observations of trends in abundance from research gillnet catch rates, used independently, have formed the basis of the assessments for these stocks (Wheeler et al. 1991, 1992, 1994). In this assessment, it was attempted to combine all available data in a cohesive manner to obtain estimates of yearclass strengths and stock abundance. Yearclass strengths were estimated from research indices using a multiplicative model and from research gillnet catch at age data using a modified Leslie-DeLury depletion approach. Stock sizes were first estimated using a separable VPA, tuned by the Laurec - Shepherd method (Pope and Shepherd 1982). This approach was rejected by the assessment review committee in favour of an extended survivors analysis (Shepherd 1992) which was deemed to be a more appropriate way to estimate stock abundance.

This document outlines the steps taken to assess these herring stocks in 1994. The effects that both the environment and predators (ie. seals) have on the survival of herring are examined. Background information on the 1993 commercial fishery and age distributions by stock area from the fishery are also provided. Results of an acoustic survey conducted in 1994 are presented; the paper also summarizes the results of all herring acoustic surveys conducted in the Newfoundland region since 1983. The 1993 results from the research gillnet program are presented, including age distributions and catch rates at age by stock area. Catch rates only from 1994 are also presented. As these herring stocks consist predominantly of spring spawning herring which are also targeted by the commercial fishery, only that

spawning component is assessed. The methods used to estimate stock sizes and yearclass strengths of spring spawning herring are examined in detail, including a discussion of their inherent sources of variability. The paper concludes with a summary of stock status and conservation concerns. The document includes, in as much detail as possible, deliberations of the assessment review committee. The stock status report and list of assessment review participants is appended.

Description of the 1993 Commercial Fishery

Herring landings from east and southeast Newfoundland herring stocks peaked at 31000 t in 1979. The increased landings through the late 1970's coincided both with the recruitment of the very strong 1968 yearclass and with increased markets due to the collapse of the North Sea herring stocks. Commercial fisheries were closed, or reduced to bait fisheries only, during the early 1980's due to a decline in abundance caused by poor recruitment subsequent to the 1968 yearclass. Stock sizes increased again through the 1980's with the recruitment of the moderately sized 1982 yearclass and the somewhat smaller 1987 yearclass. Landings over the last five years have been controlled by markets; TAC's have not been a limiting factor. During this time, annual landings have been between 6000 - 8000 t, with the exception of 1991, when landings increased to 17000 t due to a government subsidy program paid to fishermen and processors.

Landings in 1993 (Table 1, Fig. 2), were approximately 5500 t. Similar to recent years, most fish (75%) from the Newfoundland Region were landed in White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay during the fall purse seine fishery (Tables 2 and 3). However, there was little effort exerted in this fishery in these two northern areas due to the low price of herring. In White Bay - Notre Dame Bay, the purse seine fleet directed their efforts towards mackerel because of its higher value. Herring were taken when fish of the required market size were encountered. This was confounded by the presence of numerous concentrations of small fish, primarily 1991 yearclass. Similarly, in Bonavista Bay - Trinity Bay, there were numerous comments by fishermen during the fall fishery of concentrations of small herring. The market requirements in both areas were for large herring, greater than 300 g (age 9+); the combination of the presence of small fish and low prices reduced the fishing effort in both areas. There was a limited winter purse seine fishery in St. Mary's Bay - Placentia Bay (Table 5) targeted towards large herring. The fisheries in the remaining two areas, Conception Bay - Southern Shore and Fortune Bay were negligible (<300 t) and were spring gillnet fisheries for bait only (Tables 4 and 6).

Assessment Data Sources

Environmental Considerations

Most herring from east and southeast Newfoundland herring stocks are spring spawners (Tables 9 - 13). Due to colder oceanographic conditions in recent years, spawning was delayed in 1991, 1992 and 1993. However, there were no reports of delayed spawning in 1994. Cold environmental conditions have also affected herring growth rates; mean weights at

age have declined through the 1990's (Table 7).

Variations in yearclass strength of east and southeast Newfoundland spring spawning herring for the 1963 to 1976 yearclasses have been shown to be determined largely by annual variations in overwintering temperatures and salinities associated with the Labrador current (Winters and Wheeler 1987). The derived relationship was used to predict the strengths of the 1977 to 1990 yearclasses for three areas, White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay and St. Mary's Bay - Placentia Bay (Table 24). In all areas, the 1982 yearclass was predicted to be the largest during this time period decreasing in strength from White Bay - Notre Dame Bay to St. Mary's Bay - Placentia Bay. The 1987 yearclass was predicted to be small in relation to the 1982 yearclass in all these areas.

Predation on Herring by Seals

Information was provided on the diet of harp seals in inshore areas (G. Stenson pers. comm.). From 1990-1993, herring represented approximately 10% of the wet weight in age 1+ harp seal stomachs and in Div. 3KL were the second most important prey species after Arctic cod. These herring ranged in length from 20-30 cm (approximately ages 2 to 4). Herring did not occur in the diet of either harp seal adults or pups in offshore areas. There are indications that herring account for approximately 3% of the energy requirements of harp seals in Div. 3KL. A consumption model is not yet available for harp seals.

Historically, herring did not occur in the diet of harp seals in 1982 or 1983 but did occur in 1984 concurrent with the recruitment of the 1982 yearclass at age 2. As harp seals tend to select juvenile herring, there is potential to examine their annual diet as a indicator of herring yearclass strength.

Herring also account for approximately 10% of the wet weight in the diet of hooded seals when they are in the inshore areas of Div. 3KL. However, hooded seals occur inshore only in the late winter and early spring and their distribution is dependent on the occurrence of inshore pack ice.

The impacts of seal predation on herring cannot yet be fully quantified but may be possible when a seal consumption model is available within the next year.

Biological Sampling

There were 12490 herring sampled in 1993, 10154 from the research gillnet program and 2336 from the commercial fishery. When apportioned by stock area, month, and gear type (Table 8), samples were available for 94% of the commercial catch. The processing of biological samples from 1994 was not completed in time for inclusion in this assessment.

1993 Commercial Fishery Catch at Age

As in recent years, the 1987 yearclass dominated (>40%) the fishery (by number) in the two northern areas, White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay, where 85%

of the total catch was taken (Tables 9 and 10, Fig. 3). Older fish, aged 11+, accounted for approximately 10% of the catch in each of these areas. The catch was dominated also by spring spawners (>85%) in both areas.

In St. Mary's Bay - Placentia Bay (Table 12, Fig. 3), the only other area with a fishery of any consequence (1100 t), fish aged 11+ accounted for 60% of the catch (by number). The 1987 yearclass accounted for approximately 10% of the catch. Spring spawners accounted for only 54% of the catch in this area. The lower percentage of spring spawners was unusual and due to a limited but directed fishery during the fall of 1993 in St. Mary's Bay in which autumn spawners were caught.

There was no evidence of recruitment of younger yearclasses to the fishery in any of these areas.

Research Gillnet Program

Program Description

The research gillnet program was initiated in the Newfoundland Region in the early 1980's to derive abundance indices for herring, by stock area, independent of the commercial fishery. Each year, commercial fishermen in each of the five stock areas are provided with a fleet of five standardized gillnets, mesh sizes 2"-3". They are contracted to fish these nets for a period of one month each year, to maintain an accurate daily record of their catches, and to collect samples of their catch at specified intervals. In some areas, research gillnet data are also available from the 1970's when nets were set by research technicians from Science Branch.

As in 1992, the 1993 and 1994 programs were restricted to the spring season only. A fall program, conducted annually in the three northern stock areas from 1980 to 1991, was eliminated due to a reduction in operating budget. The spring program has been conducted annually in the two southern areas since 1982 and in the three northern areas since 1985. In 1993 and 1994, 25 fishermen participated in the spring program. There were no changes to the database from the most recent assessment (Wheeler et al. 1994).

Research Gillnet Catch at Age

As in 1992, the 1987 yearclass dominated the 1993 research gillnet catch (by number) in the two northern areas (Fig. 4). There was a greater percentage of older fish in the three southern areas, perhaps indicating either a lower level of exploitation of these stocks or the relative strength of the 1987 yearclass in these areas.

There was little or no evidence of recruitment of the 1989 or 1990 yearclasses in the catch in any of the areas. Where they did occur in Conception Bay - Southern Shore and St. Mary's Bay - Placentia Bay, they represented less than 10% of the catch. More recent yearclasses would not be recruited to the research gillnets as herring are first recruited to these nets at age 3.

Research Gillnet Catch Rates at Age

Catch rates at age for spring spawning herring from the research gillnet programs conducted during both the spring and fall are given in Tables 14 - 18. Catch rates only are available for 1994 as the 1994 research gillnet biological samples were not processed in time for inclusion in this report.

Research gillnet catch rates from the 1993 spring program in four of the five stock areas continued the declining trend exhibited since the mid 1980's (Fig. 5). This is consistent with the passage of the 1982 and 1987 yearclasses through these populations and poor recruitment of the 1988 - 90 yearclasses.

The increased catch rates in three of the five areas in 1994 may represent the recruitment of the 1991 yearclass although samples have not yet been processed to indicate if this is the case.

1994 Acoustic Survey

Survey Design, Biological Sampling, and System Calibration

Results were available from an acoustic survey of St. Mary's Bay - Placentia Bay conducted in January 1994. Survey design was unchanged from previous surveys (Wheeler 1990, 1991, 1992 and Wheeler et. al. 1994). The survey was conducted from the *R.V. Marinus*, equipped with a herring purse seine (150 fathoms by 30 fathoms) for biological sampling.

Biological sampling was adequate to calculate a biomass estimate. Herring were detected acoustically in five locations during the survey and were caught in three of these locations.

The echo integrator and transducer used during the survey were calibrated by BioSonics Inc. in March, 1992 . In addition, the dual beam processor, used to calculate in situ target strengths, was calibrated with a standard sphere on several occasions during the survey. To avoid any potential problems caused by differences in water and air temperatures, the transducer was left in the water throughout the entire survey, except during vessel berthing operations. The following calibration parameters were used during the survey:

Source Level (dB/uPa)		216.25
Receive Sens. (dBv/UPa)		-155.28
Fixed Receiver Gain (dB)		-6
TVG Gain		20 log R
Pulse Length (msec)		0.4
Beam Pattern Factor		0.00092
Sampling Threshold (v)	@3-120 m	0.05
	@120-150m	0.10

Acoustic Survey Results

Integrated density estimates were calculated for the 114 transects surveyed. The herring target strength - fish length relationship calculated from the 1993 Holyrood target strength experiments (Wheeler et al. 1994) was used to calculate biomass. Herring were detected in three strata (Table 19); the biomass estimate from the survey was 43900 t. Formulas used to calculate mean densities, variances, and biomass estimates remain unchanged from previous surveys and are given in Wheeler (1991).

Consistent with the age distribution from the last acoustic survey of St. Mary's Bay - Placentia Bay in 1992, the 1991 yearclass dominated again in the 1994 survey (Fig. 6), representing approximately 40% of the population estimate by number. This is somewhat different from the 1993 age distributions of the commercial fishery and research gillnets (Figs. 3 and 4). However, this is to be expected as the commercial fishery targets larger herring and would avoid the 1991 yearclass. The 1991 yearclass would also not be recruited to the research gillnets in 1993. Its occurence in the acoustic survey estimates is consistent with the increase in research gillnet catch rates in 1994 (Fig. 5).

Summary of Acoustic Survey Data from 1983 to 1994

The first herring acoustic survey in the Newfoundland Region was conducted in 1983. From 1983 to 1987, biomass estimates were derived from sonar - sounder surveys, the methodology for which is described in Wheeler and Winters (1991). Since 1988, biomass has been estimated from echo integration surveys for which survey design and methods have been described in this and previous research documents (Wheeler 1990,1991,1992).

Population numbers at age and biomass estimates for White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay and St. Mary's Bay - Placentia Bay from all acoustic surveys are given in Table 20. For the two northern areas, in particular Bonavista - Trinity Bay, there has been a declining trend in abundance in acoustic survey estimates since the mid 1980's. For St. Mary's Bay - Placentia Bay, three of the four acoustic survey estimates indicate stability in the stock. For all of the areas, the acoustic surveys tend to track the major yearclasses, that of 1982 and 1987.

Estimation of Stock Size

In previous assessments of these stocks, trends in stock abundance were examined by independent analysis of research gillnet catch rates and acoustic survey results. In this assessment, these data were consolidated to produce an analytical assessment of stock abundance.

Yearclass strengths were examined using three approaches, a relationship between overwintering temperatures and salinities (already described in the Environmental Consideration section of this document), a multiplicative model and a modified Leslie-DeLury depletion approach.

The multiplicative model integrated research gillnet catch rates at age from the spring and fall series and population numbers at age from acoustic surveys to examine cohort effects (Tables 21 -23). There were concerns expressed during the assessment review that significant interaction effects between COHORT and SAGE may make difficult to interpret COHORT results. However, it was decided to ignore interaction effects as no acceptable way has yet been demonstrated to account for them. It was also noted that in the multiplicative model, catchability of small cohorts is much greater than large cohorts. Small cohorts may be overestimated but large cohorts would be underestimated. Therefore, in the case of these herring stocks which are dominated by a few large yearclasses, results from the model should be conservative. For all three stock areas examined, results were significant with the model explaining in excess of 70% of the variation. Research gillnet catch rates at age from the 1970's were included, when available, as they provided estimates of the large 1966 and 1968 yearclasses. It was then possible to examine the relative size of the 1982 and 1987 yearclasses to these large yearclasses (Table 24). For White Bay - Notre Dame Bay, the model shows the 1982 and 1987 yearclasses to be of comparable strength. For Bonavista Bay - Trinity Bay, the 1982 yearclass is estimated to be larger than the 1987 yearclass and both are estimated to be smaller than the 1968 yearclass. The 1991 yearclass is estimated to be of comparable size to the 1982 yearclass; however, this yearclass is estimated from one acoustic survey only. For St. Mary's Bay - Placentia Bay, the 1982 yearclass is estimated to be much larger than the 1987 yearclass but both are also smaller than either the 1966 or 1968 yearclasses. The 1991 and 1992 yearclasses are both estimated to be equal to or larger than the 1982 yearclass. However, as with Bonavista Bay - Trinity Bay, these estimates were derived from acoustic surveys only as the yearclasses have not yet recruited to the research gillnets. The results of the multiplicative model are consistent with observations from the research gillnet age distributions (Fig. 4) which suggest that the size of the 1987 yearclass, relative to that of 1982, is smaller in St. Mary's Bay - Placentia Bay than in the two northern areas.

The modified Leslie-DeLury model is a depletion estimator for estimating initial cohort strength while also accounting for natural mortality. It can be used to scale relative yearclass strengths from multiplicative analyses in order to provide a time series of absolute estimates. In this document, it was applied to research gillnet catch rate at age and commercial catch at age data to estimate the strength of selected cohorts of herring . Only selected cohorts could be examined. For the 1982 yearclass, the result (Table 24) was comparable to that derived from the multiplicative model for White Bay - Notre Dame Bay, was much larger for Bonavista Bay - Trinity Bay, and much smaller for St. Mary's Bay - Placentia Bay.

An initial attempt was made to estimate stock sizes using separable VPA, tuned by the Laurec-Shepherd method. However, concerns were expressed during the assessment review that age selectivity may change depending on yearclass size whereas the method assumes a constant exploitation pattern. The VPA also generated very low fishing mortalities. The method was deemed to be inappropriate for these stocks as even small changes in natural mortality would mask changes in fishing mortality. The method is also sensitive to observation errors in the data for the final year which is assumed to be exact. To address some of these concerns, it was decided to estimate stock sizes using an extended survivors analysis (XSA). The XSA is not as sensitive to observation errors in the data in the final year and also utilizes yearclass strength information contained within disaggregated catch data. CPUE indices from each fleet are also assumed to be related to population abundance by a constant catchability model. The XSA was run for White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, and

St. Mary's Bay - Placentia Bay research catch rates at age from spring and fall programs and population numbers at age from acoustic surveys. The XSA software requires the choice of several options. For each of the above XSA runs, catchability was assumed to be independent of stock size for all ages, catchability was assumed to be independent of yearclass strength for ages >= 9, tapered time weighting was not applied, survivor estimates were shrunk to the mean of the last 5 years and the 5 oldest ages, and all three fleets of CPUE data were given equal weight. XSA diagnostics files were examined without the above shrinkage option to determine the magnitude of the standard errors within the data. For White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay, a standard error of 0.80 was chosen; for St. Mary's Bay - Placentia Bay, a standard error of 0.30 was chosen. The results of the XSA, including input parameters, log catchability residuals for each CPUE fleet, fishing mortality matrices, population numbers at age and stock biomasses at age are presented in Tables 25 - 30. The were several problems identified with the XSA's during the assessment review primarily dealing with the lack of convergence and with the treatment of the plus age groups (ie. ages 11+). The estimates for the plus age groups in some years are biased since the fishing mortalities on the oldest ages are low (sometimes by an order of magnitude) thus affecting the estimates of the plus age groups. The Review Committee recommended that the treatment of the plus age groups be examined for next year. In the interim, it was decided to use ages 3 to 10 only and to exclude the plus age groups from the present analyses. Although there were concerns expressed with the XSA, as with the multiplicative model and modified Leslie-DeLury depletion method, all exhibited similar trends in declining abundance.

For the three stocks examined , the XSA showed similar trends with peak abundance in the early 1970's, a rapid decline in the early 1980's to the lowest observed biomass estimates, followed by some rebuilding during the 1980's and a further decline in abundance in the 1990's. Fishing mortalities throughout the time series have been relatively low suggesting that changes in abundance have been related more to recruitment.

Status of Stocks

Biomass estimates (ages 3 to 10) for 1995 were projected from the XSA's for White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay and St. Mary's Bay - Placentia Bay (Table 31) using 1993 weights at age, assuming M=0.20, geometric mean recruitment (1970 -1990) and a historical recruitment pattern (Wheeler et al. 1989). The 1995 population estimates are projected to be less than 10% of maximum observed levels for White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay and approximately 15% of the maximum level for St. Mary's Bay - Placentia Bay. Catch projections were made at two levels of fishing mortality (F=0.10 and F=0.20); in both cases, and even in the absence of fishing, stocks would continue to decline in 1995.

Egg production estimates were calculated for 1995 using both recruitment estimates from acoustic surveys and more conservative geometric mean recruitment estimates (Table 31). In all cases, projections of egg production in 1995 are low and are below the critical levels necessary to ensure maximum recruitment to the stocks (Winters and Wheeler 1987).

All available catch rate data from research gillnets, estimation of yearclass sizes from the multiplicative model, the modified Leslie-DeLury depletion approach and XSA, and

biomass estimates from acoustic surveys and XSA for the three stock areas are summarized in Figures 7 - 9 and Table 32. For all areas, the 1987 yearclass, upon which the fishery is currently dependent, is smaller than the 1982 yearclass, which itself is only of moderate strength in relation to the large 1968 yearclass. Although the 1991 and 1992 yearclasses have been evident in recent acoustic surveys and research gillnet catch rates increased in 1994, there is no evidence of strong recruitment of these yearclasses.

The Conception Bay - Southern Shore and Fortune Bay herring stock complexes were not examined in detail in this assessment. However, in previous assessments, parallelism in yearclass strength has been evident in all of these stocks. Conception Bay - Southern Shore has historically been a small stock complex and an area of overlap between adjacent areas. The same conclusions would apply to it as for adjacent stocks. In Fortune Bay, exploitation levels have been extremely low for the past fifteen years with annual catches of less than 200 t. In comparison to other areas, this stock complex would be relatively less depressed.

Conservation Concerns

The short-term prospect for the herring stocks in the Newfoundland Region is poor. For the stocks examined in detail in this assessment, current biomass levels are less than 15% of maximum observed levels, spawning biomasses are at or below the level necessary to ensure maximum recruitment given favourable environmental conditions, and recruitment of recent yearclasses does not appear to be strong. Given these concerns from the scientific community, from a strictly biological viewpoint, managers should warrant consideration of closure of these fisheries.

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Table 1. Landings and TAC's ('000 t) of east and southeast Newfoundland herring, by stock area.

	WB-NDB		BB-TB		CB-SS		SMB-PB		FB	
Year	Catch	TAC	Catch	TAC	Catch	TAC	Catch	TAC	Catch	TAC
1974	4.0	-	2.3	-	2.7	-	6.5	-	2.3	-
1975	5.6	-	5.9	-	3.5	-	6.7	-	0.9	-
1976	12.5	-	9.9	-	2.5	-	4.1	-	0.5	-
1977	11.6	10.0	12.0	9.5	2.2	2.1	3.3	3.3	0.6	3.4
1978	13.4	7.9	8.0	7.8	1.9	1.8	3.5	4.0	1.0	1.0
1979	15.7	11.5	9.8	8.4	0.9	0.9	3.6	3.4	1.2	1.0
1980	6.5	5.3	5.4	4.4	0.5	0.4	2.5	2.5	0.5	1.0
1981	4.7	5.3	4.0	4.8	0.2	0.5	0.6	1.2	0.1	0.2
1982	2.0	1.2	0.5	0.7	0.1	0.2	0.1	0.0	0.1	0.0
1983	0.4	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0
1984	1.5	1.5	0.2	0.4	0.1	0.1	0.1	0.0	0.1	0.0
1985	1.8	2.0	0.6	0.8	0.1	0.2	0.1	0.6	0.1	0.3
1986	2.8	5.5	1.8	3.8	0.2	0.6	0.1	2.1	0.1	0.7
1987	13.5	32.5	6.1	13.7	1.0	3.5	0.3	2.5	0.1	2.4
1988	7.4	34.7	11.7	16.2	0.3	0.6	1.1	8.9	0.1	4.7
1989	6.4	14.0	4.9	6.9	1.2	1.5	0.4	1.5	0.1	1.5
1990	5.1	16.5	3.7	23.4	0.3	1.5	0.5	1.5	0.1	1.5
*1991	8.5	13.5	9.1	10.0	0.4	1.5	1.0	1.5	0.1	1.5
*1992	5.6	13.5	4.6	10.0	0.1	1.5	0.9	1.5	0.1	1.5
*1993	1.7	13.5	2.3	10.0	0.1	1.5	1.1	1.5	0.2	1.5

* provisional

Table 2. White Bay (WB) - Notre Dame Bay (NDB) herring landings and TAC's (t), by gear, 1977-93.

		Gear							
Year	Area	Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap	Total	TAC
1977	WB	-	1228	-	39	268	240	1775	
	NDB	-	4961	-	2096	2438	355	9850	
	Combined	-	6189	-	2135	2706	595	11625	10000
1978	WB	-	1254	-	240	1133	331	2958	
	NDB	-	3980	-	306	5859	311	10456	
	Combined	-	5234	-	546	6992	642	13414	7900
1979	WB	-	832	-	9	978	64	1883	
	NDB	-	1968	-	2274	8971	598	13811	
	Combined	-	2800	-	2283	9949	662	15694	11500
1980	WB	-	747	-	-	1269	83	2099	
	NDB	-	913	-	727	2778	13	4431	
	Combined	-	1660	-	727	4047	96	6530	5300
1981	WB	-	220	-	14	646	23	903	
	NDB	-	1065	-	400	2209	107	3781	
	Combined	-	1285	-	414	2855	130	4684	5300
1982	WB	-	-	-	7	402	52	461	
	NDB	-	-	-	136	1425	1	1562	
	Combined	-	-	-	143	1827	53	2023	1200
1983	WB	-	15	-	-	76	7	98	
	NDB	-	-	-	-	329	-	329	
	Combined	-	15	-	-	406	7	427	0
1984	WB	-	-	-	4	342	4	350	
	NDB	-	-	-	3	1115	-	1118	
	Combined	-	-	-	7	1457	4	1468	1500
1985	WB	-	-	-	2	564	-	566	
	NDB	1	-	-	9	1248	-	1258	
	Combined	1	-	-	11	1812	-	1824	2000
1986	WB	112	-	-	1	196	7	316	
	NDB	1152	-	-	86	1119	83	2440	
	Combined	1264	-	-	87	1315	90	2756	5500
1987	WB	4283	-	-	37	396	-	4716	
	NDB	6570	-	-	530	1030	650	8780	
	Combined	10853	-	-	567	1426	650	13496	32500
1988	WB	1822	-	-	20	65	-	1907	
	NDB	4410	-	-	284	704	113	5511	
	Combined	6232	-	-	304	769	113	7418	34700
1989	WB	672	-	-	-	113	10	795	
	NDB	4372	-	-	45	976	206	5599	
	Combined	5044	-	-	45	1089	216	6394	14000
1990	WB	108	-	-	1	90	21	220	
	NDB	3398	-	-	30	1289	151	4868	
	Combined	3506	-	-	31	1379	172	5088	16500
1991*	WB	1318	-	-	2	311	23	1654	
	NDB	5805	-	-	80	946	41	6872	
	Combined	7123	-	-	82	1257	64	8526	13500
1992*	WB	1252	-	-	-	252	4	1508	
	NDB	2964	-	-	6	1102	48	4120	
	Combined	4216	-	-	6	1354	52	5628	13500
1993*	WB	121	-	-	-	34	-	155	
	NDB	686	-	-	104	739	2	1531	
	Combined	807	-	-	104	773	-	1686	13500

* provisional

Table 3. Bonavista Bay (BB) - Trinity Bay (TB) herring landings and TAC's (t), by gear, 1977-93.

		Gear							
Year	Area	Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap	Total	TAC
1977	BB	-	6223	236	2495	309	-	9263	
	TB	-	1548	-	927	174	45	2694	
	Combined	-	7771	236	3422	483	45	11957	9500
1978	BB	-	4239	-	150	1320	3	5712	
	TB	-	1055	-	966	308	8	2337	
	Combined	-	5294	-	1116	1628	11	8049	7800
1979	BB	-	3490	-	377	2374	4	6245	
	TB	-	1181	-	1615	680	55	3531	
	Combined	-	4671	-	1992	3054	59	9776	8400
1980	BB	-	1714	-	652	1321	-	3687	
	TB	-	964	-	405	336	13	1718	
	Combined	-	2678	-	1057	1657	13	5405	4400
1981	BB	-	1100	-	713	1399	7	3219	
	TB	-	78	-	361	367	19	825	
	Combined	-	1178	-	1074	1766	26	4044	4800
1982	BB	-	-	-	-	386	4	390	
	TB	-	-	-	25	76	6	107	
	Combined	-	-	-	25	462	10	497	700
1983	BB	-	-	-	-	52	-	52	
	TB	-	-	-	27	17	-	44	
	Combined	-	-	-	27	69	-	96	0
1984	BB	-	-	-	-	135	-	135	
	TB	-	-	-	-	41	-	41	
	Combined	-	-	-	-	176	-	176	400
1985	BB	-	-	-	4	290	2	296	
	TB	-	-	-	2	312	6	320	
	Combined	-	-	-	6	602	8	616	800
1986	BB	767	-	-	7	362	5	1141	
	TB	356	-	-	30	233	5	624	
	Combined	1123	-	-	37	595	10	1765	3800
1987	BB	4762	-	-	72	218	-	5052	
	TB	838	-	-	15	175	1	1029	
	Combined	5600	-	-	87	393	1	6081	13700
1988	BB	7550	-	-	151	144	-	7845	
	TB	3410	-	-	317	93	82	3902	
	Combined	10960	-	-	468	237	82	11747	16200
1989	BB	1459	-	-	13	92	-	1564	
	TB	3149	-	-	141	65	6	3361	
	Combined	4608	-	-	154	139	6	4925	6900
1990	BB	904	-	-	2	126	7	1039	
	TB	1819	-	-	721	84	24	2648	
	Combined	2723	-	-	723	210	31	3687	23400
1991*	BB	4458	-	-	7	147	43	4655	
	TB	3760	-	-	567	85	-	4412	
	Combined	8218	-	-	574	232	43	9067	10000
1992*	BB	4209	-	-	3	197	2	4411	
	TB	51	-	-	63	44	-	158	
	Combined	4260	-	-	66	241	2	4569	10000
1993*	BB	2001	-	-	4	234	-	2239	
	TB	31	-	-	2	72	1	106	
	Combined	2032	-	-	6	306	1	2345	10000

* provisional

Table 4. Conception Bay (CB) - Southern Shore (SS) herring landings and TAC's (t), by gear, 1977-93.

		Gear							
Year	Area	Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap	Total	TAC
1977	CB	-	1248	-	58	174	12	1492	
	SS	-	442	-	-	18	200	660	
	Combined	-	1690	-	58	192	212	2152	2100
1978	CB	-	1098	-	11	415	3	1527	
	SS	-	133	-	14	78	193	418	
	Combined	-	1231	-	25	493	196	1945	1800
1979	CB	-	432	-	-	210	63	705	
	SS	-	10	-	18	49	111	188	
	Combined	-	442	-	18	259	174	893	900
1980	CB	-	319	-	16	107	1	443	
	SS	-	-	-	-	2	32	34	
	Combined	-	319	-	16	109	33	477	400
1981	CB	-	-	-	-	160	2	162	
	SS	-	-	-	-	53	8	61	
	Combined	-	-	-	-	213	10	223	500
1982	CB	-	-	-	-	84	1	85	
	SS	-	-	-	-	7	5	12	
	Combined	-	-	-	-	91	6	97	200
1983	CB	-	-	-	-	17	-	17	
	SS	-	-	-	-	-	-	-	
	Combined	-	-	-	-	17	-	17	0
1984	CB	-	-	-	-	49	-	49	
	SS	-	-	-	-	-	-	-	
	Combined	-	-	-	-	49	-	49	100
1985	CB	-	-	-	-	81	-	81	
	SS	-	-	-	-	16	-	16	
	Combined	-	-	-	-	97	-	97	200
1986	CB	76	-	-	-	102	1	179	
	SS	-	-	-	1	23	1	25	
	Combined	76	-	-	1	125	2	204	600
1987	CB	580	-	-	187	185	10	962	
	SS	-	-	-	-	15	3	18	
	Combined	580	-	-	187	200	13	980	3500
1988	CB	197	-	-	1	36	1	235	
	SS	1	-	-	-	7	73	81	
	Combined	198	-	-	1	43	74	316	600
1989	CB	1167	-	-	-	69	-	1236	
	SS	-	-	-	-	9	1	10	
	Combined	1167	-	-	-	78	1	1246	1500
1990	CB	261	-	-	-	53	-	314	
	SS	-	-	-	-	12	-	12	
	Combined	261	-	-	-	65	-	326	1500
1991*	CB	382	-	-	-	18	-	400	
	SS	8	-	-	-	7	1	16	
	Combined	390	-	-	-	25	1	416	1500
1992*	CB	16	-	-	-	33	-	49	
	SS	-	-	-	-	4	-	4	
	Combined	16	-	-	-	37	-	53	1500
1993*	CB	10	-	-	-	23	-	33	
	SS	-	-	-	1	10	-	11	
	Combined	10	-	-	1	33	-	44	1500

* provisional

Table 5. St. Mary's Bay (SMB) - Placentia Bay (PB) herring landings and TAC's (t), by gear, 1977-93.

		Gear							
Year	Area	Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap	Total	TAC
1977	SMB	-	1131	-	221	531	29	1912	
	PB	740	524	-	14	78	-	1356	
	Combined	740	1655	-	235	609	29	3268	3300
1978	SMB	-	1523	-	66	490	3	2082	
	PB	557	612	-	29	214	33	1445	
	Combined	557	2135	-	95	704	36	3527	4000
1979	SMB	-	1570	-	131	332	9	2042	
	PB	359	891	-	17	307	1	1575	
	Combined	359	2461	-	148	639	10	3617	3400
1980	SMB	-	645	-	16	352	12	1025	
	PB	182	892	-	9	339	30	1452	
	Combined	182	1537	-	25	691	42	2477	2500
1981	SMB	-	44	-	8	122	-	174	
	PB	-	311	-	-	149	1	461	
	Combined	-	355	-	8	271	1	635	1200
1982	SMB	-	-	-	-	10	-	10	
	PB	-	-	-	4	31	-	35	
	Combined	-	-	-	4	41	-	45	0
1983	SMB	-	-	-	-	13	-	13	
	PB	-	-	-	-	27	-	27	
	Combined	-	-	-	-	40	-	40	0
1984	SMB	-	-	-	-	11	-	11	
	PB	-	-	-	1	95	-	96	
	Combined	-	-	-	1	106	-	107	0
1985	SMB	-	-	-	1	31	-	32	
	PB	3	-	-	-	113	-	116	
	Combined	3	-	-	1	144	-	148	600
1986	SMB	4	-	-	-	17	-	21	
	PB	-	-	-	2	107	-	109	
	Combined	4	-	-	2	124	-	130	2100
1987	SMB	33	-	-	5	47	5	90	
	PB	-	-	-	1	161	-	162	
	Combined	33	-	-	6	208	5	252	2500
1988	SMB	-	-	-	-	25	-	25	
	PB	887	-	-	12	176	-	1075	
	Combined	887	-	-	12	201	-	1100	8900
1989	SMB	-	-	-	-	8	-	8	
	PB	263	-	-	1	131	2	397	
	Combined	263	-	-	1	139	2	405	1500
1990	SMB	-	-	-	-	18	-	18	
	PB	379	-	-	-	144	-	523	
	Combined	379	-	-	-	162	-	541	1500
1991*	SMB	-	-	-	-	16	-	16	
	PB	742	-	-	110	104	34	990	
	Combined	742	-	-	110	120	34	1006	1500
1992*	SMB	-	-	-	-	2	-	2	
	PB	781	-	-	2	125	-	908	
	Combined	781	-	-	2	127	-	910	1500
1993*	SMB	262	-	-	-	3	-	265	
	PB	667	-	-	84	119	-	870	
	Combined	929	-	-	84	122	-	1135	1500

* provisional

Table 6. Fortune Bay (FB) herring landings and TAC's (t), by gear, 1977-93.

	Gear							
Year	Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap	Total	TAC
1977	188	-	-	364	22	5	579	3400
1978	104	-	-	854	41	-	999	1000
1979	285	-		-829	81	-	1195	1000
1980	97	-	-	265	89	-	451	1000
1981	-	-	-	30	37	-	67	200
1982	-	-	-	-	20	2	22	0
1983	-	-	-	-	15	-	15	0
1984	-	-	-	-	21	-	21	0
1985	-	-	-	-	52	-	52	300
1986	1	-	-	1	92	-	94	700
1987	-	-	-	2	144	-	146	2400
1988	-	-	-	-	89	-	89	4700
1989	-	-	-	3	104	2	109	1500
1990	-	-	-	-	92	-	92	1500
1991*	-	-	-	-	123	-	123	1500
1992*	-	-	-	-	130	-	130	1500
1993*	-	-	-	-	175	-	175	1500

* provisional

Table 7. Mean weights at age (g) of spring-spawning herring, by stock area, from samples collected January to June, 1988 - 1993 Sample sizes in parenthesis.

Stock Area	Age	1988		1989		1990		1991		1992		1993	
WB-NDB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	81	(5)	-	-	-	-	-	-	-	-	-	-
	3	148	(40)	124	(65)	122	(293)	122	(16)	122	(1)	85	(10)
	4	214	(22)	195	(198)	179	(152)	172	(665)	164	(52)	159	(58)
	5	235	(207)	227	(54)	234	(158)	212	(77)	199	(1108)	189	(218)
	6	256	(207)	249	(579)	259	(72)	247	(44)	229	(81)	221	(1208)
	7	295	(42)	273	(915)	279	(475)	278	(29)	261	(45)	252	(46)
	8	316	(57)	296	(52)	296	(696)	287	(214)	277	(40)	279	(34)
	9	323	(102)	311	(71)	329	(43)	312	(405)	296	(142)	298	(25)
	10	333	(12)	332	(121)	336	(126)	331	(37)	322	(405)	304	(118)
	11+	414	(217)	412	(364)	418	(333)	393	(236)	373	(375)	343	(456)
BB-TB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	83	(5)	82	(17)	70	(8)	-	-	-	-	-	-
	3	129	(207)	147	(94)	144	(227)	132	(15)	133	(16)	108	(120)
	4	196	(17)	212	(429)	219	(138)	202	(670)	174	(20)	170	(49)
	5	233	(91)	248	(27)	262	(376)	257	(188)	216	(707)	211	(120)
	6	255	(1049)	265	(172)	272	(51)	287	(484)	256	(166)	239	(873)
	7	285	(20)	280	(1423)	285	(204)	286	(54)	287	(345)	284	(152)
	8	318	(24)	293	(22)	314	(962)	289	(287)	287	(46)	311	(213)
	9	358	(19)	323	(26)	353	(19)	322	(1053)	282	(192)	299	(80)
	10	-	-	347	(27)	362	(37)	339	(65)	307	(638)	309	(280)
	11+	421	(281)	411	(240)	421	(178)	387	(140)	340	(305)	343	(516)
CB-SS	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	4	(5)
	2	69	(6)	125	(24)	-	-	54	(1)	-	-	28	(160)
	3	149	(34)	188	(61)	173	(161)	137	(2)	129	(12)	104	(37)
	4	232	(19)	220	(176)	250	(127)	235	(133)	-	-	174	(26)
	5	248	(37)	274	(25)	271	(117)	269	(48)	241	(161)	217	(21)
	6	269	(665)	282	(48)	282	(12)	286	(91)	276	(96)	265	(207)
	7	284	(25)	293	(517)	303	(62)	311	(12)	293	(133)	305	(63)
	8	313	(41)	294	(14)	329	(474)	296	(46)	298	(11)	316	(78)
	9	346	(7)	342	(31)	349	(15)	321	(289)	300	(46)	319	(13)
	10	346	(2)	375	(10)	359	(27)	345	(18)	318	(239)	328	(54)
	11+	425	(87)	416	(98)	426	(56)	388	(65)	348	(134)	355	(219)
SMB-PB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	14	(1)	30	(1)	30	(3)	-	-	22	(35)	-	-
	2	120	(4)	97	(14)	87	(8)	77	(4)	59	(16)	39	(7)
	3	164	(29)	163	(222)	162	(148)	140	(22)	137	(36)	130	(84)
	4	232	(33)	221	(70)	242	(186)	212	(271)	191	(12)	189	(80)
	5	261	(32)	266	(17)	273	(63)	258	(103)	242	(340)	215	(32)
	6	285	(1111)	271	(57)	291	(16)	278	(45)	276	(101)	267	(283)
	7	305	(58)	309	(908)	311	(44)	298	(13)	292	(58)	292	(80)
	8	320	(188)	328	(37)	343	(667)	302	(30)	299	(17)	305	(90)
	9	330	(28)	343	(126)	362	(43)	331	(233)	315	(32)	317	(25)
	10	350	(6)	347	(32)	367	(184)	346	(26)	331	(194)	330	(68)
	11+	419	(92)	430	(41)	406	(122)	362	(189)	362	(349)	372	(432)
FB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	15	(80)	-	-
	2	-	-	112	(1)	102	(1)	-	-	61	(170)	-	-
	3	-	-	144	(42)	145	(393)	134	(2)	138	(5)	120	(3)
	4	-	-	180	(6)	215	(16)	186	(143)	170	(22)	177	(2)
	5	236	(5)	209	(2)	252	(3)	233	(53)	209	(313)	222	(24)
	6	275	(932)	252	(29)	268	(1)	244	(7)	254	(36)	240	(429)
	7	295	(26)	296	(1028)	292	(52)	276	(5)	288	(7)	281	(22)
	8	331	(130)	329	(18)	322	(716)	289	(54)	295	(11)	297	(12)
	9	353	(38)	348	(64)	339	(47)	319	(672)	309	(41)	284	(3)
	10	390	(6)	378	(46)	356	(162)	338	(63)	329	(305)	287	(22)
	11+	462	(58)	463	(58)	421	(148)	372	(284)	367	(685)	355	(642)

Table 8. Commercial catch (t) and number of fish sampled (bold print) for 1993, by stock area, gear type and month. Boxed areas indicate the catch - sample combinations used for calculating commercial catch at age.

AREA	GEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
WB-NDB	Gillnet	1	2		12	395 **100**	299 **100**	34	2	5	10 **50**	13 **50**	1
	Purse seine										172 **100**	527 **100**	108 **46**
	Bar Seine					73	31						
	Trap										2		
BB-TB	Gillnet				19	153 **100**	74 **50**	13	1	6 **36**	9	21 **100**	11
	Purse seine				277 **149**		1			3	143 **97**	852 **250**	756 **100**
	Bar Seine					2		1			2	1	
	Trap											1	
CB-SS	Gillnet					1 **50**	4	5		4	6		
	Purse seine									1			
	Bar Seine			1	3	8	9	3			1		
	Trap												
SMB-PB	Gillnet			3	49 **50**	44 **100**	20	3		1	3		
	Purse seine			567 **150**	100 **50**						41 **50**	184 **50**	37
	Bar Seine				67 **50**		1						17 50
	Trap												
FB	Gillnet	2	1	4 **50**	44 **20**	91 **50**	30 **38**	1					4 **50**
	Purse seine												
	Bar Seine												
	Trap												

Table 9. Commercial catch at age of spring and autumn spawning herring for White Bay - Notre Dame Bay, 1970-1993.

Spring Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987 b	1988 c	1989	1990	1991 a	1992 a	1993 a
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	195	26	3113	1	1	2273	1	1
2	10	1	5	1	1	2	56	50	1	1	115	445	76	1	6	3	29	1105	407	23	1	29	940	1
3	1	129	290	727	4	128	24	1671	55	60	46	152	371	38	12	187	975	324	1044	128	1936	386	207	96
4	12	88	2396	1411	123	215	506	107	2034	50	1240	41	332	46	124	350	2945	7201	291	613	285	16183	942	31
5	24	161	353	2825	3142	453	237	468	317	2928	92	1231	59	23	1218	240	308	25843	2984	124	637	1542	8940	263
6	24	64	69	761	5446	5438	868	184	1034	323	1080	63	268	14	73	1486	667	1651	11819	3106	240	553	483	3614
7	972	425	122	719	1193	7069	10893	793	517	1410	17	805	34	93	114	108	1258	1067	1036	10566	2451	103	371	75
8	11	10184	403	654	697	1123	17145	7363	2509	767	496	64	258	1	157	275	198	2088	1137	370	7360	2145	211	199
9	83	233	1363	416	1506	838	1328	12675	10807	2222	179	344	19	26	37	94	162	399	1454	1081	532	4432	722	70
10	159	254	205	1685	858	810	3364	1055	11756	14413	1450	194	192	4	122	81	179	442	315	844	1132	537	2796	544
11+	275	3105	808	794	2378	3999	8535	15707	14379	27508	14653	10908	4059	805	1938	2110	1973	4566	2943	2178	1148	2201	3509	861
Total	1572	14645	6015	9994	15349	20076	42957	40074	43410	49683	19369	14248	5669	1052	3802	4935	8889	44712	26543	19034	15723	30384	19122	5755

Autumn Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	53	1	1	6	1	1	1	1	71	1	72	1	1	1	10	2	1	1	1	1	1	1
4	1	1	17	7	11	64	31	45	6	1	13	13	26	74	60	29	67	297	92	65	130	188	109	1
5	26	6	74	22	124	3	35	35	24	10	13	86	62	25	409	94	69	469	115	12	65	450	187	48
6	10	14	79	25	10	25	51	85	155	267	23	11	16	23	66	333	79	156	45	5	52	98	172	78
7	39	11	67	60	48	16	20	54	171	172	272	1	12	1	30	137	373	112	20	574	84	36	48	113
8	60	26	1	25	2	21	40	1	24	160	4	100	9	1	8	32	68	630	7	70	37	128	46	79
9	20	17	164	13	46	3	46	94	2	133	19	1	42	6	7	23	6	152	560	1	1	249	80	42
10	11	19	81	97	7	2	4	1	130	1	1	4	1	1	3	10	1	10	6	533	4	120	19	21
11+	172	291	562	298	346	302	329	182	238	298	450	65	23		24	74	42	108	306	29	577	2733	613	349
Total	342	388	1100	550	597	444	559	500	753	1045	868	284	265	134	610	735	717	1938	1154	1292	953	4005	1277	734

Spring and Autumn Spawners

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987 b	1988 c	1989	1990	1991 a	1992 a	1993 a
Total	1914	15033	7115	10544	15946	20520	43516	40574	44163	50728	20237	14532	5934	1186	4412	5670	9606	46650	27697	20326	16676	34389	20399	6489
% SS	82.1	97.4	84.5	94.8	96.3	97.8	98.7	98.8	98.3	97.9	95.7	98.0	95.5	88.7	86.2	87.0	92.5	95.8	95.8	93.6	94.3	88.4	93.7	88.7
% AS	17.9	2.6	15.5	5.2	3.7	2.2	1.3	1.2	1.7	2.1	4.3	2.0	4.5	11.3	13.8	13.0	7.5	4.2	4.2	6.4	5.7	11.6	6.3	11.3

a - preliminary
b - also 4475 age 0 SS
c - also 10 age 0 SS

Table 10. Commercial catch at age of spring and autumn spawning herring for Bonavista Bay - Trinity Bay , 1970-1993.

Spring Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985 b	1986	1987 c	1988	1989	1990	1991 a	1992 a	1993 a
1	1	1	1	1	1	1	5	10	1	1	1	1	1	1	1	1	151	296	717	1	1	115	1	1
2	1	1	1	1	1	1	14	16	22	6	15	136	1	1	4	13	207	1352	6612	563	58	689	499	354
3	1	690	10	1	1	392	77	248	26	286	13	246	8	4	22	175	443	413	9910	1043	3094	210	1056	621
4	1	311	1347	60	2	134	493	135	357	167	195	53	11	34	35	70	4445	2845	267	3323	422	13551	271	160
5	9	102	389	4887	235	163	123	759	122	765	43	256	2	7	210	87	261	16208	3674	264	2350	2586	12612	344
6	55	64	91	126	4795	2564	166	227	251	19	293	26	30	2	9	351	161	334	21739	1428	94	3859	2422	3779
7	808	361	75	96	424	14330	4897	50	112	436	52	288	5	15	5	37	262	359	782	8639	629	347	579	422
8	35	1373	88	1	151	455	20697	6209	598	101	264	23	35	1	12	27	38	126	713	13	4439	1550	194	385
9	126	151	480	48	294	995	909	23206	4412	530	75	321	5	8	2	13	10	33	8	216	235	7505	1394	132
10	69	126	14	271	69	727	854	774	13394	5575	967	88	65	2	2	22	31	6	55	100	325	447	2054	657
11+	212	522	213	1	1849	1679	4306	5890	5956	19994	12259	11762	1186	159	154	797	657	956	1247	508	466	891	653	1092
Total	1318	3702	2709	5493	7822	21441	32541	37524	25251	27880	14177	13200	1349	234	456	1593	6666	22928	45724	16098	12113	31750	21735	7947

Autumn Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	253	1	1	1	1	1
3	1	1	1	1	1	1	10	1	1	1	14	6	3	1	1	1	1	1	54	1	5	6	1	11
4	9	1	1	1	1	26	22	55	16	1	11	115	1	10	3	5	51	2	22	55	139	140	10	1
5	1	10	1	1	1	30	77	16	14	27	17	106	8	2	84	18	80	391	88	76	55	837	219	146
6	1	1	1	1	1	1	23	176	61	114	83	33	10	5	14	203	59	237	357	136	9	152	205	205
7	4	4	2	1	16	22	66	86	58	30	188	83	3	2	17	96	292	87	216	237	61	17	118	163
8	17	23	2	48	2	41	34	112	28	175	45	283	8	1	3	54	149	360	202	18	50	99	1	121
9	18	3	5	1	1	6	62	30	23	13	112	36	25	1	5	22	24	138	818	83	58	104	5	39
10	17	21	1	1	1	19	8	73	82	16	3	4	1	1	1	10	1	2	2	697	19	125	1	14
11+	738	406	33	1	1216	259	1069	1069	417	800	463	230	37	3	9	29	30	156	237	193	89	481	167	376
Total	808	472	49	58	1242	407	1373	1620	702	1179	938	898	98	28	139	440	689	1394	2250	1498	487	1963	729	1078

Spring and Autumn Spawners

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985 b	1986	1987 c	1988	1989	1990	1991 a	1992 a	1993 a
Total	2126	4174	2758	5551	9064	21848	33914	39144	25953	29059	15115	14098	1447	262	595	2033	7355	24322	47974	17596	12600	33713	22464	9025
% SS	62.0	88.7	98.2	99.0	86.3	98.1	96.0	95.9	97.3	95.9	93.8	93.6	93.2	89.3	76.6	78.4	90.6	94.3	95.3	91.5	96.1	94.2	96.8	88.1
% AS	38.0	11.3	1.8	1.0	13.7	1.9	4.0	4.1	2.7	4.1	6.2	6.4	6.8	10.7	23.4	21.6	9.4	5.7	4.7	8.5	3.9	5.8	3.2	11.9

a - preliminary
b - also 10 age 0 SS
c - also 3124 age 0 SS

Table 11. Commercial catch at age of spring and autumn spawning herring for Conception Bay - Southern Shore , 1970-1993.

Spring Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	714	22	1	1	1	1	1
2	1	1	1	67	4	9	1177	7	1	1	1	1	1	1	1	1	6	1	2	718	1	1	1	1
3	1	36	7	2	1	418	28	127	1	4	1	25	2	1	3	58	1	36	87	833	87	1	1	1
4	15	31	1625	34	5	30	97	5	99	9	3	4	5	1	27	11	389	73	25	1319	36	304	1	1
5	17	19	134	4521	122	16	23	101	32	34	1	26	1	1	47	11	7	3486	252	15	49	70	12	5
6	21	11	55	242	9655	2057	31	45	65	7	19	9	2	1	5	17	13	17	502	123	1	214	17	30
7	255	43	29	329	153	8592	2330	13	14	38	1	28	1	1	1	2	16	26	33	1696	57	23	27	9
8	12	272	79	142	83	120	4771	950	3	4	12	3	5	1	2	2	3	10	5	10	434	4	2	6
9	13	26	361	44	39	517	89	4241	734	31	1	14	1	1	1	1	1	2	1	37	18	356	3	1
10	11	11	67	175	13	238	252	49	3080	270	49	13	1	1	1	1	3	1	1	2	24	47	33	8
11+	46	65	122	28	658	891	714	959	1358	1640	1101	504	176	13	7	97	81	65	45	138	82	57	26	58
Total	393	516	2481	5585	10734	12889	9513	6498	5388	2039	1190	628	196	23	96	202	521	4431	975	4892	790	1078	124	121

Autumn Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	2	7	1	1	1	1	1	1	9	1	1	1	23	1	1	365	1	1	1	1
4	1	1	1	2	3	162	1	7	4	2	1	14	5	1	4	3	7	7	1	1	3	70	7	1
5	1	1	1	2	8	40	49	29	50	17	1	8	14	2	60	6	18	37	49	1	10	25	23	1
6	8	1	1	1	6	81	27	150	30	80	1	3	1	3	6	52	21	27	96	3	4	24	9	2
7	20	1	1	38	17	18	23	87	69	15	32	7	1	1	6	24	94	32	90	67	2	3	1	6
8	36	6	1	35	1	49	23	72	9	57	3	14	2	2	3	13	29	32	39	13	2	1	1	1
9	5	34	1	1	6	11	31	13	10	17	6	2	2	5	1	3	10	21	42	5	15	4	1	1
10	6	11	1	1	1	14	12	7	34	6	1	1	1	1	1	1	3	13	1	31	18	6	1	1
11+	114	89	1	94	45	318	193	373	282	245	32	9	5	12	1	15	10	8	1	15	89	14	15	7
Total	194	147	11	177	91	702	362	741	491	442	80	61	42	30	85	120	217	180	322	503	146	150	61	23

Spring and Autumn Spawners

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a
Total	587	663	2492	5762	10825	13591	9875	7239	5879	2481	1270	689	238	53	181	322	738	4611	1297	5395	936	1228	185	144
% SS	67.0	77.8	99.6	96.9	99.2	94.8	96.3	89.8	91.6	82.2	93.7	91.1	82.4	43.4	53.0	62.7	70.6	96.1	75.2	90.7	84.4	87.8	67.0	84.0
% AS	33.0	22.2	0.4	3.1	0.8	5.2	3.7	10.2	8.4	17.8	6.3	8.9	17.6	56.6	47.0	37.3	29.4	3.9	24.8	9.3	15.6	12.2	33.0	16.0

a - preliminary

Table 12. Commercial catch at age of spring and autumn spawning herring for St. Mary's Bay - Placentia Bay , 1970-1993.

Spring Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a
1	3	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	476	1	1	76	995	74	365	52	30	87	133	1	1	1	8	1	1	34	1	22	1	37	68	5
3	109	557	207	326	280	2234	391	1423	175	663	332	193	1	5	9	7	1	19	1	48	115	1	47	62
4	4434	116	20375	77	234	471	1906	140	1817	279	133	42	2	2	24	18	143	2	22	9	189	222	7	34
5	59	2111	725	15470	126	147	208	736	123	2263	153	111	3	3	36	27	19	502	163	1	64	160	363	11
6	76	80	5154	566	14328	1591	267	87	596	96	1270	51	8	2	6	21	28	29	2457	24	15	170	231	187
7	645	251	365	6757	436	13858	862	50	64	614	57	338	3	4	3	15	9	47	119	463	30	12	55	118
8	66	45	650	93	6049	146	5622	1039	106	85	470	28	14	1	24	3	4	9	213	34	494	110	53	74
9	72	13	352	224	138	3391	201	3830	512	66	38	80	4	9	1	25	1	3	16	100	45	493	74	63
10	37	22	73	193	238	350	2256	134	3827	501	237	6	4	1	10	5	5	1	36	5	172	88	383	56
11+	107	96	403	315	624	1323	1361	2448	2185	4785	2971	466	69	39	44	125	30	11	147	34	128	948	965	1174
Total	6084	3293	28306	24098	23451	23586	13440	9940	9436	9440	5795	1317	110	68	166	248	242	658	3176	741	1254	2242	2247	1785

Autumn Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1
3	1	1	24	5	2	1	11	1	1	1	1	1	1	1	1	1	1	4	1	5	7	1	1	1
4	1	9	61	150	2	7	4	47	23	11	96	139	1	18	17	9	16	12	20	5	37	14	7	2
5	2	2	175	52	96	68	214	52	435	143	35	116	7	6	101	20	24	32	30	18	61	87	8	208
6	1	53	15	71	146	182	67	209	92	598	52	10	1	12	32	86	15	80	239	8	54	40	50	239
7	71	31	61	10	80	89	32	81	244	73	419	11	1	4	21	46	97	30	90	56	24	23	33	173
8	112	43	37	54	95	206	17	69	122	216	79	50	1	1	5	36	28	82	35	43	47	65	27	41
9	19	84	101	17	93	6	94	26	38	21	126	7	1	1	3	10	16	24	270	67	58	98	64	41
10	28	35	71	68	51	37	11	22	52	2	25	1	1	1	1	3	4	3	5	178	17	40	1	3
11+	202	314	539	737	970	677	329	526	561	348	492	29	2	4	8	24	15	12	53	164	173	495	479	863
Total	439	574	1086	1166	1537	1275	781	1035	1570	1415	1327	366	18	50	191	237	218	282	745	546	480	865	672	1573

Spring and Autumn Spawners

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a
Total	6523	3867	29392	25264	24988	24861	14221	10975	11006	10855	7122	1683	128	118	357	485	460	940	3921	1287	1734	3107	2919	3358
% SS	93.3	85.2	96.3	95.4	93.8	94.9	94.5	90.6	85.7	87.0	81.4	78.3	85.9	57.6	46.5	51.1	52.6	70.0	81.0	57.6	72.3	72.2	77.0	53.2
% AS	6.7	14.8	3.7	4.6	6.2	5.1	5.5	9.4	14.3	13.0	18.6	21.7	14.1	42.4	53.5	48.9	47.4	30.0	19.0	42.4	27.7	27.8	23.0	46.8

a - preliminary

Table 13. Commercial catch at age of spring and autumn spawning herring for Fortune Bay , 1970-1993.

Spring Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a
1	1	1	617	23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	29475	167	1515	2210	389	2	82	27	1	1	25	1	1	1	2	1	1	1	1	1	1	1	1	1
3	5988	23223	256	925	1314	277	15	2103	42	1	16	144	1	2	1	54	1	1	1	1	1	1	1	2
4	11953	6086	19690	67	552	581	318	25	2677	183	3	16	3	2	4	3	145	1	1	1	1	23	1	1
5	133	23525	2896	5694	130	112	228	327	62	3833	69	4	3	1	3	39	4	304	1	1	2	8	3	1
6	281	1165	10767	475	4435	87	129	166	237	15	1122	3	1	1	2	12	69	11	219	18	2	1	1	327
7	7894	5747	351	1712	250	1490	11	26	43	165	7	21	2	1	1	2	20	49	7	274	12	1	1	2
8	233	3514	4432	73	1094	16	338	43	139	5	183	2	36	1	2	1	6	18	26	1	155	6	1	3
9	16	132	991	282	36	142	36	188	52	24	1	23	1	10	1	1	1	4	6	17	17	274	2	8
10	225	148	34	558	117	22	188	4	326	1	11	1	5	1	2	1	2	1	1	11	20	1	75	10
11+	257	537	366	173	255	201	140	244	302	167	50	12	5	18	23	15	14	38	10	24	1	72	266	217
Total	56456	64245	41915	12192	8573	2931	1486	3154	3882	4396	1488	228	59	39	42	130	264	429	274	350	213	389	353	573

Autumn Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	7	1	7	1	1	1	1	5	1	1	1	1	1	1	1	1	1	1	1	1
4	1	598	1	48	9	22	9	23	1	7	4	64	1	1	1	17	3	1	2	3	10	1	1	1
5	334	1	84	50	87	12	38	19	36	5	3	16	7	1	9	4	8	4	1	6	5	1	4	1
6	1	136	25	79	65	39	26	19	6	50	3	1	2	2	4	26	16	7	5	1	12	8	5	3
7	443	175	185	8	12	19	13	1	25	1	3	1	1	1	6	12	38	11	5	6	17	1	3	11
8	816	769	44	32	27	20	1	1	12	17	1	1	1	1	1	7	12	25	1	31	7	3	1	1
9	412	626	310	15	5	11	27	1	6	12	1	1	1	1	1	4	5	10	13	3	54	1	1	1
10	1	470	125	27	1	7	1	1	1	1	1	1	1	1	1	1	1	5	1	17	1	3	1	1
11+	2201	1956	793	97	85	45	9	2	18	12	1	1	1	1	1	2	5	14	10	5	5	1	5	26
Total	4212	4734	1570	359	300	178	133	70	108	108	20	93	18	12	27	76	91	80	41	75	114	22	24	48

Spring and Autumn Spawners

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a
Total	60668	68979	43485	12551	8873	3109	1619	3224	3990	4504	1508	321	77	51	69	206	355	509	315	425	327	411	377	621
% SS	93.1	93.1	96.4	97.1	96.6	94.3	91.8	97.8	97.3	97.6	98.7	71.0	76.6	76.5	60.9	63.1	74.4	84.3	87.0	82.4	65.1	94.6	93.6	92.3
% AS	6.9	6.9	3.6	2.9	3.4	5.7	8.2	2.2	2.7	2.4	1.3	29.0	23.4	23.5	39.1	36.9	25.6	15.7	13.0	17.6	34.9	5.4	6.4	7.7

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Table 14. Spring and fall research gillnet catch rates at age (numbers per days fished), spring spawners only, for White Bay - Notre Dame Bay.

Spring Program

Age	1971	...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.0										0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0										0.0	0.0	0.0	0.0	0.0	0.0	
3	0.0										5.0	17.5	91.0	18.2	0.0	1.2	
4	24.9										2.0	47.1	56.2	410.0	21.5	10.9	
5	3.9										23.9	12.2	57.7	47.7	493.7	50.8	
6	22.3										63.9	138.3	17.8	22.7	33.5	359.0	
7	27.5										6.0	199.2	157.6	12.5	13.7	18.8	
8	1010.9										5.0	10.6	213.1	139.7	10.3	6.7	
9	14.4										12.9	17.5	12.6	272.5	47.2	13.3	
10	28.8										1.9	26.5	28.9	36.3	127.9	29.7	
11+	176.8										36.6	61.4	105.8	176.0	110.8	115.6	
Total	1309.5										157.0	529.7	740.1	1135.6	858.6	605.3	602.8

Fall Program

Age	1971	...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0			
2			9.8	4.5	8.5	0.5	23.3	2.6	0.2	1.2	5.7	5.2	3.2	0.3			
3			8.1	5.2	29.1	50.1	6.4	134.5	9.0	0.6	3.9	10.8	120.9	5.2			
4			204.1	1.2	5.6	81.4	19.1	19.0	107.3	38.8	3.6	20.1	21.1	262.1			
5			7.2	25.2	3.5	7.3	84.0	11.6	12.5	352.0	18.0	7.6	7.0	15.8			
6			92.2	1.0	1.9	14.1	4.2	60.1	9.0	35.1	90.4	39.2	3.5	2.4			
7			2.7	5.3	0.8	19.8	8.5	7.1	38.2	16.0	7.8	123.8	12.1	3.1			
8			29.5	0.5	9.3	2.6	14.0	6.7	3.8	57.3	6.6	4.1	51.8	10.3			
9			4.5	1.9	0.0	22.4	0.8	7.5	2.6	8.6	13.3	12.2	7.3	32.3			
10			34.0	0.8	15.5	5.2	8.5	5.2	3.1	5.5	1.2	25.6	10.8	1.7			
11+			503.9	83.7	192.6	318.7	254.8	119.5	50.2	102.3	27.0	41.9	33.5	10.3			
Total			895.0	129.4	266.8	521.6	424.0	373.5	235.9	616.4	177.9	290.7	270.0	343.5			

Table 15. Spring and fall research gillnet catch rates at age (numbers per days fished), spring spawners only, for Bonavista Bay - Trinity Bay.

Spring Program

Age	1971	1972	...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.1	0.0		0.0	0.0	0.0	0.0	1.1	0.0	1.6	0.3	0.1	0.1	0.0	0.0	0.0	0.0	
3	1.6	2.6		0.0	19.9	3.1	4.4	20.2	18.3	0.9	1.2	5.8	2.3	8.8	1.4	0.3	2.6	
4	15.5	483.5		17.3	4.6	1.4	35.8	8.2	7.6	151.6	1.2	0.3	21.8	8.2	76.3	1.2	1.7	
5	2.5	220.8		0.0	1.7	0.3	1.2	37.7	4.3	2.4	104.5	2.3	0.9	27.7	18.4	46.2	8.2	
6	2.6	14.4		53.1	1.5	1.0	0.0	3.5	11.2	2.6	1.5	30.0	5.5	4.5	42.5	8.1	50.6	
7	13.9	44.4		0.0	5.2	0.0	0.7	0.7	1.0	3.1	0.0	0.5	57.7	12.2	4.9	10.3	6.4	
8	80.2	56.2		3.5	0.0	0.7	0.0	2.2	1.0	0.9	0.0	0.4	0.9	60.8	30.1	2.3	7.0	
9	4.1	331.9		0.0	4.2	0.3	9.8	0.0	1.0	0.3	0.3	0.6	0.6	0.8	94.9	17.6	3.7	
10	10.6	5.2		41.4	5.9	0.3	1.6	2.2	1.1	0.2	0.7	0.0	0.7	3.2	5.7	34.8	13.1	
11+	13.9	147.7		575.0	166.7	56.3	181.0	146.4	39.3	10.8	6.4	12.5	5.5	8.9	12.6	16.8	20.2	
Total	145.1	1306.8		690.2	209.4	63.5	233.8	221.8	84.8	174.2	116.0	52.6	96.0	135.1	286.8	137.6	113.5	162.9

Fall Program

Age	1971	1972	...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.1	0.0	0.0			
2				20.6	1.3	4.6	1.0	18.3	2.2	2.4	3.7	4.9	9.7	1.8	0.9			
3				1.3	1.9	73.0	8.1	7.6	50.3	5.8	0.3	14.7	3.0	39.9	2.2			
4				12.8	0.2	19.8	101.9	7.4	4.0	109.9	4.4	1.5	10.3	10.2	56.4			
5				0.9	0.8	5.0	11.0	57.3	1.8	2.1	43.9	6.3	1.1	8.3	8.1			
6				4.3	0.2	14.6	4.3	2.3	8.0	2.2	1.9	50.9	4.2	0.5	14.0			
7				0.3	1.6	0.1	11.5	1.3	5.1	4.6	1.7	1.9	20.8	2.9	1.1			
8				0.9	0.0	3.0	0.2	2.0	0.1	0.6	1.6	1.6	0.5	13.4	7.5			
9				0.1	1.2	0.0	4.5	0.0	0.6	0.1	0.5	1.1	1.0	1.3	33.2			
10				1.9	0.1	0.6	1.0	1.9	0.0	0.8	0.2	0.2	1.0	1.2	2.1			
11+				101.2	61.8	64.8	95.9	44.6	17.6	10.4	6.3	3.9	2.4	4.4	6.9			
Total				144.1	69.0	185.2	239.2	142.6	85.1	138.7	64.4	87.6	54.0	84.0	132.4			

Table 16. Spring and fall research gillnet catch rates at age (numbers per days fished), spring spawners only, for Conception Bay - Southern Shore.

Spring Program

Age	1971	...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1			0.0					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2			0.0					0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	
3			0.0					8.4	0.0	19.1	5.9	16.2	19.2	0.0	0.6	3.2	
4			0.0					1.5	121.9	2.5	26.4	25.3	11.7	25.5	0.0	2.2	
5			0.0					6.5	3.3	180.2	22.5	13.9	9.0	8.7	17.9	1.7	
6			0.0					18.6	22.8	8.3	725.2	20.4	1.2	24.7	7.3	10.6	
7			0.9					2.6	5.6	13.7	32.3	110.0	5.6	2.7	8.5	3.6	
8			0.0					2.2	4.3	4.5	69.5	7.4	49.8	9.7	1.6	3.7	
9			0.0					0.5	1.3	3.2	9.8	6.5	1.7	70.3	1.9	0.6	
10			0.9					0.0	1.3	1.3	2.0	1.4	2.4	6.0	19.4	3.3	
11+			42.2					130.6	57.6	85.5	84.2	31.1	5.5	14.1	7.3	13.2	
Total			44.0					171.0	217.3	317.9	978.7	232.0	106.3	161.6	64.8	42.1	37.9

Fall Program

Age	1971	...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1						0.0	0.0	0.0	1.5		0.0	0.0	0.0	0.0			
2						2.3	80.0	1.1	0.9		14.3	41.7	0.1	0.2			
3						1.2	18.7	461.0	0.4		118.2	6.3	2.1	0.8			
4						2.1	68.0	26.0	34.9		4.2	12.2	0.5	17.1			
5						0.2	130.2	14.7	2.3		6.5	0.6	4.3	7.8			
6						0.3	8.7	18.1	2.4		295.6	0.7	0.3	23.1			
7						0.3	7.0	0.1	1.6		8.8	11.8	0.3	0.4			
8						0.0	13.3	1.1	0.2		10.6	0.4	6.6	0.6			
9						0.3	0.0	1.1	0.5		0.9	0.3	0.6	30.8			
10						0.3	0.0	0.0	0.6		0.0	0.7	0.8	3.0			
11+						7.3	88.7	41.8	3.0		2.8	0.9	0.3	9.2			
Total						14.3	414.5	565.0	48.3		461.8	75.6	16.0	93.0			

Table 17. Spring research gillnet catch rates at age (numbers per days fished), spring spawners only, for St. Mary's Bay - Placentia Bay.

Spring Program

Age	1970	1971	1972	1973	...	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0		0.0		0.2	1.8	0.7	0.0	0.0	0.0	0.4	0.2	0.1	0.1	0.0	0.2	
3	6.7	230.3		0.6		0.2	11.3	18.5	59.2	0.3	13.7	2.3	23.5	11.2	1.2	2.7	3.5	
4	627.5	35.0		0.0		0.6	2.0	21.7	5.9	125.6	1.7	4.2	6.0	19.5	21.5	0.7	3.3	
5	71.5	420.5		243.1		0.4	1.0	6.9	9.9	8.5	151.9	2.7	1.8	5.7	9.3	21.8	1.5	
6	56.7	37.0		4.8		1.4	1.1	2.7	6.9	17.4	11.6	100.3	3.5	2.4	2.5	3.8	12.1	
7	278.0	178.9		39.9		0.2	3.5	0.9	2.4	3.5	17.7	6.2	64.3	5.0	0.7	2.4	2.4	
8	87.7	33.9		0.3		1.7	0.4	7.3	2.1	2.6	4.0	14.4	3.3	69.9	1.4	1.0	2.7	
9	18.9	13.4		1.2		0.4	5.2	0.2	8.6	0.1	2.1	3.0	12.6	2.4	10.8	1.6	1.1	
10	62.1	15.4		8.2		0.4	0.6	10.1	2.7	2.4	0.6	0.1	3.1	16.7	1.4	7.5	2.1	
11+	139.0	64.8		4.8		6.5	21.5	46.7	45.4	12.1	7.4	7.2	4.9	6.8	6.3	13.1	17.2	
Total	1349.4	1028.1		302.4		11.9	48.4	115.6	143.1	172.5	210.4	140.9	123.3	139.5	55.1	54.8	46.2	92.0

Table 18. Spring gillnet catch rates at age (numbers per days fished), spring spawners only, for Fortune Bay.

Spring Program

Age	1970	1971	...	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0		0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	
3	0.0	10.4		0.6	8.4	0.0	14.4	0.0	0.0	0.0	12.2	98.8	0.7	0.3	0.0	
4	122.4	13.8		0.8	6.0	19.6	2.8	224.5	0.0	0.0	0.9	1.4	71.2	3.6	0.0	
5	5.6	168.3		0.6	3.9	13.2	205.4	8.8	532.1	3.1	0.9	0.0	22.0	61.3	9.1	
6	16.7	15.2		0.1	3.1	5.4	69.5	70.0	11.7	419.7	15.9	0.0	2.9	11.6	140.4	
7	236.5	31.5		0.2	2.4	1.2	15.8	48.4	48.3	9.8	664.7	6.2	2.2	1.3	5.0	
8	2.8	86.4		6.0	2.7	3.6	4.6	10.0	20.7	50.5	15.0	236.8	28.6	1.7	3.7	
9	5.6	0.0		0.3	44.0	0.3	8.8	0.8	4.8	11.3	65.4	19.7	371.2	6.3	0.0	
10	0.0	6.2		0.8	4.6	3.9	6.5	2.0	1.4	2.1	33.7	59.0	49.9	70.3	9.5	
11+	8.3	13.8		0.8	53.7	90.6	135.8	36.0	71.8	19.6	125.3	56.1	184.9	175.0	245.3	
Total	397.5	345.6		10.3	128.7	137.9	463.6	400.1	690.2	515.6	934.9	479.4	733.5	331.4	413.0	645.3

Table 19. Biomass and backscatter estimate for St. Mary's Bay - Placentia Bay, from the 1994 acoustic survey.

STOCK AREA	STRATUM	STRATUM AREA (m2)	TARGET STRENGTH (dB/kg)	TRANSECT NUMBER	TRANSECT LENGTH (n.mi.)	TRANSECT AREA (m2)	TRANSECT BIOMASS (t)	WEIGHTED DENSITY (kg/m2)	STRATUM BIOMASS (t)	ABSOLUTE STRATUM VARIANCE	TRANSECT TOTAL SCATTER (m2/sr)	WEIGHTED SCATT. COEFF. (/sr)	STRATUM TOTAL SCATTER (m2/sr)	RELATIVE STRATUM VARIANCE
SMB-PB	7	9.390E+07	-28.51	27	2.02	1.732E+06	1066	0.80110			1503	1.129E-03		
				28	1.69	1.449E+06	0	0.00000			0	0.000E+00		
				29	1.93	1.655E+06	0	0.00000			0	0.000E+00		
				30	0.57	4.888E+05	0	0.00000			0	0.000E+00		
				4		1.331E+06		0.20028	18806	2.99113E+14		2.822E-04	26503	5.941E+08
						5.325E+06								
	10	9.000E+07	-29.81	36	0.73	6.260E+05	0	0.00000			0	0.000E+00		
				40	1.32	1.132E+06	0	0.00000			0	0.000E+00		
				41	1.31	1.123E+06	0	0.00000			0	0.000E+00		
				42	2.23	1.912E+06	0	0.00000			0	0.000E+00		
				43	0.72	6.174E+05	0	0.00000			0	0.000E+00		
				44	0.92	7.889E+05	393	0.38019			410	3.972E-04		
				6		1.033E+06		0.06337	5703	3.68069E+13		6.620E-05	5958	4.017E+07
						6.200E+06								
	11	9.240E+07	-29.81	73	1.03	8.832E+05	0	0.00000			0	0.000E+00		
				74	1.42	1.218E+06	0	0.00000			0	0.000E+00		
				75	2.74	2.349E+06	0	0.00000			0	0.000E+00		
				76	2.87	2.461E+06	0	0.00000			0	0.000E+00		
				81	1.76	1.509E+06	0	0.00000			0	0.000E+00		
				82	1.94	1.664E+06	0	0.00000			0	0.000E+00		
				83	1.67	1.432E+06	0	0.00000			0	0.000E+00		
				84	0.99	8.489E+05	0	0.00000			0	0.000E+00		
				85	1.96	1.681E+06	3985	2.52465			4163	2.638E-03		
				88	2.30	1.972E+06	0	0.00000			0	0.000E+00		
				89	2.07	1.775E+06	0	0.00000			0	0.000E+00		
				90	1.34	1.149E+06	0	0.00000			0	0.000E+00		
				12		1.578E+06		0.21039	19440	3.76836E+14		2.198E-04	20309	4.113E+08
						1.894E+07								
										7.12756E+14				1.046E+09
				Total Transect Length =	35.53			Total Stock Biomass =	43949	26697		Total Stock Scatter =	52770	32335
										0.607				0.613

Table 20. Population numbers at age (millions) and biomass estimates (t) from acoustic surveys, spring spawners only, by stock area and year.

WBNDB	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0	623.0	0.0	0.0	0.0	14.6	0.1				3226.3		
1	979.1	187.7	0.0	12.6	0.4	29.6				0.0		
2	33.0	572.2	438.6	4.3	5.1	2.2				70.7		
3	4.5	4.6	832.5	27.1	1.6	1.3				2.1		
4	81.5	3.5	9.5	212.8	24.5	0.9				7.2		
5	4.2	34.2	0.0	17.6	65.4	9.5				191.5		
6	4.2	8.0	12.9	32.0	2.0	28.9				22.5		
7	22.2	6.1	0.0	36.2	1.8	2.0				10.1		
8	0.0	15.4	0.0	0.8	4.4	4.0				9.3		
9	9.1	0.0	0.0	0.3	1.3	5.2				16.4		
10	0.0	3.2	0.0	7.5	0.8	1.1				57.2		
11+	54.3	162.8	26.1	70.7	2.9	12.3				18.8		
Total	1815.1	997.7	1319.6	421.9	124.8	97.1				3632.1		
Biomass (t)	136000	78700	198400	126200	30900	22700				113500		

BBTB	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0		172.5	93.2	64.1	0.4	0.0		0.0			0.0	
1		63.6	0.0	171.5	0.0	0.3		9.3			1.5	
2		409.4	244.2	3.9	1.8	8.3		16.9			197.3	
3		1.8	378.2	6.3	0.3	26.4		156.8			20.8	
4		4.1	5.2	47.9	6.7	1.5		7.4			0.6	
5		11.7	0.0	1.7	26.6	10.0		3.2			2.1	
6		0.4	9.6	0.4	0.2	60.1		0.7			12.7	
7		0.0	0.0	0.4	0.1	1.1		1.6			1.0	
8		0.3	0.0	0.0	0.3	0.8		46.8			1.2	
9		0.0	0.0	0.0	0.1	0.0		0.2			0.4	
10		1.7	0.0	0.4	0.0	0.5		2.6			2.1	
11+		17.5	1.7	7.1	1.3	3.9		2.7			1.6	
Total		683.0	732.1	303.7	37.8	112.9		248.2			241.3	
Biomass (t)		59800	99900	25700	10400	30800		54000			24400	

SMBPB	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0				0.0				0.0		0.0		0.0
1				0.0				1.8		17.0		0.0
2				0.0				3.0		1.0		20.7
3				1.7				17.6		0.9		94.8
4				136.6				13.2		0.3		9.6
5				1.7				2.5		7.8		6.0
6				1.7				0.9		5.0		0.7
7				0.0				4.5		1.3		8.2
8				0.0				50.3		0.4		0.7
9				0.0				4.6		1.4		0.0
10				0.0				4.5		7.5		1.5
11+				0.0				7.1		5.9		26.2
Total				141.7				110.0		48.5		168.4
Biomass (t)				42200				39800		12000		43900

Table 21. Results from GLM procedure to predict yearclass sizes for White Bay - Notre Dame Bay from research gillnet catch rates at age and acoustic survey population numbers at age.

SAS System
General Linear Models Procedure

Dependent Variable: LOGCATCH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	44	484.52	11.01	9.31	0.0001
Error	153	181.00	1.18		
Corrected Total	197	665.52			

R-Square	0.728	C.V.	45.118	Root MSE	1.087	LOGCATCH Mean	2.41

Source	DF	Type I SS	Mean Square	F Value	Pr > F
COHORT	20	409.317	20.466	17.30	0.0001
SAGE	24	75.203	3.133	2.65	0.0002

Source	DF	Type III SS	Mean Square	F Value	Pr > F
COHORT	20	321.325	16.066	13.58	0.0001
SAGE	24	75.203	3.133	2.65	0.0002

Parameter		Estimate	T for HO: Parameter=0	Pr > ITI	Std Error of Estimate
INTERCEPT					
COHORT	1971	1.586	0.96	0.3399	1.656
	1972	3.675	2.54	0.0119	1.444
	1973	1.990	1.46	0.1469	1.365
	1974	4.451	3.50	0.0006	1.298
	1975	1.944	1.53	0.1272	1.268
	1976	3.994	3.20	0.0017	1.249
	1977	3.043	2.46	0.0150	1.237
	1978	3.039	2.48	0.0142	1.225
	1979	5.270	4.32	0.0001	1.219
	1980	4.141	3.40	0.0009	1.218
	1981	3.799	3.13	0.0021	1.213
	1982	6.598	5.49	0.0001	1.202
	1983	5.221	4.35	0.0001	1.201
	1984	2.722	2.26	0.0250	1.203
	1985	3.628	3.01	0.0031	1.205
	1986	3.869	3.19	0.0017	1.213
	1987	6.598	5.38	0.0001	1.226
	1988	4.094	3.17	0.0018	1.289
	1989	2.431	1.78	0.0765	1.363
	1990	3.670	2.54	0.0121	1.445
	1991	0.000			
SAGE	a2	0.513	0.82	0.4142	0.627
	a3	-0.710	-1.15	0.2521	0.617
	a4	-0.639	-1.05	0.2966	0.610
	a5	-0.542	-0.85	0.3959	0.637
	a6	-0.572	-0.93	0.3525	0.614
	a7	-1.155	-1.87	0.0639	0.618
	a8	-1.729	-2.78	0.0061	0.622
	a9	-2.414	-3.83	0.0002	0.630
	a10	-1.010	-1.57	0.1193	0.645
	f3	-0.655	-1.17	0.2446	0.561
	f4	-0.026	-0.05	0.9624	0.559
	f5	0.022	0.04	0.9683	0.558
	f6	-0.392	-0.70	0.4842	0.559
	f7	-0.424	-0.75	0.4521	0.562
	f8	-0.670	-1.18	0.2403	0.569
	f9	-0.867	-1.50	0.1356	0.578
	f10	-0.517	-0.87	0.3844	0.593
	s3	-0.831	-1.20	0.2328	0.693
	s4	0.742	1.10	0.2712	0.672
	s5	0.890	1.36	0.1765	0.655
	s6	0.599	0.93	0.3545	0.645
	s7	0.355	0.56	0.5778	0.637
	s8	0.024	0.04	0.9697	0.632
	s9	0.000			
	s10	-0.200	-0.32	0.7516	0.631

Table 22. Results from GLM procedure to predict yearclass sizes for Bonavista Bay - Trinity Bay from research gillnet catch rates at age and acoustic survey population numbers at age.

SAS System
General Linear Models Procedure

Dependent Variable: LOGCATCH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	54	802.52	14.86	9.97	0.0001
Error	216	321.94	1.49		
Corrected Total	270	1124.45			

R-Square	0.714	C.V.	120.158	Root MSE	1.221	LOGCATCH Mean	1.016

Source	DF	Type I SS	Mean Square	F Value	Pr > F
COHORT	30	656.037	21.867	14.67	0.0001
SAGE	24	146.479	6.103	4.09	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
COHORT	30	501.494	16.716	11.22	0.0001
SAGE	24	146.479	6.103	4.09	0.0001

Parameter		Estimate	T for HO: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT					
COHORT	1962	1.086	0.59	0.5559	1.842
	1963	5.453	2.97	0.0034	1.838
	1964	3.647	1.99	0.0483	1.836
	1965	3.175	1.73	0.0849	1.835
	1966	1.185	0.65	0.5186	1.833
	1967	4.160	2.27	0.0242	1.833
	1968	4.611	2.52	0.0125	1.830
	1969	0.362	0.20	0.8431	1.831
	1970	3.161	1.72	0.0876	1.842
	1971	-1.195	-0.78	0.4340	1.524
	1972	-0.005	0.00	0.9969	1.451
	1973	-1.261	-0.89	0.3749	1.418
	1974	0.887	0.63	0.5265	1.399
	1975	-1.946	-1.41	0.1606	1.382
	1976	-0.244	-0.18	0.8585	1.371
	1977	-1.361	-1.00	0.3192	1.363
	1978	-0.550	-0.40	0.6863	1.360
	1979	0.787	0.58	0.5628	1.358
	1980	-0.304	-0.22	0.8226	1.357
	1981	-0.066	-0.05	0.9610	1.356
	1982	3.187	2.35	0.0198	1.357
	1983	1.091	0.81	0.4188	1.348
	1984	-0.946	-0.70	0.4841	1.350
	1985	1.408	1.04	0.2997	1.354
	1986	0.364	0.27	0.7892	1.360
	1987	2.035	1.48	0.1392	1.371
	1988	-0.048	-0.03	0.9726	1.425
	1989	-0.668	-0.47	0.6399	1.426
	1990	0.921	0.57	0.5675	1.608
	1991	3.059	1.63	0.1036	1.871
	1992	0.000			
SAGE	a2	1.873	3.01	0.0029	0.623
	a3	1.205	2.01	0.0460	0.600
	a4	0.801	1.36	0.1747	0.588
	a5	-0.047	-0.08	0.9349	0.584
	a6	-0.214	-0.37	0.7124	0.580
	a7	-1.382	-2.39	0.0177	0.578
	a8	-1.226	-2.12	0.0348	0.577
	a9	-1.738	-3.02	0.0028	0.575
	a10	0.054	0.09	0.9313	0.632
	f3	0.997	1.95	0.0520	0.510
	f4	1.377	2.72	0.0071	0.506
	f5	1.078	2.14	0.0333	0.503
	f6	0.842	1.68	0.0939	0.500
	f7	0.454	0.91	0.3627	0.498
	f8	-0.377	-0.76	0.4482	0.497
	f9	-0.304	-0.61	0.5399	0.495
	f10	-0.508	-1.03	0.3048	0.494
	s3	0.241	0.50	0.6194	0.485
	s4	1.218	2.54	0.0117	0.479
	s5	0.885	1.87	0.0635	0.474
	s6	1.131	2.40	0.0172	0.471
	s7	0.266	0.57	0.5696	0.468
	s8	0.030	0.07	0.9472	0.465
	s9	0.000			
	s10	0.211	0.45	0.6542	0.470

Table 23. Results from GLM procedure to predict yearclass sizes for St. Mary's Bay - Placentia Bay from research gillnet catch rates at age and acoustic survey population numbers at age.

SAS System
General Linear Models Procedure

Dependent Variable: LOGCATCH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	48	443.80	9.24	7.63	0.0001
Error	107	129.69	1.21		
Corrected Total	155	573.55			

R-Square	0.774	C.V.	78.129	Root MSE	1.101	LOGCATCH Mean	1.409

Source	DF	Type I SS	Mean Square	F Value	Pr > F
COHORT	32	396.207	12.381	10.22	0.0001
SAGE	16	47.648	2.978	2.46	0.0033

Source	DF	Type III SS	Mean Square	F Value	Pr > F
COHORT	32	359.806	11.243	9.28	0.0001
SAGE	16	47.648	2.978	2.46	0.0033

Parameter		Estimate	T for HO: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT					
COHORT	1960	5.037	2.83	0.0055	1.779
	1961	3.828	2.42	0.0173	1.583
	1962	4.342	2.75	0.0070	1.578
	1963	4.305	2.86	0.0051	1.507
	1964	3.564	2.37	0.0196	1.504
	1965	2.353	1.57	0.1200	1.501
	1966	5.377	3.59	0.0005	1.498
	1967	2.445	1.64	0.1049	1.495
	1968	5.584	3.56	0.0005	1.567
	1969	-1.290	-0.73	0.4648	1.759
	1970	-0.114	-0.06	0.9483	1.760
	1972	-0.007	0.00	0.9963	1.779
	1973	0.277	0.18	0.8610	1.583
	1974	2.338	1.55	0.1244	1.510
	1975	-0.101	-0.17	0.9449	1.471
	1976	1.868	1.29	0.1996	1.447
	1977	-0.139	-0.10	0.9220	1.419
	1978	0.355	0.25	0.8017	1.411
	1979	1.066	0.76	0.4481	1.400
	1980	2.905	2.07	0.0408	1.403
	1981	2.083	1.50	0.1374	1.392
	1982	4.509	3.22	0.0017	1.399
	1983	1.252	0.91	0.3671	1.382
	1984	0.843	0.60	0.5482	1.400
	1985	1.050	0.78	0.4376	1.348
	1986	2.247	1.59	0.1148	1.413
	1987	2.987	2.14	0.0349	1.397
	1988	0.444	0.31	0.7584	1.440
	1989	1.710	1.27	0.2069	1.346
	1990	1.821	1.19	0.2382	1.536
	1991	5.265	3.72	0.0003	1.416
	1992	4.468	2.37	0.0193	1.888
	1993	0.000			
SAGE	a2	-0.363	-0.45	0.6504	0.800
	a3	0.231	0.31	0.7552	0.741
	a4	0.957	1.36	0.1782	0.706
	a5	0.439	0.64	0.5251	0.688
	a6	-0.116	-0.17	0.8635	0.675
	a7	-0.123	-0.18	0.8541	0.668
	a8	-0.829	-1.25	0.2123	0.660
	a9	-0.673	-1.02	0.3079	0.657
	a10	-1.228	-1.44	0.1523	0.852
					0.426
	s3	0.677	1.47	0.1449	0.461
	s4	1.161	2.57	0.0116	0.452
	s5	1.233	2.79	0.0062	0.441
	s6	1.071	2.49	0.0142	0.429
	s7	0.863	2.04	0.0441	0.423
	s8	0.532	1.28	0.2047	0.417
	s9	0.000			
	s10	0.165	0.39	0.6993	

Table 24. Estimates of yearclass strength (in millions at age 2) by various methods for herring in White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay and St. Mary's Bay - Placentia Bay.

	WBNDB			BBTB			SMBPB		
Yearclass	Method 1	Method 2 *	Method 3	Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
1977	26	(23)		10	3		27	6	
1978	34	(23)		13	6		8	8	
1979	78	(81)	55	36	14	5	50	12	
1980	51	(42)		20	7		17	34	
1981	16	(34)		6	8		9	21	
1982	211	(175)	173	102	65	252	53	85	20
1983	33	(79)		24	17		7	13	
1984	7	(19)		2	4		1	10	
1985	8	(31)	5	3	20		3	11	
1986	6	(36)	13	3	10		3	23	1
1987	11	(175)		4	30		10	35	
1988	53	(41)		22	8		4	8	
1989	33	(16)		14	5		3	17	
1990	35	(32)		15	15		7	18	
Maximum observed recruitment		650			780			280	

Method 1 - Environmental recruitment model (Winters and Wheeler 1987)
Method 2 - Multiplicative catch rate model
Method 3 - Modified Leslie-DeLury model

* estimates in brackets using the regression equation for SMBPB

Table 25. Results of extended survivors analysis for White Bay - Notre Dame Bay, spring spawning herring.

Data for 3 fleets over 24 years
Age range from 3 to 10

Fleet	Alpha	Beta
Spring Res. Gillnets	0.25	0.5
Fall Res. Gillnets	0.75	1
Acoustic Surveys	0.75	1

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages
Catchability independent of age for ages >= 9

Terminal population estimation :

Final estimates shrunk towards mean of the last 5 years and the 5 oldest ages.
S.E. of the mean to which the estimates are shrunk = .800
Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .008

Fishing mortalities

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3	0.017	0.005	0.002	0.001	0.001	0.02	0.059	0.103	0.007	0.01	0.022	0.116	0.053
4	0.006	0.046	0.001	0.007	0.026	0.017	0.198	0.069	0.081	0.019	0.113	0.068	0.023
5	0.077	0.01	0.004	0.027	0.016	0.029	0.201	0.116	0.038	0.113	0.134	0.084	0.024
6	0.038	0.022	0.003	0.016	0.041	0.057	0.216	0.133	0.17	0.096	0.136	0.057	0.044
7	0.108	0.026	0.009	0.029	0.029	0.044	0.122	0.204	0.169	0.197	0.054	0.127	0.011
8	0.145	0.046	0.001	0.019	0.092	0.068	0.096	0.185	0.104	0.17	0.264	0.15	0.093
9	0.108	0.058	0.006	0.044	0.014	0.072	0.191	0.089	0.269	0.213	0.147	0.133	0.068
10	0.142	0.081	0.016	0.034	0.128	0.035	0.286	0.228	0.069	0.503	0.347	0.13	0.14

Log catchability residuals.

Fleet : Spring Res. Gillnets

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3								-0.34	0.31	-0.34	0.41	0	-0.04
4								-1.74	0.83	0.32	0.05	-0.55	1.09
5								-1.42	-0.03	0.98	0.07	0.19	0.21
6								-1.7	0.65	0.59	0.35	0	0.12
7								-1.23	-0.23	1.14	0.5	0.16	-0.35
8								-1.62	-0.31	0.18	1.42	0.58	-0.26
9								-1.85	-0.17	-0.02	0.57	0.53	0.93

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.31	-5.95	-5.6	-5.58	-5.56	-5.54	-5.32	-5.32
S.E	0.35	1.03	0.78	0.87	0.81	1.02	0.99	1.46

Fleet : Fall Res. Gillnets

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3	0.27	-0.05	1.63	-0.12	0.35	-0.89	-1.37	-0.09	0.27	0.39	-0.39		
4	-1.82	-0.25	0.34	0.02	0.35	-0.5	0.1	-0.16	0.99	0.32	0.62		
5	0.21	-0.8	-0.03	0.34	-0.51	-0.1	0.81	-0.59	0.58	-0.01	0.09		
6	-0.6	-1.99	0.96	-0.21	0.4	-0.36	1.49	-0.05	0.71	0.25	-0.59		
7	-0.68	-0.86	0.31	0.42	0.28	-0.07	0.28	0.13	0.37	-0.33	0.13		
8	-0.29	0.04	0.43	0.09	0.37	-0.18	0.53	-0.33	-0.29	-0.23	-0.13		
9	-1	0	1.08	-0.56	-0.37	-0.35	0.97	-0.69	0.69	0.63	-0.4		

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.65	-6.81	-6.56	-6.71	-6.46	-6.36	-6.31	-6.31
S.E	0.77	0.73	0.49	0.93	0.44	0.32	0.76	1.45

Fleet : Acoustic Surveys

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3			-0.87	-0.54	2.09	0.13	-0.48	-1.28				0.94	
4			0.92	-1.09	0.23	0.76	0.22	-0.96				-0.07	
5			-0.14	-0.12	0	0.69	-0.43	-0.79				0.79	
6			0	0.68	-0.89	1.16	-1.13	-0.94				1.12	
7			0.73	0.39	0	0.18	-1.6	-0.93				1.22	
8			0	0.77	0	-1.14	-1.45	-0.24				2.06	
9			1.03	0	0	-1.66	-0.07	-0.78				1.48	

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.57	-7.39	-7	-6.96	-6.76	-6.95	-7.16	-7.16
S.E	1.17	0.78	0.62	1	1.06	1.44	1.29	1.51

Table 26. Fishing mortalities, population numbers and biomass for White Bay - Notre Dame Bay from extended survivors analy

Fishing mortality (F) at age

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE														
3	0	0.0002	0.0008	0.0082	0.0004	0.0068	0.0095	0.0614	0.0167	0.0023	0.0052	0.0168	0.0053	0.0017
4	0.0001	0.0011	0.0052	0.0048	0.0017	0.0248	0.0334	0.0533	0.0989	0.0189	0.0596	0.0056	0.0463	0.0008
5	0.0003	0.001	0.0056	0.0076	0.013	0.0077	0.0344	0.0391	0.2208	0.2019	0.0439	0.0774	0.01	0.004
6	0.0003	0.0009	0.0005	0.0148	0.018	0.0281	0.0183	0.0338	0.1137	0.3675	0.1062	0.0382	0.0216	0.0029
7	0.0033	0.0062	0.002	0.0066	0.0291	0.0293	0.0724	0.0208	0.1254	0.224	0.029	0.1076	0.026	0.0093
8	0.0002	0.0437	0.0073	0.0134	0.0079	0.0345	0.0921	0.064	0.0848	0.2771	0.1141	0.1452	0.0455	0.0009
9	0.0037	0.004	0.0073	0.0093	0.0387	0.0117	0.052	0.0912	0.126	0.1006	0.0954	0.108	0.0583	0.0057
10	0.0019	0.0139	0.0043	0.0112	0.0237	0.0262	0.0595	0.0532	0.1144	0.247	0.0881	0.1422	0.081	0.0156
+gp	0.0019	0.0139	0.0043	0.0112	0.0237	0.0262	0.0595	0.0532	0.1144	0.247	0.0881	0.1422	0.081	0.0156
FBAR 5- 8	0.001	0.013	0.0039	0.0106	0.017	0.0249	0.0543	0.0394	0.1362	0.2676	0.0733	0.0921	0.0258	0.0043

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	FBAR 91-93
AGE											
3	0.0007	0.0009	0.0195	0.0589	0.1032	0.0068	0.0104	0.0219	0.1163	0.0533	0.0638
4	0.0068	0.0264	0.0169	0.1957	0.0689	0.0811	0.0188	0.1128	0.0683	0.0228	0.068
5	0.0265	0.0162	0.0292	0.2013	0.1159	0.0378	0.1135	0.1343	0.084	0.0244	0.0809
6	0.0157	0.0409	0.0572	0.2155	0.1331	0.1698	0.0956	0.1363	0.0565	0.0442	0.079
7	0.0295	0.0291	0.0441	0.1221	0.2037	0.1689	0.1965	0.054	0.1275	0.0111	0.0642
8	0.0195	0.0922	0.0684	0.0958	0.1852	0.1038	0.1702	0.2641	0.1495	0.0933	0.169
9	0.0438	0.0145	0.072	0.1915	0.0894	0.2695	0.2133	0.1468	0.1327	0.0676	0.1157
10	0.0336	0.1275	0.0345	0.2862	0.2275	0.0686	0.5035	0.3468	0.1299	0.14	0.2056
+gp	0.0336	0.1275	0.0345	0.2862	0.2275	0.0686	0.5035	0.3468	0.1299	0.14	
FBAR 5- 8	0.0228	0.0446	0.0497	0.1587	0.1595	0.1201	0.144	0.1472	0.1044	0.0432	

Stock number at age (start of year) Numbers*10**-3

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE														
3	104676	621686	402115	98172	11848	20962	2809	30999	3661	28990	9892	10063	77203	24780
4	219583	85701	508876	328961	79718	9697	17047	2278	23868	2948	23681	8058	8101	62873
5	99288	179769	70086	414465	268054	65156	7745	13499	1768	17701	2368	18266	6560	6332
6	92118	81269	147037	57062	336779	216621	52936	6126	10628	1161	11843	1856	13841	5317
7	322406	75398	66479	120321	46030	270804	172434	42555	4849	7766	658	8719	1462	11090
8	78241	263084	61346	54318	97860	36607	215319	131320	34123	3503	5083	523	6410	1167
9	24937	64048	206180	49861	43880	79490	28955	160775	100854	25668	2174	3712	371	5015
10	93044	20342	52227	167573	40446	34563	64323	22505	120162	72793	19004	1618	2728	286
+gp	160655	248194	205494	78817	111869	170283	162764	334199	146449	138131	191447	90590	57504	57493
TOTAL	1194947	1639489	1719840	1369550	1036485	904184	724330	744255	446364	298661	266151	143405	174181	174354

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	GMST 70-90	AMST 70-90
AGE													
3	18142	237823	55761	6256	11771	20760	206990	19690	2084	2046	0	33156	95493
4	20254	14843	194544	44771	4829	8692	16881	167717	15771	1519	1607	27060	80295
5	51434	16470	11835	156614	30140	3690	6562	13563	122672	12060	1230	23482	68943
6	5164	41009	13268	9411	104841	21976	2909	4796	9709	92346	9791	20894	58722
7	4341	4162	32231	10259	6211	75142	15182	2165	3426	7512	73192	20220	61833
8	8995	3451	3309	25250	7434	4148	51961	10213	1679	2470	6180	16995	52069
9	954	7223	2576	2530	18784	5058	3061	35882	6420	1184	1874	12632	39815
10	4082	748	5828	1963	1711	14063	3163	2025	25368	4603	921	11497	35389
+gp	64702	19405	64099	20147	15896	36189	3176	8239	31715	7257	8507		
TOTAL	178069	345132	383453	277202	201616	189719	309885	264289	218845	130996	103303		

Stock biomass at age (start of year) Tonnes

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE														
3	12980	77089	49862	12173	1469	2599	348	3844	487	3856	1583	1610	10654	5724
4	40623	15855	94142	60858	14748	1794	3154	421	4797	593	4713	1603	1596	16095
5	20156	36493	14227	84136	54415	13227	1572	2740	428	4284	703	5425	1528	1887
6	20358	17960	32495	12611	74428	47873	11699	1354	2689	294	3340	523	3654	1664
7	77055	18020	15889	28757	11001	64722	41212	10171	1290	2066	194	2572	424	3660
8	20186	67876	15827	14014	25248	9445	55552	33881	9247	949	1520	156	1923	415
9	6758	17357	55875	13512	11892	21542	7847	43570	27735	7059	667	1140	113	1795
10	25959	5675	14571	46753	11285	9643	17946	6279	33525	20309	5796	493	835	100
+gp	51731	79918	66169	25379	36022	54831	52410	107612	45546	42959	62795	29714	19839	22882
TOTALBIO	275805	336243	359058	298193	240507	225676	191740	209871	125744	82367	81311	43237	40566	54224

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
AGE										
3	2721	35673	8030	907	1742	2574	25253	2402	254	174
4	5104	2924	39103	9268	1033	1695	3022	28847	2586	242
5	12396	4315	2639	36491	7083	838	1536	2875	24412	2279
6	1771	10785	3609	2532	26839	5472	753	1185	2223	20408
7	1324	1248	8992	3006	1832	20514	4236	602	894	1893
8	3211	1122	1046	8029	2349	1228	15380	2931	465	689
9	350	2398	850	883	6067	1573	1007	11195	1900	353
10	1625	264	1912	648	570	4669	1063	670	8168	1399
+gp	24781	7296	23781	8039	6581	14910	1327	3238	11830	2489
TOTALBIO	53283	66026	89962	69803	54097	53472	53577	53946	52734	29927

Table 27. Results of extended survivors analysis for Bonavista Bay - Trinity Bay, spring spawning herring.

Data for 3 fleets over 24 years
Age range from 3 to 10

Fleet	Alpha	Beta
Spring Res. Gillnets	0.25	0.5
Fall Res. Gillnets	0.75	1
Acoustic Surveys	0.75	1

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages
Catchability independent of age for ages >= 9

Terminal population estimation :

Final estimates shrunk towards mean of the last 5 years and the 5 oldest ages.
S.E. of the mean to which the estimates are shrunk = .800
Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .016

Fishing mortalities

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
	1991	1992	1993																	
3	0.001	0	0	0	0.029	0.022	0.014	0.015	0.036	0.008	0.055	0	0	0.002	0.001	0.011	0.072	0.25	0.044	0.027
0.03	0.39	0.065																		
4	0.005	0.002	0	0	0.047	0.046	0.05	0.025	0.123	0.03	0.04	0.003	0.002	0.004	0.009	0.025	0.094	0.061	0.123	0.023
0.157	0.049	0.092																		
5	0.004	0.006	0.01	0.001	0.005	0.056	0.092	0.058	0.068	0.042	0.051	0.002	0.002	0.017	0.011	0.042	0.119	0.189	0.079	0.12
0.187	0.214	0.081																		
6	0.002	0.005	0.003	0.012	0.017	0.006	0.138	0.04	0.011	0.033	0.032	0.008	0.002	0.004	0.036	0.026	0.07	0.232	0.092	0.036
0.297	0.269	0.091																		
7	0.018	0.003	0.006	0.012	0.044	0.04	0.002	0.093	0.09	0.039	0.042	0.008	0.005	0.007	0.019	0.034	0.075	0.231	0.136	0.053
0.183	0.065	0.068																		
8	0.008	0.005	0	0.012	0.017	0.063	0.065	0.033	0.114	0.072	0.022	0.006	0.002	0.005	0.048	0.025	0.02	0.211	0.005	0.096
0.179	0.148	0.058																		
9	0.032	0.004	0.004	0.019	0.102	0.042	0.126	0.08	0.037	0.116	0.117	0.006	0.002	0.006	0.006	0.023	0.027	0.002	0.091	0.125
0.232	0.242	0.142																		
10	0.014	0.004	0.002	0.006	0.059	0.12	0.045	0.1	0.101	0.088	0.194	0.031	0.003	0.001	0.065	0.018	0.017	0.057	0.025	0.192
0.369	0.091	0.171																		

Log catchability residuals.

Fleet : Spring Res. Gillnets

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3	-4.08	-2.81								0	3.56	0.3	1.12	2.83	-0.41	-1.69	0.51	0.13	-0.25	-0.5	0.48	-0.16	0.77
4	-0.88	0.29								1.52	1.78	-0.4	1.39	0.4	0.51	0.36	-2.71	-2.16	0.3	-0.3	0.39	-1	0.5
5	-1.75	1.94								0	-0.6	-0.77	-0.4	1.61	-0.09	-0.47	0.21	-1.78	-0.83	0.82	0.75	0.22	1.13
6	-2.17	-0.04								2.04	0.86	-1.14	0	0.63	0.37	-0.62	-0.93	-0.92	-0.81	0.79	1.39	0.1	0.43
7	-0.07	0.94								0	0.03	0	-1.22	0.31	-0.34	-0.6	0	-1.62	0.2	0.34	1.24	0.48	0.34
8	-0.51	1.44								0.17	0	-1.84	0	0.04	0.8	-0.32	0	-1.94	-0.78	0.48	1.45	0.77	0.24
9	0.05	1.07								0	0.59	-0.87	0.96	0	-0.59	-0.21	-1.23	-1.94	-1.21	-0.69	1.23	1.27	1.54

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-9.01	-7.46	-7.42	-7.18	-7.25	-7.16	-7.12	-7.12
S.E	1.89	1.23	1.11	1.1	0.8	1.07	1.12	1.8

Fleet : Fall Res. Gillnets

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3										0.75	0.14	2.35	0.63	0.75	-0.5	-0.92	-1.94	0.08	-1.07	-0.08	-0.18		
4										1.02	-1.56	2.03	2.22	0.08	-0.35	-0.17	-1.58	-0.74	-0.6	-0.29	-0.06		
5										0.27	-1.43	1.94	1.71	1.93	-1.05	-0.58	-0.7	-0.79	-0.7	-0.43	-0.06		
6										-0.32	-1.01	1.68	1.99	0.35	0.19	-0.63	-0.52	-0.14	-0.9	-1.25	0.57		
7										-0.91	-0.88	-1.3	1.84	1.19	1.55	0.07	-0.43	0.08	-0.5	-0.82	0.1		
8										-0.4	0	0.37	0.01	0.7	-0.72	0.04	-0.38	0.31	-0.61	-0.23	0.9		
9										-0.94	0.1	0	0.88	0	-0.4	-0.59	-0.01	-0.83	0.05	0.56	0.99		

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.81	-7.14	-7.22	-7.21	-7.4	-7.81	-7.71	-7.71
S.E	1.09	1.21	1.2	1.02	1.03	0.53	0.68	1.01

Fleet : Acoustic Surveys

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3														-0.94	1.26	-1.09	-2.2	0.41		1.04			1.52
4														0.17	0.8	-0.31	-0.47	-0.05		0.08			-0.03
5														0.97	0	-0.27	-0.58	0.3		-0.75			0.33
6														-0.29	1.49	-1.23	-1.66	1.14		0.2			0.35
7														0	0	-0.63	-1.51	1.29		0.34			0.52
8														-0.53	0	0	-1.37	0.28		1.69			-0.07
9														0	0	0	-0.87	0		-0.37			1.04

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.56	-7.83	-7.84	-8.32	-9.15	-8.48	-8.66	-8.66
S.E	1.42	0.35	0.65	1.15	1.09	1.13	0.91	1.09

Table 28. Fishing mortalities, population numbers and biomass for Bonavista Bay - Trinity Bay from extended survivors analysis.

Fishing mortality (F) at age

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE														
3	0	0.0009	0	0	0.0003	0.0286	0.0223	0.0138	0.0146	0.0354	0.0079	0.0549	0.0004	0.0003
4	0	0.0049	0.0022	0.0003	0	0.0471	0.0455	0.0495	0.0248	0.1229	0.0305	0.0404	0.0031	0.0022
5	0.0003	0.0044	0.0075	0.0097	0.0012	0.0048	0.0556	0.0917	0.0577	0.0679	0.042	0.0509	0.0019	0.0024
6	0.0022	0.0022	0.0048	0.003	0.0118	0.0167	0.006	0.138	0.0396	0.0114	0.0334	0.0322	0.0075	0.0023
7	0.0039	0.0176	0.0032	0.0062	0.0124	0.0442	0.04	0.0022	0.0934	0.0895	0.0389	0.0417	0.0077	0.0046
8	0.006	0.0082	0.0053	0.0001	0.012	0.0165	0.0831	0.0653	0.0332	0.1141	0.0718	0.0217	0.0063	0.0019
9	0.0116	0.0325	0.0035	0.0036	0.0187	0.1022	0.0415	0.1263	0.0604	0.0372	0.1161	0.1171	0.0058	0.0018
10	0.0061	0.0143	0.0037	0.0024	0.0063	0.0587	0.1197	0.0451	0.0997	0.101	0.0882	0.1942	0.0312	0.0029
+gp	0.0061	0.0143	0.0037	0.0024	0.0063	0.0587	0.1197	0.0451	0.0997	0.101	0.0882	0.1942	0.0312	0.0029
FBAR 5- 8	0.0031	0.0081	0.0052	0.0047	0.0094	0.0206	0.0462	0.0743	0.056	0.0707	0.0465	0.0366	0.0059	0.0028

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	FBAR 91-93
AGE											
3	0.0023	0.0008	0.0114	0.0723	0.2495	0.0441	0.0267	0.0298	0.3901	0.065	0.1616
4	0.0037	0.009	0.0249	0.0941	0.061	0.1234	0.0226	0.1567	0.0489	0.0924	0.0993
5	0.0171	0.0114	0.0422	0.1191	0.1691	0.0791	0.1204	0.1872	0.2142	0.0809	0.1608
6	0.0038	0.0359	0.0263	0.0697	0.2321	0.0915	0.0364	0.2965	0.2685	0.0915	0.2188
7	0.0071	0.0192	0.0339	0.0755	0.2311	0.1356	0.0529	0.1831	0.0653	0.0678	0.1054
8	0.0045	0.0484	0.0247	0.0205	0.2109	0.0053	0.0956	0.1787	0.1476	0.0564	0.1275
9	0.0046	0.006	0.0227	0.0268	0.0016	0.0909	0.1246	0.2321	0.2419	0.1417	0.2052
10	0.0005	0.0645	0.0177	0.017	0.057	0.0248	0.1922	0.3688	0.0914	0.1715	0.2105
+gp	0.0005	0.0645	0.0177	0.017	0.057	0.0248	0.1922	0.3688	0.0914	0.1715	
FBAR 5- 8	0.0081	0.0287	0.0318	0.0712	0.2108	0.0779	0.0763	0.2114	0.1739	0.0741	

Stock number at age (start of year) Numbers*10**-3

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE														
3	85717	835638	312733	55794	3931	15379	3857	19967	1978	9080	1822	5094	20439	12669
4	31627	70178	683538	256035	45679	3217	12237	3088	16123	1596	7175	1480	3948	16727
5	39258	25893	57175	558415	209569	37397	2513	9573	2406	12878	1156	5698	1164	3222
6	27952	32134	21107	46459	452769	171368	30471	1946	7151	1860	9851	907	4434	951
7	227903	22836	26251	17198	37924	366357	137984	24797	1388	5627	1506	7800	719	3603
8	6421	185860	18369	21425	13994	30666	286982	108541	20257	1035	4213	1186	6126	584
9	12120	5225	150927	14960	17540	11321	24695	216233	83248	16044	756	3210	950	4984
10	12564	9809	4141	123134	12205	14095	8368	19396	156039	64165	12656	551	2338	773
+gp	38536	40561	62898	454	326475	32465	42040	147245	69157	229352	159943	73302	42564	61360
TOTAL	482098	1228133	1337140	1093874	1120087	682266	549148	550788	357747	341637	199078	99228	82681	104873

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	GMST 70-90	AMST 70-90
AGE													
3	10542	244237	43268	6543	49598	26697	129556	7896	3613	10912	0	22751	90216
4	10369	8611	199806	35024	4983	31641	20914	103272	6274	2003	8489	17121	69714
5	13664	8457	6987	159565	26101	3839	22898	16741	72290	4892	1516	14112	57516
6	2632	10997	6846	5484	115975	18045	2904	16621	11366	47775	3763	11316	46297
7	777	2147	8686	5459	4188	75282	13482	2292	10117	7115	36505	11098	47234
8	2936	632	1724	6875	4145	2721	53819	10469	1563	7759	5567	8480	37072
9	477	2393	493	1377	5514	2748	2216	40047	7169	1104	6143	6297	27497
10	4073	389	1948	394	1098	4508	2055	1602	25997	4608	802	5434	21652
+gp	313104	14059	41194	62701	24820	22851	2932	3168	8238	7625	8511		
TOTAL	358574	291922	310951	283423	236423	188332	250776	202108	146628	93791	71296		

Stock biomass at age (start of year) Tonnes

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE														
3	11400	111140	41593	7421	523	2045	513	2656	277	1262	264	840	3372	2838
4	6294	13965	136024	50951	9090	640	2435	615	3386	327	1507	363	967	4316
5	8441	5567	12293	120059	45057	8040	540	2058	602	3219	307	1664	340	980
6	6653	7648	5023	11057	107759	40786	7252	463	1966	480	2975	290	1419	316
7	57887	5800	6668	4368	9633	93055	35048	6298	437	1508	468	2535	234	1261
8	1753	50740	5015	5849	3820	8372	78346	29632	6685	284	1335	400	2064	216
9	3588	1547	44674	4428	5192	3351	7310	64005	29137	4572	249	1130	334	1914
10	3845	3002	1267	37679	3735	4313	2561	5935	57735	18993	3949	198	839	295
+gp	13218	13912	21574	156	111981	11136	14420	50505	26971	76833	55660	26755	15536	27060
TOTALBIO	113077	213321	274132	241968	296790	171738	148425	162167	127195	107479	66715	34175	25106	39194

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
AGE										
3	1370	28820	5235	890	6398	3924	18656	1042	481	1178
4	2001	1714	37563	7180	977	6708	4580	20861	1092	340
5	3293	1979	1642	35423	6082	952	5999	4302	15615	1032
6	761	3013	1903	1470	29574	4782	790	4770	2910	11418
7	245	646	2597	1632	1194	21079	3842	656	2903	2021
8	963	217	564	2186	1318	797	16899	3026	449	2413
9	159	811	177	545	1974	888	782	12895	2022	330
10	1393	142	713	129	406	1564	744	543	7981	1424
+gp	121171	5525	16436	24892	10449	9392	1234	1226	2801	2615
TOTALBIO	131356	42867	66831	74348	58371	50086	53527	49321	36253	22772

Table 29. Results of extended survivors analysis for St. Mary's Bay - Placentia Bay spring spawning herring.

Data for 2 fleets over 24 years
Age range from 3 to 10

Fleet	Alpha	Beta
Research Gillnets	0.25	0.5
Acoustic Surveys	0	0.25

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages
Catchability independent of age for ages >= 9

Terminal population estimation :

Final estimates shrunk towards mean of the last 5 years and the 5 oldest ages.
S.E. of the mean to which the estimates are shrunk = .300
Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .007

Fleet : Research Gillnets

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3	0.24		2.88	-1.66									-2.02	-0.52	1.24	0.36	-2.42	1.41	-0.51	0.81	-0.09	0.66	0.13	-0.61
4	1.84		-1.53	0									-1.34	0.08	-0.07	-0.11	0.91	-0.89	0.03	0.24	0.43	0.36	-0.08	0.14
5	1.58		3.76	0.04									-0.77	-1.32	0.84	-1.34	-0.23	0.61	-0.9	-1.3	-0.29	-0.79	-0.09	0.21
6	1.85		-0.96	-0.13									-0.94	0.69	0.12	1.3	-0.34	0.53	0.68	-0.16	-0.57	-0.84	-1.22	-0.21
7	3.3		2.9	-0.88									-1.59	-0.1	0.41	-0.07	0.56	-0.39	-0.16	0.2	0.13	-1.87	-0.72	-1.74
8	3.53		1.53	-3.29									-0.87	-0.74	0.79	1.42	0.17	0.85	-0.45	-0.62	0.45	-0.97	-1.36	-0.43
9	2.04		0.98	-1.24									-0.22	0.67	-1.01	1.4	-1.19	0.38	1	-0.14	-0.5	-0.97	-0.36	-0.81

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.44	-7.03	-6.34	-6.59	-6.31	-6.26	-6.48	-6.48
S.E	1.4	0.86	1.34	0.87	1.47	1.56	1.02	1.97

Fleet : Acoustic Surveys

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3																	-0.25				0.79		-0.54	
4																	0.96				0		-0.96	
5																	-0.48				0.24		0.23	
6																	-0.94				0.17		0.77	
7																	0				0.68		-0.68	
8																	0				1.2		-1.2	
9																	0				0.32		-0.32	

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.92	-7.05	-7.76	-8.36	-7.02	-7.39	-6.71	-6.71
S.E	0.7	0.96	0.41	0.87	0.96	1.69	0.46	1.3

Table 30. Fishing mortalities, population numbers and biomass for St. Mary's Bay - Placentia Bay from extended survivors analysis.

Fishing mortality (F) at age

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE														
3	0.0125	0.0024	0.0107	0.0634	0.1448	0.2097	0.1978	0.0949	0.0914	0.126	0.3578	0.0604	0.0004	0.0002
4	0.0404	0.0165	0.1155	0.0049	0.0591	0.3859	0.2785	0.1005	0.1686	0.2062	0.0334	0.0688	0.0008	0.001
5	0.0072	0.0243	0.1356	0.1206	0.0099	0.0478	0.2931	0.1642	0.1205	0.3277	0.1665	0.0353	0.0062	0.0014
6	0.0121	0.0121	0.0762	0.1491	0.1566	0.1664	0.115	0.1911	0.1942	0.1302	0.309	0.0766	0.0032	0.0051
7	0.1189	0.0503	0.07	0.1355	0.164	0.2235	0.1276	0.0283	0.2098	0.3144	0.1063	0.1252	0.0057	0.0019
8	0.0509	0.0108	0.1782	0.0228	0.1727	0.0757	0.1325	0.2237	0.0772	0.4757	0.4237	0.0696	0.0068	0.0023
9	0.0464	0.0126	0.1097	0.0857	0.0427	0.1382	0.1418	0.1254	0.1636	0.0629	0.4044	0.1162	0.0127	0.0053
10	0.0521	0.0179	0.0912	0.0808	0.1234	0.1453	0.1284	0.1324	0.1781	0.2387	0.3354	0.1011	0.0076	0.0039
+gp	0.0521	0.0179	0.0912	0.0808	0.1234	0.1453	0.1284	0.1324	0.1781	0.2387	0.3354	0.1011	0.0076	0.0039
FBAR 5- 8	0.0473	0.0244	0.115	0.107	0.1258	0.1284	0.1671	0.1518	0.1504	0.312	0.2514	0.0767	0.0055	0.0027

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	FBAR 91-93
AGE											
3	0.001	0.0001	0.0002	0.0034	0.0002	0.0028	0.0057	0.001	0.012	0.0058	0.0063
4	0.0009	0.0025	0.0026	0.0004	0.0049	0.0017	0.0135	0.0135	0.0084	0.0108	0.0109
5	0.0218	0.0013	0.0032	0.011	0.0447	0.0003	0.0152	0.0141	0.0275	0.0163	0.0193
6	0.0035	0.0158	0.0016	0.006	0.0686	0.0082	0.005	0.0509	0.0254	0.0177	0.0313
7	0.0094	0.0109	0.0084	0.0033	0.0306	0.0165	0.0127	0.0049	0.0208	0.0162	0.014
8	0.0143	0.0116	0.0036	0.0103	0.0187	0.0109	0.0219	0.0591	0.0269	0.0352	0.0404
9	0.0029	0.0185	0.0048	0.0033	0.0228	0.0109	0.0179	0.0273	0.0513	0.0404	0.0397
10	0.0073	0.0177	0.0046	0.0059	0.0494	0.0089	0.0233	0.0441	0.0266	0.0499	0.0402
+gp	0.0073	0.0177	0.0046	0.0059	0.0494	0.0089	0.0233	0.0441	0.0266	0.0499	
FBAR 5- 8	0.0123	0.0099	0.0042	0.0077	0.0406	0.009	0.0137	0.0322	0.0252	0.0213	

Stock number at age (start of year) Numbers*10**-3

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE														
3	9702	252656	21436	5868	2295	13053	2408	17377	2215	6191	1220	3637	2755	34798
4	123640	7845	206353	17363	4509	1626	8666	1618	12939	1655	4469	698	2803	2255
5	9074	97216	6318	150511	14146	3480	905	5370	1198	8950	1103	3539	534	2293
6	6987	7376	77684	4517	109231	11468	2716	553	3731	869	5280	764	2797	434
7	6361	5652	5967	58938	3186	76466	7950	1982	374	2515	625	3174	580	2283
8	1471	4624	4400	4555	42141	2214	50066	5729	1578	248	1504	460	2292	472
9	1756	1144	3745	3014	3645	29029	1680	35903	3750	1196	126	806	351	1864
10	805	1372	925	2748	2265	2859	20698	1194	25930	2607	919	69	587	284
+gp	2322	5976	5091	4472	5917	10764	12439	21727	14736	24759	11441	5339	10116	11058
TOTAL	162118	383861	331919	251986	187335	150959	107528	91453	66450	48991	26687	18487	22816	55741

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	GMST 70-90	AMST 70-90
AGE													
3	9831	75702	6157	6110	7018	19122	22517	1134	4342	11829	0	9241	24860
4	28486	8041	61973	5040	4985	5745	15612	18331	928	3512	9946	7757	25063
5	1844	23301	6567	50610	4125	4062	4695	12611	14807	753	2936	5819	19040
6	1875	1477	19052	5359	40982	3229	3325	3786	10180	11795	626	4555	14748
7	354	1530	1191	15574	4362	31330	2622	2708	2946	8126	9804	3581	11096
8	1865	287	1239	967	12708	3463	25232	2120	2207	2362	6766	2648	7977
9	385	1505	232	1011	783	10212	2805	20211	1636	1759	1931	1753	4997
10	1518	315	1210	189	825	627	8270	2256	16101	1272	1430	1270	3629
+gp	6668	7851	7247	2078	3359	4255	6142	24241	40483	26611	21752		
TOTAL	52827	120008	104868	86937	79146	82044	91219	87398	93630	68019	55192		

Stock biomass at age (start of year) Tonnes

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
AGE														
3	1572	33856	3301	939	365	1997	392	2676	343	953	222	611	452	5707
4	24481	1326	39207	3612	960	341	2045	391	3105	401	1050	152	664	534
5	2096	21290	1447	33414	3239	846	226	1536	353	2622	342	1062	149	642
6	1879	1822	20042	1089	26434	2924	742	165	1175	285	1779	245	873	136
7	1813	1639	1659	16149	857	20799	2083	603	121	913	226	1130	202	797
8	453	1313	1294	1275	12221	635	14119	1776	521	97	589	171	860	177
9	551	340	1157	892	1119	8912	507	11417	1256	462	52	301	133	705
10	275	478	302	857	702	895	6727	386	9075	912	347	26	232	112
+gp	889	2205	1787	1592	2006	3714	4341	7626	5600	9681	5000	2237	4360	4766
TOTALBIO	34009	64269	70196	59818	47903	41063	31182	26576	21551	16327	9607	5934	7925	13575

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
AGE										
3	1740	10068	997	1118	1151	3117	3648	159	595	1538
4	6552	1697	13324	1119	1157	1270	3778	3886	177	664
5	485	5615	1721	13361	1077	1080	1282	3254	3583	162
6	564	417	5430	1576	11680	875	967	1053	2810	3149
7	121	483	367	4828	1330	9681	816	807	860	2373
8	690	95	463	329	4067	1136	8654	640	660	721
9	143	524	82	374	258	3503	1015	6690	515	557
10	568	121	473	72	289	218	3035	780	5330	420
+gp	2887	3227	3319	929	1408	1830	2494	8775	14655	9899
TOTALBIO	13751	22248	26176	23704	22415	22709	25689	26044	29185	19483

Table 31. Maximum observed biomass estimates for ages 3 to 10 (t) from extended survivors analyses, illustrative catch and biomass projections (t) for 1995 assuming F = 0.20, F = 0.10, and F = 0.00, projected egg production estimates for 1995 ($x10^{11}$) and critical egg production estimates ($x10^{11}$) to maximize recruitment for White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, and St.Mary's Bay - Placentia Bay. (1995 catch and biomass projections use 1993 weights at age, M = 0.20, geometric mean recruitment (1970-1990), and a historical partial recruitment pattern; 1995 egg production estimates are calculated using both geometric mean recruitment and recruitment estimates from acoustic surveys, where available).

	WB-NDB	BB-TB	SMB-PB
Maximum observed biomass	293000	253000	68000
1995 projected biomass	27700	19300	9700
Current TAC	13500	5000	1500
F=0.20 Catch	3700	2400	1100
F=0.10 Catch	1900	1200	600
Residual biomass at F=0.20	19300	13600	6900
at F=0.10	20900	14700	7400
at F=0.00	22700	15800	7900
1995 projected egg production			
- geometric mean recruitment	36	24	22
- acoustic survey recruitment	-	37	42
Critical egg production	66	45	48

Table 32. Estimated sizes the dominant yearclasses ($x10^6$) at age 3 calculated from extended survivors analyses, qualitative estimates of recent yearclasses from acoustic surveys, and research gillnet catch rates, spring spawners only, 1991-1994 (catch numbers per days fished) for White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, and St. Mary's Bay - Placentia Bay.

		WB-NDB	BB-TB	SMB-PB
Dominant yearclasses	1987	207	130	23
	1982	238	244	76
	1968	622	836	253
Recent yearclasses	1990	weak	weak	weak
	1991	weak	~=1987 yc	>1987 yc
	1992	????	weak	~=1987 yc
Res. GN catch rates	1991	1136	287	55
	1992	859	138	54
	1993	605	114	46
	1994	603	163	92

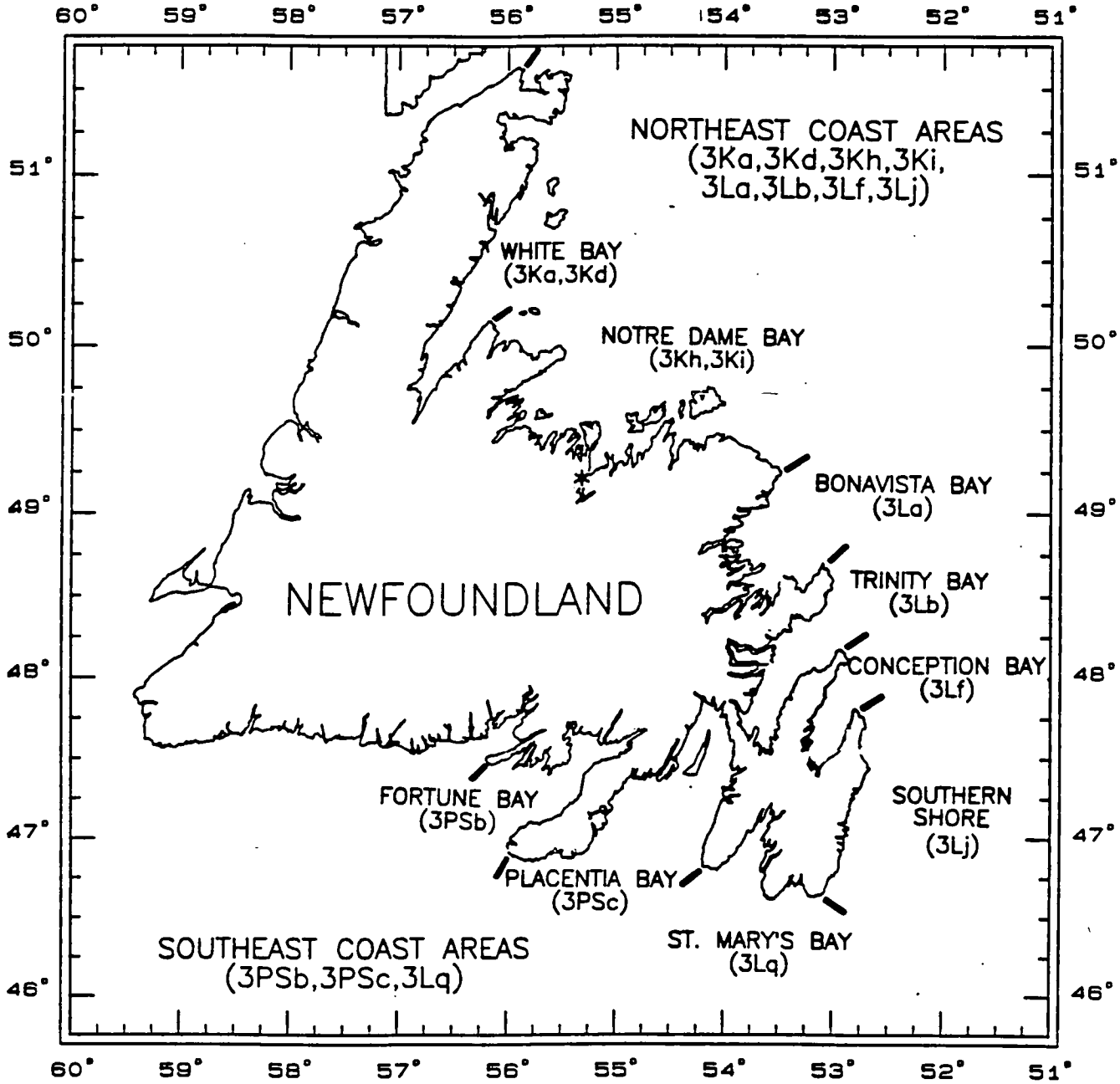


Fig. 1. Area map indicating herring stock complexes within the Newfoundland Region.

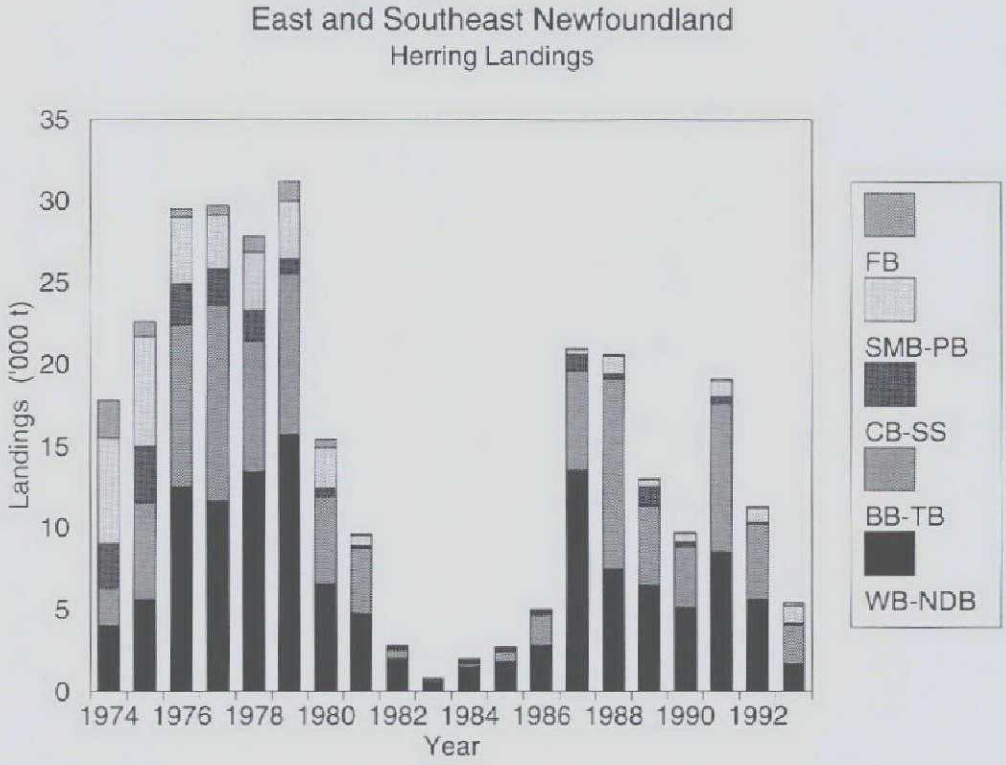


Fig. 2. East and southeast Newfoundland herring landings, 1974-93, for White Bay - Notre Dame Bay (WB-NDB), Bonavista Bay - Trinity Bay (BB-TB), Conception Bay - Southern Shore (CB-SS), St. Mary's Bay - Placentia Bay (SMB-PB), and Fortune Bay (FB).

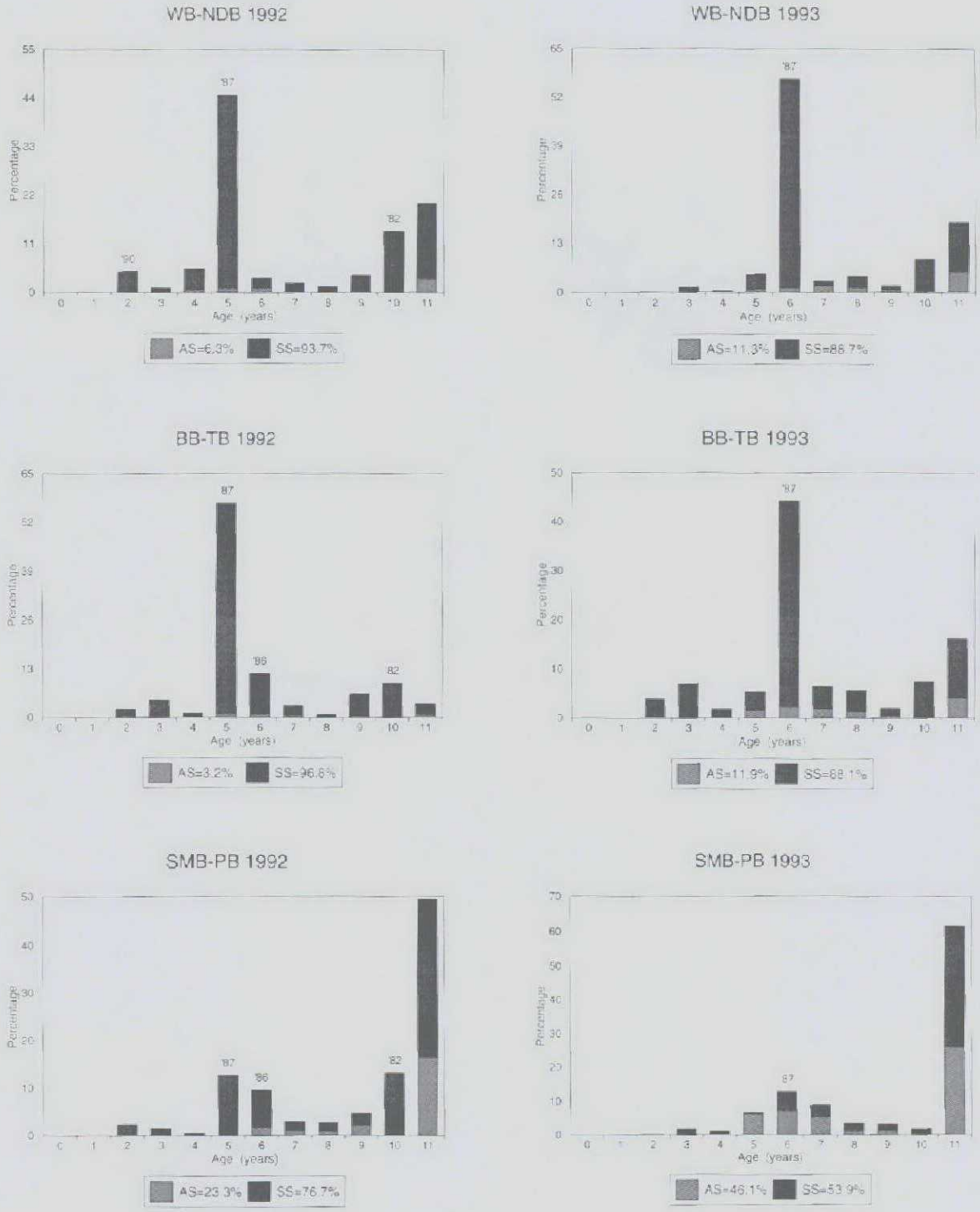


Fig. 3. Age distribution of herring from the commercial fishery, White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, and St. Mary's Bay - Placentia Bay, 1992 and 1993.

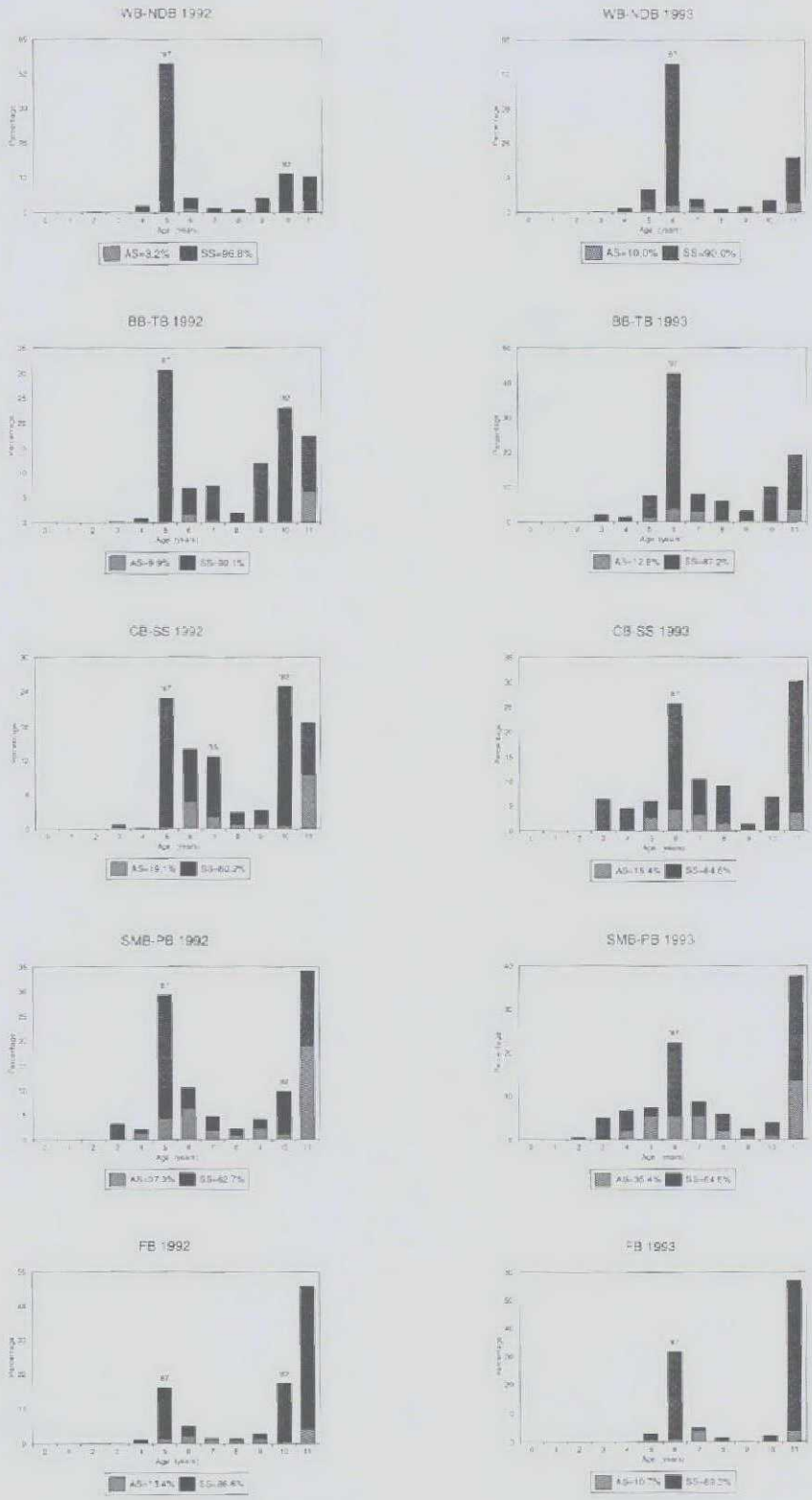


Fig. 4. Age distribution (by number) of herring from the spring reseach gillnet program, White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, and Conception Bay - Southern Shore, St. Mary's Bay - Placentia Bay, and Fortune Bay, 1992 and 1993.

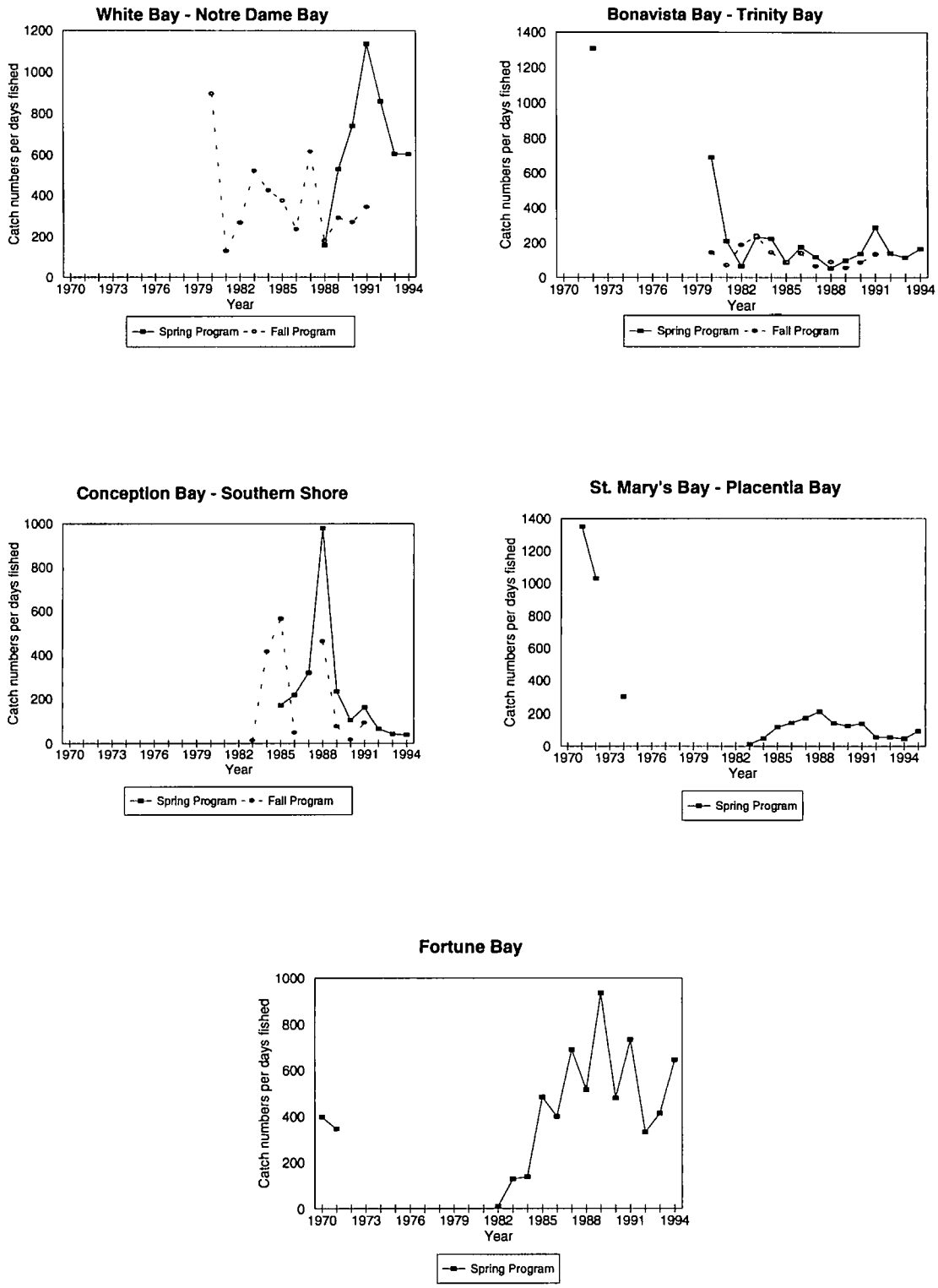
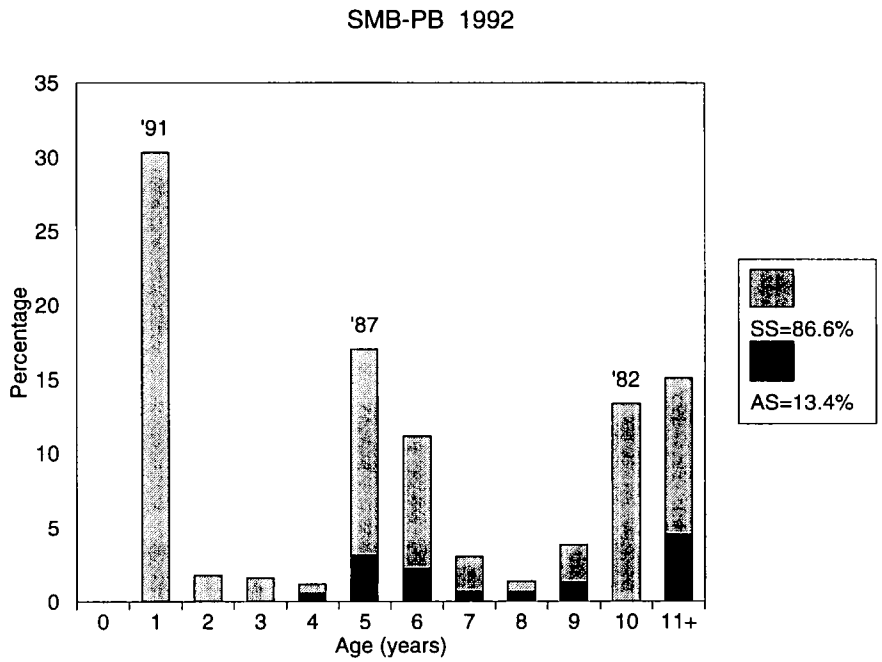


Fig. 5. Spring and fall research gillnet catch rates (numbers per days fished), spring spawners only, by stock area and year.



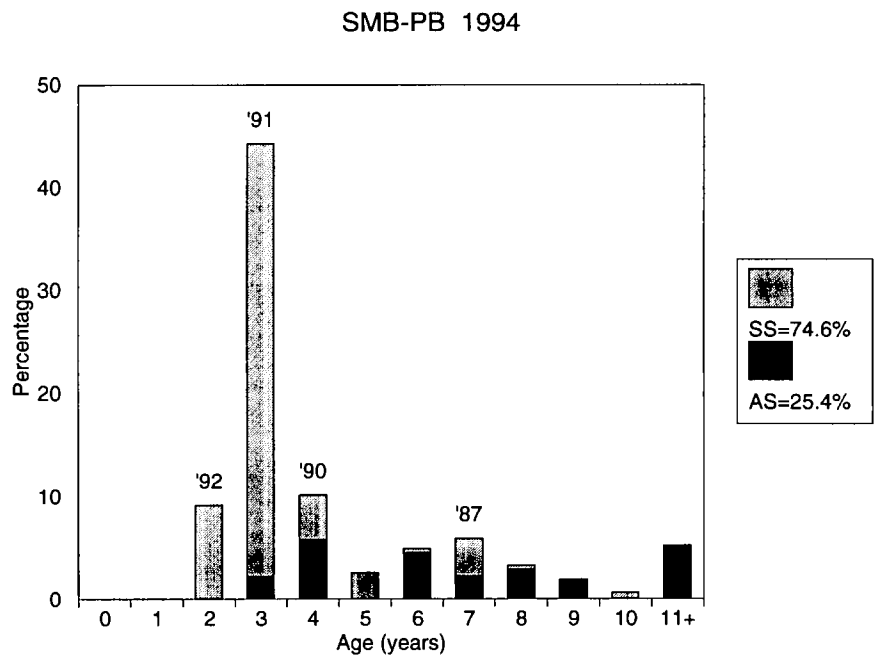
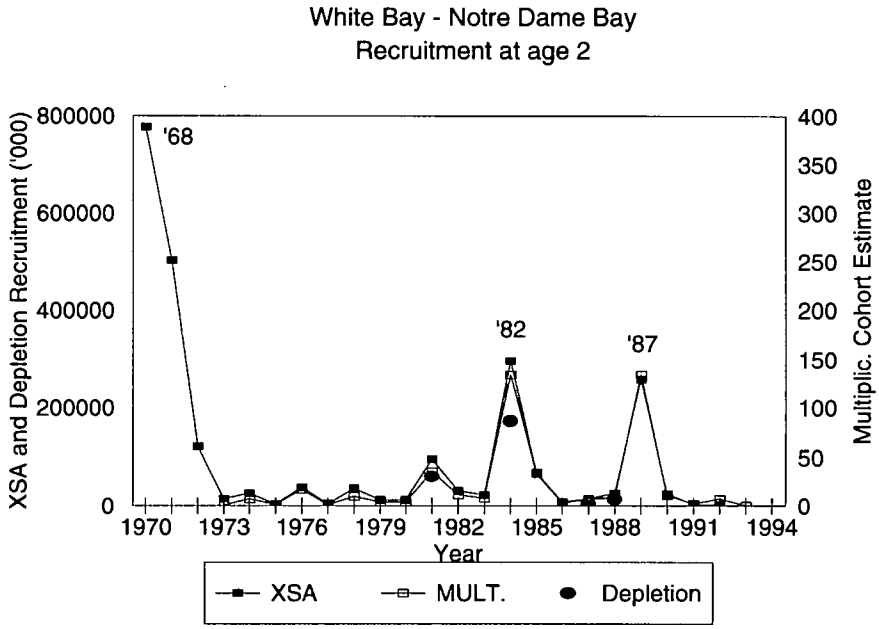


Fig. 6. Age distribution (by number) of herring from acoustic surveys of St. Mary's Bay - Placentia Bay, 1992 and 1994.

A



B

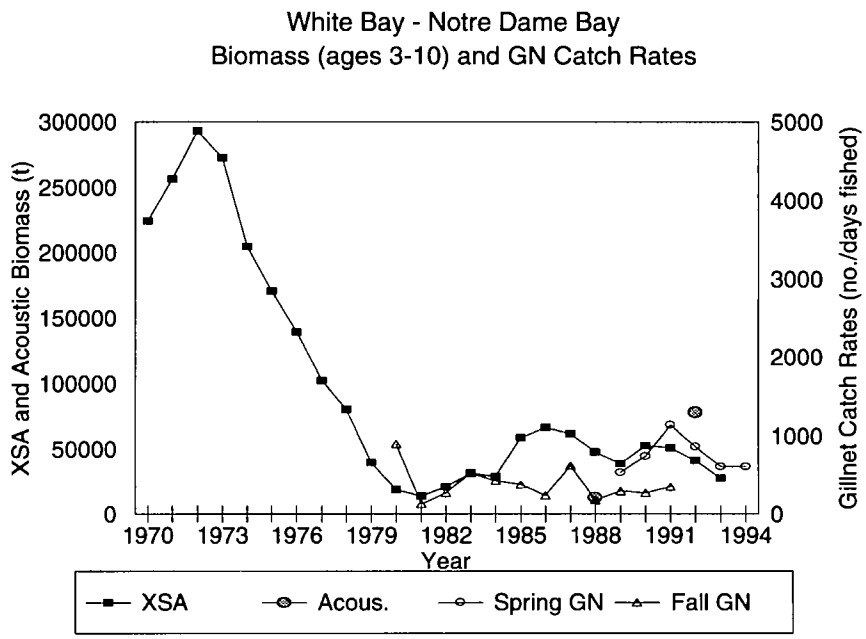
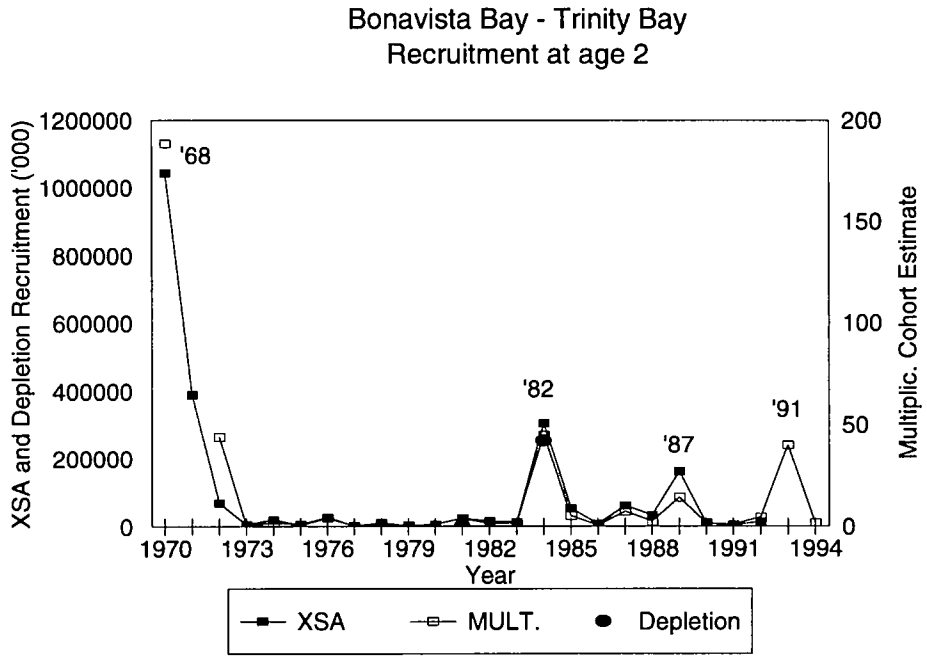


Fig. 7. Summary of abundance estimates for White Bay - Notre Dame Bay:
A) Recruitment estimates from extended survivors analysis, multiplicative model, and modified Leslie-DeLury depletion method.
B) Biomass estimates (ages 3-10) from extended survivors analysis and acoustic surveys, and research gillnet catch rates from spring and fall programs.

A



B

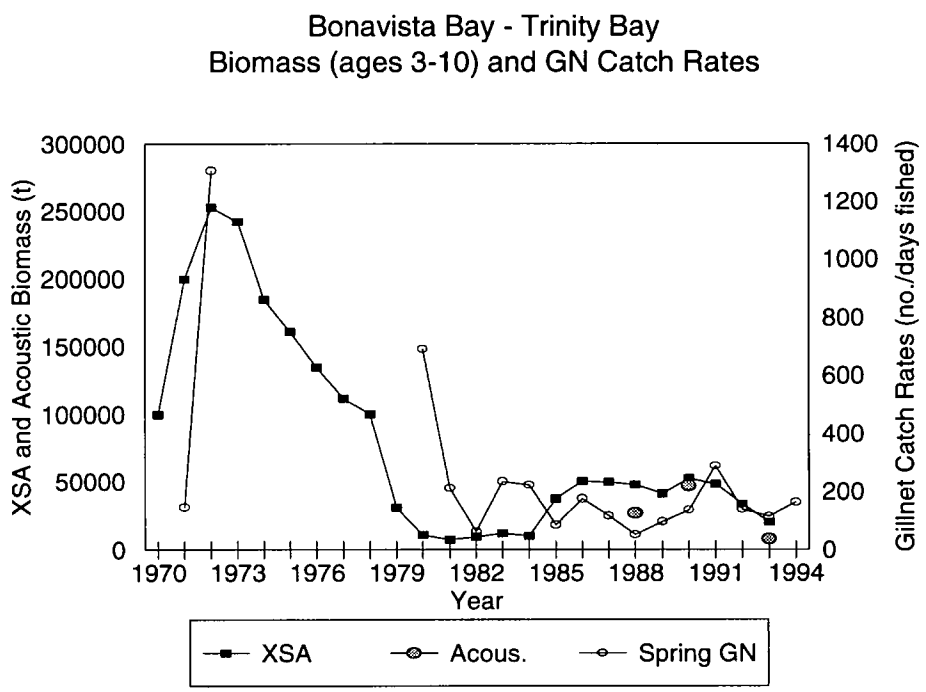
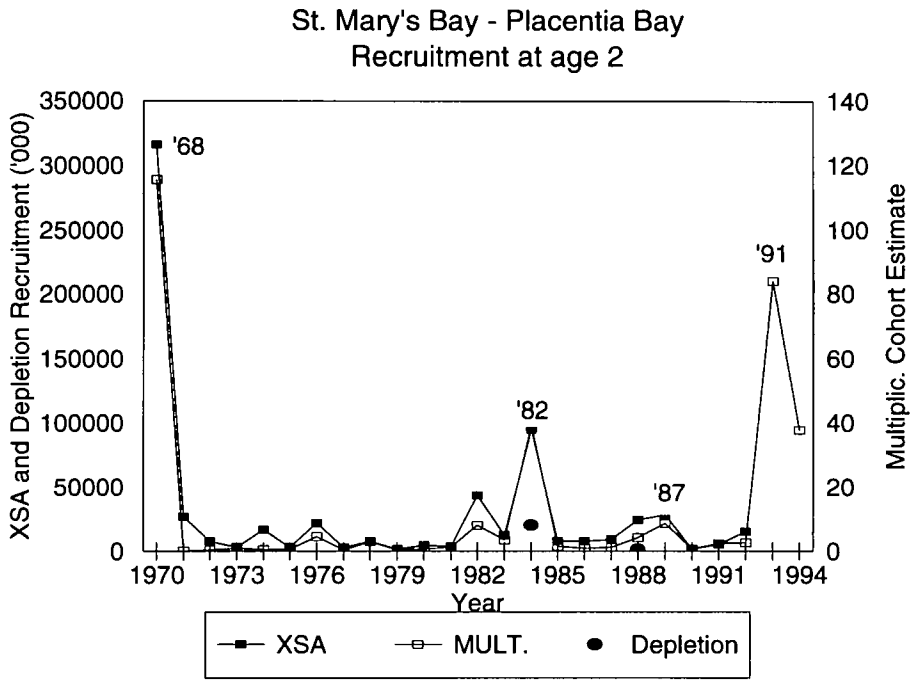


Fig. 8. Summary of abundance estimates for Bonavista Bay - Trinity Bay:
A) Recruitment estimates from extended survivors analysis, multiplicative model, and modified Leslie-DeLury depletion method.
B) Biomass estimates (ages 3-10) from extended survivors analysis and acoustic surveys, and research gillnet catch rates from the spring program.

A



B

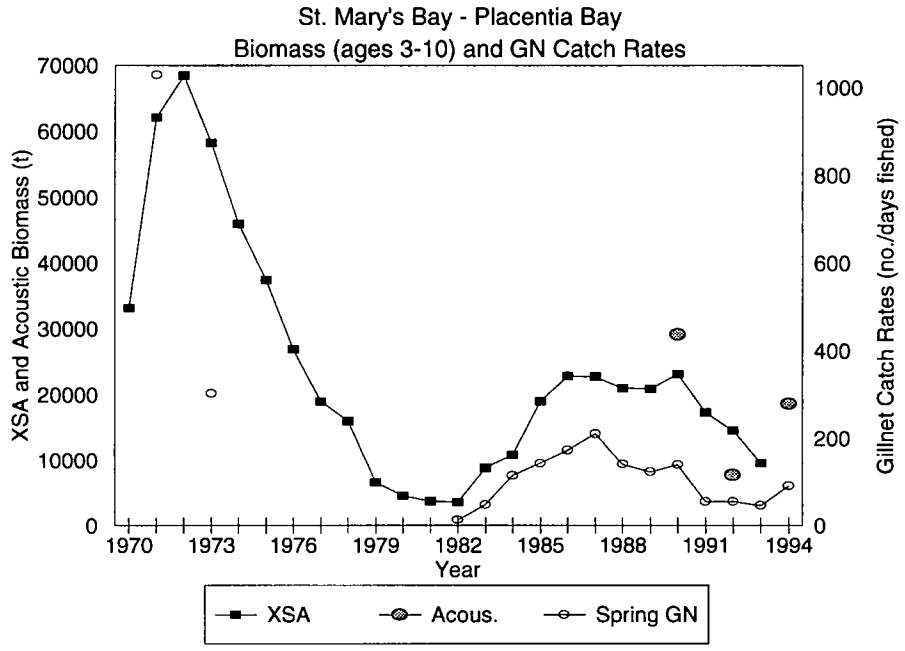


Figure 9. Summary of abundance estimates for St. Mary's Bay - Placentia Bay:
A) Recruitment estimates from extended survivors analysis, multiplicative model, and modified Leslie-DeLury method.
B) Biomass estimates (ages 3-10) from extended survivors analysis and acoustic surveys, and research gillnet catch rates from the spring program.

Appendix 1. Stock Status Report

East and Southeast Coast Newfoundland Herring

Background

The most recent assessment of these stocks was conducted during October - November, 1994 and incorporated detailed information from 1993 and preliminary data from 1994.

The Fishery

Figure 1 (see Fig. 2 in doc.)

Landings over the last five years have been controlled by available markets; TAC's have not been a limiting factor. During this time, annual landings have been between 6000 - 8000 t, with the exception of 1991, when landings increased to 17000 t due to a government subsidy program paid to fishermen and processors.

The most recent and complete information available is for 1993 when landings were approximately 6000 t. Most fish were landed in White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay during the fall purse seine fishery. There was little effort exerted in the fall purse seine fishery in these two northern areas due to the low price of herring. In White Bay - Notre Dame Bay, the purse seine fleet directed their efforts towards mackerel because of its higher value. Herring were taken when fish of the required market size were encountered. This was confounded by the presence of numerous concentrations of small fish, primarily 1991 yearclass. Similarly, in Bonavista Bay - Trinity Bay, there were comments by fishermen during the 1993 fall fishery of concentrations of small herring. The market preference in both areas was for large herring, greater than 300 g (age 9+); the combination of the presence of small fish and low prices reduced the fishing effort in Bonavista Bay - Trinity Bay. There was also a limited winter purse seine fishery in St. Mary's Bay - Placentia Bay. The fisheries in the remaining two areas, Conception Bay - Southern Shore and Fortune Bay were negligible (<300 t) and were spring gillnet fisheries for bait only.

Initial reports from the 1994 fall fishery in White Bay indicated the continued presence of small fish (1991 yearclass) and the general absence of larger marketable herring. In Notre Dame Bay, there was very limited effort as there were few if any concentrations of mackerel and hence very little effort directed towards herring. The herring that were found were too small for the markets, ie. 1991 yearclass. The fishery in Notre Dame Bay was closed in mid-November at the request of fishermen due to the lack of marketable herring. In Bonavista Bay, the fall purse seine quota of approximately 500 t was taken by ten to twelve vessels in approximately ten days. Most of the fish were caught in one area (near Burnside) and were in excess of 300 g. There were no reports of small fish confounding this fishery. There were reports of a mixture of small herring with larger marketable herring during the winter purse seine fishery in Placentia Bay.

Environmental Considerations

Most herring from east and southeast Newfoundland herring stocks are spring spawners. Due to colder oceanographic conditions in recent years, spawning was delayed in 1991, 1992 and 1993. There were no reports of delayed spawning in 1994. Cold environmental conditions have also affected herring growth rates; mean weights at age have declined through the 1990's.

Predators

From data for 1990-1993, herring represented approximately 10% of the wet weight in age 1+ harp seal stomachs and were the second most important prey species after Arctic cod. These herring ranged in length from 20-30 cm (approximately ages 2 to 4). Herring did not occur in the diet of harp seal pups or in the adult diet in offshore areas. There are indications that herring account for approximately 3% of the energy requirements of harp seals in Div. 3KL.

Herring also account for approximately 10% of the wet weight in the diet of hooded seals while they are in the inshore areas of Div. 3KL. However, hooded seals occur inshore only in the late winter and early spring and their distribution is dependent on the occurrence of inshore pack ice.

The impacts of seal predation on herring cannot yet be quantified but may be possible when a seal consumption model is available.

Assessment Data Sources

Commercial Fishery Catch at Age

In 1993, as in 1992, the 1987 yearclass accounted for greater than 40% (by number) of the commercial landings in the two northern areas, White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay. There was a relative absence of other yearclasses in the fishery. Fish aged 11+ (primarily 1982 yearclass) accounted for less than 20% of the landings.

In St. Mary's Bay - Placentia Bay, the only other area with a commercial fishery, fish aged 11+ continued to dominate in 1993, as in 1992, representing approximately 60% of the landings. The 1987 yearclass accounted for only 10% of the landings.

Acoustic Surveys Figure 2 (see Fig. 6 in doc.)

The results of a January 1994 acoustic survey of St. Mary's Bay - Placentia Bay indicated a biomass of 43900 t. This biomass estimate was derived from three concentrations of herring, all in Placentia Bay. The 1991 yearclass was dominant in this estimate, accounting for 30% of the biomass. Fish aged 11+ represented approximately 25% of the biomass. It should be noted that biological sampling from the acoustic surveys tend to overestimate younger age groups.

Results from a fall (November - December 1994) acoustic survey of White Bay - Notre Dame Bay have not yet been analysed but initial indications suggest a continued decline in abundance.

An acoustic survey of Fortune Bay has just been completed (January 1995). Results are not yet available.

Population estimates from acoustic surveys conducted from 1983 to 1994 in White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, and St. Mary's Bay - Placentia Bay indicate that for the two northern areas, population estimates peaked in the mid 1980's and have declined since then. For St. Mary's Bay - Placentia Bay, three of four acoustic survey estimates indicate stability in population levels.

Research Gillnet Program

Figure 3 (see Table 20 in doc.)

The research gillnet program was initiated in the Newfoundland Region in 1980 to derive an abundance index independent of the commercial fishery. Commercial fishermen in each of the five stock areas are provided with a fleet of five standardized gillnets, mesh sizes 2"-3". They are contracted to fish these nets for a period of one month each year, to maintain an accurate daily log record of their catches, and to collect samples of their catch at specified intervals.

A total of 25 commercial fishermen participated in the spring research gillnet program in 1993 and 1994.

Age distributions, by number, from 1993 showed the continued dominance of the 1987 yearclass in the two northern areas. The percentage of older fish (ages 7+) was less in these areas than in the three southern areas. There was no evidence of the 1988-1990 yearclasses in any of the areas. More recent yearclasses would not be recruited to the research gillnets.

Mean catch rates decreased from 1992 to 1993 in four of the five stock areas, similar to the declining trend in catch rates in most areas since the late 1980's. However, 1994 catch rates have increased in Bonavista Bay - Trinity Bay, St. Mary's Bay - Placentia Bay, and Fortune Bay and have remained stable in White Bay - Notre Dame Bay and Conception Bay - Southern Shore. There is evidence in all areas from catch rates at ages 4 and 5, that the 1987 yearclass is much smaller than the 1982 yearclass. In addition, comparison of research gillnet catch rates for two stock areas during the early 1970's, indicates that the 1982 yearclass is also much smaller than the very large 1968 yearclass.

Stock Status

Tables 1-2 (see Tbles 31-32 in doc.)
Figures 4-6 (see Figs.7-9 in doc.)

In the most recent assessment, an extended survivors analysis, tuned with research gillnet catch rates and acoustic survey population estimates, was used to estimate stock sizes for the period 1970 - 1993 for the three stocks where there are commercial fisheries, White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, and St. Mary's Bay - Placentia Bay.

For these stocks, the 1995 population estimates are projected to be approximately 10% of maximum observed levels for White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay . The St. Mary's Bay - Placentia Bay stock is relatively less depressed. For all areas, the 1987 yearclass, upon which the fishery is currently dependent, is smaller than the 1982 yearclass, which itself is only of moderate strength in relation to the large 1968 yearclass. Projections of egg production in 1995 are low and are below the levels necessary to ensure maximum recruitment to the stocks. There is also no evidence of strong recruitment of recent (1990-1992) yearclasses. A commercial fishery in 1995, even at low levels of F (0.10), could further reduce stock sizes.

Although neither the Conception Bay - Southern Shore nor the Fortune Bay stock were examined in detail, parallelism in yearclass strength has been exhibited in the past. Therefore, it is expected that similar conclusions would apply for Conception Bay - Southern Shore. As exploitation levels have been extremely low in Fortune Bay in recent years, this stock should be relatively less depressed.

The current analysis of stock status has quantified the previous assessments, which indicated that these herring stocks were in gradual decline because of poor recruitment. The current perception is due to the integration of research gillnet catch rate data and acoustic survey population estimates into an analytical assessment which provides estimates of current population sizes in relation to those during the 1970's when stock sizes were much larger. It should be noted that the extended survivors analysis relies on catch at age data derived from the commercial fishery and that misreporting of landings would affect the results.

Conservation Concerns

The spawning biomass for the three stocks examined in detail is at or below the level necessary to ensure maximum recruitment given favourable environmental conditions. This is a conservation concern and from a biological viewpoint, warrants consideration of closure of these fisheries.

In 1994, there were requests from industry to consider reducing the minimum legal size of herring for the commercial fishery (presently set at 26.7 cm) in order to exploit some of the smaller herring that were available. The present minimum legal size represents the length at which approximately 50% of herring are mature. Due to the steep slope of the maturity ogive, even a reduction of 0.5 cm in the minimum size would have a serious impact on the number of herring available to spawn. Given the current state of the various herring stocks, a reduction in the minimum legal size should not be considered.

Appendix 2. Memorandum from Chair of the Newfoundland east and southeast coast herring stock assessment meeting to the Regional Director, Science re. results of the meeting and research recommendations, and a list of participants at the assessment meetings.

To / À
L. W. Coady
Regional Director, Science

From / De
D. G. Parsons
Chair, Newfoundland East and Southeast
Herring Stock Assessment Meeting

Security Classification - Classification de sécurité
Our File - Notre référence
Your File - Votre référence
Date November 7, 1994

Subject / Objet

Regional Review of the Status of East and Southeast Coast Newfoundland Herring

Attached for your information and immediate roll-up is the stock status report of regional herring assessments which were conducted during a series of meetings held at NAFC on October 4, 17, November 2 and 3, 1994. A composite list of participants from the four meetings is also attached. There was no participation from either Freshwater or Groundfish assessment scientists.

This represents the final step in the process to provide managers with information on the status of these herring resources prior to the formulation of management plans for 1995. Please note that the information is urgently needed and must be forwarded to Mr. Dunne and Biological Sciences Directorate in Ottawa as soon as possible.

Details of the assessment, including the treatment of contentious issues, will be available in a DFO Atlantic Fisheries Research Document to be compiled by J. Wheeler. The attached stock status report includes sections on environmental and multispecies considerations and incorporates input from fishermen both directly, through the research gillnet program, and indirectly, through anecdotal information. Contributions from the CODE both in data analyses and review were significant: several new approaches were introduced and will be pursued further in future assessments.

The meeting produced interesting discussions and resulted in several recommendations for future research which are listed below for reference in the next round of PRE discussions and subsequent work plans.

1. The extended survivor analysis (XSA) requires further evaluation regarding its treatment of the 11+ ages, the assumption of constant catchability over all ages and the implications of lack of convergence.

2. The herring acoustic survey methodology should be examined to determine the most appropriate design for the fall surveys of the northeast coast stocks and winter surveys of southern stocks.

3. The modified Leslie-DeLury depletion method should be evaluated further to examine year-class size.

4. All available multispecies data, including those from seabirds, should be compiled and included for review in the next assessment.

There was general agreement that the lack of a structured, regional, assessment process resulted in much uncertainty regarding definition of objectives, provision of advice and format for reporting. To date, no direction or attention has been given to the regional assessment process other than that initiated by those responsible for meeting existing requirements. Participants stressed that inaction by the Regional Director of Science to coordinate, formalize and implement a regional process is unsatisfactory and negatively impacts the most important service provided by Science Branch.

D. G. Parsons

List of participants

Name	Affiliation
Baird, J.	FHM/RMD
Campbell, S.	NCSP
Carscadden, J.	PSMM
Chaulk, R.	"
Coombs, R.	FF&A (Prov.)
Dawson, F.	PSMM
Hoenig, J.	CODE
Kriest, I.	Kiel Univ.
Knight, L.	FHM/RMD
Lilly, G.	Fish. Ecol.
Miller, D.	PSMM
Myers, R.	CODE
Nakashima, B.	PSMM
Narayanan, S.	Phys. Ocean.
Parsons, D. (Chair)	PSMM
Russell, R.	FHM/RMD
Shelton, P.	CODE
Stenson, G.	PSMM
Wheeler, J.	PSMM
Winters, G.	PSMM