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Newfoundland East and Southeast Coast Herring - An Assessment of Stocks to the Spring of 1995

by

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Abstract

Results of the analysis of data from 1994 and the spring of 1995 are presented for five herring stock complexes assessed within the Newfoundland region. Commercial landings in 1994 were unchanged from 1993 at approximately 5500 t. The 1987 yearclass of spring spawners continued as the dominant yearclass in the commercial fishery in the northern areas, while in the south, the 1982 yearclass of spring spawners was dominant. As in the last assessment, stock abundances were estimated using an extended survivors analysis. Yearclass strengths were estimated using a multiplicative model and a stock-recruit relationship. A stock status classification system was also developed which links exploitation rates to recruitment estimates at given spawning stock levels. All of these herring stocks are at relatively low levels. There is no evidence of strong recruitment of yearclasses produced in the 1990's and it is therefore unlikely that biomass levels will increase significantly within the next few years.

RÉSUMÉ

Sont présentés les résultats de l'analyse des données de 1994 et du printemps 1995 sur cinq stocks de hareng de la région de Terre-Neuve. Les débarquements de la pêche commerciale de 1994 d'environ 5 500 se comparaient à ceux de 1993. La classe d'âge de reproducteurs de printemps de 1987 a continué d'être la plus importante dans les prises commerciales réalisées dans le nord, tandis que la classe d'âge de 1982 l'était dans le sud. On a estimé l'abondance des stocks par une analyse étendue des survivants, comme dans la dernière évaluation, et l'abondance des classes d'âge par un modèle multiplicatif et une relation stock-recrues. On a en outre développé un système de classification de l'état des stocks, qui établit un lien entre les taux d'exploitation et les estimations du recrutement à une abondance donnée de reproducteurs. Les effectifs de tous ces stocks de hareng sont relativement faibles. Comme il n'y a aucun signe d'un recrutement marqué des classes d'âge des années 90, il est peu probable que la biomasse augmentera de façon significative au cours des prochaines années.

Introduction

This report contains information on the Atlantic herring stocks along the east and southeast coasts of Newfoundland, including the stock 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). The stock status was assessed for all areas except Conception Bay - Southern Shore, where there was insufficient data available to calculate stock biomass.

The review of these stocks was conducted regionally in St. John's by personnel from the Department of Fisheries and Oceans, Memorial University of Newfoundland, and the Fisheries Association of Newfoundland and Labrador. The review was conducted during three meetings in October, 1995 in order to have the most current information on the status of these stocks available for inclusion in the Newfoundland Herring Management Plan for 1996.

Prior to the assessment meetings, meetings were held in September and October of a Herring Working Group (Eastern Newfoundland) of the Small Pelagics Advisory Committee. This Working Group consists of members from Science Branch, Fisheries Management Branch, the Provincial Department of Fisheries, Food and Agriculture, the Fisherman, Food, and Allied Workers Union, the Fisheries Association of Newfoundland and Labrador, the Newfoundland and Labrador Fisheries Co-ops, and the Independent Fish Processors Association. The mandate of this Working Group is to examine science and resource management issues, and provide to the Small Pelagics Advisory Committee recommendations on solutions or courses of action to address such issues and concerns. As one of it's first initiatives, the Working Group developed a stock status classification system which links exploitation rates to recruitment estimates at given spawning stock levels. This was a joint industry and departmental initiative to provide a more flexible and better approach to management of these fisheries, providing a mechanism to reduce fishing mortalities at low stock levels without fishery closure. The stock status classification system was discussed, in detail, at the regional herring assessment meetings and incorporated in the draft 1995 Stock Status Report.

As in recent years, three primary data sources were 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. There was also consideration given to the interaction between species in the environment, specifically to the impact of seal, cod, and seabird predation on herring. The effect of environmental conditions was also considered, in particular the effect of overwintering temperatures and salinities on the survival success of herring yearclasses.

This document outlines the steps taken to assess these herring stocks in 1995. As in previous assessments, only the spring spawning component of these stocks is considered, as the stocks consist predominantly of spring spawners and it is this component which is targeted by the commercial fishery. Background information on the 1994 commercial fishery and age distributions by stock area from the fishery is provided. The effects that both the environment and predators have on the survival of herring are also examined. The 1994 results from the research gillnet program are presented, including age distributions and catch rates at age by stock area. Catch rates only from the 1995 research gillnet program are also presented.

Results of acoustic surveys conducted in the fall of 1994 and the winter of 1995 are presented. Estimates of stock abundance and yearclass strengths are presented for each of the four assessed stock areas. Information is provided on the development of the stock status classification system. The paper concludes with a summary of the status of each of the stocks in relation to the stock status classification system. The assessment review proceedings, including a list of research recommendations, and a list of assessment review participants are included in appendices.

The 1994 Commercial Fishery and Catch at Age

Landings in 1994 (Table 1, Fig. 2), were unchanged from 1993 at approximately 5500 t. Similar to recent years, most fish (75%) from the east and southeast coast stocks were taken 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 the fishery in these two northern areas due to the low price of herring. There was also 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).

There were 1724 herring sampled from the 1994 commercial fisheries. When apportioned by stock area, month and gear type (Table 7), samples were available for 86% of the commercial catch.

As in 1993, the 1987 yearclass dominated (>40%) the fishery (by number) in the two northern areas, White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay (Tables 8 and 9, Fig. 3). Older fish, aged 11+, accounted for approximately 10-20% of the catch in each of these areas. The catch was also dominated by spring spawners (95%) in both areas. In St. Mary's Bay - Placentia Bay (Table 11, Fig. 3), fish aged 11+ accounted for >50% of the catch (by number). The 1987 yearclass accounted for only 13% of the catch. Unlike in the north where spring spawners predominated, in this area they accounted for only 54% of the catch.

With the exception of the 1990 yearclass, which was caught primarily in the White Bay portion of the White Bay - Notre Dame Bay stock complex, there was no evidence of recruitment of younger yearclasses to the fishery in any of the areas.

Predatory and Environmental Factors

In the last assessment of these stocks (Wheeler et al. 1995), the effects of predation on herring was first examined, specifically in relation to the diet of seals. In this assessment, further information was available on the effects of seal predation on herring. Information was also available on the diet of gannets and, to a lesser extent, on the diet of cod.

As anticipated in the last assessment, a seal consumption model was completed within the past year (Stenson et al. 1995). The seal consumption data indicated that herring are important in the diet of harp seals in the near shore areas along the northeast coast of

Newfoundland during the April - June period but are not important when seals are in offshore waters. However, it has not yet been determined what percentage of the seal's energy requirements are derived in the near shore areas. This is the focus of research currently underway. Until this is resolved, it is not possible to quantify the impacts of harp seal predation on these herring stocks.

Of the various species of seabirds in coastal Newfoundland waters, gannets are the most important predator of herring. Gannet feeding studies have been conducted on Funk Island (Montevecchi and Myers 1995) off the northeast coast of Newfoundland each summer (August) since 1977. Results from these studies indicate that mackerel are the preferred food for gannets during late summer while herring, and other species, are taken when mackerel are not available. For example, in 1982, herring formed a large component of the gannet's diet in a year when mackerel didn't migrate into coastal waters along the northeast coast. However, in recent years when mackerel have not been available, gannets have depended upon capelin rather than herring. In these studies, observations were made during one month of the year; if the study was conducted during the spring when herring are abundant in near shore waters prior to spawning, conclusions may have been different. Although consumption estimates of herring by gannets are not available, the impact of their predation on herring stocks is not thought to be significant. For next year's assessment, it is hoped to be able to assess the size and age classes of herring taken by gannets.

Although herring are reported to be preyed upon by cod in most areas throughout their range (Scott and Scott 1988), little published information is available for the Newfoundland area. There is an extensive time series of cod feeding data from offshore Newfoundland waters. Herring is seldom found in the stomachs of these cod and is not an important component of their diet (Lilly 1991). However, there is no specific time series of cod feeding data from inshore Newfoundland waters. There are specific inshore cod feeding data sets from selected areas and years which should be examined more thoroughly to document incidents of herring predation. An inshore sentinel fishery program, which commenced in 1995, may also provide valuable information on cod feeding habits.

The cold oceanographic conditions in recent years continued to affect the growth of herring in 1994 (Table 13). Smaller mean weights at age, evident through the early 1990's, were again observed in 1994.

Research Gillnet Program Results

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 spring, 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.

Although there were general trends in the relative abundance of yearclasses between

stock areas in 1994, there were also some distinct differences (Fig. 4). In White Bay - Notre Dame Bay, the 1990 yearclass dominated the catch (by number) followed closely by the 1987 yearclass. However, as in the commercial catch, the 1990 yearclass was more abundant in the White Bay portion of the stock area. In Bonavista Bay - Trinity Bay, the 1987 yearclass dominated in the catch, followed by fish aged 11+. In the three southern areas, fish aged 11+ continued to dominate the catch as in the previous two years. The 1990 yearclass recruited to research gillnets in all areas in 1994 and accounted for greater than 10% of the catch numbers in four of the five areas. The 1991 yearclass was also evident in St. Mary's Bay - Placentia Bay. Yearclasses are normally recruited to the research gillnets at age three; the delay in the recruitment of the 1990 yearclass until age four may be due to the reduced growth rates during the 1990's.

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 and Fig. 5. Catch rates only are available for 1995 as the 1995 research gillnet biological samples were not processed in time for inclusion in this document. Catch rates in White Bay - Notre Dame Bay were stable from 1994 to 1995 but have declined from the peak in 1991. Catch rates increased in White Bay portion of the stock area with the recruitment of the 1990 yearclass, but declined in Notre Dame Bay. In Bonavista Bay - Trinity Bay, catch rates declined in 1995, continuing the general trend since 1991. Catch rates are also low in relation to historical catch rates in the 1970's. In Conception Bay - Southern Shore, 1995 catch rates increased substantially from 1994. However, there was only one fisher in the area in 1995 compared to three in most years; this may have affected the trend for the area. In St. Mary's Bay - Placentia Bay, catch rates declined in 1995, continuing a general trend since 1988. Catch rates in this area are also low in relation to catch rates in the 1970's. Catch rates in Fortune Bay increased slightly in 1995, continuing a three year trend. Catch rates in this area are the highest of all of the stock areas and are good in relation to historical catch rates in the 1970's.

1994 Fall and 1995 Winter Acoustic Survey Results

Results were available from an acoustic survey of White Bay - Notre Dame Bay conducted in November - December, 1994 and from a survey of Fortune Bay conducted in January 1995.

Survey design was modified from previous surveys (Wheeler et. al. 1989). For the White Bay - Notre Dame Bay survey, the stock area was divided into low, medium and high density strata based upon distributional information from previous surveys. Sampling intensity (total transect length) was allocated on a 2:6:11 ratio for the low, medium and high density strata respectively, based upon stratum area. For the Fortune Bay survey, headland, low, medium and high density strata were defined with respective sampling ratios of 1:2:6:11. For both surveys, the survey design within each stratum consisted of a series of equidistant parallel transects from the coastline to the 120 m depth contour. The placement of the first transect within each stratum was chosen randomly along a reference line drawn parallel to the coastline. Due to the irregular nature of the coastline, transects within strata were of unequal length. The transects were surveyed at a vessel speed of 5.5 to 6.0 knots. Transect lengths were measured using the vessel's GPS.

Due to weather conditions and operational constraints, coverage during the fall survey was limited to the Notre Dame Bay portion of the White Bay - Notre Dame Bay stock area. The biomass estimated from this survey must therefore be considered as a minimum estimate and is not directly comparable with prior survey results.

Both surveys were conducted from the *R.V. Marinus*, equipped with a herring purse seine (150 fathoms by 30 fathoms) for biological sampling. Biological sampling was adequate during the surveys to calculate biomass estimates. During the fall survey, biological samples were supplemented with samples from the commercial purse seine fishery in Notre Dame Bay.

The echo integrator and transducer used during the surveys were calibrated by BioSonics Inc. in June, 1994. In addition, the dual beam processor, used to calculate in situ target strengths, was calibrated with a standard sphere on several occasions during each of the surveys. 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)		216.6
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

The herring target strength - fish length relationship calculated from the 1993 Holyrood target strength experiments (Wheeler et al. 1994) was used to calculate biomass. Formulas used to calculate mean densities, variances, and biomass estimates remain unchanged from previous surveys and are given in Wheeler et al. (1989).

For the fall survey of Notre Dame Bay, integrated density estimates were calculated for the 83 transects surveyed. Herring were detected in five strata (Table 19); the biomass estimate from the survey was 2200 t. The 1990 yearclass was dominant followed closely by the 1987 yearclass (Table 21). For the winter survey of Fortune Bay, integrated density estimates were calculated for the 177 transects surveyed. Herring were detected in three strata (Table 20); the biomass estimate from the survey was 2800 t. The 1992 yearclass was dominant followed by the 1990 yearclass (Table 21).

Estimation of Stock Size

As in the last assessment of these stocks (Wheeler et al. 1995), stock sizes were estimated using an extended survivors analysis (Pope and Shepherd 1982). The commercial

catch at age matrices of spring spawning herring were changed from last year; each was extended to include the 1966 to 1969 catches (Tables 8 -12). The expanded catch matrices were used in the extended survivors analysis (XSA) to provide a greater historical perspective for each of the stocks at a time of high abundance in the 1960's. Yearclass strengths from the XSA were compared to those estimated from a multiplicative model and a stock-recruit model (Winters and Wheeler 1987).

The XSA was used to estimate stock sizes because it 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, St. Mary's Bay - Placentia Bay, and Fortune 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, and for Fortune Bay, a standard error of 0.245 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 22 - 29. In the last assessment of these stocks, there was a problem identified with the XSA's during the assessment review dealing with the treatment of the plus age groups (ie. ages 11+). The estimates for the plus age groups in some years were biased since the fishing mortalities on the oldest ages were 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 this year. In this assessment, the problem was addressed by applying the maximum fishing mortality at age (F) for the particular year to the plus age groups and recalculating the numbers and biomass of the plus group. This was considered to be a conservative approach to estimating the plus age groups.

For all of the stocks examined (Figs. 6 - 9), the XSA showed similar trends to last year 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. The inclusion of the 1966 to 1969 catch data showed that biomass levels were high before the recruitment of the large yearclasses in the 1960's, in the order of 100000 t to 200000 t for White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay and 20000 t to 40000 t for St. Mary's Bay - Placentia Bay and Fortune Bay.

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 30 - 33). For all four 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 recent yearclasses to the large yearclasses of the 1960's. The results of the model with the addition of the 1994 data point were consistent with those presented in the last assessment (Wheeler et al. 1995). For White Bay - Notre Dame Bay (Fig. 6), the model showed the 1982 and 1987 yearclasses to be of comparable strength but both much smaller than yearclasses from the 1960's. For Bonavista Bay - Trinity Bay (Fig. 7), the 1982 yearclass was estimated to be larger than the 1987 yearclass and both were estimated to be smaller than the 1968 yearclass. The 1991 yearclass, which in the last assessment was estimated to be of comparable size to the 1982 yearclass, is now estimated to be much smaller. For St. Mary's Bay - Placentia Bay (Fig. 8), the 1982 yearclass was estimated to be much larger than the 1987 yearclass but both were also smaller than either the 1966 or 1968 yearclasses. As was the case last year, the 1991 and 1992 yearclasses were both estimated to be equal to the 1982 yearclass. For Fortune Bay (Fig. 9), the 1982 yearclass was estimated to be approximately twice the strength of the 1987 yearclass and of similar strength to the 1966 and 1968 yearclasses. The 1990 yearclass was of similar strength to the 1987 yearclass and the 1992 yearclass was comparable to the 1982 yearclass. With the exception of Fortune Bay, yearclasses produced in the 1980's and 1990's have been smaller than those of the 1960's and consequently current stock sizes are smaller than in the 1960's.

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). In this publication, an environmentally dependent Ricker stock-recruit model was used to estimate threshold egg production levels for each of the stock areas. The derived relationships from the original publication were updated in this assessment to include an additional ten data points (1977 to 1986 yearclasses) and threshold levels were expressed as stock specific mature (5+) biomass (Tables 34 - 36). The updated relationships were then used to predict the strength of the 1987 to 1993 yearclasses. The yearclass estimates from the environmentally dependent recruitment model were then compared with those from the XSA (Fig. 10). Although trends in recent years from the recruitment model and the XSA do not match as well as trends for earlier years, both data sources showed that yearclasses from the 1990's were not large.

Stock Status Classification System

Prior to this assessment, after discussions and reaching a consensus with industry, a stock status classification system was developed for east and southeast Newfoundland herring which links exploitation rates to recruitment estimates at given spawning stock levels (Fig. 11). The classification system uses spawning stock threshold levels from the environmentally dependent recruitment model (Table 34) as its key reference point. This is a modification of the minimum spawning stock / critical egg production concept used last year, where stock status zones are now defined along stock recruit curves with appropriate exploitation levels.

The choice of zones is based, insofar as possible, on scientific analyses in the published literature. Mace (1994) and Myers et al. (1994) showed that for most fish stocks,

the point at which the risk of recruitment overfishing accelerates, is the point on the stock-recruit curve at which recruitment is one half of the maximum of the curve. The corresponding threshold on the X-axis conveniently describes the boundary between zones 1 and 2. The boundary between zones 2 and 3 is the level of maximum recruitment. The boundary between zones 3 and 4 is chosen arbitrarily to make zone 3 equivalent in size to zone 2.

The premise of the classification system is to provide a mechanism to reduce fishing mortalities at low stock levels without fishery closure. In determining fishing mortality levels for each zone, Doubleday (1985) proposed a rate of 0.20 for herring stocks because this rate would allow at least 70% of maximum yields to be taken at a relatively high level of stock stability. Simulation analyses by Winters and Wheeler (1987) supported this conclusion and, in fact, indicated that more than 70% of maximum yields would be taken at F = 0.20. This was therefore chosen as the reference level for the stock status classification system. Ranges of F's from 0.00 - 0.05 for zone 1, 0.05 - 0.10 for zone 2, and 0.10 - 0.20 for zone 3, were chosen arbitrarily in relation to the reference level.

Status of Stocks

All four of the assessed herring stocks are at low levels. Although the stocks rebuilt to a certain degree in the 1980's, yearclasses produced in the 1980's and 1990's were not as large as those in the 1960's and stocks never rebuilt to historical levels.

For White Bay - Notre Dame Bay, the 1995 age 3+ biomass from XSA is 22000 t (Table 23), the lowest in the time series. The 1982 yearclass is the largest in recent times followed by the 1987 yearclass. However, both are relatively small in comparison to the large yearclasses produced in the 1960's. There is no evidence of significant recruitment of yearclasses produced in the 1990's. Based upon the stock status classification system, previously described, the status of this stock would be classified in zone 2, poor to moderate (Fig. 12).

For Bonavista Bay - Trinity Bay, the age 3+ biomass estimate from XSA is 25000 t (Table 25), the fourth lowest estimate in the time series. The 1982 yearclass is the largest in recent times followed by the 1987 yearclass. However, both are relatively small in comparison to the large yearclasses produced in the 1960's. There is no evidence of significant recruitment of yearclasses produced in the 1990's. Based upon the stock status classification system, previously described, the status of this stock would be classified in zone 2, poor to moderate (Fig. 12).

For St. Mary's Bay - Placentia Bay, the age 3+ biomass estimate from XSA is 9500 t (Table 27), the fourth lowest estimate in the time series. Biomass levels increased in the 1980's and reached approximately 40% of he average level for the 1970's; however, biomass levels have subsequently declined in the 1990's. The 1982 yearclass is the largest in recent times but is relatively small in comparison to the large yearclasses produced in the 1960's. There is no evidence of significant recruitment of yearclasses produced in the 1990's. Based upon the stock status classification system, previously described, the status of this stock would be classified in zone 2, poor to moderate (Fig. 12).

For Fortune Bay, the age 3+ biomass estimate from XSA is 6400 t (Table 29). Biomass levels increased in the 1980's and reached approximately 50% of peak levels in the 1960's but have subsequently declined in the 1990's. The 1982 yearclass is the largest in recent times and is of comparable size to some of the large yearclasses of the 1960's. There is no evidence of significant recruitment of yearclasses produced in the 1990's. Based upon the stock status classification system, previously described, the status of this stock would be classified in zone 2, poor to moderate (Fig. 12).

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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
*1994	1.4	13.5	2.7	10.0	0.1	1.5	1.0	1.5	0.3	1.5

* provisional

Table 2. White Bay (WB) - Notre Dame Bay (NDB) herring landings and TAC's (t), by gear, 1978-94.

Year	Area	Gear						Total	TAC
		Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap		
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
1994*	WB	145	-	-	5	20	59	229	
	NDB	234	-	-	84	859	-	1177	
	Combined	379	-	-	89	879	59	1406	13500

* provisional

Table 3. Bonavista Bay (BB) - Trinity Bay (TB) herring landings and TAC's (t), by gear, 1978-94.

Year	Area	Gear						Total	TAC
		Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap		
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
1994*	BB	1984	-	-	1	357	1	2342	
	TB	39	-	-	235	71	1	346	
	Combined	2023	-	-	236	428	2	2688	10000

* provisional

Table 4. Conception Bay (CB) - Southern Shore (SS) herring landings and TAC's (t), by gear, 1978-94.

Year	Area	Gear						Total	TAC
		Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap		
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
1994*	CB	30	-	-	-	32	-	62	
	SS	-	-	-	-	8	-	8	
	Combined	30	-	-	-	40	-	70	1500

* provisional

Table 5. St. Mary's Bay (SMB) - Placentia Bay (PB) herring landings and TAC's (t), by gear, 1978-94.

Year	Area	Gear						Total	TAC
		Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap		
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
1994*	SMB	-	-	-	-	1	-	1	
	PB	681	-	-	78	194	10	962	
	Combined	681	-	-	78	195	10	963	1500

* provisional

Table 6. Fortune Bay (FB) herring landings and TAC's (t), by gear, 1978-94.

Year	Gear						Total	TAC
	Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap		
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
1994*	1	-	-	2	250	-	253	1500

* provisional

Table 7. Commercial catch (t) and number of fish sampled (bold print) for 1994, 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				19 **100**	597	192 **100**	11	1	4	18 **50**	31 **50**	8
	Purse seine					180 **50**	3			108 **50**	52	35 **50**	
	Bar Seine					55	29	5					
	Trap									26	20 **50**	14	
BB-TB	Gillnet				68 **50**	233 **100**	67 **49**	11		9	5	28 **50**	6
	Purse seine				1330 **200**	132				3	526 **50**	32 **50**	
	Bar Seine					31 **50**	206						
	Trap										1 **50**	1	
CB-SS	Gillnet				9	12 **50**	7	3	1	2	5	1	
	Purse seine										5 **50**	17	8
	Bar Seine												
	Trap												
SMB-PB	Gillnet			9	104 **50**	60 **50**	19 **50**					2	
	Purse seine			680 **50**	1								
	Bar Seine			**49**	70	7							
	Trap											8 **50**	2
FB	Gillnet			1	53 **20**	146 **50**	48 **20**					2	1
	Purse seine		**86**		1								
	Bar Seine				2								
	Trap												

Table 8. Commercial catch at age of spring and autumn spawning herring for White Bay - Notre Dame Bay, 1966-1994.

Spring Spawners

Age	1966	1967	1968	1969	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	1994 a
1	1	1	1	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	1
2	1	1	1	1	10	1	5	1	1	2	56	50	1	1	115	445	76	1	6	3	29	1105	407	23	1	29	940	1	1
3	40	43	64	54	1	129	290	727	4	128	24	1671	55	60	46	152	371	38	12	187	975	324	1044	128	1936	386	207	96	1
4	2	1551	1	103	12	88	2396	1411	123	215	506	107	2034	50	1240	41	332	46	124	350	2945	7201	291	613	285	16183	942	31	1052
5	27	86	718	19	24	161	353	2825	3142	453	237	468	317	2928	92	1231	59	23	1218	240	308	25843	2984	124	637	1542	8940	263	121
6	67	43	11	1155	24	64	69	781	5446	5438	868	184	1034	323	1080	63	268	14	73	1486	667	1651	11819	3106	240	553	483	3614	1669
7	190	1	48	1	972	425	122	719	1193	7069	10893	793	517	1410	17	805	34	93	114	108	1258	1067	1036	10566	2451	103	371	75	2183
8	128	86	161	108	11	10184	403	654	697	1123	17145	7363	2509	767	496	64	258	1	157	275	198	2088	1137	370	7360	2145	211	199	107
9	23	1	295	9	83	233	1383	416	1506	838	1328	12675	10807	2222	179	344	19	26	37	94	162	399	1454	1081	532	4432	722	70	191
10	6	1	188	58	159	254	205	1685	858	810	3364	1055	11756	14413	1450	194	192	4	122	81	179	442	315	844	1132	537	2796	544	48
11+	75	86	91	41	275	3105	808	794	2378	3999	8535	15707	14379	27508	14653	10908	4059	805	1938	2110	1973	4566	2943	2178	1148	2201	3509	861	438
Total	550	1900	1579	1551	1572	14645	6015	9994	15349	20078	42957	40074	43410	49683	19369	14248	5669	1052	3802	4935	8889	44712	26543	19034	15723	30384	19122	5755	5812

Autumn Spawners

Age	1966	1967	1968	1969	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	1994 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	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	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	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	7
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	70
6					10	14	79	25	10	25	51	85	155	267	23	11	16	23	68	333	79	156	45	5	52	98	172	78	80
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	137
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	25
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	4
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	1
11+					172	291	582	298	346	302	329	182	238	298	450	65	23		24	74	42	108	306	29	577	2733	613	349	15
Total					342	388	1100	550	597	444	559	500	753	1045	888	284	265	134	610	735	717	1938	1154	1292	953	4005	1277	734	342

Spring and Autumn Spawners

	1966	1967	1968	1969	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	1994 a
Total	550	1900	1579	1551	1914	15033	7115	10544	15946	20520	43516	40574	44163	50728	20237	14532	5934	1186	4412	5670	9606	46650	27697	20326	16676	34389	20399	6489	6154
% SS	100.0	100.0	100.0	100.0	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	94.4
% AS	0.0	0.0	0.0	0.0	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	5.6

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

Table 9. Commercial catch at age of spring and autumn spawning herring for Bonavista Bay - Trinity Bay , 1966-1994.

Spring Spawners

Age	1966	1967	1968	1969	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	1994 a
1	1	1	1	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	1
2	1	1	1	1	1	1	1	1	1	1	14	16	22	6	15	136	1	1	4	13	207	1352	6812	563	58	689	499	354	1
3	33	17	42	6	1	690	10	1	1	392	77	248	26	286	13	246	8	4	22	175	443	413	9910	1043	3094	210	1056	621	386
4	15	628	1	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	806
5	9	35	469	10	9	102	389	4887	235	163	123	758	122	765	43	256	2	7	210	87	261	16206	3674	264	2350	2586	12612	344	301
6	83	17	7	332	55	64	91	126	4795	2564	166	227	251	19	293	26	30	2	9	351	161	334	21739	1428	94	3859	2422	3779	1067
7	96	1	32	4	808	361	75	96	424	14330	4897	50	112	436	52	288	5	15	5	37	262	359	782	8639	629	347	579	422	3881
8	179	35	105	52	35	1373	88	1	151	455	20697	6209	598	101	264	23	35	1	12	27	38	126	713	13	4439	1550	194	385	474
9	32	1	193	27	126	151	480	48	294	995	909	23206	4412	530	75	321	5	8	2	13	10	33	8	216	235	7505	1394	132	470
10	40	1	123	38	69	126	14	271	69	727	854	774	13394	5575	967	88	65	2	2	22	31	6	55	100	325	447	2054	657	530
11+	300	35	61	294	212	522	213	1	1849	1679	4306	5890	5956	19994	12259	11762	1186	159	154	797	657	956	1247	508	466	891	653	1092	1828
Total	789	772	1035	769	1318	3702	2709	5493	7822	21441	32541	37524	25251	27880	14177	13200	1349	234	456	1593	6666	22928	45724	16098	12113	31750	21735	7947	9724

Autumn Spawners

Age	1966	1967	1968	1969	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	1994 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	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	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	1
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	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	53
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	169
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	27
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	115
9					18	3	5	1	1	6	62	30	23	13	112	38	25	1	5	22	24	138	818	83	58	104	5	39	1
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	1
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	79
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	448

Spring and Autumn Spawners

	1966	1967	1968	1969	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	1994 a
Total	789	772	1035	769	2126	4174	2758	5551	9064	21848	33914	39144	25953	29059	15115	14098	1447	262	595	2033	7355	24322	47974	17596	12600	33713	22464	9025	10172
% SS	100.0	100.0	100.0	100.0	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	95.6
% AS	0.0	0.0	0.0	0.0	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	4.4

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

Table 10. Commercial catch at age of spring and autumn spawning herring for Conception Bay - Southern Shore , 1970-1994.

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	1994 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	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	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	173
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	8
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	1
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	10
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	24
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	11
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	4
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	2
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	55
Total	393	516	2481	5585	10734	12889	9513	6498	5388	2039	1190	628	196	23	98	202	521	4431	975	4892	790	1078	124	121	290

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	1994 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	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	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	8
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	10
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	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	15
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	7
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	7
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	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	2
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	3
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	57

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	1994 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	347
% 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	83.6
% 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	16.4

a - preliminary

Table 11. Commercial catch at age of spring and autumn spawning herring for St. Mary's Bay - Placentia Bay , 1966-1994.

Spring Spawners

Age	1966	1967	1968	1969	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	1994 a
1	1	1	1	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	13
2	1	1	3232	1	476	1	1	76	995	74	385	52	30	87	133	1	1	1	8	1	1	34	1	22	1	37	68	5	24
3	1066	1	439	629	109	557	207	326	280	2234	391	1423	175	663	332	193	1	5	9	7	1	19	1	48	115	1	47	62	137
4	104	2362	29	54	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
5	114	158	7417	53	59	2111	725	15470	126	147	208	736	123	2263	153	111	3	3	36	27	19	502	163	1	64	160	363	11	36
6	164	302	399	861	76	80	5154	566	14328	1591	267	87	596	96	1270	51	8	2	6	21	28	29	2457	24	15	170	231	187	6
7	1912	788	679	67	645	251	365	6757	436	13858	882	50	64	614	57	338	3	4	3	15	9	47	119	463	30	12	55	118	224
8	1282	1451	953	55	66	45	650	93	6049	146	5622	1039	106	85	470	28	14	1	24	3	4	9	213	34	494	110	53	74	60
9	137	407	2836	99	72	13	352	224	138	3391	201	3830	512	66	38	80	4	9	1	25	1	3	16	100	45	493	74	63	98
10	43	85	2577	347	37	22	73	193	238	350	2256	134	3827	501	237	6	4	1	10	5	5	1	38	5	172	88	383	56	172
11+	993	787	3680	348	107	96	403	315	624	1323	1361	2448	2185	4785	2971	456	69	39	44	125	30	11	147	34	128	948	965	1174	998
Total	5817	6343	22242	2515	6084	3293	28306	24098	23451	23586	13440	9940	9436	9440	5795	1317	110	68	166	248	242	658	3176	741	1254	2242	2247	1785	1773

Autumn Spawners

Age	1966	1967	1968	1969	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	1994 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	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	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	7
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	7
5					2	2	175	52	96	68	214	52	435	143	35	116	7	6	101	20	24	32	30	18	61	87	8	206	62
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	116
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	182
8					112	43	37	54	95	208	17	69	122	218	79	50	1	1	5	36	28	82	35	43	47	65	27	41	231
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	182
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	1
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	457
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	1247

Spring and Autumn Spawners

	1966	1967	1968	1969	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	1994 a
Total	5817	6343	22242	2515	6523	3867	29392	25264	24988	24861	14221	10975	11006	10855	7122	1683	128	118	357	485	460	940	3921	1287	1734	3107	2919	3358	3020
% SS	100.0	100.0	100.0	100.0	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	58.7
% AS	0.0	0.0	0.0	0.0	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	41.3

a - preliminary

Table 12. Commercial catch at age of spring and autumn spawning herring for Fortune Bay , 1966-1994.

Spring Spawners

Age	1966	1967	1968	1969	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	1994 a
1	1	1	1	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	1
2	1	1	6549	515	29475	167	1515	2210	389	2	82	27	1	1	25	1	1	1	2	1	1	1	1	1	1	1	1	1	1
3	223	89	128	11984	5988	23223	256	925	1314	277	15	2103	42	1	16	144	1	2	1	54	1	1	1	1	1	1	1	2	5
4	13	24784	317	85	11953	6086	19690	67	552	581	318	25	2677	183	3	16	3	2	4	3	145	1	1	1	1	23	1	1	1
5	22	46	48563	187	133	23525	2896	5694	130	112	228	327	62	3833	69	4	3	1	3	39	4	304	1	1	2	8	3	1	2
6	90	49	216	13038	281	1165	10767	475	4435	87	129	166	237	15	1122	3	1	1	2	12	69	11	219	18	2	1	1	327	1
7	66	422	124	188	7894	5747	351	1712	250	1490	11	26	43	165	7	21	2	1	1	2	20	49	7	274	12	1	1	2	24
8	90	450	610	261	233	3514	4432	73	1094	16	338	43	139	5	183	2	36	1	2	1	6	18	26	1	155	6	1	3	23
9	28	513	770	690	16	132	991	282	36	142	36	188	52	24	1	23	1	10	1	1	1	4	6	17	17	274	2	8	9
10	2	358	920	1935	225	148	34	558	117	22	188	4	326	1	11	1	5	1	2	1	2	1	1	11	20	1	75	10	8
11+	17	138	855	1706	257	537	366	173	255	201	140	244	302	167	50	12	5	18	23	15	14	38	10	24	1	72	266	217	647
Total	553	26831	59053	30590	56456	64245	41915	12192	8573	2931	1486	3154	3882	4396	1488	228	59	39	42	130	264	429	274	350	213	389	353	573	722

Autumn Spawners

Age	1966	1967	1968	1969	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	1994 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	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	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	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	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	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	1
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	1
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	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	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	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	14
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	24

Spring and Autumn Spawners

	1966	1967	1968	1969	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	1994 a
Total	553	26831	59053	30590	60668	68979	43485	12551	8873	3109	1619	3224	3990	4504	1508	321	77	51	69	206	355	509	315	425	327	411	377	621	746
% SS	100.0	100.0	100.0	100.0	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	96.8
% AS	0.0	0.0	0.0	0.0	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	3.2

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Table 13. Mean weights at age (g) of spring-spawning herring, by stock area, from samples collected January to June, 1989 - 1994 Sample sizes in parenthesis.

Stock Area	Age	1989		1990		1991		1992		1993		1994	
WB-NDB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-
	3	124	(65)	122	(293)	122	(16)	122	(1)	85	(10)	74	(6)
	4	195	(198)	179	(152)	172	(665)	164	(52)	159	(58)	132	(724)
	5	227	(54)	234	(158)	212	(77)	199	(1108)	189	(218)	187	(65)
	6	249	(579)	259	(72)	247	(44)	229	(81)	221	(1208)	210	(353)
	7	273	(915)	279	(475)	278	(29)	261	(45)	252	(46)	238	(697)
	8	296	(52)	296	(696)	287	(214)	277	(40)	279	(34)	271	(37)
	9	311	(71)	329	(43)	312	(405)	296	(142)	298	(25)	283	(37)
	10	332	(121)	336	(126)	331	(37)	322	(405)	304	(118)	304	(39)
	11+	412	(364)	418	(333)	393	(236)	373	(375)	343	(456)	330	(252)
BB-TB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	82	(17)	70	(8)	-	-	-	-	-	-	-	-
	3	147	(94)	144	(227)	132	(15)	133	(16)	108	(120)	81	(20)
	4	212	(429)	219	(138)	202	(670)	174	(20)	170	(49)	144	(265)
	5	248	(27)	262	(376)	257	(188)	216	(707)	211	(120)	198	(105)
	6	265	(172)	272	(51)	287	(484)	256	(166)	239	(873)	224	(192)
	7	280	(1423)	285	(204)	286	(54)	287	(345)	284	(152)	255	(941)
	8	293	(22)	314	(962)	289	(287)	287	(46)	311	(213)	295	(122)
	9	323	(26)	353	(19)	322	(1053)	282	(192)	299	(80)	308	(207)
	10	347	(27)	362	(37)	339	(65)	307	(638)	309	(280)	306	(158)
	11+	411	(240)	421	(178)	387	(140)	340	(305)	343	(516)	345	(966)
CB-SS	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	4	(5)	-	-
	2	125	(24)	-	-	54	(1)	-	-	28	(160)	42	(3)
	3	188	(61)	173	(161)	137	(2)	129	(12)	104	(37)	86	(83)
	4	220	(176)	250	(127)	235	(133)	-	-	174	(26)	163	(84)
	5	274	(25)	271	(117)	269	(48)	241	(161)	217	(21)	222	(50)
	6	282	(48)	282	(12)	286	(91)	276	(96)	265	(207)	231	(39)
	7	293	(517)	303	(62)	311	(12)	293	(133)	305	(63)	278	(243)
	8	294	(14)	329	(474)	296	(46)	298	(11)	316	(78)	305	(60)
	9	342	(31)	349	(15)	321	(289)	300	(46)	319	(13)	318	(59)
	10	375	(10)	359	(27)	345	(18)	318	(239)	328	(54)	330	(43)
	11+	416	(98)	426	(56)	388	(65)	348	(134)	355	(219)	364	(304)
SMB-PB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	30	(1)	30	(3)	-	-	22	(35)	-	-	-	-
	2	97	(14)	87	(8)	77	(4)	59	(16)	39	(7)	59	(28)
	3	163	(222)	162	(148)	140	(22)	137	(36)	130	(84)	115	(260)
	4	221	(70)	242	(186)	212	(271)	191	(12)	189	(80)	168	(108)
	5	266	(17)	273	(63)	258	(103)	242	(340)	215	(32)	219	(59)
	6	271	(57)	291	(16)	278	(45)	276	(101)	267	(283)	249	(16)
	7	309	(908)	311	(44)	298	(13)	292	(58)	292	(80)	291	(150)
	8	328	(37)	343	(667)	302	(30)	299	(17)	305	(90)	322	(40)
	9	343	(126)	362	(43)	331	(233)	315	(32)	317	(25)	332	(95)
	10	347	(32)	367	(184)	346	(26)	331	(194)	330	(68)	330	(60)
	11+	430	(41)	406	(122)	362	(189)	362	(349)	372	(432)	384	(511)
FB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	15	(80)	-	-	-	-
	2	112	(1)	102	(1)	-	-	61	(170)	-	-	-	-
	3	144	(42)	145	(393)	134	(2)	138	(5)	120	(3)	114	(5)
	4	180	(6)	215	(16)	186	(143)	170	(22)	177	(2)	157	(68)
	5	209	(2)	252	(3)	233	(53)	209	(313)	222	(24)	195	(13)
	6	252	(29)	268	(1)	244	(7)	254	(36)	240	(429)	214	(28)
	7	296	(1028)	292	(52)	276	(5)	288	(7)	281	(22)	257	(242)
	8	329	(18)	322	(716)	289	(54)	295	(11)	297	(12)	279	(17)
	9	348	(64)	339	(47)	319	(672)	309	(41)	284	(3)	294	(8)
	10	378	(46)	356	(162)	338	(63)	329	(305)	287	(22)	320	(11)
	11+	463	(58)	421	(148)	372	(284)	367	(685)	355	(642)	362	(366)

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	1995
1	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	0.0	0.0	0.0	0.0	
3	0.0										5.0	17.5	91.0	18.2	0.0	1.2	0.6	
4	24.9										2.0	47.1	56.2	410.0	21.5	10.9	230.8	
5	3.9										23.9	12.2	57.7	47.7	493.7	50.8	14.6	
6	22.3										63.9	138.3	17.8	22.7	33.5	359.0	51.9	
7	27.5										6.0	199.2	157.6	12.5	13.7	18.8	181.9	
8	1010.9										5.0	10.6	213.1	139.7	10.3	6.7	14.0	
9	14.4										12.9	17.5	12.6	272.5	47.2	13.3	7.6	
10	28.8										1.9	26.5	28.9	36.3	127.9	29.7	12.8	
11+	176.8										36.6	61.4	105.8	176.0	110.8	115.6	68.8	
Total	1309.5										157.0	529.7	740.1	1135.6	858.6	605.3	583.0	545.7

Fall Program

Age	1971	...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
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	1995
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	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	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	0.7	
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	16.6	
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	9.6	
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	12.6	
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	65.0	
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	6.5	
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	8.9	
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	7.5	
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	40.1	
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	167.6	98.4

Fall Program

Age	1971	1972	...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
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	1995
1			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	0.0	0.3	0.0	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	1.5	
4			0.0					1.5	121.9	2.5	26.4	25.3	11.7	25.5	0.0	2.2	3.3	
5			0.0					6.5	3.3	180.2	22.5	13.9	9.0	8.7	17.9	1.7	2.5	
6			0.0					18.6	22.8	8.3	725.2	20.4	1.2	24.7	7.3	10.6	1.6	
7			0.9					2.6	5.6	13.7	32.3	110.0	5.6	2.7	8.5	3.6	9.3	
8			0.0					2.2	4.3	4.5	69.5	7.4	49.8	9.7	1.6	3.7	2.1	
9			0.0					0.5	1.3	3.2	9.8	6.5	1.7	70.3	1.9	0.6	2.7	
10			0.9					0.0	1.3	1.3	2.0	1.4	2.4	6.0	19.4	3.3	1.3	
11+			42.2					130.6	57.6	85.5	84.2	31.1	5.5	14.1	7.3	13.2	11.2	
Total			44.0					171.0	217.3	317.9	978.7	232.0	106.3	161.6	64.8	42.1	35.5	260.0

Fall Program

Age	1971	...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
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	1995
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	0.0	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	0.0	
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	15.6	
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	25.4	
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	2.9	
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	0.4	
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	6.9	
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	2.1	
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	3.8	
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	3.2	
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	45.6	
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	105.9	62.5

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	1995
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		0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	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	1.3	
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	32.1	
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	14.0	
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	21.4	
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	252.5	
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	3.3	
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	12.0	
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	12.0	
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	319.3	
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	668.0	708.6

Table 19. Biomass and backscatter estimates, for White Bay - Notre Dame 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
WB - NDB	10	8.800E+07	-29.08	15	1.32	1.132E+06	0	0.00000			0	0.000E+00		
				16	2.24	1.921E+06	43	0.04276			54	5.285E-05		
				17	2.14	1.835E+06	0	0.00000			0	0.000E+00		
				18	1.09	9.346E+05	11	0.01111			14	1.373E-05		
				19	0.20	1.715E+05	28	0.02731			34	3.375E-05		
				20	0.10	8.575E+04	0	0.00000			0	0.000E+00		
				6		1.013E+06		0.01353	1191	4.51939E+11		1.672E-05	1472	6.904E+05
						6.080E+06								
	13	8.400E+07	-29.08	33	1.34	1.149E+06	0	0.00000			0	0.000E+00		
				34	1.84	1.578E+06	0	0.00000			0	0.000E+00		
				35	0.65	5.574E+05	16	0.01431			19	1.768E-05		
				3		1.095E+06		0.00477	401	2.50966E+11		5.894E-06	495	3.834E+05
						3.284E+06								
	14	5.500E+07	-29.08	36	0.31	2.658E+05	0	0.00000			0	0.000E+00		
				37	0.68	5.831E+05	0	0.00000			0	0.000E+00		
				38	0.79	1.355E+06	0	0.00000			0	0.000E+00		
				39	2.49	4.270E+06	25	0.01307			31	1.615E-05		
				40	2.52	4.322E+06	0	0.00000			0	0.000E+00		
				41	0.48	8.232E+05	0	0.00024			1	2.987E-07		
				6		1.936E+06		0.00222	122	9.55466E+09		2.741E-06	151	1.460E+04
						1.162E+07								
	17	1.250E+08	-29.08	53	0.47	4.030E+05	0	0.00000			0	0.000E+00		
				54	0.59	5.059E+05	0	0.00000			0	0.000E+00		
				55	0.14	1.200E+05	0	0.00000			0	0.000E+00		
				56	1.14	9.775E+05	0	0.00000			0	0.000E+00		
				58	0.46	3.944E+05	0	0.00000			0	0.000E+00		
				60	1.10	9.432E+05	0	0.00000			0	0.000E+00		
				61	2.25	1.929E+06	0	0.00000			0	0.000E+00		
				62	1.40	1.200E+06	9	0.01147			11	1.417E-05		
				8		8.092E+05		0.00143	179	2.97223E+10		1.771E-06	221	4.540E+04
						6.474E+06								
	18	2.430E+08	-29.08	51	1.83	1.569E+06	0	0.00000			0	0.000E+00		
				57	2.42	2.075E+06	0	0.00000			0	0.000E+00		
				59	2.14	1.835E+06	25	0.00784			31	9.686E-06		
				65	4.74	4.064E+06	0	0.00000			0	0.000E+00		
				66	5.02	4.305E+06	0	0.00000			0	0.000E+00		
				67	3.41	2.924E+06	0	0.00000			0	0.000E+00		
				68	3.46	5.934E+06	0	0.00000			0	0.000E+00		
				7		3.244E+06		0.00112	272	8.72836E+10		1.384E-06	336	1.333E+05
						2.271E+07								
										8.29466E+11				1.267E+06
				Total Transect Length =	48.76			Total Stock Biomass =	2164	911		Total Stock Scatter =	2675	1126
										0.421				0.421

Table 20. Biomass and backscatter estimate for Fortune Bay, from the 1995 acoustic survey.

STOCK AREA	STRATUM	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
FB	2	-28.10	7	0.86	7.374E+05	0	0.00000			0	0.000E+00		
			8	0.79	6.774E+05	0	0.00000			0	0.000E+00		
			9	0.83	7.117E+05	0	0.00000			0	0.000E+00		
			10	1.08	9.261E+05	0	0.00000			0	0.000E+00		
			11	0.95	8.146E+05	0	0.00000			0	0.000E+00		
			12	0.56	4.802E+05	0	0.00000			0	0.000E+00		
			13	0.62	5.316E+05	0	0.00000			0	0.000E+00		
			14	0.57	4.888E+05	0	0.00000			0	0.000E+00		
			15	0.49	4.202E+05	0	0.00000			0	0.000E+00		
			16	0.53	4.545E+05	0	0.00000			0	0.000E+00		
			17	0.56	4.802E+05	0	0.00000			0	0.000E+00		
			18	0.33	2.830E+05	0	0.00000			0	0.000E+00		
			19	0.35	6.002E+05	0	0.00000			0	0.000E+00		
			20	0.42	7.203E+05	349	0.22243			541	3.445E-04		
			21	0.27	4.630E+05	72	0.04552			111	7.050E-05		
			26	0.58	9.947E+05	0	0.00000			0	0.000E+00		
			27	0.67	1.149E+06	0	0.00000			0	0.000E+00		
			28	1.56	2.675E+06	0	0.00000			0	0.000E+00		
			29	1.64	2.813E+06	0	0.00000			0	0.000E+00		
			30	2.52	4.322E+06	0	0.00000			0	0.000E+00		
			31	2.97	5.093E+06	0	0.00000			0	0.000E+00		
			32	2.54	4.356E+06	0	0.00000			0	0.000E+00		
			33	1.88	3.224E+06	0	0.00000			0	0.000E+00		
			34	1.88	3.224E+06	0	0.00000			0	0.000E+00		
			35	1.30	2.229E+06	0	0.00000			0	0.000E+00		
			36	1.15	1.972E+06	0	0.00000			0	0.000E+00		
			26		1.571E+06		0.01031	739	4.28429E+11		1.804E-05	1294	1.048E+06
					4.084E+07								
	6	-28.10	57	1.41	1.209E+06	0	0.00000			0	0.000E+00		
			58	1.87	1.603E+06	0	0.00000			0	0.000E+00		
			59	2.14	1.835E+06	0	0.00000			0	0.000E+00		
			60	2.38	2.041E+06	2	0.00149			3	2.300E-06		
			61	1.40	1.200E+06	0	0.00000			0	0.000E+00		
			62	1.28	2.195E+06	0	0.00000			0	0.000E+00		
			63	0.59	1.012E+06	0	0.00000			0	0.000E+00		
			64	1.01	1.732E+06	0	0.00000			0	0.000E+00		
			65	0.60	1.029E+06	0	0.00000			0	0.000E+00		
			66	0.90	1.543E+06	0	0.00000			0	0.000E+00		
			67	0.09	1.543E+05	0	0.00000			0	0.000E+00		
			11		1.414E+06		0.00014	12	139222899.3		2.091E-07	19	3.340E+02
					1.555E+07								
	11	-28.10	128	1.32	1.132E+06	71	0.05978			110	9.259E-05		
			129	1.16	9.947E+05	0	0.00000			0	0.000E+00		
			130	1.67	2.864E+06	0	0.00000			0	0.000E+00		
			131	1.06	1.818E+06	6	0.00489			9	7.574E-06		
			132	0.50	8.575E+05	0	0.00000			0	0.000E+00		
			133	0.45	7.717E+05	0	0.00000			0	0.000E+00		
			134	0.35	6.002E+05	0	0.00000			0	0.000E+00		
			135	1.73	2.967E+06	0	0.00000			0	0.000E+00		
			136	1.29	2.212E+06	0	0.00000			0	0.000E+00		
			140	0.34	5.831E+05	0	0.00000			0	0.000E+00		
			141	0.41	7.031E+05	0	0.00000			0	0.000E+00		
			142	0.43	7.374E+05	0	0.00000			0	0.000E+00		
			143	0.31	5.316E+05	0	0.00000			0	0.000E+00		
			144	0.33	5.659E+05	0	0.00000			0	0.000E+00		
			145	0.26	4.459E+05	0	0.00000			0	0.000E+00		
			146	0.21	3.601E+05	0	0.00000			0	0.000E+00		
			147	0.14	2.401E+05	0	0.00000			0	0.000E+00		
			148	0.10	1.715E+05	0	0.00000			0	0.000E+00		
			149	0.10	1.715E+05	0	0.00000			0	0.000E+00		
			150	0.14	2.401E+05	0	0.00000			0	0.000E+00		
			151	0.19	3.258E+05	0	0.00000			0	0.000E+00		
			152	0.13	2.229E+05	0	0.00000			0	0.000E+00		
			153	0.16	2.744E+05	0	0.00000			0	0.000E+00		
			154	0.17	2.915E+05	0	0.00000			0	0.000E+00		
			155	0.19	3.258E+05	0	0.00000			0	0.000E+00		
			156	0.56	9.604E+05	0	0.00000			0	0.000E+00		
			157	0.63	1.080E+06	0	0.00000			0	0.000E+00		
			158	1.64	2.813E+06	506	0.42698			784	6.613E-04		
			159	1.77	3.035E+06	447	0.37665			692	5.834E-04		
			160	1.39	2.384E+06	0	0.00000			0	0.000E+00		
			161	2.28	3.910E+06	833	0.70236			1290	1.088E-03		
			162	1.96	3.361E+06	0	0.00000			0	0.000E+00		
			32		1.186E+06		0.04908	2052	9.44979E+11		7.602E-05	3178	2.267E+06
					3.795E+07								
									1.37355E+12				3.315E+06
		Total Transect Length =		64.94			Total Stock Biomass =	2803	1172		Total Stock Scatter =	4490	1821
									0.418				0.405

Table 21. 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	1995
0	623.0	0.0	0.0	0.0	14.6	0.1				3226.3		0.0	
1	979.1	187.7	0.0	12.6	0.4	29.6				0.0		0.0	
2	33.0	572.2	438.6	4.3	5.1	2.2				70.7		0.0	
3	4.5	4.6	832.5	27.1	1.6	1.3				2.1		0.4	
4	81.5	3.5	9.5	212.8	24.5	0.9				7.2		4.2	
5	4.2	34.2	0.0	17.6	65.4	9.5				191.5		0.1	
6	4.2	8.0	12.9	32.0	2.0	28.9				22.5		0.1	
7	22.2	6.1	0.0	36.2	1.8	2.0				10.1		2.9	
8	0.0	15.4	0.0	0.8	4.4	4.0				9.3		0.1	
9	9.1	0.0	0.0	0.3	1.3	5.2				16.4		0.2	
10	0.0	3.2	0.0	7.5	0.8	1.1				57.2		0.2	
11+	54.3	162.8	26.1	70.7	2.9	12.3				18.8		0.6	
Total	1815.1	997.7	1319.6	421.9	124.8	97.1				3632.1		9.7	
Biomass (t)	136000	78700	198400	126200	30900	22700				113500		2100	

BBTB	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
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	1995
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	

FB	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0				0.0				0.0		0.0			0.0
1				0.0				0.0		0.2			0.6
2				0.0				0.0		5.1			0.0
3				0.0				22.4		0.1			14.2
4				18.4				2.2		0.7			1.9
5				0.6				0.3		9.2			4.4
6				2.1				0.3		0.7			0.0
7				1.8				7.3		0.0			0.0
8				0.9				19.3		0.4			0.0
9				0.6				0.8		5.6			0.0
10				1.5				0.8		22.8			0.0
11+				3.5				2.2		13.0			0.3
Total				29.4				55.6		57.8			21.4
Biomass (t)				9100				15200		18600			2800

Table 22. Results of extended survivors analysis for White Bay - Notre Dame Bay, spring spawning herring.

Data for 3 fleets over 29 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 = .009

Fishing mortalities

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	0.016	0.004	0.002	0.001	0.001	0.018	0.053	0.096	0.008	0.012	0.021	0.09	0.007	0.007
4	0.004	0.043	0.001	0.007	0.026	0.016	0.183	0.062	0.075	0.023	0.126	0.067	0.017	0.094
5	0.065	0.008	0.004	0.019	0.016	0.029	0.193	0.107	0.034	0.104	0.167	0.095	0.024	0.088
6	0.026	0.018	0.002	0.015	0.029	0.057	0.212	0.126	0.155	0.084	0.123	0.072	0.05	0.207
7	0.09	0.018	0.008	0.022	0.027	0.031	0.122	0.199	0.159	0.176	0.047	0.114	0.014	0.039
8	0.148	0.038	0.001	0.016	0.068	0.063	0.065	0.184	0.101	0.159	0.231	0.129	0.082	0.025
9	0.086	0.06	0.005	0.029	0.012	0.052	0.175	0.059	0.268	0.207	0.135	0.113	0.057	0.106
10	0.122	0.063	0.016	0.027	0.083	0.029	0.197	0.203	0.044	0.498	0.333	0.118	0.116	0.051

Log catchability residuals.

Fleet : Spring Res. Gillnets

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3								-0.41	0.51	-0.23	0.39	0	-2.1	1.85
4								-2.12	0.49	0.26	-0.11	-0.84	0.56	1.76
5								-1.65	-0.29	0.74	0.14	0.16	0.04	0.86
6								-1.82	0.49	0.4	0.18	0.17	0.18	0.41
7								-1.2	-0.24	1.09	0.42	0.1	-0.04	-0.14
8								-1.52	-0.24	0.22	1.39	0.53	-0.28	-0.09
9								-2.11	-0.03	0.1	0.64	0.52	0.92	-0.04

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.31	-5.68	-5.45	-5.51	-5.62	-5.64	-5.47	-5.47
S.E	1.3	1.22	0.83	0.81	0.69	0.89	1	1.53

Fleet : Fall Res. Gillnets

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3	0.24	-0.34	1.66	-0.1	0.35	-0.91	-1.44	-0.13	0.51	0.54	-0.38	0	0	0
4	-2.03	-0.26	0.07	0.08	0.39	-0.48	0.09	-0.21	0.96	0.58	0.8	0	0	0
5	0.13	-0.98	-0.01	0.09	-0.43	-0.02	0.85	-0.58	0.55	-0.02	0.42	0	0	0
6	-0.84	-2.01	0.83	-0.14	0.2	-0.21	1.62	0.05	0.76	0.27	-0.55	0	0	0
7	-0.7	-1.08	0.3	0.3	0.37	-0.26	0.44	0.27	0.48	-0.28	0.16	0	0	0
8	-0.11	0.01	0.2	0.07	0.23	-0.1	0.3	-0.17	-0.16	-0.14	-0.12	0	0	0
9	-1.04	0	1.08	-0.77	-0.36	-0.48	1.07	-0.91	0.89	0.8	-0.29	0	0	0

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.69	-6.87	-6.65	-6.87	-6.62	-6.52	-6.51	-6.51
S.E	0.82	0.81	0.52	0.95	0.51	0.17	0.86	1.5

Fleet : Acoustic Surveys

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
3			-1.03	-0.71	1.9	-0.09	-0.74	-1.51	0	0	0	0.53	0	1.65
4			0.71	-0.97	0.34	0.84	0.27	-0.96	0	0	0	0.03	0	-0.27
5			0.19	-0.05	0	1.08	-0.07	-0.46	0	0	0	1.32	0	-2.02
6			0.31	1.2	-0.65	1.75	-0.56	-0.41	0	0	0	1.96	0	-3.59
7			1.12	0.68	0	0.39	-1.04	-0.38	0	0	0	1.67	0	-2.45
8			0	1.33	0	-0.49	-1.1	0.49	0	0	0	2.64	0	-2.88
9			1.34	0	0	-1.48	0.34	-0.69	0	0	0	1.82	0	-1.33

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.41	-7.51	-7.41	-7.55	-7.33	-7.69	-7.67	-7.67
S.E	1.25	0.69	1.1	1.78	1.41	1.93	1.39	1.73

Table 23. Fishing mortalities, population numbers and biomass for White Bay - Notre Dame Bay from extended survivors analysis.

Fishing mortality (F) at age

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	0.0001	0.0003	0.0004	0.0002	0	0.0002	0.0008	0.0073	0.0003	0.0059	0.0096	0.0548	0.0118	0.002	0.0039
4	0	0.0027	0	0.0009	0.0001	0.0011	0.0048	0.0045	0.0015	0.0228	0.0291	0.0538	0.0875	0.0132	0.0509
5	0.0005	0.0006	0.0015	0.0002	0.0003	0.0009	0.0052	0.007	0.0124	0.0069	0.0316	0.0339	0.2234	0.1753	0.0304
6	0.0003	0.001	0.0001	0.003	0.0003	0.0008	0.0005	0.0138	0.0167	0.0266	0.0183	0.0309	0.0977	0.3732	0.0903
7	0.0029	0	0.0013	0	0.0031	0.0059	0.0019	0.0062	0.027	0.027	0.0684	0.0185	0.114	0.1875	0.0295
8	0.0011	0.0017	0.0012	0.0037	0.0001	0.0411	0.0068	0.0126	0.0074	0.032	0.0848	0.0602	0.0748	0.2469	0.0928
9	0.0127	0	0.0071	0.0001	0.0035	0.0038	0.0069	0.0087	0.0362	0.0109	0.0481	0.0831	0.1179	0.0878	0.0832
10	0.0043	0.0007	0.0025	0.0017	0.0018	0.0131	0.0041	0.0105	0.0222	0.0245	0.0553	0.049	0.1033	0.2279	0.0759
+gp	0.0043	0.0007	0.0025	0.0017	0.0018	0.0131	0.0041	0.0105	0.0222	0.0245	0.0553	0.049	0.1033	0.2279	0.0759
FBAR 5- 8	0.0012	0.0008	0.001	0.0017	0.001	0.0122	0.0038	0.0099	0.0159	0.0231	0.0502	0.0359	0.1275	0.2457	0.0607
MAX F	0.0127	0.0027	0.0071	0.0037	0.0035	0.0411	0.0069	0.0138	0.0362	0.032	0.0846	0.0831	0.2234	0.3732	0.0928
CATCH 11+	75000	86000	91000	41000	275000	3105000	808000	794000	2378000	3999000	6535000	1.57E+07	1.47E+07	2.75E+07	1.47E+07

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	FBAR 92-94
AGE															
3	0.0157	0.0038	0.0017	0.0007	0.0008	0.0183	0.053	0.0957	0.0083	0.0115	0.0214	0.0902	0.0067	0.0073	0.0347
4	0.0043	0.0431	0.0006	0.0068	0.026	0.0162	0.1827	0.0616	0.0747	0.023	0.126	0.0667	0.0174	0.0939	0.0593
5	0.0655	0.0076	0.0037	0.0189	0.0162	0.0267	0.1928	0.107	0.0338	0.1036	0.167	0.095	0.0238	0.0875	0.0688
6	0.0262	0.0182	0.0022	0.0146	0.0289	0.0569	0.2116	0.1284	0.1549	0.0843	0.1231	0.0721	0.0504	0.2068	0.1097
7	0.0699	0.0176	0.0078	0.0222	0.0289	0.0308	0.1215	0.1992	0.1592	0.1782	0.0472	0.1135	0.0143	0.0389	0.0556
8	0.1482	0.0375	0.0006	0.0163	0.0685	0.0631	0.0655	0.1841	0.1011	0.1588	0.2306	0.1289	0.082	0.0254	0.0788
9	0.0859	0.0597	0.0047	0.0293	0.0121	0.0523	0.1748	0.0593	0.2676	0.2067	0.1353	0.1127	0.0574	0.1056	0.0919
10	0.122	0.0631	0.0159	0.0275	0.0829	0.0286	0.1973	0.2033	0.0443	0.4983	0.3329	0.1184	0.1163	0.0507	0.0951
+gp	0.122	0.0631	0.0159	0.0275	0.0829	0.0288	0.1973	0.2033	0.0443	0.4983	0.3329	0.1184	0.1163	0.0507	
FBAR 5- 8	0.0824	0.0202	0.0038	0.018	0.0351	0.0449	0.1478	0.1542	0.1122	0.1307	0.142	0.1024	0.0426	0.0896	
MAX F	0.1482	0.0631	0.0159	0.0293	0.0829	0.0631	0.2116	0.2033	0.2676	0.4983	0.3329	0.1289	0.1163	0.2068	
CATCH 11+	1.09E+07	4059000	805000	1938000	2110000	1973000	4566000	2943000	2178000	1148000	2201000	3509000	861000	438000	

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

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	473642	179195	157986	287746	112227	671093	423847	110002	12859	23967	2782	34621	5194	33769	12994
4	143748	387749	146673	129290	235537	91883	549328	346754	89404	10524	19507	2256	26833	4202	27583
5	38741	117689	316059	120085	105761	182831	75147	447583	282622	73086	8422	15513	1750	20129	3395
6	141633	31694	96278	258117	88300	86568	157731	61206	363894	228548	59428	6681	12277	1146	13831
7	44372	115898	25910	78816	210283	80460	70818	129077	49423	293004	182199	47870	5303	9118	646
8	80815	36166	94889	21170	64528	171288	65490	57870	105028	39384	233495	139315	38475	3874	6188
9	1304	66050	29532	77543	17235	52821	131022	53254	46788	85359	31229	175656	107399	29231	2478
10	990	1047	54076	23912	63478	14036	43035	106039	43224	36944	69128	24367	132348	78153	21922
+gp	12351	89688	26130	16588	109603	171234	169325	84040	119556	182018	174936	361874	161328	148347	220880
TOTAL	937598	1025375	947533	1013267	1016952	1532210	1685744	1395825	1112798	972836	781125	808153	490907	327987	309927
REVISED +gp	6556	35189	14190	12248	86837	85020	129833	63906	73754	140025	115923	217029	80926	96840	182142
REVISED TOTAL	931801	970677	935593	1008927	994186	1445998	1646051	1375691	1066996	930641	722113	663308	410503	276460	271189
MEAN WGT +gp	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.322	0.311	0.311	0.328

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	GMST 66-91	AMST 66-91	
AGE																		
3	10801	107543	24882	18430	247183	59293	6933	12648	17055	186677	20139	2651	15945	152	0	48436	138464	0.074
4	10597	8705	87713	20337	15078	202207	47663	5383	9411	13848	151087	16139	1883	12968	125	43012	117922	0.132
5	21470	8639	6827	71772	16538	12028	162888	32507	4144	7150	11080	109056	12361	1596	9739	33307	93299	0.187
6	2697	16464	7020	5569	57659	13323	9569	109978	23915	3280	5278	7676	81199	9883	1217	29539	82932	0.21
7	10346	2151	13237	5735	4493	45863	10305	6341	79348	16789	2469	3821	5848	63210	6673	25503	69150	0.238
8	514	7743	1730	10753	4592	3581	36411	7471	4254	55404	11512	1928	2792	4720	50141	23243	59920	0.271
9	4617	363	6106	1416	8662	3511	2753	27922	5088	3148	38702	7484	1388	2108	3803	16920	46902	0.283
10	1867	3469	280	4975	1126	7007	2728	1893	21545	3188	2096	27676	5474	1073	1579	11655	35984	0.304
+gp	104575	73142	56165	78867	29231	77067	28039	17594	55464	3201	8529	34607	8633	9764	8442			
TOTAL	167484	228219	203958	217853	384563	423880	307288	221737	220223	292666	250890	211039	135623	105470	81720			
REVISED +gp	87160	73159	56291	74016	29222	35561	26323	17591	10190	3201	8529	31944	8636	2580	2230.827			0.33
REVISED TOTAL	150069	228236	204088	213003	384553	382374	305573	221734	174950	292665	250892	208375	135626	98288	75507.83			
MEAN WGT +gp	0.328	0.345	0.398	0.383	0.383	0.376	0.371	0.399	0.414	0.412	0.418	0.393	0.373	0.343				

Stock biomass at age (start of year) Tonnes

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	58732	22220	19590	35680	13916	83216	52557	13640	1594	2972	345	4293	691	4491	2079
4	26593	71734	27135	23919	43574	16998	101626	64150	16540	1947	3609	417	5394	845	5491
5	7885	23891	64160	24377	21469	39145	15255	90859	57372	14837	1710	3149	424	4871	1006
6	31301	7004	21277	57044	21724	19132	34859	13527	80421	50509	13134	1476	3106	290	3900
7	10605	27700	6193	18837	50258	19230	16925	30849	11812	70028	43545	11441	1411	2425	191
8	20850	9331	24481	5462	16648	44192	16896	14931	27097	10161	60242	35943	10427	1050	1850
9	353	17899	8003	21014	4671	14314	35507	14432	12680	23132	8463	47603	29535	8038	761
10	276	292	15087	6671	17710	3916	12007	29585	12060	10306	19287	6798	36925	21805	6686
+gp	3977	28944	8414	5341	35292	55137	54523	27061	38497	58610	56329	116524	50173	46136	72449
TOTALBIO	160552	209015	194340	198346	225263	295279	340155	299033	258073	242503	206663	227645	138084	89951	94415
REVISED +gp	2111	11331	4569	3944	27962	27377	41742	20578	23749	45088	37327	69883	25168	30117	59742
REVISED TOTAL	158686	191402	190495	196948	217932	267520	327374	292551	243325	228982	187662	181003	113081	73932	81708
5+ BIOMASS	73361	97448	143770	137349	160442	167306	173191	214761	225191	224063	183708	176293	106996	68596	74138

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE															
3	1728	14841	5748	2764	37077	8538	1005	1872	2115	22775	2457	323	1355	11	0
4	2109	1715	22454	5125	2970	40644	9866	1152	1835	2479	25987	2647	315	1712	17
5	6376	2013	2034	17297	4333	2682	37953	7639	941	1673	2349	21702	2338	298	1821
6	760	4346	2197	1910	15164	3624	2574	28154	5955	850	1304	1758	17945	2075	256
7	3052	624	4368	1749	1348	12796	3019	1870	21662	4679	686	997	1474	15044	1588
8	154	2323	616	3839	1492	1132	11579	2361	1259	16400	3304	534	779	1279	13588
9	1418	111	2186	520	2876	1159	961	9019	1582	1036	12075	2215	413	596	1076
10	569	1062	98	1980	397	2298	900	630	7153	1071	694	8912	1664	326	480
+gp	34301	25234	22354	30206	10991	28592	11188	7284	22851	1338	3352	12909	2961	3222	
TOTALBIO	50467	52268	62055	65390	76650	101464	79045	59982	65353	52299	52207	51997	29243	24564	
REVISED +gp	28588	25240	22404	28348	11192	13371	9788	7019	4219	1319	3565	12554	3221	885	736
REVISED TOTAL	44754	52275	62105	63532	76849	86244	77623	59716	46721	52282	52421	51642	29502	22226	18562
5+ BIOMASS	40917	35719	33903	55643	36802	37062	66752	56692	42771	27028	23977	48672	27832	20503	19546

Table 24. Results of extended survivors analysis for Bonavista Bay - Trinity Bay, spring spawning herring.

Data for 3 fleets over 29 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 = .002

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	1994																
3	0.001	0	0	0	0.034	0.032	0.018	0.017	0.054	0.01	0.133	0.001	0	0.003	0.001	0.011	0.049	0.251	0.042	0.018
0.019	0.26	0.023	0.078																	
4	0.006	0.002	0	0	0.051	0.054	0.073	0.032	0.149	0.047	0.054	0.008	0.003	0.005	0.014	0.025	0.088	0.041	0.124	0.022
0.104	0.031	0.056	0.038																	
5	0.004	0.009	0.01	0.001	0.005	0.061	0.111	0.087	0.089	0.052	0.081	0.003	0.006	0.026	0.014	0.064	0.12	0.157	0.051	0.121
0.178	0.134	0.049	0.143																	
6	0.002	0.005	0.003	0.012	0.018	0.007	0.152	0.049	0.017	0.045	0.04	0.012	0.003	0.01	0.056	0.033	0.109	0.234	0.084	0.023
0.3	0.252	0.054	0.213																	
7	0.02	0.003	0.006	0.014	0.046	0.043	0.002	0.104	0.112	0.06	0.056	0.01	0.007	0.01	0.05	0.054	0.095	0.401	0.137	0.049
0.112	0.068	0.063	0.071																	
8	0.009	0.006	0	0.012	0.019	0.086	0.07	0.037	0.129	0.092	0.034	0.009	0.002	0.007	0.085	0.067	0.033	0.276	0.01	0.097
0.162	0.084	0.057	0.093																	
9	0.038	0.004	0.004	0.015	0.105	0.048	0.131	0.065	0.042	0.134	0.154	0.009	0.002	0.006	0.01	0.031	0.076	0.003	0.125	0.253
0.235	0.215	0.076	0.092																	
10	0.016	0.004	0.003	0.007	0.048	0.123	0.052	0.104	0.109	0.099	0.229	0.042	0.005	0.001	0.082	0.029	0.023	0.175	0.041	0.281
1.102	0.093	0.149	0.49																	

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	1994
3	-4.01	-2.51	0	0	0	0	0	0	0	0	4.48	0.75	1.37	3.27	-0.37	-1.71	0.17	0.17	-0.26	-0.84	0.05	-0.52	-0.2	0.16
4	-0.82	0.24	0	0	0	0	0	0	0	1.88	1.99	0.45	1.74	0.53	0.84	0.3	-2.84	-2.63	0.24	-0.42	-0.09	-1.55	-0.06	0.22
5	-1.84	1.86	0	0	0	0	0	0	0	0	-0.36	-0.69	0.32	1.82	-0.09	-0.26	0	-2.06	-1.47	0.62	0.49	-0.46	0.43	1.78
6	-2.55	-0.19	0	0	0	0	0	0	0	2.15	0.9	-0.85	0	1.39	0.63	-0.58	-0.66	-1.09	-1.07	0.17	1.22	-0.14	-0.27	0.98
7	-0.17	0.54	0	0	0	0	0	0	0	0	0.12	0	-0.94	0.41	0.42	-0.34	0	-1.29	0.01	0.05	0.56	0.27	0.08	0.29
8	-0.7	1.32	0	0	0	0	0	0	0	0.18	0	-1.76	0	0.29	0.87	0.44	0	-1.9	-0.37	0.26	1.12	-0.02	0.03	0.23
9	-0.11	0.81	0	0	0	0	0	0	0	0	0.56	-0.71	0.98	0	-0.41	-0.2	-0.5	-1.76	-1.19	-0.3	0.94	0.85	0.62	0.42

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-9.05	-7.39	-7.21	-7	-7.05	-6.93	-6.81	-6.81
S.E	2	1.37	1.21	1.17	0.54	0.94	0.83	1.66

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	1994
3										0.95	0.98	2.69	0.76	1.08	-0.57	-1.06	-2.41	0.01	-1.19	-0.53	-0.71	0	0	0
4										1.31	-1.42	2.81	2.49	0.14	-0.09	-0.31	-1.79	-1.3	-0.74	-0.48	-0.63	0	0	0
5										0.28	-1.17	2.03	2.45	2.15	-1.04	-0.46	-0.9	-1.07	-1.34	-0.62	-0.33	0	0	0
6										-0.27	-1.02	1.92	2.04	1.05	0.4	-0.65	-0.29	-0.37	-1.22	-1.94	0.34	0	0	0
7										-0.75	-0.86	-1.36	2.03	1.2	2.24	0.24	-0.48	0.41	-0.77	-1.19	-0.71	0	0	0
8										-0.51	0	0.32	-0.12	0.83	-0.77	0.7	-0.24	0.25	-0.32	-0.57	0.44	0	0	0
9										-1.21	-0.04	0	0.77	0	-0.33	-0.7	0.63	-0.57	-0.04	0.89	0.59	0	0	0

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.73	-7	-7.02	-6.98	-7.12	-7.45	-7.29	-7.29
S.E	1.36	1.48	1.41	1.22	1.23	0.54	0.71	1.25

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	1994
3														-0.33	1.47	-0.95	-2.38	0.62	0	0.86	0	0	0.7	0
4														0.44	1.07	-0.24	-0.48	-0.4	0	0.09	0	0	-0.48	0
5														1.35	0	0.11	-0.62	0.17	0	-0.79	0	0	-0.22	0
6														0.5	1.78	-1.16	-1.35	0.99	0	-0.41	0	0	-0.35	0
7														0	0	-0.39	-1.51	1.67	0	0.02	0	0	0.21	0
8														-0.3	0	0	-1.15	0.32	0	1.44	0	0	-0.31	0
9														0	0	0	0	0	0	0	0	0	0	0

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.76	-7.89	-7.79	-8.17	-8.92	-8.22	-8.27	-8.27
S.E	1.32	0.58	0.76	1.14	1.15	0.98	0	1.67

Table 25. Fishing mortalities, population numbers and biomass for Bonavista Bay - Trinity Bay from extended survivors analysis.

Fishing mortality (F) at age

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	0.0001	0.0004	0.0006	0.0002	0	0.0009	0	0	0.0003	0.0339	0.0322	0.0178	0.0175	0.0538	0.0104
4	0.0013	0.0017	0	0.0001	0	0.0056	0.0022	0.0003	0.0001	0.0513	0.0545	0.0726	0.032	0.1488	0.0472
5	0.0004	0.0038	0.0016	0.0004	0.0002	0.0045	0.0086	0.01	0.0013	0.0054	0.0608	0.1112	0.0867	0.089	0.0518
6	0.0036	0.001	0.0009	0.0014	0.0024	0.0018	0.0049	0.0034	0.0121	0.0178	0.0087	0.1523	0.0487	0.0174	0.0445
7	0.0029	0.0001	0.0022	0.0007	0.0041	0.0195	0.0026	0.0064	0.0142	0.0456	0.0427	0.0025	0.1044	0.1119	0.0604
8	0.0046	0.0013	0.0067	0.0044	0.007	0.0086	0.0059	0	0.0123	0.019	0.0859	0.0699	0.037	0.1292	0.0916
9	0.0153	0	0.0089	0.0021	0.013	0.0376	0.0037	0.0039	0.0153	0.1051	0.0479	0.131	0.0649	0.0416	0.1336
10	0.0066	0.0006	0.0047	0.0021	0.0067	0.0161	0.0044	0.0025	0.007	0.0475	0.1235	0.0523	0.1039	0.1093	0.0995
+gp	0.0066	0.0006	0.0047	0.0021	0.0067	0.0161	0.0044	0.0025	0.007	0.0475	0.1235	0.0523	0.1039	0.1093	0.0995
FBAR 5- 8	0.0029	0.0015	0.0029	0.0017	0.0034	0.0086	0.0055	0.005	0.01	0.0219	0.049	0.094	0.0692	0.0869	0.0621
MAX F	0.0153	0.0038	0.0089	0.0044	0.013	0.0376	0.0086	0.01	0.0153	0.1051	0.1235	0.1523	0.1044	0.1488	0.1336
CATCH 11+	300000	35000	61000	294000	212000	522000	213000	1000	1849000	1679000	4306000	5890000	5956000	2E+07	1.23E+07

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	FBAR 92-94
AGE															
3	0.1334	0.0007	0.0004	0.0035	0.0008	0.0107	0.0493	0.2512	0.0422	0.0184	0.0189	0.2596	0.0235	0.0784	0.1205
4	0.0536	0.0078	0.0034	0.0046	0.0135	0.0251	0.0884	0.0407	0.1244	0.0215	0.1044	0.0306	0.0584	0.0384	0.0418
5	0.0806	0.0025	0.0061	0.0262	0.0141	0.0641	0.1199	0.1575	0.0514	0.1215	0.1779	0.1336	0.0493	0.1431	0.1087
6	0.04	0.0121	0.0031	0.0097	0.0557	0.0327	0.1093	0.2341	0.0844	0.0232	0.2999	0.252	0.0537	0.2126	0.1728
7	0.0562	0.0096	0.0075	0.0096	0.0502	0.0536	0.0948	0.4008	0.137	0.0486	0.112	0.0662	0.0629	0.0714	0.0668
8	0.0342	0.0088	0.0024	0.0073	0.0654	0.0667	0.0329	0.276	0.0101	0.0967	0.1622	0.0844	0.0572	0.0933	0.0783
9	0.1537	0.0093	0.0024	0.0058	0.0098	0.0311	0.076	0.0026	0.1251	0.2527	0.2353	0.215	0.076	0.0919	0.1276
10	0.2293	0.042	0.0046	0.0007	0.0816	0.0291	0.0234	0.1752	0.0405	0.2809	1.102	0.0929	0.1486	0.4896	0.2437
+gp	0.2293	0.042	0.0046	0.0007	0.0816	0.0291	0.0234	0.1752	0.0405	0.2809	1.102	0.0929	0.1486	0.4896	
FBAR 5- 8	0.0528	0.0082	0.0048	0.0132	0.0463	0.0543	0.0892	0.2671	0.0707	0.0725	0.188	0.1341	0.0558	0.1301	
MAX F	0.2293	0.042	0.0075	0.0262	0.0816	0.0667	0.1199	0.4008	0.137	0.2809	1.102	0.2596	0.1486	0.4896	
CATCH 11+	1.18E+07	1186000	159000	154000	797000	657000	956000	1247000	508000	466000	891000	653000	1092000	1828000	

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

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	487443	46125	71627	37648	75102	811048	293888	50248	3621	12988	2689	15569	1659	6029	1386
4	12452	399055	37748	58605	30818	61487	663406	240606	41139	2963	10279	2131	12523	1335	4677
5	24158	10181	326150	30905	47978	25231	50060	541932	196937	33680	2305	7970	1623	9930	942
6	25870	19771	8304	266805	25294	39273	20565	40634	439274	161026	27427	1778	5838	1218	7438
7	36256	21105	16171	6792	217977	20659	32096	16755	33154	355309	129517	22305	1249	4553	980
8	43370	29597	17279	13211	5557	177733	16588	26210	13631	26761	277936	101609	18217	921	3333
9	2327	35346	24200	14052	10769	4518	144274	13501	21458	11023	21498	208827	77572	14373	663
10	6679	1876	28938	19639	11480	8703	3563	117687	11010	17303	8125	16779	149976	59518	11288
+gp	50004	65554	14326	151685	35209	35886	54110	434	294518	39862	40814	127359	66465	212712	142633
TOTAL	688558	628610	544744	599142	460185	1184639	1278548	1048006	1054743	660915	520590	504325	335120	310590	173341
REVISED +gp	21794	10181	7595	73879	18108	15598	27440	111	134326	18536	40810	45885	66173	159162	107914
REVISED TOTAL	660349	573237	538012	521336	443081	1164250	1251880	1047684	894550	639589	520588	422851	334830	257039	138621
MEAN WGT +gp	0.343	0.343	0.343	0.343	0.343	0.343	0.343	0.343	0.343	0.343	0.343	0.343	0.39	0.335	0.348

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	GMST 66-91	AMST 66-91	
AGE																		
3	2177	13450	10284	7048	242628	45905	9498	49307	27884	187942	12382	5104	29557	5660	0	24307	97137	0.081
4	1123	1559	11005	8416	5749	198488	37183	7402	31402	21886	151074	9947	3223	23637	4292	19542	79020	0.144
5	3653	872	1267	8978	6859	4644	158486	27869	5819	22703	17537	111428	7899	2494	18655	14570	60333	0.198
6	732	2759	712	1031	7162	5537	3566	115092	19492	4525	16462	12018	79818	6156	1773	11706	48745	0.224
7	5824	576	2232	581	836	5548	4388	2617	74559	14667	3620	9686	7648	61930	4082	9608	39628	0.255
8	756	4508	467	1814	471	651	4304	3267	1435	53227	11439	2650	7652	5880	47290	8300	32857	0.295
9	2490	598	3659	381	1474	361	498	3409	2030	1163	39562	7963	1994	5916	4394	6178	25388	0.308
10	475	1748	485	2989	310	1195	287	378	2784	1467	740	25600	5258	1513	4429	4530	18870	0.306
+gp	63092	31823	38484	229735	11212	25276	45605	8537	14110	2090	1446	8113	8704	5168	3352			0.345
TOTAL	80322	57894	68594	260972	276701	287603	263814	217879	179517	309670	254261	192808	151752	118354	88266			
REVISED +gp	63091	31783	23476	6568	11207	11222	8317	4139	4368	2090	1446	3138	8704	5168				
REVISED TOTAL	80321	57863	53587	37805	276696	273549	227527	213480	169773	309670	254262	187834	151753	118354				
MEAN WGT +gp	0.365	0.365	0.441	0.387	0.393	0.399	0.397	0.421	0.411	0.421	0.387	0.34	0.343	0.345				

Stock biomass at age (start of year) Tonnes

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	64830	6135	9526	5007	9989	107869	39087	6683	482	1727	358	2071	232	838	201
4	2478	79412	7512	11662	6133	12236	132018	47881	8187	590	2048	424	2630	274	982
5	5194	2189	70122	6645	10315	5425	10763	116515	42342	7241	496	1714	406	2482	250
6	6157	4705	1976	63452	6020	9347	4894	9671	104547	38324	6528	423	1606	314	2246
7	9209	5361	4106	1725	55366	5247	8152	4256	8421	90248	32897	5666	393	1220	305
8	11840	8080	4717	3607	1517	48521	4528	7155	3721	7306	75876	27739	6012	252	1057
9	689	10463	7163	4159	3188	1337	42705	3996	6352	3263	6363	61813	27150	4096	219
10	2044	574	8855	6009	3513	2663	1090	36012	3369	5295	2486	5134	55491	17817	3522
+gp	17151	22485	4914	52028	12077	12343	18560	149	101020	13673	13999	43684	25921	71259	49636
TOTALBIO	119592	139403	118894	154295	108117	204989	261798	232318	278440	167667	141049	148667	119840	98353	58418
REVISED +gp	7475	3492	2605	25341	6210	5350	9412	38	46074	6358	13998	15739	25807	53319	37554
REVISED TOTAL	109916	120411	116584	127607	102251	197995	252649	232207	223495	160352	141048	120723	119727	80412	46336
5+ BIOMASS	42608	34864	99546	110938	86129	77890	81544	177643	214826	158035	138644	118228	116865	79300	45153

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE															
3	359	2219	2304	916	28630	5555	1292	6361	4099	27064	1834	679	3192	458	0
4	275	382	2839	1624	1144	37316	7623	1451	6657	4793	30517	1731	548	3404	618.048
5	1067	255	385	2164	1605	1091	35184	6483	1443	5948	4507	24068	1667	494	3693.69
6	234	883	236	298	1962	1539	956	29348	5166	1231	4724	3077	19078	1379	397.152
7	1893	187	781	183	252	1658	1312	746	20877	4180	1035	2866	2172	15792	1040.91
8	255	1519	173	595	162	213	1369	1039	421	16713	3306	760	2380	1735	13950.55
9	877	210	1405	127	500	130	197	1221	656	411	12739	2246	596	1822	1353.352
10	170	628	185	1022	113	437	94	140	966	531	251	7859	1625	463	1355.274
+gp	23029	11618	16971	88907	4406	10085	18105	3594	5799	880	560	2758	2985	1783	1156.44
TOTALBIO	28158	17899	25280	95837	38774	58024	86130	50383	46083	61750	59273	46044	34241	27330	
REVISED +gp	23028	11604	10353	2542	4404	4478	3699	1742	1795	880	560	1067	2885	1783	
REVISED TOTAL	28158	17887	18661	9471	38772	52417	51726	48541	42080	61751	59273	44353	34241	27330	23565.42
5+ BIOMASS	27524	15288	13518	6931	8998	9546	42811	40729	31324	29894	27122	41943	30501	23468	22947.37

Table 26. Results of extended survivors analysis for St. Mary's Bay - Placentia Bay spring spawning herring.

Data for 2 fleets over 29 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

Fishing mortalities

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	1994															
3	0.013	0.002	0.011	0.064	0.146	0.212	0.203	0.097	0.098	0.136	0.376	0.068	0	0	0.001	0	0	0.002	0	0.006
0.006	0.003	0.026	0.169	0.046																
4	0.043	0.017	0.114	0.005	0.06	0.389	0.282	0.104	0.173	0.218	0.036	0.073	0.001	0.001	0.001	0.002	0.004	0	0.003	0.002
0.042	0.014	0.024	0.023	0.018																
5	0.007	0.026	0.138	0.119	0.01	0.049	0.296	0.167	0.125	0.338	0.178	0.039	0.007	0.002	0.025	0.001	0.003	0.018	0.048	0
0.014	0.045	0.029	0.048	0.031																
6	0.012	0.012	0.081	0.152	0.155	0.17	0.117	0.193	0.198	0.136	0.323	0.082	0.003	0.005	0.004	0.018	0.002	0.008	0.1	0.009
0.003	0.047	0.085	0.019	0.033																
7	0.122	0.051	0.071	0.145	0.188	0.22	0.131	0.029	0.213	0.322	0.111	0.132	0.006	0.002	0.01	0.012	0.01	0.004	0.028	0.025
0.014	0.003	0.019	0.057	0.028																
8	0.062	0.011	0.182	0.023	0.187	0.078	0.13	0.23	0.079	0.486	0.44	0.073	0.007	0.003	0.016	0.012	0.004	0.012	0.021	0.01
0.033	0.063	0.018	0.033	0.037																
9	0.047	0.013	0.113	0.068	0.044	0.152	0.148	0.123	0.169	0.064	0.418	0.122	0.013	0.006	0.003	0.02	0.005	0.004	0.026	0.012
0.017	0.042	0.055	0.026	0.055																
10	0.053	0.018	0.093	0.063	0.127	0.149	0.143	0.137	0.174	0.249	0.344	0.105	0.008	0.004	0.008	0.019	0.005	0.008	0.054	0.01
0.027	0.041	0.041	0.054	0.093																

Log catchability residuals.

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	1994
3	-0.29	0	2.48	-2.18	0	0	0	0	0	0	0	0	-2.43	-0.93	0.82	0.17	-2.9	0.47	-1.12	1.38	-0.58	1.17	0.34	2.2	1.6
4	1.37	0	-2.07	0	0	0	0	0	0	0	0	0	-1.78	-0.32	-0.47	-0.71	0.74	-1.35	-0.9	-0.35	1.03	-0.11	0.45	0.38	4.11
5	1.41	0	3.59	-0.16	0	0	0	0	0	0	0	0	-0.89	-1.41	0.79	-1.4	-0.49	0.79	-1.01	-1.89	-0.54	0.18	-0.22	1.1	0.13
6	1.73	0	-1.03	-0.25	0	0	0	0	0	0	0	0	-0.98	0.81	0.07	1.3	-0.34	0.32	0.91	-0.23	-1.11	-0.85	-0.16	-0.29	0.31
7	3.25	0	2.85	-0.86	0	0	0	0	0	0	0	0	-1.58	-0.07	0.41	-0.06	0.63	-0.33	-0.3	0.53	0.13	-2.35	-0.88	-0.56	-0.84
8	3.54	0	1.54	-3.28	0	0	0	0	0	0	0	0	-0.83	-0.68	0.87	1.47	0.24	0.97	-0.33	-0.71	0.84	-0.91	-1.78	-0.52	-0.44
9	1.99	0	0.92	-1.28	0	0	0	0	0	0	0	0	-0.23	0.87	-1	1.42	-1.2	0.4	1.07	-0.07	-0.65	-0.62	-0.35	-1.3	0.23

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-6.9	-6.5	-6.16	-6.45	-6.24	-6.24	-6.41	-6.41
S.E	1.61	1.51	1.35	0.83	1.42	1.56	1.01	1.9

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	1994
3																	-1.5	0	0	0	-0.46	0	-1.1	0	3.06
4																	-0.22	0	0	0	-0.42	0	-1.44	0	2.09
5																	-1.13	0	0	0	-0.4	0	-0.29	0	1.82
6																	-1.72	0	0	0	-1.14	0	1.04	0	1.82
7																	0	0	0	0	0.73	0	-0.77	0	0.04
8																	0	0	0	0	1.75	0	-1.46	0	-0.3
9																	0	0	0	0	0.25	0	-0.25	0	0

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-6.61	-5.51	-7.18	-7.45	-7	-7.54	-6.71	-6.71
S.E	2.08	1.49	1.27	1.7	0.75	1.63	0.35	0.72

Table 27. Fishing mortalities, population numbers and biomass for St. Mary's Bay - Placentia Bay from extended survivors analysis.

Fishing mortality (F) at age

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	0.0373	0.0001	0.0356	0.0049	0.0127	0.0024	0.0109	0.0643	0.1456	0.2118	0.2034	0.097	0.0957	0.1364	0.3757
4	0.0269	0.1085	0.0031	0.0055	0.0428	0.0167	0.1144	0.005	0.06	0.3885	0.2821	0.1038	0.1729	0.2176	0.0365
5	0.0227	0.0519	0.579	0.007	0.0073	0.0258	0.1378	0.1192	0.0101	0.0486	0.2958	0.1669	0.1249	0.3384	0.1777
6	0.0386	0.0772	0.1795	0.1179	0.0123	0.0123	0.081	0.1519	0.1546	0.1697	0.117	0.1934	0.198	0.1356	0.3231
7	0.1213	0.2624	0.2491	0.0412	0.1216	0.0513	0.0713	0.1451	0.1676	0.2201	0.1305	0.0288	0.2129	0.3224	0.1113
8	0.0919	0.1273	0.5854	0.0284	0.0519	0.0111	0.1823	0.0233	0.1873	0.0776	0.1301	0.2298	0.0787	0.4859	0.4395
9	0.1466	0.0381	0.3916	0.1064	0.0471	0.0129	0.1125	0.0879	0.0436	0.152	0.1457	0.1229	0.169	0.0643	0.418
10	0.1005	0.1274	0.3567	0.0743	0.0526	0.0182	0.0932	0.0831	0.127	0.1486	0.1432	0.1367	0.1738	0.2485	0.344
+gp	0.1005	0.1274	0.3567	0.0743	0.0526	0.0182	0.0932	0.0831	0.127	0.1486	0.1432	0.1367	0.1738	0.2485	0.344
FBAR 5- 8	0.0686	0.1297	0.3982	0.0486	0.0483	0.0251	0.1181	0.1099	0.1299	0.129	0.1684	0.1547	0.1536	0.3206	0.2629
MAX F	0.1466	0.2624	0.5854	0.1179	0.1216	0.0513	0.1823	0.1519	0.1873	0.3885	0.2958	0.2298	0.2129	0.4859	0.4395
CATCH 11+	993000	787000	3680000	348000	107000	96000	403000	315000	624000	1323000	1381000	2448000	2185000	4785000	2971000

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	FBAR 92-94
AGE															
3	0.0657	0.0005	0.0002	0.0009	0.0001	0.0002	0.0023	0.0001	0.0084	0.006	0.0028	0.0255	0.1695	0.0456	0.0802
4	0.0731	0.0009	0.0011	0.0011	0.0023	0.0036	0.0005	0.0033	0.0016	0.0417	0.0143	0.0242	0.0231	0.0184	0.0219
5	0.0386	0.0066	0.0016	0.0249	0.0015	0.003	0.0158	0.0476	0.0002	0.0142	0.045	0.0291	0.0481	0.0307	0.036
6	0.0825	0.0035	0.0054	0.0039	0.0181	0.0019	0.0056	0.1	0.0088	0.0033	0.0474	0.0646	0.0188	0.0334	0.0456
7	0.1323	0.0062	0.0021	0.01	0.0119	0.0096	0.0038	0.0284	0.0245	0.0136	0.0033	0.0194	0.0567	0.0281	0.0347
8	0.0733	0.0072	0.0025	0.0157	0.0124	0.0039	0.0119	0.0213	0.0101	0.0329	0.0633	0.0178	0.0326	0.0369	0.0291
9	0.1219	0.0134	0.0057	0.0031	0.0204	0.0051	0.0036	0.0262	0.0124	0.0165	0.0416	0.0552	0.0284	0.0552	0.0456
10	0.1054	0.0079	0.0041	0.0078	0.0192	0.005	0.0063	0.0542	0.0102	0.0267	0.0406	0.0411	0.0539	0.0934	0.0828
+gp	0.1054	0.0079	0.0041	0.0078	0.0192	0.005	0.0063	0.0542	0.0102	0.0267	0.0406	0.0411	0.0539	0.0934	
FBAR 5- 8	0.0817	0.0059	0.0029	0.0136	0.011	0.0046	0.0093	0.0493	0.0109	0.016	0.0397	0.0377	0.039	0.0323	
MAX F	0.1323	0.0134	0.0057	0.0249	0.0204	0.0096	0.0158	0.1	0.0245	0.0417	0.0633	0.0846	0.1695	0.0934	
CATCH 11+	466000	69000	39000	44000	125000	30000	11000	147000	34000	128000	948000	965000	1174000	998000	

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

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	32189	12617	13861	143563	9561	255013	21069	5789	2284	12935	2348	17020	2120	5745	1172
4	4332	25389	10329	10951	116970	7729	208283	17063	4444	1617	8569	1569	12647	1577	4104
5	5611	3453	18650	8430	8917	91755	6223	152092	13900	3427	898	5291	1158	8711	1039
6	4791	4491	2684	8558	6854	7248	73212	4439	110525	11266	2673	547	3666	836	5084
7	18503	3774	3404	1837	6228	5543	5881	55278	3122	77525	7784	1947	369	2462	598
8	16129	13419	2377	2172	1443	4515	4311	4469	39144	2162	50933	5593	1549	244	1480
9	1110	12045	9673	1084	1729	1122	3656	2941	3575	26575	1638	36614	3639	1172	123
10	497	785	9493	5354	798	1350	907	2675	2208	2802	18689	1159	26511	2516	900
+gp	11443	7243	13454	5354	2301	5881	4989	4352	5761	10547	11229	21092	15068	23895	11197
TOTAL	94605	83216	83926	187302	154801	380156	328512	249097	184960	148856	104762	90832	66726	47159	25676
REVISED +gp	8015	3746	9075	3446	1029	2116	2660	2460	4018	4505	5836	13106	12527	13606	9150
REVISED TOTAL	91177	79719	79546	185395	153529	376391	326182	247206	183218	142814	99368	82846	64188	36871	23630
MEAN WGT +gp	0.383	0.383	0.383	0.383	0.383	0.369	0.351	0.356	0.339	0.345	0.349	0.351	0.38	0.391	0.437

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	GMST 66-91	AMST 66-91	
AGE																		
3	3352	2421	30563	10595	53007	5782	9148	7517	6305	21281	397	2059	440	3397	0	9215	26448	0.115
4	659	2570	1981	25019	8666	43392	4733	7471	6154	5119	17320	324	1644	304	2706	7862	21487	0.168
5	3240	501	2102	1620	20462	7079	35397	3873	6096	5030	4020	13979	259	1315	249	5815	16114	0.219
6	712	2552	408	1719	1294	16728	5778	28527	3024	4990	4060	3146	11117	202	1063	4427	12179	0.249
7	3013	537	2082	332	1402	1040	13671	4705	21132	2454	4072	3171	2367	8932	163	3559	9564	0.291
8	438	2161	437	1701	269	1134	844	11150	3744	16883	1982	3323	2546	1831	7245	2812	7333	0.322
9	770	333	1757	357	1371	218	925	683	8936	3035	13375	1523	2673	2018	1473	2028	5325	0.332
10	66	558	269	1430	291	1100	177	754	544	7228	2444	10505	1180	2131	1594	1350	3519	0.33
+gp	5129	9615	10482	6282	7263	6588	1947	3073	3695	5366	26266	26406	24676	12327	10813			0.384
TOTAL	17380	21249	50082	49054	94025	83061	72617	67752	59631	71384	73937	64436	46901	32458	25305			
REVISED +gp	4140	5718	7570	1973	6827	3464	774	1702	1549	3455	17034	13107	8285	12329				
REVISED TOTAL	16390	17351	47169	44746	93589	79937	71445	66382	57484	69473	64704	51137	30511	32459				
MEAN WGT +gp	0.419	0.431	0.431	0.433	0.411	0.458	0.447	0.419	0.43	0.408	0.362	0.382	0.372	0.384				

Stock biomass at age (start of year) Tonnes

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	5215	2044	2246	23257	1549	34172	3245	926	363	1979	383	2621	329	885	213
4	858	5027	2045	2168	23160	1308	39574	3549	947	340	2022	380	3035	382	964
5	1296	798	4308	1947	2060	20094	1425	33764	3183	833	224	1513	341	2552	322
6	1289	1208	722	2302	1844	1790	18889	1070	28747	2873	730	163	1155	274	1713
7	5273	1076	970	523	1775	1607	1629	15148	840	21087	2040	592	120	894	216
8	4968	4133	732	669	444	1282	1267	1251	11352	620	14363	1734	511	98	572
9	349	3782	3037	340	543	333	1130	871	1097	8158	495	11643	1219	452	50
10	170	268	3237	1826	272	470	296	835	684	877	6074	374	9279	881	339
+gp	4383	2774	5153	2050	881	2170	1751	1549	1953	3639	3919	7403	5726	9343	4893
TOTALBIO	23799	21109	22451	35084	32528	63225	69206	58961	47165	40406	30249	26424	21715	15759	9284
REVISED +gp	3070	1435	3476	1320	394	781	934	876	1362	1554	2037	4600	4760	5321	3999
REVISED TOTAL	22488	19771	20773	34352	32041	61835	68389	58288	46575	38321	28368	23620	20749	11737	8388
5+ BIOMASS	16415	12700	16482	8927	7332	26357	25570	53813	45265	36002	25963	20619	17385	10470	7211

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
AGE																
3	563	397	5012	1875	7050	937	1674	1233	1028	3448	56	282	57	391	0	
4	144	609	470	5754	1829	9329	1051	1733	1360	1239	3672	62	311	51	454.608	
5	972	140	589	426	4931	1855	9345	1011	1622	1373	1037	3383	56	288	54.531	
6	229	796	127	517	365	4768	1699	8130	819	1452	1129	868	2968	50	264.687	
7	1073	187	727	114	443	320	4238	1435	6530	763	1214	926	691	2599	47.433	
8	163	810	164	629	89	424	287	3568	1228	5791	599	994	777	590	2332.89	
9	287	126	664	133	477	77	342	225	3065	1099	4427	480	847	670	489.036	
10	25	221	106	535	112	430	67	264	189	2652	846	3477	389	703	526.02	
+gp	2149	4144	4518	2720	2985	3017	870	1288	1589	2179	9508	9559	9179	4734	4152.192	
TOTALBIO	5604	7431	12377	12704	18282	21157	19572	18887	17430	19995	22487	20031	15275	10076		
REVISED +gp	1735	2485	3263	854	2806	1586	346	713	668	1403	6168	4745	3082	4734		
REVISED TOTAL	5191	5751	11122	10837	18102	19726	19049	18312	16507	19220	19146	15217	9178	10076	8321.397	
5+ BIOMASS	4484	4745	5640	3208	9223	9460	18324	15348	14119	14533	15418	14873	8810	9634	7866.789	

Table 28. Results of extended survivors analysis for Fortune Bay spring spawning herring.

Data for 2 fleets over 29 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 = .245
Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .003

Fishing mortalities

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	1994															
3	0.37	0.399	0.289	0.433	0.618	0.095	0.036	0.161	0.058	0.003	0.064	0.243	0	0	0.001	0.001	0	0.001	0.002	0
0	0.005	0.001	0.004	0.003																
4	0.208	0.811	0.708	0.113	0.502	0.62	0.15	0.077	0.317	0.386	0.009	0.064	0.007	0.001	0.001	0.004	0.002	0.001	0.001	0.002
0	0.002	0.008	0.002	0.002																
5	0.055	0.797	1.298	0.452	0.334	0.176	0.53	0.228	0.278	1.059	0.244	0.015	0.02	0.003	0.001	0.011	0.008	0.005	0.001	0.001
0.005	0.003	0	0.007	0.004																
6	0.019	0.932	1.145	0.758	0.784	0.392	0.316	0.971	0.257	0.1	1.119	0.015	0.005	0.008	0.007	0.005	0.024	0.022	0.005	0.016
0.003	0.003	0	0.043	0.009																
7	0.688	0.655	0.837	0.538	1.307	0.67	0.077	0.098	0.733	0.286	0.062	0.048	0.012	0.006	0.01	0.009	0.011	0.021	0.017	0.007
0.013	0.002	0.004	0.001	0.004																
8	0.688	0.772	2.051	0.404	0.812	0.236	0.307	0.481	1.07	0.167	0.596	0.022	0.109	0.006	0.014	0.013	0.032	0.012	0.014	0.003
0.005	0.008	0.002	0.015	0.014																
9	0.051	1.156	0.513	0.747	0.357	0.222	1.32	0.28	2.427	0.517	0.045	0.134	0.014	0.04	0.009	0.009	0.016	0.027	0.005	0.011
0.066	0.011	0.003	0.023	0.056																
10	0.365	0.892	1.156	0.618	0.828	0.385	0.513	0.466	1.156	0.278	0.477	0.058	0.039	0.017	0.01	0.011	0.022	0.02	0.008	0.011
0.017	0.005	0.004	0.021	0.029																

Log catchability residuals.

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	1994
3	0	-1.52	0	0	0	0	0	0	0	0	0	0	-1.68	0.69	0	-1.56	0	0	0	1.22	2.17	1.47	-0.66	0	-0.11
4	-0.55	-0.74	0	0	0	0	0	0	0	0	0	0	-0.65	-0.7	0.22	0.03	-0.13	0	0	-0.6	-2.26	0.53	1.8	0	3.04
5	-1.24	-0.41	0	0	0	0	0	0	0	0	0	0	-0.68	0.34	-0.51	1.97	0.57	0.13	-1.26	-1.96	0	-0.11	-0.22	2.12	1.26
6	-2.34	-0.05	0	0	0	0	0	0	0	0	0	0	-3.21	0.79	0.48	0.96	0.72	0.68	-0.29	0.19	0	-0.22	-0.94	0.43	2.8
7	0.58	-1.17	0	0	0	0	0	0	0	0	0	0	-2.18	0.26	0.13	1.85	0.89	0.86	0.81	0.48	-0.45	-0.96	-0.73	-1.49	1.34
8	-0.79	0.03	0	0	0	0	0	0	0	0	0	0	0.05	0.18	0.42	1.23	1.15	-0.2	0.47	0.99	-0.82	0.83	-1.47	0.07	-2.16
9	-0.25	0	0	0	0	0	0	0	0	0	0	0	-1.69	2.04	-2.1	1.24	-0.59	0.36	-0.88	0.68	1.21	-0.45	-0.76	0	1.19

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.18	-5.66	-4.86	-4.47	-4.55	-4.1	-3.81	-3.81
S.E	1.45	1.35	1.19	1.46	1.13	0.97	1.24	1.61

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	1994
3																	0	0	0	0	1.23	0	-1.23	0	0
4																	-1.2	0	0	0	-0.38	0	1.58	0	0
5																	0.06	0	0	0	-0.12	0	0.06	0	0
6																	0.47	0	0	0	0.02	0	-0.49	0	0
7																	-1.06	0	0	0	1.06	0	0	0	0
8																	1.24	0	0	0	-0.82	0	-0.42	0	0
9																	0.38	0	0	0	-0.76	0	0.38	0	0

Mean catchability and Standard error.

Age	3	4	5	6	7	8	9	10
Mean Q	-7.76	-7.14	-7.06	-7.78	-5.95	-6.65	-5.12	-5.12
S.E	1.73	1.43	0.11	0.48	1.49	1.09	0.66	2.25

Table 29. Fishing mortalities, population numbers and biomass for Fortune Bay from extended survivors analysis.

Fishing mortality (F) at age

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	0.0014	0.0032	0.0331	0.1421	0.3698	0.3986	0.2887	0.4325	0.618	0.0949	0.0358	0.1612	0.0584	0.0025	0.0638
4	0.0073	0.207	0.014	0.0277	0.2059	0.8107	0.7077	0.1131	0.5016	0.6196	0.1503	0.0771	0.3173	0.3858	0.0094
5	0.0152	0.0324	0.8004	0.0102	0.0551	0.7973	1.2855	0.4519	0.3339	0.176	0.5299	0.2278	0.2782	1.0589	0.2444
6	0.0206	0.0425	0.2092	0.5144	0.0191	0.9323	1.1451	0.7582	0.7841	0.3916	0.3158	0.9713	0.2568	0.0996	1.1187
7	0.006	0.127	0.1442	0.2842	0.688	0.655	0.8366	0.5381	1.3065	0.6704	0.0769	0.0959	0.7325	0.2863	0.0615
8	0.0103	0.0511	0.2732	0.5088	0.6884	0.7725	2.0505	0.404	0.8125	0.2364	0.3074	0.4807	1.0698	0.1666	0.5962
9	0.0046	0.0749	0.1159	0.5693	0.0509	1.1564	0.513	0.7471	0.3565	0.2215	1.3201	0.2803	2.4272	0.5172	0.0453
10	0.0104	0.0741	0.1867	0.4737	0.3646	0.8918	1.1562	0.618	0.8278	0.3852	0.5125	0.4658	1.1559	0.2778	0.4767
+gp	0.0104	0.0741	0.1867	0.4737	0.3646	0.8918	1.1562	0.618	0.8278	0.3852	0.5125	0.4658	1.1559	0.2778	0.4767
FBAR 5- 8	0.013	0.0632	0.3567	0.3294	0.3626	0.7893	1.3319	0.538	0.8092	0.3686	0.3075	0.4439	0.5843	0.4028	0.5052
MAX F	0.0206	0.207	0.8004	0.5693	0.6884	1.1564	2.0505	0.7582	1.3065	0.6704	1.3201	0.9713	2.4272	1.0589	1.1187
CATCH 11+	17000	138000	815000	1706000	257000	537000	368000	173000	255000	201000	140000	244000	302000	167000	50000

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	FBAR 92-94
AGE															
3	0.2426	0.0002	0.0004	0.0011	0.0006	0.0005	0.0008	0.0018	0.0002	0.0001	0.0049	0.0013	0.0038	0.0027	0.0026
4	0.0839	0.007	0.0006	0.0009	0.0039	0.002	0.0008	0.001	0.0022	0.0003	0.002	0.006	0.0016	0.0023	0.0033
5	0.0154	0.0202	0.0029	0.0011	0.0109	0.0064	0.0052	0.0007	0.0013	0.0053	0.0026	0.0003	0.0073	0.004	0.0039
6	0.0148	0.0048	0.0084	0.007	0.0053	0.024	0.022	0.0046	0.0161	0.0031	0.0033	0.0004	0.0426	0.009	0.0173
7	0.0483	0.0122	0.0058	0.0103	0.0087	0.0109	0.0213	0.0174	0.0071	0.0133	0.0019	0.004	0.001	0.0039	0.003
8	0.0224	0.1093	0.0075	0.0144	0.0127	0.0324	0.0122	0.014	0.0031	0.0049	0.0082	0.0023	0.0148	0.0138	0.0103
9	0.1337	0.0139	0.04	0.0093	0.0089	0.0158	0.0272	0.005	0.0114	0.0659	0.0107	0.0034	0.0228	0.0562	0.0275
10	0.0582	0.0387	0.0173	0.01	0.0115	0.0221	0.0196	0.0085	0.0113	0.0165	0.0049	0.0036	0.0208	0.0285	0.0177
+gp	0.0582	0.0387	0.0173	0.01	0.0115	0.0221	0.0196	0.0085	0.0113	0.0165	0.0049	0.0036	0.0208	0.0285	
FBAR 5- 8	0.0252	0.0366	0.0082	0.0082	0.0094	0.0184	0.0151	0.0092	0.0069	0.0067	0.004	0.0018	0.0164	0.0077	
MAX F	0.2426	0.1093	0.04	0.0144	0.0127	0.0324	0.0272	0.0174	0.0161	0.0659	0.0107	0.006	0.0426	0.0562	
CATCH 11+	12000	5000	18000	23000	15000	14000	38000	10000	24000	1000	72000	266000	217000	647000	

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

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	179030	30816	4345	99967	21407	78065	1128	2911	3150	3382	471	15613	818	436	286
4	1963	146376	25150	3441	71002	12109	42901	692	1547	1390	2518	372	10880	632	356
5	1613	1595	97435	20304	2741	47316	4407	17308	506	787	613	1774	282	6486	352
6	4876	1301	1264	35831	16454	2123	17453	988	9019	297	527	295	1156	175	1842
7	12278	3911	1021	840	17539	13217	684	4547	379	3371	164	314	92	732	130
8	9700	9992	2820	724	517	7217	5621	243	2174	84	1412	125	234	36	450
9	6795	7860	7774	1757	356	213	2729	592	133	790	54	850	63	66	25
10	214	5538	5971	5668	814	277	55	1338	230	76	518	12	526	5	32
+gp	1815	2128	5523	4950	923	989	578	410	493	689	382	717	477	756	144
TOTAL	218283	209517	151302	173482	131754	161528	75558	29029	17630	10848	6659	20073	14528	9323	3617
REVISED +gp	920	812	1611	4296	563	848	449	355	378	449	206	426	352	277	80
REVISED TOTAL	217389	208201	147391	172828	131393	161385	75427	28974	17516	10606	6483	19781	14403	8845	3553
MEAN WGT +gp	0.455	0.447	0.43	0.427	0.408	0.417	0.397	0.422	0.374	0.417	0.419	0.375	0.396	0.397	0.399

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	GMST 66-91	AMST 66-91	
AGE																		
3	739	4557	5936	1032	96856	2270	1318	623	5082	15842	228	821	588	2055	0	4072	22158	0.114
4	220	475	3730	4858	844	79068	1858	1078	509	4160	12970	186	671	478	1761	3258	16581	0.157
5	289	165	386	3052	3974	688	64819	1520	882	416	3405	10598	151	549	409	2106	10881	0.195
6	225	233	133	315	2496	3218	560	52631	1244	721	339	2781	8874	123	463	1379	5989	0.214
7	493	182	190	108	256	2033	2572	448	42892	1002	588	277	2276	6806	104	972	4230	0.257
8	100	384	147	154	87	208	1646	2062	361	34869	809	481	225	1861	5780	691	3161	0.279
9	203	80	282	120	125	71	165	1332	1664	295	28408	657	393	182	1537	443	2415	0.294
10	20	145	64	222	97	101	57	131	1085	1347	226	23011	536	314	140	217	953	0.32
+gp	234	145	1159	2547	1452	706	2157	1310	2362	67	16226	81472	11614	25371	20444			
TOTAL	2522	6367	12026	12408	105987	88381	74952	61135	56081	58719	63200	120282	25127	37738	30639			
REVISED +gp	61	53	506	1775	1311	484	1562	639	1658	17	7463	49056	5737	13050	10515.8			0.362
REVISED TOTAL	2350	6274	11374	11636	105846	88159	74357	60464	55377	58669	54438	87868	19249	25418				
MEAN WGT +gp	0.411	0.42	0.426	0.441	0.439	0.474	0.46	0.462	0.463	0.421	0.372	0.387	0.355	0.382				

Stock biomass at age (start of year) Tonnes

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
AGE															
3	26317	4345	552	12196	2847	10695	178	457	482	538	62	1842	126	70	61
4	414	27372	5407	678	13561	2349	8838	152	317	307	509	77	2274	143	83
5	463	426	23482	5137	702	11167	1031	4431	116	194	153	481	74	1693	96
6	1380	388	316	9244	4426	590	4782	282	2498	88	150	87	346	45	565
7	3745	1275	311	218	5420	4177	221	1398	105	1085	53	93	29	237	49
8	3434	3258	984	227	177	2367	1967	88	676	27	484	38	77	13	154
9	2799	3018	2806	520	121	76	961	220	37	276	20	275	22	23	9
10	85	2309	2353	1961	374	102	19	508	81	27	195	4	189	2	12
+gp	826	951	2375	2114	376	413	230	173	184	287	160	269	189	300	58
TOTALBIO	39463	43342	38566	32295	28005	31935	18227	7705	4496	2828	1786	3147	3326	2525	1086
REVISED +gp	418	383	693	1834	230	354	178	150	141	187	86	160	140	110	32
REVISED TOTAL	39055	42754	36884	32015	27858	31877	18175	7682	4453	2727	1712	3037	3277	2336	1061
5+ BIOMASS	12324	11037	30925	19141	11450	18833	9159	7073	3654	1882	1141	1118	877	2123	917

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
AGE																
3	107	715	973	175	14208	331	191	90	732	2297	31	113	70	234	0	
4	49	105	888	1074	170	16529	379	216	92	894	2412	32	119	75	276.477	
5	79	46	102	787	997	167	15961	359	184	105	793	2215	34	107	79.755	
6	73	82	42	97	716	920	164	14473	313	193	83	706	2082	26	99.082	
7	180	65	69	36	81	646	831	132	12696	293	162	80	639	1749	26.728	
8	36	148	53	57	32	77	579	682	119	11228	234	142	67	519	1612.62	
9	72	31	113	52	46	29	62	470	579	100	9062	203	112	53	451.878	
10	7	58	27	89	38	42	24	51	410	480	76	7571	154	101	44.8	
+gp	96	61	494	1123	637	335	992	605	1094	28	6036	29900	4123	9184		
TOTALBIO	700	1311	2760	3491	16927	19077	19184	17079	16219	15618	18890	40961	7399	12049		
REVISED +gp	25	22	216	783	576	230	718	295	767	7	2776	18004	2037	4724	3806.719	
REVISED TOTAL	628	1272	2483	3150	16864	18971	18909	16768	15892	15597	15629	29066	5314	7588		
5+ BIOMASS	472	452	622	1901	2486	2111	18339	16462	15068	12406	13188	28921	5125	7279	6121.582	

Table 30. 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	46	602.18	13.09	11.63	0.0001
Error	177	199.29	1.13		
Corrected Total	223	801.48			

	R-Square	C.V.	Root MSE	LOGCATCH Mean
	0.751	46.35	1.061	2.29

Source	DF	Type I SS	Mean Square	F Value	Pr > F
COHORT	20	467.480	23.374	20.76	0.0001
SAGE	26	134.705	5.181	4.60	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
COHORT	20	371.727	18.586	16.51	0.0001
SAGE	26	134.705	5.181	4.60	0.0001

Parameter		Estimate	T for HO: Parameter=0	Pr > ITI	Std Error of Estimate
INTERCEPT					
COHORT	1971	0.666	0.48	0.6346	1.399
	1972	2.760	2.39	0.0179	1.154
	1973	0.808	0.80	0.4255	1.011
	1974	3.609	3.77	0.0002	0.957
	1975	0.919	0.99	0.3232	0.927
	1976	3.229	3.56	0.0005	0.907
	1977	2.154	2.41	0.0170	0.893
	1978	2.160	2.46	0.0150	0.879
	1979	4.372	5.02	0.0001	0.871
	1980	3.354	3.86	0.0002	0.869
	1981	2.878	3.34	0.0010	0.862
	1982	5.767	6.76	0.0001	0.853
	1983	4.312	5.50	0.0001	0.853
	1984	1.875	2.20	0.0293	0.853
	1985	2.750	3.24	0.0014	0.848
	1986	3.113	3.64	0.0004	0.854
	1987	5.552	6.38	0.0001	0.866
	1988	3.351	3.71	0.0003	0.902
	1989	1.631	1.74	0.0832	0.936
	1990	3.549	3.50	0.0006	1.013
	1991				
SAGE	a1	-1.077	-1.83	0.0696	0.590
	a2	0.442	0.76	0.4474	0.580
	a3	0.680	-1.19	0.2370	0.573
	a4	-0.614	-1.07	0.2840	0.571
	a5	-0.446	-0.75	0.4567	0.598
	a6	-0.544	-0.94	0.3460	0.576
	a7	-1.118	-1.93	0.0546	0.578
	a8	-1.683	-2.88	0.0045	0.584
	a9	-2.338	-3.95	0.0001	0.592
	a10	-1.839	-3.05	0.0026	0.602
	f2	-2.254	-4.33	0.0001	0.521
	f3	-0.613	-1.18	0.2386	0.518
	f4	0.029	0.06	0.9547	0.517
	f5	0.049	0.10	0.9234	0.517
	f6	-0.340	-0.66	0.5131	0.519
	f7	-0.366	-0.70	0.4849	0.524
	f8	-0.583	-1.10	0.2728	0.530
	f9	-0.779	-1.45	0.1501	0.539
	f10	-0.421	-0.76	0.4479	0.553
	s3	-0.799	-1.29	0.1976	0.618
	s4	0.996	1.66	0.0995	0.601
	s5	1.018	1.73	0.0856	0.588
	s6	0.716	1.23	0.2188	0.580
	s7	0.355	0.62	0.5376	0.574
	s8	0.053	0.09	0.9258	0.570
	s9				
	s10	0.032	0.06	0.9550	0.570

Table 31. 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	56	835.29	14.92	10.25	0.0001
Error	240	349.12	1.45		
Corrected Total	296	1184.41			

R-Square	0.705	C.V.	119.062	Root MSE	1.206	LOGCATCH Mean	1.013

Source	DF	Type I SS	Mean Square	F Value	Pr > F
COHORT	30	674.494	22.483	15.46	0.0001
SAGE	26	160.794	6.184	4.25	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
COHORT	30	512.617	17.087	11.75	0.0001
SAGE	26	160.794	6.184	4.25	0.0001

Parameter		Estimate	T for HO: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT					
COHORT	1962	0.746	0.41	0.6811	1.814
	1963	5.258	2.90	0.0040	1.811
	1964	3.421	1.89	0.0598	1.809
	1965	2.940	1.63	0.1052	1.808
	1966	0.994	0.55	0.5827	1.807
	1967	3.961	2.19	0.0292	1.805
	1968	4.522	2.50	0.0129	1.806
	1969	0.433	0.24	0.8107	1.807
	1970	2.821	1.56	0.1212	1.814
	1971	-1.435	-0.96	0.3401	1.502
	1972	-0.231	-0.16	0.8717	1.430
	1973	-1.481	-1.06	0.2902	1.397
	1974	0.668	0.49	0.6265	1.372
	1975	-2.152	-1.58	0.1144	1.358
	1976	-0.455	-0.34	0.7360	1.349
	1977	-1.561	-1.16	0.2460	1.342
	1978	-0.701	-0.52	0.6010	1.339
	1979	0.594	0.44	0.6574	1.337
	1980	-0.325	-0.24	0.8080	1.336
	1981	-0.223	-0.17	0.8673	1.336
	1982	3.004	2.25	0.0255	1.336
	1983	0.908	0.68	0.4946	1.327
	1984	-0.897	-0.68	0.5001	1.329
	1985	1.264	0.95	0.3436	1.332
	1986	0.372	0.28	0.7807	1.337
	1987	2.057	1.53	0.1273	1.344
	1988	-0.019	-0.01	0.9889	1.381
	1989	-0.420	-0.31	0.7599	1.374
	1990	0.996	0.67	0.5064	1.497
	1991	0.906	0.57	0.5687	1.588
	1992				
SAGE	a1	-0.141	-0.23	0.8173	0.609
	a2	2.046	3.49	0.0006	0.586
	a3	1.083	1.88	0.0616	0.577
	a4	0.640	1.12	0.2629	0.570
	a5	-0.121	-0.21	0.8300	0.566
	a6	-0.318	-0.56	0.5729	0.565
	a7	-1.449	-2.57	0.0108	0.563
	a8	-1.264	-2.25	0.0253	0.561
	a9	-1.780	-3.17	0.0017	0.561
	a10	-0.598	-1.07	0.2871	0.561
	f2	-0.028	-0.06	0.9541	0.496
	f3	0.885	1.80	0.0737	0.492
	f4	1.287	2.63	0.0092	0.490
	f5	1.008	2.07	0.0396	0.487
	f6	0.792	1.63	0.1039	0.485
	f7	0.411	0.85	0.3969	0.484
	f8	-0.396	-0.82	0.4135	0.484
	f9	-0.319	-0.66	0.5091	0.483
	f10	-0.517	-1.08	0.2834	0.481
	s3	-0.024	-0.05	0.9582	0.462
	s4	1.111	2.43	0.0156	0.456
	s5	0.889	1.97	0.0504	0.452
	s6	1.126	2.51	0.0128	0.449
	s7	0.306	0.69	0.4931	0.446
	s8	0.060	0.14	0.8910	0.443
	s9				
	s10	0.355	0.79	0.4287	0.448

Table 32. 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	49	454.41	9.27	7.51	0.0001
Error	118	145.64	1.23		
Corrected Total	167	600.05			

	R-Square	C.V.	Root MSE	LOGCATCH Mean
	0.757	80.19	1.111	1.385

Source	DF	Type I SS	Mean Square	F Value	Pr > F
COHORT	32	399.753	12.492	10.12	0.0001
SAGE	17	54.657	3.215	2.60	0.0013

Source	DF	Type III SS	Mean Square	F Value	Pr > F
COHORT	32	367.568	11.487	9.31	0.0001
SAGE	17	54.657	3.215	2.60	0.0013

Parameter		Estimate	T for HO: Parameter=0	Pr > ITI	Std Error of Estimate
INTERCEPT					
COHORT	1960	5.271	2.98	0.0035	1.769
	1961	4.068	2.59	0.0107	1.568
	1962	4.666	2.98	0.0035	1.564
	1963	4.647	3.11	0.0023	1.492
	1964	3.916	2.63	0.0097	1.489
	1965	2.759	1.86	0.0660	1.487
	1966	5.731	3.86	0.0002	1.484
	1967	2.828	1.91	0.0587	1.481
	1968	6.007	3.87	0.0002	1.550
	1969	-1.015	-0.58	0.5640	1.754
	1970	0.336	0.19	0.8478	1.747
	1972	0.226	0.13	0.8982	1.769
	1973	0.518	0.33	0.7417	1.568
	1974	2.633	1.76	0.0807	1.494
	1975	0.216	0.15	0.8821	1.455
	1976	1.866	1.32	0.1910	1.419
	1977	0.211	0.15	0.8806	1.403
	1978	0.699	0.50	0.6169	1.395
	1979	1.416	1.02	0.3084	1.384
	1980	3.331	2.41	0.0175	1.382
	1981	2.429	1.76	0.0802	1.377
	1982	4.833	3.51	0.0006	1.378
	1983	1.573	1.15	0.2530	1.369
	1984	1.457	1.06	0.2916	1.376
	1985	1.497	1.12	0.2652	1.337
	1986	2.528	1.82	0.0712	1.389
	1987	3.202	2.32	0.0222	1.381
	1988	0.655	0.47	0.6425	1.407
	1989	1.812	1.35	0.1792	1.341
	1990	2.562	1.75	0.0830	1.465
	1991	4.715	3.43	0.0008	1.376
	1992	4.990	2.66	0.0088	1.873
	1993				
SAGE	a1	-0.982	-1.23	0.2221	0.8
	a2	-0.639	-0.82	0.4123	0.777
	a3	0.455	0.64	0.5203	0.705
	a4	0.813	1.18	0.2401	0.689
	a5	0.407	0.60	0.5469	0.674
	a6	-0.253	-0.38	0.7045	0.667
	a7	-0.210	-0.32	0.7504	0.660
	a8	-0.974	-1.48	0.1410	0.657
	a9	-0.793	-1.22	0.2264	0.652
	a10	-1.147	-1.76	0.0813	0.652
	s3	0.473	1.06	0.2906	0.445
	s4	1.131	2.59	0.0109	0.437
	s5	1.084	2.53	0.0126	0.428
	s6	0.897	2.15	0.0338	0.417
	s7	0.720	1.75	0.0835	0.412
	s8	0.375	0.92	0.3582	0.407
	s9				
	s10	0.176	0.43	0.6713	0.415

Table 33. Results from GLM procedure to predict yearclass sizes for Fortune 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	47	586.38	12.48	8.31	0.0001
Error	101	151.54	1.50		
Corrected Total	148	737.92			

	R-Square	C.V.	Root MSE	LOGCATCH Mean
	0.794	81.22	1.225	1.508

Source	DF	Type I SS	Mean Square	F Value	Pr > F
COHORT	30	429.744	14.325	9.55	0.0001
SAGE	17	156.632	9.214	6.14	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
COHORT	30	387.361	12.912	8.61	0.0001
SAGE	17	156.632	9.214	6.14	0.0001

Parameter		Estimate	T for HO: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT					
COHORT	1961	-1.229	-0.71	0.4794	1.732
	1962	-3.641	-2.11	0.0375	1.727
	1963	1.826	1.06	0.2924	1.725
	1964	0.193	0.11	0.9106	1.723
	1965	-0.543	-0.32	0.7527	1.719
	1966	2.687	1.56	0.1216	1.721
	1967	0.730	0.37	0.7090	1.951
	1968	1.267	0.65	0.5156	1.942
	1972	-3.482	-1.78	0.0777	1.954
	1973	-2.842	-1.64	0.1039	1.732
	1974	-0.777	-0.47	0.6386	1.650
	1975	-3.056	-1.90	0.0600	1.607
	1976	-2.071	-1.32	0.1883	1.564
	1977	-2.483	-1.60	0.1128	1.552
	1978	-1.160	-0.75	0.4528	1.540
	1979	0.034	0.02	0.9822	1.527
	1980	0.991	0.65	0.5157	1.520
	1981	0.525	-0.34	0.7329	1.534
	1982	2.702	1.78	0.0774	1.515
	1983	-0.528	-0.34	0.7311	1.532
	1984	-2.523	-1.65	0.1029	1.532
	1985	-2.254	-1.52	0.1314	1.482
	1986	-0.531	-0.35	0.7287	1.528
	1987	1.920	1.25	0.2135	1.534
	1988	-1.202	-0.78	0.4374	1.542
	1989	-1.691	-1.13	0.2605	1.494
	1990	1.540	0.92	0.3599	1.675
	1991	-0.735	-0.48	0.6305	1.524
	1992	3.052	1.50	0.1368	2.035
	1993	-2.038	-0.99	0.3269	2.069
	1994				
SAGE	a1	-3.258	-3.66	0.0004	0.89
	a2	-3.010	-3.45	0.0008	0.872
	a3	-3.146	-3.71	0.0003	0.849
	a4	-1.808	-2.33	0.0217	0.775
	a5	-2.421	-3.18	0.0020	0.761
	a6	-2.588	-3.46	0.0008	0.748
	a7	-2.266	-3.09	0.0026	0.734
	a8	-3.073	-4.20	0.0001	0.731
	a9	-1.238	-1.52	0.1328	0.817
	a10	-2.337	-3.23	0.0017	0.724
	s3	-1.673	-2.79	0.0062	0.598
	s4	-0.852	-1.60	0.1138	0.534
	s5	-0.084	-0.17	0.8626	0.487
	s6	0.120	0.25	0.8026	0.480
	s7	0.262	0.55	0.5817	0.474
	s8	0.515	1.12	0.2666	0.461
	s9				
	s10	0.512	1.09	0.2772	0.469

Table 34. Correlation matrix of log-transformed recruitment estimates in relation to the environmental signals, 'Tempsum' and 'Salinity', temperature and salinity data for the overwintering / prespawning period.

	Correlation coefficient of $\log_e R_t$ with	
Stock Area	Tempsum	Salinity
WB-NDB	0.73**	0.36
BB-TB	0.66**	0.16
SMB-PB	0.55**	0.33
FB	0.56**	0.28

Table 35. Stock-specific multiple regression models of recruitment ($\log_e$ transformed).

Stock Area	Multiple regression model	R^2	SE
WB-NDB	$\log R_t = 0.43T + 5.09S - 161.11$	0.81	0.68
BB-TB	$\log R_t = 0.43T + 3.53S - 111.72$	0.54	1.21
SMB-PB	$\log R_t = 0.31T + 4.19S - 132.71$	0.52	0.99
FB	$\log R_t = 0.42T + 5.06S - 162.28$	0.49	1.39

Table 36. Environmentally dependent recruitment models derived for Newfoundland spring spawning herring stocks.

Stock Area	Empirical recruitment model	R^2	SE
WB-NDB	$R = MBe^{(-165.59 - 0.0147MB + 0.41T + 5.14S)}$	0.94	0.59
BB-TB	$R = MBe^{(-115.87 - 0.0263MB + 0.33T + 3.62S)}$	0.70	1.30
SMB-PB	$R = MBe^{(-113.26 - 0.0500MB + 0.31T + 3.52S)}$	0.55	1.12
FB	$R = MBe^{(-168.32 - 0.148MB + 0.50T + 5.23S)}$	0.49	1.39

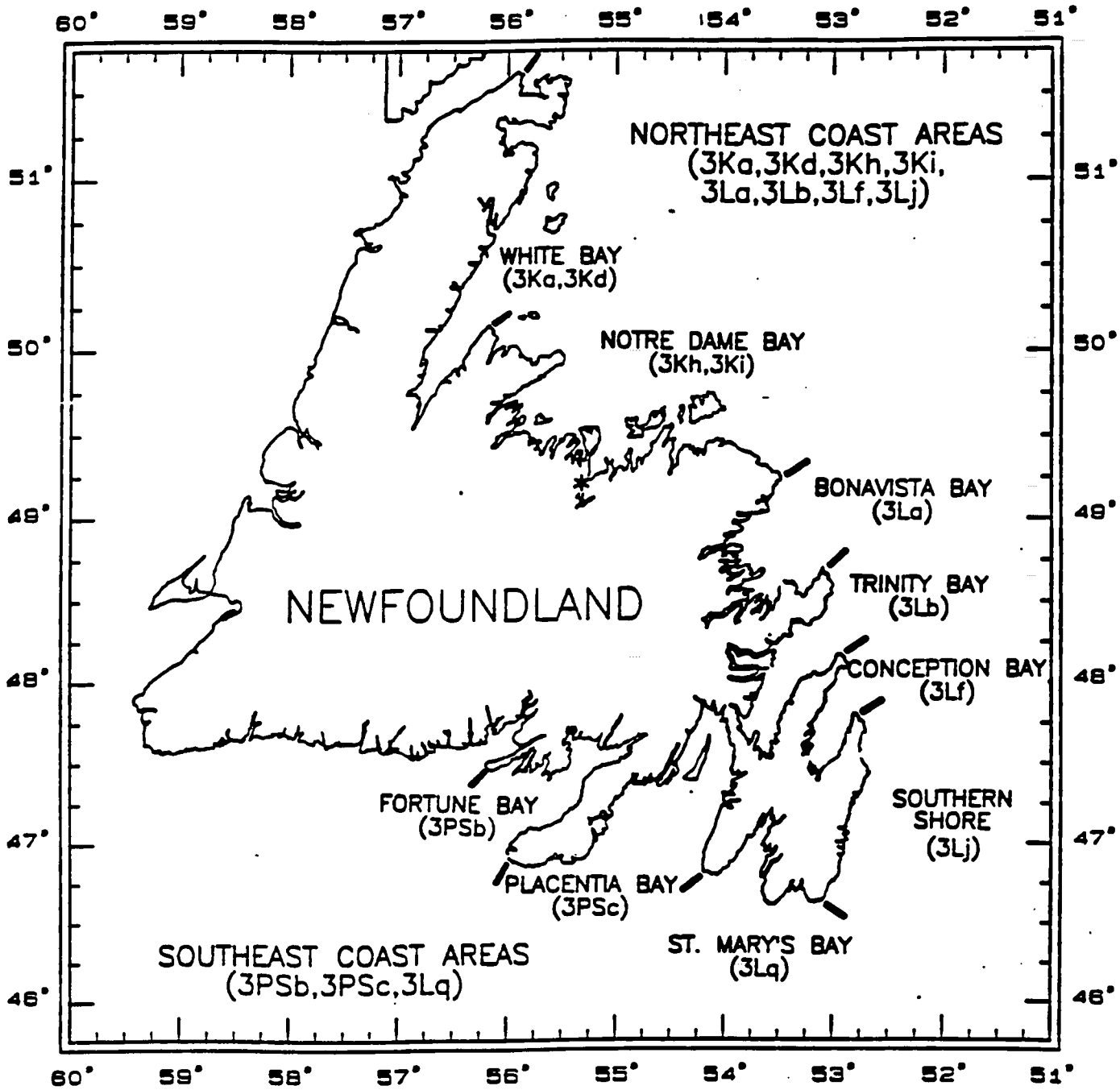


Fig. 1. Area map indicating herring stock complexes within the Newfoundland Region.

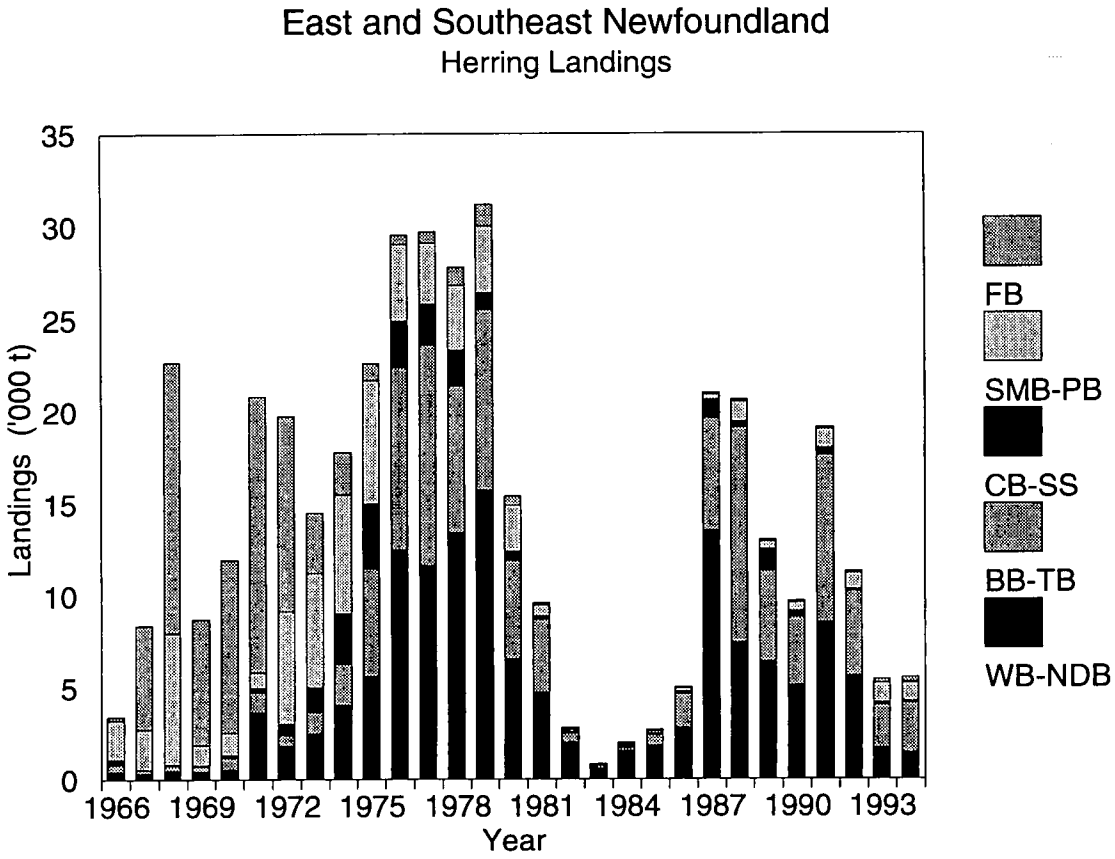


Fig. 2. East and southeast Newfoundland herring landings, 1966-94, for White Bay - Notre Dame Bay (WB-NDB), Bonavista Bay - Trinity Bay (BB-TB), Conception Bay - Southern Shore (CB-SS), St. Mary's Bay - Placentia Bay (SMI and Fortune Bay (FB).

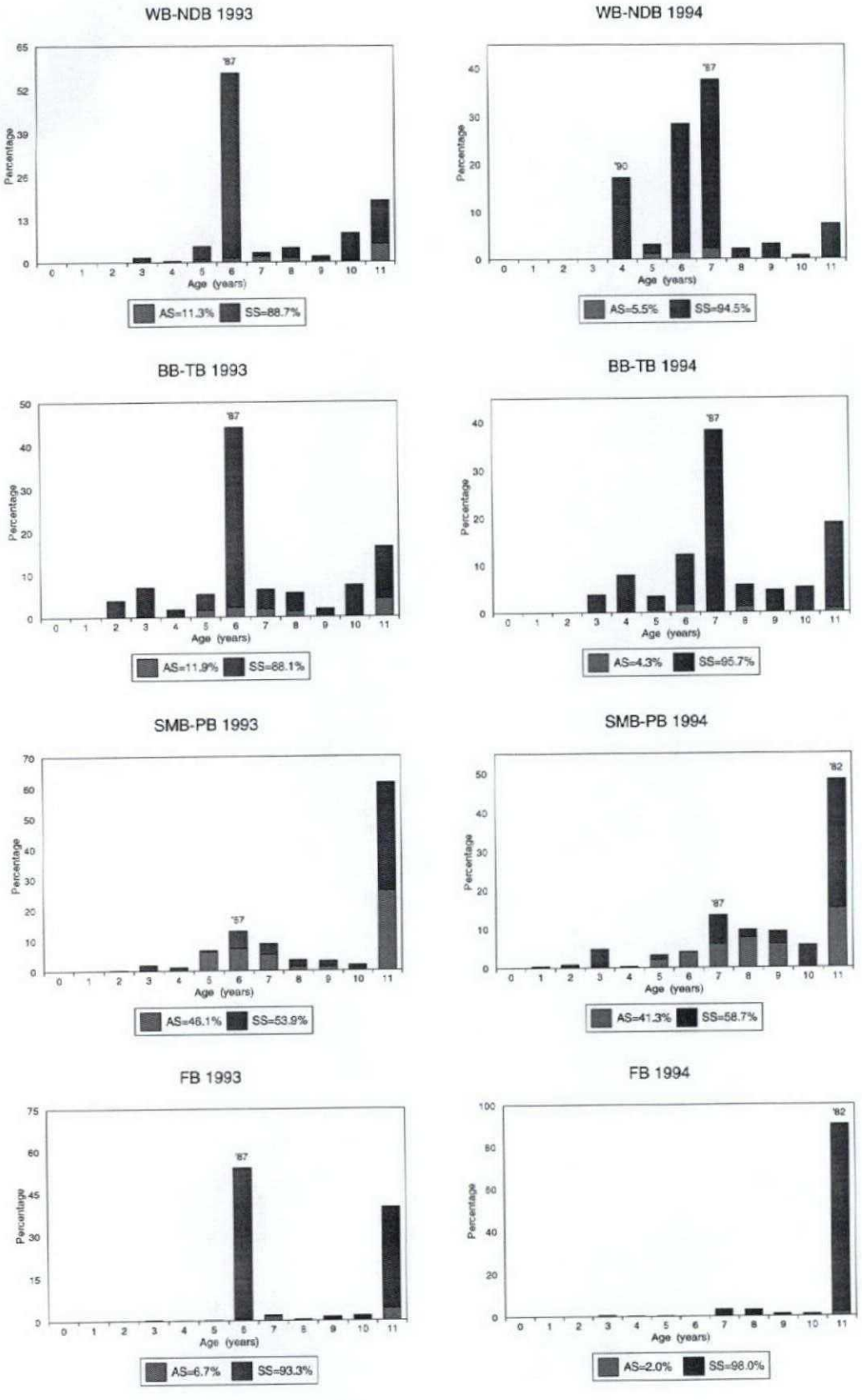


Fig. 3. Age distribution of herring from the commercial fishery, White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, St. Mary's Bay - Placentia Bay and Fortune Bay, 1993 and 1994.

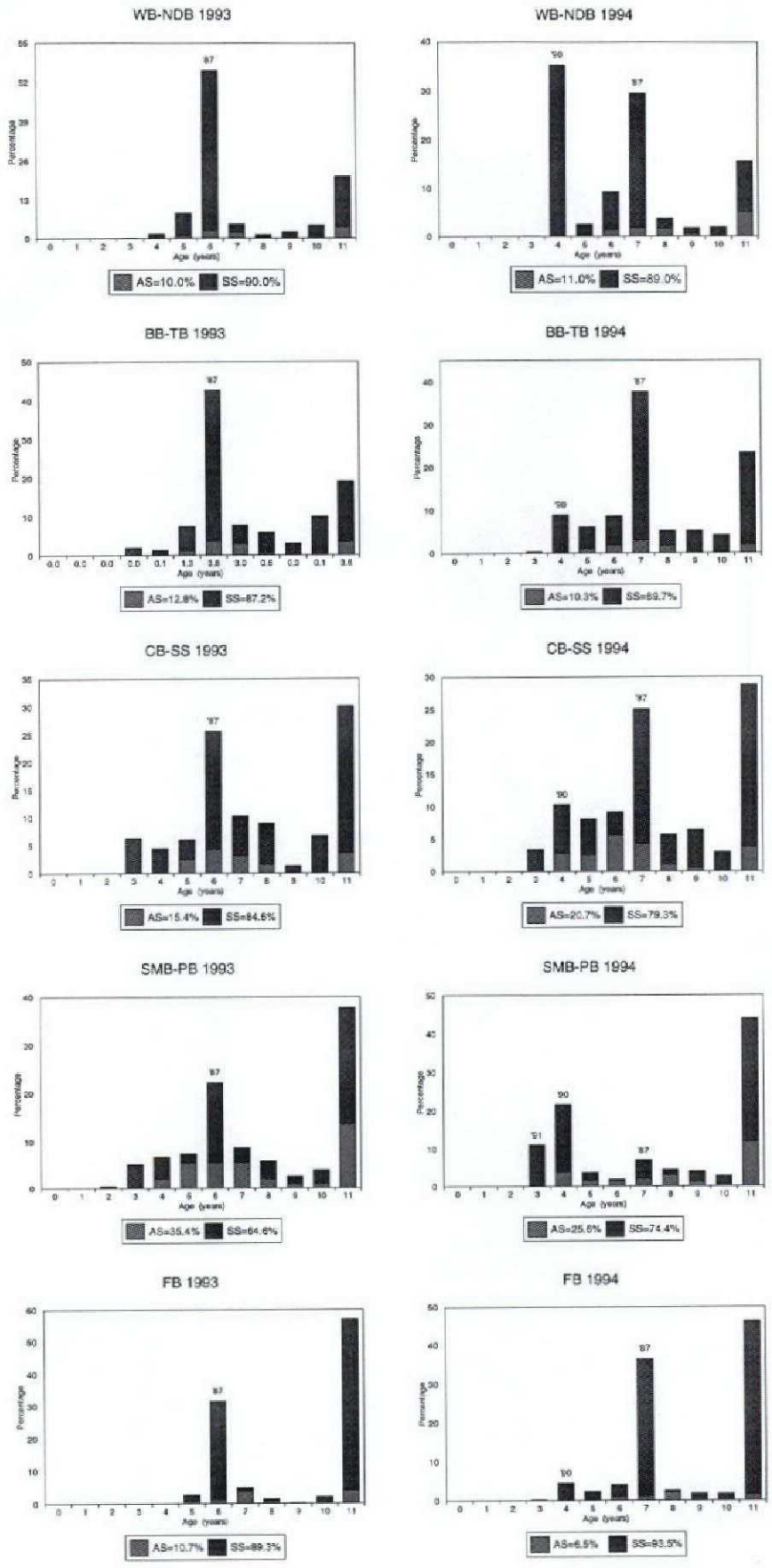


Fig. 4. Age distribution (by number) of herring from the spring research gillnet program, White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, Conception Bay - Southern Shore, St. Mary's Bay - Placentia Bay, and Fortune Bay, 1993 and 1994.

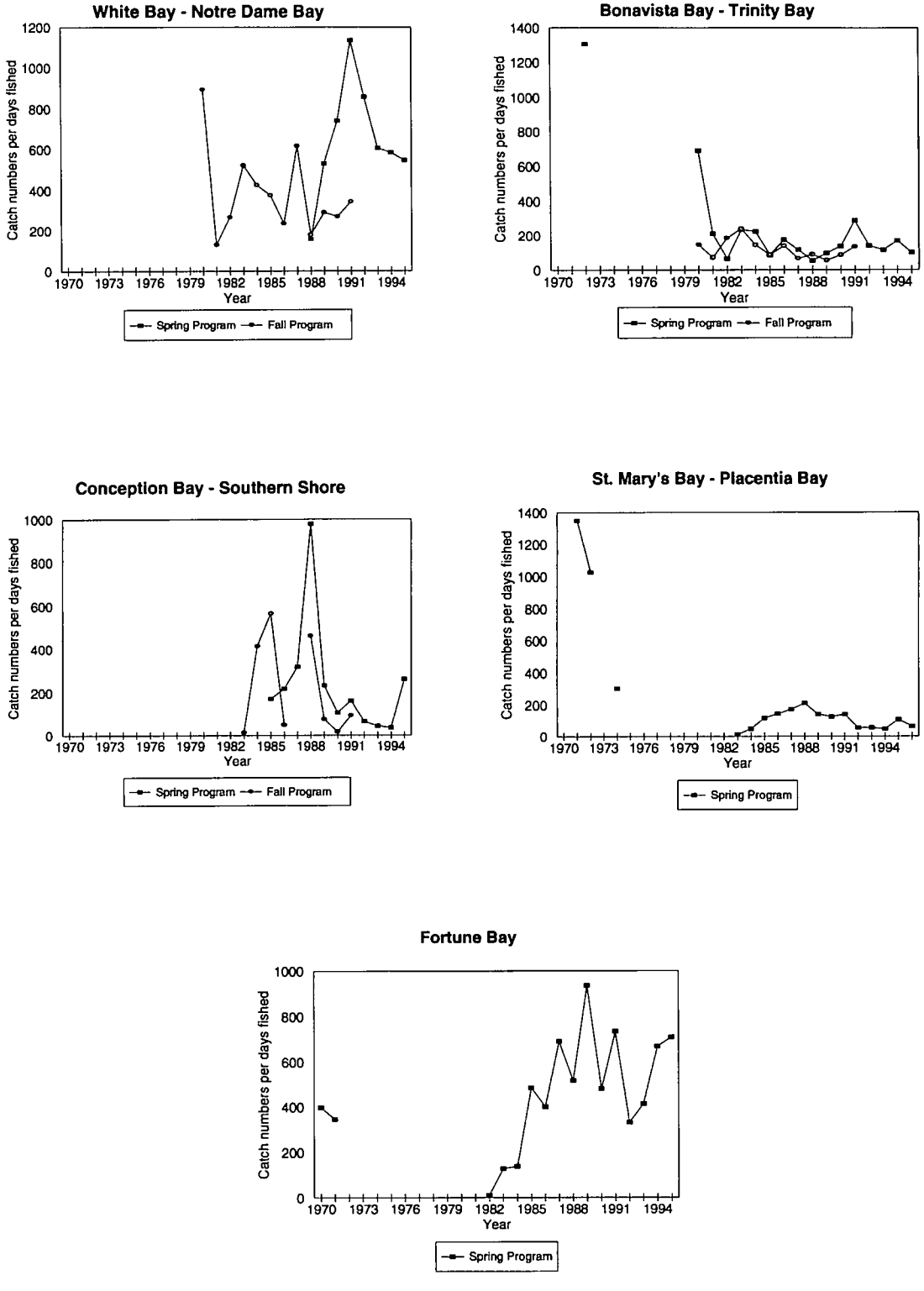
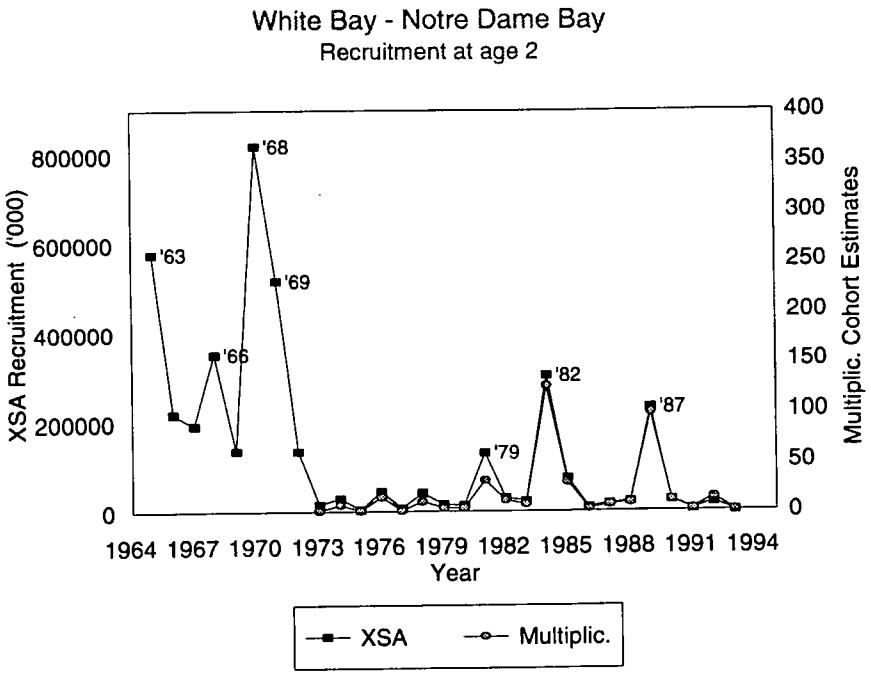


Fig. 5. Spring and fall research gillnet catch rates (numbers per days fished), spring spawners only, by stock area and year.

A



B

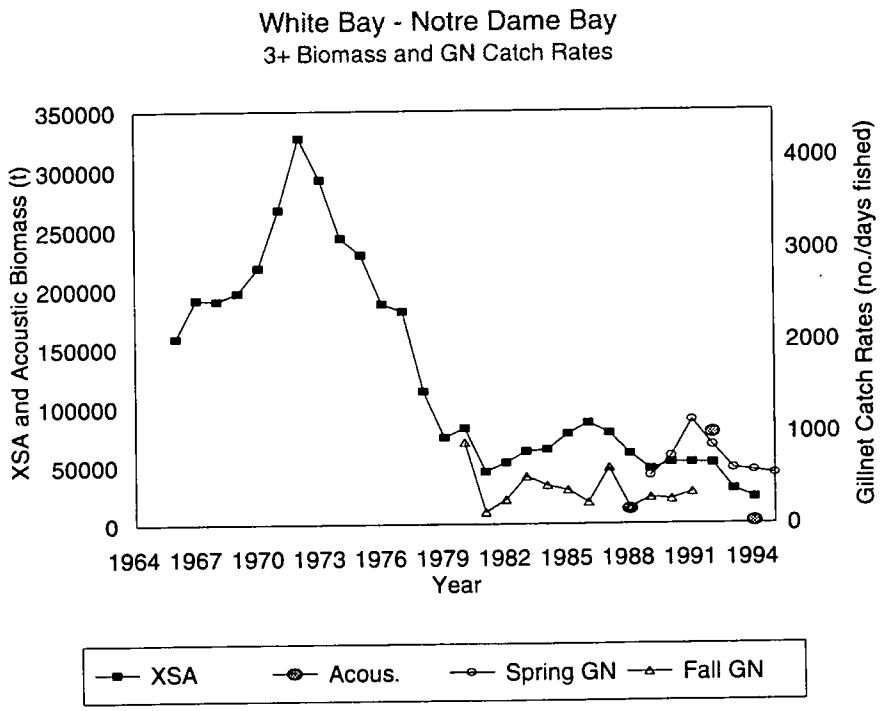
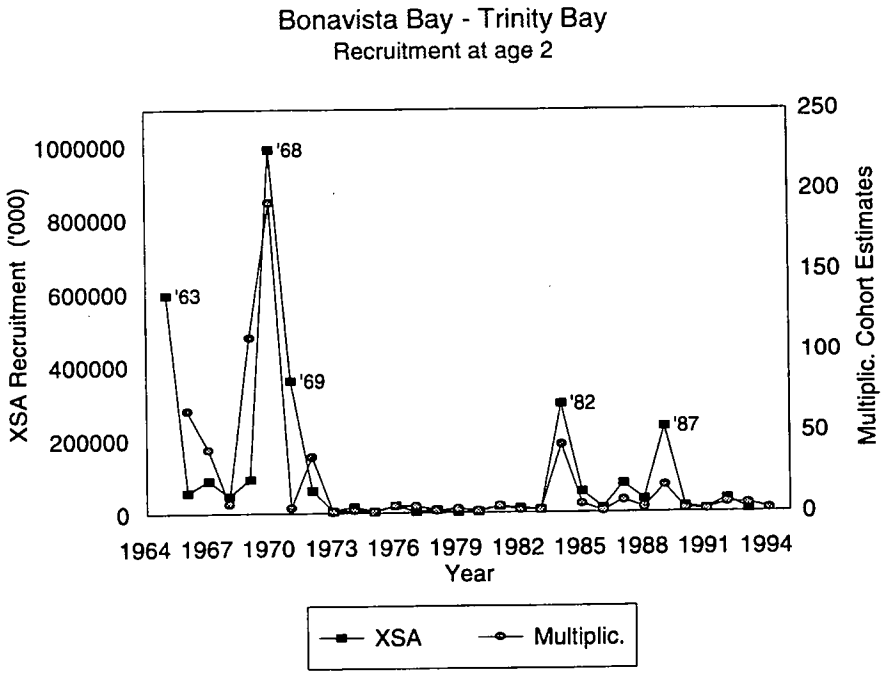


Fig.6 . Summary of abundance indices for White Bay - Notre Dame Bay:
A) Recruitment estimates from extended survivors analysis and multiplicative model.
B) Biomass estimates (ages 3+) from extended survivors analysis and acoustic surve and research gillnet catch rates from spring and fall programs.

A



B

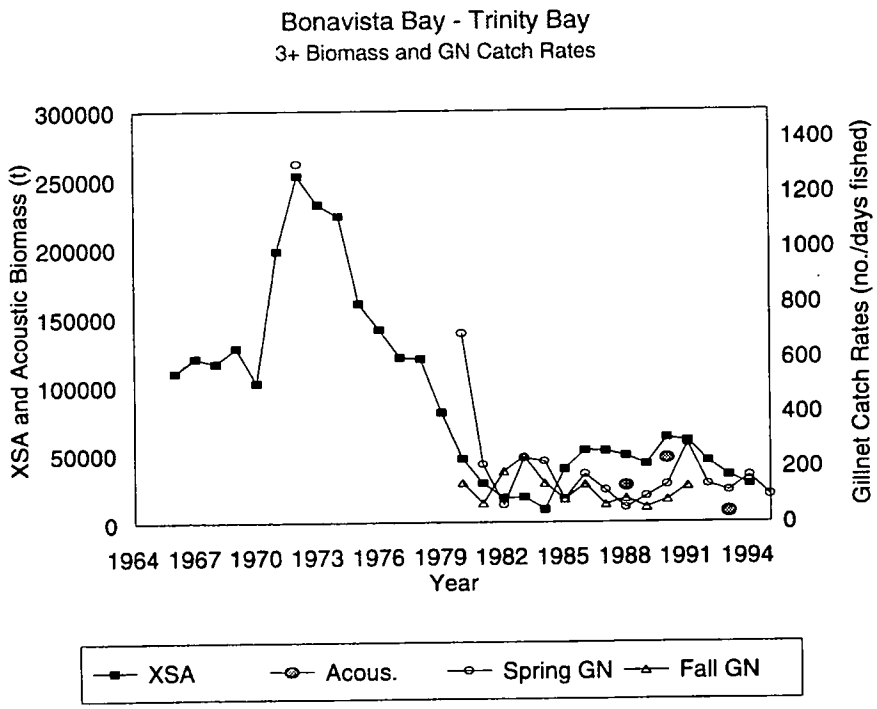
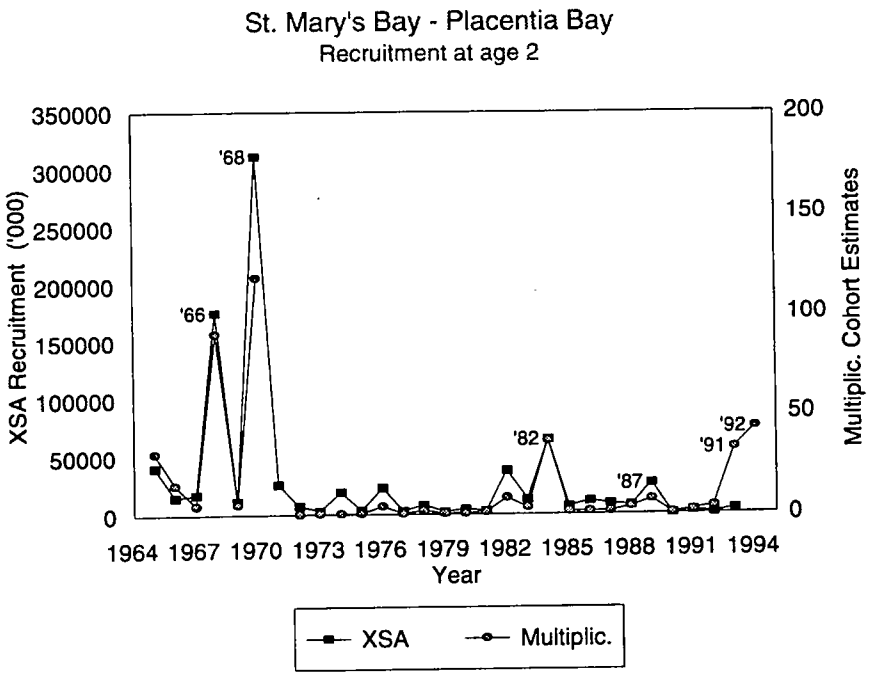


Fig. 7. Summary of abundance indices for Bonavista Bay - Trinity Bay:
A) Recruitment estimates from extended survivors analysis and multiplicative model.
B) Biomass estimates (ages 3+) from extended survivors analysis and acoustic surve and research gillnet catch rates from spring and fall programs.

A



B

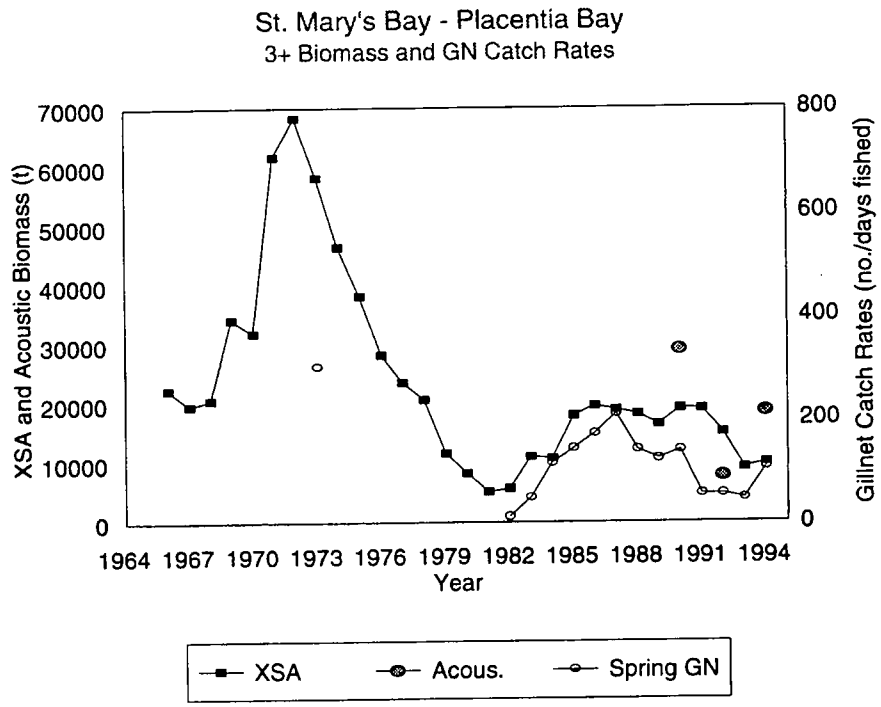
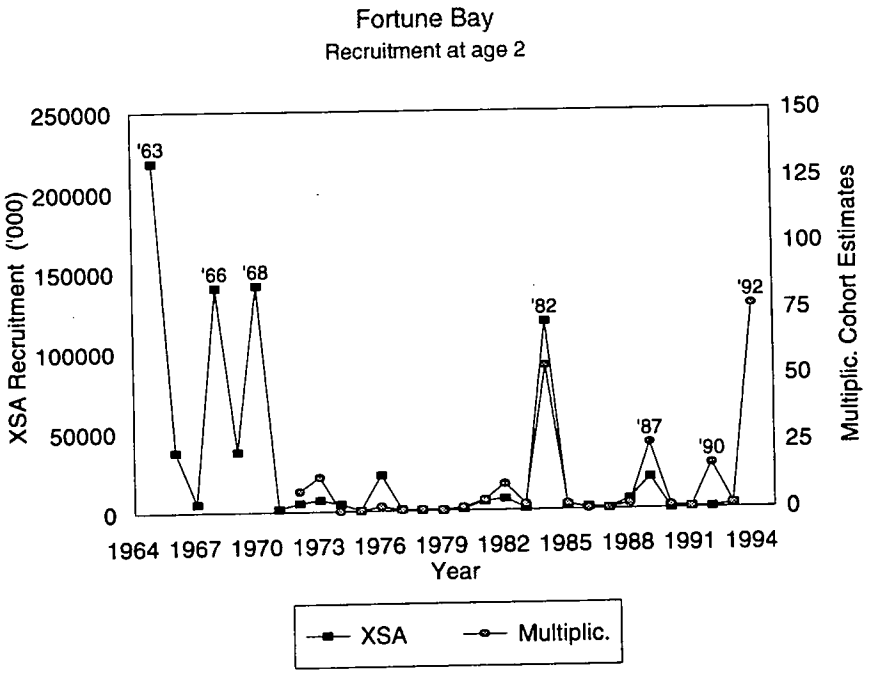


Fig. 8. Summary of abundance indices for St. Mary's Bay - Placentia Bay:
A) Recruitment estimates from extended survivors analysis and multiplicative model.
B) Biomass estimates (ages 3+) from extended survivors analysis and acoustic surve and research gillnet catch rates from spring program.

A



B

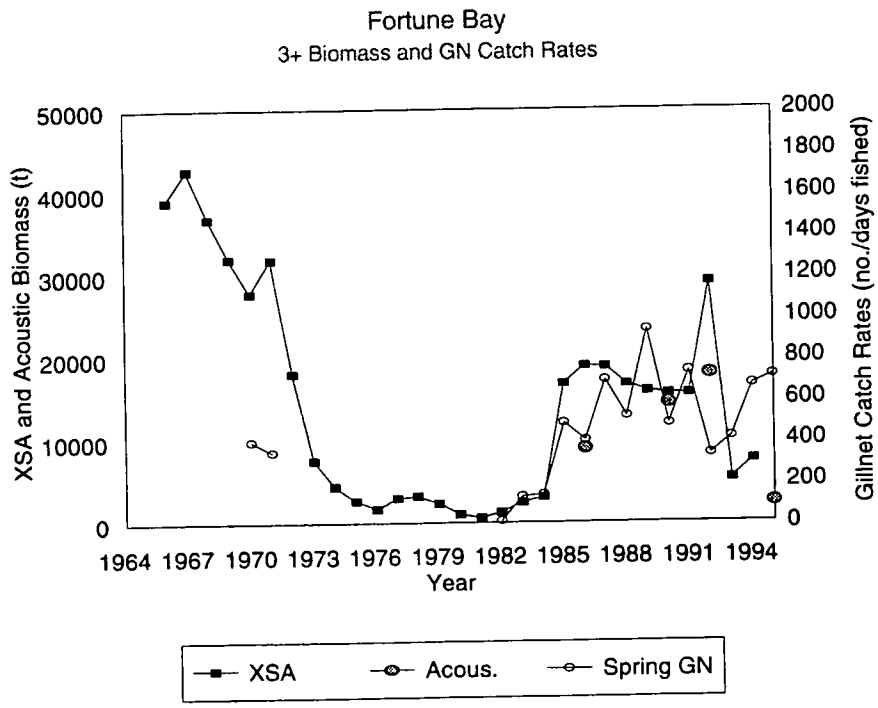


Fig. 9. Summary of abundance indices for Fortune Bay:
A) Recruitment estimates from extended survivors analysis and multiplicative model.
B) Biomass estimates (ages 3+) from extended survivors analysis and acoustic surve and research gillnet catch rates from spring program.

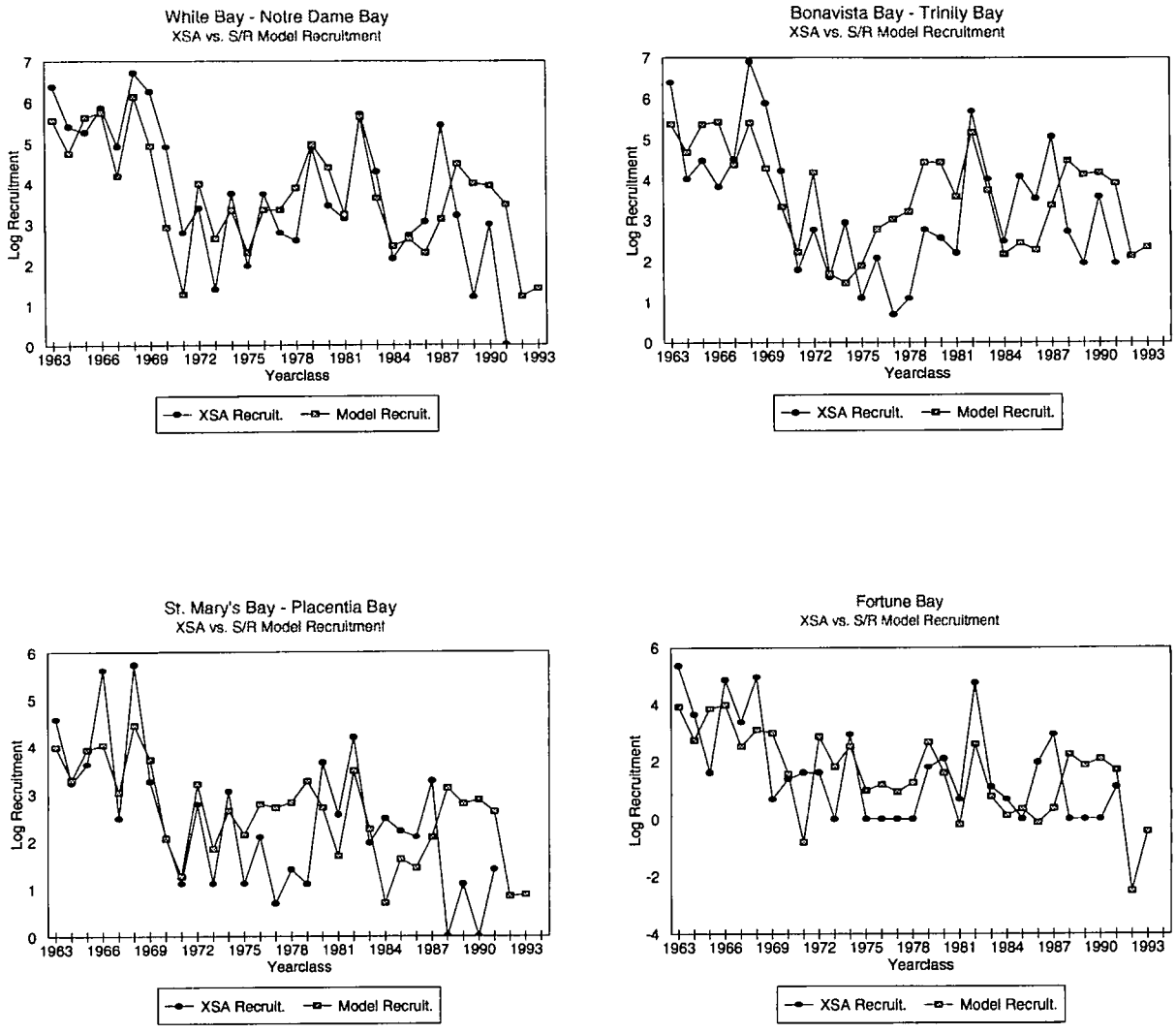
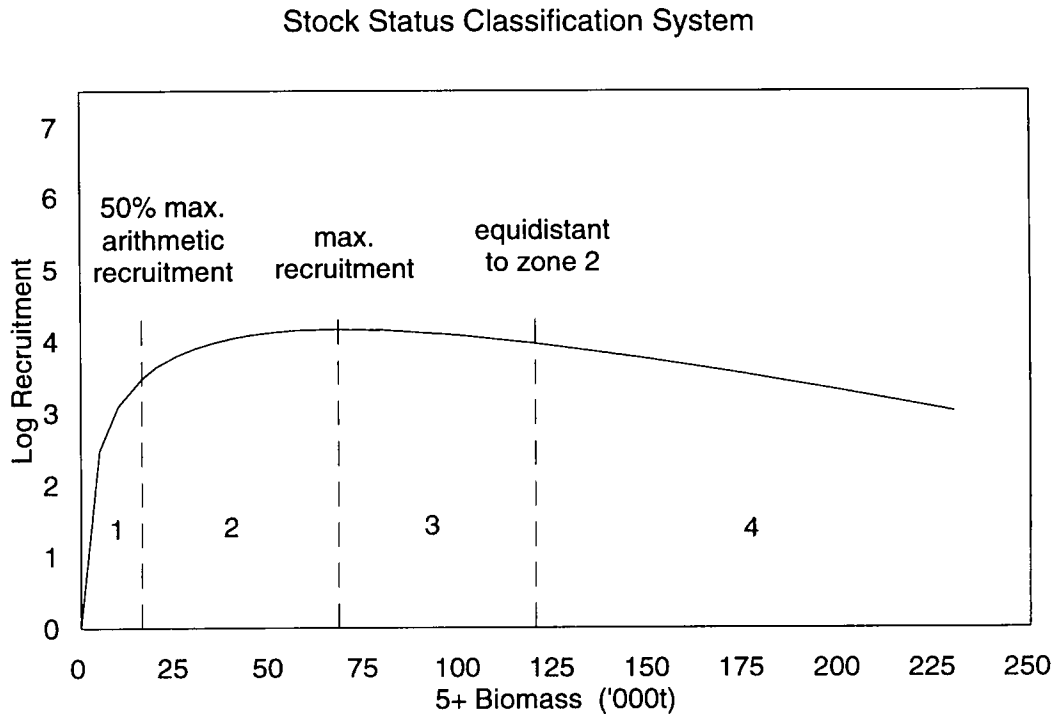


Fig. 10. Relationship between recruitment estimates from extended survivors analysis and the environmentally dependent recruitment model.



Zone	Stock Status	F	Type of Fishery
1	Very Poor	0.00 - 0.05	Scientific
2	Poor to Moderate	0.05 - 0.10	Restricted
3	Moderate to Good	0.10 - 0.20	Commercial
4	Good to Very Good	>=0.20	Accelerated

Fig. 11. Definition of zones, descriptors, and exploitation rates for east and southeast Newfoundland herring stock status classification system.

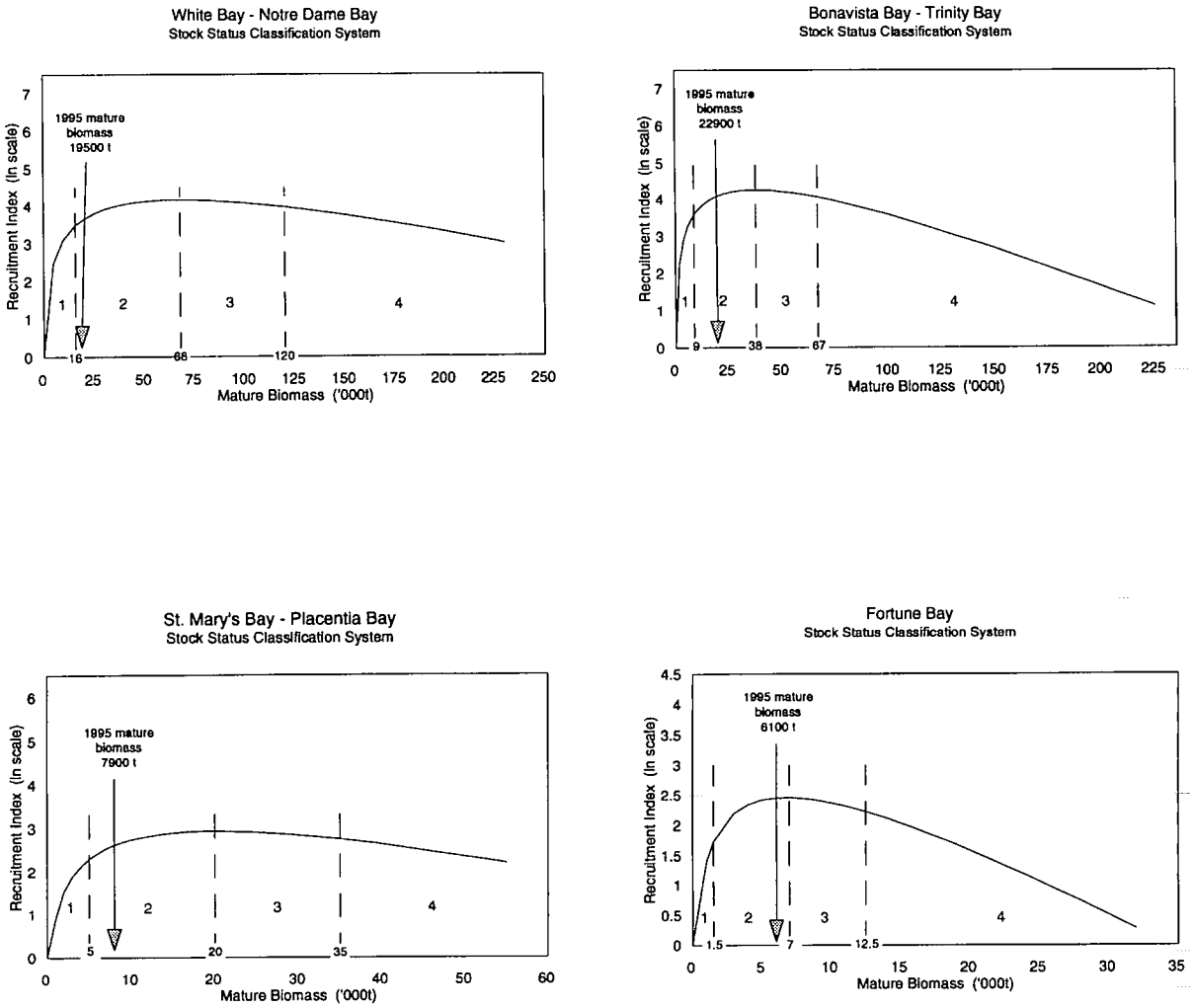


Fig. 12. Stock status classification system and 1995 mature biomass estimates for east and southeast Newfoundland herring.

Appendix 1. Assessment Review Proceedings

Assessment Deliberations

Prior to the formal assessment meetings, the Herring Working Group of the Small Pelagics Advisory Committee met on three occasions in September and October, 1995. Industry was concerned with the concept of threshold, or critical, spawning stock level which was introduced in the 1994 assessment to convey conservation concerns in a quantifiable manner. Concern was expressed that this "knife-edge" approach might lead to a fishery closure based upon insufficient scientific information. The Working Group developed the stock status classification system (as described in this Research Document) which provides a flexible framework for Science, fishery managers and the industry. For Science, it incorporates the best available information for the herring stocks in an objective manner; at the same time, the zone concept acknowledges the variability within the data. For fishery managers, the range in exploitation rates within each zone provides a degree of flexibility, using conservation as the guiding principle while still allowing for socio-economic concerns. For the industry, it allows some very limited type of fishery even at low stock levels, thus maintaining their presence in the market place. This is also of benefit to Science as it allows for better monitoring of stock status through a scientific fishery. The stock status classification system is an industry driven initiative, derived through extensive discussions and consensus with fishers and fish processors. It has the support of these stakeholders and of Resource Management Branch and was subsequently reviewed and endorsed by the Regional Assessment Review Committee.

The Regional Assessment Review Committee met on October 10, 25, and 27, 1995 to review the status of east and southeast Newfoundland herring and to prepare a draft Stock Status Report.

During the meeting of October 10th, a stock overview was presented. This was followed by a review of the 1994 commercial fishery and commercial catch at age. Presentations were then given on the predation of herring by seals, seabirds and cod. Abundance indices were then reviewed; these included catch rates at age from the 1994 research gillnet program, catch rates only from the 1995 research gillnet program, and the results of the 1994 fall acoustic survey of White Bay - Notre Dame Bay and the 1995 winter acoustic survey of Fortune Bay. Technical analyses were then presented including results of extended survivors analysis to estimate population numbers and biomass, results of a multiplicative model and an environmentally dependent recruitment model, both used to estimate yearclass strength. The stock status classification system was then described and reviewed and the status of each of the assessed stocks was summarized in relation to the classification system.

Discussions during the meeting of October 10th focused on several points. There was a discussion of how the information on the predation of herring by seals, gannets and cod can be quantified in the assessment process. There were three specific research recommendations related to this (see Appendix 2). There was a general discussion on commercial catch statistics and potential misreporting problems. There was a suggestion from industry that misreporting may have been a problem during the 1970' and 1980's. To examine this in more detail, there was a research recommendation that Economics/Statistics Branch provide a summary of herring production records over time which could then be compared with

catch statistics. In examining the 1994 commercial catch at age for White Bay - Notre Dame Bay, there appeared to be a higher than expected proportion of 1988 yearclass relative to the more abundant 1987 yearclass. A research recommendation was formulated to investigate whether this may be due to a problem in age determination. It was noted that the biomass estimate from the 1994 White Bay - Notre Dame Bay acoustic survey was very low; however, the estimate was not directly comparable to previous survey results as only the Notre Dame Bay portion of the stock was surveyed in 1994. It was recommended that this be examined further and acoustic estimates from all surveys within the area be partitioned by bay (ie. White Bay and Notre Dame Bay) for the next meeting of the Assessment Committee. During the acoustic survey of Fortune Bay, biomass estimates for two herring concentrations were derived by extrapolation from acoustic transects and by an acoustic mapping technique. The Committee requested that this information be tabled for review at its next meeting. In the review of technical analyses, discussions focused on the XSA and the options which were chosen for each of the assessed stock areas. The Committee requested that the effect of other options be examined and presented at its next meeting, specifically running XSA without shrinking the final estimates towards the mean, and weighting each of the abundance indices to determine the impact on the final results. In its discussion of the environmentally dependent recruitment model, the Committee examined the relationship between recruitment and overwintering temperatures and salinities. There was a discussion regarding the use of Station 27 temperature data for all areas. The Committee requested for its next meeting that the updated relationships be used to predict recruitment of the 1987 to 1993 yearclasses. The concept of the stock status classification system was endorsed by the Committee; it favoured the approach of reducing fishing mortalities below a reference level when stock levels were low to avoid recruitment overfishing. There was a discussion on how the boundaries between zones should be chosen. For its next meeting, the Committee requested that an objective method be determined for defining stock status zones.

The Committee met again on October 25th to discuss issues outstanding from its first meeting and to review a draft of the stock status report. Specific items which were addressed included: partitioning of acoustic survey biomass estimates for White Bay - Notre Dame Bay by bay, comparison of acoustic estimates in Fortune Bay from transect extrapolation and acoustic mapping, the sensitivity of XSA to shrinkage options and fleet weighting, the prediction of recent yearclasses from the environmentally dependent recruitment model, and objective criteria for defining stock status classification zones.

The acoustic survey estimates for White Bay - Notre Dame Bay from 1983 to 1994 were apportioned by bay. With one exception (1988), greater than 55% of biomass was detected in Notre Dame Bay in each of the surveys. A description of the acoustic mapping technique used to estimate the size of two herring concentrations in Fortune Bay was presented. Biomass estimates from transect extrapolation and acoustic mapping were within 20% for both of the concentrations. The parallel transect design appears adequate and will continue to be used in future surveys. The XSA was demonstrated to be sensitive to the shrinkage option but less so to the weighting of indices. Fishing mortalities are constrained when final estimates are not shrunk towards the mean. Although current stock estimates are not affected, estimates of historical stock sizes are reduced without the shrinkage estimate. This is a problem for all virtual population analyses which exhibit low fishing mortalities and caution must be exercised in interpreting results. A research recommendation was formulated to evaluate the XSA options to be used in future herring assessments. Recruitment estimates of recent yearclasses (1987 to 1993) from the environmentally dependent model were

examined. Although predictions from the model and XSA do not correspond as well for recent yearclasses, both data sources show that recent yearclasses are not large. Objective criteria were established for determining the boundaries between the more critical stock status classification zones. Published analyses show that for most fish stocks, the risk of recruitment overfishing accelerates when recruitment is one-half of maximum levels. The Committee accepted this as the critical boundary between zones one and two in stock status classification system. A draft of the Stock Status Report was reviewed and editorial changes were recommended. It was also recommended that a section on sources of uncertainty be added, outlining the effects of misreporting of commercial catches and the effects of low fishing mortalities on the interpretation of results from XSA.

The Committee met for the final time on October 27th to review and finalize the draft Stock Status Report. This report was submitted to the Regional Director, Science on November 1, 1995 and was subsequently forwarded to the Director General, Biological Sciences Directorate for approval and release.

Management Deliberations

On November 10, 1995 the Director General, Biological Sciences Directorate, asked the Atlantic Zone Statistics, Sampling and Surveys Committee (AZSSSC) to review the concept of the stock status classification system prior to the release of the Stock Status Report. A working paper was prepared and presented to the AZSSSC on November 28, 1995. In a short review, the AZSSSC focused on the environmentally dependent stock-recruit relationships which it felt showed that stock size had a very weak influence on recruitment. The Committee also had concerns regarding the precision of the estimates of spawning stock biomass, given the low exploitation levels. Although there was general agreement within the Committee regarding the approach of reducing fishing mortalities below a reference level when stock sizes are low, it suggested that for the present, simple heuristic approaches such as reducing F when biomass falls below a critical percentile, could be used to establish these thresholds. The AZSSSC recommended that, before implementation, the stock status classification system based upon a stock and recruitment model be evaluated through risk analysis.

On December 6, 1995 the Assistant Deputy Minister, Science suggested to the Regional Director, Science that the draft Stock Status Report be revised to address the concerns of the AZSSSC, whereby a simpler approach be used in the stock status classification system to determine biomass thresholds which would not be dependent upon a spawner-recruit relationship.

On December 11, 1995 the Regional Director, Science advised the Assistant Deputy Minister, Science, that the risk analysis, as recommended by AZSSSC, would be conducted, but could not be completed in time for the upcoming Small Pelagics Advisory Committee meeting for which the Stock Status Report would be required. It was proposed that the concerns expressed by the AZSSSC be addressed by inserting the following sentences in the Stock Status Report:

The concept of varying fishing mortality at different levels of spawning stock

biomass is a new approach to the management of these herring stocks. Although the environmentally dependent stock recruitment model provides a conceptual framework for this approach, the derived stock status classification system is still in the developmental stage. Before being implemented on a long-term basis, further evaluation through risk analysis will be required.

The alternative "simple heuristic" approach offered by the AZSSC was not seen as appropriate as it was less defensible, vague in its reference to critical percentiles and inconsistent with the AZSSSC's statement that "there were also questions regarding the precision of the estimates of spawning biomass, given the apparently low exploitation levels of these stocks."

On December 20, 1995 the Assistant Deputy Minister, Science advised the Regional Director, Science that given the concerns of the AZSSSC about the stock recruit relationship, the addition of a caveat to the Stock Status Report was not adequate; maintaining the detailed advice with a warning to take care in the long-term did not address the issue. He requested that the Stock Status Report be redrafted as reference to the classification system was ill-advised, particularly as the analyses were available to provide the information necessary on which to base management of the stocks without the new approach.

On January 12, 1996, after discussions with members of the Regional Assessment Review Committee, the Chair of the Committee advised the Regional Director, Science that as the regional assessment process had been disrupted to the extent that advice could not be provided on a timely basis, it was inappropriate to reconvene the Committee to redraft the Stock Status Report according to the instructions of the Assistant Deputy Minister, Science. Risk analysis, as recommended by the AZSSC, would proceed in an attempt to strengthen the case for a stock status classification system in 1996. There would be no official 1995 Stock Status Report from the Region to consider in the 1996 Herring Management Plan.

On February 2, 1996 the Acting Regional Director, Fisheries Management contacted the Regional Director, Science asking for a commentary on the 'risk' attached to using the 1994 Stock Status Report for inclusion in the 1996 Integrated Fisheries Management Plan. On February 5, 1996 the Regional Director, Science responded that in considering the level of "risk", the same factors existed as in 1994. The stock status indicators have not changed appreciably from 1994 to 1995, there was no evidence of strong recruitment of yearclasses produced in the 1990's and stock levels will continue to decline even at reduced levels of fishing mortality. The same conservation concern existed as in 1994, namely that "the spawning biomass of these stocks 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." It was pointed out that although this approach addressed the conservation concerns of the stocks, it did not address the concerns of fishers, of industry, or fishery managers, which Science, within the Region, tried to incorporate more fully in the 1995 assessment process.

On February 15, 1996 the Herring Working Group of the Small Pelagics Advisory Committee met and were advised of the unavailability of a 1995 Stock Status Report and that consequently, the Small Pelagics Advisory Committee would have to centre deliberations around the 1994 Stock Status Report which suggested that a closure of the fishery should be considered. Industry members of the Working Group were strongly opposed to a fishery closure. They rejected Science information that stocks were in decline and felt that the

considerable work done by the Working Group in developing the stock status classification system should be given due consideration. The consensus of the Working Group was to recommend a bait / science index fishery within the defined limits of the stock status classification system.

The Small Pelagics Advisory Committee met on February 16, 1996; industry members were strongly opposed to a fishery closure and suggested that based upon their own observations, stock abundance was much higher than projected by the Department. Given the alternative of closure, the Small Pelagics Advisory Committee recommended a bait / science index fishery as recommended by the Herring Working Group.

The Herring Integrated Management Plan for 1996, released on March 29, 1996 incorporated the views of the Small Pelagics Advisory Committee, with a limited spring fixed gear fishery and fall purse seine fishery in each area. The limited fishery was designed to enhance the collection of scientific data and enable fishers to play a greater role in providing data for stock assessment purposes.

Appendix 2. Assessment Review Research Recommendations

1. Partitioning of harp seal diet, inshore and offshore, is essential for estimating consumption of prey species, including herring. Acoustic tagging and satellite tracking of seals should be continued into the second year, as originally planned, to provide estimates of the relative time spent in each habitat.

2. Continue the documentation of data on herring predation by Atlantic cod and include information from the 1995 sentinel fishery at next year's meeting.

3. Estimate the annual consumption (tons) of herring by gannets for specific areas.

4. Economics / Statistics Branches should be requested to provide a description of methods for deriving statistics and summarize production records over time to detect trends.

5. Investigate a possible ageing problem in 1994 for the White Bay - Notre Dame Bay area.

6. Review the use of the extended survivor analysis (SA) in herring assessments with an aim to include meaningful constraints which reflect what is known about the fisheries and biology. This is considered particularly important given the low fishing mortality on these stocks in recent years.

Appendix 3. Assessment Review Participants

Name	Affiliation
Cahill, P.	Economics, DFO
Carscadden, J.	Science, DFO
Dunne, T.	Fisheries Management, DFO
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Narayanan, S.	Science, DFO
Parsons, D (Chair)	Science, DFO
Sjare, B.	Science, DFO
Squires, B.	Science, DFO
Stenson, G.	Science. DFO
Wheeler, J.	Science, DFO
Winters, G.	Science, DFO