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Newfoundland East and Southeast Coast Herring - An Assessment of Stocks to the Spring of 1996

by

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Abstract

Results of the analysis of data from 1995 and the spring of 1996 are presented for herring stocks along the east and southeast coasts of Newfoundland. Landings from the 1995 commercial fishery (4600 t) decreased approximately 900 t from 1994 due to quota reductions. The 1990 and 1991 year classes replaced the 1987 year class as the dominant ones in the fishery in most areas. Stock abundances were estimated from a research gill net catchability analysis. A risk analysis of predicted recruitment was also calculated for each of the stocks. The stock status of the two northern areas, White Bay - Notre Dame Bay and Bonavista Bay - Trinity Bay, were classified as poor to moderate. The two southern stocks, St. Mary's Bay - Placentia Bay and Fortune Bay, were classified as good to very good.

Résumé

On présente les résultats de l'analyse de données recueillies en 1995 et au printemps 1996 sur les stocks de hareng des côtes est et sud-est de Terre-Neuve. Les débarquements de la pêche commerciale de 1995 (4 600 t) ont baissé d'environ 900 t par rapport à 1994 à cause d'une réduction des quotas. Dans la plupart des régions, les classes de 1990 et 1991 ont remplacé celle de 1987 en termes d'abondance dans les prises. Les effectifs des stocks ont été déterminés par analyse du potentiel de capture aux filets maillants expérimentaux. Une analyse des risques du recrutement prévu a aussi été effectuée pou chacun des stocks. La situation des deux stocks du nord, soit baie Blanche-baie Notre Dame et baie de Bonavista-baie de la Trinité, va de médiocre à modérée, tandis que dans le cas des deux stocks du sud, soit baie Ste-Marie-baie de Plaisance et baie Fortune, elle va de bonne à très bonne.

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). Stock status was assessed for all areas except CB-SS, where there were insufficient data to calculate stock biomass.

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. Information was also available for the first time from a commercial logbook program.

This document outlines the steps taken to assess these herring stocks in 1996. 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 1995 commercial fishery and age distributions by stock area from the fishery are provided. Data from the 1995 research gill net program are presented, including age distributions and catch rates at age by stock area. Catch rates only from the 1996 research gill net program are also presented. Catch rates from the 1996 commercial gill net logbook program are presented and compared with catch rates from the research gill net program. Results of acoustic surveys conducted in the fall of 1995 and the winter of 1996 are presented. Estimates of mature biomass, derived from research gill net catchability conversion factors, and estimates of year class strengths, derived from stock specific stock-recruit relationships, are presented for each of the four assessed stock areas. A risk analysis of predicted recruitment is presented for each stock to evaluate the stock status classification system and underlying stock-recruit model. The paper concludes with a summary of the status of each stock in relation to the stock status classification system and associated risk analysis.

The 1995 Commercial Fishery and Catch at Age

Based upon the 1994 Stock Status Report which stated that abundance of these herring stocks was low and of a conservation concern, 1995 TAC's in each of the five stock areas were substantially reduced (Table 1). Consequently, landings in 1995 (4600 t) decreased from 1994 by approximately 900 t (Tables 2 - 6, Fig. 2). The 1995 fishery was administered through separate spring and fall management plans. The spring fishery included a purse seine component (333 t) in Placentia Bay which was taken within a two week period in late March. Spring fixed gear fisheries also occurred in most areas, primarily to satisfy bait requirements. These accounted for approximately 1850 t , most of which (850 t) was taken in WB-NDB. There was also a very limited experimental roe on kelp fishery in FB. The fall fishery was predominated

by the purse seining component which caught approximately 1700 t. This consisted of catches of 200 - 400 t in WB-NDB, BB-TB, and SMB-PB. In the combined fisheries (spring and fall), 66% of the catch was taken from WB-NDB and BB-TB. As in recent years, there were numerous observations by purse seine fishers of small herring (less than or approximately minimum commercial size) in the populations.

There were 1954 herring sampled from the 1995 commercial fisheries. When apportioned by stock area, month and gear type (Table 7), samples were available for 82.5% of the commercial catch.

Younger fish recruited substantially to the commercial fishery in 1995 (Tables 8 - 12, Fig. 3). The 1990 or 1991 year classes of spring spawners dominated (>40%) by number in all areas except FB, replacing the 1987 year class which was dominant in 1994. Older fish, aged 11+, were still important in the southern areas, accounting for 20% of the catch in SMB-PB and 50% in FB. The catch was also dominated by spring spawners, >90% in four areas and >70% in the remaining area (SMB-PB).

Reduced mean weights at age (Table 13) were again evident in 1995. This is consistent with the cold oceanographic conditions which have affected herring growth rates through the early 1990's.

Comparison of Historical Herring Landings and Production Estimates

In the most recent assessment of these herring stocks (Wheeler and Winters 1996), it was recommended that a description of the method for deriving catch statistics be provided and that catch statistics be compared with commercial production records to determine if trends existed over time.

In a presentation to the Regional Assessment Review Committee, Anne Marie Russell (Policy and Economics Branch) provided an overview of the method of collection of catch statistics. Converted herring production estimates and landed weights were also provided from the Newfoundland Region for the period 1965 - 1990 (Table 14). Production estimates were greater than estimates of landed weights in 17 of the 26 year time series, but were greater than 20% in four years only. This occurred twice in the mid 1970's (1975 and 1977) and twice in the mid 1980's (1985 and 1986). The years with major discrepancies in the 1980's were explained to be due to transfers of fish between areas under the jurisdiction of the Gulf and Newfoundland Regions, which has since been rectified. Based upon these data, it was concluded that under-reporting of catches has not been a significant problem in the east and southeast coast Newfoundland herring fisheries.

Predatory Factors

A harp seal consumption model (Stenson et al. 1995) 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 areas. Preliminary results of satellite tracking of harp seals (Stenson, pers. comm.) suggest that the majority of these seals spend most of their time offshore and consequently, mortality of herring by seals is not as high as originally thought. Consumption estimates by seals, when available, will be a valuable addition to the herring stock assessment.

There was little of no new scientific information available regarding the predation on herring by seabirds or cod. Gannets are considered the major seabird predator of herring in these stocks; however, their annual consumption is not considered significant. Information to date, from scientific sources, also suggests that cod aren't significant predators of herring. However, some fishers involved in the 1996 recreational cod fishery in Bonavista Bay, noted the presence of herring in cod stomachs and suggested that cod from shallower water may predate more on herring. This is also consistent with the observations of fishers in Trinity Bay (Fischer et al. 1997). No specific conclusions could be drawn from the above sources. Until more specific scientific information is available, predation of herring by seabirds and cod will not be considered in future herring stock assessments.

Research Gill Net Program Results

The research gill net program, initiated in the early 1980's to derive abundance indices independent of the commercial fishery, was continued in 1995 with twenty-five fishers participating in five stock areas (Figs. 12 - 14). As a new initiative to provide the contracted fishers with feedback regarding the data that they collect, an annual summary sheet (Fig. 4) was distributed to each fisher, providing detailed information regarding herring age distributions, and catch rates for each year of participation in the program.

Catch rates from the research gill net database were modified slightly since the last assessment to include data up to and including July in the spring catch rates. In past assessments, spring catch rates included data from January to June. The impact of these changes (Fig. 5) was minimal and did not affect overall catch rate trends.

As in the commercial fishery, younger fish also recruited to the research gill nets in 1995 (Fig. 6). A combination of the 1990 and 1991 year classes of spring spawners dominated (by number) the research gill net catches in four of five stock areas. However, there were distinct differences between stock areas. As in 1994, the 1990 year class was dominant (50%) in WB-NDB, followed by the 1987 year class. However,

in BB-TB, CB-SS, and SMB-PB, the 1991 year class was dominant. In the latter two areas, it was especially so accounting for greater than 65% of the catch. In FB, the 1987 year class remained dominant although its contribution to the catch (35%) decreased with the recruitment of the 1990 year class (12%). Age 11+ fish continued to account for a substantial portion (33%) of the catch in FB.

Year classes are normally recruited to the research gill nets at age three; however, as was the case in 1994 with the 1990 year class, the 1991 year class did not recruit until age 4 in 1995. This may be a result of the reduced growth rates of herring during the early 1990's.

Catch rates at age for spring spawning herring from the research gill net program are given in Table 15 and Fig. 7. Catch rates only are available for 1996 as the 1996 research gill net biological samples have not yet been processed. Catch rates and age distributions of the research gill net catches have also been examined by bay for the first time this year (Figs. 8 - 11).

Catch rates for the WB-NDB stock complex remained relatively stable from 1995 to 1996 but have declined since the early 1990's (Fig. 7). When examined by bay (Fig. 8), catch rates in White Bay have remained relatively stable and at high levels through the mid 1990's with the recruitment of the 1990 year class. Although this year class also recruited in Notre Dame Bay, catch rates there have declined since the early 1990's.

Catch rates for the BB-TB stock complex (Fig. 7) remained relatively stable through the 1990's but increased substantially from 1995 to 1996. When examined by bay, this increase is more evident in the Trinity Bay portion of the stock (Fig. 9) and is probably due to the recruitment of the 1991 year class.

Catch rates in the CB-SS stock complex decreased from 1995 to 1996 (Fig. 7) and continue to remain at low levels. Although catch rates in Conception Bay have been variable but relatively stable since the late 1980's (Fig. 10), catch rates along the Southern Shore have dropped substantially since 1988 and have remained very low through the 1990's.

As in BB-TB, 1996 catch rates in SMB-PB increased substantially from 1995 (Fig. 7). This increase also appeared to be due to the recruitment of younger fish, primarily 1991 year class. When examined by bay (Fig. 11), catch rates in Placentia Bay have remained relatively stable through the 1990's; the increased catch rates in 1996 occurred primarily in St. Mary's Bay.

FB research gill net catch rates continued to show increasing trends through the mid 1990's to 1996 (Fig. 7). Catch rates in FB are also the highest of the five stock complexes. Unlike other areas where increasing catch rates have been the result of the recruitment of younger fish, high catch rates in Fortune Bay have been sustained by the 1987 year class and older fish (Fig. 6). There is also evidence of recruitment of younger fish (1990 year class) in this stock area.

Commercial Gill Net Logbook Results

In a new initiative to increase scientific information from the commercial fishery and to allow for quantitative input of commercial fishers in the assessment process, a logbook was distributed to each east and southeast coast Newfoundland herring gill net fisher prior to the 1996 spring commercial and / or bait fisheries. Compilation of data and submission of logbooks was strictly on a voluntary basis. Feedback, in the form of a summary graph of catch per net per days fished, was sent to each fisher who participated. The long-term goal of this program is to develop a time series of CPUE data from the commercial fixed gear fishery. The research gill net program has been successful in tracking the abundance of herring year classes since the early 1980's. The commercial data will complement the research gill net program and provide catch rates from more fishers over a broader geographical area.

In 1996, logbooks were distributed to approximately 1900 fishers; 48 completed logbooks were returned. Geographically, 14 logbooks were returned from WB-NDB, mostly from the eastern part of the stock area (Fig. 12). There were 9 logbooks returned from BB-TB, 5 from Bonavista Bay and 4 from Trinity Bay (Fig. 13). There was only one logbook returned from CB-SS (Fig. 13). There were 13 returns from SMB-PB, one from St. Mary's Bay and the remainder uniformly distributed around Placentia Bay (Fig. 14). All 11 logbooks returned from FB (Fig. 14) came from the eastern portion of the stock area.

Catch rates (kg/net/landing) were calculated from the commercial logbooks for each of the stock areas (Table 16). The 1996 catch rates were very consistent between the WB-NDB, BB-TB, and SMB-PB stock areas. They were lower for the one fisher in CB-SS and were higher in FB.

Catch rates from the 1996 commercial logbook data were then compared with the 1996 research gill net catch rates. Commercial gill net panel areas and catch weights were standardized to research gill net panel sizes. The standardized commercial catch weights were then apportioned by mesh size net assuming 1995 research gill net catch rates by mesh size. The standardized commercial catch weights by mesh size were then converted to catch numbers assuming 1995 mean fish weights by mesh size from research gill nets. Standardized commercial catch rates (fish numbers per net nights) were then calculated for comparison with research gill net catch rates (Table 16). Standardized commercial catch rates were substantially higher than the research gill net catch rates in most areas. It was concluded that direct comparisons were not valid as the commercial catch rates reflect peak catch rates from selected sites over a relatively short time period whereas the research gill net catch rates are derived over a longer time period from less selective sites.

Although the commercial logbook catch rates can be used to supplement information from the research gill net program, it was concluded that they must be treated independently and will be of value as a potential index of abundance only when a sufficient time series has been established.

1995 Fall and 1996 Winter Acoustic Survey Results

Results were available from an acoustic survey of BB-TB conducted in November, 1995 and from a survey of SMB-PB conducted in January 1996.

The survey design was unchanged from that described in Wheeler and Winters (1996). The fall survey was conducted from the *R. V. Shamook*, equipped with a mid-water trawl. The winter survey was conducted from the *R.V. Marinus*, equipped with a herring purse seine. Biological samples from the surveys, combined with samples from commercial sources, were adequate to calculate biomass estimates.

The calibration parameters of the echo integrator and transducer used during the surveys were unchanged from the last survey conducted in January 1995 (Wheeler and Winters 1996).

The herring target strength - fish length relationship calculated from the 1993 Holyrood target strength experiments (Wheeler et al. 1994) was again 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 BB-TB, integrated density estimates were calculated for the 227 transects surveyed. The biomass estimate from the survey was 13000 t (Table 17). Herring were detected in 10 of the 21 strata and no single stratum accounted for more than 26% of the biomass estimate. Approximately 89% of the biomass estimate was derived from Bonavista Bay, the remainder from Trinity Bay. The 1991 year class was dominant by weight, accounting for approximately 55% of the biomass estimate (Table 19, Fig. 15).

For the winter survey of SMB-PB, integrated density estimates were calculated for the 130 transects surveyed. The biomass estimate from the survey was 29400 t (Table 18). Herring were detected in only 4 of the 22 strata surveyed and one stratum accounted for 98% of the biomass estimate. The entire biomass estimate was derived from Placentia Bay. No herring were detected in St. Mary's Bay. The 1991 year class and fish aged 11+ accounted for greater than 60% of the biomass estimate (Table 19, Fig. 15).

Estimation of Stock Size

An attempt was made to estimate population numbers and biomass using an extended survivors (XSA) analysis (Pope and Shepherd 1982) as had been used in the most recent assessment of these stocks (Wheeler and Winters 1996). As a new initiative, an integrated catch at age (ICA) analysis (Patterson and Melvin 1996) was also attempted to estimate stock sizes. The strengths, weaknesses and overall results of these analyses were then compared.

The visual diagnostics available with the ICA software were superior to those with the XSA software as the ICA provided plots of model fit and residual patterns for each of the abundance indices. The ICA software also allowed for combined age structured indices and age-aggregated indices of spawning biomass. This was an advantage when combining research gill net catch rates and acoustic biomass estimates as abundance indices. The provision of detailed biological samples allowed for the calculation of age-disaggregated research gill net catch rates. However, acoustic biomass estimates were considered more accurate when age-aggregated than dis-aggregated due to the paucity of biological samples in some surveys. The ICA software limited the time series of abundance estimates to 20 consecutive years and restricted the minimum estimates of fishing mortality to F=0.04. This was a disadvantage as, for some stock areas, there were research gill net catch rates from the early 1970's which could not be included in the analysis. These catch rates are important in any form of sequential population analysis as they are from a time period for which the population matrix is converged. The restriction in the minimum estimate of fishing mortality also limited the use of the ICA as, for all of these stocks, there were several years of very low catches and associated fishing mortalities.

Historical estimates of stock size until the mid 1970's were comparable from both the XSA and ICA models for all of the stock areas. This was consistent with expectations as annual catches and fishing mortalities were relatively high at that time and population matrices were converged. However, current estimates of population sizes from the two models were divergent. The models were unable to track population trends due to periods of low catches and fishing mortalities through the 1980's and 1990's. It was not possible to reconcile the divergent current population estimates from the two models and consequently, an alternate approach to estimating stock sizes was developed.

In sequential population analysis, terminal population estimates are derived by assessing the converged part of the population matrix in relation to the available abundance indices and then assuming constant catchability. As noted above, sequential population estimates during the early 1970's were insensitive to input parameters for all stocks. Research gill net catch rates were also available from FB for two years during this period (1970 and 1971). Population numbers at age were calculated for the period 1970 - 1980 from XSA and ICA and were found to be within 10% for the two years for which research gill net catch rates were available (Table 20). A research gill net catchability coefficient (q), defined as the probability of capture by a single unit of effort, was calculated for FB by regressing the calculated population numbers at age of mature fish (from ICA) for 1970 and 1971 against the research gill net catch rates at age for this period (Table 21, Fig. 16). As the research gill nets and their method of deployment have not changed from 1970 to the present, constant catchability over time was assumed and the calculated catchability coefficient was then applied to current and historical FB research gill net catch rates to estimate population sizes(Table 21). Population numbers were converted to biomass using mean weights from the research gill net data. The derived biomass estimates were compared to FB acoustic survey biomass estimates. Three of four such estimates were within +/-30%.

For the other stock areas, there were no historical (1970's) research gill net catch rates from which to derive catchability coefficients. For these areas, catchability conversion factors were calculated. The catchability coefficient for herring has been shown (Winters and Wheeler 1985) to be inversely proportional to the area occupied by the stock, implying that a unit of effort will generate a higher catch rate in a small area as compared with a larger area for the same size of stock (Fig. 17). Catchability conversion factors were calculated for the remaining three stock areas based upon the published relationship between q and area given in Winters and Wheeler (1985), using the catchability coefficient for FB as calculated above, and actual stock areas defined as the area from the shoreline to the 120 m depth contour. The stock specific conversion factors were then applied to current and historical research gill net catch rates in their respective stocks to estimate population sizes (Table 22). As a cross-check to the accuracy of this approach, estimates of mature biomass calculated from the research gill net catch rates were regressed against mature biomass estimates from acoustic surveys (Fig. 18). Estimates from the two methods were consistent for most areas and years.

Sequential population analyses were run for each stock area with the terminal year (1995) population sizes determined from the research gill net catchability analysis. The modelled estimates were used to provide a time series of mature biomass and recruitment estimates required to calculate stock-recruit relationships for the stock status classification system and risk analysis.

Risk Analysis

In its review of the proposed stock status classification system for east and southeast Newfoundland herring in the fall of 1995, the Atlantic Zone Statistics, Sampling, and Surveys Committee (AZSSSC) recommended that the classification system be evaluated through risk analysis before implementation. A risk analysis of predicted recruitment from the stock specific stock-recruit relationships of the stock status classification system (Warren 1997) was presented to the Regional Assessment Review Committee. The risk analysis incorporated the population time series and revised stock-recruit relationships calculated from the research gill net catchability analysis.

The risk analysis indicated that recruitment in the following year can be well estimated given a current year estimate of mature biomass, and estimates of overwintering temperatures and salinities. The analysis set lower and upper bounds for temperature and salinity and predicted a distribution of future recruitment given an estimate of mature biomass. Projected recruitment was somewhat more tightly distributed when predicted from mature biomass, overwintering temperatures and salinities than from mature biomass alone. The risk analysis highlighted the importance of environmental factors, as large changes in temperatures and salinities had large effects on recruitment distributions.

Status of Stocks

As in the last assessment of these stocks, stock status is described in relation to the stock status classification system (Wheeler and Winters 1996). This system links exploitation rates to recruitment estimates at given spawning stock levels based upon stock specific environmentally dependent stock-recruit relationships. Stock status zones are then defined along these stock-recruit curves with appropriate exploitation levels (Fig. 19).

This year, a risk analysis of predicted recruitment of the 1997 year class is also included in the stock status. Projected estimates of 1997 mature biomass, overwintering temperatures and salinities are used to predict the likely range in strength of the 1997 year class at age 2 in 1999. Median recruitment estimates and ranges are provided; these ranges are defined by the lower and upper quartiles of the distribution of recruitment estimates, ie. the levels at which 25% of the observations generated by the simulations are likely to be below or above, respectively. Recruitment estimates are derived for each stock at two levels of fishing mortality, assuming minimum and maximum fishing mortalities in 1997 for the zone in which the mature biomass is estimated to occur (Table 23).

For WB-NDB, although research gill net catch rates have exhibited a declining trend since the early 1990's, catch rates remained relatively stable from 1995 to 1996 with to the recruitment of the 1990 year class (Fig. 7). The 1996 mature biomass estimate from the research gill net catchability analysis is 51200 t, approximately 50% of which is projected to be the 1990 year class. The sequential population analysis indicates that this stock is at a low level relative to peak levels in the mid 1970's (Fig. 20). This is due to the continued poor recruitment through the 1980's; there is also no evidence of strong recruitment of recent year classes. Based upon the stock status classification system, the status of this stock is classified in zone 2, ***poor to moderate***. Risk analysis indicates that 1997 catches in the order of 2500 - 4900 t would not significantly increase the risk of recruitment failure of the 1997 year class (Table 23). This year class is projected to be above the long-term average because of expected favourable environmental conditions.

For BB-TB, research gill net catch rates have remained relatively stable through the 1990's but increased substantially from 1995 to 1996 with the recruitment of the 1991 year class (Fig. 7). The mature biomass from the 1995 acoustic survey is 4000 t (Table 19). The 1996 mature biomass estimate from the research gill net catchability analysis is 16900 t, approximately 60% of which is projected to be the 1991 year class. The sequential population analysis indicates that this stock is at a low level relative to peak levels in the mid 1970's (Fig. 21). There is no evidence of strong recruitment of recent year classes and year classes produced during the 1980's are not large. Based upon the stock status classification system, the status of this stock is classified in zone 2, ***poor to moderate***. Risk analysis indicates that 1997 catches in the order of 800 - 1600 t would not significantly increase the risk of recruitment failure of the 1997 year

class (Table 23). This is predicated on the accuracy of the estimate of the 1997 mature biomass which is very close to the boundary of zone 1; caution is recommended in the establishment of catch levels.

For SMB-PB, research gill net catch rates have remained relatively stable through the 1990's but increased substantially from 1995 to 1996 with the recruitment of the 1991 year class (Fig. 7). The mature biomass from the 1996 acoustic survey is 27000 t (Table 19). The 1996 mature biomass estimate from the research gill net catchability analysis is 35400 t, approximately 65% of which is projected to be the 1991 year class. The increase in the estimate of mature biomass from the last assessment is due to the recruitment of this year class. The sequential population analysis indicates that this stock is at a good level as a result of the entry of the relatively strong 1991 year class into the mature stock (Fig. 22). Based upon the stock status classification system, the status of this stock is classified in zone 4, ***good to very good***. Risk analysis indicates that 1997 catches in the order of 6400 t would not significantly increase the risk of recruitment failure of the 1997 year class (Table 23).

For FB, research gill net catch rates continue to show increasing trends through the 1990's to 1996 (Fig. 7). These catch rates have been sustained by the 1987 year class and older fish; there is also evidence of the recruitment of younger fish in the area. The 1996 mature biomass estimate from the research gill net catchability analysis is 29700 t, consisting predominantly of the 1987 and 1990 year classes and fish aged 11+. The increase in the estimate of mature biomass from the last assessment is partly due to recruitment of recent year classes and partly due to the use of research gill net catch rates only to estimate current stock size. The most recent (1995) acoustic biomass estimate is excluded in considering stock status as it is the lowest in the time series and is not considered to accurately reflect stock abundance as the magnitude and direction of change from previous surveys does not match other indicators of stock abundance. The sequential population analysis indicates that this stock is at a good level; the 1987 year class and older fish continue to contribute to the spawning biomass, there is evidence of the recruitment of the 1990 year class, and there has been very limited fishing mortality (Fig. 23). Based upon the stock status classification system, the status of this stock is classified in zone 4, ***good to very good***. Risk analysis indicates that 1997 catches in the order of 5400 t would not significantly increase the risk of recruitment failure of the 1997 year class (Table 23).

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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
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	8.7	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
*1995	1.6	1.2	1.5	1.0	0.3	0.8	0.8	1.1	0.5	1.5

* provisional

Table 2. White Bay (WB) - Notre Dame Bay (NDB) herring landings and TAC's (t), by gear, 1979-95.

Year	Area	Gear						Total	TAC
		Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap		
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	6026	-	-	80	946	41	6872	
	Combined	7344	-	-	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
1995*	WB	201	-	-	1	15	9	225	
	NDB	454	-	-	25	890	-	1369	
	Combined	655	-	-	26	905	9	1594	1200

* provisional

Table 3. Bonavista Bay (BB) - Trinity Bay (TB) herring landings and TAC's (t), by gear, 1979-95.

Year	Area	Gear						Total	TAC
		Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap		
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
1995*	BB	427	-	-	6	520	-	954	
	TB	271	-	-	133	91	2	497	
	Combined	698	-	-	139	611	2	1451	1000

* provisional

Table 4. Conception Bay (CB) - Southern Shore (SS) herring landings and TAC's (t), by gear, 1979-95.

Year	Area	Gear						Total	TAC
		Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap		
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
1995*	CS	289	-	-	-	17	-	306	
	SS	-	-	-	-	16	-	16	
	Combined	289	-	-	-	33	-	322	750

* provisional

Table 5. St. Mary's Bay (SMB) - Placentia Bay (PB) herring landings and TAC's (t), by gear, 1979-95.

Year	Area	Gear						Total	TAC
		Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap		
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
1995*	SMB	219	-	-	-	1	-	220	
	PB	332	-	-	76	135	-	543	
	Combined	551	-	-	76	136	-	763	1100

* provisional

Table 6. Fortune Bay (FB) herring landings and TAC's (t), by gear, 1979-95.

Year	Gear						Total	TAC
	Purse Seine	Ringnet	Midwater Trawl	Bar Seine	Gillnet	Trap		
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
1995*	5	-	-	4	460	-	469	1500

* provisional

Table 7. Commercial catch (t) and number of fish sampled (bold print) for 1995, by stock area, gear type and month. Boxed areas indicate the catch - sample combinations used for calculating commercial catch at age.

AREA	GEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
WB-NDB	Gillnet				1	438 **50**	332 **100**	112	5 **50**	11	4 **50**	1	1
	Purse seine					1	14	2			193 **50**	446 **197**	
	Bar Seine					9	14	2					
	Trap									9	1		
BB-TB	Gillnet				23	215 **97**	164 **50**	10	1	3	28 **46**	121 **50**	46 **50**
	Purse seine					45 **100**					171 **100**	482 **336**	
	Bar Seine				3	6		1					130 **50**
	Trap								2				
CB-SS	Gillnet				4	6	6 **50**	4	1 **50**	4	3	1	6
	Purse seine										17 **38**	246	26
	Bar Seine												
	Trap												
SMB-PB	Gillnet	6	1	9 **50**	60 **50**	41	19 **50**			1			1
	Purse seine			316 **50**		16					18 **50**	201	
	Bar Seine			76 **50**		1	1						
	Trap					1							
FB	Gillnet		1	1	52 **40**	318 **50**	88 **50**		1	1			
	Purse seine				1	1	4						
	Bar Seine				2	2							
	Trap												

Table 8. Commercial catch at age of spring and autumn spawning herring for White Bay - Notre Dame Bay, 1966-1995.

Spring Spawners

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	10	1	5	1	1	2	56	50	1	1	115
3	40	43	64	54	1	129	290	727	4	128	24	1671	55	60	46
4	2	1551	1	103	12	88	2396	1411	123	215	506	107	2034	50	1240
5	27	86	718	19	24	161	353	2825	3142	453	237	468	317	2928	92
6	67	43	11	1155	24	64	69	761	5446	5438	868	184	1034	323	1080
7	180	1	48	1	972	425	122	719	1193	7069	10893	793	517	1410	17
8	128	86	161	108	11	10184	403	654	697	1123	17145	7363	2509	767	496
9	23	1	295	9	83	233	1363	416	1506	838	1328	12675	10807	2222	179
10	6	1	188	59	159	254	205	1685	858	810	3364	1055	11756	14413	1450
11+	75	86	91	41	275	3105	808	794	2378	3999	8535	15707	14379	27508	14653
Total	550	1900	1579	1551	1572	14645	6015	9994	15349	20076	42957	40074	43410	49683	19369

Age	1981	1982	1983	1984	1985	1986	1987 b	1988 c	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
1	1	1	1	1	1	195	26	3113	1	1	2273	1	1	1	1
2	445	76	1	6	3	29	1105	407	23	1	29	940	1	1	1
3	152	371	38	12	187	975	324	1044	128	1936	386	207	96	1	96
4	41	332	46	124	350	2945	7201	291	613	285	16183	942	31	1052	609
5	1231	59	23	1218	240	308	25843	2984	124	637	1542	8940	263	121	2720
6	63	268	14	73	1486	667	1651	11819	3106	240	553	483	3614	1669	143
7	805	34	93	114	108	1258	1067	1036	10566	2451	103	371	75	2183	689
8	64	258	1	157	275	198	2088	1137	370	7360	2145	211	199	107	1503
9	344	19	26	37	94	162	399	1454	1081	532	4432	722	70	191	183
10	194	192	4	122	81	179	442	315	844	1132	537	2796	544	48	126
11+	10908	4059	805	1938	2110	1973	4566	2943	2178	1148	2201	3509	861	438	335
Total	14248	5669	1052	3802	4935	8889	44712	26543	19034	15723	30384	19122	5755	5812	6406

Autumn Spawners

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1					1	1	1	1	1	1	1	1	1	1	1
2					1	1	1	1	1	1	1	1	1	1	1
3					1	1	53	1	1	6	1	1	1	1	71
4					1	1	17	7	11	64	31	45	6	1	13
5					26	6	74	22	124	3	35	35	24	10	13
6					10	14	79	25	10	25	51	85	155	267	23
7					39	11	67	60	48	16	20	54	171	172	272
8					60	26	1	25	2	21	40	1	24	160	4
9					20	17	164	13	46	3	46	94	2	133	19
10					11	19	81	97	7	2	4	1	130	1	1
11+					172	291	562	298	346	302	329	182	238	298	450
Total					342	388	1100	550	597	444	559	500	753	1045	868

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
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	11
3	1	72	1	1	1	10	2	1	1	1	1	1	1	1	1
4	13	26	74	60	29	67	297	92	65	130	188	109	1	7	11
5	86	62	25	409	94	69	469	115	12	65	450	187	48	70	36
6	11	16	23	66	333	79	156	45	5	52	98	172	78	80	2
7	1	12	1	30	137	373	112	20	574	84	36	48	113	137	117
8	100	9	1	8	32	68	630	7	70	37	128	46	79	25	3
9	1	42	6	7	23	6	152	560	1	1	249	80	42	4	23
10	4	1	1	3	10	1	10	6	533	4	120	19	21	1	1
11+	65	23		24	74	42	108	306	29	577	2733	613	349	15	202
Total	284	265	134	610	735	717	1938	1154	1292	953	4005	1277	734	342	408

Spring and Autumn Spawners

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Total	550	1900	1579	1551	1914	15033	7115	10544	15946	20520	43516	40574	44163	50728	20237
% 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
% 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

	1981	1982	1983	1984	1985	1986	1987 b	1988 c	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
Total	14532	5934	1186	4412	5670	9606	46650	27697	20326	16676	34389	20399	6489	6154	6814
% SS	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	94.0
% AS	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	6.0

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 , 1966-1995.

Spring Spawners

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	1	1	1	1	1	1	1	1	1	1	5	10	1	1	1
2	1	1	1	1	1	1	1	1	1	1	14	16	22	6	15
3	33	17	42	6	1	690	10	1	1	392	77	248	26	286	13
4	15	628	1	4	1	311	1347	60	2	134	493	135	357	167	195
5	9	35	469	10	9	102	389	4887	235	163	123	759	122	765	43
6	83	17	7	332	55	64	91	126	4795	2564	166	227	251	19	293
7	96	1	32	4	808	361	75	96	424	14330	4897	50	112	436	52
8	179	35	105	52	35	1373	88	1	151	455	20697	6209	598	101	264
9	32	1	193	27	126	151	480	48	294	995	909	23206	4412	530	75
10	40	1	123	38	69	126	14	271	69	727	854	774	13394	5575	967
11+	300	35	61	294	212	522	213	1	1849	1679	4306	5890	5956	19994	12259
Total	789	772	1035	769	1318	3702	2709	5493	7822	21441	32541	37524	25251	27880	14177

Age	1981	1982	1983	1984	1985 b	1986	1987 c	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
1	1	1	1	1	1	151	296	717	1	1	115	1	1	1	7
2	136	1	1	4	13	207	1352	6612	563	58	689	499	354	1	1
3	246	8	4	22	175	443	413	9910	1043	3094	210	1056	621	386	137
4	53	11	34	35	70	4445	2845	267	3323	422	13551	271	160	806	2920
5	256	2	7	210	87	261	16208	3674	264	2350	2586	12612	344	301	386
6	26	30	2	9	351	161	334	21739	1428	94	3859	2422	3779	1067	65
7	288	5	15	5	37	262	359	782	8639	629	347	579	422	3861	158
8	23	35	1	12	27	38	126	713	13	4439	1550	194	385	474	1013
9	321	5	8	2	13	10	33	8	216	235	7505	1394	132	470	180
10	88	65	2	2	22	31	6	55	100	325	447	2054	657	530	166
11+	11762	1186	159	154	797	657	956	1247	508	466	891	653	1092	1828	670
Total	13200	1349	234	456	1593	6666	22928	45724	16098	12113	31750	21735	7947	9724	5703

Autumn Spawners

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1					1	1	1	1	1	1	1	1	1	1	1
2					1	1	1	1	1	1	1	1	1	1	1
3					1	1	1	1	1	1	10	1	1	1	14
4					9	1	1	1	1	26	22	55	16	1	11
5					1	10	1	1	1	30	77	16	14	27	17
6					1	1	1	1	1	1	23	176	61	114	83
7					4	4	2	1	16	22	66	86	58	30	188
8					17	23	2	48	2	41	34	112	28	175	45
9					18	3	5	1	1	6	62	30	23	13	112
10					17	21	1	1	1	19	8	73	82	16	3
11+					738	406	33	1	1216	259	1069	1069	417	800	463
Total					808	472	49	58	1242	407	1373	1620	702	1179	938

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
1	1	1	1	1	1	1	19	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	253	1	1	1	1	1	1	15
3	6	3	1	1	1	1	1	54	1	5	6	1	11	1	8
4	115	1	10	3	5	51	2	22	55	139	140	10	1	1	49
5	106	8	2	84	18	80	391	88	76	55	837	219	146	53	106
6	33	10	5	14	203	59	237	357	136	9	152	205	205	169	7
7	83	3	2	17	96	292	87	216	237	61	17	118	163	27	1
8	283	8	1	3	54	149	360	202	18	50	99	1	121	115	50
9	36	25	1	5	22	24	138	818	83	58	104	5	39	1	24
10	4	1	1	1	10	1	2	2	697	19	125	1	14	1	1
11+	230	37	3	9	29	30	156	237	193	89	481	167	376	79	88
Total	898	98	28	139	440	689	1394	2250	1498	487	1963	729	1078	448	350

Spring and Autumn Spawners

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Total	789	772	1035	769	2126	4174	2758	5551	9064	21848	33914	39144	25953	29059	15115
% 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
% 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

	1981	1982	1983	1984	1985 b	1986	1987 c	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
Total	14098	1447	262	595	2033	7355	24322	47974	17596	12600	33713	22464	9025	10172	6053
% SS	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	94.2
% AS	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	5.8

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 , 1970-1

Spring Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	67	4	9	1177	7	1	1	1	1	1	1	1
3	1	36	7	2	1	418	28	127	1	4	1	25	2	1	3
4	15	31	1625	34	5	30	97	5	99	9	3	4	5	1	27
5	17	19	134	4521	122	16	23	101	32	34	1	26	1	1	47
6	21	11	55	242	9655	2057	31	45	65	7	19	9	2	1	5
7	255	43	29	329	153	8592	2330	13	14	38	1	28	1	1	1
8	12	272	79	142	83	120	4771	950	3	4	12	3	5	1	2
9	13	26	361	44	39	517	89	4241	734	31	1	14	1	1	1
10	11	11	67	175	13	238	252	49	3080	270	49	13	1	1	1
11+	46	65	122	28	658	891	714	959	1358	1640	1101	504	176	13	7
Total	393	516	2481	5585	10734	12889	9513	6498	5388	2039	1190	628	196	23	96

Age	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
1	1	1	714	22	1	1	1	1	1	1	1
2	1	6	1	2	718	1	1	1	1	1	1
3	58	1	36	87	833	87	1	1	1	173	1
4	11	389	73	25	1319	36	304	1	1	8	1324
5	11	7	3486	252	15	49	70	12	5	1	90
6	17	13	17	502	123	1	214	17	30	10	2
7	2	16	26	33	1696	57	23	27	9	24	7
8	2	3	10	5	10	434	4	2	6	11	13
9	1	1	2	1	37	18	356	3	1	4	6
10	1	3	1	1	2	24	47	33	8	2	1
11+	97	81	65	45	138	82	57	26	58	55	28
Total	202	521	4431	975	4892	790	1078	124	121	290	1474

Autumn Spawners

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
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
3	1	1	1	1	2	7	1	1	1	1	1	1	9	1	1
4	1	1	1	2	3	162	1	7	4	2	1	14	5	1	4
5	1	1	1	2	8	40	49	29	50	17	1	8	14	2	60
6	8	1	1	1	6	81	27	150	30	80	1	3	1	3	6
7	20	1	1	38	17	18	23	87	69	15	32	7	1	1	6
8	36	6	1	35	1	49	23	72	9	57	3	14	2	2	3
9	5	34	1	1	6	11	31	13	10	17	6	2	2	5	1
10	6	11	1	1	1	14	12	7	34	6	1	1	1	1	1
11+	114	89	1	94	45	318	193	373	282	245	32	9	5	12	1
Total	194	147	11	177	91	702	362	741	491	442	80	61	42	30	85

Age	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1
3	1	23	1	1	365	1	1	1	1	8	1
4	3	7	7	1	1	3	70	7	1	10	37
5	6	18	37	49	1	10	25	23	1	1	2
6	52	21	27	96	3	4	24	9	2	15	1
7	24	94	32	90	67	2	3	1	6	7	9
8	13	29	32	39	13	2	1	1	1	7	7
9	3	10	21	42	5	15	4	1	1	1	1
10	1	3	13	1	31	18	6	1	1	2	1
11+	15	10	8	1	15	89	14	15	7	3	2
Total	120	217	180	322	503	146	150	61	23	57	63

Spring and Autumn Spawners

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Total	587	663	2492	5762	10825	13591	9875	7239	5879	2481	1270	689	238	53	181
% 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
% 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

	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
Total	322	738	4611	1297	5395	936	1228	185	144	347	1537
% SS	62.7	70.6	96.1	75.2	90.7	84.4	87.8	67.0	84.0	83.6	95.9
% AS	37.3	29.4	3.9	24.8	9.3	15.6	12.2	33.0	16.0	16.4	4.1

a - preliminary

Table 11. Commercial catch at age of spring and autumn spawning herring for St. Mary's Bay - Placentia Bay , 1966-199

Spring Spawners

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	1	1	1	1	3	1	1	1	3	1	1	1	1	1	1
2	1	1	3232	1	476	1	1	76	995	74	365	52	30	87	133
3	1066	1	439	629	109	557	207	326	280	2234	391	1423	175	663	332
4	104	2362	29	54	4434	116	20375	77	234	471	1906	140	1817	279	133
5	114	158	7417	53	59	2111	725	15470	126	147	208	736	123	2263	153
6	164	302	399	861	76	80	5154	566	14328	1591	267	87	596	96	1270
7	1912	788	679	67	645	251	365	6757	438	13858	862	50	64	614	57
8	1282	1451	953	55	66	45	650	93	6049	146	5622	1039	106	85	470
9	137	407	2836	99	72	13	352	224	138	3391	201	3830	512	66	38
10	43	85	2577	347	37	22	73	193	238	350	2256	134	3827	501	237
11+	993	787	3680	348	107	96	403	315	624	1323	1361	2448	2185	4785	2971
Total	5817	6343	22242	2515	6084	3293	28306	24098	23451	23586	13440	9940	9436	9440	5795

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	1
2	1	1	1	8	1	1	34	1	22	1	37	68	5	24	1
3	193	1	5	9	7	1	19	1	48	115	1	47	62	137	331
4	42	2	2	24	18	143	2	22	9	189	222	7	34	5	1392
5	111	3	3	36	27	19	502	163	1	64	160	363	11	36	37
6	51	8	2	6	21	28	29	2457	24	15	170	231	187	6	1
7	338	3	4	3	15	9	47	119	463	30	12	55	118	224	1
8	28	14	1	24	3	4	9	213	34	494	110	53	74	60	62
9	80	4	9	1	25	1	3	16	100	45	493	74	63	98	1
10	6	4	1	10	5	5	1	36	5	172	88	383	56	172	16
11+	466	69	39	44	125	30	11	147	34	128	948	965	1174	998	404
Total	1317	110	68	166	248	242	658	3176	741	1254	2242	2247	1785	1773	2247

Autumn Spawners

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1					1	1	1	1	1	1	1	1	1	1	1
2					1	1	1	1	1	1	1	1	1	1	1
3					1	1	24	5	2	1	11	1	1	1	1
4					1	9	61	150	2	7	4	47	23	11	96
5					2	2	175	52	96	68	214	52	435	143	35
6					1	53	15	71	146	182	67	209	92	598	52
7					71	31	61	10	80	89	32	81	244	73	419
8					112	43	37	54	95	206	17	69	122	216	79
9					19	84	101	17	93	6	94	26	38	21	126
10					28	35	71	68	51	37	11	22	52	2	25
11+					202	314	539	737	970	677	329	526	561	348	492
Total					439	574	1086	1166	1537	1275	781	1035	1570	1415	1327

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	4	1	5	7	1	1	1	7	1
4	139	1	18	17	9	16	12	20	5	37	14	7	2	7	102
5	116	7	6	101	20	24	32	30	18	61	87	8	208	62	108
6	10	1	12	32	86	15	80	239	8	54	40	50	239	116	34
7	11	1	4	21	46	97	30	90	56	24	23	33	173	182	104
8	50	1	1	5	36	28	82	35	43	47	65	27	41	231	97
9	7	1	1	3	10	16	24	270	67	58	98	64	41	182	86
10	1	1	1	1	3	4	3	5	178	17	40	1	3	1	75
11+	29	2	4	8	24	15	12	53	164	173	495	479	863	457	273
Total	366	18	50	191	237	218	282	745	546	480	865	672	1573	1247	882

Spring and Autumn Spawners

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Total	5817	6343	22242	2515	6523	3867	29392	25264	24988	24861	14221	10975	11006	10855	7122
% 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
% 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

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
Total	1683	128	118	357	485	460	940	3921	1287	1734	3107	2919	3358	3020	3129
% SS	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	71.8
% AS	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	28.2

a - preliminary

Table 12. Commercial catch at age of spring and autumn spawning herring for Fortune Bay , 1966-1995.

Spring Spawners

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	1	1	1	1	1	1	617	23	1	1	1	1	1	1	1
2	1	1	6549	515	29475	167	1515	2210	389	2	82	27	1	1	25
3	223	89	128	11984	5988	23223	256	925	1314	277	15	2103	42	1	16
4	13	24764	317	85	11953	6086	19690	67	552	581	318	25	2677	183	3
5	22	46	48563	187	133	23525	2896	5694	130	112	228	327	62	3833	69
6	90	49	216	13038	281	1165	10767	475	4435	87	129	166	237	15	1122
7	66	422	124	188	7894	5747	351	1712	250	1490	11	26	43	165	7
8	90	450	610	261	233	3514	4432	73	1094	16	338	43	139	5	183
9	28	513	770	690	16	132	991	282	36	142	36	188	52	24	1
10	2	358	920	1935	225	148	34	558	117	22	188	4	326	1	11
11+	17	138	855	1706	257	537	366	173	255	201	140	244	302	167	50
Total	553	26831	59053	30590	56456	64245	41915	12192	8573	2931	1486	3154	3882	4396	1488

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1
3	144	1	2	1	54	1	1	1	1	1	1	1	2	5	1
4	16	3	2	4	3	145	1	1	1	1	23	1	1	1	1
5	4	3	1	3	39	4	304	1	1	2	8	3	1	2	14
6	3	1	1	2	12	69	11	219	18	2	1	1	327	1	14
7	21	2	1	1	2	20	49	7	274	12	1	1	2	24	24
8	2	36	1	2	1	6	18	26	1	155	6	1	3	23	569
9	23	1	10	1	1	1	4	6	17	17	274	2	8	9	36
10	1	5	1	2	1	2	1	1	11	20	1	75	10	8	36
11+	12	5	18	23	15	14	38	10	24	1	72	266	217	647	728
Total	228	59	39	42	130	264	429	274	350	213	389	353	573	722	1425

Autumn Spawners

Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1					1	1	1	1	1	1	1	1	1	1	1
2					1	1	1	1	1	1	1	1	1	1	1
3					1	1	1	1	7	1	7	1	1	1	1
4					1	598	1	48	9	22	9	23	1	7	4
5					334	1	84	50	87	12	38	19	36	5	3
6					1	136	25	79	65	39	26	19	6	50	3
7					443	175	185	8	12	19	13	1	25	1	3
8					816	769	44	32	27	20	1	1	12	17	1
9					412	626	310	15	5	11	27	1	6	12	1
10					1	470	125	27	1	7	1	1	1	1	1
11+					2201	1956	793	97	85	45	9	2	18	12	1
Total					4212	4734	1570	359	300	178	133	70	108	108	20

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
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
3	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	64	1	1	1	17	3	1	2	3	10	1	1	1	1	1
5	16	7	1	9	4	8	4	1	6	5	1	4	1	1	1
6	1	2	2	4	26	16	7	5	1	12	8	5	3	1	1
7	1	1	1	6	12	38	11	5	6	17	1	3	11	1	25
8	1	1	1	1	7	12	25	1	31	7	3	1	1	1	31
9	1	1	1	1	4	5	10	13	3	54	1	1	1	1	10
10	1	1	1	1	1	1	5	1	17	1	3	1	1	1	1
11+	1	1	1	1	2	5	14	10	5	5	1	5	26	14	1
Total	93	18	12	27	76	91	80	41	75	114	22	24	48	24	74

Spring and Autumn Spawners

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Total	553	26831	59053	30590	60668	68979	43485	12551	8873	3109	1619	3224	3990	4504	1508
% 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
% 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

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 a	1992 a	1993 a	1994 a	1995 a
Total	321	77	51	69	206	355	509	315	425	327	411	377	621	746	1499
% SS	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	95.1
% AS	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	4.9

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Table 13. Mean weights at age (g) of spring-spawning herring, by stock area, from samples collected January to June, 1990 - 1995 Sample sizes in parenthesis.

Stock Area	Age	1990		1991		1992		1993		1994		1995	
WB-NDB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-	-	-	-
	3	122	(293)	122	(16)	122	(1)	85	(10)	74	(6)	125	(1)
	4	179	(152)	172	(665)	164	(52)	159	(58)	132	(724)	131	(15)
	5	234	(158)	212	(77)	199	(1108)	189	(218)	187	(65)	166	(332)
	6	259	(72)	247	(44)	229	(81)	221	(1208)	210	(353)	200	(16)
	7	279	(475)	278	(29)	261	(45)	252	(46)	238	(697)	226	(85)
	8	296	(696)	287	(214)	277	(40)	279	(34)	271	(37)	249	(204)
	9	329	(43)	312	(405)	296	(142)	298	(25)	283	(37)	286	(13)
	10	336	(126)	331	(37)	322	(405)	304	(118)	304	(39)	288	(15)
	11+	418	(333)	393	(236)	373	(375)	343	(456)	330	(252)	324	(53)
BB-TB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	70	(8)	-	-	-	-	-	-	-	-	-	-
	3	144	(227)	132	(15)	133	(16)	108	(120)	81	(20)	101	(3)
	4	219	(138)	202	(670)	174	(20)	170	(49)	144	(265)	133	(354)
	5	262	(376)	257	(188)	216	(707)	211	(120)	198	(105)	172	(103)
	6	272	(51)	287	(484)	256	(166)	239	(873)	224	(192)	218	(31)
	7	285	(204)	286	(54)	287	(345)	284	(152)	255	(941)	237	(62)
	8	314	(962)	289	(287)	287	(46)	311	(213)	295	(122)	270	(240)
	9	353	(19)	322	(1053)	282	(192)	299	(80)	308	(207)	291	(32)
	10	362	(37)	339	(65)	307	(638)	309	(280)	306	(158)	289	(43)
	11+	421	(178)	387	(140)	340	(305)	343	(516)	345	(966)	331	(272)
CB-SS	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	4	(5)	-	-	-	-
	2	-	-	54	(1)	-	-	28	(160)	42	(3)	-	-
	3	173	(161)	137	(2)	129	(12)	104	(37)	86	(83)	139	(1)
	4	250	(127)	235	(133)	-	-	174	(26)	163	(84)	158	(160)
	5	271	(117)	269	(48)	241	(161)	217	(21)	222	(50)	206	(22)
	6	282	(12)	286	(91)	276	(96)	265	(207)	231	(39)	271	(2)
	7	303	(62)	311	(12)	293	(133)	305	(63)	278	(243)	279	(6)
	8	329	(474)	296	(46)	298	(11)	316	(78)	305	(60)	316	(8)
	9	349	(15)	321	(289)	300	(46)	319	(13)	318	(59)	360	(3)
	10	359	(27)	345	(18)	318	(239)	328	(54)	330	(43)	337	(2)
	11+	426	(56)	388	(65)	348	(134)	355	(219)	364	(304)	393	(16)
SMB-PB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	30	(3)	-	-	22	(35)	-	-	-	-	-	-
	2	87	(8)	77	(4)	59	(16)	39	(7)	59	(28)	-	-
	3	162	(148)	140	(22)	137	(36)	130	(84)	115	(260)	107	(87)
	4	242	(186)	212	(271)	191	(12)	189	(80)	168	(108)	171	(386)
	5	273	(63)	258	(103)	242	(340)	215	(32)	219	(59)	229	(29)
	6	291	(16)	278	(45)	276	(101)	267	(283)	249	(16)	264	(4)
	7	311	(44)	298	(13)	292	(58)	292	(80)	291	(150)	278	(10)
	8	343	(667)	302	(30)	299	(17)	305	(90)	322	(40)	324	(40)
	9	362	(43)	331	(233)	315	(32)	317	(25)	332	(95)	347	(10)
	10	367	(184)	346	(26)	331	(194)	330	(68)	330	(60)	334	(12)
	11+	406	(122)	362	(189)	362	(349)	372	(432)	384	(511)	381	(122)
FB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	15	(80)	-	-	-	-	23	(2)
	2	102	(1)	-	-	61	(170)	-	-	-	-	-	-
	3	145	(393)	134	(2)	138	(5)	120	(3)	114	(5)	90	(96)
	4	215	(16)	186	(143)	170	(22)	177	(2)	157	(68)	150	(99)
	5	252	(3)	233	(53)	209	(313)	222	(24)	195	(13)	185	(162)
	6	268	(1)	244	(7)	254	(36)	240	(429)	214	(28)	218	(17)
	7	292	(52)	276	(5)	288	(7)	281	(22)	257	(242)	237	(31)
	8	322	(716)	289	(54)	295	(11)	297	(12)	279	(17)	265	(212)
	9	339	(47)	319	(672)	309	(41)	284	(3)	294	(8)	311	(19)
	10	356	(162)	338	(63)	329	(305)	287	(22)	320	(11)	311	(9)
	11+	421	(148)	372	(284)	367	(685)	355	(642)	362	(366)	359	(252)

Table 14. Comparison of commercial herring production converted to round weight (t) and herring landings (t) for the Newfoundland Region, 1965 - 199

Year	Converted Production	Landed Weight	Percent Difference
1965	11035	12926	-15%
1966	32858	28088	17%
1967	75446	81862	-8%
1968	145327	143309	1%
1969	158721	167537	-5%
1970	154269	158776	-3%
1971	128718	137884	-7%
1972	74045	64448	15%
1973	52281	55220	-5%
1974	35630	34761	2%
1975	58419	42474	38%
1976	58395	48922	19%
1977	60143	49902	21%
1978	49432	45745	8%
1979	49466	51963	-5%
1980	39945	35504	13%
1981	25246	24754	2%
1982	14874	13567	10%
1983	21690	20726	5%
1984	11450	9607	19%
1985	3708	2764	34%
1986	6360	4968	28%
1987	17578	20832	-16%
1988	13452	13338	1%
1989	14473	20693	-30%
1990	10702	10152	5%

Table 15. Spring research gillnet catch rates at age (numbers per days fished), spring spawners only, by stock area and year.

White Bay - Notre Dame Bay

Age	1970	1971	1972	1973 ...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1		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	0.0	0.0	0.0	0.0	0.0	
3		0.0											4.7	16.0	83.5	11.0	0.0	1.2	0.6	0.0	
4		24.9											1.9	43.3	51.6	247.1	21.5	10.9	232.0	18.5	
5		3.9											22.2	11.2	52.9	28.8	493.7	51.0	14.6	300.1	
6		22.3											59.6	126.9	16.3	13.7	33.5	359.9	52.1	20.2	
7		27.5											5.6	182.9	144.6	7.5	13.7	18.8	182.7	45.9	
8		1011.1											4.7	9.7	195.5	84.2	10.3	6.7	14.1	104.1	
9		14.4											12.0	16.0	11.5	164.3	47.2	13.4	7.6	8.4	
10		28.8											1.8	24.3	26.5	21.9	127.9	29.7	12.9	9.5	
11+		176.8											34.1	56.4	97.1	106.1	110.8	115.9	69.1	52.1	
Total		1309.7											146.4	486.4	678.8	684.6	858.6	606.9	585.7	559.8	493.9

Bonavista Bay - Trinity Bay

Age	1970	1971	1972	1973 ...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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	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	0.0	
3		1.6	2.6		0.0	19.9	3.1	1.6	20.2	18.3	0.9	1.2	5.6	2.3	8.8	0.9	0.3	2.6	0.7	0.0	
4		15.5	483.6		17.3	4.6	1.4	13.0	8.2	7.6	151.7	1.2	0.3	21.8	8.2	50.1	1.2	1.7	16.6	34.3	
5		2.5	220.9		0.0	1.7	0.3	0.4	37.7	4.3	2.4	104.5	2.3	0.9	27.7	12.0	46.2	8.2	9.6	8.2	
6		2.6	14.4		53.1	1.5	1.0	0.0	3.5	11.2	2.6	1.5	29.2	5.5	4.5	27.9	8.1	50.6	12.6	1.7	
7		13.9	44.4		0.0	5.2	0.0	0.3	0.7	1.0	3.1	0.0	0.5	57.7	12.2	3.2	10.3	6.4	65.0	4.6	
8		80.3	56.2		3.5	0.0	0.7	0.0	2.2	1.0	0.9	0.0	0.4	0.9	60.8	19.8	2.3	7.0	6.5	19.9	
9		4.1	332.0		0.0	4.2	0.3	3.6	0.0	1.0	0.3	0.3	0.6	0.6	0.8	62.3	17.6	3.7	8.9	2.6	
10		10.6	5.2		41.4	5.9	0.3	0.6	2.2	1.1	0.2	0.7	0.0	0.7	3.2	3.8	34.8	13.1	7.5	3.0	
11+		13.9	147.7		574.8	166.7	56.4	65.8	146.4	39.3	10.8	6.4	12.2	5.5	8.9	8.3	16.8	20.2	40.1	25.0	
Total		145.3	1306.9		690.0	209.4	63.6	85.0	221.8	84.8	174.3	116.0	51.2	96.1	135.1	188.2	137.6	113.5	167.6	99.2	234.0

Conception Bay - Southern Shore

Age	1970	1971	1972	1973 ...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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	
2					0.0					0.0	0.0	0.0	0.3	0.0	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	1.2	
4					0.0					1.5	121.9	2.6	26.5	25.3	11.7	15.8	0.0	2.2	3.3	248.9	
5					0.0					6.5	3.3	180.9	22.6	13.9	9.0	5.4	17.9	1.7	2.5	26.0	
6					0.0					18.8	22.8	8.3	727.5	20.4	1.2	15.3	7.3	10.6	1.6	1.5	
7					0.9					2.6	5.7	13.7	32.4	110.0	5.6	1.7	8.5	3.6	9.3	5.6	
8					0.0					2.2	4.3	4.5	69.7	7.4	49.9	6.0	1.6	3.7	2.1	3.2	
9					0.0					0.5	1.3	3.2	9.8	6.5	1.7	43.4	1.9	0.6	2.7	0.0	
10					0.9					0.0	1.3	1.3	2.0	1.4	2.4	3.7	19.4	3.3	1.3	3.8	
11+					42.2					131.5	57.6	85.8	84.4	31.1	5.5	8.7	7.3	13.2	11.2	4.4	
Total					44.0					172.1	217.3	319.0	981.8	232.0	106.3	99.8	64.7	42.1	35.5	294.9	85.1

St. Mary's Bay - Placentia Bay

Age	1970	1971	1972	1973 ...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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	0.0	0.0		0.0			0.2	1.6	0.7	0.0	0.0	0.0	0.4	0.2	0.1	0.1	0.0	0.2	0.0	0.0	
3	6.7	230.3		0.6			0.2	10.2	18.6	59.3	0.3	13.7	2.3	23.5	11.2	0.9	2.7	3.5	15.6	11.3	
4	627.5	35.0		0.0			0.6	1.8	21.9	5.9	125.6	1.7	4.2	6.0	19.5	16.5	0.7	3.3	25.4	49.2	
5	71.5	420.5		243.2			0.4	0.9	7.0	9.9	8.5	152.1	2.7	1.8	5.7	7.1	21.8	1.5	2.9	1.8	
6	56.7	37.0		4.8			1.4	1.0	2.7	6.9	17.4	11.6	100.2	3.5	2.4	1.9	3.8	12.1	0.4	0.4	
7	278.0	178.9		39.9			0.2	3.2	0.9	2.4	3.4	17.7	6.2	64.3	5.0	0.5	2.4	2.4	6.9	0.8	
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	1.1	1.0	2.7	2.1	1.8	
9	18.9	13.4		1.2			0.4	4.7	0.2	8.6	0.1	2.1	3.0	12.6	2.4	8.3	1.6	1.1	3.8	1.2	
10	62.1	15.4		8.2			0.4	0.5	10.1	2.7	2.4	0.6	0.1	3.1	16.7	1.1	7.5	2.1	3.2	0.3	
11+	139.0	64.8		4.8			6.5	19.4	47.0	45.4	12.1	7.4	7.2	4.9	6.8	4.8	13.1	17.2	45.6	3.5	
Total	1349.4	1028.1		302.4			11.9	43.8	116.3	143.1	172.5	210.7	140.7	123.2	139.5	42.3	54.8	46.2	105.9	70.3	273.8

Fortune Bay

Age	1970	1971	1972	1973 ...	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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					0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	
3	0.0	10.4					0.6	8.4	0.0	14.3	0.0	0.0	0.0	12.1	98.8	0.6	0.3	0.0	1.3	0.0	
4	122.5	13.8					0.8	6.0	22.1	2.8	224.0	0.0	0.0	0.9	1.4	54.4	3.6	0.0	32.1	22.6	
5	5.6	168.3					0.6	3.9	15.0	204.5	8.8	532.2	3.1	0.9	0.0	16.8	61.3	9.1	14.0	85.4	
6	16.7	15.2					0.1	3.1	6.1	69.2	69.9	11.7	420.7	15.8	0.0	2.2	11.6	140.4	21.4	8.9	
7	236.6	31.4					0.2	2.4	1.4	15.7	48.3	48.3	9.8	659.3	6.2	1.7	1.3	5.0	252.5	19.8	
8	2.8	86.4					6.0	2.7	4.1	4.6	10.0	20.7	50.6	14.8	236.8	21.9	1.7	3.7	3.3	258.4	
9	5.6	0.0					0.3	44.0	0.3	8.8	0.8	4.8	11.4	64.9	19.7	283.8	6.3	0.0	12.0	39.0	
10	0.0	6.2					0.8	4.6	4.4	6.5	2.0	1.4	2.1	33.4	59.0	38.1	70.3	9.5	12.0	12.3	
11+	8.4	13.8					0.8	53.7	102.5	135.3	35.9	71.8	19.6	124.3	56.1	141.4	175.0	245.3	319.3	237.2	
Total	397.7	345.6					10.3	128.7	156.0	461.6	399.3	690.2	516.8	927.3	479.4	560.9	331.4	413.0	668.0	683.6	830.1

Table 16. Catch rates (kg/net/landing) from 1996 commercial gillnet logbook program and comparison of 1996 commercial and research gillnet catch rates (number caught per net night night) where commercial catch rates by mesh size have been standardized to research gillnet catch rates and conversion factors have been derived from regressions of research gillnet catch rates by mesh size vs. research fleet catch rates.

	White Bay - Notre Dame Bay			Bonavista Bay - Trinity Bay			Conception Bay - Southern Shore			St. Mary's Bay - Placentia Bay			Fortune Bay		
	CPUE	# of Fishers	# Nights Fished	CPUE	# of Fishers	# Nights Fished	CPUE	# of Fishers	# Nights Fished	CPUE	# of Fishers	# Nights Fished	CPUE	# of Fishers	# Nights Fished
1996	47	14	278	48	9	133	27	1	26	46	13	386	63	11	519

Mesh Size	White Bay - Notre Dame Bay			Bonavista Bay - Trinity Bay			Conception Bay - Southern Shore			St. Mary's Bay - Placentia Bay			Fortune Bay		
	Stand. Catch Rate	Conversion Factor	Mean Std. Catch Rate	Stand. Catch Rate	Conversion Factor	Mean Std. Catch Rate	Stand. Catch Rate	Conversion Factor	Mean Std. Catch Rate	Stand. Catch Rate	Conversion Factor	Mean Std. Catch Rate	Stand. Catch Rate	Conversion Factor	Mean Std. Catch Rate
2 1/4"	99	4.08	404	28	4.66	130	88	4.20	370	55	3.75	206	28	6.58	184
2 1/2"	242	3.52	852	126	3.61	455	-	-	-	217	3.75	814	110	4.78	526
2 5/8"	241	4.60	1109	176	3.98	700	-	-	-	122	4.39	536	166	3.78	627
2 3/4"	130	6.50	845	66	4.16	275	-	-	-	185	5.16	955	113	3.09	349
2 7/8"	-	-	-	-	-	-	-	-	-	-	-	-	370	3.48	1288
3"	-	-	-	-	-	-	-	-	-	239	8.82	2108	293	3.90	1148
Combined			803			390			370			924			686
Res. GN			541			259			94			328			920

Table 17. Biomass estimate for Bonavista Bay - Trinity Bay, from the 1995 acoustic survey.

STRATUM	TARGET STRENGTH (dB/kg)	TRANS. NO.	TRANSECT LENGTH (n.mi.)	TRANSECT AREA (sq.m.)	TRANSECT BIOMASS (t)	WEIGHTED DENSITY (kg/sq.m.)	STRATUM BIOMASS (t)	ABSOLUTE STRATUM VARIANCE
27	-29.55	2	1.43	2.648E+03	0.096	0.02152		
		3	3.97	7.352E+03	0.000	0.00000		
		4	2.66	4.926E+03	0.000	0.00000		
		5	2.99	5.537E+03	0.000	0.00000		
		6	2.92	5.408E+03	0.000	0.00000		
		7	2.50	4.630E+03	0.000	0.00000		
		8	3.99	7.389E+03	0.091	0.02046		
		9	1.86	3.445E+03	0.000	0.00000		
		10	1.83	3.389E+03	0.002	0.00034		
		11	0.72	1.333E+03	0.000	0.00000		
		12	2.25	4.167E+03	0.135	0.03037		
		13	1.67	3.093E+03	0.046	0.01035		
		12		4.443E+03		0.00692	1917	830405123499.5
				5.332E+04				
28	-29.55	14	0.31	5.741E+02	0.000	0.00000		
		15	1.83	3.389E+03	0.000	0.00000		
		16	4.20	7.778E+03	0.000	0.00000		
		17	3.03	5.612E+03	0.000	0.00000		
		18	3.71	6.871E+03	0.000	0.00000		
		19	4.24	7.852E+03	0.374	0.10801		
		20	2.98	5.519E+03	0.442	0.12757		
		21	1.34	2.482E+03	0.000	0.00000		
		22	0.79	1.463E+03	0.000	0.00000		
		23	1.50	2.778E+03	0.000	0.00000		
		24	0.58	1.074E+03	0.000	0.00000		
		25	0.53	9.816E+02	0.000	0.00000		
		26	0.33	6.112E+02	0.000	0.00000		
		27	0.80	1.482E+03	0.000	0.00000		
		14		3.462E+03		0.01683	3365	4194430804450
				4.847E+04				
29	-29.55	28	0.73	1.352E+03	0.000	0.00000		
		29	3.07	5.686E+03	0.000	0.00000		
		30	1.72	3.185E+03	0.000	0.00000		
		31	0.82	1.519E+03	0.000	0.00000		
		32	2.92	5.408E+03	0.538	0.11461		
		33	5.56	1.030E+04	0.027	0.00569		
		34	3.77	6.982E+03	0.000	0.00000		
		35	5.52	1.022E+04	0.000	0.00000		
		36	2.13	3.945E+03	0.000	0.00000		
		37	1.90	3.519E+03	0.071	0.01504		
		38	1.66	3.074E+03	0.000	0.00000		
		39	0.59	1.093E+03	0.000	0.00000		
		12		4.690E+03		0.01128	2346	3945665729462
				5.628E+04				
30	-29.55	40	3.35	6.204E+03	0.000	0.00000		
		41	4.25	7.871E+03	0.000	0.00000		
		42	3.81	7.056E+03	0.000	0.00000		
		43	1.71	3.167E+03	0.000	0.00000		
		46	4.30	7.964E+03	0.000	0.00000		
		47	3.39	6.278E+03	0.058	0.01040		
		48	1.39	2.574E+03	0.435	0.07752		
		49	2.06	3.815E+03	0.000	0.00000		
		8		5.616E+03		0.01099	3077	8636270564083
				4.493E+04				
31	-29.55	50	0.90	1.667E+03	0.000	0.00000		
		51	1.94	3.593E+03	0.000	0.00000		
		52	1.93	3.574E+03	0.000	0.00000		
		53	2.41	4.463E+03	0.000	0.00000		
		54	1.90	3.519E+03	0.000	0.00000		
		55	1.48	2.741E+03	0.000	0.00000		
		56	1.01	1.871E+03	0.000	0.00000		
		57	1.04	1.926E+03	0.000	0.00000		
		58	1.27	2.352E+03	0.000	0.00000		
		59	0.57	1.056E+03	0.014	0.00524		
		10		2.676E+03		0.00052	63	4542042869.284
				2.676E+04				
32	-29.55	60	0.82	1.519E+03	0.000	0.00000		
		61	0.96	1.778E+03	0.000	0.00000		
		62	1.27	2.352E+03	0.000	0.00000		
		63	0.47	8.704E+02	0.026	0.01636		
		74	0.79	1.463E+03	0.004	0.00268		
		5		1.596E+03		0.00381	274	69288680621.06
				7.982E+03				

Table 17 (cont.'). Biomass estimate for Bonavista Bay - Trinity Bay, from the 1995 acoustic survey.

STRATU	TARGET STRENGT (dB/kg)	TRANS. NO.	TRANSECT LENGTH (n.mi.)	TRANSECT AREA (sq.m.)	TRANSECT BIOMASS (t)	WEIGHTED DENSITY (kg/sq.m.)	STRATUM BIOMASS (t)	ABSOLUTE STRATUM VARIANCE
33	-29.55	64	0.30	5.556E+02	0.000	0.00000		
		65	0.26	4.815E+02	0.000	0.00000		
		66	0.91	1.685E+03	0.019	0.01114		
		67	0.78	1.445E+03	0.018	0.01069		
		68	1.26	2.334E+03	0.000	0.00000		
		69	1.03	1.908E+03	0.000	0.00000		
		70	0.84	1.556E+03	0.000	0.00000		
		71	1.22	2.259E+03	0.000	0.00000		
		72	1.30	2.408E+03	0.000	0.00000		
		73	1.10	2.037E+03	0.089	0.05337		
		10		1.667E+03		0.00752	496	118502706507.9
				1.667E+04				
34	-29.55	75	1.04	1.926E+03	0.000	0.00000		
		76	2.15	3.982E+03	0.000	0.00000		
		77	2.42	4.482E+03	0.000	0.00000		
		78	1.85	3.426E+03	0.000	0.00000		
		79	0.90	1.667E+03	0.000	0.00000		
		80	0.43	7.964E+02	0.000	0.00000		
		81	1.20	2.222E+03	0.000	0.00000		
		82	0.95	1.759E+03	0.000	0.00000		
		83	2.11	3.908E+03	0.000	0.00000		
		84	3.74	6.926E+03	0.000	0.00000		
		85	2.40	4.445E+03	0.000	0.00000		
		86	1.51	2.797E+03	0.000	0.00000		
		87	1.21	2.241E+03	0.014	0.00492		
		88	0.85	1.574E+03	0.000	0.00000		
		89	0.13	2.408E+02	0.000	0.00000		
		15		2.826E+03		0.00033	44	2035251975.635
				4.239E+04				
38	-29.59	98	0.34	6.297E+02	0.000	0.00000		
		99	0.29	5.371E+02	0.000	0.00000		
		100	1.95	3.611E+03	0.076	0.07019		
		101	0.75	1.389E+03	0.000	0.00000		
		102	0.26	4.815E+02	0.000	0.00000		
		103	0.33	6.112E+02	0.000	0.00000		
		104	0.34	6.297E+02	0.000	0.00000		
		105	0.69	1.278E+03	0.000	0.00000		
		106	0.37	6.852E+02	0.000	0.00000		
		107	0.35	6.482E+02	0.000	0.00000		
		108	0.56	1.037E+03	0.000	0.00000		
		109	0.30	5.556E+02	0.000	0.00000		
		110	0.21	3.889E+02	0.000	0.00000		
		111	0.88	1.630E+03	0.000	0.00000		
		112	1.23	2.278E+03	0.000	0.00000		
		113	0.84	1.556E+03	0.000	0.00000		
		114	0.73	1.352E+03	0.000	0.00000		
		115	0.55	1.019E+03	0.000	0.00000		
		116	0.36	6.667E+02	0.000	0.00000		
		117	0.32	5.926E+02	0.000	0.00000		
		20		1.079E+03		0.00351	323	81164950964.84
				2.158E+04				
40	-24.40	119	0.10	1.852E+02	0.000	0.00000		
		120	0.16	2.963E+02	0.000	0.00000		
		121	0.19	3.519E+02	0.000	0.00000		
		122	0.15	2.778E+02	0.000	0.00000		
		123	0.09	1.667E+02	0.000	0.00000		
		124	0.06	1.111E+02	0.000	0.00000		
		125	0.06	1.111E+02	0.000	0.00000		
		126	0.73	1.352E+03	0.000	0.00000		
		127	0.33	6.112E+02	0.069	0.05901		
		128	1.04	1.926E+03	0.000	0.00039		
		129	0.67	1.241E+03	0.000	0.00000		
		130	0.65	1.204E+03	0.000	0.00000		
		131	0.39	7.223E+02	0.000	0.00000		
		132	0.47	8.704E+02	0.000	0.00000		
		133	0.42	7.778E+02	0.000	0.00000		
		134	0.29	5.371E+02	0.000	0.00000		
		135	0.36	6.667E+02	0.000	0.00000		
		136	0.38	7.038E+02	0.000	0.00000		
		137	0.34	6.297E+02	0.000	0.00000		
		138	0.78	1.445E+03	0.000	0.00000		
		139	0.95	1.759E+03	0.000	0.00000		
		140	1.43	2.648E+03	0.411	0.35002		
		141	1.28	2.371E+03	0.001	0.00097		
		142	1.58	2.926E+03	0.000	0.00000		
		143	1.22	2.259E+03	0.000	0.00000		
		144	1.04	1.926E+03	0.058	0.04939		
		145	0.89	1.648E+03	0.000	0.00000		
		146	0.92	1.704E+03	0.000	0.00000		
		147	1.07	1.982E+03	0.000	0.00000		
		148	0.85	1.574E+03	0.000	0.00000		
		149	0.75	1.389E+03	0.000	0.00000		
		31		1.173E+03		0.01483	1142	710864772554
				3.637E+04				

Total Transect Length 190.12

Total Stock Biomass = 13047

S.E. = 4312

C.V. = 0.330

Table 18. Biomass estimate for St. Mary's Bay - Placentia Bay, from the 1996 acoustic survey.

STRATU	STRATUM AREA (sq.m.)	TARGET STRENGTH (dB/kg)	TRANS. NO.	TRANSEC LENGTH (n.mi.)	TRANSECT AREA (sq.m.)	TRANSECT BIOMASS (t)	WEIGHTED DENSITY (kg/sq. m.)	STRATUM BIOMASS (t)	ABSOLUTE STRATUM VARIANCE
9	1.484E+08	-29.90	26	4.02	7445	0.000	0.00000		
			27	0.82	1519	0.000	0.00000		
			28	0.58	1074	0.000	0.00000		
			29	0.26	482	0.000	0.00000		
			30	3.44	6371	0.000	0.00000		
			31	3.16	5852	0.000	0.00000		
			32	4.38	8112	0.105	0.01826		
			33	5.78	10705	0.000	0.00000		
			34	5.61	10390	0.000	0.00000		
			9		5772		0.00203	301	8.613E+10
					51949				
11	9.240E+07	-29.90	86	0.47	870	0.000	0.00000		
			87	1.46	2704	0.000	0.00000		
			88	1.72	3185	0.000	0.00000		
			89	2.07	3834	0.000	0.00000		
			90	1.64	3037	0.000	0.00000		
			91	0.94	1741	6.865	2.50865		
			92	1.92	3556	0.000	0.00000		
			93	1.60	2963	0.000	0.00000		
			8		2736		0.31358	28975	9.4021E+14
					21891				
12	4.970E+07	-29.90	75	0.12	222	0.000	0.00000		
			76	0.56	1037	0.000	0.00000		
			77	0.41	759	0.000	0.00000		
			78	0.93	1722	0.000	0.00000		
			79	0.59	1093	0.000	0.00000		
			80	0.56	1037	0.000	0.00000		
			81	1.27	2352	0.016	0.01473		
			82	0.33	611	0.000	0.00000		
			83	0.88	1630	0.000	0.00000		
			84	0.56	1037	0.000	0.00000		
			85	0.23	426	0.000	0.00000		
			11		1084		0.00134	67	3523963343
					11927				
13	7.420E+07	-29.90	20	1.54	2852	0.018	0.00610		
			21	1.21	2241	0.000	0.00000		
			22	0.70	1296	0.000	0.00000		
			23	1.21	2241	0.000	0.00000		
			24	1.85	3426	0.000	0.00000		
			25	3.02	5593	0.000	0.00000		
			6		2942		0.00102	75	5997769741
					17650				

Total Transect Length 48.80

Total Stock Biomass = 29418

S.E.= 30664

C.V.= 1.042

Table 19. Population numbers at age (millions) and biomass estimates (t) from acoustic surveys, spring spawners only, by stock area and year.

White Bay - Notre Dame Bay

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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	22500				104500		2100		

Bonavista Bay - Trinity Bay

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0		172.5	93.2	64.1	0.4	0.0		0.0			0.0		133.1	
1		63.6	0.0	171.5	0.0	0.3		9.3			1.5		0.2	
2		409.4	244.2	3.9	1.8	8.3		16.9			197.3		0.0	
3		1.8	378.2	6.3	0.3	26.4		156.8			20.8		2.9	
4		4.1	5.2	47.9	6.7	1.5		7.4			0.6		31.0	
5		11.7	0.0	1.7	26.6	10.0		3.2			2.1		5.4	
6		0.4	9.6	0.4	0.2	60.1		0.7			12.7		0.5	
7		0.0	0.0	0.4	0.1	1.1		1.6			1.0		1.3	
8		0.3	0.0	0.0	0.3	0.8		46.8			1.2		5.8	
9		0.0	0.0	0.0	0.1	0.0		0.2			0.4		1.1	
10		1.7	0.0	0.4	0.0	0.5		2.6			2.1		0.4	
11+		17.5	1.7	7.1	1.3	3.9		2.7			1.6		2.0	
Total		683.0	732.1	303.7	37.8	112.9		248.2			241.3		183.8	
Biomass (t)		59800	99900	25700	10400	29700		51900			23100		12300	

St. Mary's Bay - Placentia Bay

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0				0.0				0.0		0.0		0.0		0.0
1				0.0				1.8		17.0		0.0		0.0
2				0.0				3.0		1.0		20.7		0.0
3				1.7				17.6		0.9		94.8		0.0
4				136.6				13.2		0.3		9.6		0.0
5				1.7				2.5		7.8		6.0		29.3
6				1.7				0.9		5.0		0.7		5.5
7				0.0				4.5		1.3		8.2		0.0
8				0.0				50.3		0.4		0.7		0.0
9				0.0				4.6		1.4		0.0		1.8
10				0.0				4.5		7.5		1.5		0.0
11+				0.0				7.1		5.9		26.2		18.3
Total				141.7				110.0		48.5		168.4		55.0
Biomass (t)				42200				32700		10200		29300		17700

Fortune Bay

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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				14400		18400			2500	

Table 20. Fortune Bay population numbers and biomass from XSA and ICA for 1970 to 1980 using 1970 and 1971 research gillnet indices only.

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

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
2	127630	1554	5166	6218	3982	302	18180	600	79	86	301
3	21403	77825	1121	2859	3091	2908	245	14810	467	64	69
4	70929	12105	42704	686	1504	1342	2130	187	10223	344	51
5	2734	47256	4404	17147	501	732	573	1456	131	5947	116
6	1814	2118	17404	985	8887	293	498	263	897	51	1401
7	31940	1231	680	4507	377	3263	161	291	65	520	28
8	806	19007	838	239	2141	82	1323	122	215	14	276
9	431	449	7403	587	130	763	53	778	61	50	7
10	1188	338	198	1320	226	74	496	11	466	3	19
11+	1350	1211	653	404	484	668	366	647	421	449	86
TOTAL	260225	163094	80571	34954	21322	10427	24025	19165	13024	7527	2355
2+ Biom.	37905	32273	18582	8065	4703	2698	2886	2906	2964	2029	658

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

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
2	138502	1902	6392	7315	13479	955	105326	8377	278	1055	3809
3	21224	86888	1407	3871	4006	10916	780	85994	6840	227	863
4	73189	12001	50280	921	2338	3079	8760	628	69324	5496	185
5	2893	49160	4400	23543	694	1586	2375	6836	491	53685	4419
6	2261	2249	19254	1038	14158	398	1160	1776	5130	362	42478
7	31957	1598	803	6185	426	6381	270	816	1256	3520	280
8	822	19071	1139	344	3527	237	4624	200	608	918	2777
9	366	464	7565	834	216	1861	169	3384	147	437	720
10	668	285	211	1565	430	107	1298	122	2448	104	341
11+	8369	4669	1764	709	1135	898	735	1520	1232	2712	2228
TOTAL	280251	178287	93215	46325	40409	26418	125497	109653	87754	68516	58100
2+ Biom.	41848	35569	21428	10870	7967	6193	12702	15175	19243	18202	14891

Table 21. Calculation of Fortune Bay research gillnet catchability coefficient where population numbers (ICA Nos.) are from Table 20 and adjusted population number (Adj. Nos.) exclude the catch; the catchability coefficient (123.33) is then applied to current and historical research gillnet catch rates to calculate population sizes.

Year	Age	ICA Nos.	Catch	Adj. Nos.	RGN C.R.
1970	5	2893	133	2760	5.6
	6	2261	281	1980	16.7
	7	31957	7894	24063	236.5
	8	822	233	589	2.8
	9	366	16	350	5.6
	10	668	225	443	0.0
	11	8369	257	8112	8.3
1971	5	49160	23525	25635	168.3
	6	2249	1165	1084	15.2
	7	1598	1598	0	31.5
	8	19071	3514	15557	86.4
	9	464	132	332	0.0
	10	285	148	137	6.2
	11	4669	537	4132	13.8

Regression Output:	
Constant	0
Std Err of Y Est	3407.133
R Squared	0.857146
No. of Observations	14
Degrees of Freedom	13
X Coefficient(s)	123.3346
Std Err of Coef.	11.137

	RGN Catch Rate	Pop'n. Nos.	Mean Wgt	Pop'n. Biomass	Acoustic Biomass
1986	399.3	49295	0.266	13094	9100
1990	479.4	59013	0.301	17764	14400
1992	331.4	40872	0.322	13145	18400
1995	683.6	84308	0.286	24100	2500
1996	830.1	102376	0.286	29280	

Table 22. Calculation of population numbers and biomass for White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay and St. Mary's Bay - Placentia Bay using the following catchability conversion factors: WB-NDB = 500, BB-TB = 279, and SMB-PB = 396.

White Bay - Notre Dame Bay

	RGN 5+ Catch Rate	RGN 5+ Numbers	Mean Wgt.	RGN 5+ Biomass	Acous. 5+ Biomass
1988	139.8	69900	0.296	20669	18623
1992	837.1	418550	0.247	103520	78758
1994	353.1	176550	0.206	36330	1070
1996	493.9	246950	0.205	50625	

Bonavista Bay - Trinity Bay

	RGN 5+ Catch Rate	RGN 5+ Numbers	Mean Wgt.	RGN 5+ Biomass	Acous. 5+ Biomass
1984	192.8	53782	0.244	13123	10388
1985	58.9	16442	0.290	4768	3299
1986	20.4	5690	0.204	1161	3610
1987	113.5	31660	0.232	7345	6628
1988	45.1	12590	0.281	3538	20050
1990	118.1	32943	0.291	9587	18329
1993	109.2	30461	0.268	8163	5453
1995	65.0	18136	0.229	4153	4034
1996	234.0	65286	0.229	14950	

St. Mary's Bay - Placentia Bay

	RGN 5+ Catch Rate	RGN 5+ Numbers	Mean Wgt.	RGN 5+ Biomass	Acous. 5+ Biomass
1986	46.5	18416	0.269	4954	930
1990	108.9	43141	0.331	14280	25796
1992	51.3	20308	0.297	6031	8826
1994	64.9	25711	0.285	7328	14656
1996	229.8	91001	0.193	17563	15782

Table 23. Risk analysis of predicted recruitment of 1997 yearclass, by stock area, assuming two different levels of fishing mortality dependent upon the stock status classification zone in which mature biomass is estimated to occur.

Stock Area	5+ Biomass	Zone	F	1997 Catch	Risk Analysis		Long-term VPA Median Recrutiment
					Median Recruit.	Range of Recruitment	
WB-NDB	51200 t	2	0.05	2500 t	81.5	28.8 - 230.0	61.6
			0.10	4900 t	84.0	29.9 - 296.0	
BB-TB	16900 t	2	0.05	800 t	34.0	11.0 - 105.0	26.1
			0.10	1600 t	29.7	10.0 - 88.5	
SMB-PB	35400 t	4	0.20	6400 t	11.2	3.9 - 31.8	11.0
			0.40	11700 t	13.1	4.5 - 38.1	
FB	29700 t	4	0.20	5400 t	8.5	2.3 - 31.9	8.6
			0.40	9800 t	11.9	3.2 - 43.5	

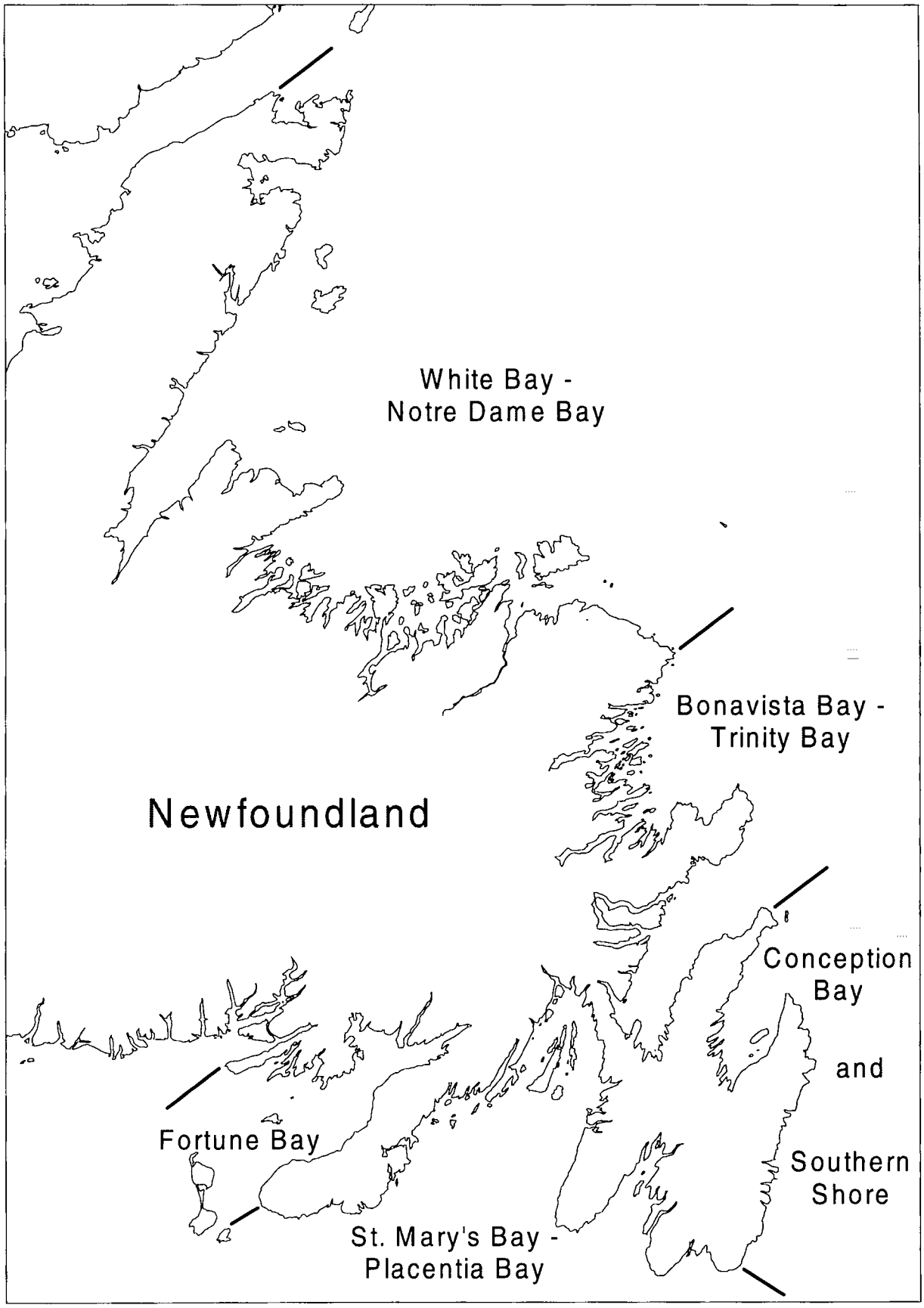


Fig. 1. Area map indicating herring stock complexes within the Newfoundland Region.

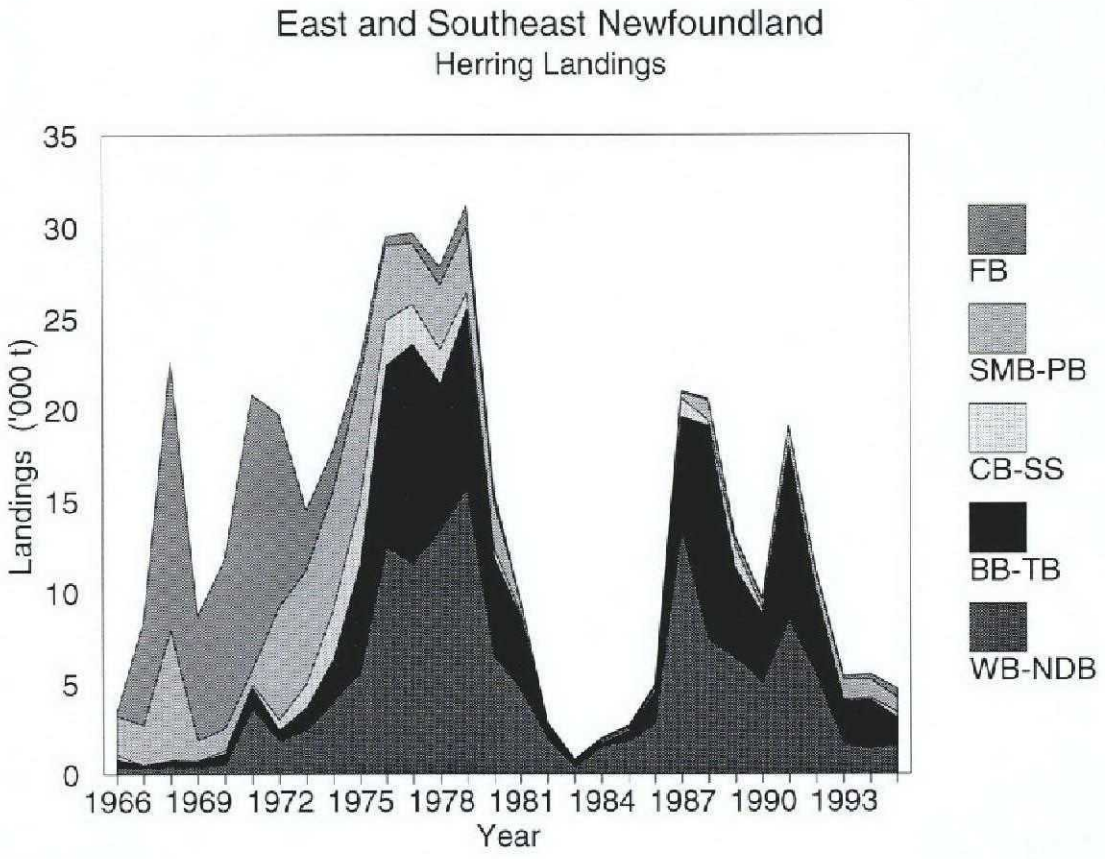


Fig. 2. East and southeast Newfoundland herring landings, 1966-95, for White Bay - Notre Dame Bay (WB-NDB), Bonavista Bay - Trinity Bay (BB-TB), Conception Bay - Southern Shore (CB-SS), St. Mary's Bay - Placentia Bay (SMB-PB), and Fortune Bay (FB).

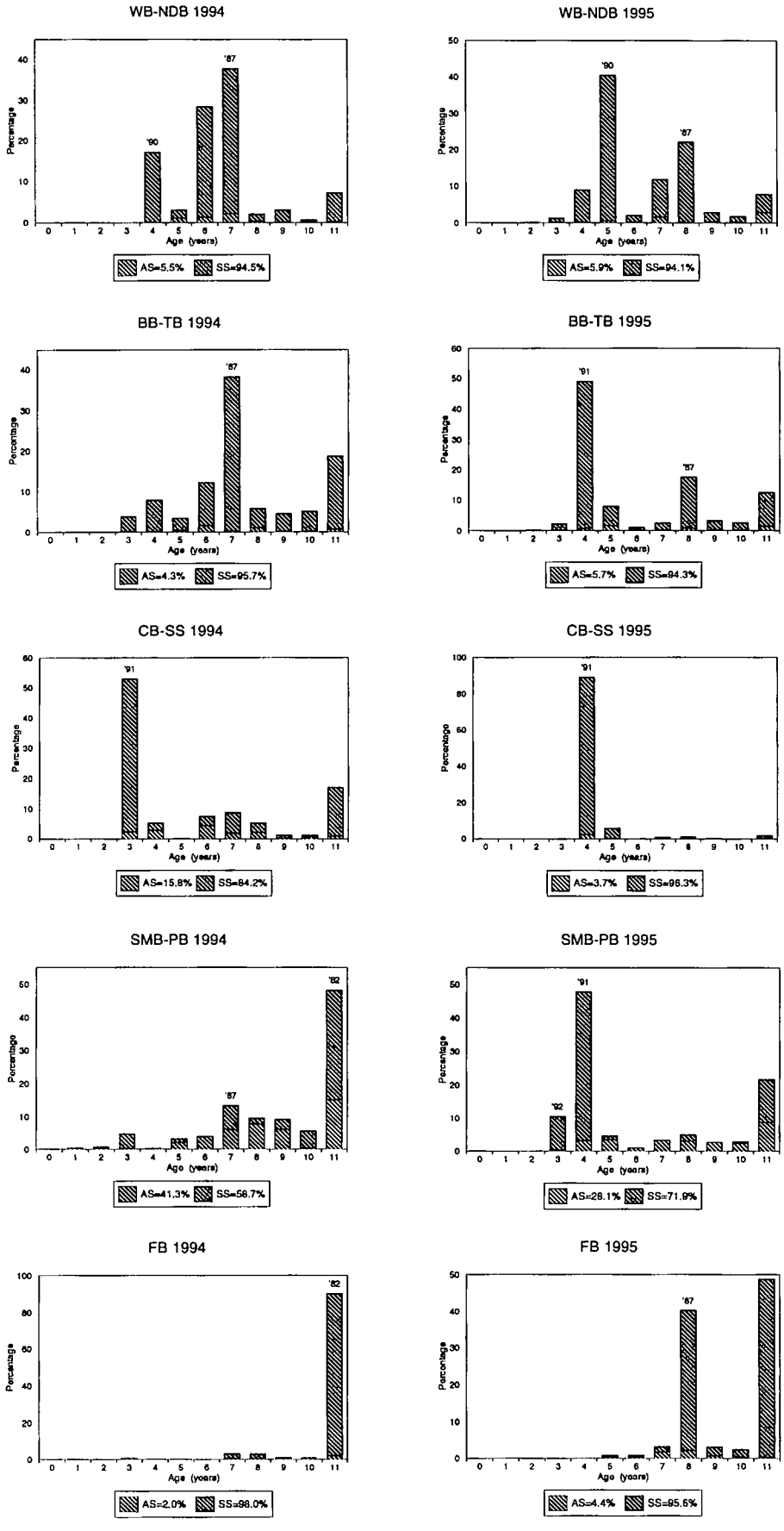


Fig. 3. Age distribution of herring from the commercial fishery, White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, Conception Bay - Southern Shore, St. Mary's Bay - Placentia Bay and Fortune Bay, 1994 and 1995.

Department of Fisheries and Oceans
Science Branch

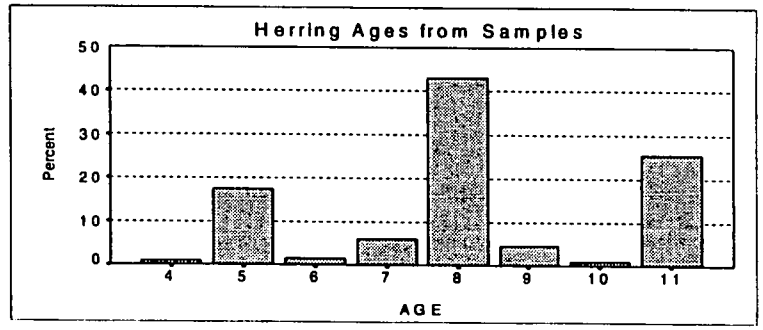
Name:
Location:
Stock Area:
Year: 1995

Herring Research Gillnet Program Summary Sheet

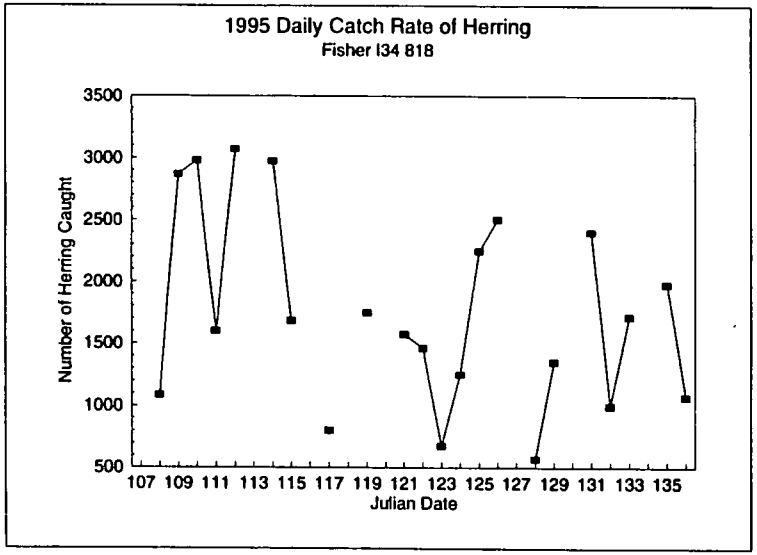
1) Herring Catch and Catch Rates by Net Size

Mesh Size	Catch (numbers)	Number of Days Fished	Number of Days Hauled	Catch per Days Fished
2"	1872	30	22	62.4
2 1/4"	1651	30	22	55.0
2 1/2"	9076	30	22	302.5
2 3/4"	13420	30	22	447.3
3"	12559	30	22	418.6
All Nets	38578	30	22	1285.9

2) Age Distribution from Samples Collected by You



3) Total Daily Catch of Herring During Current Year



4) Annual Catch Rate of Herring

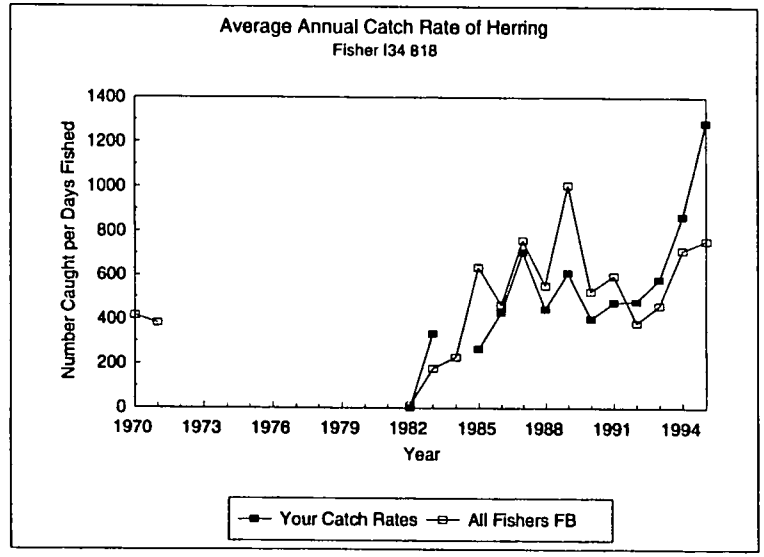
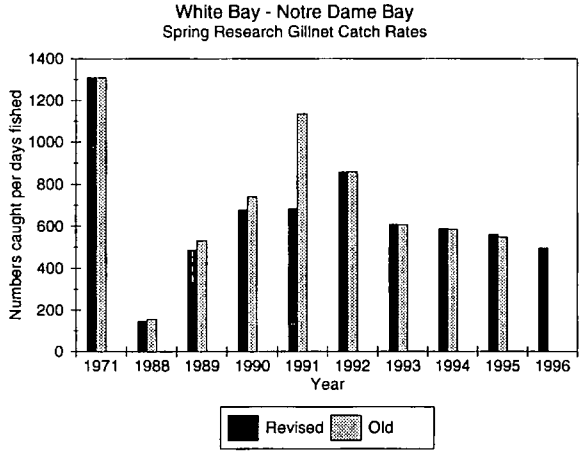
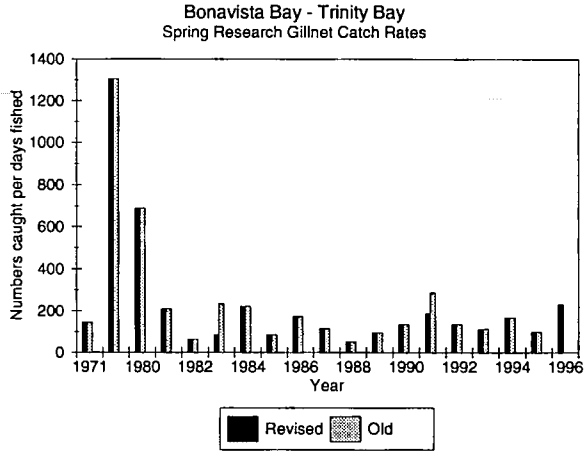
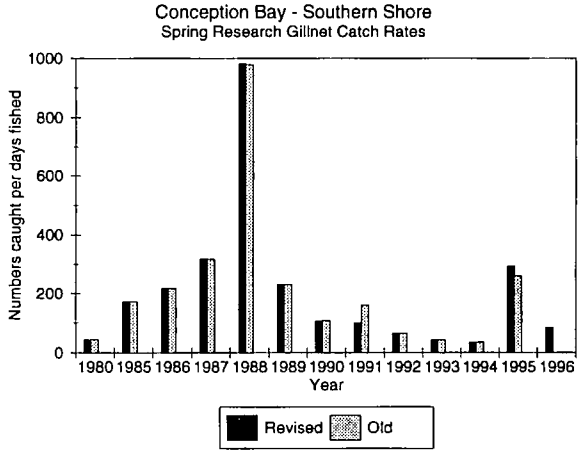
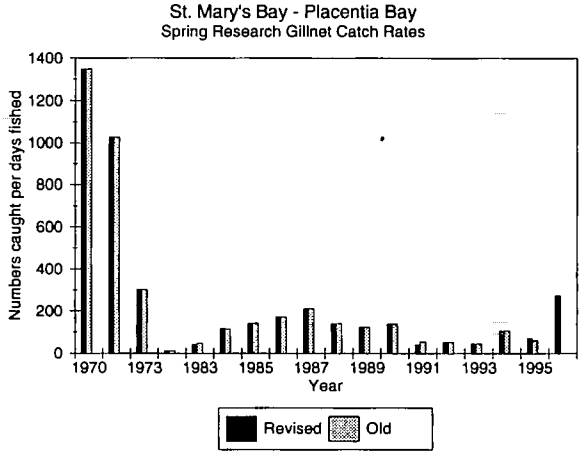


Fig. 4. Sample annual summary sheet sent to each research gillnet fisher.









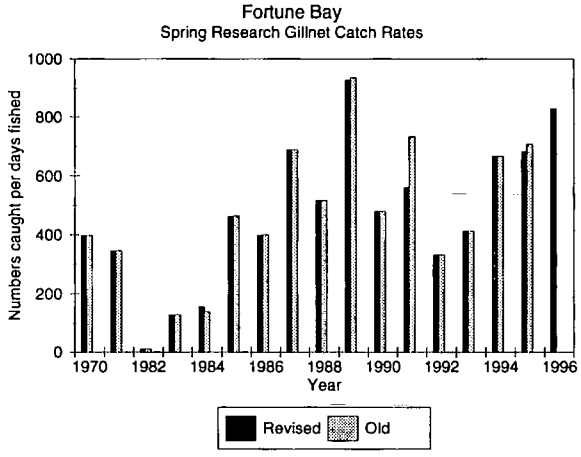


Fig. 5. Comparison of 'old' and 'revised' spring research gillnet catch rates; revised catch rat have incorporated catches from January to July.

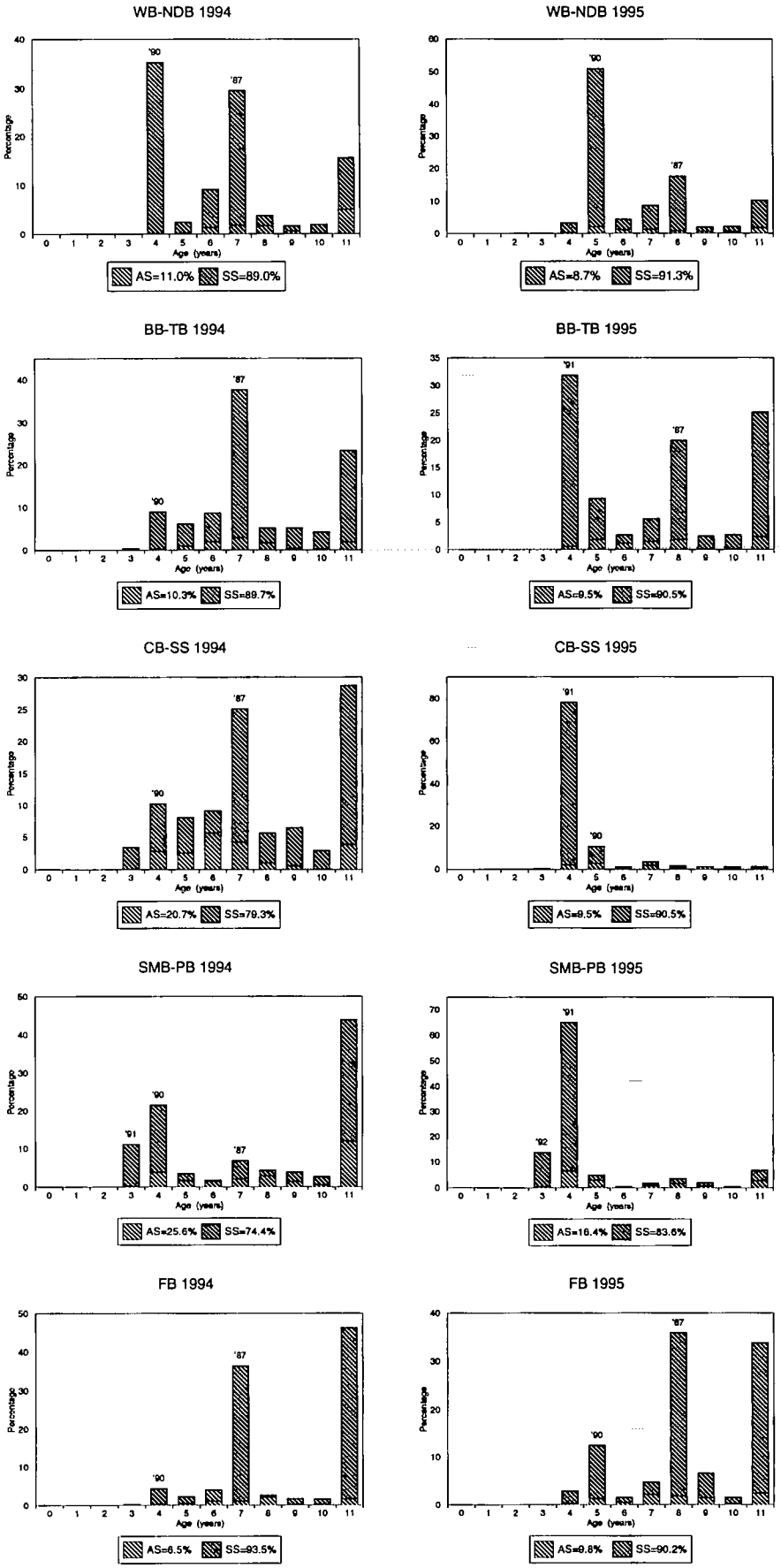
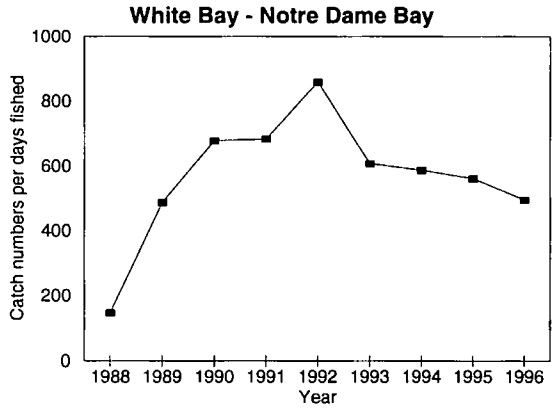
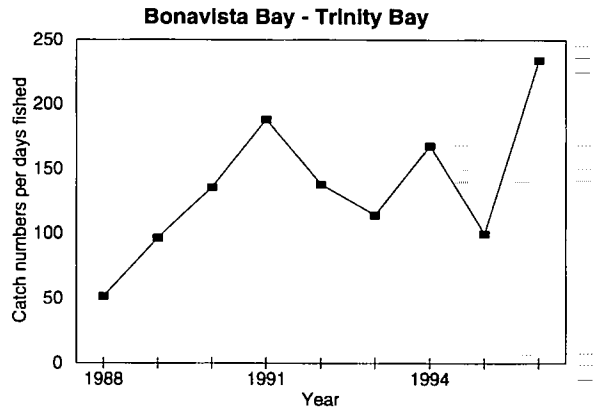
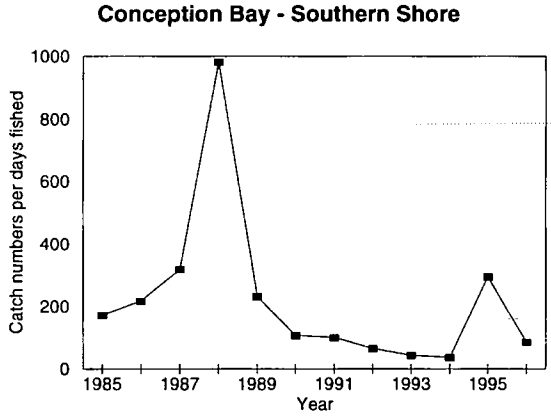
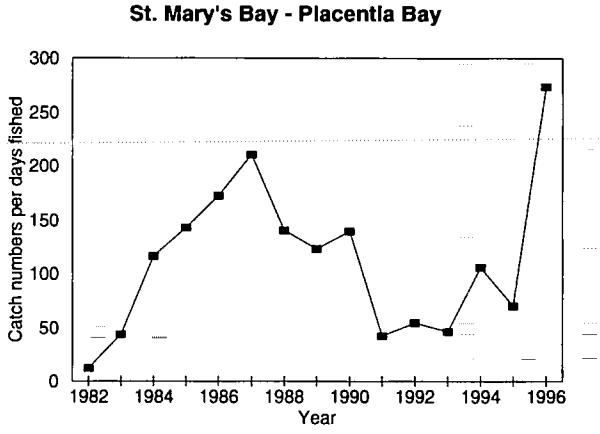


Fig. 6. Age distribution (by number) of herring from the spring research gillnet program, White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, Conception Bay - Southern Shore, St. Mary's Bay - Placentia Bay, and Fortune Bay, 1994 and 1995.









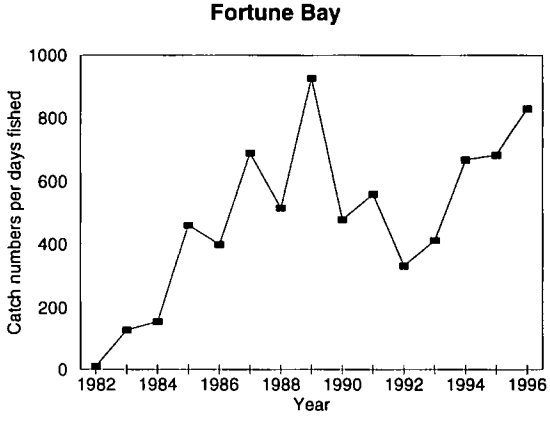


Fig. 7. Spring research gillnet catch rates (numbers per days fished), spring spawners only, by stock area and year.

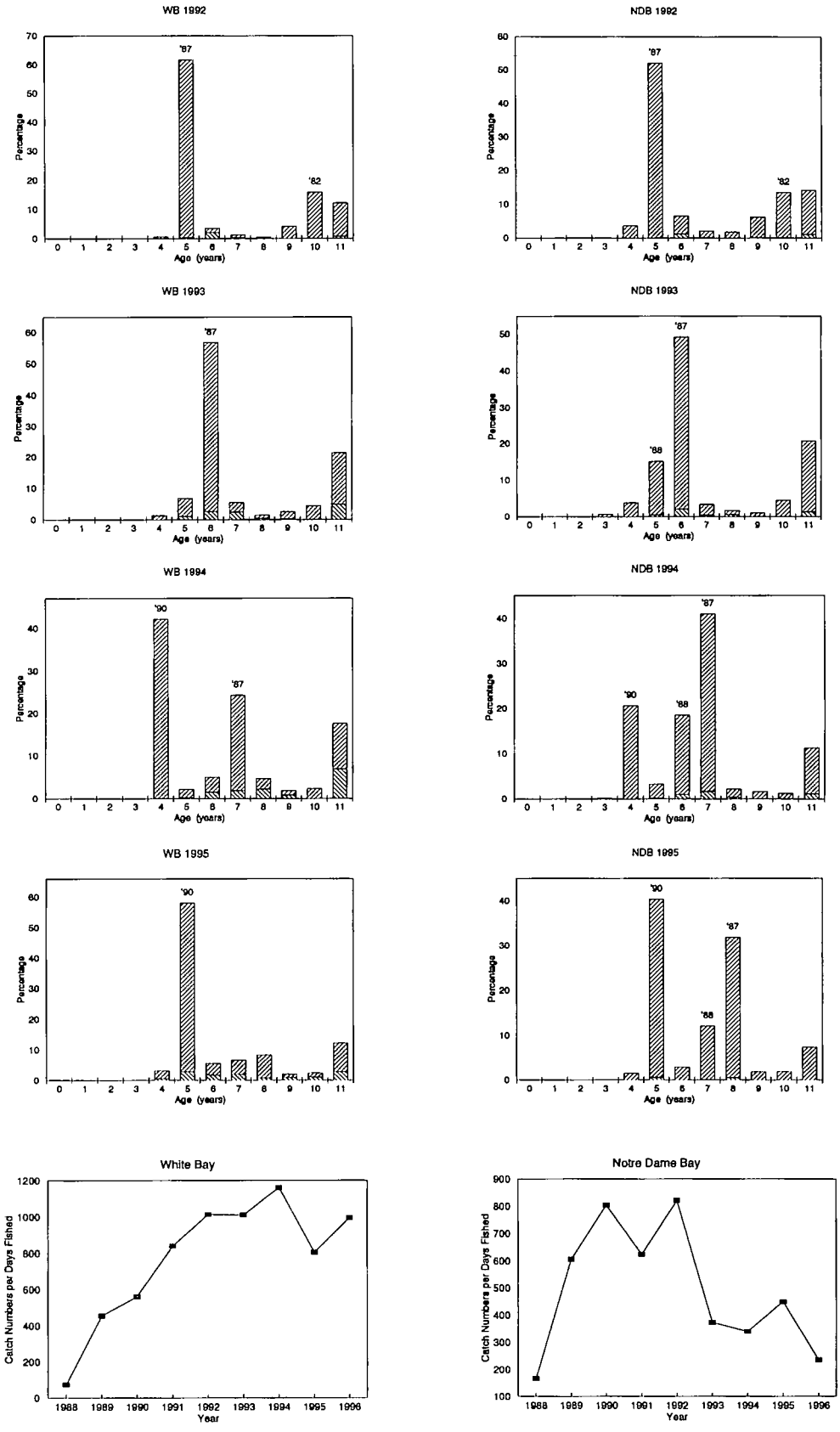


Fig. 8. Herring age distributions (by number), 1992-1995, and catch rates (numbers per days fished) 1988-1996, from the spring research gillnet program for White Bay and Notre Dame Bay separately.

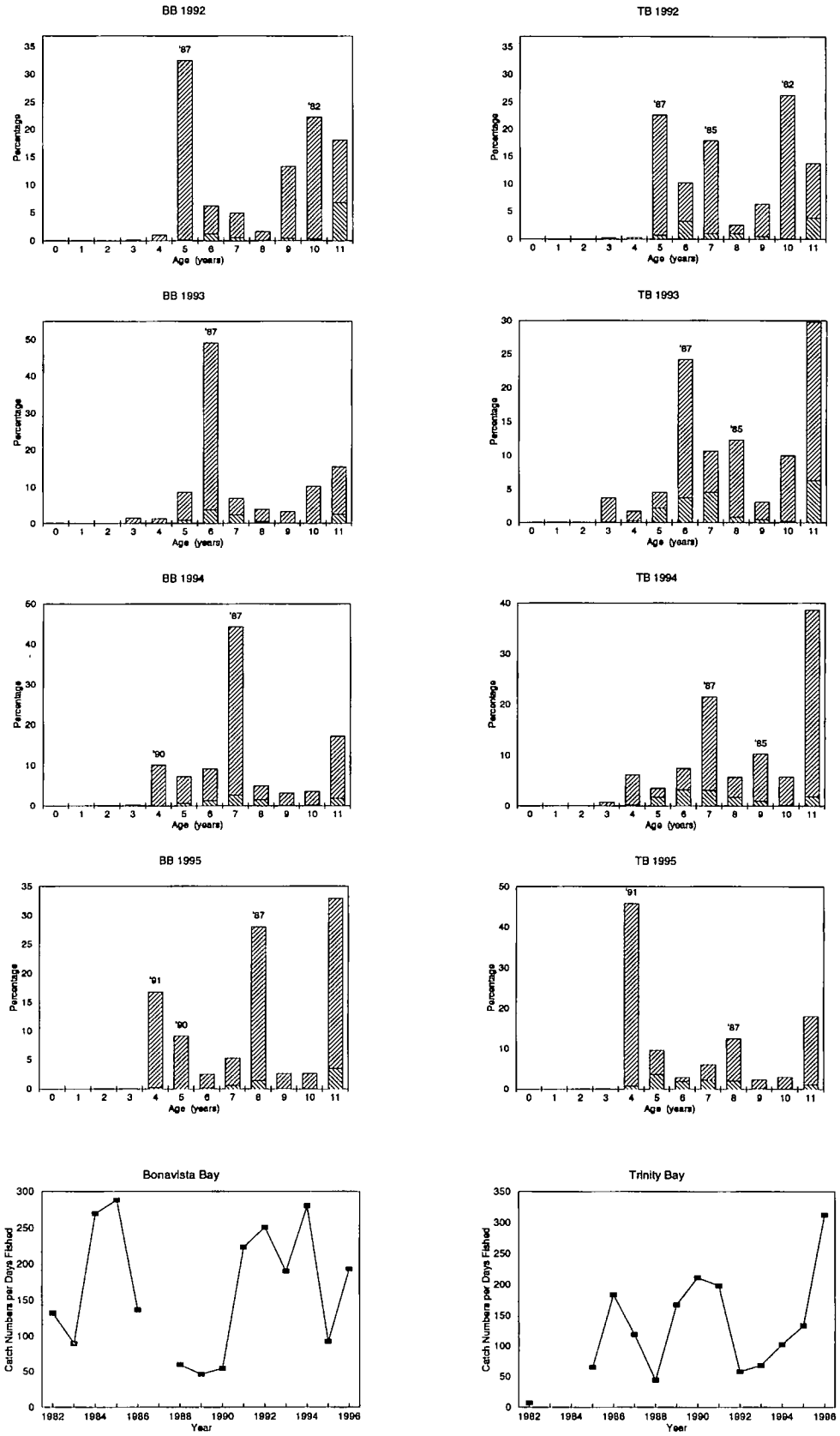


Fig. 9. Herring age distributions (by number), 1992-1995, and catch rates (numbers per days fished) 1982-1996, from the spring research gillnet program for Bonavista Bay and Trinity Bay separately.

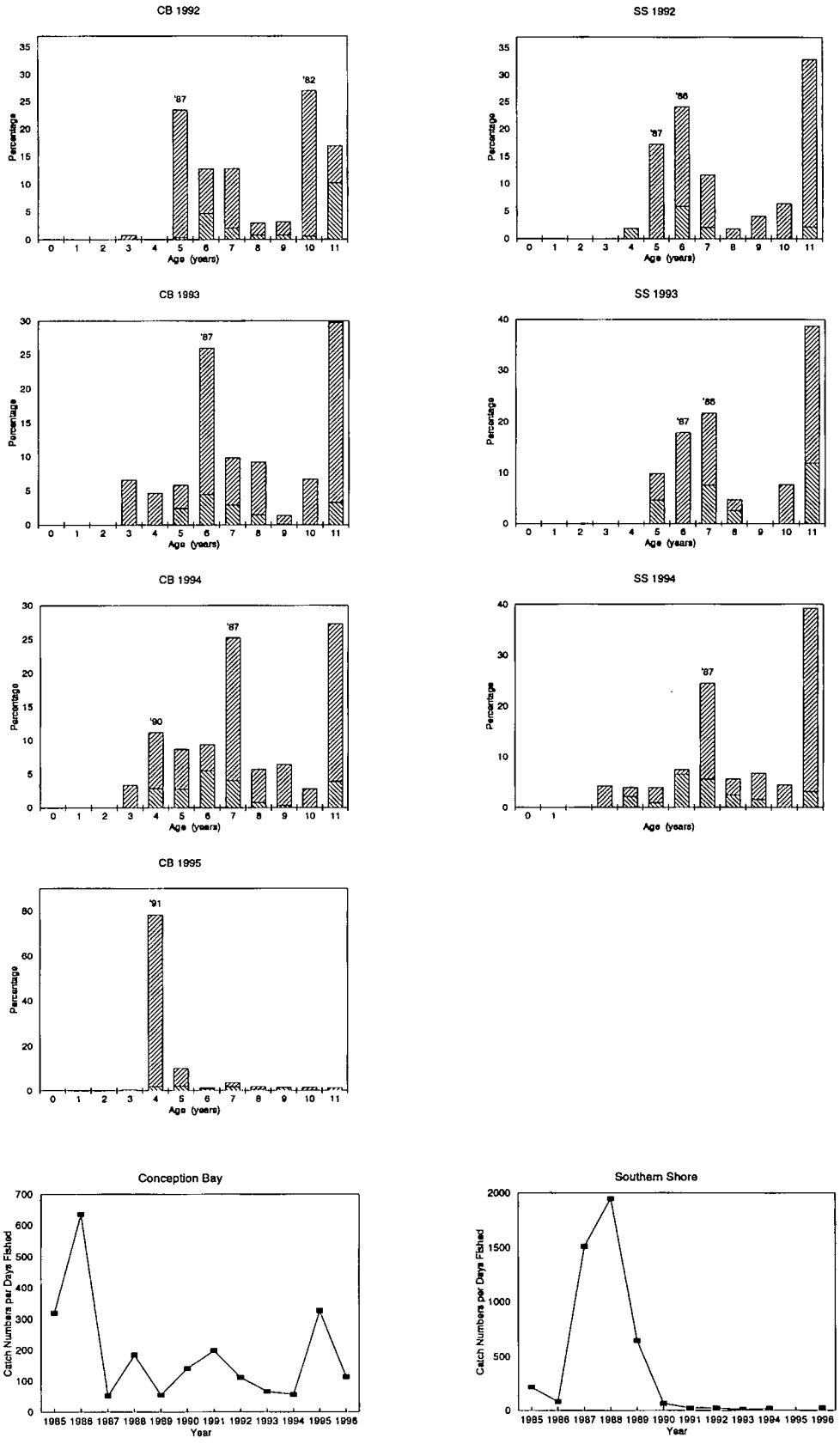


Fig. 10. Herring age distributions (by number), 1992-1995, and catch rates (numbers per days fished), 1985-1996, from the spring research gillnet program for Conception Bay and Southern Shore separately

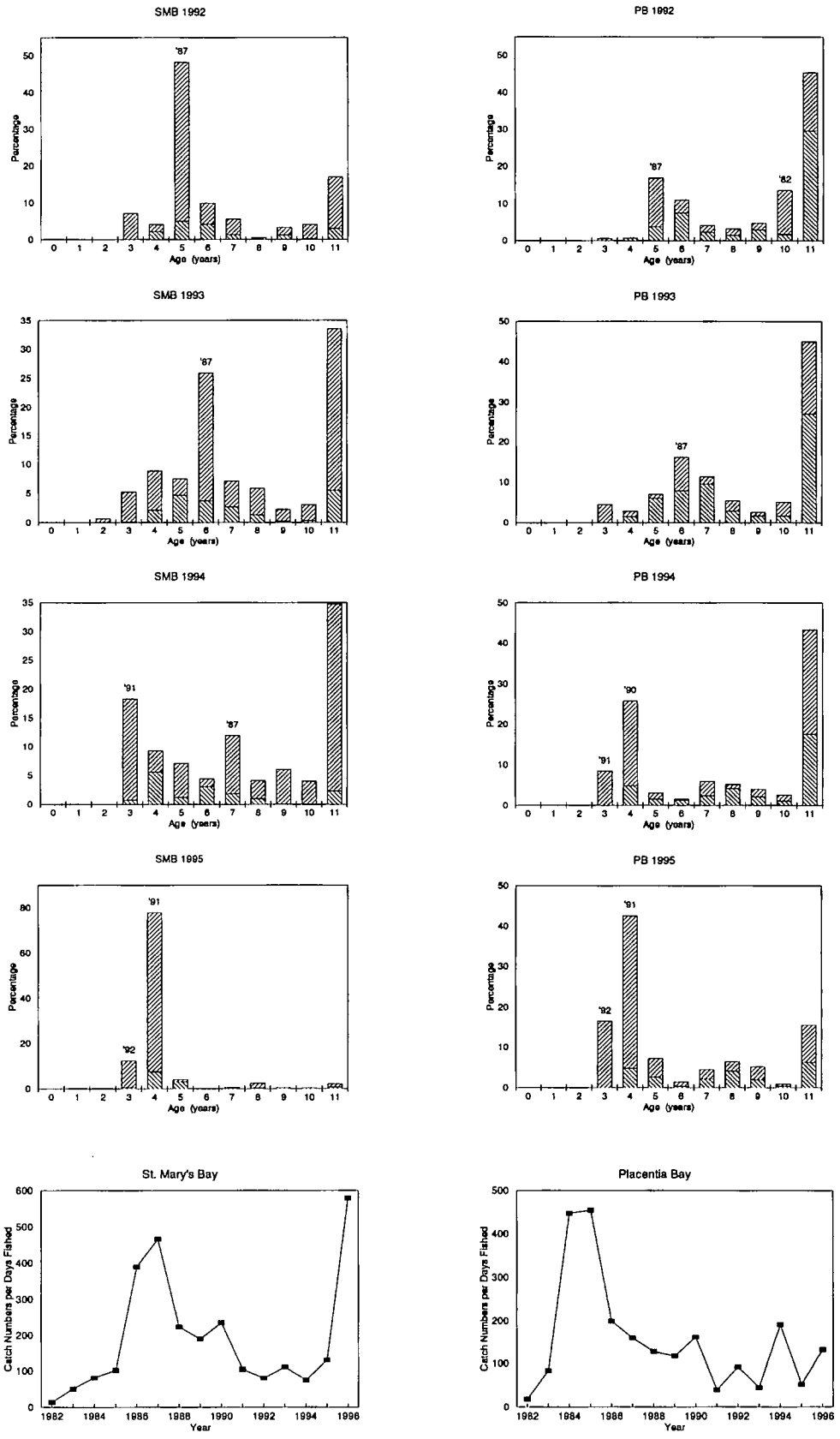


Fig. 11. Herring age distributions (by number), 1992-1995, and catch rates (numbers per days fished), 1982-1996, from the spring research gillnet program for St. Mary's Bay and Placentia Bay separately.

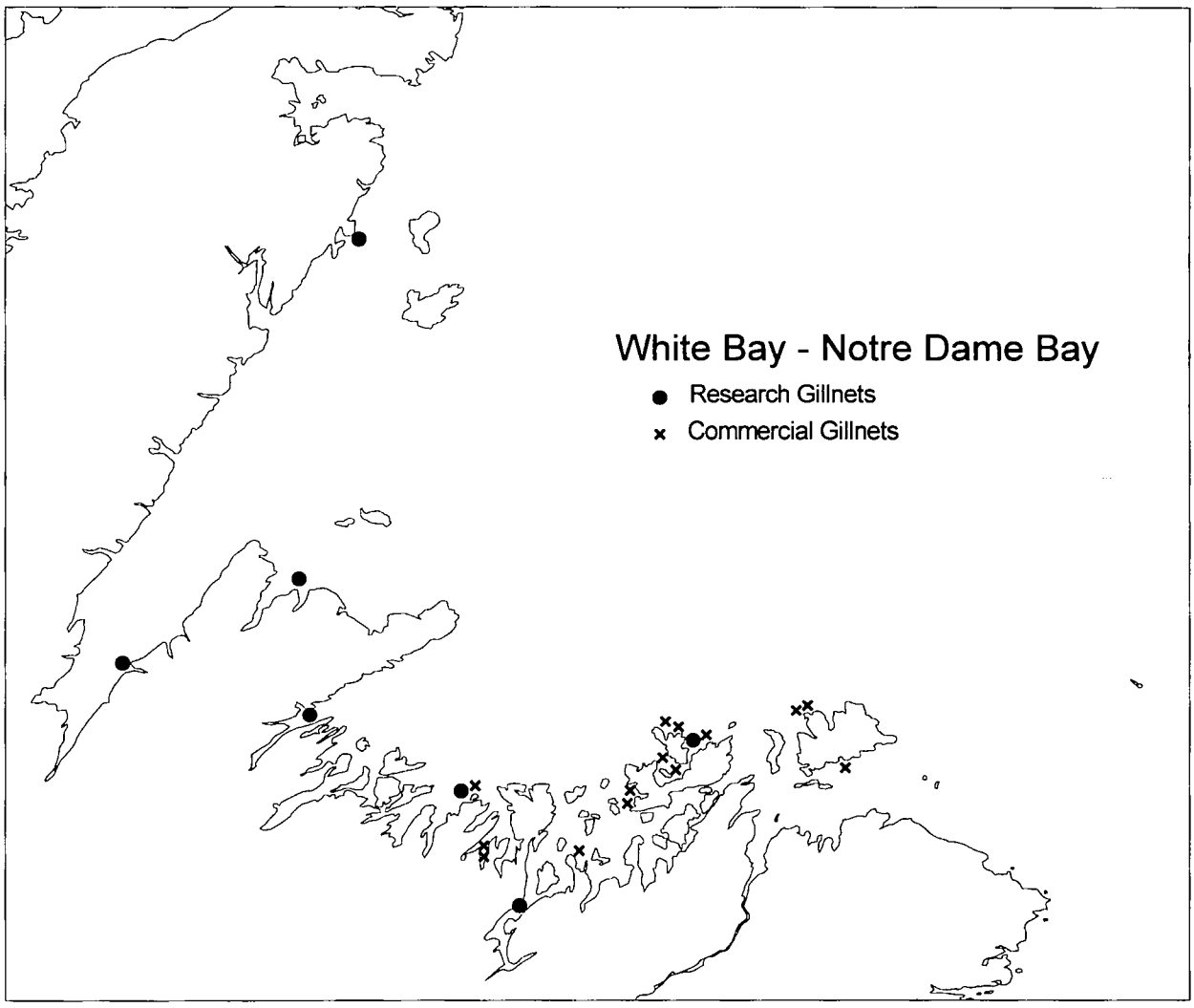


Fig. 12. 1996 herring set locations from Commercial Gillnet Logbooks and Research Gillnet Programs, White Bay - Notre Dame Bay.

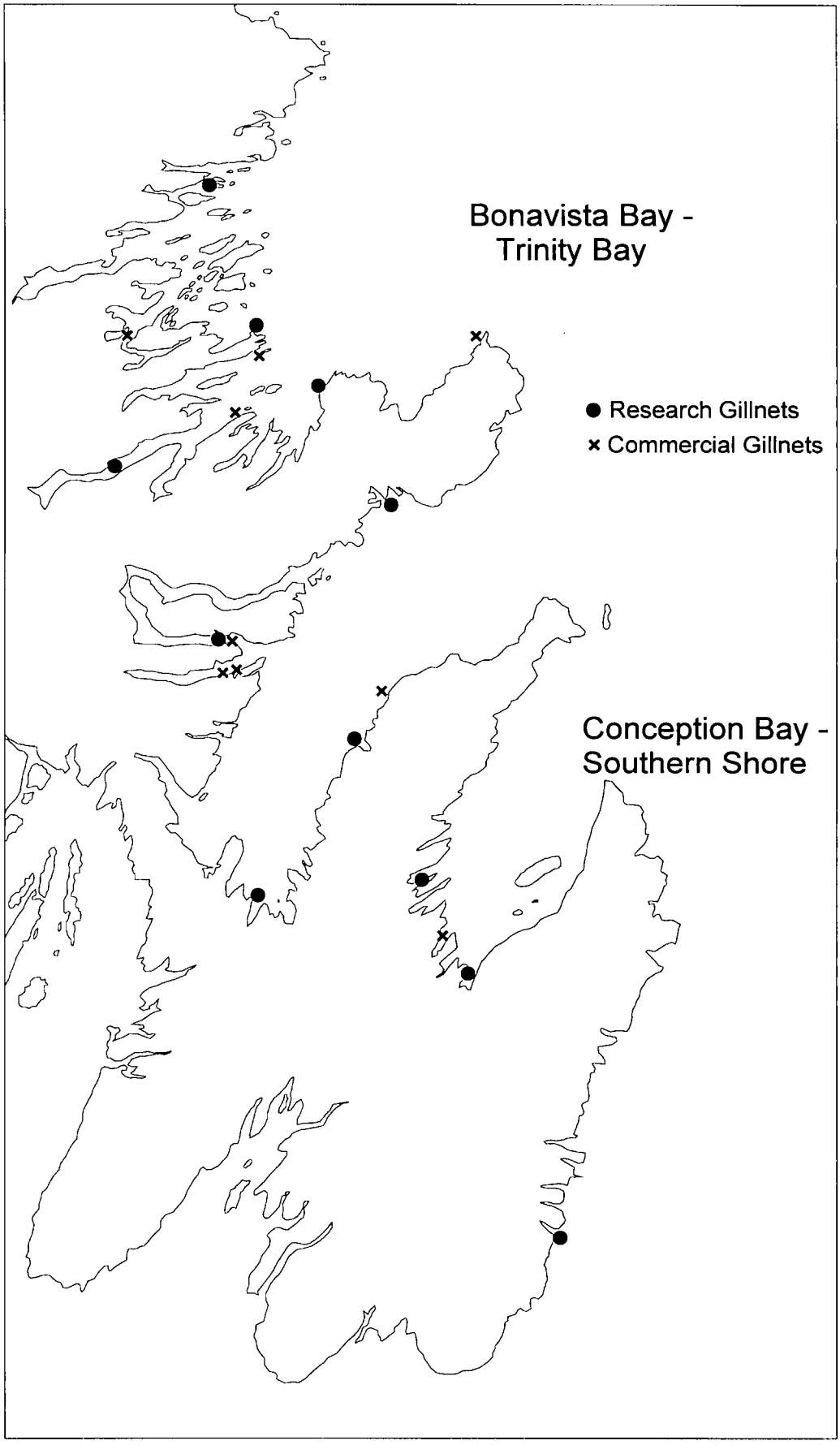


Fig. 13. 1996 herring set locations from Commercial Gillnet Logbooks and Research Gillnet Programs, Bonavista Bay - Trinity Bay and Conception Bay - Southern Shore.

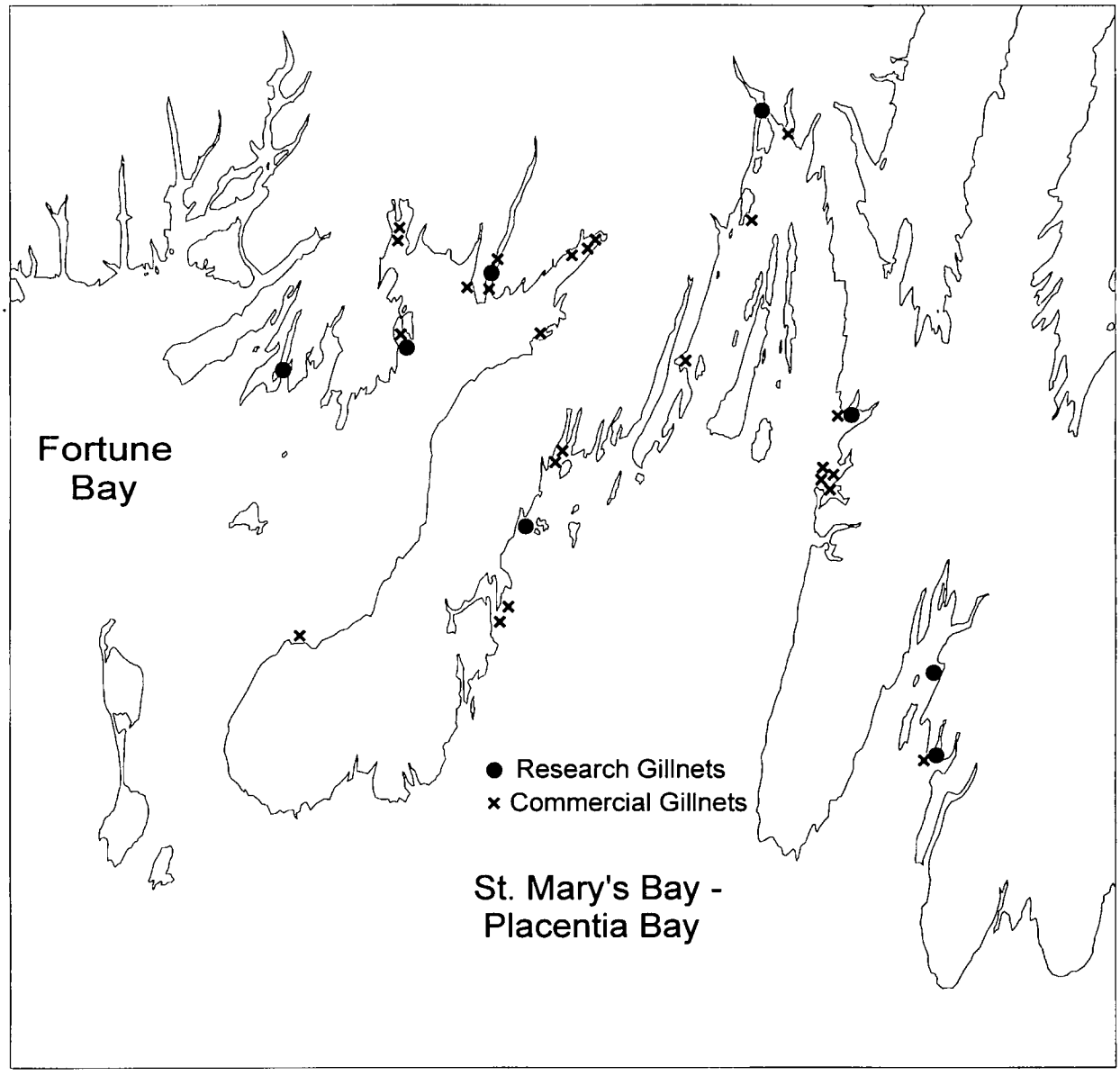
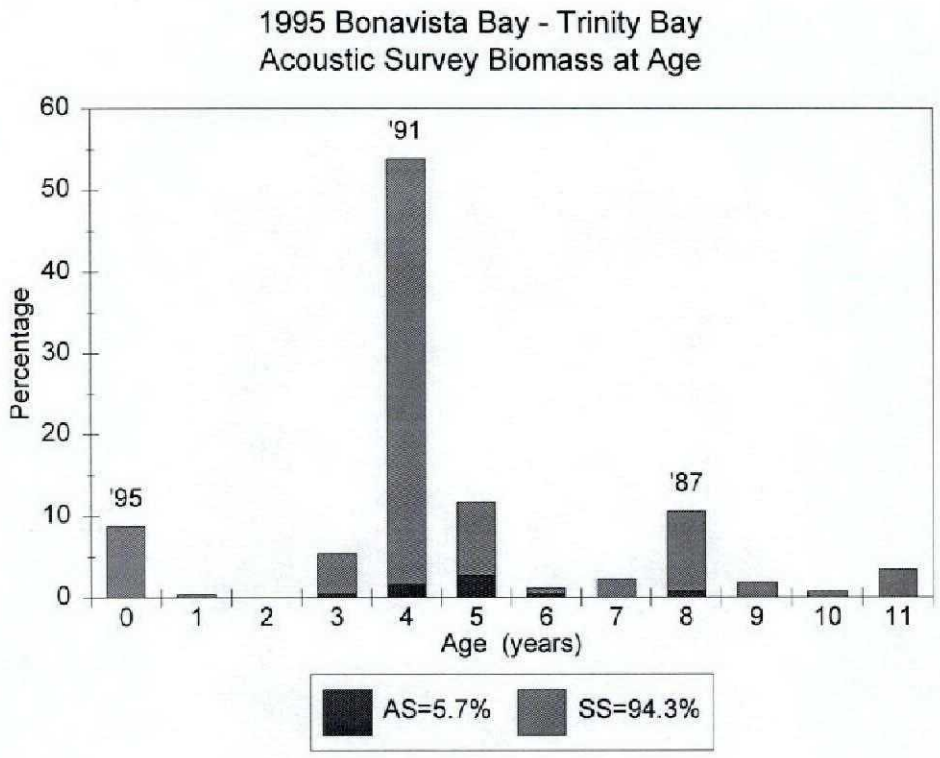


Fig. 14. 1996 herring set locations from Commercial Gillnet Logbooks and Research Gillnet Programs, St. Mary's Bay - Placentia Bay and Fortune Bay.



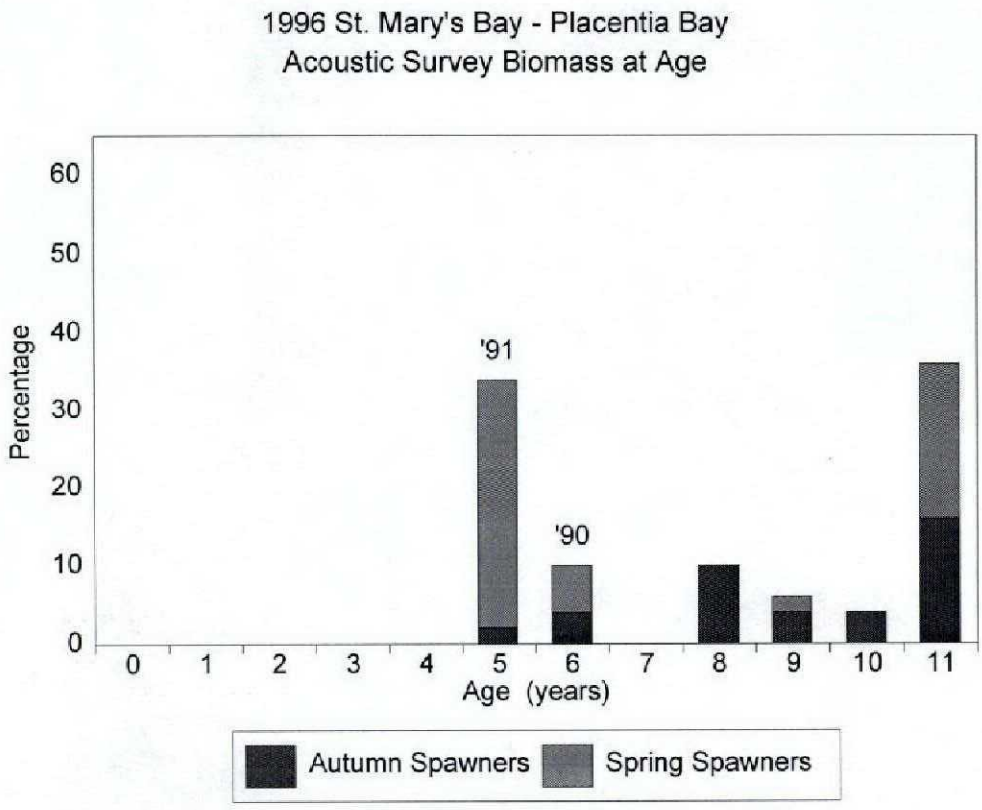


Fig. 15. Age distributions from 1995 Bonavista Bay - Trinity Bay and 1996 St. Mary's Bay - Placentia Bay acoustic surveys.

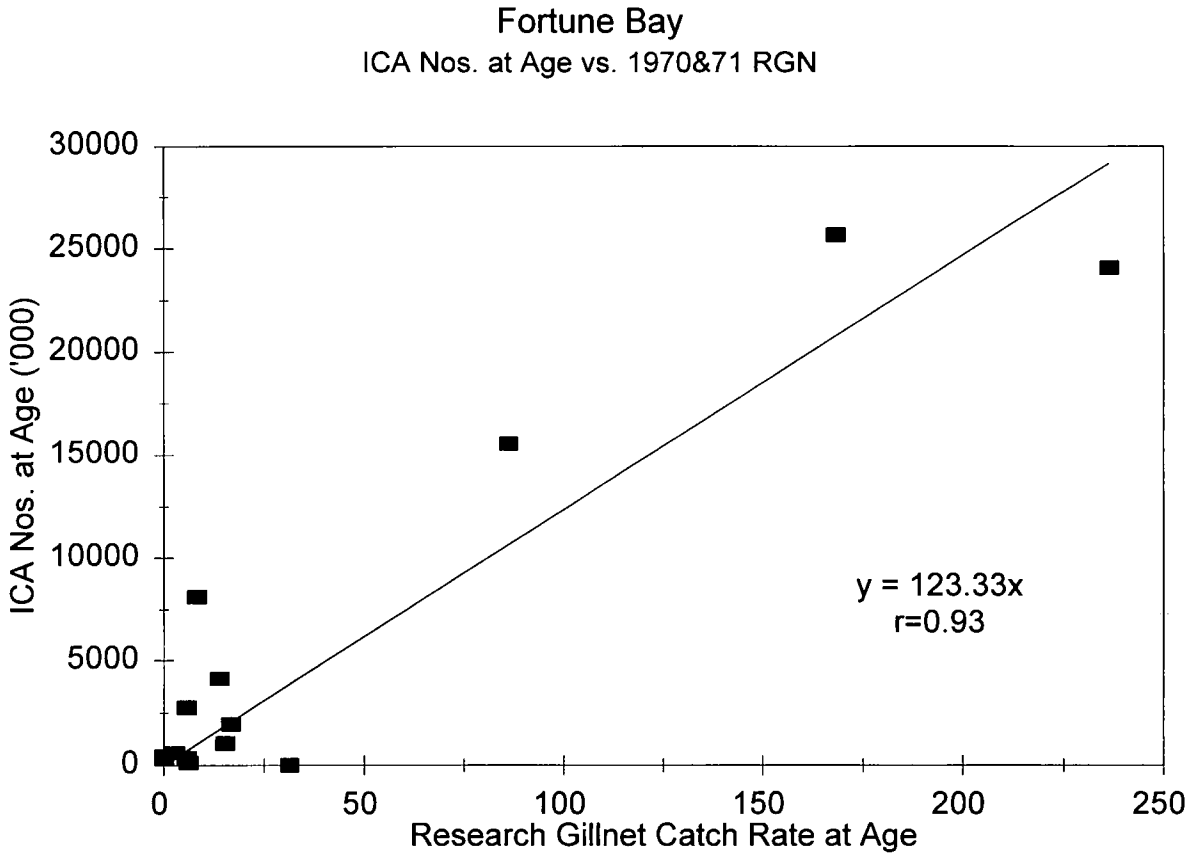


Fig. 16. Calculation of Fortune Bay research gillnet catchability coefficient by regressing 1970 - 1971 research gillnet catch rates at age against 1970 -1971 ICA population numbers at age.

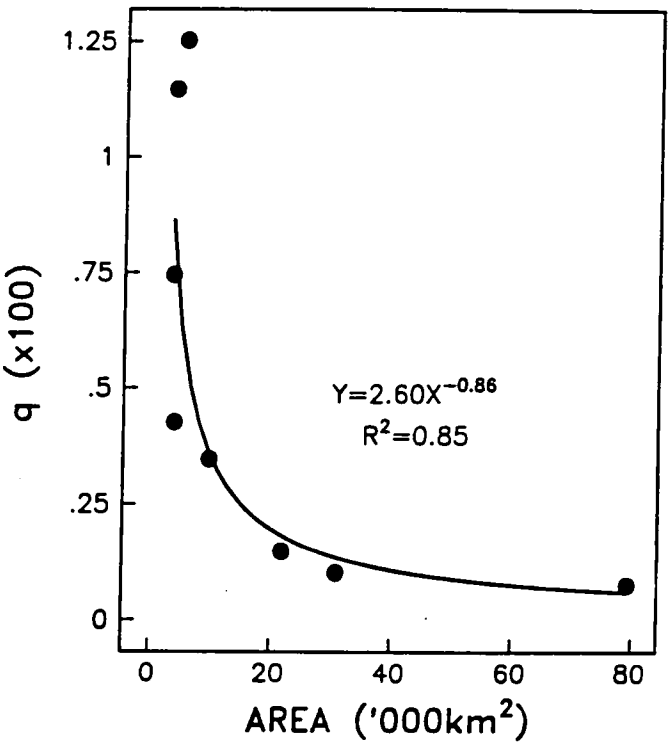


Fig. 17. Catchability coefficient (q) of herring gillnets and stock area for various Northwest Atlantic herring stocks (from Winters and Wheeler 1985).

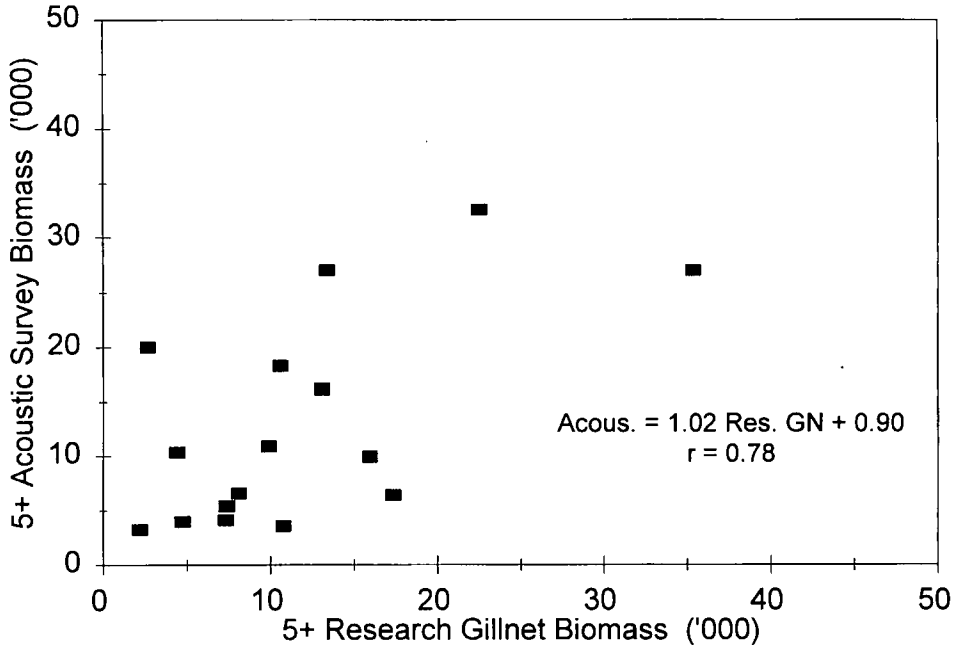
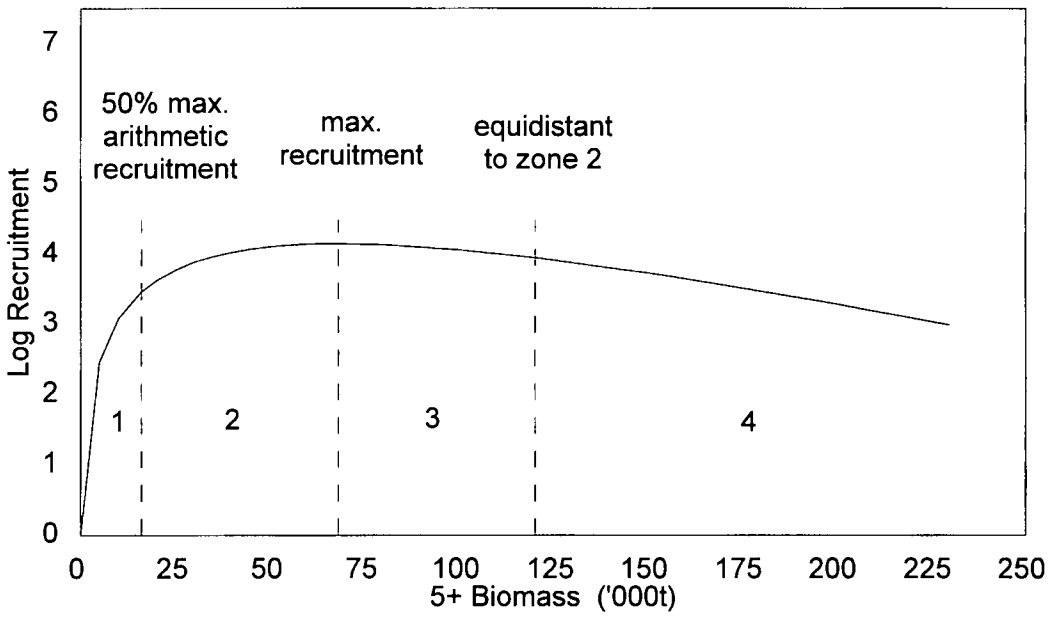


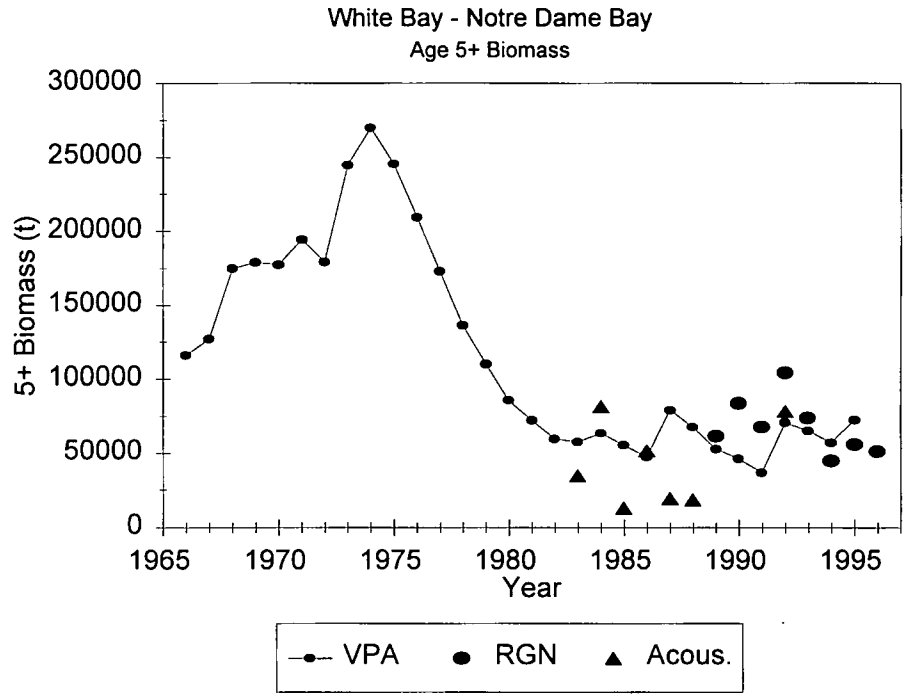
Fig. 18. Comparison of mature biomass estimated from research gillnet catchability conversion factors and from acoustic surveys.

Stock Status Classification System



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



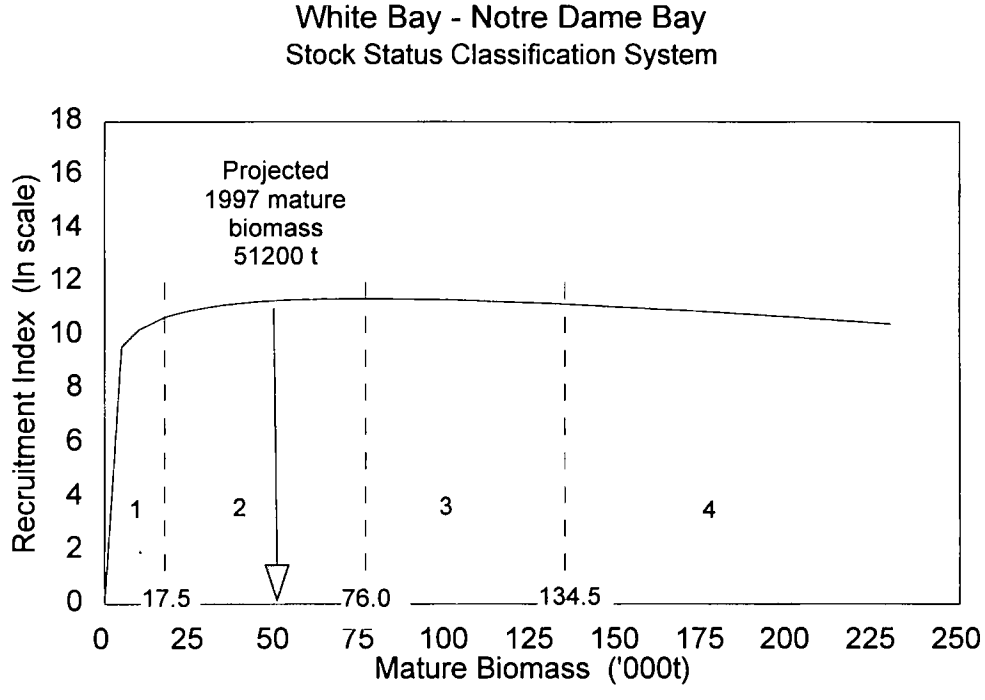
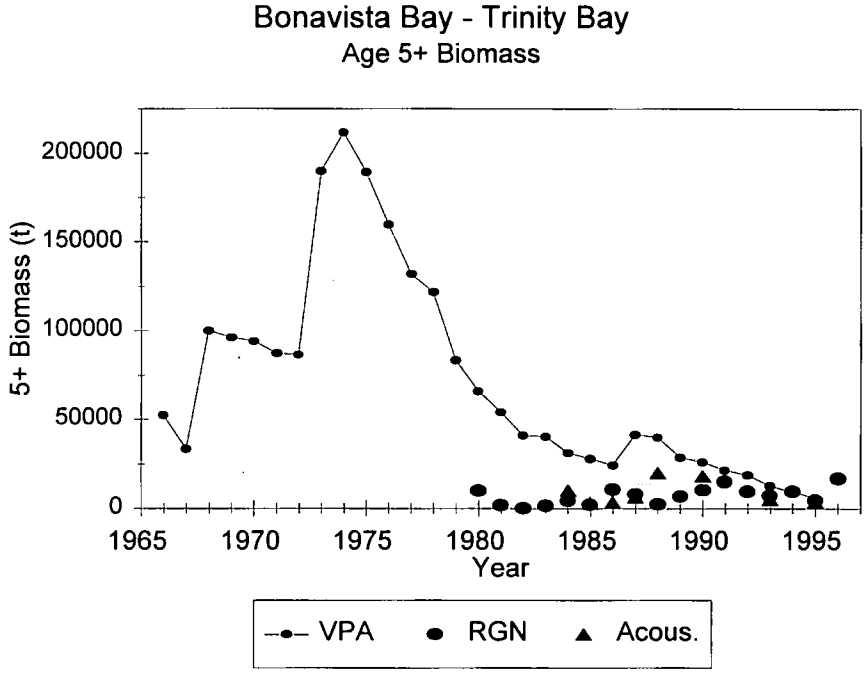


Fig. 20. White Bay - Notre Dame Bay stock status. Upper panel indicates mature biomass estimates from virtual population analysis, research gillnets, and acoustic surveys. Lower panel indicates that projected 1997 mature biomass is within zone 2 of stock status classification system.



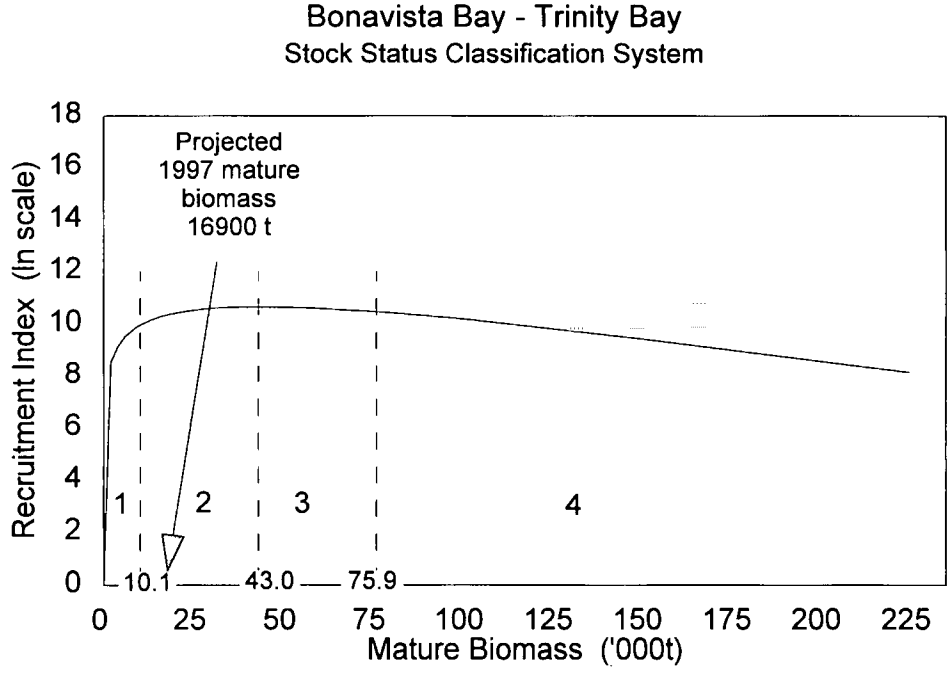
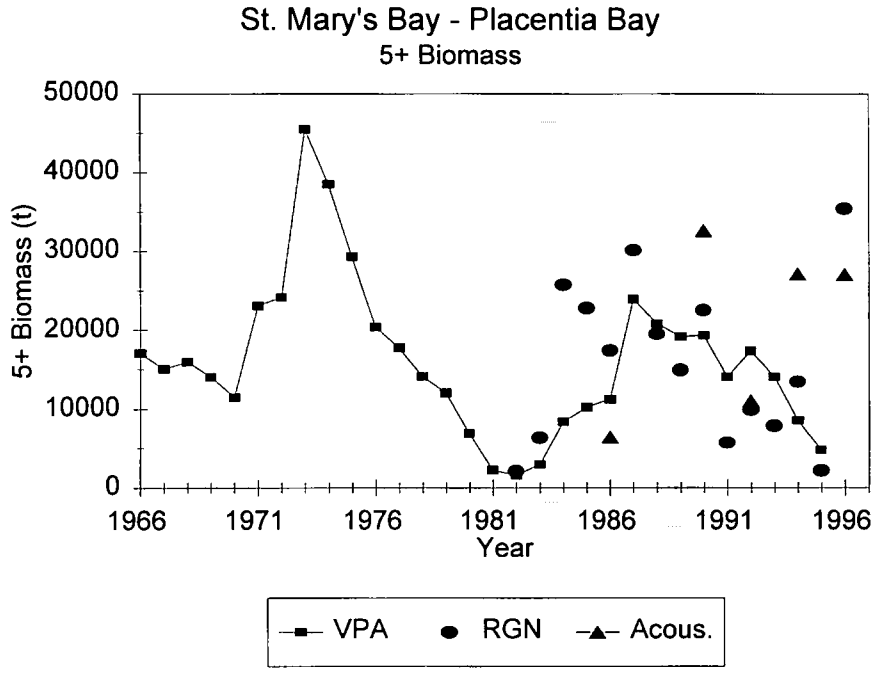


Fig. 21. Bonavista Bay - Trinity Bay stock status. Upper panel indicates mature biomass estimates from virtual population analysis, research gillnets, and acoustic surveys. Lower panel indicates that projected 1997 mature biomass is within zone 2 of stock status classification system.



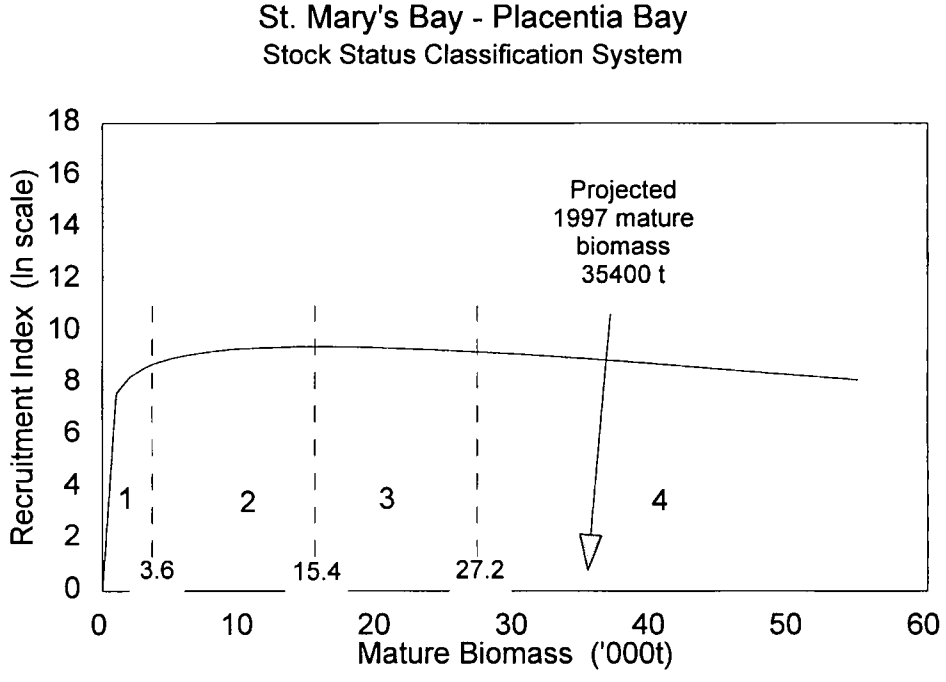
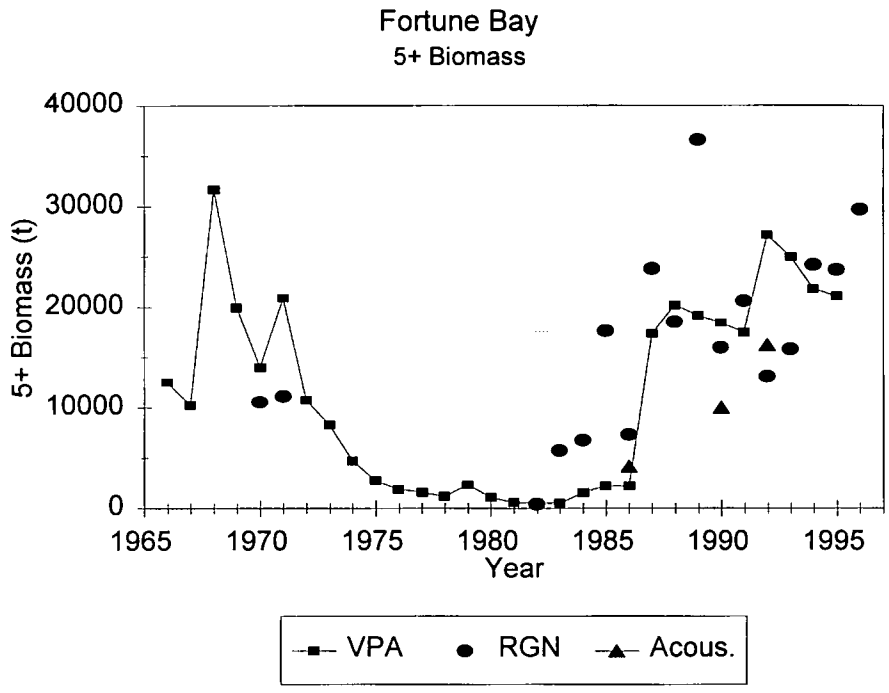


Fig. 22. St. Mary's Bay - Placentia Bay stock status. Upper panel indicates mature biomass estimates from virtual population analysis, research gillnets, and acoustic surveys. Lower panel indicates that projected 1997 mature biomass is within zone 4 of stock status classification system.



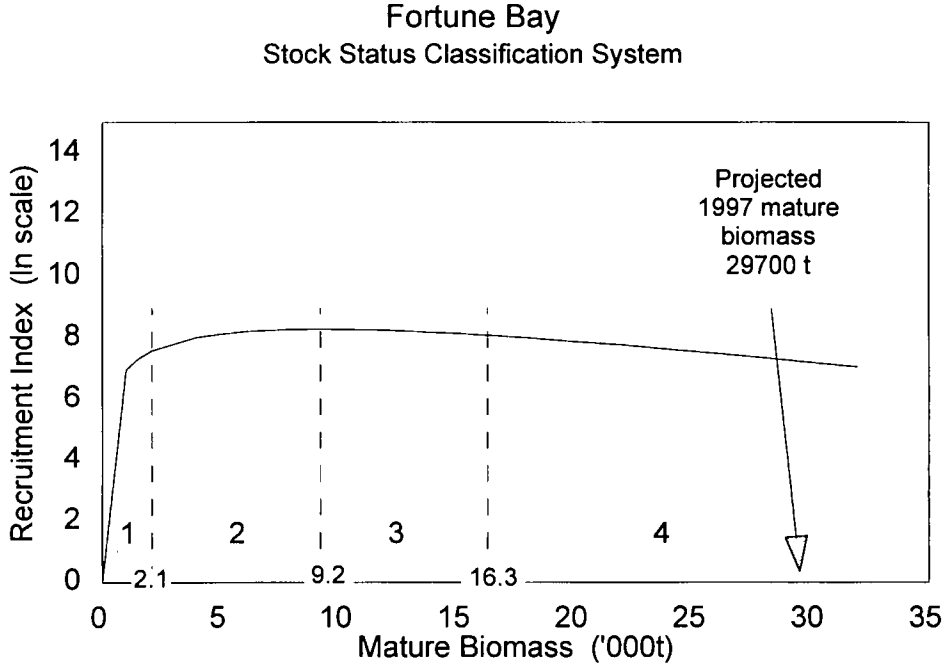


Fig. 23. Fortune Bay stock status. Upper panel indicates mature biomass estimates from virtual population analysis, research gillnets, and acoustic surveys. Lower panel indicates that projected 1997 mature biomass is within zone 2 of stock status classification system.

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 September 27, 1996. An update of herring stock status was presented including the results of the 1996 commercial fixed gear logbook program. This program was a new initiative in 1996 to provide enhanced information from commercial fishers for the assessment of these herring stocks. It was noted that response to this voluntary logbook program was limited as only 50 logbooks out of approximately 1900 were completed and returned. Fishers were encouraged to increase participation in 1997.

The Regional Assessment Review Committee met on October 3, 10, 25 and 29, 1996 to review the status of east and southeast Newfoundland herring and to prepare a draft Stock Status Report. The participants (Appendix 3) included representatives from Science Branch within the Region and from Headquarters, from Memorial University, from Fisheries Management Branch and from the fishing industry.

During the meeting of October 3, 1996, research recommendations from the 1995 assessment were reviewed, noting how each had been incorporated in the current assessment. One research recommendation, an overview of the methods used to derive herring catch statistics, was presented by Anne Marie Russell (Policy and Economics Branch). This included a table comparing converted herring production to landed weight for 1965-1990. Production figures tended to be higher in the mid 1970's and 1980's. With the exception of five years during the time series, these two series of estimates were within +/- 20%. The years with major discrepancies in the 1980's (1984 and 1985) were explained to be due to transfers of fish between areas under the jurisdiction of the Gulf and Newfoundland Regions. Reporting of such transfers has now been reconciled.

Presentations were then given on the predation of herring by seals (Garry Stenson and Bill Warren), gannets (Bill Montevecchi) and cod (George Lilly). Preliminary results of satellite tracking of harp seals suggests that these seals spend most of their time offshore and their distribution and that of herring overlaps primarily inshore in late winter and early spring. This suggests that mortality of herring by seals will not be as high as originally thought although consumption estimates are not yet available. Gannets are the major seabird predator of herring in these stocks; however, their annual consumption is not considered significant. Cod feeding data indicates that there is little predation of herring in offshore waters. From the limited scientific data available from the inshore, cod appear to feed infrequently on herring. Fishers from Bonavista Bay noted the presence of herring in cod taken during the 1996 recreational fishery and commented that cod from shallower water may predate more on herring. There was a consensus that, from the available data, seals may be a major predator of herring in these stocks. A consumption estimate of herring by harp seals would be a valuable addition to the assessment. It was also concluded that it is not necessary to examine the details of cod and seabird feeding data in future assessments unless

significant changes, related to herring abundance, are observed by lead researchers in these fields.

As per the recommendation of AZSSSC, a risk analysis was presented to evaluate the stock status classification system and underlying stock-recruit model. This analysis (Bill Warren) indicated that recruitment in the following year can be well estimated given a current year estimate of mature biomass, and estimates of overwintering water temperatures and salinity. Overwintering temperatures can be predicted as they exhibit strong serial correlation; however, salinity must be randomly selected as salinities are not serially correlated. The risk analysis set lower and upper bounds for temperature and salinity and predicted a distribution of future recruitment given an estimate of mature biomass. The model provided a narrower distribution of predicted recruitments than if mature biomass alone has been used for prediction. There were concerns expressed regarding the use of Station 27 data for all stock areas including those along the southeast coast. However, it was accepted that these are the only consistent long-term environmental data series available. There were also comments regarding the asymmetrical approach to predicting overwintering temperatures. It was noted that the approach used is data driven, ie. modelled in concurrence with the data.

A stock overview was presented, followed by a review of the 1995 commercial fishery and commercial catch at age. There was a question as to why herring were not aged beyond 10 years. It was explained that annual growth rings on otoliths become indistinct at older ages and that 10 years is the maximum age to which they can reliably be read. It was noted that the 1991 year class dominated the commercial fishery (by number) in most areas except White Bay - Notre Dame Bay where the 1990 year class was dominant. Given that there is normally parallelism in year classes between adjacent areas, it was questioned whether there may be an aging problem. It was explained that this was highly unlikely because aging is not a problem with younger fish. It was also noted that the 1990 year class was abundant in the White Bay area during the 1990 fall acoustic survey. There was a comment from a commercial fisher that there was a change in the mesh size of herring gill nets in his area of Bonavista Bay in 1995, because of a market requirement for larger herring.

Abundance indices were then reviewed; these included catch rates from the 1996 commercial gill net logbook program, catch rates at age from the 1995 research gill net program, catch rates only from the 1996 research gill net program, and the results of the 1995 fall acoustic survey of Bonavista Bay - Trinity Bay and the 1996 winter acoustic survey of St. Mary's Bay - Placentia Bay. It was noted that the research gill net catch rates series had been modified since the last assessment to include catch rates from July as well as January to June, the impact of which was minimal. A short discussion ensued on the merits of the research gill net program and the commercial gill net logbook program. It was the view of a commercial fisher that the commercial gill net logbook program was more valuable as it included more fishers throughout the stock area. It was pointed out that although this was true, the research gill net program was standardized and that both had their merits and should be considered as complimentary. There were some questions concerning the variability and differences

in research gill net catch rates between St. Mary's Bay and Placentia Bay. It was recommended that this be examined using a multiplicative model to address the area effect (see App. 2, R.R. #1).

Technical analyses were then presented including results of both extended survivors analysis (XSA) and integrated catch at age analysis (ICA) to estimate population numbers and biomass. It was noted that the extended survivors analysis was a continuation of the methodology used in the last assessment of these stocks whereas the integrated catch at age analysis was a new initiative this year. It was noted that both are derivatives of virtual population analysis. There was extensive discussion of the underlying assumptions and merits of each of these techniques. There was a general consensus that the visual diagnostics available with the ICA software allowed for better evaluation of the model fit than with the XSA. The ICA also allowed for combined age structured indices and age-aggregated indices of spawning biomass. This was deemed to be an advantage for these herring data, as age-aggregated acoustic biomass estimates are probably more accurate than disaggregated estimates. However, there was a major constraint with the ICA as the available software limits the time series to 20 years, limits observations to 1000, and restricts minimum estimates of fishing mortality. This restricted the use of the ICA as, for some areas, there were research gill net catch rates from the early 1970's which could not be included in the analysis. Although historical estimates of stock size were comparable from both XSA and ICA, estimates of current stock sizes were divergent. The Committee concluded that current stock sizes could not be accurately estimated from either of the models due to the low levels of catch and associated fishing mortalities during parts of the time series. However, it was shown that fishing mortalities for Fortune Bay during the early 1970's were sufficiently high for sequential population estimates to be insensitive to input parameters. It was suggested that a research gill net catchability coefficient (q) could be calculated based upon population estimates and catch rates at that time and that this coefficient could be applied to current research gill net catch rates to estimate current population size. The Committee recommended that this be examined prior to its next meeting.

The Committee met again on October 10, 1996 at which time it reviewed the calculation of a catchability coefficient for Fortune Bay. Research gill net catch rates at age were available for two years during the 1970's (1970 and 1971). Population numbers at age were calculated for the period 1970 to 1980 from ICA and XSA. Population estimates from the two models for 1970 and 1971 were within 10%. The calculated population numbers at age of mature fish (from ICA) were regressed against the research gill net catch rates at age to calculate a research gill net catchability coefficient (q). This coefficient was then applied to the 1996 Fortune Bay research gill net catch rate to estimate current population size. There was some discussion concerning the application of a catchability coefficient calculated from data in the 1970's to estimate current population sizes. However, it was concluded that the assumption of constant catchability over time was valid as the research gill nets are a standardized fleet of nets which were set in the same manner during both time periods. There was also some discussion as to whether the current population size for Fortune Bay should be estimated solely from the catchability coefficient or whether the most recent acoustic

biomass estimate should also be used. However, it was decided that the most recent 5+ acoustic biomass estimate (1000 t) did not accurately reflect stock biomass as the magnitude and direction of change from previous surveys did not match the trend in the research gill net catch rates.

For the remaining stock areas, where there were no historical (1970's) research gill net catch rates from which to derive catchability coefficients, catchability conversion factors were calculated. These conversion factors were based upon the inverse relationship between the catchability coefficient and the area occupied by a stock (Winters and Wheeler 1985). The stock specific conversion factors were applied to current and historical research gill net catch rates in their respective stocks to estimate population sizes. There were concerns expressed regarding the use of a catchability coefficient from one area extrapolated to other stock areas. However, these concerns were allayed as the relationship between mature biomass calculated from research gill nets versus acoustic surveys was good. There was also further discussion whether current population estimates should be derived from research gill nets only, from acoustic surveys, or a combination of both. The Committee recommended that for the long-term, a smoothing technique would be required to use both indices, rather than a single point estimate (see App. 2, R.R. #3). To proceed with risk analysis, a time series of population estimates was required. The terminal year population estimates for each stock area, derived from the research gill net catchability conversion factors, were used to initiate sequential population analysis.

The Committee met for a third time on October 25, 1996 to review the results of the sequential population analysis and the risk analysis. There was a discussion regarding the approach of fixing terminal year population estimates in sequential population analyses. It was noted that in the classical tuning of sequential population analysis, terminal population estimates are derived by assessing the converged part of the population matrix in relation to the available abundance indices and then assuming constant catchability. The approach used in this assessment applied the same principles; however, results were dependent upon the accuracy of current year estimates. There was also a question as to what approach should be used next year, given that the same problem of low catch levels and associated fishing mortalities will continue to exist. The Committee recommended that a new method be investigated for tuning sequential population analysis (see App. 2, R.R. #2). It was suggested that the stock-recruit relationship be used to forecast the current year population estimate. This could then be compared with research gill net and acoustic estimates; a weighted mean could then be calculated as the terminal population estimate.

The risk analysis was revised to incorporate the population time series calculated above; revised stock-recruit relationships were calculated for each of the stock areas. The relationships were stronger for the two northern areas than for the two southern areas. It was felt that the weaker relationship for Fortune Bay may be due to the use of Station #27 temperature and salinity data. The risk analysis highlighted the importance of environmental factors as large changes in temperatures and salinities had large effects on recruitment distributions. Given a projected mature biomass estimate in year $t+1$, the risk analysis used projected overwintering temperatures and random salinities

to provide a distribution of recruitment estimates in year *t*+2. There was a discussion regarding the use of randomized estimates of salinities in these projections. The Committee recommended investigating the possibility of using summer temperatures and salinities to predict overwintering temperatures and salinities for each stock area (see App. 2. R.R. #4). It was also questioned if there was any interaction between salinity and temperature. This was not tested in the model; it was concluded that unless there is a biological basis for any such interaction, it need not be considered.

The Committee met for the last time on October 29, 1996 to review a draft of the Stock Status Report. It was agreed that the format of the SSR would be similar to last year with summary sections for each stock area. A description of the risk analysis was added to the Assessment Methods and the results of the risk analysis were included for each stock area. The draft Stock Status Report was submitted to the Director on October 30, 1996.

Management Deliberations

The draft Stock Status Report was forwarded to Science headquarters in Ottawa on October 31, 1996 for review by the Director General, Science.

On November 7, 1996, the Director General, Science reviewed the draft Stock Status Report and provided comments for the assessment of these stocks.

On November 13, 1996, the Regional Assessment Review Committee revised the Stock Status Report to incorporate the substantive points of the Director General, Science and made the necessary changes to enhance interpretation clarity. The final Stock Status Report was then forwarded to Science headquarters in Ottawa for approval and release.

On November 26, 1996, the Assistant Deputy Minister, Science expressed concerns with the new approach being proposed (stock status classification system) as "it raises policy questions which must be addressed by a broader audience". He requested that the new approach and its related policy questions be considered at a zonal meeting in the spring of 1997. Until then, he suggested that it would be premature to adopt the approach as a basis for the current Stock Status Report. He stated that "the report should, at this stage, be modified to eliminate the reliance on stock-recruit models. For the stocks where there is evidence of low spawning biomass, the projections for 1997 could be based on reduced levels of exploitation (eg: 5-10%), simply by making reference to the need for a precautionary approach in setting exploitation levels under current conditions".

The Regional Assessment Review Committee was again unwilling to remove the stock status classification system from the Stock Status Report based upon comments and opinions outside the context of the assessment meetings. On December 6, 1996, the Committee proposed that the following caveat be included in the Stock Status Report: "the stock status classification system is a new approach to providing advice on

reference catch levels since it explicitly incorporates statistical descriptors of the risk of recruitment overfishing. This approach (model) will receive national peer review in early 1997. Until then, its application must be considered provisional".

On December 10, 1996 the Assistant Deputy Minister, Science approved the release of a "Draft" Stock Status Report. The final sentence of the caveat was revised to read: "Until then, its applicability for management purposes is uncertain".

The Small Pelagics Advisory Committee met on February 12, 1997 and used the "Draft" Stock Status Report and stock status classification system in formulating the 1997 Herring Management Plan.

On March 27, 1997, Fisheries Management Branch released the 1997-98 Herring Management Plan for Eastern Newfoundland, the first multi-year plan for this fishery.

Reference

Winters, G. H. and J. P. Wheeler. 1985. Interaction between stock area, stock abundance, and catchability coefficient. Can. J. Fish. Aquat. Sci. 42: 989-998.

Appendix 2. Assessment Review Research Recommendations

1. Include an AREA effect in a multiplicative analysis of the research gill net data.

2. Given the problems encountered with the XSA and ICA analyses, develop a new method of tuning for future sequential population analyses.

3. When using illustrative VPA to calculate historical stock and recruitment estimates, develop a method that smooths over several indices rather than using the research gill net estimate alone. Projections for the current year from the stock-recruit model can be compared with empirical estimates.

4. Investigate the possibility of using summer temperatures and salinities to predict the overwintering temperatures and salinities for each stock area.

Appendix 3. Assessment Review Participants

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