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

Canadian Atlantic Fisheries
Scientific Advisory Committee

CAFSAC Research Document 87/60

Ne pas citer sans
autorisation des auteurs[1]

Comité scientifique consultatif des
pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 87/60

Newfoundland East and Southeast Coast Herring - 1986 Assessment

by

J. P. Wheeler and R. Chaulk
Science Branch
Department of Fisheries and Oceans
P. O. Box 5667
St. John's, Newfoundland A1C 5X1

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

Research Documents are produced in the official language in which they are provided to the Secretariat by the author.

[1] Cette série documente les bases scientifiques des conseils de gestion des pêches sur la côte atlantique du Canada. Comme telle, elle couvre les problèmes actuels selon les échéanciers voulus et les Documents de recherche qu'elle contient ne doivent pas être considérés comme des énoncés finals sur les sujets traités mais plutôt comme des rapports d'étape sur les études en cours.

Les Documents de recherche sont publiés dans la langue officielle utilisée par les auteurs dans le manuscrit envoyé au secrétariat.

ABSTRACT

Data analyses are presented for 1986 for the five herring stock complexes within the Newfoundland Region: 1) White Bay-Notre Dame Bay, 2) Bonavista Bay-Trinity Bay, 3) Conception Bay-Southern Shore, 4) St. Mary's Bay-Placentia Bay, and 5) Fortune Bay. Landings from the commercial fishery, which included purse seines, bar seines, traps, and gillnets approximated 4800 t, an increase of 177% from 1985. The 1982 year-class dominated both in the commercial fishery and in the research gillnet program. There were no catch rate data available from the commercial fishery and therefore cohort analysis was not attempted as reliable estimates of terminal fishing mortality could not be calculated. Minimum biomass estimates and population numbers at age were calculated from the acoustic purse seine survey using consistently surveyed core grids only. Projections were made to 1988 assuming both a fixed catch and F = 0.30 in 1987.

RESUME

L'analyse des données de 1986 est présentée pour cinq stocks de hareng situés dans la région de Terre-Neuve. 1) baie White-baie Notre-Dame, 2) Baie Bonavista-baie de la Trinity, 3) baie de la Conception-côte Sud, 4) baie St. Mary's-baie de Placentia et 5) baie de Fortune. Les prises de la pêche commerciale, c'est-à-dire faites au moyen de seines coulissantes, de seines-barrages, de cages ou de filets maillants, atteignant environ 4 800 t, ce qui représente une augmentation de 177 % par rapport à 1985. La classe d'âge de 1982 dominait, aussi bien dans les prises commerciales que dans les prises réalisées dans le cadre du programme de recherche sur les filets maillants. On ne possède pas de données sur les taux de prises de la pêche commerciale; l'analyse des cohortes ne peut donc être faite puisqu'on n'a pu estimer de façon fiable le taux de mortalité terminal par pêche. Les estimations de la biomasse minimale et les tailles des différentes classes d'âge des populations ont été calculées à partir des données du recensement acoustique au moyen de seines coulissantes, en n'utilisant que les grilles centrales recensées régulièrement. Des prévisions ont été faites pour 1988 en supposant une prise fixe et un F=0,30 pour 1987.

INTRODUCTION

Description of the Fishery

For the first time since 1981, the 1986 commercial herring fishery in the Newfoundland region was open to all gear sectors. The management plan provided an allowance for fixed gear (gillnets and traps) within each stock area with allocations to bar seines and purse seines based on TAC residuals. There was also a limited fixed gear allowance along the Labrador coast and south coast (Pass Island to Cinq Cerf Bay) of Newfoundland. The fixed gear fishery extended from April 1 to May 31 and from September 1 to December 31 with the exception of the south and southeast coasts where the spring fishery commenced January 1. The bar seine fishery extended from April 1 to May 31 and from October 1 to December 31 in all areas. The purse seine fishery extended from April 1 to May 31 and from October 1 to December 31 along the southeast coast but was restricted to the fall season only along the northeast coast (see Fig. 1 for area designations). Any uncaught portion of allocations after the spring fishery were transferred to the fall fishery. No fishery was closed due to quota overruns. Advised catch levels and allocations by fleet sector and stock area were as follows:

Stock area	TAC (t)	Fixed gear allowance (t)	Allocation (t)	
			Bar seine	Purse seine
White Bay-Notre Dame Bay (WB-NDB)	5500	2000	400 600	1000 1500
Bonavista Bay-Trinity Bay (BB-TB)	3800	1800	500 500	500 500
Conception Bay-Southern Shore (CB-SS)	600	400	100 100	0 0
St. Mary's Bay-Placentia Bay (SMB-PB)	2100	600	500 500	250 250
Fortune Bay (FB)	700	200	500	0
Labrador Coast	500	500	0	0
South coast Newfoundland	100	100	0	0

Nominal catches

TAC's and landings ($x10^3$t) by stock area are listed below for 1979 to 1986.

		1979	1980	1981	1982	1983	1984	1985	1986
WB-NDB	TAC	11.5	5.3	5.3	1.2	0.0	1.5	2.0	5.5
	Catch	15.7	6.5	4.7	2.0	0.4	1.5	1.8*	2.7*
BB-TB	TAC	8.4	4.4	4.8	0.7	0.0	0.4	0.8	3.8
	Catch	9.8	5.4	4.0	0.5	0.1	0.2	0.6*	1.7*
CB-SS	TAC	0.9	0.4	0.5	0.2	0.0	0.1	0.2	0.6
	Catch	0.9	0.5	0.2	0.1	<0.1	<0.1	0.1*	0.2*
SMB-PB	TAC	3.4	2.5	1.2	0.0	0.0	0.0	0.6	2.1
	Catch	3.6	2.5	0.6	<0.1	<0.1	0.1	0.1*	0.1*
FB	TAC	1.0	1.0	0.2	0.0	0.0	0.0	0.3	0.7
	Catch	1.2	0.5	0.1	<0.1	<0.1	<0.1	0.1*	0.1*

* preliminary

TAC values for the three northeast coast areas in 1981 have been corrected since last year's assessment.

Anecdotal Information

This year, all herring stocks in the Newfoundland region were assessed in a single research document. As in recent assessments, there are five stock complexes considered (Fig. 1): 1) White Bay-Notre Dame Bay (3Ka, 3Kd, 3Kh, and 3Ki), 2) Bonavista Bay-Trinity Bay (3La and 3Lb), 3) Conception Bay-Southern Shore (3Lf and 3Lj), 4) St. Mary's Bay-Placentia Bay (3Lq and 3PSc), and 5) Fortune Bay (3PSb). These stock areas have been delineated from the results of tagging experiments conducted from 1975 to 1981 (Wheeler and Winters 1984).

The history of the modern commercial fishery along the northeast coast is short, from 1974 with the introduction of large (>65 ft) mobile purse seiners to 1981 when the fishery was closed to the mobile fleet, which by then consisted of smaller (<65 ft) ringnet vessels. Prior to the 1970's, average annual landings were less than 2000 t. Landings increased rapidly through the 1970's, peaking at approximately 26,000 t in 1979. This coincided with the recruitment of the very large 1968 year-class, the development of the mobile fishery, and the availability of markets due to the collapse of the North Sea herring stocks. Landings have declined during the 1980's, averaging approximately 3500 t annually (Tables 1-3). The history of the commercial fishery on the southeast coast is longer than that of the northeast coast. Average annual landings from the southeast coast herring stocks peaked around 30,000 t between 1945-50, declined to an average of 3500 t from 1958 to 1962, and increased to approximately 22,000 t in 1968 with the introduction of the purse seine fleet from

British Columbia. Landings have declined since then, averaging 5000 t annually throughout the 1970's and less than 300 t annually during the 1980's (Tables 4 and 5).

Quota controls were first placed on the purse seine fishery along the southeast coast in 1973. The northeast coast ringnet fishery was placed under quotas in 1977, the same year that large purse seine vessels were excluded from the area. Gillnets, in all areas, came under quota control in 1980 as the fishery was being restricted due to poor recruitment. Stocks continued to decline during the early 1980's; the northeast coast ringnet fishery and the Fortune Bay purse seine fishery (the only remaining area in which large purse seine vessels were allowed to fish) were closed in 1981. The ringnet fishery in St. Mary's Bay-Placentia Bay and the bar seine fishery in Fortune Bay were closed in 1982. The bar seine fishery in St. Mary's Bay-Placentia Bay and all remaining fixed gear fisheries along the east and southeast coasts were closed in 1983. The commercial fishery remained closed along the southeast coast in 1984 and 1985 with the exception of a limited fixed gear bait fishery. Despite similar CAFSAC advice for the northeast coast, a limited fixed gear fishery was allowed in 1984 and 1985. With the recruitment of the 1982 year-class and increasing stock sizes in all areas, the commercial fishery was reopened to all gear sectors in 1986. In the intervening period between 1981 and 1986 ringnetters have "evolved or matured" and are now considered by Statistics Branch as purse seiners.

INPUT DATA

Biological Sampling

The number of herring sampled in the Newfoundland region in 1986, from the commercial fishery and research programs, was 15,820 (Table 6). This represented a slight increase from 1985 when 14,833 fish were sampled. When apportioned by stock area, month and gear type (Table 7), samples were available for 79% of the commercial catch. This represented a decrease of 19% from 1985, attributable mainly to fall purse seine landings along the northeast coast for which no samples were available. Samples were collected randomly; all fish sampled were measured and aged.

Mean weights at age for 1986 (Table 8) were derived from commercial and research samples of spring spawning herring collected from January to June.

Commercial Fishery Data

Commercial catch-at-age data (Tables 9-13) were generated for spring and autumn spawners for each stock area by applying age compositions from the appropriate commercial samples to the landings. Where no commercial samples were available, catch-at-age data were generated using research samples collected from commercial mesh size (2 1/2" and 2 3/4") gillnets. Both 1985 and 1986 catch data are preliminary as final catch statistics are not yet available. For the first time, catch-at-age data for autumn spawners have been presented as in the three southern areas, autumn spawners represented greater than 25% of the catch. Data for autumn spawners, 1970-76, were not available for the northeast coast areas for this assessment but will be included in the next assessment of these stocks.

The 1982 year-class dominated the commercial fishery (by number) in all areas in 1986 (Figs. 2 and 3) representing from 30 to 60% of the catch. The 1979 year-class and fish age 11+ accounted for approximately 10-20% of the catch in each area. The 1980 year-class represented approximately 25% of the catch in Fortune Bay. This was the only area in which this year-class represented greater than 10% of the catch. The proportion of fish age 11+ in the commercial catch decreased from north to south and for the first time, age 1 (1985 year-class) fish were evident in the catch (2%) in White Bay-Notre Dame Bay and Bonavista Bay-Trinity bay. The percentage of autumn spawners in the catch decreased from 1985 to 1986 in all areas (except St. Mary's Bay-Placentia Bay) coincident with the recruitment of the 1982 year-class. As in previous years, the percentage of autumn spawners increased from north to south, from 7.5% in White Bay-Notre Dame Bay to 48.5% in St. Mary's Bay-Placentia Bay. Autumn spawners in all areas were dominated by the 1979 year-class.

No commercial catch rate data were available in 1986.

Research Survey Data

i) Acoustic Purse Seine Survey:

Two commercial purse seine vessels were chartered for five weeks in October-November, 1986 to conduct an acoustic survey along the northeast coast from Notre Dame Bay to Conception Bay. The research vessel MARINUS plus one commercial purse seine vessel continued the survey for a additional four weeks in November-December along the southeast coast from St. Mary's Bay to Fortune Bay. This was the fifth consecutive year that an acoustic survey has been conducted along the northeast coast, the fourth from which quantitative biomass estimates have been derived. Three quantitative surveys have been conducted along the southeast coast, one in 1985 and two in 1986. The first survey in 1986 was in February-March, the results of which were reported in last year's assessment (Wheeler and Dalley 1986). It was decided to change the time of this survey from winter to fall due to inclement survey conditions in the January to March period.

Horizontal and vertical dimensions of 1137 herring schools were measured from sounder tracings over a cruise track of 4464 km. There were 22 successful purse seine sets during the survey (Table 14), an increase of 100% from 1985. Unlike 1985, herring schools were higher in the water column and were more readily available to the gear. Sampling was adequate in the northern areas: eight samples (50 herring/sample) were taken in Notre Dame Bay and eleven in Bonavista Bay-Trinity Bay. However, only one sample was taken in each of the three southern stock areas. Anchor (9500) and dart (1400) tags were applied to 10,900 herring in eight locations during the survey (Table 15) to further elucidate migratory patterns.

Age distributions from the acoustic purse seine survey, weighted to account for abundance differences in subareas within stock areas (Figs. 4 and 5), showed the dominance of the 1982 year-class in all areas except Bonavista Bay-Trinity Bay where the 1985 year-class was most dominant. Very few 1982 year-class herring were sampled in the Trinity Bay portion of this stock area. It was felt during the survey that sampling may have been biased as these fish had not yet reentered

the bay to overwinter and were therefore unavailable during the survey. The 1983 year-class appeared weaker in 1986, approximately 10-20% that of the 1982 year-class in White Bay-Notre Dame Bay and Bonavista Bay-Trinity Bay rather than the 60-80% observed in 1985 suggesting that sampling may indeed have been biased in 1985 as was hypothesized in last year's assessment (Wheeler et al. 1986). Age distributions for the two southeast coast stocks (Fig. 5) were very similar for the two 1986 surveys. This would be expected for Fortune Bay as no samples were available from the February-March survey and therefore samples from the November-December survey were used to derive both age distributions. However, for St. Mary's Bay-Placentia Bay, except for a reduction in the percentage of autumn spawners in the fall survey, the age distributions were very similar. As was the case for the commercial catch at age, the percentage of autumn spawners increased from north to south though not to the same degree.

ii) Research Gillnet Program

The research gillnet program was continued for the seventh consecutive year during the spring and fall along the northeast coast and for the fifth year during the spring along the southeast coast. In 1986, 25 fishermen were each contracted to fish a fleet of five gillnets, mesh sizes 2", 2 1/4", 2 1/2", 2 3/4", and 3", for one month to maintain an accurate daily log record of catches and to collect and freeze samples of their catch.

Catch at age (Tables 16-22) and age distributions (Fig. 6 and 7) were calculated by applying age distributions of samples taken during the month, normally at four-day intervals, to catches during that interval and then combining these interval age distributions to obtain one for the entire month. In all areas (Figs. 6 and 7), the 1982 year-class was dominant, representing 40-70% of the catch, by number. However, it was only in Fortune Bay that the proportion of 1982 year-class increased greatly from 1985 to 1986, from 4% to 50% of the catch. In other areas, the increase ranged from 5% to 25% and in Conception Bay-Southern Shore, there was a decrease of 20% in the proportion of 1982 year-class in the catch. The 1979 year-class was the second strongest in the catch in all areas except Fortune Bay where the 1979 and 1980 year-classes were of similar strength. The percentage of 1979 year-class in the catch remained approximately the same as in 1985, ranging from 10 to 20%. As in the commercial fishery, the percentage of fish age 11+ decreased from north to south. The percentage of autumn spawners increased from north to south and the percentages were comparable to that of the commercial fishery. In three of the five stock areas, the percentage of autumn spawners decreased from 1985 to 1986. There has been a general decrease in autumn spawners in all stock areas over the past three years consistent with the recruitment of the 1982 year-class. Catch at age by mesh size (Fig. 8) for 1986 shows, as expected, the dominance of 1982 year-class fish in the smaller mesh sized nets and the 1979 year-class and older fish in the larger mesh sized nets.

As in previous years, two catch-per-unit-effort indices were calculated from the research gillnet program: 1) number of herring caught per fishing day, and 2) number of herring caught per days hauled (Tables 23-27). In order to examine the variability within the research gillnet data, catch per days fished by mesh size was also calculated (Table 28 and Fig. 9). No clear trend in catch rates can

be seen across all stock areas. In White Bay-Notre Dame Bay, catch rates have declined steadily from 1983 to 1986 although 2" and 2 1/4" (mesh nets) increased from 1981 to 1985. A similar trend exists in Bonavista Bay-Trinity Bay where catch rates increased from 1981 to 1983, decreased from 1983 to 1985, but increased to approximately 1984 levels in 1986. However catch rates for 1986 are biased downward as one fisherman in Trinity Bay (Long Beach) had substantially higher catch rates than in any previous year but misplaced his logbook and therefore could not be included in the analysis. The 2" and 2 1/4" catch rates have remained relatively constant over the last three years. Catch rates in Bonavista Bay-Trinity Bay have averaged approximately 55% those in White Bay-Notre Dame Bay over the past six years. Catch rate data for Conception Bay-Southern Shore is very difficult to interpret. Catch rates in 1984 and 1985 were exceptionally high, higher than any area except White Bay-Notre Dame Bay in 1980. The 900% decrease from 1985 to 1986 cannot be explained by present stock status. Catch rates in the two southeast coast stock areas have shown a general increase from 1982 to 1986 although in St. Mary's Bay-Placentia Bay catch rates have remained constant over the past two years and in Fortune Bay catch rates declined from 1985 to 1986. Catch rates in these two areas in 1986 were higher than in any area along the northeast coast. Research gillnet catch rates over the past three years do not suggest that the 1982 year-class is exceptionally strong. Although catch rates have increased in the two southeast coast stock areas, they have not continued to do so as expected with the recruitment of a strong year-class. Catch rates in the northeast coast stock areas increased from 1981 to 1983 consistent with the recruitment of the 1979 year-class but have not even remained at 1983 levels with the recruitment of the 1982 year-class.

iii) BIOSONICS Hydroacoustic System

As recommended last year by CAFSAC, a BIOSONICS dual-beam hydroacoustic system was leased from McGill University for a two-week experiment in Notre Dame Bay during the 1986 acoustic purse seine survey. There were four objectives to the experiment: 1) to obtain density estimates of individual herring schools and make comparisons between schools, 2) to determine in situ target strength estimates of herring and mackerel, to distinguish between each and to possibly distinguish size differentiation within herring, 3) given certain assumptions concerning school shape, to obtain school biomass estimates and to make comparisons with the commercial sounder method, and 4) to determine the suitability of the system for future inshore quantitative herring acoustic surveys. The hydroacoustic system was used aboard the research vessel MARINUS. There were initial problems locating herring schools due to a malfunction in the vessel's sonar. However, once repaired, measurements were made on seventeen schools over a seven day period (see Figs. 10 and 11 for locations).

Relative densities (mean squared voltages) were calculated for thirteen schools (Table 29) six of which field observations suggested were herring, two mackerel, four herring and mackerel combined, and one unknown. Measurements ranged from 0.06 to 7.77 mv for schools identified as herring and 0.02 and 0.07 mv for the two mackerel schools. When converted to fish per cubic meter using in situ target strength estimates the range for herring schools was 0.04 to 5.0 fish/m^3 and for mackerel, 0.01 and 0.05 fish/m^3. Unlike the actual fish

density estimates which require target strength calculations, the mean squared voltages are directly comparable between schools. They suggest that density of herring schools vary greatly and the assumption of constant density in biomass calculations is not valid.

Mean backscattering cross sections and average target strength estimates were calculated for all seventeen schools (Table 29). In most cases, the number of targets accepted by the system as single targets was small (2-68) due to the dense nature of the schools. Average target strength estimates for schools identified as herring ranged from -28.8 to -39.3 dB. For three mackerel schools, the estimates ranged from -46.6 to -50.3 dB. A frequency distribution of all target strength estimates is given in Figure 12. The majority of observations ranged from -35 to -48 dB. A method is presently being developed to distinguish between species using density differences within schools (Rose 1987). It was impossible to differentiate between size classes of herring based upon the number of targets measured.

School size (number of fish) was estimated for eleven schools (Table 29). The assumption was made that each school was circular in shape and that it was transected at its widest point. Estimates were made using in situ target strengths. There were only two schools, at Little Denier Island and Burnt Island, for which school size estimates were available from both the BIOSONICS equipment and the commercial sounder method used in the acoustic purse seine survey. The Little Denier school was estimated by the BIOSONICS system to consist of 68,139 fish. A purse seine set upon the school was unsuccessful due to a broken purse line. However, five herring (three 1982 year-class and two 1979 year-class) were entangled in the seine. If it is assumed that the school consisted of equal proportions of these two year-classes with a mean fish weight of 312 g, then the school would be 21,300 kg. As calculated by the sounder method, explained later in this paper, the school would be 46,600 kg. There are three types of estimates available for the Burnt Island school, a BIOSONICS estimate, a sounder estimate, and a visual estimate. A purse seine set was made in which it was felt that the entire school had been caught. After being pursed up and prior to being released. the school was visually estimated at 41,000 kg. Three estimates were derived using the BIOSONICS system: 1) 2400 kg using a target strength calculated for the mean fish length from the purse seine sample, 2) 5200 kg using the in situ target strength, and 3) 23,700 kg using a target strength of -34 dB/kg. It was subsequently determined that the system receiver gain had been set too low and that these estimates should be increased by 70 to 100%. The sounder method produced an estimate of 14,600 kg. In both of these examples, numerous critical assumptions are made concerning school shape and the determination of target strength. However, in both instances, when in situ target strengths were used, the BIOSONICS estimates were lower than the two sounder estimates. In the second example, both the BIOSONICS and sounder estimates were much lower than the visual estimate.

The use of the BIOSONICS dual-beam hydroacoustic system proved very successful. It showed that there are differences in school densities and that it is possible to quantify them. It is also possible to distinguish between mackerel and herring, a problem using the present sounder method, and given certain

assumptions, school biomass estimates can be derived which are comparable in magnitude to sounder estimates. Such a system would be very valuable in future inshore herring surveys. Relative density estimates could be obtained on an annual basis using mean squared voltages. Biomass estimates could then be derived using in situ or arbitrary calculated target strengths. A survey design will be developed over the next three months and if sufficient financial resources are available, a survey will be conducted using the system in the fall of 1987.

Estimation of Parameters

Similar to previous years, instantaneous total mortality estimates (Paloheimo 1961) were calculated for ages 4+ for each of the research gillnet catch rate series (Tables 30 and 31). As in the past, results between fishermen within stock areas were highly variable. However, for communities combined within each stock area, all Z values for 1985-86 were positive and ranged from 0.39 for St. Mary's Bay-Placentia Bay to 2.26 for Conception Bay-Southern Shore. Cohort analysis was not attempted using these data.

ASSESSMENT RESULTS

Biomass Calculation from Acoustic Survey

Survey design in 1986 was similar to 1985. Two vessels covered separate cruise tracks primarily within the 90 m contour. Only active searching time was included in calculating cruise track length. The cruise track width was estimated to be 0.304 km, the lateral distance swept by the sonar. Accurate estimates of area surveyed within subareas and stock areas were then calculated.

Each vessel used its sonar to locate schools within the cruise track. Single line transects through the widest lateral dimension of each school were then marked on the sounder paper. Horizontal and vertical dimensions of each school were subsequently measured, school depth directly from the sounder scale and the horizontal dimension by converting from "MM" on the sounder to "M" by relating sounder paper speed (sec/MM) to vessel speed (M/sec). Not all schools observed by the sonar within the cruise track were recorded on the sounder.

The relationship between cross-sectional area of schools (M^2) and weight per school (kg) derived from the 1984 and 1985 acoustic purse seine surveys ($Y = 10.03X^{1.10}$) is shown in Figure 13. A second relationship ($Y = 2.12X^{1.39}$) has been derived which includes three schools from the 1986 survey where it was considered that the entire school had been caught. The maximum school size that can be accurately predicted is 17 t for the first relationship ($Y = 10.03X^{1.10}$) and 25 t for the revised relationship ($Y = 2.12X^{1.39}$). During the 1986 survey, 91% of the schools measured along the northeast coast, which represented approximately 62% of the observed biomass using the first relationship and 49% of the biomass with the revised relationship, were within this range (Table 32, Fig. 14). Along the southeast coast, 75% of schools, 23% of biomass using the first relationship and 17% of biomass using the revised relationship, were within range. As can be seen from the pattern of residuals of these relationships (Fig. 15), the size of larger schools tends to be underestimated. The revised relationship including 1986 points has a reduced pattern and better fits the

data. Although biomass estimates have been calculated using both relationships, estimates calculated using the revised relationship have been used in all projections.

The relationship between school volume (M^3) and school weight (kg) was examined (Fig. 16) assuming a spherical school shape with the same horizontal and vertical measurements used for the school area - school weight relationship. The linear relationship is consistent with theoretical expectations of the relationship between school area and school volume and supports the empirical relationship between school area and school weight used in these analyses.

As suggested by CAFSAC in research recommendations last year, the relationship between school area and school weight was examined for sets where the entire school was not caught (Fig. 17). Approximately 70% of the schools fall below the line for the relationship $Y = 2.12X^{1.39}$ and approximately 90% are within the 95% confidence limits of the regression. The relationship between mean fish length and the area of the schools from which the sample was derived, was also examined (Fig. 18). There is a general increase in school area with increased fish length.

The same subareas or grids were used within each stock area this year as in previous years (Fig. 19). However, this year, the stock area (i.e. the area within the 90 m contour) had been calculated for each of these grids and therefore biomass estimates could be calculated for each grid and then combined to determine stock biomass. This year, as in previous years, not all grids were surveyed (Table 33). This has been a particular problem in White Bay-Notre Dame Bay where only grids in Notre Dame Bay have been consistently surveyed over the last four years. In last year's assessment, stock biomass estimates included estimates for non-surveyed grids derived by areal expansion from surveyed grids. As this assumes equal distribution of fish in surveyed and non-surveyed areas, it was decided this year to select a group of core grids within each stock area which have been consistently surveyed each year and to calculate a minimum estimate of stock biomass from these grids. For Bonavista Bay-Trinity Bay these core grids comprised the entire stock area. However for White Bay-Notre Dame Bay they represented only 43% of the stock area, for Conception Bay-Southern Shore 46%, for St. Mary's Bay-Placentia Bay 82% and for Fortune Bay 69%. It must be stressed that with the exception of Bonavista Bay-Trinity Bay, biomass estimates represent minimum stock estimates and that even though historical fishing patterns suggest less fish in non-surveyed versus surveyed areas, there is biomass not accounted for in these projections.

Both the old and revised relationships between school area and school size were applied to each of the schools measured during the survey to obtain an estimate of observed biomass (t) within each core grid. The detailed calculations for 1986 using the revised relationship ($Y = 2.12X^{1.39}$) are shown in Table 34. Given an estimate of the area surveyed and the stock area within each grid, a conversion factor was derived to prorate the observed biomass to total biomass within each grid. These grid biomass estimates were combined for all core grids surveyed. Stock biomass estimates for all previous acoustic purse seine surveys, 1983-86, were recalculated by this method (Table 35) using core grids only. Biomass estimates for White Bay-Notre Dame Bay and Bonavista Bay-Trinity Bay have decreased from 1985 to 1986 by 36% and 74%, respectively. The lack of 1982 year-class herring in Trinity Bay during the survey is the main cause of the decline in that stock area. It is interesting to note that

biomass estimates for St. Mary's Bay-Placentia Bay are very comparable from the two surveys conducted in 1986. However, such is not the case in Fortune Bay where estimates have declined over the three surveys.

It is impossible to make comparisons between biomass estimates calculated last year and this year as methodologies have changed substantially. Last year, biomass estimates could not be derived for individual grids as stock areas within grids had not been calculated. Also, biomass estimates presented last year included areal expansion to non-surveyed grids rather than sampled core grids only as presented this year.

Population numbers and population numbers at age have been recalculated for all previous surveys for core grids only. Detailed calculations for 1986 using the revised relationship ($Y = 2.12X^{1.39}$) are shown in Tables 36 and 37. Grid biomass estimates (from Table 34) were converted to grid numbers using the mean weight of fish sampled within the grid (Table 36). For grids from which no samples were available, the mean sample weight from all sampled grids within the stock area, was used. These grid numbers were apportioned by spawning type based upon the spawning type percentages within the samples. Total numbers for each grid, by spawning type, were then apportioned into numbers at age based upon the age composition of samples from that grid (Table 37). Similarly, for grids from which no samples were available, the combined age composition of samples from all grids within the stock area, was used. However, for Bonavista Bay-Trinity Bay, where samples were available from both bays within the stock area, samples from each bay were applied to the biomass estimates of non-sampled grids within the bay to derive population numbers and numbers at age. The population numbers for each bay were then combined to determine stock numbers. This was done to help account for the possible biased sampling in Trinity Bay in 1986. A similar procedure was used for the 1984 and 1985 surveys to provide consistency in methodology.

Population numbers at age and biomass estimates from all acoustic purse seine surveys, 1983-86, are summarized by stock area in Tables 38-42. For White Bay-Notre Dame Bay (Table 38) population numbers have decreased from 799 ($x10^6$) in 1985 to 262 ($x10^6$) in 1986. The estimate of the 1982 year-class has decreased by 74%. However, unlike 1985 when only five year-classes were represented in the samples, this year, all but the 1986 year-class were represented. Age 11+ fish were the second most dominant group in the population, approximately 35% that of the 1982 year-class. The 1983 year-class did not show as strongly as in 1985. For Bonavista Bay-Trinity Bay (Table 39), population numbers decreased by 58% from 1985 to 1986 and the estimate of the 1982 year-class decreased by 87%. The population tended to be stabilized by the 1985 year-class. As in White Bay-Notre Dame Bay, the 1983 year-class did not show strongly in 1986; similarly, most year-classes were represented in samples in 1986, including the 1986 year-class which is of similar strength to the 1985 year-class, when estimated at age 0. However, sampling may have been biased in this stock area in 1986 due to the non-availability of 1982 year-class during the survey. For Conception Bay-Southern Shore (Table 40), the 1982 year-class was dominant in 1986, accounting for 83% of the population numbers. There was also an increase in the percent of autumn spawners in relation to the two northern areas. In St. Mary's Bay-Placentia Bay (Table 41) there was an increase of 16% in the estimate of population numbers from February-March to November-December 1986. In both surveys, the 1982 year-class was

dominant, representing 76% and 83% of total population numbers. Autumn spawners represented 26% and 15% of the population totals in the two surveys. In the first survey, the 1982 year-class accounted for approximately half the autumn spawners; in the second survey, the 1979 and 1981 year-classes were present in approximately equal proportions. In Fortune Bay (Table 42) population numbers have dropped substantially from 1985 (January-February) to 1986 from 141 x 10^6 to 29 x 10^6. The percentage of 1982 year-class has also dropped from 81% to 63%. The percentage of autumn spawners has remained at approximately 10%. As in St. Mary's Bay-Placentia Bay no 1983-86 year-class fish are represented in the population. This is probably due to the small sample sizes (one sample per stock area) used to derive population numbers at age.

As pointed out last year, there are several sources of uncertainty in the calculation of stock biomass from purse seine surveys. Several of these have been examined within the past year, such as the relationship between school area and school weight where the entire school was not caught (Fig. 17). The relationship between mean fish length and school area has also been examined (Fig. 18). In addition, during the 1986 survey, schools were transected through the widest lateral dimension as viewed by the sonar thereby increasing consistency in school area calculations. Population estimates in 1986 were calculated from grid summations; this should better account for intra-stock differences. Biomass estimates were calculated for consistently surveyed core grids only which provide minimum estimates of stock biomass.

The relationship between school area and school size was empirically tested for one particular school in Notre Dame Bay (Muddy Hole, Bay of Exploits). The area of the school, based on the sounder transect, was 834 M^2. By applying the revised relationship between school area and school size ($Y = 2.12X^{1.39}$), a school biomass of 24,400 kg was derived. From a purse seine set made to sample the school, it was felt that the entire school had been caught (as the water was shallow enough for the seine to reach bottom). After the seine was pursed alongside the vessel, the vessel master estimated approximately 27,200 kg in the seine. The catch was loaded into the vessel hold and was estimated at 29,500 kg. The catch was sold and provided a shipped weight of 29,800 kg.

PROGNOSIS

Catch Projections

Population numbers at age from each survey (1983-86) were projected to January 1987 assuming no fishing mortality and a natural mortality rate of 0.20. An average population numbers-at-age vector, including spring and autumn spawners, was calculated for each stock area (Table 43). An average population vector was used for projections as it was felt that this was the best information available indicative of population status. Inclusion of year-classes other than the 1982 year-class allowed for more realistic stock projections.

Two options were used in projections. The first assumed the following catches in 1987 and an F = 0.30 in 1988.

Stock area	Catch (t)
White Bay-Notre Dame Bay	31,500
Bonavista Bay-Trinity Bay	13,700
Conception Bay-Southern Shore	3,500
St. Mary's Bay-Placentia Bay	2,550
Fortune Bay	2,400

These were the catch levels as advised by CAFSAC last year. The 1987 herring management plan, for the spring fishery only, has allocated 16,500 t, 7000 t, and 2000 t, respectively for each of the three northeast coast stock areas. The entire TAC has been allocated for the spring fishery in each of the two southeast coast areas. The remainder of the east coast TAC has been held in reserve for the fall herring management plan to be announced later. The second option assumed F = 0.30 in both 1987 and 1988. In both options, the mean weights at age were those derived from samples collected in 1986 (Table 8), natural mortality was assumed to be 0.20, and recruitment at age 2 in 1988 was assumed to be zero.

Average population numbers at age from the purse seine surveys were projected to July 1986 and compared with the 1986 commercial catch at age. The resultant partial recruitment vectors showed full recruitment at ages 8 or 9 for all stock areas. This was inconsistent with the historical pattern for these stocks and it was felt that it may have been due to the sampling variability within the purse seine surveys where there is a tendency not to sample older fish. Therefore, as in previous years the following partial recruitment pattern, based upon a historical combined purse seine and gillnet fishery (Winters and Moores 1977), was used for all stock areas:

Age	2	3	4	5	6	7	8	9	10	11+
	0.10	0.35	0.60	1.00	1.00	1.00	1.00	1.00	1.00	1.00

The catch ($x10^3$ t) projections for 1988 (Tables 44-48) are summarized in the following text table:

	WB-NDB		BB-TB		CB-SS		SMB-PB		FB	
	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988
OPTION 1										
2+ biomass	109.4	70.6	81.5	70.7	3.1	-	38.9	31.9	17.3	13.8
Catch	31.5	16.6	13.7	14.5	3.5	-	2.5	7.5	2.4	3.3
OPTION 2										
2+ biomass	109.4	78.8	81.5	68.5	3.1	2.2	38.9	25.5	17.3	12.1
Catch	23.6	18.5	15.8	14.0	0.7	0.5	9.1	6.0	4.1	2.9

The first projection was not possible for Conception Bay-Southern Shore as the advised 1987 catch was larger than the population biomass estimate.

It should again be stressed that with the exception of Bonavista Bay-Trinity Bay, these projections represent minimum estimates from consistently surveyed grids. To determine an upper limit on biomass and catch projections, stock biomass levels were calculated which represented 50% of the difference between the minimum biomass estimates derived from core grids only and maximum biomass estimates assuming equal distribution of fish between surveyed and non-surveyed areas. The following conversion factors were calculated for each stock area:

White Bay-Notre Dame Bay	1.66
Bonavista Bay-Trinity Bay	0.00
Conception Bay-Southern Shore	1.59
St. Mary's Bay-Placentia Bay	1.11
Fortune Bay	1.22

These were then applied to each of the preceding projection options to determine maximum acceptable catches ($x10^3$ t) in 1987 and 1988.

	WB-NDB		BB-TB		CB-SS		SMB-PB		FB	
	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988
OPTION 1	31.5	27.6	13.7	14.5	3.5	-	2.5	8.3	2.4	4.0
OPTION 2	39.2	30.7	15.8	14.0	1.1	0.6	10.0	6.7	5.0	3.5

These were considered as maximum acceptable levels as they took into account non-surveyed areas and yet did not assume equal distribution of fish between surveyed and non-surveyed areas.

Illustrative projections have been made to 1995 for each stock area (Tables 49-53) with the same minimum population estimates (from core grids only), mean weights at age, and partial recruitment pattern as used above. Projections have been made assuming two different levels of recruitment at age 2, 0 and 10×10^6 for White Bay-Notre Dame Bay and Bonavista Bay-Trinity Bay, and 0 and 5×10^6 for each of the three remaining stocks. Zero recruitment is presented as the worse case scenario; the second recruitment option presents a more realistic yet conservative view. Projections have also been made assuming two different levels of fishing mortality: $F = 0.30$, the assumed $F_{0.1}$ traditional level, and $F = 0.20$, a level which has been recently suggested (Doubleday 1985, Winters and Wheeler 1987) to be more appropriate for herring stocks. In these projections, catch levels for 1987 are those advised by CAFSAC last year.

Management Implications

This year, population estimates and projections have again been based entirely upon acoustic purse seine survey results. Some of the same reservations exist this year as last year concerning survey methodology. However, the method continues to

evolve and each year further refinements have been made. This year's biomass estimates are considered more conservative as they include only those core grids which have been consistently surveyed and do not include areal expansion to non-surveyed grids. The use of a dual-beam hydroacoustic system plus consideration of near-shore vs mid-shore stock areas in the coming year will allow for further refinements.

The short term future of the Newfoundland herring stocks appears to depend on the 1982 year-class. Subsequent year-classes appear to be weak with the exception of the 1985 year-class which was evident in White Bay-Notre Dame Bay and Bonavista Bay-Trinity Bay. However, as already suggested, the strength of this year-class in the latter stock area may have been overestimated due to biased sampling. The 1983 year-class which showed relatively strongly last year in the two northern stock areas, appears much weaker. The strength of the 1982 year-class may have been overestimated initially. Now, as it becomes more fully recruited, it appears to be of moderate strength. Yields from these stocks will start to decrease over the next few years unless there is adequate recruitment of younger year-classes.

ACKNOWLEDGMENTS

We would like to express our gratitude to Dr. Bill Leggett of McGill University for the lease of the BIOSONICS hydroacoustic system and to George Rose for both his technical expertise in operating the system and his scientific expertise in analyzing the results.

We would also like to thank all technical staff who were in any way associated with the collection of data used in this assessment, in particular M. F. Dawson for administering the research gillnet program and P. J. Williams for administering the sampling program. Special thanks must also be extended to our typist, M. Y. Hynes.

REFERENCES

Doubleday, W. G. 1985. Managing herring fisheries under uncertainty. Can. Jour. Fish. Aquat. Sci. Vol. 42(Suppl. 1): 245-257.

Paloheimo, J. E. 1961. Studies on estimation of mortalities. I. Comparison of a method described by Beverton and Holt and a new linear formula. J. Fish. Res. Board Can. 18: 646-662.

Rose, G. 1987. Hydroacoustic classification of cod, capelin and mackerel schools by target strength and school structure. (in prep.)

Wheeler, J. P., and G. H. Winters. 1984. Migrations and stock relationships of east and southeast Newfoundland herring (Clupea harengus) as shown by tagging studies. J. Northw. Atl. Fish. Sci. Vol. 5: 121-129.

Wheeler, J. P., and E. L. Dalley. 1986. Southeast Coast Newfoundland Herring - 1985 Assessment. CAFSAC Res. Doc. 86/114. 43 p.

Wheeler, J. P., R. Chaulk, and G. H. Winters. 1986. East Coast Newfoundland Herring - 1985 Assessment. CAFSAC Res. Doc. 86/58. 63 p.

Winters, G. H., and J. A. Moores. 1977. Assessment of yield potential of eastern Newfoundland herring stocks. CAFSAC Res. Doc. 77/12.

Winters, G. H., and J. P. Wheeler. 1987. Recruitment dynamics of spring-spawning herring in the Northwest Atlantic. Can. Jour. Fish. Aquat. Sci. 44: 882-900.

Table 1. White Bay (W.B.)- Notre Dame Bay (N.D.B.) herring landings (t)*, by gear, 1974-86.

Year	Area	Gear						Total
		Purse seine	Ringnet	Midwater trawl	Bar seine	Gillnet	Trap	
1974	W.B.	-	8	11	53	738	632	1442
	N.D.B.	-	6	-	85	2191	312	2594
	Combined	-	14	11	138	2929	944	4036
1975	W.B.	828	-	-	46	1209	329	2412
	N.D.B.	1183	108	-	12	1631	209	3143
	Combined	2011	108	-	58	2840	538	5555
1976	W.B.	1724	487	-	18	509	246	2984
	N.D.B.	2908	3412	-	589	2242	353	9504
	Combined	4632	3899	-	607	2751	599	12488
1977	W.B.	-	1228	-	39	268	240	1775
	N.D.B.	-	4961	-	2096	2438	355	9850
	Combined	-	6189	-	2135	2706	595	11625
1978	W.B.	-	1254	-	240	1133	331	2958
	N.D.B.	-	3980	-	306	5859	311	10456
	Combined	-	5234	-	546	6992	642	13414
1979	W.B.	-	832	-	9	978	64	1883
	N.D.B.	-	1968	-	2274	8971	598	13811
	Combined	-	2800	-	2283	9949	662	15694
1980	W.B.	-	747	-	-	1269	83	2099
	N.D.B.	-	913	-	727	2778	13	4431
	Combined	-	1660	-	727	4047	96	6530
1981	W.B.	-	220	-	14	646	23	903
	N.D.B.	-	1065	-	400	2209	107	3781
	Combined	-	1285	-	414	2855	130	4684
1982	W.B.	-	-	-	7	402	52	461
	N.D.B.	-	-	-	136	1425	1	1562
	Combined	-	-	-	143	1827	53	2023
1983	W.B.	-	15	-	-	76	7	98
	N.D.B.	-	-	-	-	329	-	329
	Combined	-	15	-	-	406	7	427
1984	W.B.	-	-	-	4	342	4	350
	N.D.B.	-	-	-	3	1115	-	1118
	Combined	-	-	-	7	1457	4	1468
1985*	W.B.	-	-	-	2	564	-	566
	N.D.B.	1	-	-	9	1248	-	1258
	Combined	1	-	-	11	1812	-	1824
1986*	W.B.	112	-	-	1	196	7	316
	N.D.B.	1124	-	-	71	1108	81	2384
	Combined	1236	-	-	72	1304	88	2700

* provisional

Table 2. Bonavista Bay (B.B.) - Trinity Bay (T.B.) herring landings (t), by gear, 1974-86.

Year	Area	Gear						Total
		Purse seine	Ringnet	Midwater trawl	Bar seine	Gillnet	Trap	
1974	B.B.	-	-	-	21	611	10	642
	T.B.	-	428	-	154	976	93	1651
	Combined	-	428	-	175	1587	103	2293
1975	B.B.	1559	-	-	34	414	2	2009
	T.B.	1370	1790	-	242	411	90	3903
	Combined	2929	1790	-	276	825	92	5912
1976	B.B.	2812	3052	-	24	328	139	6355
	T.B.	1614	1054	-	465	419	30	3582
	Combined	4426	4106	-	489	747	169	9937
1977	B.B.	-	6223	236	2495	309	-	9263
	T.B.	-	1548	-	927	174	45	2694
	Combined	-	7771	236	3422	483	45	11957
1978	B.B.	-	4239	-	150	1320	3	5712
	T.B.	-	1055	-	966	308	8	2337
	Combined	-	5294	-	1116	1628	11	8049
1979	B.B.	-	3490	-	377	2374	4	6245
	T.B.	-	1181	-	1615	680	55	3531
	Combined	-	4671	-	1992	3054	59	9776
1980	B.B.	-	1714	-	652	1321	-	3687
	T.B.	-	964	-	405	336	13	1718
	Combined	-	2678	-	1057	1657	13	5405
1981	B.B.	-	1100	-	713	1399	7	3219
	T.B.	-	78	-	361	367	19	825
	Combined	-	1178	-	1074	1766	26	4044
1982	B.B.	-	-	-	-	386	4	390
	T.B.	-	-	-	25	76	6	107
	Combined	-	-	-	25	462	10	497
1983	B.B.	-	-	-	-	52	-	52
	T.B.	-	-	-	27	17	-	44
	Combined	-	-	-	27	69	-	96
1984	B.B	-	-	-	-	135	-	135
	T.B.	-	-	-	-	41	-	41
	Combined	-	-	-	-	176	-	176
1985*	B.B.	-	-	-	4	290	2	296
	T.B.	-	-	-	2	312	6	320
	Combined	-	-	-	6	602	8	616
1986*	B.B.	706	-	-	7	402	5	1120
	T.B.	347	-	-	35	215	5	602
	Combined	1053	-	-	42	617	10	1722

* provisional

Table 3. Conception Bay (C.B.)- Southern Shore (S.S.) herring landings (t), by gear, 1974-86.

Year	Area	Gear						Total
		Purse seine	Ringnet	Midwater trawl	Bar seine	Gillnet	Trap	
1974	C.B.	48	2107	-	67	131	134	2487
	S.S.	-	32	-	14	72	86	204
	Combined	48	2139	-	81	203	220	2691
1975	C.B.	13	2281	-	388	166	24	2872
	S.S.	315	-	-	23	160	169	667
	Combined	328	2281	-	411	326	193	3539
1976	C.B.	-	1704	258	76	153	92	2283
	S.S.	-	44	-	-	8	149	201
	Combined	-	1748	258	76	161	241	2484
1977	C.B.	-	1248	-	58	174	12	1492
	S.S.	-	442	-	-	18	200	660
	Combined	-	1690	-	58	192	212	2152
1978	C.B.	-	1098	-	11	415	3	1527
	S.S.	-	133	-	14	78	193	418
	Combined	-	1231	-	25	493	196	1945
1979	C.B.	-	432	-	-	210	63	705
	S.S.	-	10	-	18	49	111	188
	Combined	-	442	-	18	259	174	893
1980	C.B.	-	319	-	16	107	1	443
	S.S.	-	-	-	-	2	32	34
	Combined	-	319	-	16	109	33	477
1981	C.B.	-	-	-	-	160	2	162
	S.S.	-	-	-	-	53	8	61
	Combined	-	-	-	-	213	10	223
1982	C.B.	-	-	-	-	84	1	85
	S.S.	-	-	-	-	7	5	12
	Combined	-	-	-	-	91	6	97
1983	C.B.	-	-	-	-	17	-	17
	S.S.	-	-	-	-	-	-	-
	Combined	-	-	-	-	17	-	17
1984	C.B.	-	-	-	-	49	-	49
	S.S.	-	-	-	-	-	-	-
	Combined	-	-	-	-	49	-	49
1985*	C.B.	-	-	-	-	81	-	81
	S.S.	-	-	-	-	16	-	16
	Combined	-	-	-	-	97	-	97
1986*	C.B.	62	-	-	-	102	1	165
	S.S.	-	-	-	1	23	1	25
	Combined	62	-	-	1	125	2	190

* provisional

Table 4. St. Mary's Bay (SMB)-Placentia Bay (PB) herring landings (t), by gear, 1974-86.

Year	Area	Gear					Total
		Purse seine	Ringnet	Bar seine	Gillnet	Trap	
1974	S.M.B.	1710	51	271	470	37	2539
	P.B.	3200	-	212	510	11	3933
	Combined	4910	51	483	980	48	6472
1975	S.M.B.	1032	711	554	674	243	3214
	P.B.	2638	-	225	450	188	3501
	Combined	3670	711	779	1124	431	6715
1976	S.M.B.	-	920	158	352	25	1455
	P.B.	2056	172	242	177	-	2647
	Combined	2056	1092	400	529	25	4102
1977	S.M.B.	-	1131	221	531	29	1912
	P.B.	740	524	14	78	-	1356
	Combined	740	1655	235	609	29	3268
1978	S.M.B.	-	1523	66	490	3	2082
	P.B.	557	612	29	214	33	1445
	Combined	557	2135	95	704	36	3527
1979	S.M.B.	-	1570	131	332	9	2042
	P.B.	359	891	17	307	1	1575
	Combined	359	2461	148	639	10	3617
1980	S.M.B.	-	645	16	352	12	1025
	P.B.	182	892	9	339	30	1452
	Combined	182	1537	25	691	42	2477
1981	S.M.B.	-	44	8	122	-	174
	P.B.	-	311	-	149	1	461
	Combined	-	355	8	271	1	635
1982	S.M.B.	-	-	-	10	-	10
	P.B.	-	-	4	31	-	35
	Combined	-	-	4	41	-	45
1983	S.M.B.	-	-	-	13	-	13
	P.B.	-	-	-	27	-	27
	Combined	-	-	-	40	-	40
1984	S.M.B.	-	-	-	11	-	11
	P.B.	-	-	1	95	-	96
	Combined	-	-	1	106	-	107
1985*	S.M.B.	-	-	1	31	-	32
	P.B.	3	-	-	113	-	116
	Combined	3	-	1	144	-	148
1986*	S.M.B.	1	-	-	17	-	18
	P.B.	-	-	2	107	-	109
	Combined	1	-	2	124	-	127

* provisional

Table 5. Fortune Bay herring landings (t), by gear, 1974-86.

Year	Gear				Total
	Purse seine	Bar seine	Gillnet	Trap	
1974	1928	268	72	-	2268
1975	809	81	19	-	909
1976	109	310	43	-	462
1977	188	364	22	5	579
1978	104	854	41	-	999
1979	285	829	81	-	1195
1980	97	265	89	-	451
1981	-	30	37	-	67
1982	-	-	20	2	22
1983	-	-	15	-	15
1984	-	-	21	-	21
1985*	-	-	52	-	52
1986*	1	1	91	-	93

* provisional

Table 6. Number of fish sampled from the Newfoundland herring fishery, by area and gear, 1982-86 (research samples in parenthesis).

Year	Area	Gear type: Trap	Bar seine	Gillnet	Ringnet	Total sampled	Comm. catch (t)
1982	WB	196	-	(1133)	-	196 (1133)	461
	NDB	-	150	1000	(1022)	1150 (1022)	1562
	BB	-	-	850 (1378)	(2202)	850 (3580)	390
	TB	-	-	10 (381)	-	10 (381)	107
	CB	-	-	100	-	100	85
	SS	-	-	-	-	-	12
	SMB	-	-	1196 (439)	-	1196 (439)	10
	PB	-	-	(428)	-	(428)	35
	FB	-	-	(273)	-	(273)	22
	Total	196	150	3156 (4032)	(3224)	3502 (7256)	2684
1983	WB	-	63	376 (799)	22	461 (799)	98
	NDB	-	-	(1230)	200 (2927)	200 (4157)	329
	BB	700	-	645 (1210)	(2065)	1345 (3275)	52
	TB	527	-	548 (678)	(700)	1075 (1378)	44
	CB	326	-	50 (145)	(450)	376 (595)	17
	SS	150	-	-	-	150	-
	SMB	-	-	(659)	798	798 (659)	13
	PB	100	-	(605)	-	100 (605)	27
	FB	-	-	(1017)	-	(1017)	15
	Total	1803	63	1619 (6343)	1020 (6142)	4505 (12485)	595
1984	WB	121	-	825 (1207)	-	946 (1207)	350
	NDB	-	50	2116 (1150)	(664)	2166 (1814)	1118
	BB	-	-	550 (1860)	(844)	550 (2704)	135
	TB	150	(100)	200 (800)	(700)	350 (1600)	41
	CB	(100)	-	50 (400)	(464)	50 (964)	49
	SS	-	-	-	-	-	-
	SMB	-	-	(1110)	223	223 (1110)	11
	PB	98	-	488 (653)	(136)	586 (789)	96
	FB	-	-	466 (612)	(182)	466 (794)	21
	Total	369 (100)	50 (100)	4695 (7792)	223 (2990)	5337 (10982)	1821
1985	WB	175	-	580 (1047)	-	755 (1047)	566
	NDB	-	100	994 (1200)	(237)	1094 (1437)	1258
	BB	-	-	1048 (2036)	(350)	1048 (2386)	296
	TB	-	-	536 (1000)	(317)	536 (1317)	320
	CB	26	-	450 (800)	(150)	476 (950)	81
	SS	-	-	100 (500)	-	100 (500)	16
	SMB	-	-	50 (598)	50	100 (598)	32
	PB	-	-	92 (697)	50	142 (697)	116
	FB	-	-	500 (900)	(250)	500 (1150)	52
	Total	201	100	4350 (8778)	100 (1304)	4751 (10082)	2737
1986	WB	-	-	(1150)	100	100 (1150)	316
	NDB	77	50	600 (1222)	50 (400)	777 (1622)	2384
	BB	150	-	400 (1949)	389 (150)	939 (2099)	1120
	TB	150	100	400 (800)	150 (700)	800 (1500)	602
	CB	150 (236)	-	344 (1010)	(100)	494 (1346)	165
	SS	-	-	(579)	-	(579)	25
	SMB	50	-	100 (850)	150	300 (850)	18
	PB	50	-	582 (558)	(350)	632 (908)	109
	FB	-	-	286 (1338)	(100)	286 (1438)	93
	Total	627 (236)	150	2712 (9456)	839 (1800)	4328 (11492)	4832

Table 7. Commercial catch (t) and sampling (number of fish) for 1986, by stock area, month, and gear type.

		WB-NDB		BB-TB		CB-SS		SMB-PB		FB	
Month	Gear	Catch	# Sampled	Catch	# Sampled	Catch	# Sampled	Catch	# Sampled	Catch	# Sampled
January	Gillnet	-	-	2	-	-	-	2	-	1	-
March	Gillnet	1	-	-	-	-	-	1	45	1	-
April	Gillnet	157	100	94	223	41	203	45	314	33	226
	Trap	-	-	5	-	-	-	-	-	-	-
	Purse seine	2	-	1	-	-	-	-	-	-	-
May	Gillnet	555	100	105	533	41	184	51	477	32	439
	Trap	7	50	4	50	-	-	-	-	-	-
	Bar seine	28	-	27	50	-	-	-	-	-	-
June	Gillnet	174	100	12	-	19	67	18	137	12	64
	Trap	-	-	-	-	1	50	-	-	-	-
	Bar seine	4	-	4	-	-	-	2	-	-	-
July	Gillnet	76	50	2	-	3	-	-	-	-	-
August	Gillnet	26	333	6	345	2	45	1	-	3	-
	Trap	5	27	-	-	-	-	-	-	-	-
	Bar seine	1	-	-	-	-	-	-	-	-	-
	Purse seine	-	-	-	-	-	-	1	50	-	-
September	Gillnet	32	208	17	50	10	14	1	145	4	50
	Trap	26	-	-	-	-	-	-	-	-	-
	Bar seine	12	-	1	-	1	-	-	-	-	-
	Purse seine	1	-	-	-	1	-	-	-	-	-
October	Gillnet	178	1057	126	680	4	148	2	-	2	50
	Trap	45	-	-	-	-	-	-	-	-	-
	Bar seine	5	50	7	-	-	-	-	-	-	-
	Purse seine	772	450	119	450	17	-	-	-	-	-
November	Gillnet	106	30	249	365	2	235	3	-	2	50
	Trap	6	-	-	-	-	-	-	-	-	-
	Bar seine	21	-	-	-	-	-	-	-	-	-
	Purse seine	413	-	574	739	8	50	-	-	-	-
December	Gillnet	-	-	4	-	4	148	1	-	1	-
	Purse seine	49	-	359	150	36	-	-	-	-	-
Combined	Gillnet	1305	1978	617	2196	126	1044	125	1118	91	879
	Trap	89	77	9	50	1	50	-	-	-	-
	Bar seine	71	50	39	50	1	-	2	-	-	-
	Purse seine	1237	450	1053	1339	62	50	1	50	-	-

Table 8. Mean weight at age (g) of Newfoundland herring from samples collected January-June, 1986. Sample sizes in parenthesis.

Age	Stock area				
	WB-NDB	BB-TB	CB-SS	SMB-PB	FB
2	-	59 (6)	-	89 (2)	-
3	144 (1)	121 (11)	-	162 (3)	-
4	201 (37)	188 (955)	199 (340)	215 (1005)	209 (692)
5	223 (11)	235 (52)	244 (12)	262 (92)	242 (17)
6	272 (46)	278 (45)	283 (14)	285 (105)	286 (216)
7	279 (68)	299 (94)	301 (26)	308 (45)	318 (91)
8	316 (16)	327 (13)	355 (8)	374 (18)	370 (30)
9	330 (13)	360 (7)	-	353 (1)	415 (5)
10	328 (9)	366 (13)	384 (5)	391 (20)	412 (6)
11+	371 (116)	399 (257)	409 (93)	458 (163)	474 (113)

Table 9. Commercial catch at age of spring and autumn spawning herring for White Bay-Notre Dame Bay, 1970-86 (* preliminary).

	Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Spring spawners	1	1	1	1	1	1	1	1	1	1	1	1
	2	10	1	5	1	1	2	121	50	1	1	115
	3	1	303	292	728	5	128	32	1671	55	60	46
	4	13	51	2448	1494	119	216	611	107	2034	50	1240
	5	24	159	362	2928	3177	460	245	468	317	2928	92
	6	25	57	70	775	5523	5458	815	184	1034	323	1080
	7	988	431	126	734	1198	7090	10280	793	517	1410	17
	8	11	10134	408	663	705	1123	16377	7363	2509	767	496
	9	86	235	1391	419	1511	836	1295	12675	10807	2222	179
	10	161	278	208	1695	861	809	3304	1055	11756	14413	1450
	11+	283	3139	825	804	2351	3998	8265	15707	14379	27508	14653
Total SS		1603	14789	6136	10242	15452	20121	41346	40074	43410	49683	19369
Autumn spawners	1								1	1	1	1
	2								1	1	1	1
	3								1	1	1	71
	4								45	6	1	13
	5								35	24	10	13
	6								85	155	267	23
	7								54	171	172	272
	8								1	24	160	4
	9								94	2	133	19
	10								1	130	1	1
	11+								182	238	298	450
Total AS									500	753	1045	868
Total AS & SS									40572	44163	50728	20237
% SS									98.8	98.3	97.9	95.7
% AS									1.2	1.7	2.1	4.3

	Age	1981	1982	1983	1984	1985*	1986*
Spring spawners	1	1	1	1	1	1	1
	2	445	76	1	6	3	26
	3	152	371	38	12	187	947
	4	41	332	46	124	350	2843
	5	1231	59	23	1218	240	302
	6	63	268	14	73	1486	661
	7	805	34	93	114	108	1236
	8	64	258	1	157	275	198
	9	344	19	26	37	94	161
	10	194	192	4	122	81	177
	11+	10908	4059	805	1938	2110	1951
Total SS		14248	5669	1052	3802	4935	8503
Autumn spawners	1	1	1	1	1	1	1
	2	1	1	1	1	1	1
	3	1	72	1	1	1	10
	4	13	26	74	60	29	66
	5	86	62	25	409	94	68
	6	11	16	23	66	333	76
	7	1	12	1	30	137	372
	8	100	9	1	8	32	68
	9	1	42	6	7	23	6
	10	4	1	1	3	10	1
	11+	65	23	1	24	74	39
Total AS		284	265	135	610	735	708
Total AS & SS		14532	5934	1187	4412	5670	9211
% SS		98.0	95.5	88.6	86.2	87.0	92.3
% AS		2.0	4.5	11.4	13.8	13.0	7.7

Table 10. Commercial catch at age of spring and autumn spawning herring for Bonavista Bay-Trinity Bay, 1970-86 (* preliminary).

	Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Spring	1								10	1	1	1
spawners	2	1	1	1	1	1	1	14	16	22	6	15
	3	1	416	10	2	1	396	77	248	26	286	13
	4	10	226	1354	78	2	136	495	135	357	167	195
	5	10	21	390	3632	236	164	122	759	122	765	43
	6	57	18	91	380	4848	2577	167	227	251	19	293
	7	867	200	76	63	440	14373	4936	50	112	436	52
	8	37	1042	90	80	152	456	20812	6209	598	101	264
	9	135	129	486	107	301	1002	912	23206	4412	530	75
	10	74	128	14	756	69	729	860	774	13394	5575	967
	11+								5890	5956	19994	12259
Total SS		1192	2181	2512	5099	6050	19834	28395	37524	25251	27880	14177
Autumn	1								1	1	1	1
spawners	2								1	1	1	1
	3								1	1	1	14
	4								55	16	1	11
	5								16	14	27	17
	6								176	61	114	83
	7								86	58	30	188
	8								112	28	175	45
	9								30	23	13	112
	10								73	82	16	3
	11+								1069	417	800	463
Total AS									1620	702	1179	938
Total AS & SS									39114	25953	29059	15115
% SS									95.9	97.3	95.9	93.8
% AS									4.1	2.7	4.1	6.2

	Age	1981	1982	1983	1984	1985*	1986*
Spring	1	1	1	1	1	1	141
spawners	2	136	1	1	4	13	190
	3	246	8	4	22	175	397
	4	53	11	34	35	70	4163
	5	256	2	7	210	87	253
	6	26	30	2	9	351	162
	7	288	5	15	5	37	262
	8	23	35	1	12	27	39
	9	321	5	8	2	13	10
	10	88	65	2	2	22	31
	11+	11762	1186	159	154	797	635
Total SS		13200	1349	234	456	1593**	6283
Autumn	1	1	1	1	1	1	1
spawners	2	1	1	1	1	1	1
	3	6	3	1	1	1	1
	4	115	1	10	3	5	50
	5	106	8	2	84	18	81
	6	33	10	5	14	203	58
	7	83	3	2	17	96	277
	8	283	8	1	3	54	150
	9	36	25	1	5	22	25
	10	4	1	1	1	10	1
	11+	230	37	3	9	29	30
Total AS		898	98	28	139	440	675
Total AS & SS		14098	1447	262	595	2033	6958
% SS		93.6	93.2	89.3	76.6	78.4	90.3
% AS		6.4	6.8	10.7	23.4	21.6	9.7

** 10 age 0's in 1985 SS not included

Table 11. Commercial catch at age of spring and autumn spawning herring for Conception Bay-Southern Shore, 1970-86 (* preliminary).

	Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Spring spawners	1								1	1	1	1
	2	1	1	1	68	3	13	1046	7	1	1	1
	3	1	10	7	1	1	424	15	127	1	4	1
	4	17	31	1625	23	5	30	85	5	99	9	3
	5	20	13	135	4525	130	16	22	101	32	34	1
	6	24	8	55	264	9544	2055	28	45	65	7	19
	7	290	41	29	469	150	8816	2364	13	14	38	1
	8	14	308	79	136	75	116	4779	950	3	4	12
	9	15	33	359	40	40	492	73	4241	734	31	1
	10	12	13	67	188	13	256	226	49	3080	270	49
	11+								959	1358	1640	1101
Total SS		394	458	2357	5714	9961	12218	8638	6498	5388	2039	1190
Autumn spawners	1								1	1	1	1
	2								1	1	1	1
	3								1	1	1	1
	4								7	4	2	1
	5								29	50	17	1
	6								150	30	80	1
	7								87	69	15	32
	8								72	9	57	3
	9								13	10	17	6
	10								7	34	6	1
	11+								373	282	245	32
Total AS									741	491	442	80
Total AS & SS									7239	5879	2481	1270
% SS									89.8	91.6	82.2	93.7
% AS									10.2	8.4	17.8	6.3

	Age	1981	1982	1983	1984	1985*	1986*
Spring spawners	1	1	1	1	1	1	1
	2	1	1	1	1	1	5
	3	25	2	1	3	58	1
	4	4	5	1	27	11	346
	5	26	1	1	47	11	7
	6	9	2	1	5	17	12
	7	28	1	1	1	2	16
	8	3	5	1	2	2	3
	9	14	1	1	1	1	1
	10	13	1	1	1	1	3
	11+	504	176	13	7	97	80
Total SS		628	196	23	96	202	475
Autumn spawners	1	1	1	1	1	1	1
	2	1	1	1	1	1	1
	3	1	9	1	1	1	19
	4	14	5	1	4	3	6
	5	8	14	2	60	6	18
	6	3	1	3	6	52	21
	7	7	1	1	6	24	93
	8	14	2	2	3	13	29
	9	2	2	5	1	3	10
	10	1	1	1	1	1	3
	11+	9	5	12	1	15	10
Total AS		61	42	30	85	120	211
Total AS & SS		689	238	53	181	322	686
% SS		91.1	82.4	43.4	53.0	62.7	69.2
% AS		8.9	17.6	56.6	47.0	37.3	30.8

Table 12. Commercial catch at age of spring and autumn spawning herring for St. Mary's Bay-Placentia Bay, 1970-86 (* preliminary).

	Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Spring	1	3	1	1	1	3	1	1	1	1	1	1
spawners	2	476	1	1	76	995	74	365	52	30	87	133
	3	109	557	207	326	280	2234	391	1423	175	663	332
	4	4434	116	20375	77	234	471	1906	140	1817	279	133
	5	59	2111	725	15470	126	147	208	736	123	2263	153
	6	76	80	5154	566	14328	1591	267	87	596	96	1270
	7	645	251	365	6757	436	13858	862	50	64	614	57
	8	66	45	650	93	6049	146	5622	1039	106	85	470
	9	72	13	352	224	138	3391	201	3830	512	66	38
	10	37	22	73	193	238	350	2256	134	3827	501	237
	11+	107	96	403	315	624	1323	1361	2448	2185	4785	2971
Total SS		6084	3293	28306	24098	23451	23586	13440	9940	9436	9440	5795
Autumn	1	1	1	1	1	1	1	1	1	1	1	1
spawners	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 AS		439	574	1086	1166	1537	1275	781	1035	1570	1415	1327
Total AS & SS		6523	3867	29392	25264	24988	24861	14221	10975	11006	10855	7122
% SS		93.3	85.2	96.3	95.4	93.8	94.9	94.5	90.6	85.7	87.0	81.4
% AS		6.7	14.8	3.7	4.6	6.2	5.1	5.5	9.4	14.3	13.0	18.6

	Age	1981	1982	1983	1984	1985*	1986*
Spring	1	1	1	1	1	1	1
spawners	2	1	1	1	8	1	1
	3	193	1	5	9	7	1
	4	42	2	2	24	18	132
	5	111	3	3	36	27	19
	6	51	8	2	6	21	27
	7	338	3	4	3	15	9
	8	28	14	1	24	3	4
	9	80	4	9	1	25	1
	10	6	4	1	10	5	5
	11+	466	69	39	44	125	30
Total SS		1317	110	68	166	248	230
Autumn	1	1	1	1	1	1	1
spawners	2	1	1	1	1	1	1
	3	1	1	1	1	1	1
	4	139	1	18	17	9	16
	5	116	7	6	101	20	24
	6	10	1	12	32	86	15
	7	11	1	4	21	46	96
	8	50	1	1	5	36	28
	9	7	1	1	3	10	16
	10	1	1	1	1	3	4
	11+	29	2	4	8	24	15
Total AS		366	18	50	191	237	217
Total AS & SS		1683	128	118	357	485	447
% SS		78.3	85.9	57.6	46.5	51.1	51.5
% AS		21.7	14.1	42.4	53.5	48.9	48.5

Table 13. Commercial catch at age of spring and autumn spawning herring for Fortune Bay, 1970-86 (* preliminary).

	Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Spring spawners	1	1	1	617	23	1	1	1	1	1	1	1
	2	29475	167	1515	2210	389	2	82	27	1	1	25
	3	5988	23223	256	925	1314	277	15	2103	42	1	16
	4	11953	6086	19690	67	552	581	318	25	2677	183	3
	5	133	23525	2896	5694	130	112	228	327	62	3833	69
	6	281	1165	10767	475	4435	87	129	166	237	15	1122
	7	7894	5747	351	1712	250	1490	11	26	43	165	7
	8	233	3514	4432	73	1094	16	338	43	139	5	183
	9	16	132	991	282	36	142	36	188	52	24	1
	10	225	148	34	558	117	22	188	4	326	1	11
	11+	257	537	366	173	255	201	140	244	302	167	50
Total SS		56456	64245	41915	12192	8573	2931	1486	3154	3882	4396	1488
Autumn spawners	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 AS		4212	4734	1570	359	300	178	133	70	108	108	20
Total AS & SS		60668	68979	43485	12551	8873	3109	1619	3224	3990	4504	1508
% SS		93.1	93.1	96.4	97.1	96.6	94.3	91.8	97.8	97.3	97.6	98.7
% AS		6.9	6.9	3.6	2.9	3.4	5.7	8.2	2.2	2.7	2.4	1.3

	Age	1981	1982	1983	1984	1985*	1986*
Spring spawners	1	1	1	1	1	1	1
	2	1	1	1	2	1	1
	3	144	1	2	1	54	1
	4	16	3	2	4	3	137
	5	4	3	1	3	39	4
	6	3	1	1	2	12	68
	7	21	2	1	1	2	19
	8	2	36	1	2	1	5
	9	23	1	10	1	1	1
	10	1	5	1	2	1	2
	11+	12	5	18	23	15	13
Total SS		228	59	39	42	130	252
Autumn spawners	1	1	1	1	1	1	1
	2	1	1	1	1	1	1
	3	5	1	1	1	1	1
	4	64	1	1	1	17	3
	5	16	7	1	9	4	8
	6	1	2	2	4	26	16
	7	1	1	1	6	12	38
	8	1	1	1	1	7	12
	9	1	1	1	1	4	5
	10	1	1	1	1	1	1
	11+	1	1	1	1	2	5
Total AS		93	18	12	27	76	91
Total AS & SS		321	77	51	69	206	343
% SS		71.0	76.6	76.5	60.9	63.1	73.5
% AS		29.0	23.4	23.5	39.1	36.9	26.5

Table 14. Purse seine set details, acoustic purse seine survey, October-December 1986.

Vessel set no.									
SEALER	SILAS T.	MARINUS	Date	Time	Location	Surface temp. (°C)	Catch weight (kg)	Grid	Comments
-	-	-	Oct. 7	1730	Kings Pt., Green Bay	8.2	25,000	1	Mixture of herring (98%) and mackerel (2%)
-	2	-	Oct. 8	0905	Middle Arm, Green Bay	8.4	-		A few juvenile cod only
-	3	-	Oct. 8	1015	Middle Arm, Green Bay	8.4	-		Approx. 100 juvenile cod only
-	4	-	Oct. 8	1620	Southern Arm, Green Bay	8.8	225,000	1	Large set, mixture of yc's, predominantly '82's
-	5	-	Oct. 9	1135	Long Beach, Little Bay	8.5	-		Fish went under seine while pursing
1	-	-	Oct. 10	1030	Springdale, Halls Bay	7.8	13,500	2	Mixture of yc's, predominantly '82's
-	6	-	Oct. 10	1050	Hunts Rock, Halls Bay	8.4	1,800	2	Mixture of yc's, predominantly '82's
2	-	-	Oct. 10	1325	Indian Head, Halls Bay	7.8	-		Fish wild, caught none
-	7	-	Oct. 10	1705	Burnt Pt., Roberts Arm	8.6	100 fish		Caught mackerel only
3	-	-	Oct. 10	1855	Moorey Cove, Roberts Arm	8.2	36,000	3	Mixture of yc's, predominantly '82's
-	8	-	Oct. 11	1225	Gt. Denier Is., Badger Bay	8.2	5 fish		Purse line broke, saved 5 herring only
-	9	-	Oct. 11	1645	Wild Bight, Badger Bay	8.5	-		Marked fish while setting, caught none
-	10	-	Oct. 11	1830	Wild Bight, Badger Bay	8.4	6,000	3	Mixture of herring (90%) and mackerel (10%)
4	-	-	Oct. 12	1610	Osmonton Arm, New Bay	8.8	-		Approx. 400 juvenile cod only
-	11	-	Oct. 13	1630	Exploits Is., Bay of Exploits	8.2	26 fish		Caught mackerel only, plus some sticklebacks
5	-	-	Oct. 13	1640	Lt. Muddy Hole, Bay of Exploits	8.2	30,000	5	Mixture of yc's, predominantly '82's
6	-	-	Oct. 14	1602	Burnt Is., Bay of Exploits	-	41,000	5	Mixture of yc's, predominantly '82's
-	12	-	Oct. 21	1825	Indian Bay, Bonavista Bay	7.0	400	8	Small school, mostly '82 yc
-	13	-	Oct. 22	0955	Trinity Gut, Bonavista Bay	6.6	6 fish		Marked fish while setting, saved 6 herring
-	14	-	Oct. 22	1215	Lockers Bay, Bonavista Bay	7.0	2,300	8	Mixture of yc's, 50% '82 yc
7	-	-	Oct. 22	1625	Hare Is., Bonavista Bay	7.3	13,000	8	Mixture of yc's, predominantly '82's
8	-	-	Oct. 25	1530	Swale Is., Bonavista Bay	7.3	-		Fish wild and close to shore, caught none
-	15	-	Oct. 27	0945	Beaver Cove, Long Is.	7.0	-		Marked fish while setting, caught none
9	-	-	Oct. 27	1015	Beaver Cove, Long Is.	7.0	-		Fish wild and deep, caught none
-	16	-	Oct. 29	1435	Broad Cove, Smith Sound	6.8	500 fish	15	Juvenile cod and '86 yc herring
10	-	-	Oct. 30	1410	Queens Cove, Southeast Arm	7.8	-		Shoal water, tore seine, caught nothing
-	17	-	Nov. 3	1400	Clarenville, Northwest Arm	6.8	500 fish	16	'86 yc herring
-	18	-	Nov. 3	1635	Robinsons Bight, Northwest Arm	7.0	18,000	16	All '85 yc herring
11	-	-	Nov. 4	1025	Hillview, Southwest Arm	6.8	36,000	16	All '85 yc herring
-	19	-	Nov. 5	0925	Seal Island, Trinity Bay	7.4	-		Marked fish while setting, caught none
-	20	-	Nov. 6	0715	Lt. Mosquito Cove, Bull Arm	6.8	-		Fish went out under seine, caught none
-	21	-	Nov. 6	0825	Bald Pt., Bull Arm	6.8	1,300	17	98% '85 yc herring
12	-	-	Nov. 6	1305	St. Jones Is., Trinity Bay	6.8	-		Fish wild and strong tide, caught none
-	22	-	Nov. 6	1400	St. Jones Is., Trinity Bay	6.8	-		Marked fish, strong tide, caught none
13	-	-	Nov. 6	1615	Niagra Ledge, Trinity Bay	7.2	20,500	17	All '85 yc herring
-	23	-	Nov. 7	1150	Cottler Bay, Trinity Bay	6.4	2,000	18	Mixture of yc's, 90% '85 yc
14	-	-	Nov. 7	1325	Tickle Hr. Pt., Trinity Bay	7.2	1 fish		Caught one mackerel only
-	24	-	Nov. 9	1255	Souther Pt., Hearts Cohtent	6.6	300		Caught mackerel only
15	-	-	Nov. 9	1440	Souther Pt., Hearts Content	6.6	25,000	19	Mixture of yc's, majority '82 and '85 yc's
-	25	-	Nov. 12	1435	Kellys Is., Conception Bay	6.4	14,000	21	Mixture of yc's, predominantly '82's
-	-	1	Dec. 6	1410	St. Lawrence Harbour	3.4	90,700	30	65% '82 yc, 10% age 11+
-	-	2	Dec. 10	1510	Long Cove, Fortune Bay	3.7	-		Seine hooked in bottom, no catch
-	-	3	Dec. 12	0850	East Bay, Fortune Bay	2.7	181,000	32	80% '82 yc

Table 15. Herring tagging experiments, acoustic purse seine survey, October-December 1986.

Date	Time	Location	No. tagged		Tag series
Oct. 7	1800	Kings Pt., Green Bay	1000		32501D-33500D
Oct. 11	1900	Wild Bight, Badger Bay	1000		33501D-34500D
Oct. 14	1640	Burnt Island, Bay of Exploits	1000		34501D-35500D
Oct. 22	1245	Lockers Bay, Bonavista Bay	1000		35501D-36500D
Nov. 9	1525	Souther Point, Trinity Bay	2000		36501D-38500D
Nov. 12	1510	Kelly's Island, Conception Bay	2000		38501D-40500D
Dec. 6	1500	St. Lawrence Harbour	1000	anchor	D40501-D41500
			1000	dart	A79000-A79999
Dec. 12	1030	East Bay, Fortune Bay	500	anchor	D41501-D42000
			400	dart	A80600-A80999

Table 16. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season (* adjusted to account for shallow nets).

Area	Season	Age	Autumn spawners 1980*	1981*	1982*	1983	1984	1985	1986
WB-NDB	Fall	1	-	-	-	-	-	-	-
		2	-	-	-	-	-	-	-
		3	465	36	633	11	2513	10	1
		4	63	130	312	2047	370	290	517
		5	206	6	351	238	7364	286	692
		6	253	51	305	613	1841	2657	589
		7	259	5	8	197	227	1432	1831
		8	14	27	6	27	190	13	472
		9	22	-	139	44	57	10	64
		10	-	-	-	124	44	5	10
		11+	600	28	33	274	598	441	233
		Total	1881	284	1786	3576	13204	5145	4409

Age	Spring spawners 1980*	1981*	1982*	1983	1984	1985	1986
1	3	-	-	-	-	-	-
2	1383	705	779	53	4194	518	32
3	1172	817	2688	7224	1146	25839	1608
4	28735	179	515	11780	3431	3626	19228
5	974	3950	315	1068	15124	2226	2249
6	12983	160	178	2058	778	11544	1604
7	360	833	72	2896	1522	1317	6864
8	4109	74	844	347	2544	1297	665
9	619	314	-	3247	180	1430	444
10	4760	126	1432	761	1516	1003	532
11+	71096	13087	17733	46209	45887	22918	8991
Total	126189	20244	24554	75642	76322	71718	42218

Age	Autumn and spring spawners combined 1980*	1981*	1982*	1983	1984	1985	1986
1	3	-	-	-	-	-	-
2	1383	705	779	53	4194	518	32
3	1636	853	3321	7234	3659	25849	1609
4	28798	309	825	13827	3801	3916	19745
5	1180	3955	666	1306	22487	2512	2941
6	13236	211	483	2671	2619	14201	2193
7	619	838	79	3093	1749	2749	8695
8	4122	102	852	374	2734	1311	1137
9	641	314	139	3291	238	1440	508
10	4760	126	1432	885	1560	1008	542
11+	71695	13117	17766	46483	46485	23360	9224
Total	128070	20528	26340	79218	89526	76863	46626

Table 17. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season (* adjusted to account for shallow nets).

Area	Season	Age	Autumn spawners 1980*	1981*	1982*	1983	1984	1985	1986
BB-TB	Fall	1	-	-	-	-	-	-	-
		2	-	-	-	-	-	-	-
		3	99	1	3071	36	74	61	24
		4	160	170	481	5279	203	156	94
		5	66	30	1598	1327	3907	131	336
		6	154	22	53	1559	847	1467	383
		7	336	19	269	364	826	638	1070
		8	80	302	17	231	77	135	275
		9	33	3	777	98	315	45	174
		10	-	-	-	687	-	8	19
		11+	267	155	826	704	736	195	138
		Total	1199	699	7090	10285	6986	2837	2512
			Spring spawners						
			1980*	1981*	1982*	1983	1984	1985	1986
		1	-	-	-	-	-	-	-
		2	2714	166	761	138	3046	356	340
		3	168	235	10889	1290	1285	8405	807
		4	1694	31	2918	16008	1239	668	15251
		5	110	97	735	1709	9579	302	287
		6	564	25	2140	655	469	1342	307
		7	36	196	9	1801	217	84	628
		8	99	-	429	24	344	23	89
		9	28	155	-	715	-	93	14
		10	242	6	95	135	304	-	110
		11+	13354	7783	9550	15076	7476	2934	1444
		Total	19005	8695	27523	37551	23959	14206	19277
			Autumn and spring spawners combined						
			1980*	1981*	1982*	1983	1984	1985	1986
		1	-	-	-	-	-	-	-
		2	2714	166	761	138	3046	356	340
		3	267	236	13960	1325	1359	8466	831
		4	1854	201	3396	21287	1442	824	15345
		5	176	127	2328	3036	13486	433	623
		6	718	47	2196	2215	1316	2809	690
		7	374	214	278	2165	1043	722	1698
		8	179	302	445	254	421	158	364
		9	61	158	777	813	315	138	188
		10	242	6	95	822	304	8	129
		11+	13621	7935	10376	15780	8212	3129	1582
		Total	20204	9393	34613	47836	30945	17043	21789

Table 18. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season (* adjusted to account for shallow nets).

Area	Season	Age	1980	1981	1982	1983*	1984	1985	1986
			Autumn spawners						
BB-TB	Spring	1	-	-	-	-	-	-	-
		2	-	-	-	-	-	-	-
		3	-	-	-	6	-	-	-
		4	-	-	-	33	-	2	-
		5	-	-	-	3	311	19	-
		6	-	-	-	3	50	409	23
		7	-	-	-	-	-	72	33
		8	-	-	-	3	-	49	9
		9	-	-	-	-	3	-	-
		10	-	-	-	-	-	5	-
		11+	-	-	-	14	17	28	-
		Total	-	-	-	61	382	585	65
			Spring spawners						
			1980	1981	1982	1983*	1984	1985	1986
		1	-	-	-	-	-	-	-
		2	-	-	-	-	8	-	60
		3	-	-	-	22	161	697	30
		4	-	-	-	179	65	289	5606
		5	-	-	-	6	301	165	87
		6	-	-	-	-	29	426	97
		7	-	-	-	3	5	39	113
		8	-	-	-	-	18	37	32
		9	-	-	-	50	-	38	10
		10	-	-	-	8	17	40	9
		11+	-	-	-	905	1171	1495	400
		Total	-	-	-	1169	1775	3226	6444
			Autumn and spring spawners combined						
			1980	1981	1982	1983*	1984	1985	1986
		1	-	-	-	-	-	-	-
		2	-	-	-	-	8	-	60
		3	-	-	-	28	161	697	30
		4	-	-	-	212	65	291	5606
		5	-	-	-	8	612	184	87
		6	-	-	-	3	79	835	120
		7	-	-	-	3	5	110	146
		8	-	-	-	3	18	86	41
		9	-	-	-	50	3	38	10
		10	-	-	-	8	17	45	9
		11+	-	-	-	919	1189	1523	400
		Total	-	-	-	1229	2157	3811	6509

Table 19. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season.

Area	Season	Age	Autumn spawners 1980	1981	1982	1983	1984	1985	1986
CB-SS	Fall	1	-	-	-	-	-	-	-
		2	-	-	-	58	-	-	-
		3	-	-	-	7	229	280	6
		4	-	-	-	137	201	804	220
		5	-	-	-	24	6837	472	375
		6	-	-	-	38	1260	3376	240
		7	-	-	-	3	332	1046	856
		8	-	-	-	2	36	691	382
		9	-	-	-	32	57	3	193
		10	-	-	-	-	33	5	100
		11+	-	-	-	22	41	402	51
		Total	-	-	-	323	9026	7079	2423

Age	Spring spawners 1980	1981	1982	1983	1984	1985	1986
1	-	-	-	-	-	-	137
2	-	-	-	70	2565	75	86
3	-	-	-	37	597	29034	36
4	-	-	-	62	2174	1623	3239
5	-	-	-	6	4162	930	214
6	-	-	-	8	275	1139	220
7	-	-	-	9	224	4	153
8	-	-	-	-	426	66	19
9	-	-	-	10	-	79	46
10	-	-	-	8	-	-	59
11+	-	-	-	218	2841	2644	282
Total	-	-	-	428	13263	35594	4492

Age	Autumn and spring spawners combined 1980	1981	1982	1983	1984	1985	1986
1	-	-	-	-	-	-	137
2	-	-	-	128	2565	75	86
3	-	-	-	44	826	29314	42
4	-	-	-	199	2374	2427	3459
5	-	-	-	30	10999	1402	589
6	-	-	-	46	1535	4516	460
7	-	-	-	12	556	1049	1009
8	-	-	-	2	461	757	401
9	-	-	-	42	57	82	239
10	-	-	-	8	33	5	159
11+	-	-	-	239	2883	3046	333
Total	-	-	-	751	22289	42673	6915

Table 20. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season.

Area	Season	Age	Autumn spawners 1980	1981	1982	1983	1984	1985	1986
CB-SS	Spring	1	-	-	-	-	-	-	-
		2	-	-	-	-	-	-	-
		3	-	-	-	-	-	-	-
		4	-	-	-	-	-	54	21
		5	-	-	-	-	-	81	285
		6	-	-	-	-	-	1624	626
		7	-	-	-	-	-	1266	4089
		8	-	-	-	-	-	1017	1234
		9	-	-	-	-	-	219	771
		10	-	-	-	-	-	118	48
		11+	-	-	-	-	-	1655	1823
		Total	-	-	-	-	-	6033	8898

		Spring spawners 1980	1981	1982	1983	1984	1985	1986
	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	-	-	-	-	-	506	-
	4	-	-	-	-	-	101	7444
	5	-	-	-	-	-	397	202
	6	-	-	-	-	-	1141	1388
	7	-	-	-	-	-	152	341
	8	-	-	-	-	-	133	268
	9	-	-	-	-	-	28	-
	10	-	-	-	-	-	-	81
	11+	-	-	-	-	-	7973	3511
	Total	-	-	-	-	-	10431	13234

		Autumn and spring spawners combined 1980	1981	1982	1983	1984	1985	1986
	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	-	-	-	-	-	506	-
	4	-	-	-	-	-	155	7465
	5	-	-	-	-	-	477	487
	6	-	-	-	-	-	2765	2014
	7	-	-	-	-	-	1418	4430
	8	-	-	-	-	-	1150	1502
	9	-	-	-	-	-	247	771
	10	-	-	-	-	-	118	129
	11+	-	-	-	-	-	9628	5334
	Total	-	-	-	-	-	16464	22132

Table 21. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season.

Area	Season	Age	Autumn spawners 1982	1983	1984	1985	1986
SMB-PB	Spring	1	-	-	-	-	-
		2	-	-	-	-	-
		3	67	67	863	126	104
		4	68	1370	1508	4778	1122
		5	234	150	7454	1854	2327
		6	22	699	2232	5073	1426
		7	4	132	3178	1886	5913
		8	18	61	206	1585	1458
		9	8	97	567	194	508
		10	5	45	112	320	205
		11+	58	349	1891	1413	623
		Total	484	2970	18010	17228	13685
			Spring spawners				
			1982	1983	1984	1985	1986
		1	-	-	-	-	-
		2	18	227	101	-	1
		3	23	1444	2589	7692	55
		4	66	256	3038	750	17580
		5	49	126	962	1293	1188
		6	162	147	372	903	2452
		7	18	452	132	310	483
		8	200	50	1022	279	366
		9	46	669	34	1123	7
		10	48	82	1393	354	340
		11+	790	2747	6540	5902	1682
		Total	1421	6200	16182	18607	24155
			Combined				
			1982	1983	1984	1985	1986
		1	-	-	-	-	-
		2	18	227	101	-	1
		3	90	1511	3452	7818	159
		4	134	1626	4546	5527	18702
		5	282	276	8416	3148	3515
		6	184	846	2604	5976	3879
		7	21	584	3309	2196	6396
		8	218	111	1228	1864	1824
		9	54	766	601	1317	515
		10	54	127	1505	674	545
		11+	849	3096	8430	7315	2305
		Total	1905	9170	34192	35835	37841

Table 22. Catch at age (numbers of herring) calculated from catch/effort data and biological samples for the research gillnet program, by area and season.

Area	Season	Age	Autumn spawners 1982	1983	1984	1985	1986
FB	Spring	1	-	-	-	-	-
		2	-	-	-	-	-
		3	2	-	-	8	-
		4	18	1082	-	833	808
		5	86	361	1595	476	479
		6	13	1236	608	4442	887
		7	2	122	1006	2324	2687
		8	-	63	207	1051	855
		9	-	30	51	827	192
		10	-	-	12	197	95
		11+	4	39	177	351	166
		Total	126	2933	3658	10508	6169
			Spring spawners				
			1982	1983	1984	1985	1986
		1	-	-	-	-	-
		2	4	-	-	-	-
		3	38	495	-	870	-
		4	51	361	1130	153	21317
		5	40	234	765	12321	824
		6	5	183	316	4179	6662
		7	15	152	78	950	4589
		8	392	159	208	274	938
		9	19	2642	19	522	92
		10	53	275	229	385	171
		11+	55	3219	5250	8139	3414
		Total	672	7720	7996	27793	38006
			Combined				
			1982	1983	1984	1985	1986
		1	-	-	-	-	-
		2	4	-	-	-	-
		3	40	495	-	878	-
		4	70	1443	1130	986	22125
		5	127	596	2360	12797	1303
		6	17	1419	925	8621	7549
		7	17	274	1084	3274	7276
		8	392	222	415	1324	1793
		9	19	2672	71	1349	284
		10	53	275	241	582	266
		11+	59	3257	5428	8490	3580
		Total	798	10653	11654	38301	44175

Table 23. Total catch (number of fish), number of days fished, number of days hauled, and catch rates for the research gillnet program, White Bay-Notre Dame Bay (* catch rates adjusted to account for shallow nets).

Area	Community	Year	Total catch	Days fished	Days hauled	Catch/ days fished	Catch/ days hauled
WB	Croque	1984	1486	25	18	60	84
		1985	1151	29	20	40	58
		1986	3139	29	15	108	207
	Westport	1980	5962*	56	33	103*	181*
		1981	2835*	37	21	77*	135*
		1982	6474*	30	23	216*	281*
		1983	6991	31	25	226	280
		1984	11112	31	25	358	444
		1985	28211	31	22	910	1282
		1986	5859	31	18	189	326
	Brents Cove	1982	19866	30	17	662	1169
		1983	27270	19	14	1420	1948
		1984	53915	30	18	1785	2962
		1985	9066	33	20	275	453
		1986	5987	26	15	230	399
	La Scie	1980	17256*	26	18	664*	959*
		1981	4262	25	14	173	304
NDB	Harry's Harbour	1981	2395	29	18	81	135
		1983	34027	33	25	1031	1361
		1984	4881	33	24	148	203
		1985	7334	35	24	210	306
		1986	15051	31	26	486	579
	Leading Tickles	1981	3528	33	20	107	176
		1983	10637	30	18	355	591
		1984	10642	30	18	355	578
		1985	25729	31	17	841	1513
		1986	3555	32	21	111	172
	Hillgrade	1980	104852*	59	37	1777*	2834*
		1981	7788*	32	17	243*	458*
		1982	0*	32	18	0*	0*
		1983	293	32	25	9	12
	Herring Neck	1984	7890	31	23	255	343
		1985	5373	33	21	163	256
		1986	13036	30	25	435	521
WB-NDB	Combined	1980	128070*	141	88	908*	1455*
		1981	20808*	156	90	136*	231*
		1982	26340*	92	58	286*	454*
		1983	79218	145	107	546	740
		1984	89926	180	126	500	713
		1985	76864	192	124	401	620
		1986	46627	179	120	260	389

Table 24. Total catch (number of fish), number of days fished, number of days hauled, and catch rates for the research gillnet program, Bonavista Bay-Trinity Bay (* catch rates adjusted to account for shallow nets).

Area	Community	Year	Total catch	Days fished	Days hauled	Catch/ days fished	Catch/ days hauled
BB	Centreville	1980	2720*	53	33	51*	82*
		1981	2280*	31	23	74*	99*
		1982	1404	27	19	52	74
		1983	1430	31	25	46	57
		1984	1754	31	23	57	76
		1985	3459	32	24	108	144
		1986	5514	34	21	162	263
	Salvage	1980	11594*	33	22	351*	527*
		1981	633*	36	24	18*	26*
		1982	27944*	31	19	901*	1471*
		1983	19639	28	19	701	1034
		1984	11656	31	18	376	648
		1985	1819	30	18	61	101
		1986	3354	32	22	105	152
	Portland	1981	6734	28	19	237	354
		1982	3059	30	8	102	364
	Charlottetown	1983	12660	37	25	339	515
		1984	5888	30	15	198	387
		1985	6666	32	18	208	370
		1986	1874	33	18	57	106
	Newman Sound (S)	1983	1229*	5	4	246	307
		1984	2157	8	7	270	308
		1985	1728	6	6	288	288
		1986	817	6	6	136	136
	Newman Sound (F)	1984	199	11	9	18	22
		1985	440	8	8	55	55
		1986	569	8	8	71	71
TB	Port Rexton	1982	1698	31	25	55	68
		1983	13435	32	23	420	584
		1984	6244	32	27	195	231
		1985	3233	32	24	101	134
		1986	10478	32	22	327	476
	Hickmans Harbour	1980	5891*	46	31	128*	190*
		1981	242*	31	26	8*	9*
		1982	424*	31	23	14*	18*
	Long Beach	1983	721	29	18	25	40
		1984	5205	33	22	158	237
		1985	1436	33	19	44	76
	Chance Cove (S)	1985	2083	32	18	65	116
		1986	5692	31	18	184	316
BB-TB	Combined (S)	1983	1229*	5	4	246*	307*
		1984	2157	8	7	270	308
		1985	3811	38	24	100	159
		1986	6509	37	24	176	276
	Combined (F)	1980	20204*	132	86	153*	235*
		1981	9888*	126	92	78*	107*
		1982	34412*	150	94	229*	366*
		1983	47885	157	110	304	436
		1984	30946	168	114	184	271
		1985	17043	167	111	102	154
		1986	21789	139	91	157	240

Table 25. Total catch (number of fish), number of days fished, number of days hauled, and catch rates for the research gillnet program, Conception Bay-Southern Shore.

Area	Community	Year	Total catch	Days fished	Days hauled	Catch/ days fished	Catch/ days hauled
CB	Foxtrap (S)	1985	10515	33	20	319	521
		1986	19695	31	15	635	1349
	Bay Roberts (F)	1983	2442	30	12	81	207
		1984	22289	32	24	697	929
		1985	42453	31	19	1369	2234
		1986	5245	29	12	181	437
	Holyrood (F)	1986	1030	32	26	32	39
SS	Burnt Cove (S)	1985	5949	28	11	216	531
		1986	2437	30	21	81	116
	Burnt Cove (F)	1985	220	32	24	7	9
		1986	640	32	21	20	30
CB-SS	Combined (S)	1985	16464	61	31	272	524
		1986	22132	61	36	363	622
	Combined (F)	1983	2442	30	12	81	207
		1984	22289	32	24	697	929
		1985	42673	63	43	677	992
		1986	6915	93	59	74	116

Table 26. Total catch (number of fish), number of days fished, number of days hauled, and catch rates for the research gillnet program, St. Mary's Bay-Placentia Bay.

Area	Community	Year	Total catch	Days fished	Days hauled	Catch/ days fished	Catch/ days hauled
SMB	Riverhead	1982	680	25	21	27	32
		1983	962	31	24	31	41
		1984	2960	46	37	64	80
		1985	6108	32	25	191	244
		1986	16386	22	17	732	942
	Colinet	1982	71	31	26	2	3
		1983	3193	37	30	86	106
		1984	3270	31	25	105	131
		1985	637	34	28	19	23
		1986	4040	30	25	135	162
PB	Long Harbour	1982	663	32	18	21	37
		1983	3142	29	18	108	175
		1984	27357	32	16	855	1710
		1985	20823	32	17	651	1225
		1986	12720	31	21	410	606
	Swift Current	1982	491	31	20	16	25
		1983	1873	31	23	60	81
		1984	818	31	17	26	48
		1985	8267	32	19	258	435
		1986	1351	30	22	45	61
	Red Harbour	1986	3343	27	20	126	167
SMB-PB	Combined	1982	1905	119	85	16	22
		1983	9174	142	100	65	92
		1984	34405	140	95	246	362
		1985	35835	130	89	276	403
		1986	37840	140	105	270	359

Table 27. Total catch (number of fish), number of days fished, number of days hauled, and catch rates for the research gillnet program, Fortune Bay.

Area	Community	Year	Total catch	Days fished	Days hauled	Catch/ days fished	Catch/ days hauled
FB	Long Harbour	1982	53	33	24	2	2
		1983	9711	29	23	335	422
		1984	5806	32	23	181	257
		1985	9016	34	21	265	429
		1986	14214	33	22	431	646
	Belle Bay	1982	746	32	25	23	30
		1983	942	31	25	30	38
		1984	5908	26	14	227	422
		1985	29285	26	16	1118	1786
		1986	21560	37	27	580	793
	Connaigre Bay	1986	8401	25	19	336	442
FB	Combined	1982	799	65	49	12	16
		1983	10653	60	48	178	222
		1984	11714	58	37	202	320
		1985	38301	60	37	636	1024
		1986	44175	95	68	464	648

Table 28. Catch per days fished, by stock area, year, and mesh size, from the research gillnet program.

Stock area	Year	Mesh size					Combined
		2"	2 1/4"	2 1/2"	2 3/4"	3"	
WB-NDB	1980	69	218	262	206	133	908
	1981	16	23	41	33	18	133
	1982	13	30	97	17	57	286
	1983	46	63	195	163	75	546
	1984	42	85	164	150	72	499
	1985	76	81	134	66	45	401
	1986	40	36	82	62	41	260
BB-TB	1980	15	32	51	39	16	153
	1981	4	8	30	21	15	78
	1982	8	75	82	34	28	227
	1983	24	46	91	81	60	304
	1984	29	28	53	43	30	184
	1985	21	25	25	17	14	102
	1986	23	33	58	28	15	157
CB-SS	1983	5	4	6	1	9	81
	1984	88	123	262	138	84	697
	1985	172	182	192	81	48	677
	1986	3	16	25	18	12	74
SMB-PB	1982	2	2	5	4	3	16
	1983	15	13	15	15	14	72
	1984	38	56	61	49	41	246
	1985	77	73	51	47	29	276
	1986	73	77	70	32	17	270
FB	1982	1	3	4	2	2	12
	1983	31	26	41	49	30	176
	1984	9	48	29	49	65	201
	1985	37	164	153	154	130	636
	1986	76	87	99	139	62	464

Table 29. Results of the BIOSONICS dual-beam hydroacoustic experiment conducted in Notre Dame Bay, October 1986, including school locations and dates, relative school densities ($\bar{v}^2$), number of targets selected for target strength calculations, average backscattering cross sections (dB), average target strengths (dB), fish densities, fish numbers, and comments recorded during the survey.

Date	Location	$\bar{v}^2$	# of targets	Avg. backscat. cross sect.	Avg. T.S.	Fish/M^2	Fish nos.	Field observations
Oct. 11	Little Denier Island	7.766	10	-33.08	-39.29	4.973	68139	'79 & '82 yc herring sampled
Oct. 12	Wild Bight	-	12	-33.28	-38.61	-	-	field observations suggested herring - herring sampled from same area
Oct. 12	Budgells Cove	2.258	14	-32.20	-36.94	1.446	10697	field observations suggested herring
Oct. 12	Budgells Cove	-	3	-22.17	-22.69	-	-	field observations suggested herring
Oct. 13	Exploits Island	-	68	-46.45	-47.75	-	-	sampled small mackerel & sticklebacks
Oct. 14	Baptist Cove	1.793	21	-34.54	-37.61	1.148	2974	field observations suggested a mixture of herring and mackerel
Oct. 14	Baptist Cove	2.192	17	-31.10	-36.91	2.192	6767	field observations suggested a mixture of herring and mackerel
Oct. 14	High Grego Island	2.361	21	-31.82	-34.50	1.512	24615	field observations suggested a mixture of herring and mackerel
Oct. 14	High Grego Island	0.070	2	-49.79	-50.30	0.045	8847	field observations suggested mackerel
Oct. 14	High Grego Island	0.017	4	-44.31	-46.69	0.011	206	field observations suggested mackerel
Oct. 14	Granfer Island	0.554	40	-31.43	-36.33	0.355	10417	field observations suggested herring
Oct. 14	Burnt Island	0.206	51	-34.36	-37.16	0.132	25710	field observations suggested herring and mackerel mixed - sampled herring 38% '85 yc
Oct. 15	Southern Head Cove	0.056	22	-37.31	-38.91	0.036	-	field observations suggested herring
Oct. 15	Southern Head Cove	0.169	33	-30.32	-38.08	0.108	-	field observations suggested herring
Oct. 16	Summerford Arm	-	43	-26.14	-36.98	-	-	field observations suggested mackerel and cod
Oct. 16	Black Island Tickle	0.478	4	-34.07	-34.97	0.306	2241	no field observations
Oct. 16	Black Island Ticlle	3.879	39	-26.70	-28.83	2.484	15341	field observations suggested herring

Table 30. Calculation of instantaneous total mortality (Z) from research gillnet program, where F is number of days fished.

Area	Community	Z4+						
		80-81	81-82	82-83	83-84	84-85	85-86	84-86
WB/NDB	Croque	-	-	-	-	0.60	-	-
	Westport	0.39	0.18	0.84	0.21	-0.81	2.06	2.30
	Brents Cove	-	-	-0.67	-0.01	2.12	0.54	2.81
	La Scie	1.35	-	-	-	-	-	-
	Harry's Harbour	-	-	-	2.14	0.04	-0.70	-0.65
	Leading Tickles	-	-	-	-0.02	-0.64	2.19	1.60
	Hillgrade	2.09	-	-	-	-	-	-
	Herring Neck	-	-	-	-	0.74	-0.70	0.08
	Combined	2.00	-0.62	-0.53	2.53	0.56	0.68	1.31
BB/TB	Centreville	-0.22	0.72	-0.04	-0.02	0.79	-0.61	0.08
	Salvage	3.22	-3.47	0.99	0.71	3.51	-0.49	2.95
	Portland	-	2.06	-	-	-	-	-
	Charlottetown	-	-	-	0.83	0.45	2.24	2.63
	Newman Sound (S)	-	-	-	0.18	0.14	1.68	1.98
	Newman Sound (F)	-	-	-	-	-2.05	0.37	-1.99
	Port Rexton	-	-	-1.32	1.56	0.78	0.99	1.69
	Hickmans Harbour	-	-	-	-	-	-	-
	Long Beach	-	-	-	-1.97	3.61	-	-
	Chance Cove (S)	-	-	-	-	-	0.95	-
	Combined (F)	0.62	-0.27	-0.19	0.74	1.41	0.45	1.84
	Combined (S)	-	-	-	0.18	1.23	1.19	2.42
CB/SS	Bay Roberts (F)	-	-	-	-3.14	0.71	2.01	2.66
	Holyrood (F)	-	-	-	-	-	-	-
	Foxtrap (S)	-	-	-	-	-	0.32	-
	Burnt Cove (F)	-	-	-	-	-	-1.10	-
	Burnt Cove (S)	-	-	-	-	-	1.96	-
	Combined (F)	-	-	-	-	2.19	2.26	3.63
SMB-PB	Riverhead			0.02	0.21	-1.10	-0.08	-0.95
	Collnet			-4.00	-0.20	2.92	-1.41	1.67
	Long Harbour			-0.79	-2.07	0.46	0.81	1.42
	Swift Current			-0.78	0.66	0.81	1.32	0.50
	Red Harbour			-	-	-	-	-
	Combined			-0.95	-0.85	0.21	0.39	0.53
FB	Long Harbour			-5.25	0.54	0.20	0.35	0.16
	Belle Bay			-0.25	-1.40	-1.77	0.98	-0.72
	Connaigre Bay			-	-	-	-	-
	Combined			-2.47	0.02	-1.17	1.13	0.20

Table 31. Calculation of instantaneous total mortality (Z) from research gillnet program, where F is number of days hauled.

Area	Community	Z4+						
		80-81	81-82	82-83	83-84	84-85	85-86	84-86
WB/NDB	Croque	-	-	-	-	0.55	-	-
	Westport	1.26	-0.42	0.89	0.21	-0.68	1.86	-0.75
	Brents Cove	-	-	-0.41	-0.22	2.13	0.49	2.77
	La Scie	1.14	-	-	-	-	-	-
	Harry's Harbour	-	-	-	2.10	-0.02	-0.49	-0.51
	Leading Tickles	-	-	-	-0.02	-0.73	2.37	1.69
	Hillgrade	1.93	-	-	-	-	-	-
	Herring Neck	-	-	-	-	0.59	-0.43	0.20
	Combined	1.92	-0.53	-0.37	0.18	0.48	0.72	1.26
BB/TB	Centreville	-0.04	0.67	0.10	-0.10	0.80	-0.80	-0.10
	Salvage	3.22	-3.55	1.09	0.55	3.54	-0.35	3.12
	Portland	-	1.12	-	-	-	-	-
	Charlottetown	-	-	-	0.53	0.57	2.07	2.72
	Newman Sound (S)	-	-	-	0.27	0.27	1.68	2.12
	Newman Sound (F)	-	-	-	-	-1.85	0.37	-1.79
	Port Rexton	-	-	-1.43	1.72	0.66	0.91	1.49
	Hickmans Harbour	-	-	-	-	-	-	-
	Long Beach	-	-	-	-1.90	3.46	-	-
	Chance Cove (S)	-	-	-	-	-	0.98	-
	Combined (F)	0.74	-0.42	-0.08	0.71	1.39	0.44	1.80
	Combined (S)	-	-	-	0.27	0.90	1.22	2.12
CB/SS	Bay Roberts (F)	-	-	-	-2.51	0.50	1.62	2.06
	Holyrood (F)	-	-	-	-	-	-	-
	Foxtrap (S)	-	-	-	-	-	0.10	-
	Burnt Cove (F)	-	-	-	-	-	-1.23	-
	Burnt Cove (S)	-	-	-	-	-	2.54	-
	Combined (F)	-	-	-	-	2.10	2.19	3.46
SMB-PB	Riverhead			0.02	0.21	-1.10	-0.08	-0.95
	Colinet			-4.00	-0.20	2.92	-1.41	1.67
	Long Harbour			-0.79	-2.07	0.46	0.81	1.42
	Swift Current			-0.78	0.66	0.81	1.32	0.50
	Red Harbour			-	-	-	-	-
	Combined			-0.95	-0.85	0.21	0.39	0.53
FB	Long Harbour			-5.25	0.54	0.20	0.35	0.16
	Belle Bay			-0.25	-1.40	-1.77	0.98	-0.72
	Connaigre Bay			-	-	-	-	-
	Combined			-2.47	0.02	-1.17	1.13	0.20

Table 32. Percentages of schools, by area and weight, within the limits of the regression between school area and school weight from the acoustic purse seine surveys, 1983-86.

	$Y = 10.03X^{1.10}$		$Y = 2.12X^{1.39}$	
	M^2	kg	M^2	kg
1983 East Coast	85.5%	26.8%	85.5%	12.1%
1984 East Coast	91.4%	42.2%	91.4%	25.8%
1985 East Coast	85.7%	44.1%	85.7%	26.9%
1986 East Coast	91.1%	61.5%	91.1%	49.3%
1985 Southeast Coast	45.9%	7.7%	45.9%	4.2%
1986 Southeast Coast	75.0%	23.3%	75.0%	16.5%

Table 33. Grids surveyed and percentage of stock area surveyed with each grid, 1983-86 acoustic purse seine surveys. Core grids are framed by solid lines.

Stock area	Grid no.	% of stock area	1983	1984	1985	1986[2]	1986[1]
WB-NDB	38	16					
	39	2					
	40	10					
	41	5					
	42	1					
	43	1			24.7		
	44	1					
	45	3			11.0		
	1	9	3.5	5.4	5.1	3.6	
	2	1	22.9	59.8	33.2	49.8	
	3	2	34.1	26.3	21.9	24.5	
	4	2	35.1	22.0	27.5	32.9	
	5	7	19.0	11.8	15.7	16.0	
	6	22	2.1		1.8	1.1	
	7	17					
BB-TB	8	20	12.5	11.6	11.0	10.5	
	9	18	5.7	9.3	8.0	7.1	
	10	6	22.4	47.1	27.7	38.3	
	11	1	16.7	24.8	29.3	21.9	
	12	5	35.4	49.4	33.6	30.8	
	13	8		10.4	5.6	7.2	
	14	15		13.0	6.1	6.3	
	15	3		53.4	32.3	37.5	
	16	5		44.9	45.5	49.0	
	17	8		28.9	12.7	34.8	
	18	4		22.5	13.5	37.0	
	19	8			5.9	16.3	
CB-SS	20	28			9.5	5.2	
	21	18				19.0	
	22	23					
	23	31					
SMB-PB	24	18					
	25	35			2.5	3.1	
	26	11			2.1	4.3	
	27	5			17.1	11.3	
	28	7			14.3	29.8	
	29	10			7.4	18.5	
	30	14			2.4	2.0	
FB	31	31					
	32	12		26.3	22.6	33.6	
	33	13		28.1	18.0	42.1	
	34	44		2.8	2.7	7.8	

[1] (Feb.-Mar.)
[2] (Nov.-Dec.)

Table 34. Calculation of biomass by grid and stock area from the 1986 acoustic purse seine survey, using the relationship between school area and school size derived from the 1984, 1985, and 1986 data points ($Y = 2.12X^{1.39}$).

Stock area	Grid no.	Observed biomass (t)	Area surveyed (km^2)	Stock area (km^2)	Conv. factor[1]	Biomass (t) within grids
WB-NDB	1	1,843	28.2	785	27.84	51,295
	2	1,168	40.8	82	2.01	2,348
	3	460	52.2	213	4.08	1,879
	4	258	58.5	178	3.04	785
	5	965	97.9	611	6.24	6,024
	6	155	22.9	2,013	87.90	13,631
						75,963
BB-TB	8	571	67.2	638	9.49	5,422
	9	338	39.2	556	14.18	4,787
	10	669	75.0	196	2.61	1,748
	11	5	5.9	27	4.58	21
	12	854	52.6	171	3.25	2,776
	13	43	18.2	254	13.96	597
	14	71	28.9	460	15.92	1,135
	15	36	29.6	79	2.67	97
	16	1,489	82.4	168	2.04	3,036
	17	1,553	82.4	237	2.88	4,467
	18	147	40.7	110	2.70	398
	19	194	39.2	240	6.12	1,187
						25,672
CB-SS	20	83	19.5	377	19.33	1,608
	21	331	45.6	240	5.26	1,740
						3,348
SMB-PB	25	352	72.3	2,854	39.47	13,907
	26	0	18.3	861	47.05	0
	27	50	70.8	415	5.86	294
	28	474	84.4	590	6.99	3,316
	29	1	58.6	796	13.58	5
	30	583	26.9	1,139	42.34	24,666
						42,188
FB	32	1,249	44.2	196	4.43	5,538
	33	91	36.3	202	5.56	508
	34	83	18.8	696	37.02	3,071
						9,117

1) conversion from area surveyed to stock area within grids

Table 35. Comparison of stock biomass estimates using the school area vs school weight relationships calculated from the 1985 and 1986 acoustic purse seine surveys for core grids only.

Stock area	Year	Stock biomass (t) $Y = 10.03X^{1.10}$ ('84 & '85 pts)	Stock biomass (t) $Y = 2.12X^{1.39}$ ('84, '85 & '86 pts)
WB-NDB	1983	34,043	81,919
	1984	58,770	91,460
	1985	68,304	119,460
	1986	46,974	75,963
BB-TB	1984	33,769	59,793
	1985	61,501	99,916
	1986	18,863	25,672
CB-SS	1986	2,650	3,348
SMB-PB	1986[1]	20,000	36,336
	1986[2]	18,437	42,188
FB	1985	10,402	23,345
	1986[1]	6,412	17,167
	1986[2]	4,909	9,117

1 (Feb.-Mar.)

2 (Nov.-Dec.)

Table 36. Calculation of population numbers, by spawning type, grid, and stock area, from the 1986 acoustic purse seine survey, using the relationship $Y = 2.12^{1.39}$ between school area and school size.

Stock area	Grid no.	Total grid biomass (t)	Mean sample weight (kg)	Total grid numbers ($\times 10^6$)	% from samples		Total stock numbers ($\times 10^6$)	
					AS	SS	AS	SS
WB-NDB	1	51,295	0.303	169.3	2.0	98.0	3.4	165.9
	2	2,348	0.281	8.4	2.0	98.0	0.2	8.2
	3	1,879	0.299	6.3	4.0	96.0	0.3	6.0
	5	6,024	0.234	25.7	7.0	93.0	1.8	23.9
	4 & 6	14,416	0.279	51.7	3.8	96.3	2.0	49.8
							7.7	253.8
BB-TB	8	5,422	0.243	22.3	5.3	94.7	1.2	21.1
	15	97	0.005	19.4	0.0	100.0	0.0	19.4
	16	3,036	0.027	112.4	0.0	100.0	0.0	112.4
	17	4,467	0.063	70.9	0.0	100.0	0.0	70.9
	18	398	0.096	4.1	0.0	100.0	0.0	4.1
	19	1,187	0.146	8.1	0.0	100.0	0.0	8.1
	9-13	9,929	0.243	40.9	5.3	94.7	2.2	38.7
	14	1,135	0.039	29.1	0.0	100.0	0.0	29.1
							3.4	303.8
CB-SS	21	1,740	0.263	6.6	12.0	88.0	0.8	5.8
	20	1,608	0.263	6.1	12.0	88.0	0.7	5.4
							1.5	11.2
SMB-PB	30	24,666	0.253	97.5	15.0	85.0	14.6	82.9
	25-29	17,522	0.253	69.3	15.0	85.0	10.4	58.9
							25.0	141.8
FB	32	5,538	0.313	17.7	10.0	90.0	1.8	15.9
	33 & 34	6,046	0.313	19.3	10.0	90.0	1.9	17.4
							3.7	33.3

Table 37. Calculation of population numbers at age, by spawning type, grid, and stock area, from the 1986 acoustic purse seine survey, using the relationship $Y = 2.12X^{1.39}$ between school area and school size.

Stock area	Age	Grid #1 % from samples AS	Grid #1 % from samples SS	Grid #1 Nos. at age ($\times 10^6$) AS	Grid #1 Nos. at age ($\times 10^6$) SS	Grid #2 % from samples AS	Grid #2 % from samples SS	Grid #2 Nos. at age ($\times 10^6$) AS	Grid #2 Nos. at age ($\times 10^6$) SS	Grid #3 % from samples AS	Grid #3 % from samples SS	Grid #3 Nos. at age ($\times 10^6$) AS	Grid #3 Nos. at age ($\times 10^6$) SS
WB-NDB	0	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	1.0	-	0.1	-	-	-	-
	2	-	1.0	-	1.7	-	-	-	-	-	-	-	-
	3	-	1.0	-	1.7	-	20.4	-	1.7	-	28.2	-	1.7
	4	-	57.2	-	94.9	50.0	37.9	0.1	3.1	25.0	18.8	0.1	1.1
	5	-	5.1	-	8.5	-	2.0	-	0.2	-	1.0	-	0.1
	6	-	9.2	-	15.3	-	7.1	-	0.6	-	3.1	-	0.2
	7	50.0	7.1	1.7	11.8	-	9.2	-	0.8	50.0	19.8	0.2	1.2
	8	-	-	-	-	50.0	-	0.1	-	25.0	1.0	0.1	0.1
	9	-	-	-	-	-	-	-	-	-	1.0	-	0.1
	10	-	2.0	-	3.3	-	1.0	-	0.1	-	2.1	-	0.1
	11+	50.0	17.4	1.7	28.9	-	21.4	-	1.8	-	25.0	-	1.5
				3.4	166.1			0.2	8.4			0.4	6.1

Age	Grid #5 % from samples AS	Grid #5 % from samples SS	Grid #5 Nos. at age ($\times 10^6$) AS	Grid #5 Nos. at age ($\times 10^6$) SS	Grids 4 & 6 % from samples AS	Grids 4 & 6 % from samples SS	Grids 4 & 6 Nos. at age ($\times 10^6$) AS	Grids 4 & 6 Nos. at age ($\times 10^6$) SS	All grids Nos. at age ($\times 10^6$) AS	All grids Nos. at age ($\times 10^6$) SS
0	-	-	-	-	-	-	-	-	-	-
1	-	20.4	-	4.9	-	5.2	-	2.6	-	7.6
2	-	2.2	-	0.5	-	0.8	-	0.4	-	2.6
3	14.3	14.0	0.3	3.3	6.7	15.8	0.1	7.9	0.4	16.3
4	14.3	40.8	0.3	9.8	20.0	38.7	0.4	19.3	0.7	128.2
5	14.3	2.2	0.3	0.5	6.7	2.6	0.1	1.3	0.4	10.6
6	14.3	2.2	0.3	0.5	6.7	5.5	0.1	2.7	0.4	19.3
7	42.8	9.7	0.8	2.3	40.0	11.4	0.8	5.7	3.5	21.8
8	-	1.0	-	0.2	13.2	0.5	0.3	0.2	0.5	0.5
9	-	-	-	-	-	0.3	-	0.1	-	0.2
10	-	1.0	-	0.2	-	1.6	-	0.8	-	4.5
11+	-	6.5	-	1.6	6.7	17.6	0.1	8.8	1.8	42.6
			2.0	23.8			1.9	49.8	7.9	254.2

Stock area	Age	Grid #8 % from samples AS	Grid #8 % from samples SS	Grid #8 Nos. at age ($\times 10^6$) AS	Grid #8 Nos. at age ($\times 10^6$) SS	Grids 9-13 % from samples AS	Grids 9-13 % from samples SS	Grids 9-13 Nos. at age ($\times 10^6$) AS	Grids 9-13 Nos. at age ($\times 10^6$) SS	Grid #15 % from samples AS	Grid #15 % from samples SS	Grid #15 Nos. at age ($\times 10^6$) AS	Grid #15 Nos. at age ($\times 10^6$) SS
BB-TB	0	-	-	-	-	-	-	-	-	-	100.0	-	19.4
	1	-	4.2	-	0.9	-	4.2	-	1.6	-	-	-	-
	2	-	4.9	-	1.0	-	4.9	-	1.9	-	-	-	-
	3	-	10.6	-	2.2	-	10.6	-	4.1	-	-	-	-
	4	12.5	64.8	0.2	13.7	12.5	64.8	0.3	25.1	-	-	-	-
	5	-	2.8	-	0.6	-	2.8	-	1.1	-	-	-	-
	6	12.5	0.7	0.2	0.1	12.5	0.7	0.3	0.3	-	-	-	-
	7	62.5	0.7	0.8	0.1	62.5	0.7	1.4	0.3	-	-	-	-
	8	-	-	-	-	-	-	-	-	-	-	-	-
	9	-	-	-	-	-	-	-	-	-	-	-	-
	10	-	0.7	-	0.1	-	0.7	-	0.3	-	-	-	-
	11+	12.5	10.6	0.2	2.2	12.5	10.6	0.3	4.1	-	-	-	-
				1.4	20.9			2.3	38.8			-	19.4

Table 37. Continued.

Stock area	Age	Grid #16 % from samples AS	Grid #16 % from samples SS	Grid #16 Nos. at age (x10^6) AS	Grid #16 Nos. at age (x10^6) SS	Grid #17 % from samples AS	Grid #17 % from samples SS	Grid #17 Nos. at age (x10^6) AS	Grid #17 Nos. at age (x10^6) SS	Grid #18 % from samples AS	Grid #18 % from samples SS	Grid #18 Nos. at age (x10^6) AS	Grid #18 Nos. at age (x10^6) SS
BB-TB	0	-	33.3	-	37.4	-	-	-	-	-	-	-	-
	1	-	64.7	-	72.7	-	99.0	-	70.2	-	84.0	-	3.4
	2	-	0.7	-	0.8	-	-	-	-	-	2.0	-	0.1
	3	-	-	-	-	-	-	-	-	-	-	-	-
	4	-	1.3	-	1.5	-	-	-	-	-	14.0	-	0.6
	5	-	-	-	-	-	-	-	-	-	-	-	-
	6	-	-	-	-	-	-	-	-	-	-	-	-
	7	-	-	-	-	-	-	-	-	-	-	-	-
	8	-	-	-	-	-	-	-	-	-	-	-	-
	9	-	-	-	-	-	-	-	-	-	-	-	-
	10	-	-	-	-	-	-	-	-	-	-	-	-
	11+	-	-	-	-	-	1.0	-	0.7	-	-	-	-
				-	112.4			-	70.9			-	4.1

Age	Grid #19 % from samples AS	Grid #19 % from samples SS	Grid #19 Nos. at age (x10^6) AS	Grid #19 Nos. at age (x10^6) SS	Grid 14 % from samples AS	Grid 14 % from samples SS	Grid 14 Nos. at age (x10^6) AS	Grid 14 Nos. at age (x10^6) SS	All grids Nos. at age (x10^6) AS	All grids Nos. at age (x10^6) SS
0	-	-	-	-	-	25.0	-	7.3	-	64.1
1	-	46.0	-	3.7	-	65.3	-	19.0	-	171.5
2	-	-	-	-	-	0.5	-	0.1	-	3.9
3	-	-	-	-	-	-	-	-	-	6.3
4	-	54.0	-	4.4	-	9.0	-	2.6	0.5	47.9
5	-	-	-	-	-	-	-	-	-	1.7
6	-	-	-	-	-	-	-	-	0.5	0.4
7	-	-	-	-	-	-	-	-	2.2	0.4
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	0.4
11+	-	-	-	-	-	0.3	-	0.1	0.5	7.1
			-	8.1				29.1	3.7	303.7

Table 37. Continued

Stock area	Age	All grids: % from samples AS	All grids: % from samples SS	All grids: Nos. at age (x10^6) AS	All grids: Nos. at age (x10^6) SS
CB-SS	0	-	-	-	-
	1	-	-	-	-
	2	-	2.3	-	0.3
	3	66.6	-	1.0	-
	4	16.7	93.1	0.3	10.4
	5	-	-	-	-
	6	-	2.3	-	0.3
	7	16.7	-	0.3	-
	8	-	-	-	-
	9	-	-	-	-
	10	-	-	-	-
	11+	-	2.3	-	0.3
				1.6	11.3
SMB-PB	0	-	-	-	-
	1	-	-	-	-
	2	-	-	-	-
	3	20.0	1.2	5.0	1.7
	4	6.7	96.4	1.7	136.7
	5	33.3	1.2	8.3	1.7
	6	-	1.2	-	1.7
	7	33.3	-	8.3	-
	8	-	-	-	-
	9	-	-	-	-
	10	-	-	-	-
	11+	6.7	-	1.7	-
				25.0	141.8
FB	0	-	-	-	-
	1	-	-	-	-
	2	-	-	-	-
	3	-	-	-	-
	4	20.0	67.9	0.6	17.8
	5	-	2.2	-	0.6
	6	10.0	6.7	0.3	1.8
	7	20.0	4.4	0.6	1.2
	8	-	3.3	-	0.9
	9	20.0	-	0.6	-
	10	20.0	3.3	0.6	0.9
	11+	10.0	12.2	0.3	3.2
				3.0	26.4

Table 38. Stock numbers at age ($x10^6$), by spawning type, and biomass estimates (t) for White Bay-Notre Dame Bay core grids only, derived from the 1983-86 acoustic purse seine surveys, using the following relationships between school area and school size (1) $Y = 10.03X^{1.10}$ and (2) $Y = 2.12X^{1.39}$.

Spawning type	Age	1983 (1)	1983 (2)	1984 (1)	1984 (2)	1985 (1)	1985 (2)	1986 (1)	1986 (2)
A.S.	0	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	0.2	0.4
	4	-	-	-	-	-	-	0.5	0.9
	5	-	-	1.1	1.9	-	-	0.2	0.4
	6	-	-	-	-	2.5	3.9	0.2	0.4
	7	-	-	-	-	-	-	2.3	3.5
	8	-	-	-	-	-	-	0.3	0.5
	9	-	-	-	-	-	-	-	-
	10	-	-	-	-	-	-	-	-
	11+	-	-	-	-	-	-	1.0	1.8
Total numbers		-	-	1.1	1.9	2.5	3.9	4.7	7.9
S.S.	0	222.8	375.3	-	-	-	-	-	-
	1	360.6	589.8	73.6	113.1	-	-	5.6	7.6
	2	7.4	19.9	225.6	344.7	161.9	264.2	1.7	2.6
	3	1.0	2.7	1.8	2.8	279.4	501.5	11.2	16.3
	4	14.9	49.1	1.4	2.1	3.1	5.7	76.1	128.2
	5	0.8	2.5	13.1	20.6	-	-	8.2	10.6
	6	0.8	2.5	3.2	4.8	4.4	7.8	11.1	19.3
	7	4.1	13.4	2.4	3.7	-	-	14.2	21.8
	8	-	-	5.9	9.3	-	-	0.9	0.5
	9	1.7	5.5	-	-	-	-	0.1	0.2
	10	-	-	1.3	1.9	-	-	2.9	4.5
	11+	9.9	32.7	62.4	98.1	8.9	15.7	26.3	42.6
Total numbers		624.0	1093.4	390.7	600.9	457.8	794.9	158.3	254.2
A.S. & S.S.	0	222.8	375.3	-	-	-	-	-	-
	1	360.6	589.8	73.6	113.1	-	-	5.6	7.6
	2	7.4	19.9	225.6	344.7	161.9	264.2	1.7	2.6
	3	1.0	2.7	1.8	2.8	279.4	501.5	11.4	16.7
	4	14.9	49.1	1.4	2.1	3.1	5.7	76.6	129.1
	5	0.8	2.5	14.2	22.5	-	-	8.4	11.0
	6	0.8	2.5	3.2	4.8	6.9	11.7	11.3	19.7
	7	4.1	13.4	2.4	3.7	-	-	16.5	25.3
	8	-	-	5.9	9.3	-	-	1.2	1.0
	9	1.7	5.5	-	-	-	-	0.1	0.2
	10	-	-	1.3	1.9	-	-	2.9	4.5
	11+	9.9	32.7	62.4	98.1	8.9	15.7	27.3	44.4
Total numbers		624.0	1093.4	391.8	602.8	460.3	798.8	163.0	262.1
Biomass (t)		34,043	81,919	58,770	91,460	68,304	119,460	46,974	75,963

Table 39. Stock numbers at age ($x10^6$), by spawning type, and biomass estimates (t) for Bonavista Bay-Trinity Bay core grids only, derived from the 1984-86 acoustic purse seine surveys, using the following relationships between school area and school size (1) $Y = 10.03X^{1.10}$ and (2) $Y = 2.12X^{1.39}$.

Spawning type	Age	1984 (1)	1984 (2)	1985 (1)	1985 (2)	1986 (1)	1986 (2)
A.S.	0	-	-	-	-	-	-
	1	-	-	-	-	-	-
	2	-	-	1.2	1.9	-	-
	3	-	-	1.2	1.9	-	-
	4	-	-	1.2	1.9	0.3	0.4
	5	1.9	4.8	1.2	1.9	-	-
	6	-	-	-	-	0.3	0.4
	7	0.1	0.4	-	-	1.6	2.1
	8	-	-	-	-	-	-
	9	0.1	0.4	-	-	-	-
	10	-	-	-	-	-	-
	11+	0.3	0.7	-	-	0.3	0.4
Total numbers		2.4	6.3	4.8	7.6	2.5	3.3
S.S.	0	138.4	172.5	63.9	93.2	51.5	64.1
	1	44.2	63.6	-	-	119.4	171.5
	2	249.2	409.4	152.6	244.2	2.9	3.9
	3	0.7	1.8	231.0	378.2	4.7	6.3
	4	1.5	4.1	3.0	5.2	36.0	47.9
	5	5.0	11.7	-	-	1.3	1.7
	6	0.1	0.4	5.9	9.6	0.3	0.4
	7	-	-	-	-	0.3	0.4
	8	0.1	0.3	-	-	-	-
	9	-	-	-	-	-	-
	10	0.6	1.7	-	-	0.3	0.4
	11+	7.3	17.5	1.0	1.7	5.3	7.1
Total numbers		447.2	683.0	457.4	732.1	222.0	303.7
A.S. & S.S.	0	138.4	172.5	63.9	93.2	51.5	64.1
	1	44.2	63.6	-	-	119.4	171.5
	2	249.2	409.4	153.8	246.1	2.9	3.9
	3	0.7	1.8	232.2	380.1	4.7	6.3
	4	1.5	4.1	4.2	7.1	36.3	48.3
	5	6.9	16.5	1.2	1.9	1.3	1.7
	6	0.1	0.4	5.9	9.6	0.6	0.8
	7	0.1	0.4	-	-	1.9	2.5
	8	0.1	0.3	-	-	-	-
	9	0.1	0.4	-	-	-	-
	10	0.6	1.6	-	-	0.3	0.4
	11+	7.6	18.2	1.0	1.7	5.6	7.5
Total numbers		449.6	689.3	462.2	739.7	224.5	307.0
Biomass (t)		33,769	59,793	61,501	99,916	18,863	25,672

Table 40. Stock numbers at age ($x10^6$), by spawning type, and biomass estimates (t) for Conception Bay-Southern Shore core grids only, derived from the 1986 acoustic purse seine survey, using the following relationships between school area and school size (1) $Y = 10.03X^{1.10}$ and (2) $Y = 2.12X^{1.39}$.

Spawning type	Age	1986 (1)	1986 (2)
A.S.	0	-	-
	1	-	-
	2	-	-
	3	0.8	1.0
	4	0.2	0.3
	5	-	-
	6	-	-
	7	0.2	0.3
	8	-	-
	9	-	-
	10	-	-
	11+	-	-
Total numbers		1.2	1.6
S.S.	0	-	-
	1	-	-
	2	0.2	0.3
	3	-	-
	4	8.3	10.4
	5	-	-
	6	0.2	0.3
	7	-	-
	8	-	-
	9	-	-
	10	-	-
	11+	0.2	0.3
Total numbers		8.9	11.3
A.S. & S.S.	0	-	-
	1	-	-
	2	0.2	0.3
	3	0.8	1.0
	4	8.5	10.7
	5	-	-
	6	0.2	0.3
	7	0.2	0.3
	8	-	-
	9	-	-
	10	-	-
	11+	0.2	0.3
Total numbers		10.1	12.9
Biomass (t)		2,650	3,348

Table 41. Stock numbers at age ($x10^6$), by spawning type, and biomass estimates (t) for St. Mary's Bay-Placentia Bay core grids only, derived from the 1986 acoustic purse seine surveys, using the following relationships between school area and school size (1) $Y = 10.03^{1.10}$ and (2) $Y = 2.12^{1.39}$.

Spawning type	Age	1986 (Feb.-Mar.) (1)	1986 (Feb.-Mar.) (2)	1986 (Nov.-Dec.) (1)	1986 (Nov.-Dec.) (2)
A.S.	0	-	-	-	-
	1	-	-	-	-
	2	-	-	-	-
	3	-	-	2.2	5.0
	4	10.4	18.9	0.7	1.7
	5	2.1	3.9	3.6	8.3
	6	0.6	1.1	-	-
	7	5.2	9.5	3.6	8.3
	8	0.3	0.6	-	-
	9	0.6	1.1	-	-
	10	-	-	-	-
	11+	0.3	0.6	0.7	1.7
Total numbers		19.5	35.7	10.8	25.0
S.S.	0	-	-	-	-
	1	-	-	-	-
	2	0.3	0.5	-	-
	3	-	-	0.7	1.7
	4	47.5	86.4	59.8	136.6
	5	5.5	10.0	0.7	1.7
	6	2.5	4.5	0.7	1.7
	7	0.9	1.7	-	-
	8	-	-	-	-
	9	-	-	-	-
	10	-	-	-	-
	11+	0.3	0.5	-	-
Total numbers		57.0	103.6	61.9	141.7
A.S. & S.S.	0	-	-	-	-
	1	-	-	-	-
	2	0.3	0.5	-	-
	3	-	-	2.9	6.7
	4	57.9	105.3	60.5	138.3
	5	7.6	13.9	4.3	10.0
	6	3.1	5.6	0.7	1.7
	7	6.1	11.2	3.6	8.3
	8	0.3	0.6	-	-
	9	0.6	1.1	-	-
	10	-	-	-	-
	11+	0.6	1.1	0.7	1.7
Total numbers		76.5	139.3	72.7	166.7
Biomass (t)		20,000	36,336	18,437	42,188

Table 42. Stock numbers at age ($x10^6$), by spawning type, and biomass estimates for (†) Fortune Bay core grids only, derived from the 1985 and 1986 acoustic purse seine surveys, using the following relationships between school area and school size (1) $Y = 10.03X^{1.10}$ and (2) $Y = 2.12X^{1.39}$.

Spawning type	Age	1985 (1)	1985 (2)	1986 (Nov.-Dec.) (1)	1986 (Nov.-Dec.) (2)
A.S.	0	-	-	-	-
	1	-	-	-	-
	2	-	-	-	-
	3	1.5	4.2	-	-
	4	2.0	4.3	0.3	0.6
	5	0.5	1.0	-	-
	6	2.2	4.7	0.2	0.3
	7	0.1	0.3	0.3	0.6
	8	0.1	0.3	-	-
	9	0.1	0.3	0.3	0.6
	10	-	-	0.3	0.6
	11+	-	-	0.2	0.3
Total numbers		6.5	15.1	1.6	3.0
S.S.	0	-	-	-	-
	1	-	-	-	-
	2	-	-	-	-
	3	49.3	109.4	-	-
	4	0.2	0.7	9.6	17.8
	5	4.4	10.2	0.3	0.6
	6	1.8	4.2	0.9	1.8
	7	-	-	0.6	1.2
	8	0.1	0.3	0.5	0.9
	9	0.1	0.3	-	-
	10	0.1	0.3	0.5	0.9
	11+	0.3	1.0	1.7	3.2
Total numbers		56.3	126.4	14.1	26.4
A.S. & S.S.	0	-	-	-	-
	1	-	-	-	-
	2	-	-	-	-
	3	50.8	113.6	-	-
	4	2.2	5.0	9.9	18.4
	5	4.9	11.2	0.3	0.6
	6	4.0	8.9	1.1	2.1
	7	0.1	0.3	0.9	1.8
	8	0.2	0.6	0.5	0.9
	9	0.2	0.6	0.3	0.6
	10	0.1	0.0	0.8	1.5
	11+	0.3	1.0	1.9	3.5
Total numbers		62.8	141.2	15.7	29.4
Biomass (†)		10,402	23,345	4,909	9,117

Table 43. Population numbers at age, spring and autumn spawners combined, from acoustic purse seine surveys, 1983-86, projected to January 1987 assuming no fishing mortality and a natural mortality rate of 0.20.

WHITE BAY-NOTRE DAME BAY

	January 1987 population numbers ($x10^6$) from survey year				
Year-class	1983	1984	1985	1986	Average
1987	-	-	-	-	-
1986	-	-	-	0.0	0.0
1985	-	-	0.0	7.4	3.7
1984	-	0.0	0.0	2.5	0.8
1983	199.7	73.6	209.9	16.2	124.9
1982	314.1	224.2	398.5	124.9	265.4
1981	10.6	1.8	4.5	10.6	6.9
1980	1.4	1.4	0.0	19.1	5.5
1979	26.2	14.6	9.3	24.5	18.7
1978	1.3	3.1	0.0	1.0	1.4
1977	1.3	2.4	0.0	0.2	1.0
pre 1977	27.5	71.1	12.5	47.3	39.6

BONAVISTA BAY-TRINITY BAY

	January 1987 population numbers ($x10^6$) from survey year			
Year-class	1984	1985	1986	Average
1987	-	-	-	-
1986	-	-	62.2	62.2
1985	-	73.8	166.4	120.1
1984	111.8	0.0	3.8	38.5
1983	41.2	194.8	6.1	80.7
1982	265.4	301.0	46.9	204.4
1981	1.2	5.6	1.6	2.8
1980	2.7	1.5	0.8	1.7
1979	10.7	7.6	2.4	6.9
1978	0.3	0.0	0.0	0.1
1977	0.3	0.0	0.0	0.1
pre 1977	13.3	1.4	7.5	7.4

CONCEPTION BAY-SOUTHERN SHORE

	January 1987 population numbers ($x10^6$) from 1986 survey
1987	-
1986	0.0
1985	0.0
1984	0.3
1983	1.0
1982	10.5
1981	0.0
1980	0.3
1979	0.3
1978	0.0
1977	0.0
pre 1977	0.3

Table 43. Continued.

ST. MARY'S BAY-PLACENTIA BAY

Year-class	January 1987 population numbers (x10^6) from survey year: 1986[a]	1986[b]	Average
1987	-	-	-
1986	0.0	0.0	0.0
1985	0.0	0.0	0.0
1984	0.4	0.0	0.2
1983	0.0	6.6	3.3
1982	90.7	136.1	113.4
1981	12.0	9.9	11.0
1980	4.8	1.7	3.3
1979	9.7	8.2	9.0
1978	0.5	0.0	0.3
1977	0.9	0.0	0.5
pre 1977	0.9	1.7	1.3

FORTUNE BAY

Year-class	January 1987 population numbers (x10^6) from survey year: 1985	1986[b]	Average
1987	-	-	-
1986	-	0.0	0.0
1985	0.0	0.0	0.0
1984	0.0	0.0	0.0
1983	0.0	0.0	0.0
1982	78.4	18.1	48.3
1981	3.5	0.6	2.1
1980	7.8	2.1	5.0
1979	6.2	1.8	4.0
1978	0.2	0.9	0.6
1977	0.4	0.6	0.5
pre 1977	1.3	4.9	3.1

[a] February - March, 1986

[b] November - December, 1986

Table 44. 1988 catch projections for White Bay-Notre Dame Bay using the average population vector derived from the acoustic purse seine surveys, zero recruitment at age 2, a partial recruitment vector for a combined purse seine and gillnet fishery, and F = 0.30 in 1988. Option #1 assumes a catch of 31,500 t in 1987; Option #2 assumes F = 0.30 in 1987.

Option #1	Age	Population numbers ($\times 10^3$)	Population weight (t)	Fishing mortality	Catch numbers ($\times 10^3$)	Catch weight (t)	Residual numbers ($\times 10^3$)
	2	0	0	.030	0	0	0
	3	2904	418	.105	263	38	2141
	4	565	114	.180	85	17	386
	5	79404	17707	.300	18746	4180	48161
	6	142540	38771	.300	33651	9153	86455
	7	3706	1034	.300	875	244	2248
	8	2954	933	.300	697	220	1792
	9	10043	3314	.300	2371	782	6092
	10	752	247	.300	178	58	456
	11+	21805	8090	.300	5148	1910	13226
	Total	264673	70628		62013	16603	160955

Option #2	Age	Population numbers ($\times 10^3$)	Population weight (t)	Fishing mortality	Catch numbers ($\times 10^3$)	Catch weight (t)	Residual numbers ($\times 10^3$)
	2	0	0	.030	0	0	0
	3	2940	423	.105	266	38	2167
	4	590	119	.180	88	18	403
	5	85414	19047	.300	20165	4497	51806
	6	160973	43785	.300	38003	10337	97635
	7	4185	1168	.300	988	276	2538
	8	3336	1054	.300	788	249	2023
	9	11342	3743	.300	2678	884	6879
	10	849	279	.300	200	66	515
	11+	24625	9136	.300	5814	2157	14936
	Total	294254	78753		68989	18520	178904

Table 45. 1988 catch projections for Bonavista Bay-Trinity Bay using the average population vector derived from the acoustic purse seine surveys, zero recruitment at age 2, a partial recruitment vector for a combined purse seine and gillnet fishery, and F = 0.30 in 1988. Option #1 assumes a catch of 13,700 t in 1987; Option #2 assumes F = 0.30 in 1987.

Option #1	Age	Population numbers ($\times 10^3$)	Population weight (t)	Fishing mortality	Catch numbers ($\times 10^3$)	Catch weight (t)	Residual numbers ($\times 10^3$)
	2	0	0	.030	0	0	0
	3	95847	11597	.105	8674	1050	70651
	4	28822	5419	.180	4316	811	19710
	5	56673	13318	.300	13379	3144	34374
	6	129586	36025	.300	30593	8505	78598
	7	1775	531	.300	419	125	1077
	8	1078	352	.300	254	83	654
	9	4374	1575	.300	1033	372	2653
	10	63	23	.300	15	5	38
	11+	4755	1897	.300	1123	448	2884
	Total	322974	70738		59806	14544	210639

Option #2	Age	Population numbers ($\times 10^3$)	Population weight (t)	Fishing mortality	Catch numbers ($\times 10^3$)	Catch weight (t)	Residual numbers ($\times 10^3$)
	2	0	0	.030	0	0	0
	3	95423	11546	.105	8636	1045	70339
	4	28379	5335	.180	4250	799	19407
	5	55188	12969	.300	13029	3062	33473
	6	123975	34465	.300	29268	8137	75195
	7	1698	508	.300	401	120	1030
	8	1031	337	.300	243	80	625
	9	4185	1507	.300	988	356	2538
	10	61	22	.300	14	5	37
	11+	4549	1815	.300	1074	428	2759
	Total	314489	68504		57903	14031	205404

Table 46. 1988 catch projections for Conception Bay-Southern Shore using the population vector derived from the 1986 acoustic purse seine survey, zero recruitment at age 2, a partial recruitment vector for a combined purse seine and gillnet fishery, and F = 0.30 in 1988. Option #1 assumes F = 0.30 in 1987.

Option #1	Age	Population numbers ($\times 10^3$)	Population weight (t)	Fishing mortality	Catch numbers ($\times 10^3$)	Catch weight (t)	Residual numbers ($\times 10^3$)
	2	0	0	.030	0	0	0
	3	0	0	.105	0	0	0
	4	221	44	.180	33	7	151
	5	684	167	.300	161	39	415
	6	6369	1802	.300	1504	425	3863
	7	0	0	.300	0	0	0
	8	182	65	.300	43	15	110
	9	182	66	.300	43	16	110
	10	0	0	.300	0	0	0
	11+	182	74	.300	43	18	110
	Total	7819	2219		1827	520	4760

Table 47. 1988 catch projections for St. Mary's Bay–Placentia Bay using the average population vector derived from the acoustic purse seine surveys, zero recruitment at age 2, a partial recruitment vector for a combined purse seine and gillnet fishery, and F = 0.30 in 1988. Option #1 assumes a catch of 2550 t in 1987; Option #2 assumes F = 0.30 in 1987.

Option #1	Age	Population numbers ($\times 10^3$)	Population weight (t)	Fishing mortality	Catch numbers ($\times 10^3$)	Catch weight (t)	Residual numbers ($\times 10^3$)
	2	0	0	.030	0	0	0
	3	0	0	.105	0	0	0
	4	159	34	.180	24	5	109
	5	2582	676	.300	610	160	1566
	6	86080	24533	.300	20322	5792	52210
	7	8350	2572	.300	1971	607	5064
	8	2505	937	.300	591	221	1519
	9	6832	2412	.300	1613	569	4144
	10	228	89	.300	54	21	138
	11+	1366	626	.300	323	148	829
	Total	108102	31879		25507	7523	65579

Option #2	Age	Population numbers ($\times 10^3$)	Population weight (t)	Fishing mortality	Catch numbers ($\times 10^3$)	Catch weight (t)	Residual numbers ($\times 10^3$)
	2	0	0	.030	0	0	0
	3	0	0	.105	0	0	0
	4	147	32	.180	22	5	101
	5	2257	591	.300	533	140	1369
	6	68781	19602	.300	16238	4628	41718
	7	6672	2055	.300	1575	485	4047
	8	2002	749	.300	473	177	1214
	9	5459	1927	.300	1289	455	3311
	10	182	71	.300	43	17	110
	11+	1092	500	.300	258	118	662
	Total	86591	25527		20430	6024	52531

Table 48. 1988 catch projections for Fortune Bay using the average population vector derived from the acoustic purse seine surveys, zero recruitment at age 2, a partial recruitment vector for a combined purse seine and gillnet fishery, and F = 0.30 in 1988. Option #1 assumes a catch of 2400 t in 1987; Option #2 assumes F = 0.30 in 1987.

Option #1	Age	Population numbers ($\times 10^3$)	Population weight (t)	Fishing mortality	Catch numbers ($\times 10^3$)	Catch weight (t)	Residual numbers ($\times 10^3$)
	2	0	0	.030	0	0	0
	3	0	0	.105	0	0	0
	4	0	0	.180	0	0	0
	5	0	0	.300	0	0	0
	6	33503	9582	.300	7909	2262	20320
	7	1457	463	.300	344	109	883
	8	3468	1283	.300	819	303	2104
	9	2775	1151	.300	655	272	1683
	10	416	171	.300	98	40	252
	11+	2497	1184	.300	590	279	1515
	Total	44115	13835		10415	3266	26757

Option #2	Age	Population numbers ($\times 10^3$)	Population weight (t)	Fishing mortality	Catch numbers ($\times 10^3$)	Catch weight (t)	Residual numbers ($\times 10^3$)
	2	0	0	.030	0	0	0
	3	0	0	.105	0	0	0
	4	0	0	.180	0	0	0
	5	0	0	.300	0	0	0
	6	29295	8378	.300	6916	1978	17769
	7	1274	405	.300	301	96	773
	8	3033	1122	.300	716	265	1839
	9	2426	1007	.300	573	238	1472
	10	364	150	.300	86	35	221
	11+	2184	1035	.300	515	244	1324
	Total	38575	12097		9107	2856	23397

Table 49. Illustrative projections, 1987-95, for White Bay-Notre Dame Bay, using the average population vector derived from the acoustic purse seine surveys, a combined purse seine and gillnet partial recruitment vector, and options of F = 0.30, F = 0.20, and recruitment at age 2 of 0 and 10,000 ($x10^3$).

F	Recruit.	Year	Population numbers ($x10^3$)	Population weight (t)	Catch weight (t)
0.30	0	1987	467900	109428	31500
		1988	264673	70628	16603
		1989	160955	46112	10849
		1990	97790	30366	7169
		1991	59313	19590	4625
		1992	35975	12022	2838
		1993	21820	7795	1840
		1994	13234	4900	1157
		1995	8027	2973	702
0.20	0	1987	467900	109428	31500
		1988	264673	70628	11592
		1989	177717	50929	8367
		1990	119251	37046	6107
		1991	79937	26409	4353
		1992	53583	17911	2952
		1993	35918	12833	2115
		1994	24076	8917	1470
		1995	16139	5978	985
0.30	10,000	1987	467900	109428	31500
		1988	274673	71228	16619
		1989	178901	47857	10969
		1990	121592	33287	7465
		1991	87120	23404	5132
		1992	66211	16498	3501
		1993	53530	12681	2600
		1994	45838	10069	1983
		1995	41173	8320	1571
0.20	10,000	1987	467900	109428	31500
		1988	274673	71228	11603
		1989	195743	52684	8449
		1990	143403	40033	6315
		1991	108537	30388	4725
		1992	85165	22701	3458
		1993	69499	18181	2713
		1994	58997	14688	2137
		1995	51958	12046	1701

Table 50. Illustrative projections, 1987-95, for Bonavista Bay-Trinity Bay, using the average population vector derived from the acoustic purse seine surveys, a combined purse seine and gillnet partial recruitment vector, and options of F = 0.30, F = 0.20, and recruitment at age 2 of 0 and 10,000 ($x10^3$).

F	Recruit.	Year	Population numbers ($x10^3$)	Population weight (t)	Catch weight (t)
0.30	0	1987	462700	81518	13700
		1988	322974	70738	14544
		1989	210639	53696	11530
		1990	133223	38230	9025
		1991	80804	25918	6119
		1992	49010	16583	3915
		1993	29726	10827	2556
		1994	18030	6885	1626
		1995	10936	4232	999
0.20	0	1987	462700	81518	13700
		1988	322974	70738	10123
		1989	227024	58218	8742
		1990	156264	45152	7443
		1991	104747	33775	5568
		1992	70214	23865	3934
		1993	47066	17209	2837
		1994	31549	12076	1991
		1995	21148	8201	1352
0.30	10,000	1987	462700	81518	13700
		1988	332974	71328	14559
		1989	228585	55247	11633
		1990	157025	40882	9293
		1991	108611	29512	6609
		1992	79246	20852	4564
		1993	61436	15536	3309
		1994	50633	11887	2448
		1995	44081	9429	1868
0.20	10,000	1987	462700	81518	13700
		1988	332974	71328	10134
		1989	245050	59779	8812
		1990	180415	47865	7631
		1991	133347	37534	5928
		1992	101796	28452	4431
		1993	80647	22394	3433
		1994	66470	17699	2659
		1995	56967	14147	2073

Table 51. Illustrative projections, 1987-95, for Conception Bay-Southern Shore, using the average population vector derived from the acoustic purse seine surveys, a combined purse seine and gillnet partial recruitment vector, and options of F = 0.30, F = 0.20, and recruitment at age 2 of 0 and 5,000 ($x10^3$).

F	Recruit.	Year	Population numbers ($x10^3$)	Population weight (t)	Catch weight (t)
0.30	0	1987	12700	3115	713
		1988	7819	2219	520
		1989	4760	1445	341
		1990	2887	1014	239
		1991	1751	639	151
		1992	1062	407	96
		1993	644	261	62
		1994	391	159	38
		1995	237	97	23
0.20	0	1987	12700	3115	713
		1988	7819	2219	363
		1989	5254	1595	263
		1990	3522	1237	204
		1991	2361	862	142
		1992	1582	606	100
		1993	1061	430	71
		1994	711	290	48
		1995	477	195	32
0.30	5,000	1987	12700	3115	713
		1988	12819	2569	529
		1989	13733	2248	391
		1990	14788	2399	377
		1991	15655	2514	404
		1992	16180	2625	430
		1993	16499	2701	448
		1994	16692	2758	462
		1995	16810	2794	470
0.20	5,000	1987	12700	3115	713
		1988	12819	2569	369
		1989	14266	2403	297
		1990	15598	2654	301
		1991	16661	2822	329
		1992	17373	2988	356
		1993	17851	3113	376
		1994	18171	3211	393
		1995	18386	3279	404

Table 52. Illustrative projections, 1987-95, for St. Mary's Bay-Placentia Bay, using the average population vector derived from the acoustic purse seine surveys, a combined purse seine and gillnet partial recruitment vector, and options of F = 0.30, F = 0.20, and recruitment at age 2 of 0 and 5,000 ($x10^3$).

F	Recruit.	Year	Population numbers ($x10^3$)	Population weight (t)	Catch weight (t)
0.30	0	1987	142300	38867	2550
		1988	108102	31879	7523
		1989	65579	21049	4969
		1990	39776	15019	3546
		1991	24125	8853	2090
		1992	14633	5883	1389
		1993	8875	4049	956
		1994	5383	2465	582
		1995	3265	1495	353
0.20	0	1987	142300	38867	2550
		1988	108102	31879	5253
		1989	72472	23262	3834
		1990	48579	18344	3024
		1991	32564	11950	1970
		1992	21828	8775	1447
		1993	14632	6675	1100
		1994	9808	4491	740
		1995	6574	3011	496
0.30	5,000	1987	142300	38867	2550
		1988	113102	32324	7535
		1989	74552	22138	5039
		1990	51677	16737	3710
		1991	38029	11096	2378
		1992	29751	8472	1759
		1993	24730	6865	1380
		1994	21685	5448	1045
		1995	19838	4574	839
0.20	5,000	1987	142300	38867	2550
		1988	113102	32324	5261
		1989	81484	24357	3882
		1990	60655	20097	3139
		1991	46864	14287	2181
		1992	37619	11536	1728
		1993	31422	9745	1433
		1994	27268	7811	1114
		1995	24484	6489	896

Table 53. Illustrative projections, 1987-95, for Fortune Bay, using the average population vector derived from the acoustic purse seine surveys, a combined purse seine and gillnet partial recruitment vector, and options of F = 0.30, F = 0.20, and recruitment at age 2 of 0 and 5,000 ($x10^3$).

F	Recruit.	Year	Population numbers ($x10^3$)	Population weight (t)	Catch weight (t)
0.30	0	1987	63600	17284	2400
		1988	44155	13835	3266
		1989	26757	9193	2170
		1990	16299	6300	1487
		1991	9843	4205	993
		1992	5970	2549	602
		1993	3621	1716	405
		1994	2196	1041	246
		1995	1332	631	149
0.20	0	1987	63600	17284	2400
		1988	44115	13835	2281
		1989	29571	10159	1675
		1990	19822	7695	1268
		1991	13287	5676	936
		1992	8907	3802	627
		1993	5970	2830	466
		1994	4002	1897	313
		1995	2683	1272	210
0.30	5,000	1987	63600	17284	2400
		1988	49115	14210	3276
		1989	35730	10152	2233
		1990	28130	7871	1642
		1991	23747	6260	1262
		1992	21089	4952	953
		1993	19476	4354	812
		1994	18498	3844	691
		1995	17905	3547	621
0.20	5,000	1987	63600	17284	2400
		1988	49115	14210	2287
		1989	38584	11124	1718
		1990	31898	9300	1377
		1991	27587	7819	1133
		1992	24698	6372	894
		1993	22761	5718	787
		1994	21462	5032	674
		1995	20592	4593	601

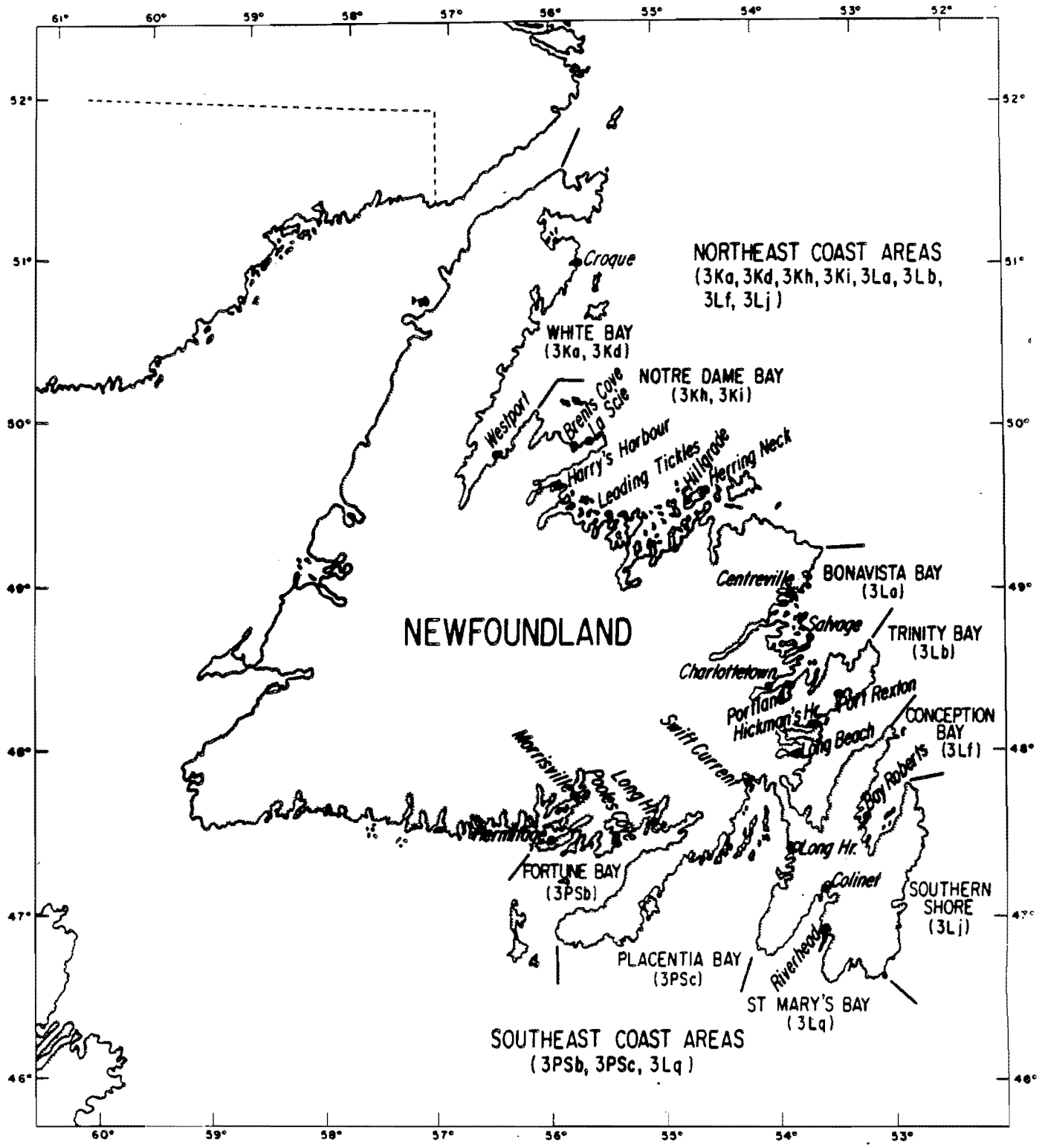

Fig. 1. Area map indicating herring stock complexes and research gillnet community locations within the Newfoundland region.

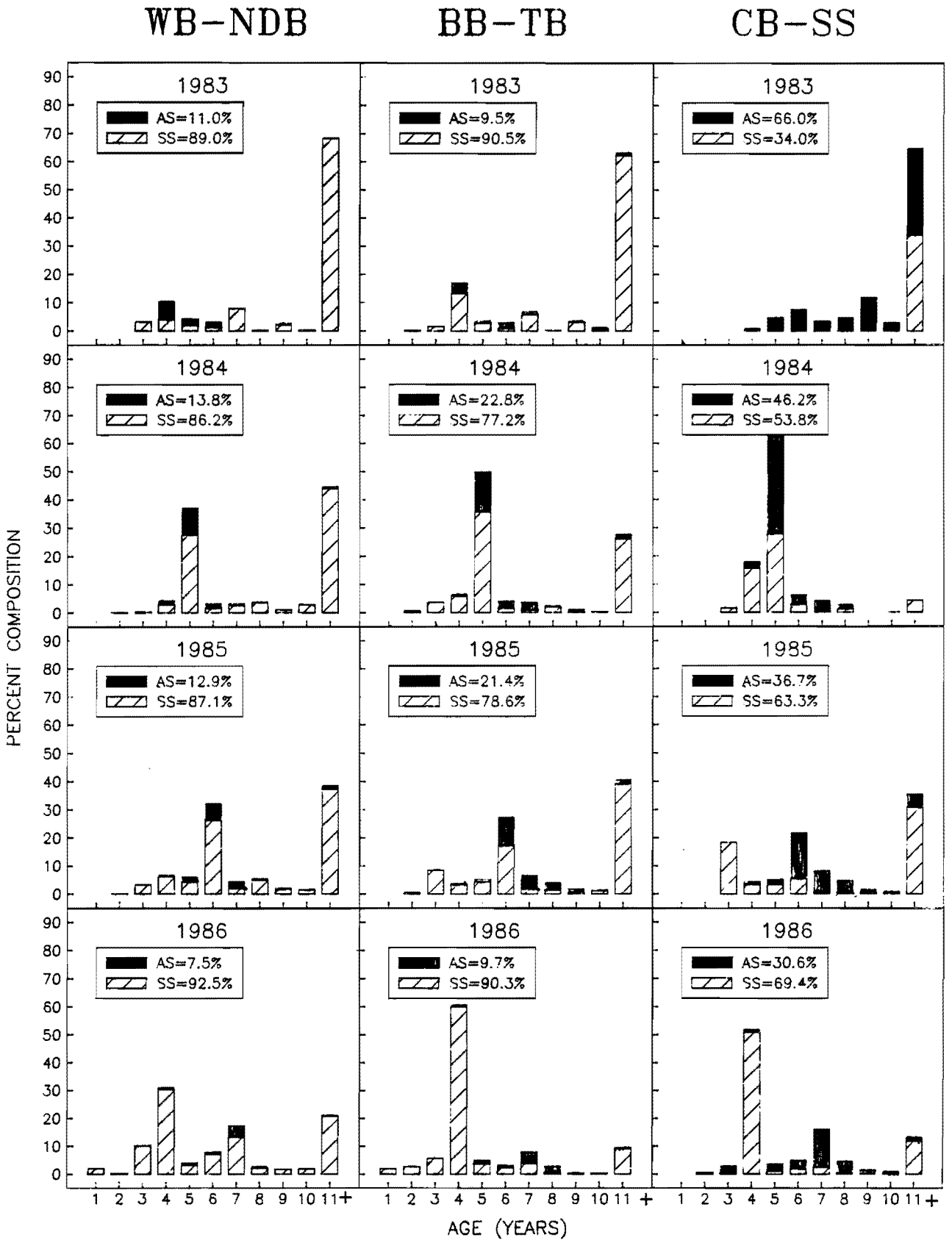

Fig.2. Age composition of herring from the commercial fishery, White Bay – Notre Dame Bay (WB–NDB), Bonavista Bay – Trinity Bay (BB–TB), and Conception Bay – Southern Shore (CB–SS), 1983–86.

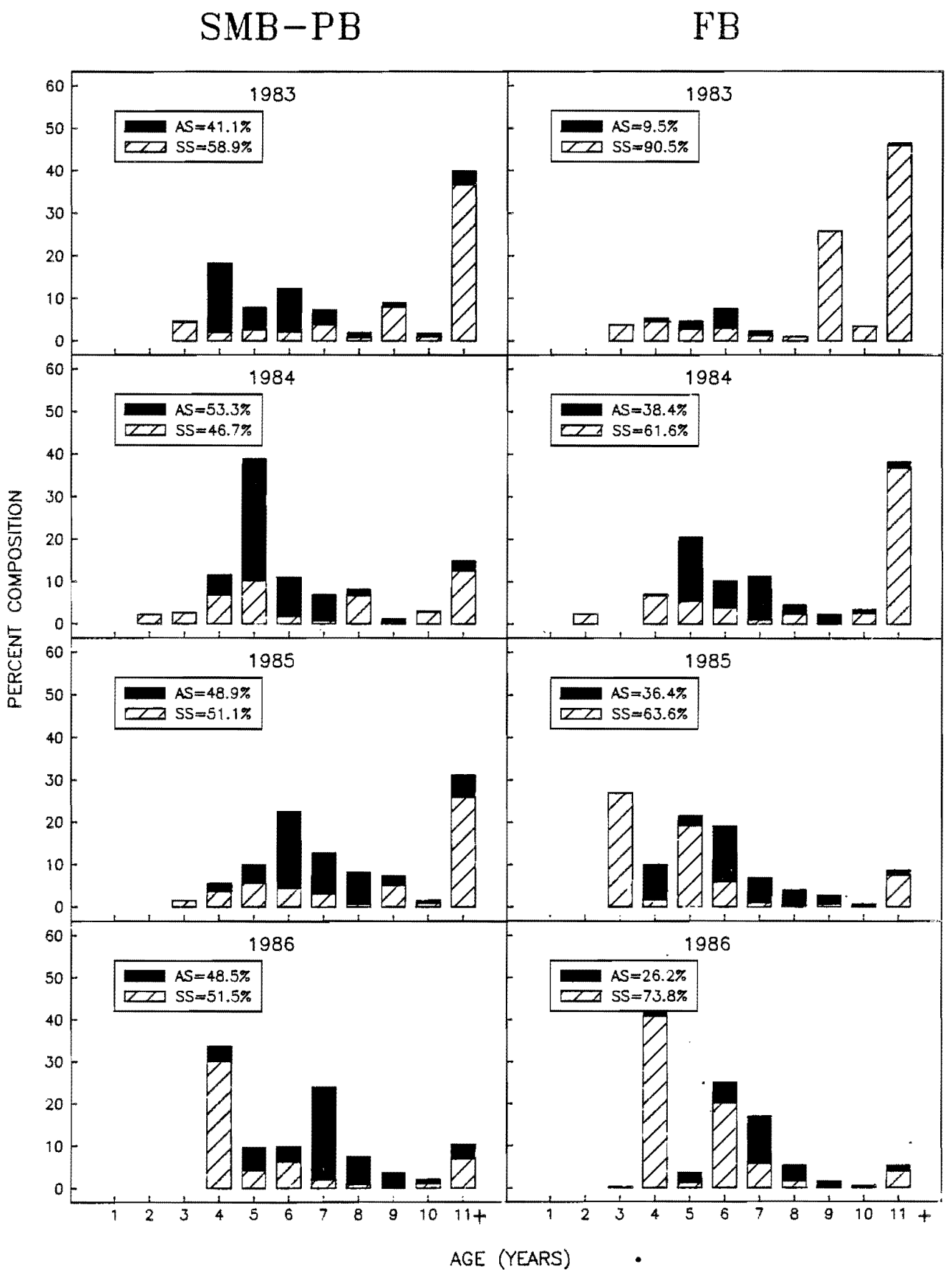

Fig.3. Age composition of herring from commercial fishery, St. Mary's Bay – Placentia Bay (SMB–PB), and Fortune Bay (FB), 1983–86.

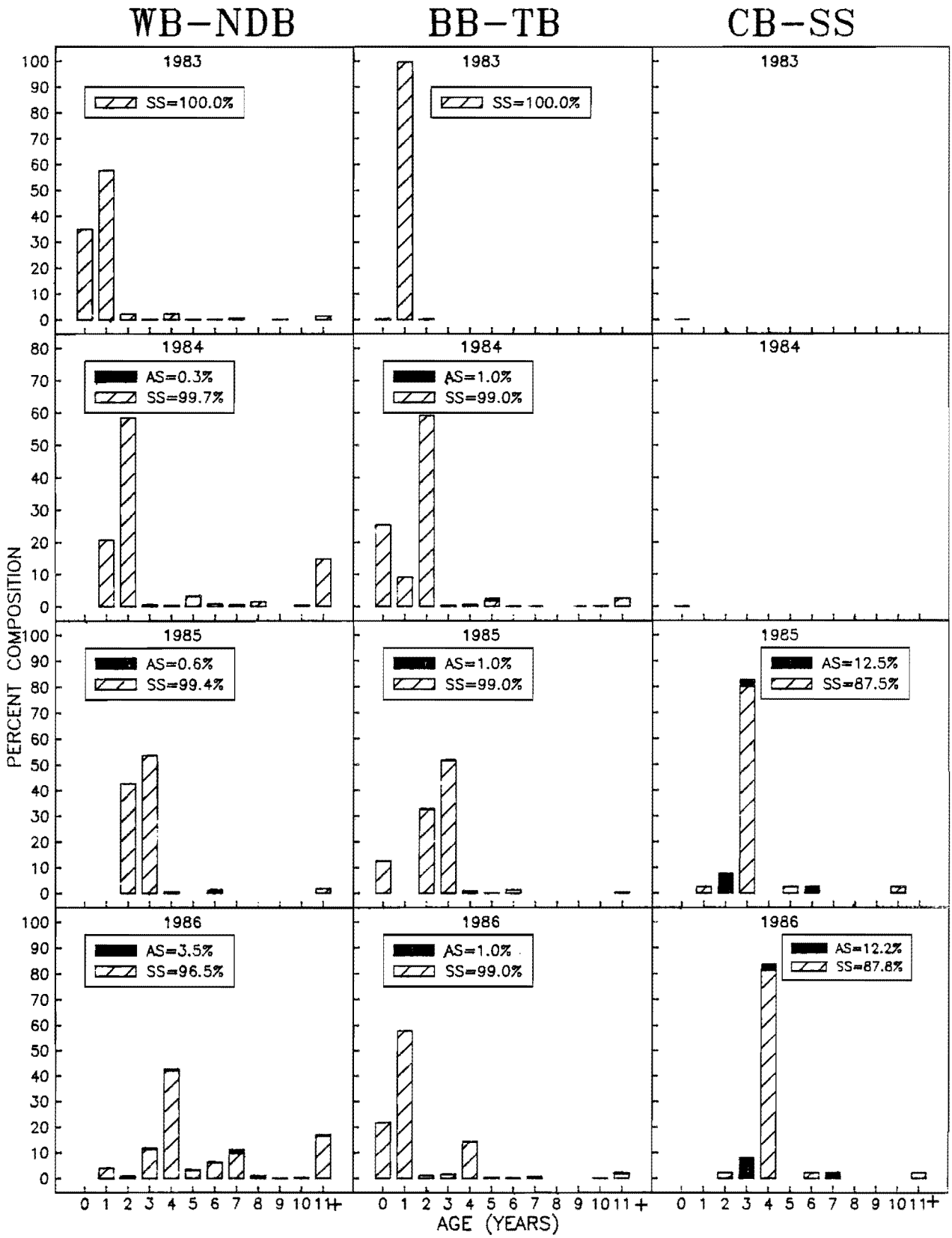

Fig.4. Stock age composition of herring from acoustic purse seine surveys, 1983–86, for White Bay–Notre Dame Bay (WB–NDB), Bonavista Bay–Trinity Bay (BB–TB), and Conception Bay–Southern Shore (CB–SS).

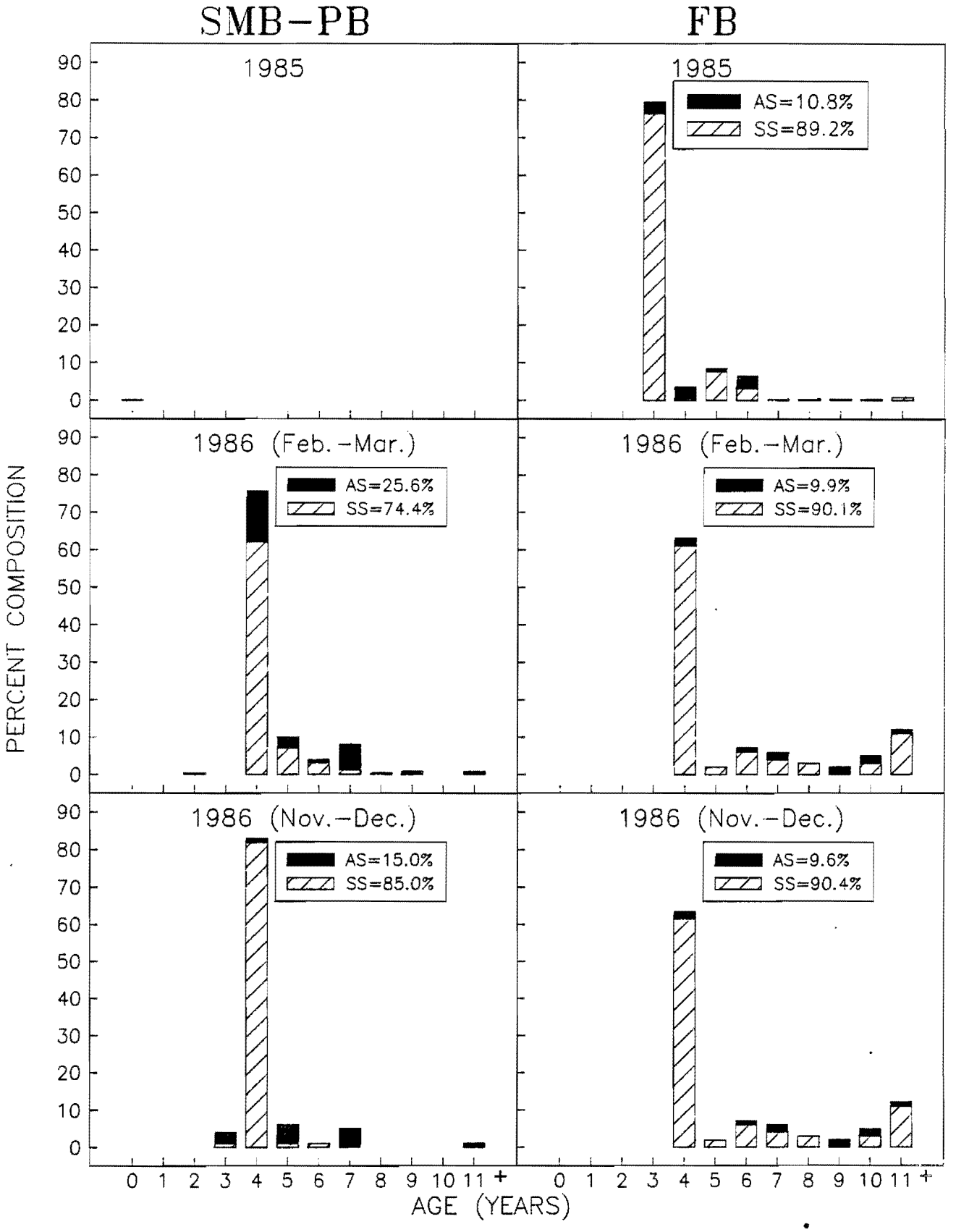

Fig.5. Stock age composition of herring from acoustic purse seine surveys, 1985–86, for St. Mary's Bay–Placentia Bay (SMB–PB), and Fortune Bay (FB).

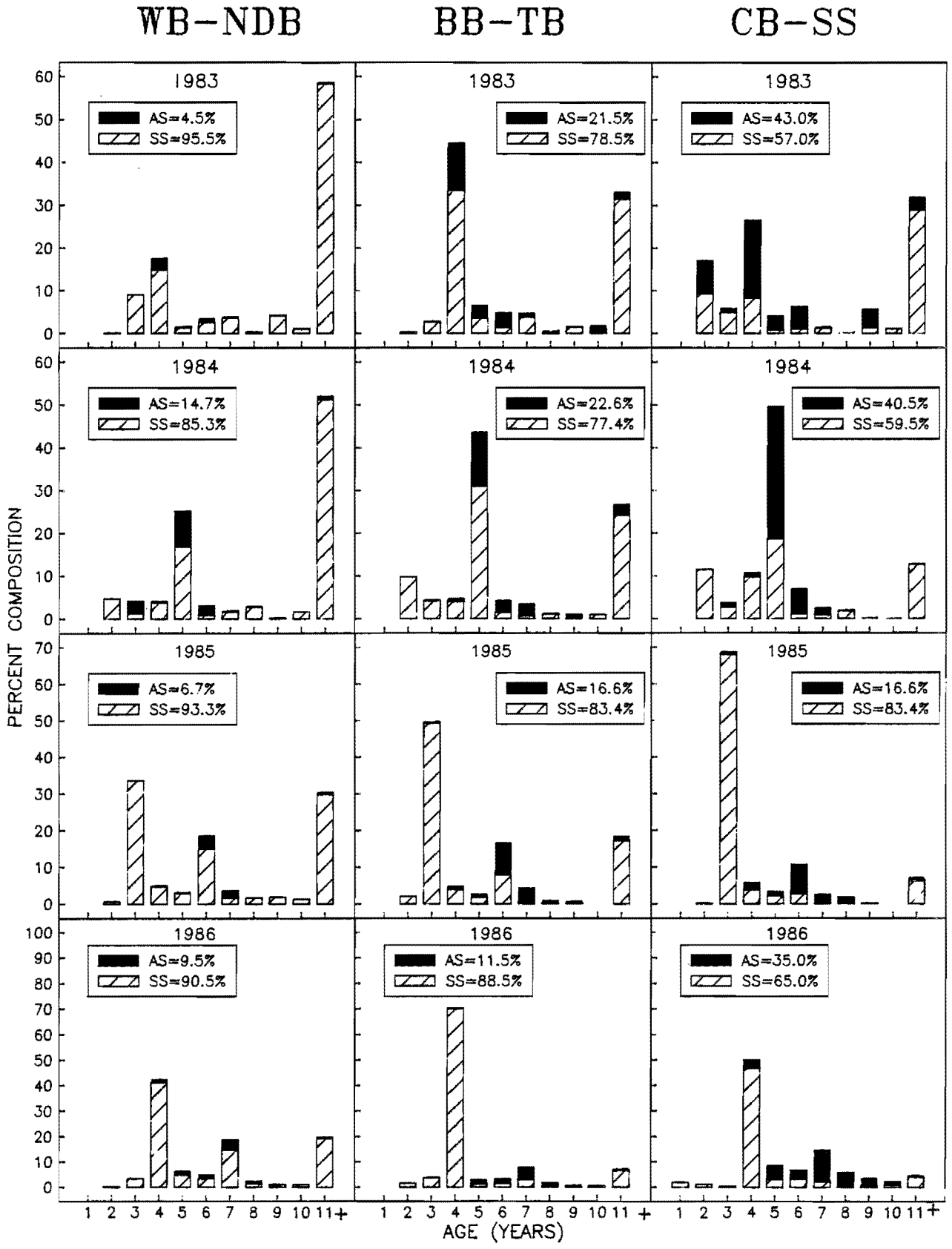

Fig.6. Age composition of herring from research gillnets, White Bay – Notre Dame Bay, Bonavista Bay – Trinity Bay, and Conception Bay – Southern Shore, 1983–86.

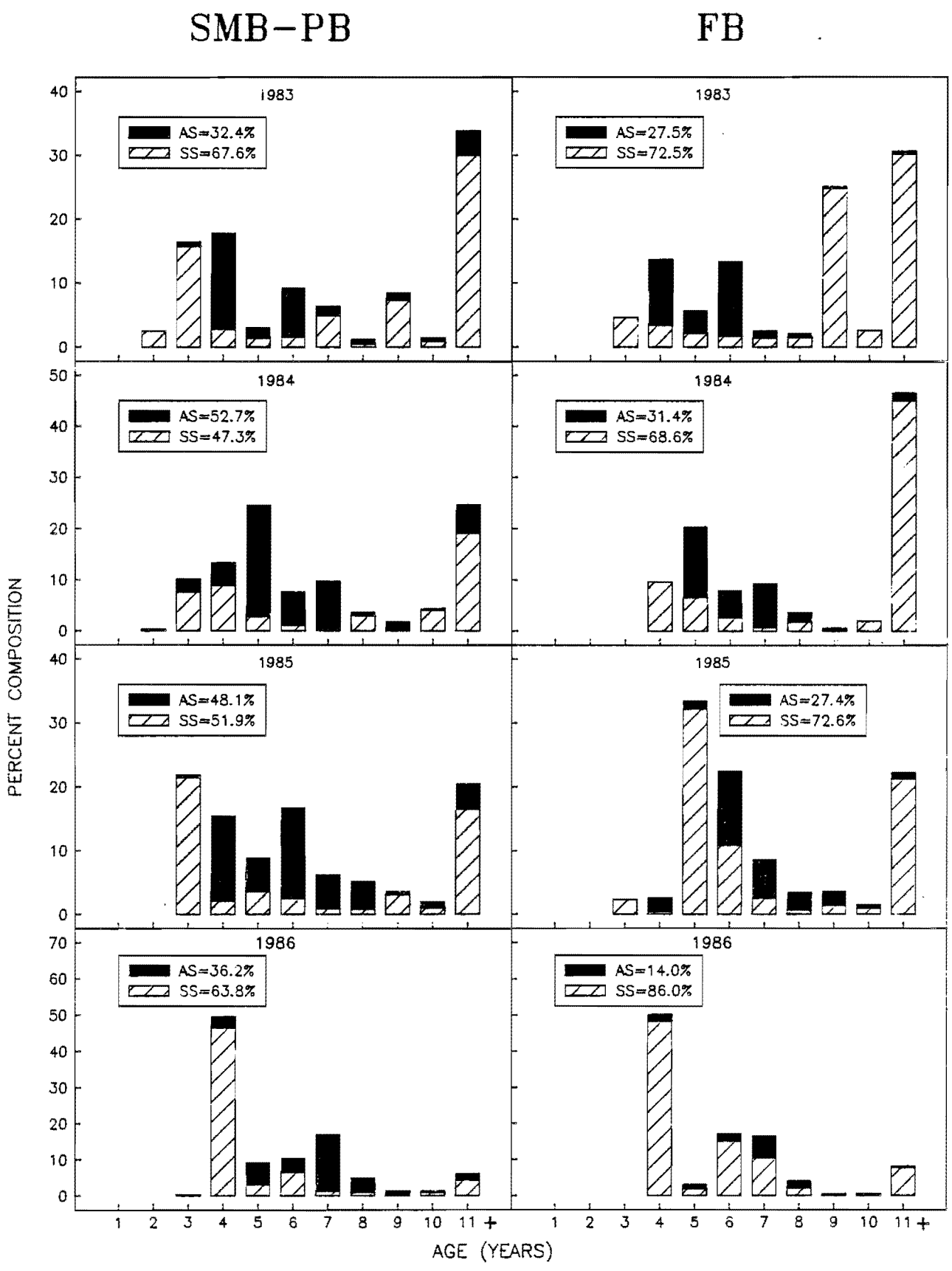

Fig.7. Age composition of herring from research gillnets, St. Mary – Placentia Bays and Fortune Bay, 1983–86.

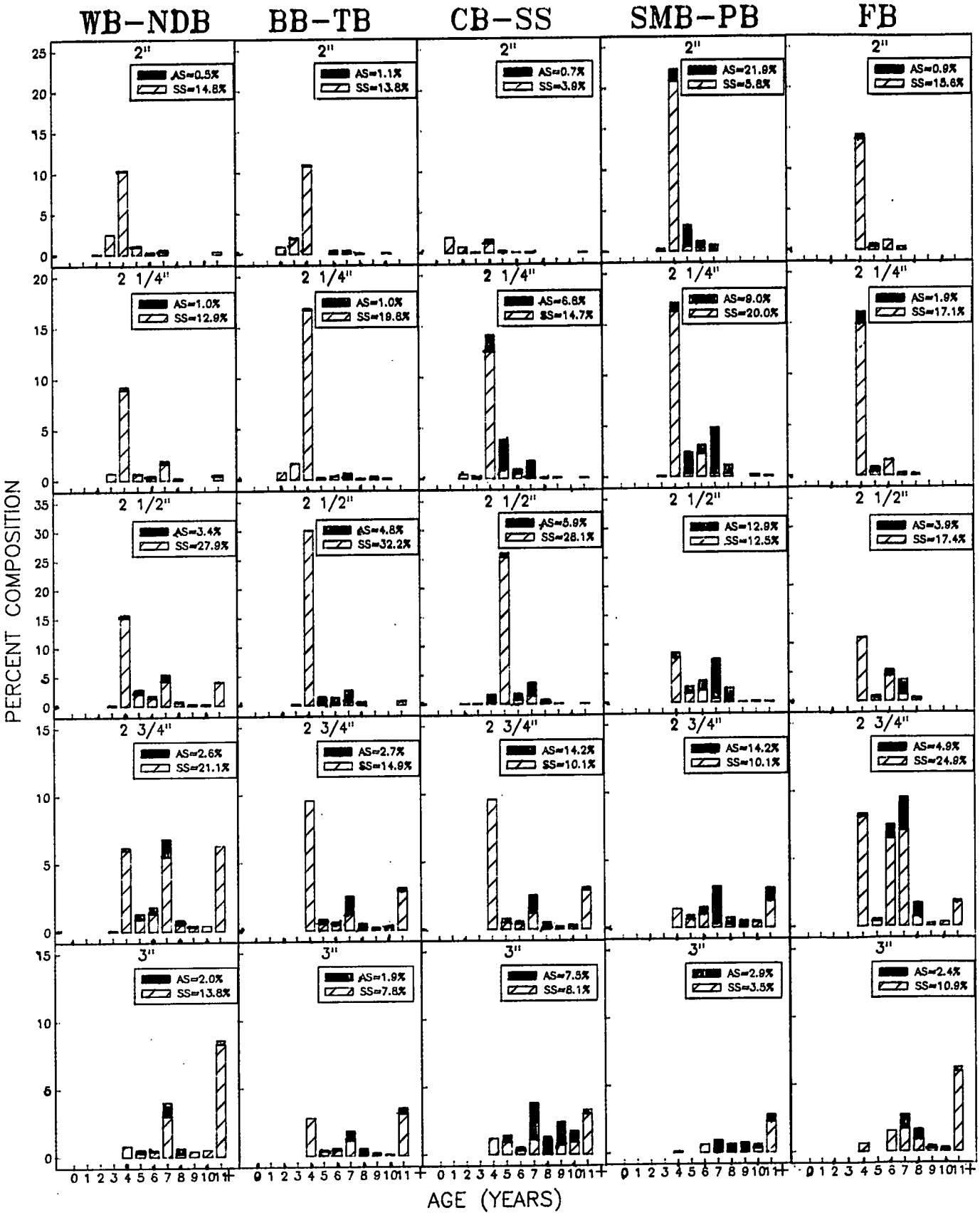

Fig.8 . Catch at age by mesh size from 1986..research gillnet program.

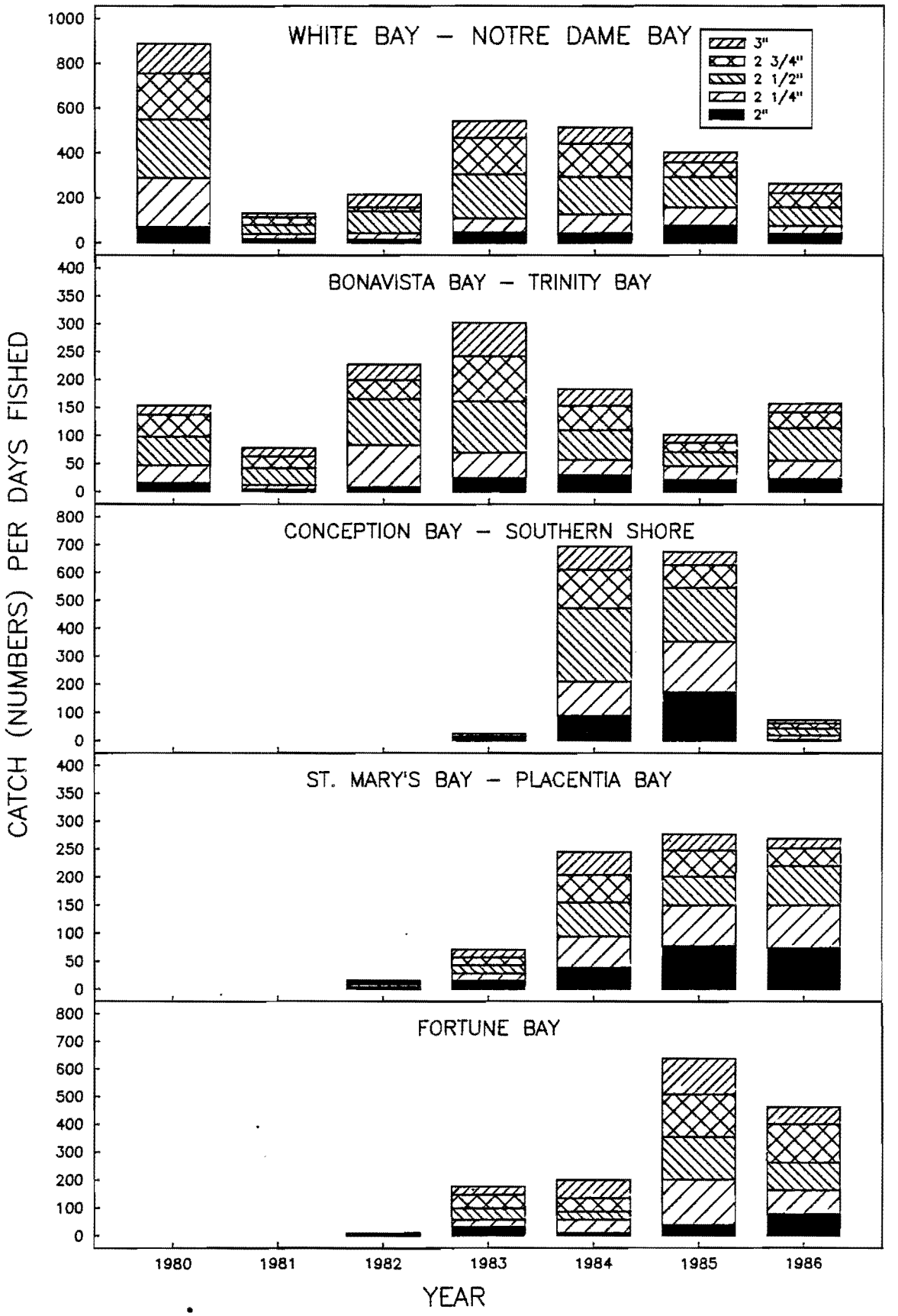

Fig.9. Catch rate (number of fish caught per days fished) by mesh size from the research gillnet program, 1980–86.

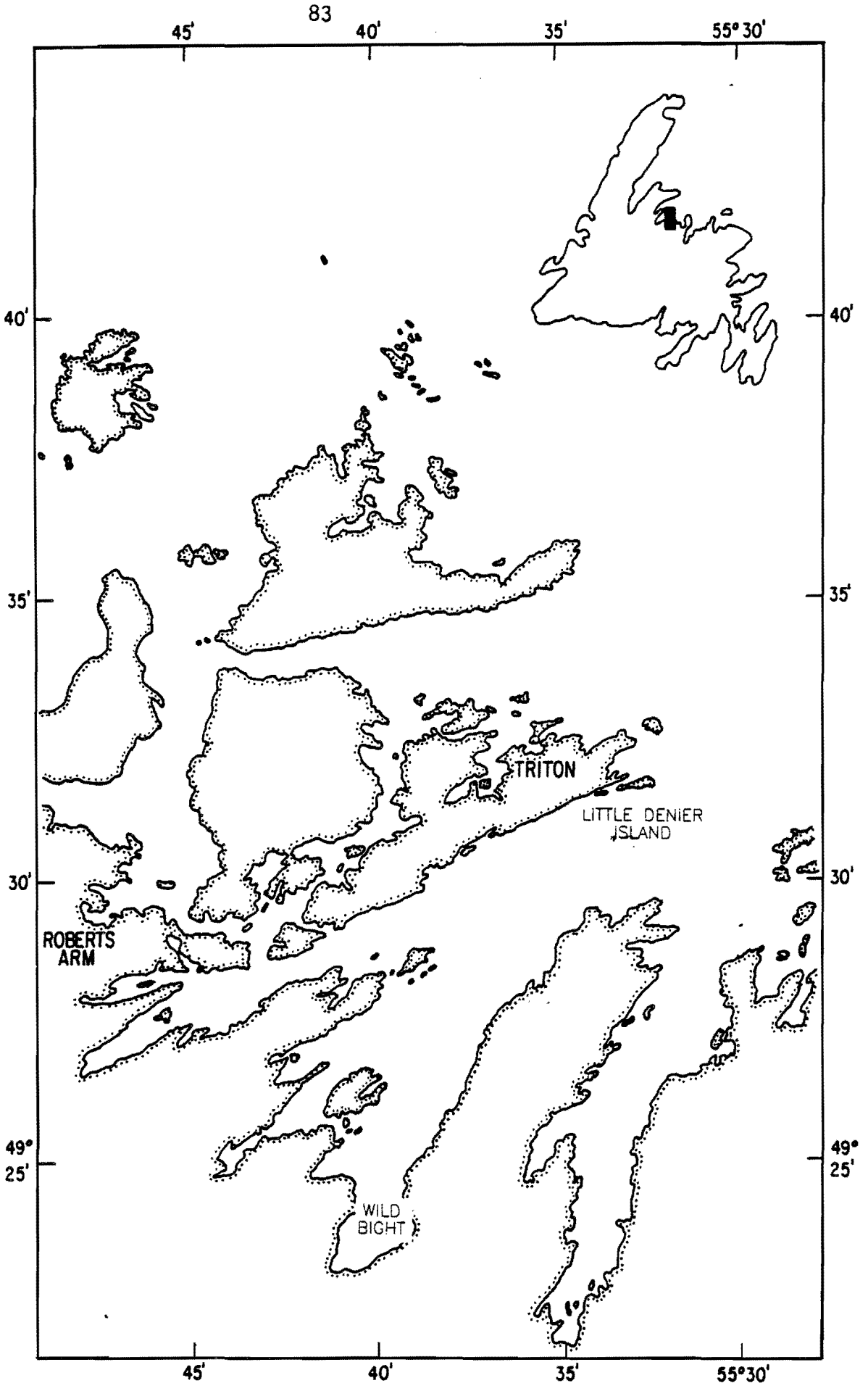

Fig.10. Location of herring schools measured by BIOSONICS hydroacoustic system, Notre Dame Bay.

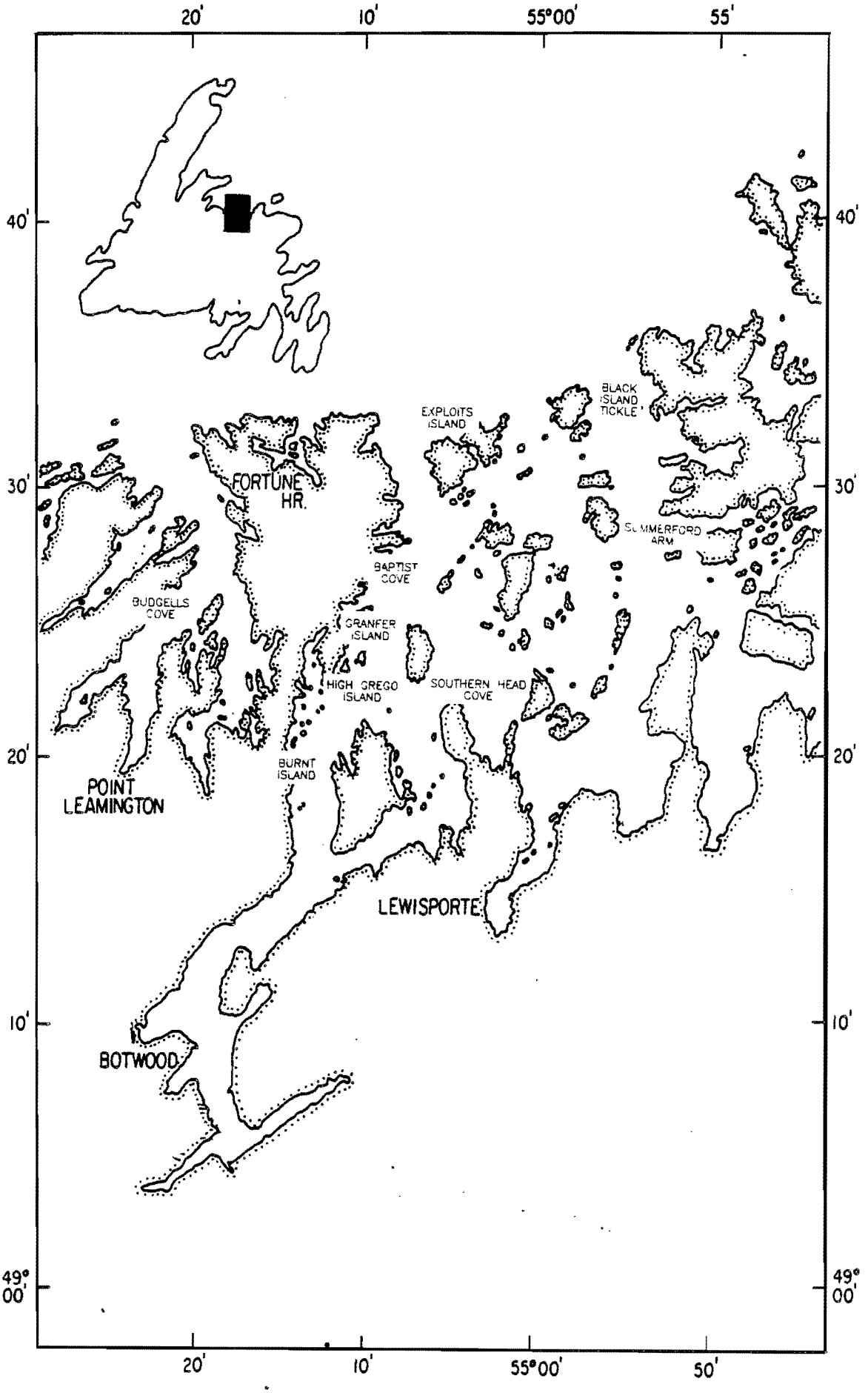

Fig.11. Location of herring schools measured by BIOSONICS hydroacoustic system, Notre Dame Bay.

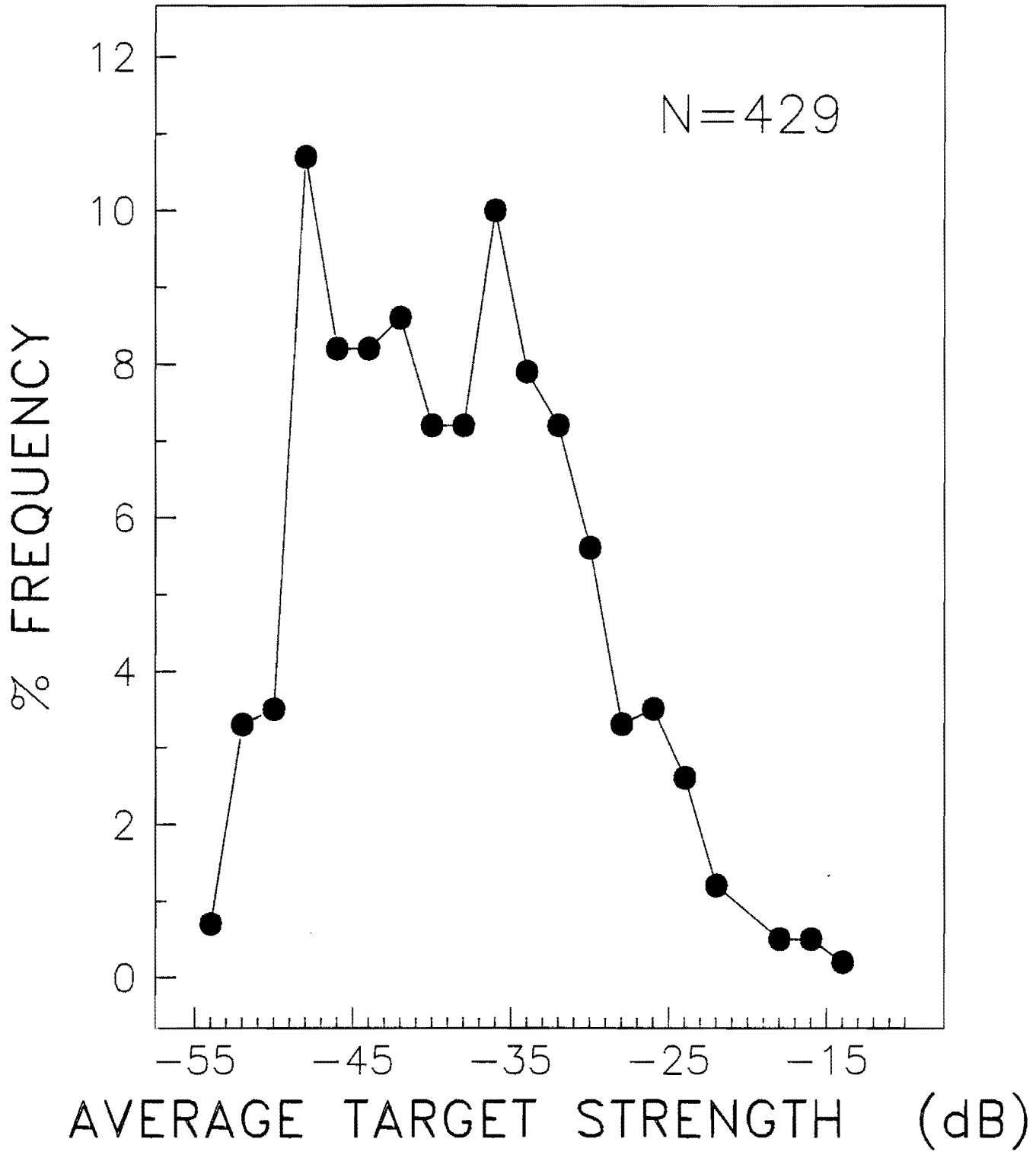

Fig.12. Frequency distribution of average target strengths of all fish measured by the BIOSONICS dual-beam hydroacoustic system

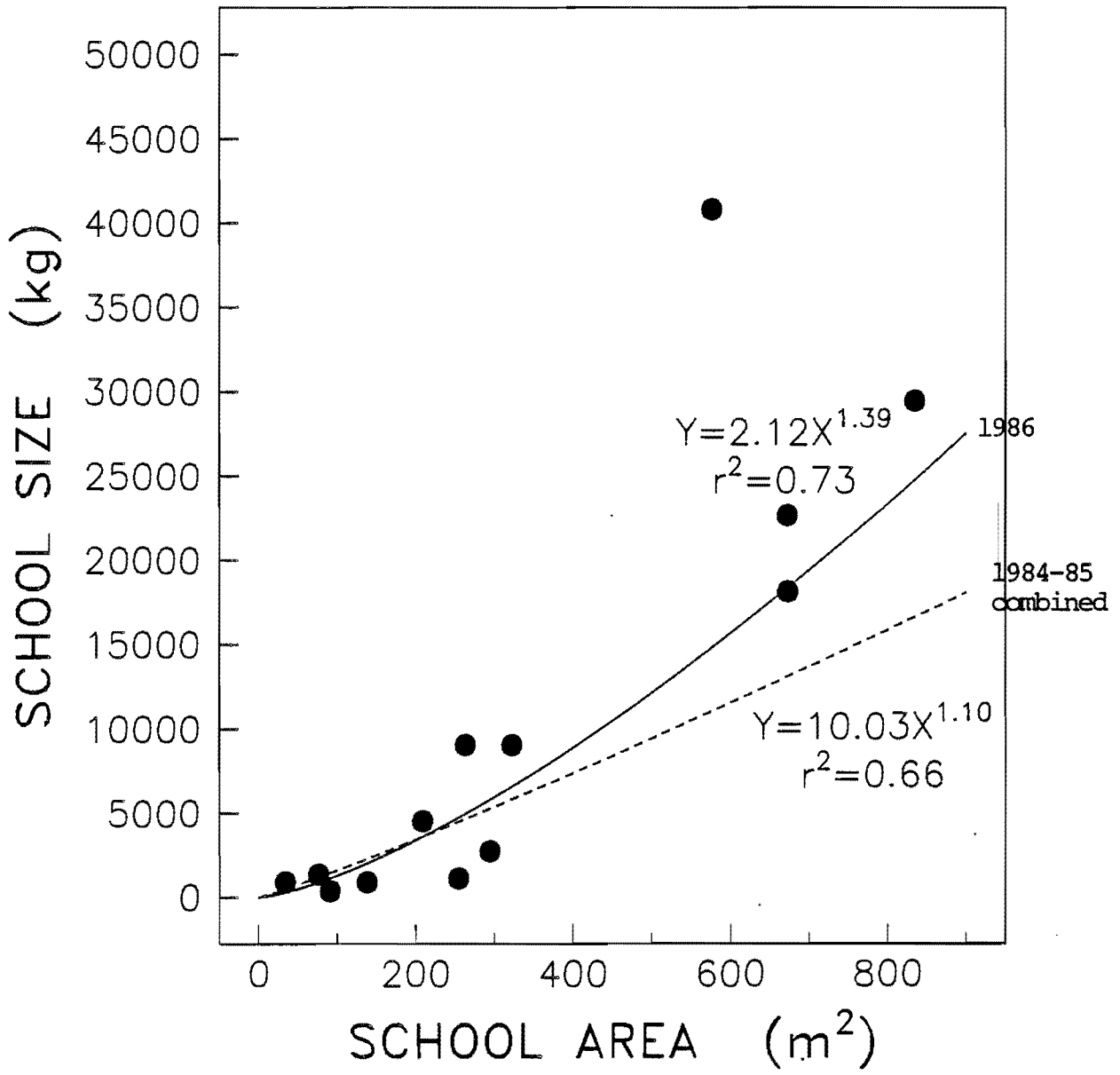

Fig. 13. The relationship between cross-sectional area of schools (m^2) and weight per school (kg) as derived from the 1984, 1985 and 1986 acoustic purse seine surveys.

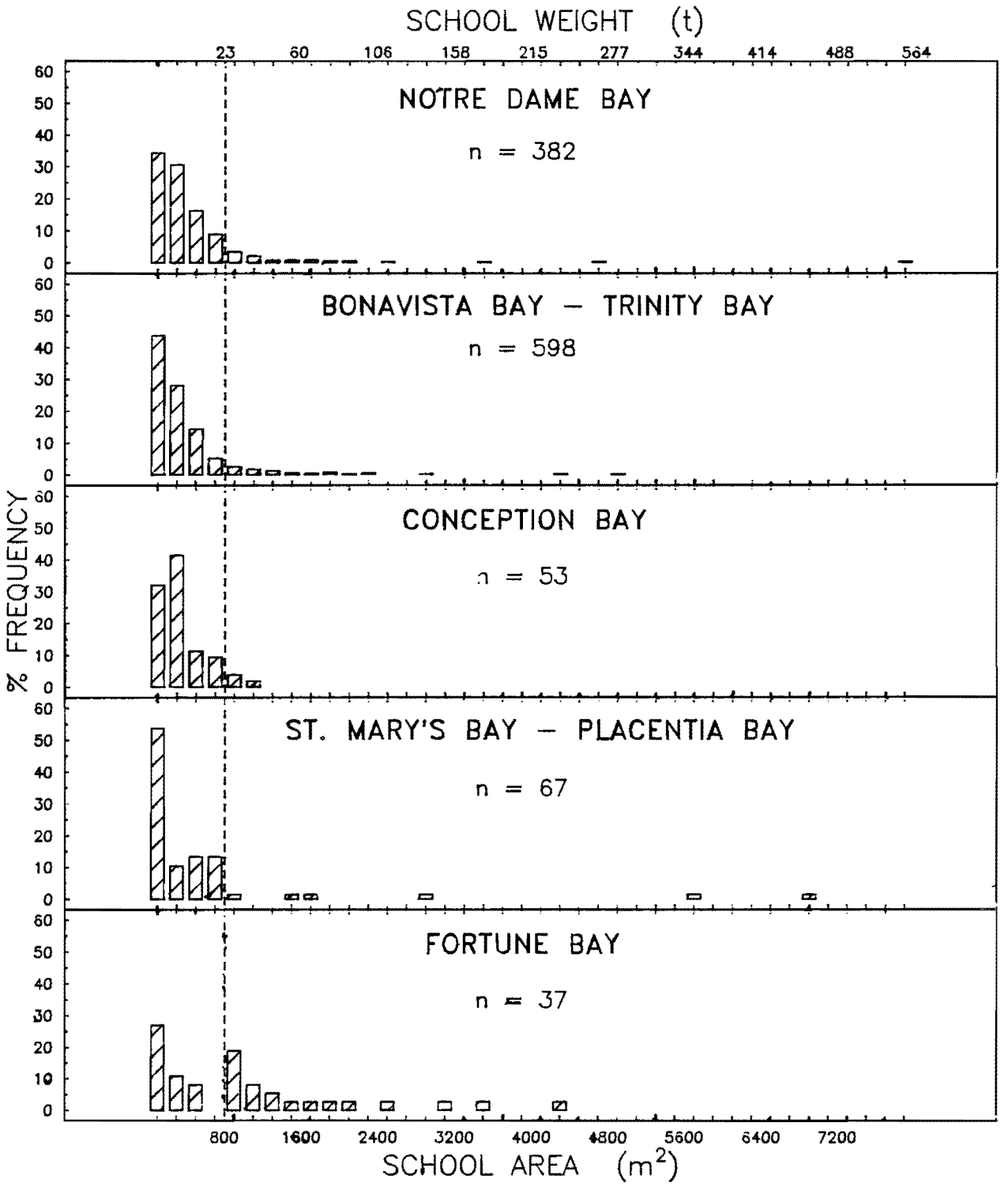

Fig. 14. Frequency of schools, by area and weight, from the 1986 acoustic purse seine survey.

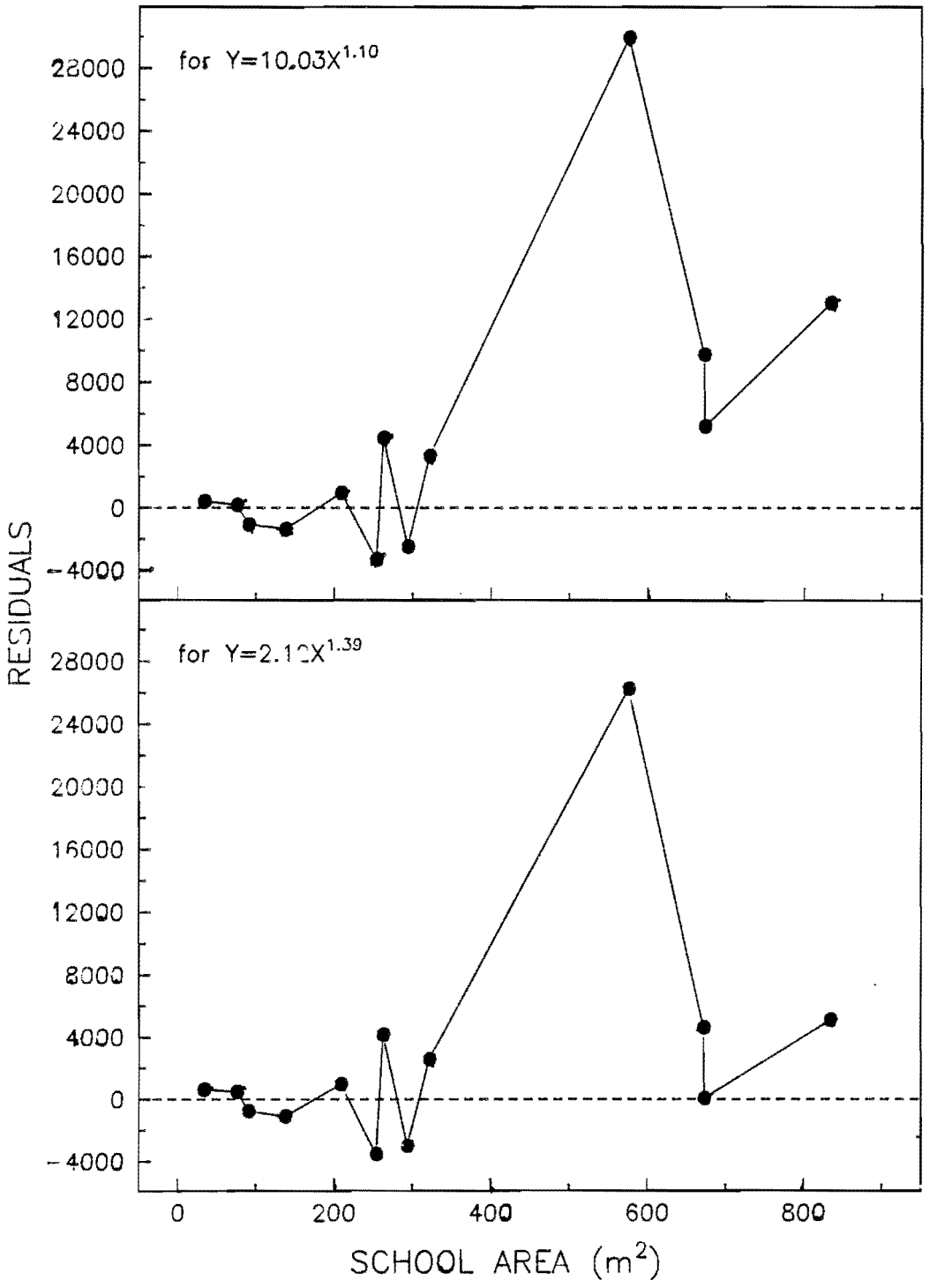

Fig.15. Pattern of residuals for the two relationships between school area and school size.

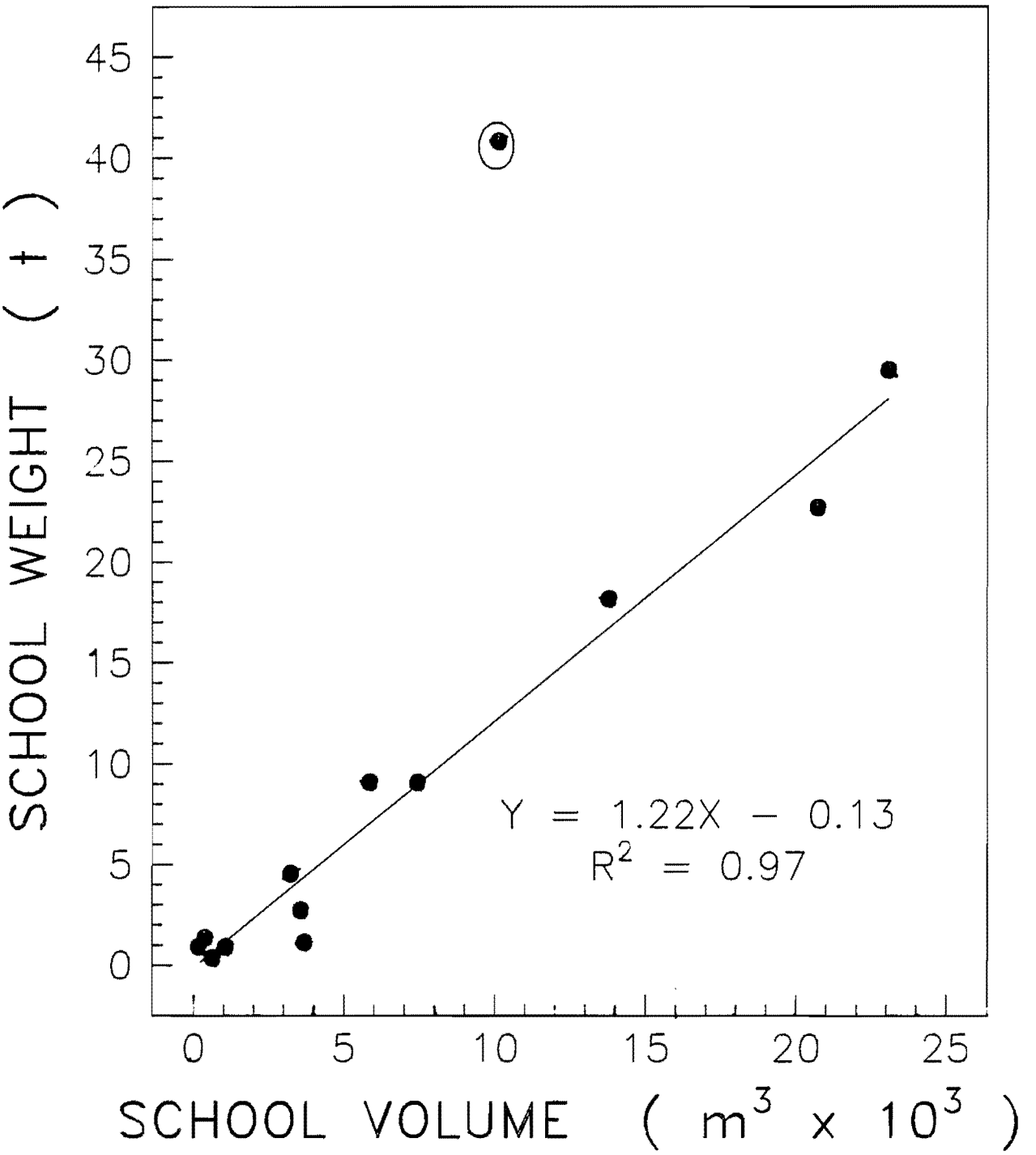

Fig. 16. Relationship between school volume and school weight (with the conversion of school area to school volume assuming a spherical shape).

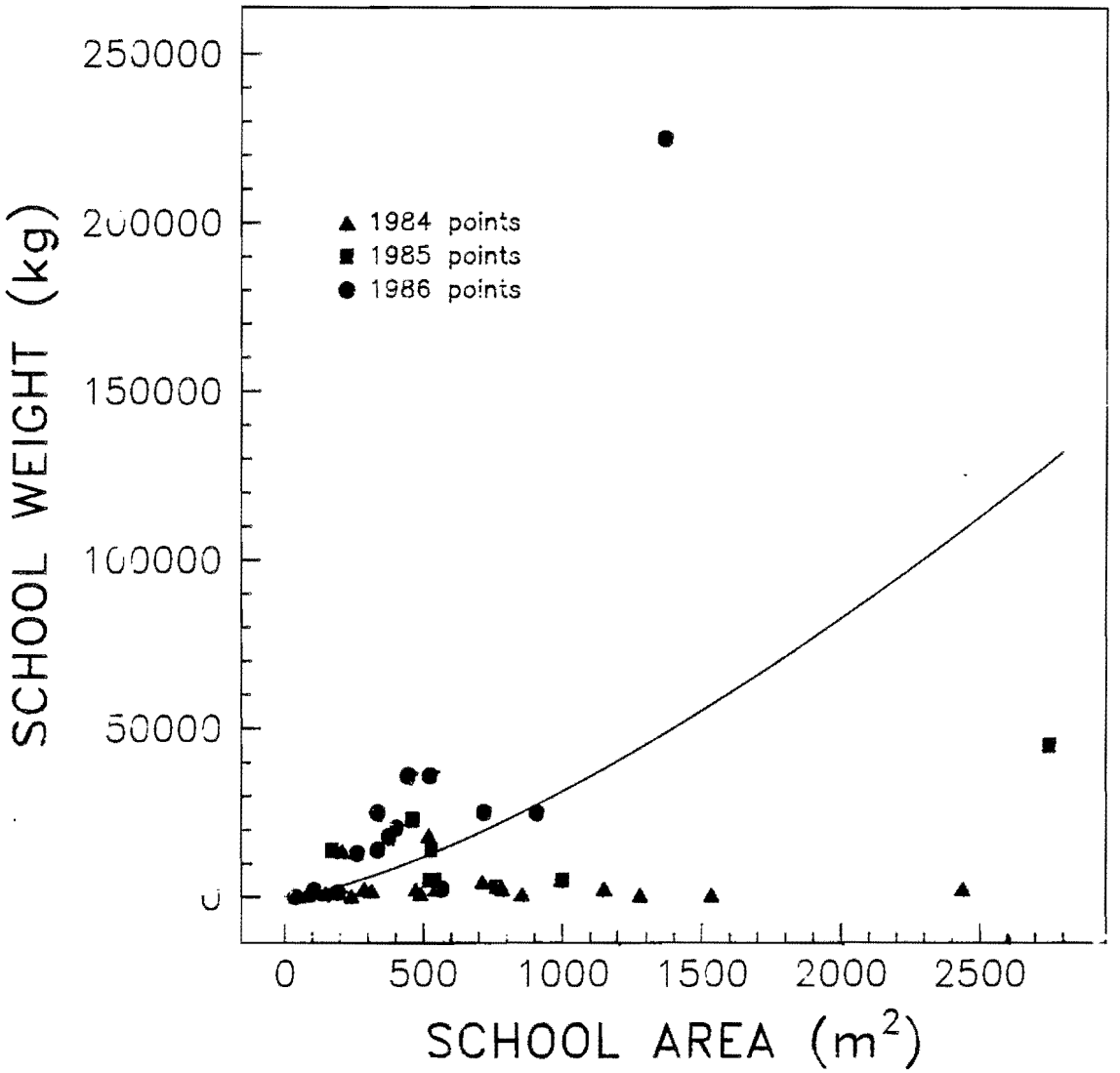

Fig.17. Areas (m^2) and estimated weights (kg) of herring schools from purse seine sets where the entire school was not taken (the line is fitted to data where entire schools were caught – see Fig.13)

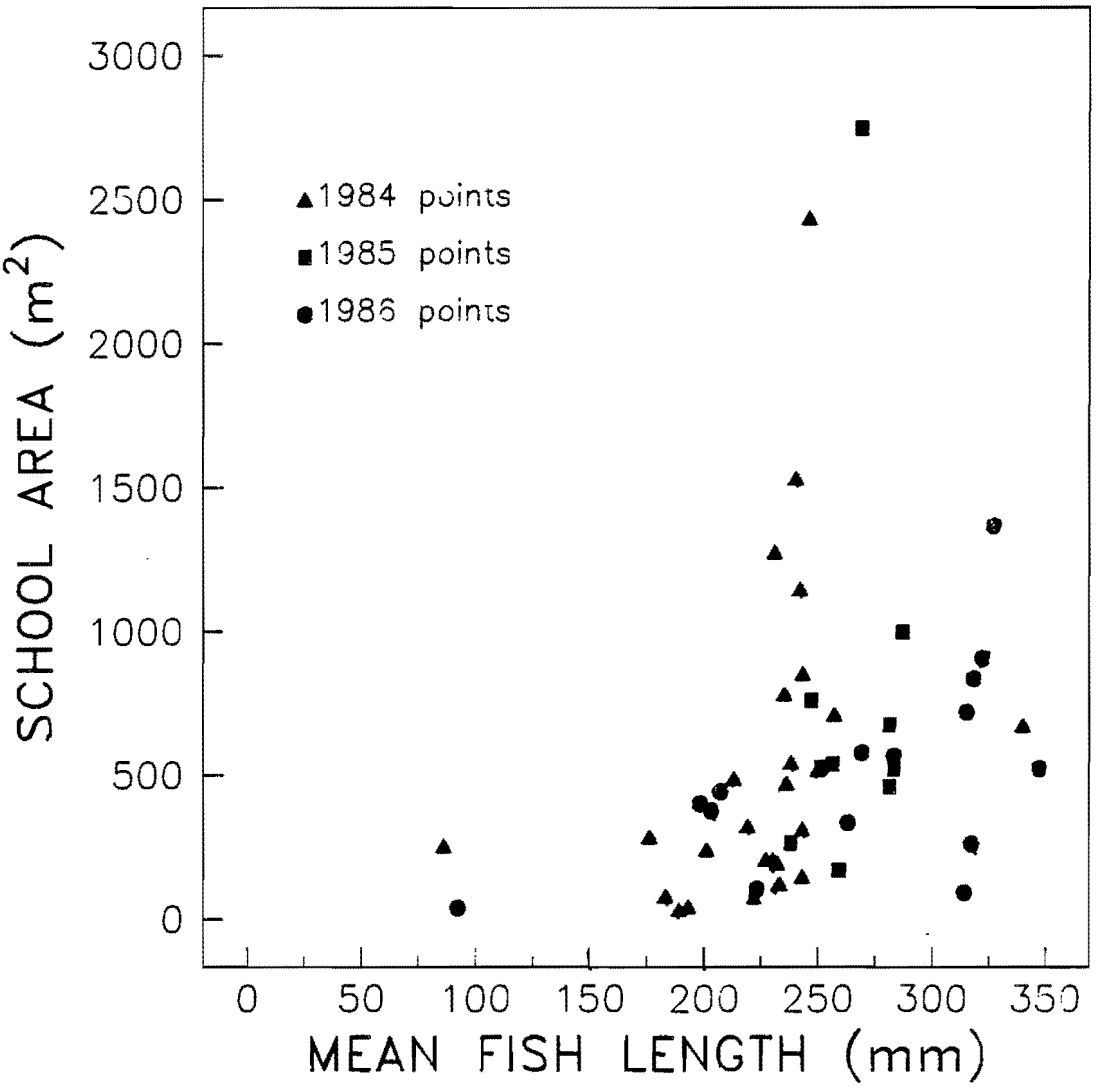

Fig.18. The relationship between mean fish length from acoustic survey purse seine samples and school area of those schools from which the samples were derived.

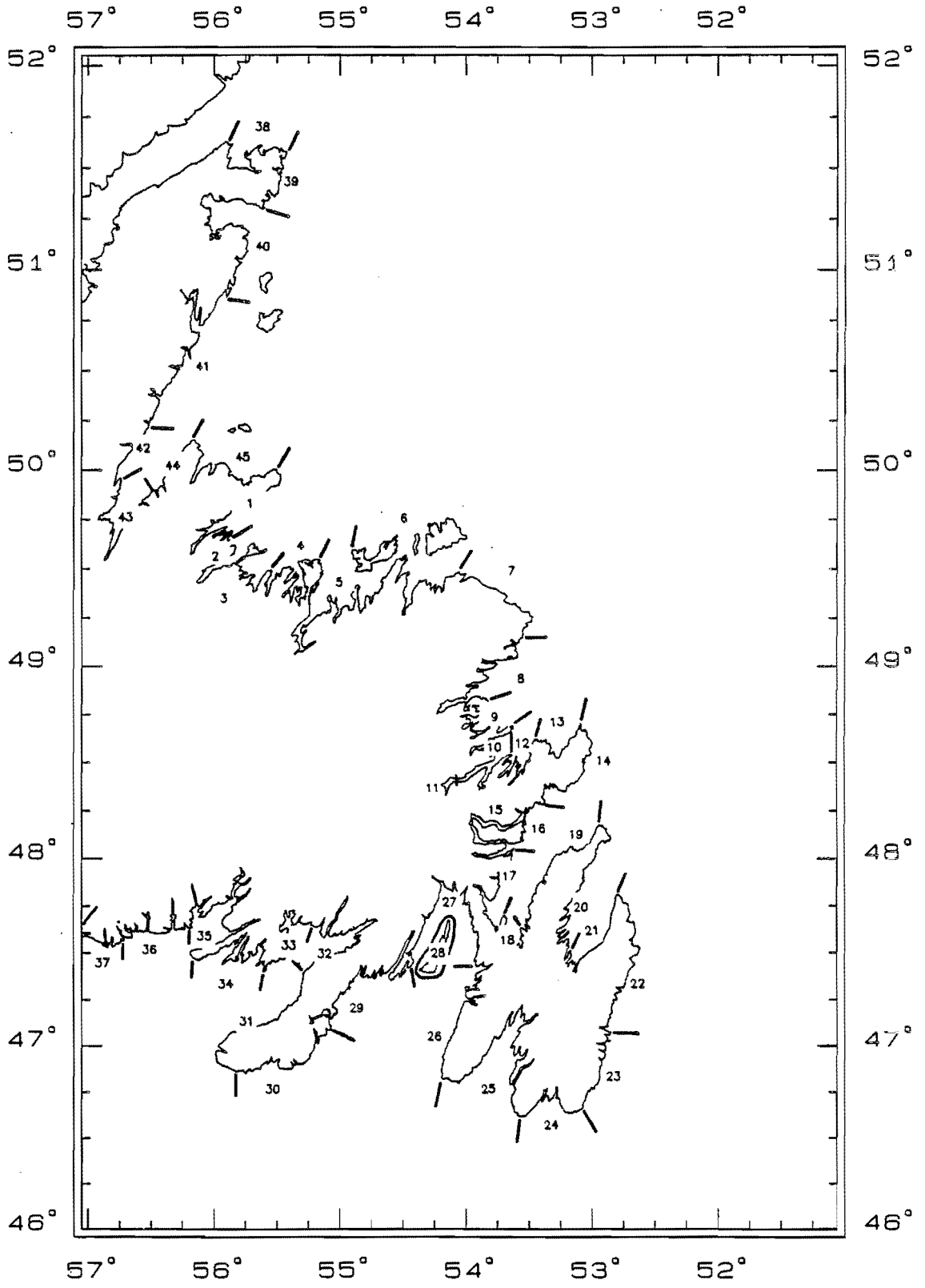

Fig.19. Grids or subareas used for the calculation of stock biomass from the acoustic purse seine survey.