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An Assessment of Newfoundland East and South Coast Herring Stocks to the Spring of 2006

Évaluation des stocks de hareng des côtes est et sud de Terre-Neuve jusqu'au printemps 2006

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ABSTRACT

Results of an assessment to the spring of 2006 are presented for four herring stocks along the east and southeast coasts of Newfoundland. Commercial landings increased from 5100 t in 2004 to 7600 t in 2005; this represented approximately 74% of the 2005 Total Allowable Catch (TAC). Complete landings data were not available for 2006. Spring spawners accounted for at least 55% of commercial landings in all areas in 2005; this represented a decrease from 2004. Dependent upon the area, the 1996, 1999, 2001 or 2002 year class was dominant in 2005 commercial landings. There was no single dominant year class in all areas. Four series of abundance indices were available for each of the stock areas: research gill net catch rates, commercial gill net catch rates, and gill net and purse seine fisher observations. The methodology to describe stock status was similar to the last assessment in 2004. Current status and future prospects were summarized for each area in a performance report. These reports were based upon a standardized interpretation of abundance indices, biological characteristics, and ecological considerations. For White Bay–Notre Dame Bay and Bonavista Bay–Trinity Bay, stock status improved from 2002 to 2006. For St. Mary's Bay–Placentia Bay, stock status deteriorated from 2002 to 2004, improved slightly in 2005, and remained stable from 2005 to 2006. For Fortune Bay, stock status deteriorated from 2001 to 2004, improved slightly in 2005 and deteriorated again in 2006. For all areas, current abundance is substantially lower than peak estimates, most of which occurred in the 1970's.

RÉSUMÉ

Sont présentés les résultats d'une évaluation jusqu'au printemps 2006 touchant quatre stocks de hareng des côtes est et sud-est de Terre-Neuve. Les débarquements commerciaux ont augmenté, passant de 5 100 t en 2004 à 7 600 t en 2005, ce qui représente environ 74 % du total autorisé des captures (TAC). On ne dispose pas de toutes les données pour 2006. Les reproducteurs de printemps représentaient 55 % des débarquements dans toutes les zones en 2005, soit une diminution par rapport à 2004. Selon la zone, la classe d'âge de 1996, 1999, 2001 ou 2002 dominait dans les débarquements. Aucune classe d'âge unique ne dominait dans toutes les zones. Il existait quatre séries d'indices de l'abondance pour chacune des zones : les taux de prises du relevé scientifique au filet maillant, les taux de prises commerciales au filet maillant, les observations des pêcheurs au filet maillant et les observations des pêcheurs à la senne coulissante. La méthodologie utilisée pour décrire l'état des stocks était semblable à celle de la dernière évaluation, en 2004. Pour chaque zone de stock, on a résumé l'état des stocks et leurs perspectives d'avenir dans un rapport de rendement. Ces rapports étaient basés sur une interprétation normalisée des indices de l'abondance, des caractéristiques biologiques et des considérations d'ordre écologique. Pour la baie Blanche – baie Notre Dame, ainsi que la baie de Bonavista – baie de la Trinité, l'état des stocks s'est amélioré entre 2002 et 2006. Dans le cas de la zone de la baie St. Mary's – baie de Plaisance, l'état des stocks s'est détérioré entre 2002 et 2004, s'est amélioré légèrement en 2005 et est demeuré stable de 2005 à 2006. Pour ce qui est de la baie de Fortune, l'état des stocks s'est détérioré de 2001 à 2004, s'est amélioré légèrement en 2005 et s'est détérioré de nouveau en 2006. Pour toutes les zones, l'abondance actuelle est sensiblement inférieure aux estimations records qui remontent aux années 1970 pour la plupart.

INTRODUCTION

There are five herring stocks in the coastal waters of east and south Newfoundland (Fig. 1): White Bay-Notre Dame Bay (WB-NDB), Bonavista Bay-Trinity Bay (BB-TB), Conception Bay-Southern Shore (CB-SS), St. Mary's Bay-Placentia Bay (SMB-PB), and Fortune Bay (FB). These stock complexes were defined from tagging experiments conducted in the 1970's and early 1980's (Wheeler and Winters 1984). In addition, herring occur along the south coast from Cape Ray to Pass Island; the affinities of these herring are uncertain. This document provides an assessment of four stocks to the spring of 2006; CB-SS and herring from the south coast were excluded due to a lack of scientific data.

In recent years, these four stocks have been assessed bi-annually, most recently in the fall of 2004 (Wheeler et al. 2004). The same data sources are available for this assessment as in 2004, with two additions. Results are available from an Industry/Science acoustic survey, conducted in the winter of 2005 in parts of SMB-PB. Results are also available from a telephone survey which was conducted in the fall of 2006. This survey was designed to estimate the number of fixed gear gill net fishers in each stock area and to provide perceptions of current abundance from those individuals who fished gill nets in 2006. An analysis is also presented, examining current and historical length and age at maturity.

Greater emphasis has been given to autumn spawning herring in this assessment, given their increased numbers in commercial and research gill net catches in most areas in recent years (Tables 9–12 and Fig. 3 and 10). In previous assessments, research gill net catch rates of spring spawning herring only were considered. In this assessment, catch rates of spring and autumn spawners combined were used for performance reports. Similarly, in the previous assessment, recruitment was estimated from the research gill net catch rates of age 4 spring spawning herring only. In this assessment, catch rates of age 4 spring and autumn spawning herring were used.

An analytical assessment has not been attempted to estimate stock biomass. The assessment methodology is the same as in 2004 and includes performance reports on the current status and future prospects of each stock. Retrospective performance reports were prepared back to 1998; all reports have been standardized for inter-annual comparisons.

This document is divided into several sections. The first section examines commercial fishery data and the biological sampling used to calculate 2004 and 2005 commercial landings at age. The second section examines survey results and abundance indices, including research gill net catch rates, commercial gill net catch rates, gill net and purse seine fisher observations, an acoustic biomass estimate for part of SMB-PB, and reconnaissance survey results from the south coast. The third section examines biological and ecological data, including lengths and weights at age, length and age at maturity, recruitment, water temperatures

and salinities. The fourth section includes performance reports on the current status and future prospects of each stock. The document concludes with sections on sources of uncertainty and research recommendations.

DESCRIPTION OF THE 2004 AND 2005 COMMERCIAL FISHERIES AND LANDINGS AT AGE

COMMERCIAL LANDINGS AND BIOLOGICAL SAMPLING

Policy and Economics Branch provides commercial landings data (t), by bay, month and gear type (Tables 1–6). Data for 2004 to 2006 are considered preliminary, as statistics have not yet been finalized. For 2006, landings are available to September only. Commercial statistics since 1996 do not include landings for bait purposes. These are assumed to be less than 500 t in WB-NDB, 400 t in FB, 300 t in BB-TB and 150 t SMB-PB.

Biological samples, collected each year from random samples of the commercial herring fisheries, provide age distributions of the commercial landings. In 2004, 1648 herring were sampled and aged to calculate numbers at age for 5100 t of landings. In 2005, 1898 herring were sampled and aged to calculate numbers at age for 7600 t of landings. The 2006 commercial fisheries are ongoing in some areas; therefore, 2006 samples have not been processed.

THE 2004 FISHERY

TAC's for the 2004 fishery were unchanged from 2003 for all areas (Tables 1-6). Landings remained unchanged from 2003 at 5100 t, which represented approximately 50% of the overall TAC (Tables 1-6 and Fig. 2). Allocations for certain gears (purse seines, bar seines and traps) were met and/or exceeded in some areas; allocations for gill nets were not met in any area.

In WB-NDB, landings decreased from 332 t in 2003 to 265 t in 2004; 24% of the TAC was taken in 2004 (Table 1). The 2000 year class accounted for 31% of landing numbers, followed by the 2002 year class at 26% (Fig. 3). The age distribution was truncated, as only 4 year classes each accounted for greater than 5% of the landings. Spring spawners accounted for 73% of landings, an increase of 21% from 2003.

In BB-TB, landings increased from 490 t in 2003 to 509 t in 2004; 17% of the TAC was taken in 2004 (Table 2). The 2000 year class accounted for 27% of landing numbers, followed by the 1999 year class at 24% (Fig. 3). The age distribution was extensive, as 5 year classes each accounted for greater than 5% of the landings. Spring spawners accounted for 62% of landings, an increase of 5% from 2003.

In SMB-PB, landings increased from 1029 t in 2003 to 1389 t in 2004; 56% of the TAC was taken in 2004 (Table 4). The 1999 year class accounted for 37% of landing numbers, followed by the 1998 year class at 26% (Fig. 3). The age distribution was extensive, as 5 year classes each accounted for greater than 5% of the landings. Spring spawners accounted for 64% of landings, an increase of 6% from 2003.

In FB, landings decreased from 3307 t in 2003 to 2930 t in 2004; 79% of the TAC was taken in 2004 (Table 5). The 1996 year class accounted for 60% of landing numbers, followed by fish aged 11+ at 23% (Fig. 3). The age distribution was truncated, as only 2 year classes each accounted for greater than 5% of the landings. Spring spawners accounted for 97% of landings, an increase of 17% from 2003.

THE 2005 FISHERY

Prior to the 2005 fishery, Fisheries and Aquaculture Management Branch formulated a new two year (2005 and 2006) integrated management plan for east and south coast Newfoundland herring. TAC's remained the same for all areas (Tables 1-6). Landings increased from 5100 t in 2004 to 7600 t in 2005, the highest since 1997. The increased landings reflected increased effort, due to price reductions in the snow crab and shrimp fisheries. The 7600 t represented approximately 74% of the overall TAC (Tables 1-6 and Fig. 2). Allocations for certain gears (purse seines, tuck seines, bar seines and traps) were met and/or exceeded in some areas; allocations for gill nets were not met in any area.

In WB-NDB, landings increased from 265 t in 2004 to 911 t in 2005; 83% of the TAC was taken in 2005 (Table 1). The 2000 year class accounted for 38% of landing numbers, followed by the 2001 year class at 28% (Fig. 3). As in 2004, the 2002 year class was important, and accounted for 24% of landing numbers. The age distribution was truncated, as only 3 year classes each accounted for greater than 5% of the landings. Spring spawners accounted for 55% of landings, a decrease of 18% from 2004.

In BB-TB, landings increased from 509 t in 2004 to 2639 t in 2005; 88% of the TAC was taken in 2005 (Table 2). The 2002 year class accounted for 27% of landing numbers, followed by the 2001 year class at 25% (Fig. 3). The age distribution was truncated as only 4 year classes each accounted for greater than 5% of the landings. Spring spawners accounted for 75% of landings, an increase of 14% from 2004.

In SMB-PB, landings increased from 1389 t in 2004 to 1426 t in 2005; 57% of the TAC was taken in 2005 (Table 4). The 1999 year class accounted for 54% of landing numbers, followed by the 2000 year class at 13% (Fig. 3). The 2002 and 2003 year classes accounted for a combined 16% of catch numbers. The age distribution was extensive, as 6 year classes each accounted for greater than 5%

of the landings. Spring spawners accounted for 70% of landings, an increase of 7% from 2004.

In FB, landings decreased from 2930 t in 2004 to 2653 t in 2005; 72% of the TAC was taken in 2005 (Table 5). The 1996 year class accounted for 47% of landing numbers, followed by fish aged 11+ at 17% (Fig. 3). The 2002 year class accounted for 8% of catch numbers. The age distribution was truncated, as only 3 year classes each accounted for greater than 5% of the landings. Spring spawners accounted for 80% of landings, a decrease of 17% from 2004.

CONCEPTION BAY – SOUTHERN SHORE AND THE SOUTH COAST

Landings data are available for CB-SS and for the south coast from Cape Ray to Pass Island (Tables 3 and 6). Biological sampling data are not available for these areas.

In CB-SS, 8 t was landed in 2005; this represented approximately 1% of the TAC (Table 3). No landings were reported from 1999 to 2004 and peak landings in the period from 1995 to 2006 occurred in 1995 (322 t).

Along the south coast, 254 t was landed in 2005; this represented 51% of the TAC (Table 6). Landings from 1998 to 2006 averaged 500 t, with a peak of 1200 t in 1999.

SURVEY RESULTS AND ABUNDANCE INDICES

RESEARCH GILL NET PROGRAM

This program, initiated in 1982, provides standardized age disaggregated abundance indices independent of the commercial fishery. Each year, commercial fishers are contracted to provide catch rate data and biological samples of their catch. Each fisher is provided with a standardized fleet of five herring gill nets; the stretched mesh size of these nets measure 50.8 mm, 57.2 mm, 63.5 mm, 69.9 mm, and 76.2 mm respectively. Each net is 32 m long and 9 m deep, with the exception of the 50.8 mm mesh net, which is 5 m deep. These nets are fished from a fixed location, for a period of one month each spring. This coincides with the spawning season for spring spawning herring, at a time when stock mixing is minimal. Fishers are required to haul the nets once a day (weather permitting) for the duration of the contract, to maintain an accurate daily log record of their catch, and to collect and freeze specified samples of their catch at eight regular intervals during the month. Multiple locations are fished annually in each stock area. Over time, some locations have been changed; however, spatial coverage has been maintained to ensure an adequate distribution of effort throughout each stock area. In 2006, 27 fishers participated in the program (Table 7 and Fig. 4), eight in WB-NDB, nine in BB-TB, six in SMB-PB and four in FB. This was unchanged from

2005. Data are available from 1988 to 2006 for WB-NDB and BB-TB and from 1982 to 2006 for SMB-PB and FB.

Catch rates at age for spring and autumn spawning herring (numbers per nights fished) are available up to and including 2005 (Tables 8-11 and Fig. 5-8). Catch rates only are available for 2006, as biological samples have not yet been processed. The variance estimates on catch rates are large due to inherent variability and the limited sample size of fishers (Fig. 9).

In WB-NDB, catch rates of spring and autumn spawners combined increased, but not significantly, from 121 (fish per nights fished) in 2004 to 307 in 2006 (Table 8). The 2006 catch rate was below average (Fig. 9), 79% of the long-term mean (1988–2006). Catch rates decreased significantly from 1992 to 2002. In 2005, the 2000 year class accounted for 31% of catch numbers, followed by the 1999 year class at 30% (Fig. 10). The age distribution was truncated, as only 3 year classes each accounted for greater than 5% of the catch. However, fish aged 11+ accounted for 16% of the catch. Spring spawners accounted for 69% of the catch, an increase of 6% from 2004.

In BB-TB, catch rates of spring and autumn spawners combined increased, but not significantly, from 181 (fish per nights fished) in 2004 to 253 in 2006 (Table 9). The 2006 catch rate was above average (Fig. 9), 180% of the long-term mean (1988–2006). Catch rates increased significantly from 2002 to 2006. In 2005, the 1999 year class accounted for 30% of catch numbers, followed by the 2000 year class at 24% (Fig. 10). The age distribution was extensive, as 5 year classes and fish aged 11+ each accounted for greater than 5% of the catch. Spring spawners accounted for 46% of the catch, a decrease of 8% from 2004.

In SMB-PB, catch rates of spring and autumn spawners combined decreased slightly, but not significantly, from 110 (fish per nights fished) in 2004 to 107 in 2006 (Table 10). The 2006 catch rate was below average (Fig. 9), 60% of the long-term mean (1982–2006). In 2005, the 1999 year class accounted for 27% of catch numbers, followed by the 1995 year class at 17% (Fig. 10). The age distribution was extensive, as 8 year classes each accounted for greater than 5% of the catch. Spring spawners accounted for 55% of the catch, a decrease of 15% from 2004.

In FB, catch rates of spring and autumn spawners combined increased from 291 (fish per nights fished) in 2004 to 348 in 2006 (Table 11). The 2006 catch rate was below average (Fig. 9), 55% of the long-term mean (1982–2006). In 2005, fish age 11+ accounted for 33% of catch numbers, followed by the 1996 year class at 25% (Fig. 10). The age distribution was truncated, as only 4 year classes each accounted for greater than 5% of the catch. Spring spawners accounted for 77% of the catch, an increase of 10% from 2004.

COMMERCIAL GILL NET LOGBOOK PROGRAM

This program, initiated in 1996, provides a time series of standardized catch per unit effort (CPUE) data from the commercial gill net and bait fisheries. The logbook, described in Wheeler et al. (1999), is designed to be completed by gill net fishers in the spring commercial (food fish) fishery, spring bait (lobster) fishery, and/or fall commercial fishery. Fishers are asked to provide information regarding the number and dimensions of their gill nets, by mesh size. They are also asked to complete a logbook entry for each day that a net or nets are hauled. This entry includes the date, the number of nets hauled by mesh size, the number of nights that the nets had fished, and the approximate catch weight. Fishers are also asked a series of questions to obtain their perceptions of herring abundance.

Each year, logbooks are sent to approximately 2800 licensed fishers and/or bait permit holders from WB to FB, including CB-SS. The return of logbooks is voluntary and the numbers returned are generally very low. In 2006, 13 logbooks were returned (to October 20th) and, depending upon the area fished, most returns were from winter/spring/early summer fisheries (Table 12). Logbooks from fall fisheries were even more limited in number and were not included in the analysis. In most areas and years, the number of logbook returns is small, generally less than 10. Given inherent variability and small sample sizes, these data provide very limited information as an abundance index.

In WB-NDB, logbook returns decreased from 8 in 2004 to 6 in 2006 (Table 12). Effort (net nights per fisher) also decreased by 29%, and was substantially lower in 2006 than for the research gill net program (Fig. 11). Documented effort in 2006 was distributed throughout the stock area (Fig. 12) from early May to late June. Catch rates (kilograms per standard net per nights fished) decreased slightly, but not significantly, from 2004 (21.4) to 2006 (19.6), and are currently 82% of the mean for the time series (Fig. 13). Fishers indicated (on a ten point scale) that herring abundance in 2006 was below average but higher than in 2004 (Fig. 13).

In BB-TB, logbook returns increased from 5 in 2004 to 6 in 2006 (Table 12). Effort (net nights per fisher) increased by 22%, but was still substantially lower in 2006 than for the research gill net program (Fig. 11). Documented effort in 2006 was distributed throughout the stock area (Fig. 12) from mid April to late June. Catch rates (kilograms per standard net per nights fished) increased, but not significantly, from 2004 (16.6) to 2006 (42.5), and are currently 145% of the mean for the time series (Fig. 14). Fishers indicated (on a ten point scale) that herring abundance in 2006 was above average and higher than in 2004 (Fig. 14).

In SMB-PB, logbook returns increased from 2 in 2004 to 3 in 2006 (Table 12). Effort (net nights per fisher) decreased by 21%, and was substantially lower in 2006 than for the research gill net program (Fig. 11). Documented effort in 2006 was restricted to two locations within the stock area (Fig. 12) from early

April to early June. Catch rates (kilograms per standard net per nights fished) increased, but not significantly, from 2004 (5.4) to 2006 (12.7), and are currently 60% of the mean for the time series (Fig. 15). Fishers indicated (on a ten point scale) that herring abundance in 2006 was below average and lower than in 2004 (Fig. 15).

In FB, logbook returns decreased from 5 in 2004 to 3 in 2006 (Table 12). Effort (net nights per fisher) decreased by 25%, and was similar in 2006 to the research gill net program (Fig. 11). Documented effort in 2006 was restricted within the stock area (Fig. 12) from early April to mid June. Catch rates (kilograms per standard net per nights fished) decreased, but not significantly, from 2004 (24.6) to 2006 (8.7), are currently 22% of the mean for the time series (Fig. 16). Catch rates decreased significantly from 2002 to 2006. Fishers indicated (on a ten point scale) that herring abundance in 2006 was below average and similar to 2004 (Fig. 16).

GILL NET TELEPHONE SURVEY

In the 2004 assessment, concern was expressed regarding the small sample sizes of logbooks returned by commercial gill net fishers and/or bait permit holders (DFO 2004) and the impact of this on the use of these data as an abundance index. In a subsequent meeting of the Small Pelagics Advisory Committee, fixed gear fishers suggested that their views were not adequately reflected in the assessment process. Therefore, a telephone survey was conducted in the fall of 2006. The objectives of the survey were two-fold: 1) to determine how many herring gill net licence and/or bait permit holders fished in 2006, and 2) to obtain perceptions of herring abundance and other information from those that did fish in 2006.

Policy and Economics Branch provided a list of all 2006 herring gill net licence and/or bait permit holders in each of the four assessed stock areas. Within each stock area, sample sizes were determined to provide a 10% margin of error, assuming an 80% response rate (Gower and Kelly 1993). A 10% margin of error was deemed to be acceptable as it would indicate that survey results are accurate 90% of the time. An 80% response rate was chosen as this was comparable with telephone response rates for surveys of capelin fishers in the same area (Nakashima pers. comm.).

The names of fishers to be contacted were chosen randomly. Each fisher was telephoned a maximum of three times (at different times and on different days). If a fisher could not be contacted after three attempts, it was considered a ‘nil’ response.

Upon contact, each fisher was asked if he/she fished herring gill nets for either commercial or bait purposes in 2006. If the answer was ‘no’, the interview

was completed. If the response was 'yes', the fisher was asked the following questions. Questions 2–6 were identical to those in the herring gill net logbooks.

1. In 2006, did you fish herring gill nets for commercial sale or for bait purposes?

2. Using a scale of 1 to 10, with 1 being the lowest and 10 being the highest, how abundant were herring in your fishing area in 2006?

3. Did you fish herring gill nets in 2005? (If YES, continue to question #4; if NO, continue to question #5.)

4. Using a scale of 1 to 10, with 1 being the lowest and 10 being the highest, how abundant were herring in your fishing area in 2005?

5. Do herring spawn each year in your area? (If YES, in what geographical location(s) – then continue to question #6; if NO, continue to question #7).

6. Using a scale of 1 to 10, with 1 being the lowest and 10 being the highest, how intense was herring spawning in 2006?

7. Did you complete and return a 'Herring Fixed Gear Logbook' in 2006? (If YES, continue to question #8; if NO, do you have a logbook and would you consider completing it – if they do not have a logbook, offer to send them one).

8. Do you have any comments regarding the herring stock in your area?

There were 2326 licence and/or bait permit holders within the four stock areas in 2006 (Table 13). Attempts were made to contact 417 fishers. Of these, 330 were contacted, representing a 79% response rate. Of those who were contacted, only 168 (51%) fished in 2006. Of those who fished, a large majority (95%) fished for bait purposes only.

As indicated earlier, commercial statistics since 1996 do not include landings for bait purposes. Consequently, the landings of 95% of active fishers who responded to the telephone survey are not included in the 2006 landings data. Also, active fishers were not questioned regarding their level of effort in 2006. In assessing perceptions of abundance, it was assumed that observations of all active fishers were equal, regardless of their level of effort.

In WB-NDB, attempts were made to contact 113 fishers, 11% of all licence and bait permit holders (Table 13). The response rate was 74%, and of the 84 fishers contacted, 40 fished in 2006, mostly for bait purposes (98%). The majority of active fishers were in NDB (Fig. 17). Fishers indicated (on a ten point scale) that herring abundance in 2006 was average and higher than in 2005 (Table 13).

This differed from the six logbooks returned in 2006 where fishers indicated that abundance in 2006 was below average and lower than in 2005 (Table 12 and Fig. 13).

In BB-TB, attempts were made to contact 106 fishers, 18% of all licence and bait permit holders (Table 13). The response rate was 83%, and of the 88 fishers contacted, 49 fished in 2006, mostly for bait purposes (90%). Active fishers were widely distributed throughout the stock area (Fig. 18). Fishers indicated (on a ten point scale) that herring abundance in 2006 was average and higher than in 2005 (Table 13). For the most part, this concurred with the six logbooks returned in 2006 where fishers indicated that abundance in 2006 was above average and higher than in 2005 (Table 12 and Fig. 14).

In SMB-PB, attempts were made to contact 103 fishers, 23% of all licence and bait permit holders (Table 13). The response rate was 77%, and of the 79 fishers contacted, only 22 fished in 2006, mostly for bait purposes (95%). The majority of active fishers were in PB (Fig. 19). Fishers indicated (on a ten point scale) that herring abundance in 2006 was below average and similar to 2005 (Table 13). This differed somewhat from the three logbooks returned in 2006 where fishers indicated that abundance in 2006 was below average and lower than in 2005 (Table 12 and Fig. 15).

In FB, attempts were made to contact 95 fishers, 31% of all licence and bait permit holders (Table 13). The response rate was 83%, and of the 79 fishers contacted, 57 fished in 2006, mostly for bait purposes (97%). Active fishers were widely distributed throughout the stock area (Fig. 19). Fishers indicated (on a ten point scale) that herring abundance in 2006 was average and lower than in 2005 (Table 13). For the most part, this concurred with the three logbooks returned in 2006 where fishers indicated that abundance in 2006 was below average and lower than in 2005 (Table 12 and Fig. 16).

In previous assessments, perceptions of abundance from commercial gill net logbooks were used as an index of abundance in evaluating stock status. In this assessment, perceptions of abundance from the 2006 telephone survey were used to evaluate stock status in 2005 and 2006 as sample sizes were much larger and spatial survey coverage was much better. As indicated above, perceptions of abundance for 2005 and 2006 from the telephone survey and logbooks concurred for two of four stock areas only (BB-TB and FB).

COMMERCIAL PURSE SEINE QUESTIONNAIRE

This program, initiated in 1996, provides a quantitative evaluation of biological and fishery related information from herring purse seine fishers. Each year, attempts are made to contact all active fishers by telephone after the purse seine fishery and each fisher is asked a series of standardized questions (Wheeler et. al. 1999). Response rates are high for most areas and years; in 2005, 20 of 28

fishers (71%) responded to the survey (Table 14). For WB-NDB and BB-TB, where there is a fall fishery only, survey results are available to 2005. For SMB-PB, where there is a winter/spring fishery, survey results are available to 2006. There is no purse seine fishery in FB.

For WB-NDB, four of four active fishers responded to the questionnaire in 2005. They indicated (on a ten point scale) that herring abundance in 2005 was above average and higher than in 2004 (Table 14 and Fig. 20).

For BB-TB, seven of ten active fishers responded to the questionnaire in 2005. They indicated (on a ten point scale) that herring abundance in 2005 was above average and higher than in 2004 (Table 14 and Fig. 20).

For SMB-PB, seven of nine active fishers responded to the questionnaire in 2006. They indicated (on a ten point scale) that herring abundance in 2006 was above average and similar to 2004 (Table 14 and Fig. 20).

RESULTS OF AN ACOUSTIC SURVEY – ST. MARY'S BAY AND PLACENTIA BAY

Background

As part of the assessment of the SMB-PB herring stock complex, DFO Science conducted seven acoustic surveys of the area between 1986 and 2000. These surveys provided empirical estimates of herring abundance independent of the commercial fishery and were used to calibrate population abundance models. Subsequent to 2000, the surveys were eliminated due to budgetary restrictions within the Department and a re-focusing of research effort in other areas.

During deliberations leading up to the 2004 assessment of Newfoundland east and southeast herring Regional Assessment Process (RAP) and during the RAP itself, purse seine fishers from SMB-PB indicated, based upon their observations, that herring abundance had increased substantially since 1998 and was well above average. However, trends in other indices (derived from research gill net catch rates, limited commercial gill net catch rates, and observations of gill net fishers) indicated that the stock had declined since 2002 and was at a low level of abundance (Wheeler et al. 2004).

Concern was expressed during the RAP, regarding the limited information available to assess the stock. The elimination of the acoustic survey index further reduced the assessment data base. Several purse seine fishers expressed interest in conducting a joint Industry/Science acoustic survey to quantify their observations of abundance and to enhance the information available to assess the stock. An agreement was reached to conduct a joint Industry/DFO Science acoustic survey in selected areas of SMB-PB.

The objective of the survey was to obtain a herring biomass estimate (t) within the surveyed area and to compare this with previous acoustic survey

estimates. However, given that the entire stock area would not be surveyed, this biomass estimate would represent an un-defined proportion of the total stock biomass. As such, it would provide an index of abundance only within the surveyed area which could be compared with prior acoustic survey results.

Methods

Industry representatives supplied a list of potentially suitable purse seine vessels for each of the bays. DFO Science personnel conducted an inspection of the proposed vessels prior to the survey to ensure that they met scientific requirements.

The vessel owners supplied a crew, fuel, and food (including scientific staff) for the duration of the survey. DFO Science provided the scientific equipment (sounder, transducer, towed body, computers, etc.), and scientific personnel for the duration of the survey. DFO Science also analyzed the results of the survey.

The design of the acoustic survey remained unchanged from previous surveys (Wheeler et al. 2001) and followed that described by Anderson et al. (1998). The survey area extended from the shoreline (5 m contour) out to a maximum depth of 120 m. In PB, the survey area included the eastern side of the bay from Argentia to Arnold's Cove. In SMB, it included the area from Point La Haye to Cape Dog. The survey area was sub-divided into smaller strata or sub-areas (Fig. 21). A series of randomly selected parallel transects were then established in each stratum (Fig. 22 and 23). The number of transects per stratum was dependent upon the likelihood of detecting herring, i.e. more transects in strata where herring are abundant and less transects in strata were herring are less abundant. Transects were surveyed at a vessel speed of approximately 7 nautical miles per hour. Herring densities, as estimated along transects by the scientific soundings, were extrapolated to the survey area to estimate fish biomass.

The PB survey was conducted from the *Miss Cherise*, a commercial purse-seining vessel. The survey commenced at Arnold's Cove on February 15, 2005 and terminated at Argentia on February 20, 2005. The total length of transects surveyed was 212 km.

The SMB survey was conducted from the *Cedar Point*, a commercial purse seining vessel. The survey commenced at St. Joseph's on February 23, 2005 and terminated at St. Mary's on February 29, 2005. The total length of transects surveyed was 109 km.

The scientific equipment consisted of a Simrad EK500 sounder, equipped with a 120 kHz transducer housed in a v-fin towed body. The towed body was deployed at a depth of approximately 3 m abeam of the vessel.

During the survey, a detailed log record was maintained for each transect and also while steaming between transects. Observations were recorded of all fish concentrations (pelagic and ground fish) detected on the echogram.

The acoustic data, as recorded in the detailed log, were edited subsequent to the survey, using the Canadian Hydroacoustic Data Analysis Tool 2 (Simard et al. 2000) editing system. All bottom signals were removed and only those fish concentrations considered to be herring were included in the analysis.

Acoustic back-scatter was converted to herring density using the target strength - fish length relationship calculated for herring by Wheeler et al. (1994).

Mean fish lengths were derived from biological samples collected during the 2005 commercial purse seine fishery. Target strength per fish was converted to target strength per unit fish weight using mean fish weights from the biological samples. Age distributions were also calculated from the samples.

Formulas used to calculate mean densities, variances, and biomass estimates remained unchanged from previous surveys and are described in Wheeler (1991).

For the purpose of plotting herring distributions, mean densities were calculated per 25 m intervals along each transect.

Placentia Bay results

During the survey, 55 transects were surveyed (Fig. 22). Herring were acoustically detected in 4 of the 15 strata surveyed. Concentrations of herring were detected and integrated on transects near Little Burke Island, St. Croix Bay, and Long Harbour (Fig. 22).

No purse seines set were made during the survey due to the mechanical breakdown of the vessel's tow off skiff. However, samples were available from the commercial purse seine fishery which occurred in the Long Harbour and St. Croix Bay areas approximately three weeks after the survey (Table 15). Mean lengths from these samples were used to calculate a target strength to apply to the survey results.

A biomass estimate of 1215 t was derived from the survey area (Table 16), all of which was detected in strata 60C and 60D (Fig. 21 and 22).

Based upon the commercial fishery samples, autumn spawners accounted for 65% of the estimated survey numbers (Fig. 24). The 1999 year class accounted for 28% of the survey numbers. Younger fish, ages 2 to 4 (2001-03 year classes) represented 15% of the estimate.

St. Mary's Bay results

During this survey, 30 transects were surveyed (Fig. 23). No herring were detected in any of the 6 strata surveyed.

Acoustic survey conclusions

The principal objective was met, as a herring biomass estimate was derived for the surveyed area. Survey intensity (transect length) was deemed to be more than adequate in the surveyed strata.

Survey strata were defined to be comparable with previous acoustic surveys. For example, strata 68A to 68E (Fig. 21) represented the same area as stratum 68 in previous surveys (Wheeler et al. 2001). However, as all strata were not surveyed (e.g. strata 60I–60J), direct comparisons cannot be made with the estimates from previous surveys. The biomass estimate from the current survey represents an un-defined portion of the biomass from comparable strata in previous surveys.

The biomass estimate from this acoustic survey was 1200 t (Table 16). This estimate was derived from herring detected in two strata only, 60C and 60D (Fig. 22). The biomass estimate from the previous most recent acoustic survey of SMB-PB, conducted in 2000, was 3800 t (Table 17). As indicated above, direct comparisons cannot be made between the two surveys as some areas which were surveyed in 2000 were not covered in 2005. Consequently, the acoustic biomass was not used as an abundance index in assessing stock status. Estimates from the 2000 and 2005 surveys were substantially lower than that from the 1998 survey (Table 17).

Biological samples are required to convert the survey acoustic back scatter to a biomass estimate. They are also used to determine the age distribution of the acoustic estimate. It is therefore important that the samples are derived from fish that are acoustically detected on transects. This was not possible during the PB survey due to a breakdown in the purse seine tow off skiff. Biological sampling represents a source of uncertainty in the survey results. As no samples were collected during the survey, samples from the PB commercial purse seine fishery were used (Table 15). This assumes that the commercial fishery, which occurred approximately three weeks after the survey, targeted the same fish which were detected during the survey. This is probably a reasonable assumption as the fishery was restricted to a small geographical area which matched the area where herring were detected during the survey.

The absence of herring in SMB during the 2005 survey indicates the importance of timing of the survey. No herring were detected although a substantial portion of the bay was surveyed (Fig. 23). This suggests that few if any herring over wintered in the bay in 2005. However, by mid May, the commercial

purse seine fleet had taken their quota. Under sized herring (<29 cm total length) did not pose a problem in the 2005 spring fishery in SMB, suggesting that the timing of the fishery is also important to minimize problems with under sized fish.

RESULTS OF RECONNAISSANCE SURVEYS – SOUTH COAST

The Barry Group Inc. conducted three reconnaissance surveys along the south coast of Newfoundland during the winter and spring of 2006 to determine the presence / absence of herring for a potential commercial fishery. Each survey included the coastal waters from Cape Ray in the west to Pass Island in the east. Personnel from Science Branch participated in each of the surveys. Science research goals were three-fold: 1) to determine the biological characteristics of sampled herring, 2) to determine the origins of sampled herring through tagging and trace element analysis, and 3) to record the areal extent and estimated biomass of all detected herring, as provided by the vessel captain from examination of echograms.

The first trip was from February 2 to February 8, 2006. A mid-water trawler (*Newfoundland Alert*) was used to conduct the survey. The vessel operated on a 24 hour per day basis. A total of 677 n. mi. of search track was covered between Cape Ray and Pass Island. Four mid-water trawl sets were made (Table 18 and Fig. 25). Herring were caught (93 fish) and sampled in one set only, in La Poile Bay (Table 19); the mean length of these fish was 27.0 cm (Fig. 26). From sounder observations, the vessel Captain estimated that approximately 100-150 t of herring were detected in the area. No tags were applied as insufficient herring were caught. Similarly, insufficient herring were sampled to conduct trace element analysis.

The second trip was from April 9 to April 12, 2006. Two herring purse seine vessels (*Ocean Provider* and *Nancy Gillian*) were used to conduct the survey. The vessels operated approximately 14 hours per day, between 0700h and 2100h, with the exception of April 11/12 when they operated through the night. The search track extended from Port aux Basques to Pass Island and included most bays in between. Pelagic fish were detected in several locations (Fig. 27). However, in most cases, schools sizes were small and no purse seine sets were made to identify fish species. No biomass estimates were provided by either vessel Captain. As no sets were made, no tags were applied and no samples were collected for trace element analysis.

The third trip was from May 15 to May 18, 2006. The same two herring purse seiners were used to conduct the survey. The vessels operated approximately 13 hours per day, between 0700h and 2000h, with the exception of May 15/16 when they operated through the night. The search track extended from Cape Ray to Pass Island and included most bays in between. Pelagic fish aggregations were detected in numerous locations (Fig. 28); the largest number of schools was detected in La Hune Bay. However, in most cases, schools sizes

were small and no purse seine sets were made to identify fish species. The captain of the *Ocean Provider* suspected that most of the herring detected were not of commercial size and estimated that no more than 100 tons were detected between Port aux Basques and Pass Island. As no sets were made, no tags were applied and no samples were collected for trace element analysis.

BIOLOGICAL AND ECOLOGICAL DATA

GROWTH AND MATURITY

Mean weights at age of spring and autumn spawning herring from 1983 to 2005 were examined. Weights at age were calculated from samples collected from January to June to minimize the impact of seasonal growth. The mean weight of herring (ages 4-10) decreased in all areas during the 1980's and 1990's (Table 20 and Fig. 29). In recent years, growth rates have increased and/or stabilized. However, the mean weights of both spring and autumn spawners in 2005 were still below the long term mean (1983–2005) in all areas.

Reduced growth rates have impacted the commercial fishery. The minimum legal size for commercial herring is 290 mm (total length). Through the 1980's, herring at age 4 were greater than 290 mm (Fig. 30). However, through the 1990's and up to 2005, herring at age 4 were at or below the minimum legal size.

At the request of Fisheries and Aquaculture Management Branch, a preliminary analysis of length and age at maturity was examined for this assessment. Historically, the minimum legal size for commercial herring was set at 290 mm (total length) as this approximated the length at which 50% of herring were mature. Two time periods were examined in the analysis, a period (1982–84) of faster growth rates and a recent period (2003–05) of slower growth rates. Data from the four stock areas were combined to maximize sample sizes; spring and autumn spawners were treated separately. Length and age at maturity were calculated using probit analysis (Table 21). For the earlier time period (1982–84), 50% of the herring were mature at 287 mm (Fig. 31). There was no difference between spring and autumn spawning herring and this length approximated the minimum commercial size. For the recent time period (2003–05), 50% of herring were mature at 248 mm (Fig. 31), approximately 40 mm less than in the historical period. Similarly, there was no difference between spring and autumn spawning herring. Age at maturity has also been affected; for the earlier period, herring were fully mature by age 5; for the recent period, herring were mostly mature by age 4 (Fig. 32).

RECRUITMENT

Good survival of young herring (i.e. recruitment) through the 1960's to 1980's was largely influenced by suitable environmental conditions, principally

warm over-wintering water temperatures and high salinities prior to spawning (Winters and Wheeler 1987). Ocean temperatures and salinities in the early to mid 1990's were below average. However, since the late 1990's ocean temperatures in coastal Newfoundland waters have been warmer (Fig. 33) and above the long-term mean. More recently, salinities have also increased (Fig. 33) and are above the long-term mean. Recent higher temperatures and salinities may enhance recruitment.

Estimation of recruiting year class strength is important in evaluating the future prospects of these herring stocks. Estimates of relative year class size of spring and autumn spawners were available from one source only, the research gill net data set and in particular from mean research gill net catch rates at ages four, five, and six (Fig. 34). It should be noted that these estimates may be biased due to systematic changes in growth; i.e. due to changes in weight and presumably girth over time, the selection pattern of ages 4-6 may have also changed over time. These age groups are also highly selected by the fishery in some years. Variable exploitation rates may also impact estimates of year class strength. For SMB-PB and FB, the time series included the 1976-2001 year classes. For WB-NDB and BB-TB, it included the 1982-2001 year classes. For each area and spawning type, there are seven mature year classes (1995-2001) that can be estimated. Based upon the age at maturity analysis (Fig. 32), fish age 4+ are considered to be fully mature. The 2001 year class (at age 4 in 2005) is the most recent recruiting year class that can be estimated. It was average in WB-NDB, above average in BB-TB and below average in SMB-PB, and FB. All year classes in this time series are considered weak in relation to the strong year classes of the late 1960's (Wheeler et al. 2001).

PREDATION

Quantitative information on the predation of herring is available only for seals. Hammill and Stenson (2000) estimated that in 1996, harp, hooded, grey and harbour seals consumed 36000 t of herring in NAFO Div. 2J3KL, an area encompassing all east and southeast Newfoundland herring stocks, except FB. The vast majority of this consumption (31,000 t) was due to harp seals with hooded seals accounting for slightly less than 5,000 t. Research on recent diets and seasonal distribution of harp and hooded seals are currently underway and revised estimates of consumption should be available for the next assessment (Stenson, pers. comm.).

STOCK STATUS

METHODOLOGY

As in the two most recent assessments (Wheeler et al. 2003, Wheeler et. al. 2004), performance reports were used to summarize current status and prospects of each stock (Tables 23–26). Observations on abundance indices, biological

characteristics, and ecological considerations were interpreted and then evaluated using the traffic light method (Caddy 1998). This method uses a system of red (-), yellow (?), and green (+) lights to categorize indicators as 'cause for concern', 'uncertain', or 'positive'. In this assessment, 'uncertain' was defined as 'uncertainty of an interpretation' rather than precautionary uncertainty.

Four series of abundance indices were evaluated for each stock including: research gill net catch rates (spring and autumn spawners combined), commercial and/or bait gill net catch rates (from logbooks), gill net fisher observations (from logbooks and telephone survey), and purse seine fisher observations (from questionnaires). Purse seine fisher observations were not available for FB, as there is no purse seine fishery in the area.

Biological characteristics, including research gill net age compositions, mean weights (ages 4-10), and year class sizes were evaluated. Ecological considerations included the potential effects of changes in water temperature and salinity on recruitment.

Current stock status was described based upon a standardized (but arbitrary) evaluation of all abundance indices and age composition of mature age groups (Table 22). Abundance indices and age composition data were weighted based upon their perceived importance and reliability in assessing current status. Research gill net catch rates were given the most weight, followed by research gill net age compositions, and then commercial gill net catch rates, gill net fisher observations and purse seine fisher observations. Based upon discussions during the 2006 regional assessment process, weightings were changed from the last assessment (Wheeler et al. 2004); research gill net age compositions were given increased weight and purse seine fisher observations were down-weighted.

Future prospects were described by evaluating the strengths of fishery dependent year classes (1999 and 2000) and other mature year classes (1996-98) and of the 2001 recruiting year class, as estimated from research gill net catch rates at age (Table 22). The strengths of fishery dependent year classes were given the most weight, followed by the strengths of other mature year classes and of the 2001 recruiting year class.

The calculation of standardized and weighted performance report indices (Fig. 35) allowed for inter-annual comparisons from 1998 to 2006. Research gill net catch rates were compared to historical population estimates (Wheeler et al. 2001) to evaluate current vs. historical status (Fig. 36).

WHITE BAY – NOTRE DAME BAY

The fishery

Reported landings increased from 265 t in 2004 to 911 t in 2005; 83% of the TAC was taken in 2005 (Table 1). In addition to reported landings, since 1996 an unknown amount of herring (considered to be less than 500 t) is caught annually in the gill net bait fishery. Mortality from discards in the 2005 fall purse seine fishery was estimated by fishers to be approximately 8 t (Table 14).

Documented effort has declined since the 1980's. Purse seine effort in the fall fishery (sets per fisher) decreased by 95% from 1997 to 2005 (Table 14). Gill net effort (net nights fished per fisher) in the spring fishery decreased by 83% from 1996 to 2006 (Table 12).

The 2005 purse seine fishery, in November and December, was mostly in the Fogo Island area. The 2006 gill net fishery, from early May to late June, was mostly in NDB (Fig. 12 and 17).

Abundance indices

Research gill net catch rates (number of fish per nights fished) of spring and autumn spawners combined increased, but not significantly, from 121 in 2004 to 307 in 2006 (Table 8). The 2006 catch rate was below average, 79% of the long-term mean (Table 7 and Fig. 5). Catch rates decreased significantly from 1992 to 2002 (Fig. 9).

Six commercial gill net logbooks were returned in 2006. Catch rates (kilograms per standard net per nights fished) decreased slightly, but not significantly, from 21.4 in 2004 to 19.6 in 2006. The 2006 catch rate was below average, 82% of the long-term mean (Table 12 and Fig. 13).

There were 40 active gill net fishers contacted in the 2006 telephone survey. They indicated (on a ten point scale) that herring abundance in 2006 was average and higher than in 2005 (Table 13). Although perceptions of abundance were available from logbooks in 2006, sample sizes from the telephone survey were larger and consequently these results were used as indices in 2005 and 2006.

Four of four active purse seine fishers responded to the purse seine questionnaire in 2005. They indicated (on a ten point scale) that herring abundance in 2005 was above average and higher than in 2004 (Table 14 and Fig. 20).

Biological characteristics

The 1999 and 2000 year classes accounted for 30% and 31% of the 2005 research gill net catch numbers respectively (Table 8 and Fig. 10). The age distribution was truncated as only 3 year classes each accounted for greater than 5% of the catch. However, fish aged 11+, which accounted for 16% of catch numbers, provided stability to the age structure.

Based on research gill net catch rates of year classes since 1982, four of seven current mature year classes (1995-2001) are below average (Fig. 34). The 2001 recruiting year class is average. The strength of the 2002 year class cannot yet be quantified. However, all year classes in this time series are considered to be weak in relation to the strong year classes of the late 1960's.

Mean weight (ages 4-10) decreased during the 1980's and 1990's, increased to 2002, and has shown a decreasing trend from 2002 to 2005 (Fig. 29). The mean weight in 2005 was below average; this can potentially lead to an increase in fishing mortality per tonne of fish caught.

Current stock status

Biomass estimates are available to 2001 from an integrated catch at age analysis (Wheeler et al. 2001). A visual comparison with research gill net catch rates suggests that current abundance is substantially lower than historical estimates in the 1970's (Fig. 36).

A standardized performance index is available for 1998-2006 (Fig. 35). The composite index indicates that stock status has improved from 2002 to 2006.

Stock outlook

Short term prospects are uncertain; the 2001 year class is average and most mature year classes are average or below average compared to year classes since 1982 (Fig. 34). All year classes in the time series are weak compared to historical levels.

BONAVISTA BAY – TRINITY BAY

The fishery

Reported landings increased from 509 t in 2004 to 2639 t in 2005; 88% of the TAC was taken in 2005 (Table 2). In addition to reported landings, since 1996 an unknown amount of herring (considered to be less than 300 t) is caught annually in the gill net bait fishery. Mortality from discards in the 2005 fall purse seine fishery was estimated by fishers to be approximately 41 t (Table 14).

Documented effort has declined since the 1980's. Purse seine effort in the fall fishery (sets per fisher) decreased by 73% from 2001 to 2005 (Table 14). Gill net effort (net nights fished per fisher) in the spring fishery decreased by 65% from 1996 to 2006 (Table 12).

The 2005 purse seine fishery, in November and December, was in the northern part of BB and in Northwest Arm, TB. The 2006 gill net fishery, from mid April to late June, was distributed widely throughout the stock area (Fig. 12 and 18).

Abundance indices

Research gill net catch rates (number of fish per nights fished) of spring and autumn spawners combined increased, but not significantly, from 181 in 2004 to 253 in 2006. The 2006 catch rate was above average, 180% of the long-term mean (Table 7 and Fig. 6). Catch rates increased significantly from 2002 to 2006 (Fig. 9).

Six commercial gill net logbooks were returned in 2006. Catch rates (kilograms per standard net per nights fished) increased, but not significantly, from 16.6 in 2004 to 42.5 in 2006. The 2006 catch rate was above average, 145% of the long-term mean (Table 12 and Fig. 14).

There were 49 active gill net fishers contacted in the 2006 telephone survey. They indicated (on a ten point scale) that herring abundance in 2006 was average and higher than in 2005 (Table 13). Although perceptions of abundance were available from logbooks in 2006, sample sizes from the telephone survey were larger and consequently these results were used as indices in 2005 and 2006.

Seven of ten active purse seine fishers responded to the purse seine questionnaire in 2005. They indicated (on a ten point scale) that herring abundance in 2005 was above average and higher than in 2004 (Table 14 and Fig. 20).

Biological characteristics

The 1999 and 2000 year classes accounted for 30% and 25% of the 2005 research gill net catch numbers respectively (Table 9 and Fig. 10). The age distribution was extensive as 5 year classes and fish aged 11+ each accounted for greater than 5% of the catch.

Based on research gill net catch rates of year classes since 1982, five of seven current mature year classes (1995-2001) are above average (Fig. 34). The 2001 recruiting year class is above average. The strength of the 2002 year class

cannot yet be quantified. However, all year classes in this time series are considered to be weak in relation to the strong year classes of the late 1960's.

Mean weight (ages 4-10) decreased during the 1980's and 1990's but has stabilized since 2001 (Fig. 29). However, the mean weight in 2005 was still below average and this can potentially lead to an increase in fishing mortality per tonne of fish caught.

Current stock status

Biomass estimates are available to 2001 from an integrated catch at age analysis (Wheeler et al. 2001). A visual comparison with research gill net catch rates suggests that current abundance is substantially lower than historical estimates in the 1970's (Fig. 36).

A standardized performance index is available for 1998-2006 (Fig. 35). The composite index indicates that stock status has improved from 2002 to 2006.

Stock outlook

Short term prospects are positive; the 2001 year class is above average and most mature year classes are above average compares to year classes since 1982 (Fig. 34). However, all year classes in the time series are weak compared to historical levels.

ST. MARY'S BAY – PLACENTIA BAY

The fishery

Reported landings increased from 1389 t in 2004 to 1426 t in 2005; 57% of the TAC was taken in 2005 (Table 4). In addition to reported landings, since 1996 an unknown amount of herring (considered to be less than 150 t) is caught annually in the gill net bait fishery. Mortality from discards in the 2005 fall purse seine fishery was estimated by fishers to be nil (Table 14).

Documented effort increased from the 1980's to the 1990's. Purse seine effort (sets per fisher) peaked in 2000 and has since decreased by 72% from 2001 to 2006 (Table 14). Gill net effort (net nights fished per fisher) peaked in 1998 and has since decreased by 95% from 1998 to 2006 (Table 12).

The 2006 purse seine fishery, from January to June, was on the eastern sides of PB and SMB. The 2006 gill net fishery, from early April to early June, was mostly in PB (Fig. 12 and 19).

Abundance indices

Research gill net catch rates (number of fish per nights fished) of spring and autumn spawners combined decreased slightly, but not significantly, from 110 in 2004 to 107 in 2006 (Table 10). The 2006 catch rate was below average, 60% of the long-term mean (Table 7 and Fig. 7).

Three commercial gill net logbooks were returned in 2006. Catch rates (kilograms per standard net per nights fished) increased, but not significantly, from 5.4 in 2004 to 12.7 in 2006. The 2006 catch rate was below average, 60% of the long-term mean (Table 12 and Fig. 15).

There were 22 active gill net fishers contacted in the 2006 telephone survey. They indicated (on a ten point scale) that herring abundance was below average and similar to 2005 (Table 13). Although perceptions of abundance were available from logbooks in 2006, sample sizes from the telephone survey were larger and consequently these results were used as indices in 2005 and 2006.

Seven of nine active purse seine fishers responded to the purse seine questionnaire in 2006. They indicated (on a ten point scale) that herring abundance in 2006 was above average and similar to 2004 (Table 14 and Fig. 20).

Biological characteristics

The 1999 year class accounted for 27% of the 2005 research gill net catch numbers; the 1995 and 1996 year classes accounted for 17% and 16% respectively (Table 10 and Fig. 10). The age distribution was extensive, as 8 year classes each accounted for greater than 5% of the catch.

Based on research gill net catch rates of year classes since 1976, four of seven current mature year classes (1995-2001) are below average (Fig. 34). The 2001 recruiting year class is below average. The strength of the 2002 year class cannot yet be quantified. However, all year classes in this time series are considered to be weak in relation to the strong year classes of the late 1960's.

Mean weight (ages 4-10) decreased during the 1980's and 1990's-2002 but has increased since then (Fig. 29). However, the mean weight in 2005 was still below average; this can potentially lead to an increase in fishing mortality per tonne of fish caught.

Current stock status

Biomass estimates are available to 2000 from an integrated catch at age analysis (Wheeler et al. 2001). A visual comparison with research gill net catch rates suggests that current abundance is substantially lower than historical estimates in the 1970's (Fig. 36).

A standardized performance index is available for 1998-2006 (Fig. 35). The composite index indicates that stock status deteriorated from 2002 to 2004, improved slightly in 2005, and remained stable from 2005 to 2006.

Stock outlook

Short term prospects are negative; the 2001 year class is below average and most mature year classes are below average compared to year classes since 1976 (Fig. 34). All year classes in the time series are weak compared to historical levels.

FORTUNE BAY

The fishery

Reported landings decreased from 2930 t in 2004 to 2653 t in 2005; 72% of the TAC was taken in 2005 (Table 5). In addition to reported landings, since 1996 an unknown amount of herring (considered to be less than 400 t) is caught annually in the gill net bait fishery.

Documented effort in the 1980's and 1990's was very low. There is no purse seine fishery in FB. However, bar seine and trap effort, which is not measured, has increased since 1999. In 1998, combined bar seine and trap landings were 0 t. From 1999 to 2006, combined bar seine and trap landings averaged 2050 t. Gill net effort (net nights fished per fisher) peaked in 1997 and has since decreased by 93% from 1998 to 2006 (Table 12).

In recent years, most landings have been taken by bar seines and traps, primarily in the Long Harbour area. The 2006 gill net fishery, from early April to mid June, was distributed widely throughout the stock area (Fig. 12 and 19).

Abundance indices

Research gill net catch rates (number of fish per nights fished) of spring and autumn spawners combined increased slightly, but not significantly, from 291 in 2004 to 348 in 2006 (Table 11). The 2006 catch rate was below average, 55% of the long-term mean (Table 7 and Fig. 8).

Three commercial gill net logbooks were returned in 2006. Catch rates (kilograms per standard net per nights fished) decreased, but not significantly, from 24.6 in 2004 to 8.7 in 2006. The 2006 catch rate was below average, 22% of the long-term mean (Table 12 and Fig. 16); catch rates decreased significantly from 2002 to 2006.

There were 57 active fishers contacted in the 2006 telephone survey. They indicated (on a ten point scale) that herring abundance in 2006 was average and

lower than in 2005 (Table 13). Although perceptions of abundance were available from logbooks in 2006, sample sizes from the telephone survey were larger and consequently, these were used as indices in 2005 and 2006.

Biological characteristics

Fish aged 11+ accounted for 33% of the 2005 research gill net catch numbers, followed by the 1996 year class at 25% (Table 11 and Fig. 10). The age distribution was truncated as only 4 year classes each accounted for greater than 5% of the catch. However, the contribution of fish aged 11+ provided stability to the age structure.

Based on research gill net catch rates of year classes since 1976, four of seven current mature year classes (1995-2001) are average or below average (Fig. 34). The 2001 recruiting year class is below average. The strength of the 2002 year class cannot yet be quantified. However, all year classes in this time series are considered to be weak in relation to the strong year classes of the late 1960's.

Mean weight (ages 4-10) decreased during the 1980's and 1990's but has stabilized since 2001 (Fig. 29). However, the mean weight in 2005 was still below average; this can potentially lead to an increase in fishing mortality per tonne of fish caught.

Current stock status

Biomass estimates are available to 2000 from a research gill net catchability analysis (Wheeler et al. 2001). A visual comparison with research gill net catch rates suggests that current abundance is substantially lower than peak estimates in the late 1990's (Fig. 36).

A standardized performance index is available for 1998-2006 (Fig. 35). The composite index indicates that stock status deteriorated steadily from 2002 to 2004, improved slightly in 2005, and deteriorated again in 2006.

Stock outlook

Short term prospects are negative; the 2001 year class is below average and most mature year classes are below average compared to year classes since 1976 (Fig. 34). All year classes in the time series are weak compared to historical levels.

SOURCES OF UNCERTAINTY

The major uncertainty in this assessment is the inability to estimate current stock sizes and exploitation rates, and to place these estimates within an historical context. Empirical estimates of abundance would be desirable. Acoustic surveys are commonly used to produce such estimates; however, given the perceived low levels of abundance of east and south coast herring stocks, such surveys would have limited success, due to the contagious nature of herring concentrations, which increases the likelihood that major concentrations could be missed.

The evaluation of trends within abundance indices is dependent, among other things, upon the uncertainties associated with each index. Due to the limited fishery and research data, sample sizes for the indices in these assessments are generally small resulting in higher uncertainties. Particular concern was expressed regarding the low rate of commercial gill net logbook returns.

There are also concerns regarding the use of perceptions of abundance from logbooks, questionnaires, and telephone surveys as abundance indices, in particular with the quantification of the term “average” and the variability of its interpretation among different fishers.

Estimation of recruiting year class strength is important in evaluating the future prospects of these stocks. Recruitment data are only available from one source, the research gill net data set, and may be biased by systematic changes in growth. Strong year classes are normally seen across stock areas and quickly become dominant in most data sources. However, it is more difficult to predict the future prospects of weak and moderately strong year classes.

Standardization of performance reports requires the combination of several indices. In this assessment, indices were weighted subjectively based upon the perceived degree to which each data source provides an index of abundance.

RESEARCH RECOMMENDATIONS

The RAP review committee identified several analyses to help reduce some of the uncertainties for the next assessment:

1. The research gill net catch rates are likely confounded by systematic changes in growth and maturation rates that have occurred since their inception. It is recommended that standardized estimates of year class and year effects be extracted from these data, using statistical models that permit the age - mesh size interaction to be quantified.

2. The commercial logbook abundance index suffers from very low return rates. It is recommended that return rates could be increased by sending out reminders subsequent to the initial request. It is also recommended

that, should this be implemented, secondary and tertiary logbook data be analyzed separately from that of the initial collection to ensure internal consistency of the full data series.

3. The gill net telephone survey has common respondents to those who submit commercial gill net log books. The consistency between observed (logbook) catch rates and oral statements of annual abundance changes, by common respondents, should be examined by statistical analyses of these two data sets.

4. The gill net telephone survey may be confounded by differing reference periods from which current year estimates are compared. It is recommended that future surveys include a standard reference period, and include an additional question on the respondents fishing history.

5. These herring populations have undergone significant changes in growth, maturity and spawning group classifications over the past several decades. It is recommended that a research document be prepared for the next assessment in which changes in these vital rates are analyzed in relation to a variety of potential causative hypotheses.

6. A variety of abundance indices are available for these stocks, some of which are data based and others which are opinion based. It is recommended that the coherence of these various indices be statistically examined so as to clarify interpretative significance and as a guide to index weighting factors.

7. Sequential population analyses (SPA) models provide a useful window through which current abundance and exploitation rates can be compared with retrospective levels. Such models have not been used in recent assessments of these stocks for a variety of reasons, including low catch levels. The Committee felt that it would be useful to re-examine the utility of these models, including variants that may be constrained by earlier acoustic estimates.

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Table 1. White Bay (WB) – Notre Dame Bay (NDB) herring landings and TAC's (t), by gear, 1995 – 2006.

Year	Area	Purse Seine	Bar Seine	Tuck Seine	Gill Net	Trap	Total	TAC
1995	WB	201	1	-	15	9	225	
	NDB	454	25	-	890	0	1369	
	Combined	655	26	-	905	9	1594	1200
1996	WB	184	0	-	1	0	185	
	NDB	252	0	-	229	0	481	
	Combined	435	0	-	230	0	665	1600
1997	WB	11	0	-	10	57	78	
	NDB	2364	0	-	11	7	2382	
	Combined	2375	0	-	21	64	2460	4900
1998	WB	106	0	-	6	27	139	
	NDB	484	7	-	30	1	522	
	Combined	606	7	-	36	28	661	2500
1999	WB	0	0	-	4	30	34	
	NDB	931	0	-	53	0	984	
	Combined	931	0	-	57	30	1018	2500
2000	WB	74	0	-	3	2	79	
	NDB	997	0	-	16	1	1014	
	Combined	1071	0	-	19	3	1093	2500
2001	WB	13	0	-	7	5	25	
	NDB	0	0	-	0	1	1	
	Combined	13	0	-	7	6	26	1100
2002	WB	0	13	-	6	5	23	
	NDB	303	0	-	7	23	333	
	Combined	300	13	-	13	28	357	1100
2003	WB	0	0	-	22	0	22	
	NDB	195	87	-	24	4	310	
	Combined	195	87	-	46	4	332	1100
2004*	WB	11	2	-	4	28	45	
	NDB	152	48	-	8	13	220	
	Combined	163	50	-	12	40	265	1100
2005*	WB	38	174	115	2	173	503	
	NDB	97	259	3	10	17	408	
	Combined	136	433	117	12	190	911	1100
2006*	WB	0	0	0	3	0	3	
	NDB	0	0	0	0	14	14	
	Combined	0	0	0	3	14	17	1100

* provisional

Table 2. Bonavista Bay (BB) – Trinity Bay (TB) herring landings and TAC's (t), by gear, 1995 – 2006.

Year	Area	Purse Seine	Bar Seine	Tuck Seine	Gill Net	Trap	Total	TAC
1995	BB	427	6	-	520	0	954	
	TB	271	133	-	91	2	497	
	Combined	698	139	-	611	2	1451	1000
1996	BB	345	0	-	300	1	645	
	TB	13	13	-	78	0	410	
	Combined	358	13	-	378	1	1054	1400
1997	BB	321	0	-	72	1	394	
	TB	329	211	-	129	41	710	
	Combined	650	211	-	201	42	1104	1600
1998	BB	352	62	-	148	0	562	
	TB	356	10	-	22	22	410	
	Combined	708	72	-	170	22	972	2500
1999	BB	563	222	-	94	0	879	
	TB	245	208	-	100	0	553	
	Combined	808	430	-	194	0	1432	2500
2000	BB	493	195	-	135	8	831	
	TB	2	190	-	67	0	259	
	Combined	495	385	-	202	0	1090	2500
2001	BB	241	16	-	37	0	294	
	TB	18	155	-	19	0	192	
	Combined	259	171	-	56	0	486	3500
2002	BB	0	297	-	25	7	329	
	TB	200	4	-	13	20	237	
	Combined	200	301	-	38	27	566	3500
2003	BB	343	1	-	48	90	482	
	TB	0	0	-	8	0	8	
	Combined	343		-	56	90	490	3000
2004*	BB	188	139	-	3	2	322	
	TB	134	19	-	21	2	177	
	Combined	322	158	-	24	5	509	3000
2005*	BB	910	456	21	152	82	1622	
	TB	604	103	142	163	5	1017	
	Combined	1515	559	162	315	87	2639	3000
2006*	BB	0	422	0	38	0	460	
	TB	0	101	0	91	0	191	
	Combined	0	522	0	129	0	651	3000

* provisional

Table 3. Conception Bay (CB) – Southern Shore (SS) herring landings and TAC's (t), by gear, 1995 – 2006.

Year	Area	Purse Seine	Bar Seine	Tuck Seine	Gill Net	Trap	Total	TAC
1995	CB	289	0	-	17	0	306	
	SS	0	0	-	16	0	16	
	Combined	289	0	-	33	0	322	750
1996	CB	80	0	-	3	0	83	
	SS	0	0	-	1	0	1	
	Combined	80	0	-	4	0	84	500
1997	CB	177	0	-	0	0	177	
	SS	0	0	-	0	0	0	
	Combined	177	0	-	0	0	177	600
1998	CB	32	0	-	5	2	40	
	SS	0	0	-	0	0	0	
	Combined	32	0	-	5	2	40	600
1999	CB	0	0	-	0	0	0	
	SS	0	0	-	0	0	0	
	Combined	0	0	-	0	0	0	600
2000	CB	0	0	-	0	0	0	
	SS	0	0	-	0	0	0	
	Combined	0	0	-	0	0	0	600
2001	CB	0	0	-	0	0	0	
	SS	0	0	-	0	0	0	
	Combined	0	0	-	0	0	0	600
2002	CB	0	0	-	0	0	0	
	SS	0	0	-	0	0	0	
	Combined	0	0	-	0	0	0	600
2003	CB	0	0	-	0	0	0	
	SS	0	0	-	0	0	0	
	Combined	0	0	-	0	0	0	600
2004*	CB	0	0	-	0	0	0	
	SS	0	0	-	0	0	0	
	Combined	0	0	-	0	0	0	600
2005*	CB	1	0	0	3	1	4	
	SS	0	0	0	0	3	3	
	Combined	1	0	0	3	4	8	600
2006*	CB	0	0	0	0	0	0	
	SS	0	0	0	0	0	0	
	Combined	0	0	0	0	0	0	600

* provisional

Table 4. St. Mary's Bay (SMB) – Placentia Bay (PB) herring landings and TAC's (t), by gear, 1995 – 2006.

Year	Area	Purse Seine	Bar Seine	Tuck Seine	Gill Net	Trap	Total	TAC
1995	SMB	219	0	-	1	0	220	
	PB	332	76	-	135	0	543	
	Combined	551	76	-	136	0	763	1100
1996	SMB	217	0	-	1	0	217	
	PB	229	15	-	37	0	282	
	Combined	446	15	-	38	0	499	700
1997	SMB	1650	0	-	1	0	1651	
	PB	2186	100	-	20	0	2306	
	Combined	3836	100	-	21	0	3957	6600
1998	SMB	707	0	-	14	0	721	
	PB	1574	0	-	4	0	1578	
	Combined	2281	0	-	18	0	2299	2000
1999	SMB	0	0	-	0	0	0	
	PB	330	0	-	1	0	331	
	Combined	330	0	-	1	0	331	2000
2000	SMB	0	0	-	0	0	0	
	PB	447	41	-	4	0	492	
	Combined	447	41	-	4	0	492	2000
2001	SMB	57	0	-	0	0	57	
	PB	394	213	-	38	0	645	
	Combined	451	213	-	38	0	702	2000
2002	SMB	100	0	-	0	0	100	
	PB	1297	0	-	135	36	1468	
	Combined	1398	0	-	135	36	1568	2000
2003	SMB	0	0	-	11	0	11	
	PB	925	19	-	74	0	1018	
	Combined	925	19	-	84	0	1029	2500
2004*	SMB	342	0	-	79	0	421	
	PB	897	71	-	1	0	968	
	Combined	1240	71	-	179	0	1389	2500
2005*	SMB	1101	43	0	0	2	1146	
	PB	146	0	0	134	0	280	
	Combined	1247	43	0	134	2	1426	2500
2006*	SMB	650	0	0	0	0	650	
	PB	535	0	0	143	0	678	
	Combined	1185	0	0	143	0	1328	2500

* provisional

Table 5. Fortune Bay (FB) herring landings and TAC's (t), by gear, 1995 – 2006.

Year	Purse Seine	Bar Seine	Tuck Seine	Gill Net	Trap	Total	TAC
1995	5	4	-	460	0	469	1500
1996	0	35	-	31	4	70	1500
1997	0	92	-	28	23	143	5400
1998	0	0	-	0	0	0	5400
1999	0	337	-	30	88	455	5400
2000	0	791	-	16	35	842	5400
2001	0	1592	-	0	190	1782	2700
2002	0	1895	-	0	364	2259	2700
2003	0	2427	-	0	880	3307	3700
2004*	0	1655	-	54	1221	2930	3700
2005*	0	2084	0	5	564	2653	3700
2006*	0	2027	0	1	295	2323	3700

* provisional

Table 6. South coast Newfoundland (Cape Ray to Pass Island) herring landings and TAC's (t) (Cinq Cerf Bay to Pass Island), by gear, 1998 – 2006.

Year	Purse Seine	Bar Seine	Tuck Seine	Gill Net	Trap	Total	TAC
1998	178	0	-	67	0	245	350
1999	1161	0	-	43	0	1205	350
2000	77	0	-	108	12	197	350
2001	843	0	-	127	66	1036	350
2002	261	28	-	170	50	510	350
2003	102	108	-	172	102	485	500
2004*	0	0	-	29	213	243	500
2005*	0	0	0	102	152	254	500
2006*	111	0	0	0	184	295	500

* provisional

Table 7. Parameters, catch data, catch rates, and effort, by stock area and year, from research gill net data.

Stock Area	Year	Number of Fishers	Fishing Dates Start	Fishing Dates End	Total Catch (numbers)	Catch Rate (numbers per nights fished) AS	Catch Rate (numbers per nights fished) SS	Catch Rate (numbers per nights fished) Comb.	Effort (net nights per fisher)
WBNDB	1988	5	14 May	17 June	17759	9	146	156	570
	1989	7	25 April	24 June	99614	61	486	547	910
	1990	7	25 April	22 June	121218	27	679	706	859
	1991	7	8 May	31 July	117333	25	685	709	827
	1992	6	6 May	7 July	139253	28	859	887	785
	1993	6	3 May	9 July	104251	67	607	674	773
	1994	7	2 May	18 July	110697	72	586	658	841
	1995	7	15 May	27 July	103011	53	560	613	840
	1996	7	7 May	11 July	114465	71	470	541	1058
	1997	7	13 May	11 July	70338	32	320	352	998
	1998	7	5 May	10 July	53055	26	246	272	975
	1999	7	5 May	16 July	46465	14	202	216	1075
	2000	6	25 April	22 July	10681	9	49	58	920
	2001	7	8 May	20 July	29934	29	107	136	1100
	2002	9	21 April	31 July	10768	10	29	39	1372
	2003	9	19 April	31 July	31444	20	91	111	1412
	2004	8	23 April	31 July	30881	45	76	121	1278
	2005	8	22 April	31 July	76674	95	207	301	1273
	2006	8	24 April	31 July	75281	96	210	307	1227
BBTB	1988	7	9 May	17 June	6554	1	51	53	622
	1989	8	18 April	12 June	25250	10	96	106	1189
	1990	7	10 April	6 June	28748	11	135	146	982
	1991	8	30 April	26 June	40320	20	188	209	966
	1992	8	20 April	18 June	35196	15	138	153	1152
	1993	8	23 April	15 June	28373	17	113	130	1090
	1994	8	18 April	21 June	45863	19	168	187	1227
	1995	7	9 May	27 June	20836	10	99	110	950
	1996	7	11 April	18 June	58278	29	229	259	1127
	1997	8	16 April	26 June	73135	33	279	312	1172
	1998	8	21 April	29 June	25564	19	83	102	1257
	1999	8	15 April	26 June	23290	21	60	81	1440
	2000	8	3 April	26 June	15579	16	41	57	1373
	2001	8	4 May	20 July	14303	18	32	50	1436
	2002	10	15 April	18 July	9859	4	23	27	1814
	2003	10	9 April	12 July	37597	36	72	108	1747
	2004	9	14 April	17 July	54260	82	99	181	1499
	2005	9	14 April	17 July	46422	87	75	162	1430
	2006	9	5 April	15 July	78838	136	117	253	1557

Table 7 cont'. Parameters, catch data, catch rates, and effort, by stock area and year, from research gill net data.

Stock Area	Year	Number of Fishers	Fishing Dates Start	Fishing Dates End	Total Catch (numbers)	Catch Rate (numbers per nights fished) AS	Catch Rate (numbers per nights fished) SS	Catch Rate (numbers per nights fished) Comb.	Effort (net nights per fisher)
SMBPB	1982	4	17 April	15 May	1905	4	12	16	595
	1983	5	6 April	3 June	9174	21	44	65	708
	1984	4	5 April	14 June	34405	129	116	246	700
	1985	4	10 April	6 June	35835	133	143	276	650
	1986	5	10 April	13 June	37840	98	172	270	700
	1987	5	1 April	31 May	43693	72	211	282	774
	1988	5	2 April	29 May	23140	29	141	170	681
	1989	5	4 April	7 June	21634	25	123	148	730
	1990	5	9 April	6 June	28591	53	139	192	743
	1991	5	3 April	12 June	9971	25	42	67	745
	1992	5	8 April	10 June	13264	32	55	87	765
	1993	5	5 April	11 June	10727	25	46	72	750
	1994	5	7 April	7 June	22350	36	106	142	785
	1995	5	5 April	3 June	12861	14	70	84	765
	1996	5	2 April	12 June	54047	61	266	328	825
	1997	5	4 April	4 June	30290	55	136	191	795
	1998	5	1 April	5 June	19392	41	80	121	803
	1999	5	1 April	27 May	38665	82	164	246	785
	2000	5	4 April	3 June	36152	107	125	232	780
	2001	5	5 April	8 June	37536	63	168	232	810
	2002	6	1 April	14 June	85521	145	262	407	1050
	2003	6	4 April	12 June	37122	45	147	192	965
	2004	6	5 April	18 June	22115	33	77	110	1009
	2005	6	5 April	14 June	24036	70	84	154	780
	2006	6	1 April	2 June	22020	49	58	107	1030
FB	1982	2	16 April	22 May	799	2	10	12	325
	1983	2	11 April	16 May	10653	49	129	178	300
	1984	1	19 April	18 May	5908	71	156	227	130
	1985	2	16 April	17 May	38301	175	462	636	301
	1986	3	15 April	6 June	44175	65	399	464	476
	1987	3	8 April	22 May	63850	70	690	760	420
	1988	3	13 April	23 May	46435	37	517	554	419
	1989	3	11 April	23 May	84066	81	927	1008	417
	1990	3	17 April	24 May	48466	47	479	527	460
	1991	3	9 April	28 May	50778	36	561	597	425
	1992	3	16 April	12 June	30235	51	331	383	395
	1993	3	13 April	5 June	39774	49	413	462	430
	1994	3	13 April	10 June	62870	46	668	714	440
	1995	3	18 April	23 June	56079	74	684	758	370
	1996	3	3 April	27 May	93868	58	862	920	510
	1997	3	7 April	31 May	96821	91	980	1071	452
	1998	3	7 April	30 May	111464	51	1224	1275	437
	1999	3	1 April	26 May	90685	213	854	1067	425
	2000	3	1 April	30 May	76734	159	727	886	433
	2001	3	6 April	1 June	110487	97	1131	1228	450
	2002	4	3 April	31 May	60195	93	447	540	557
	2003	4	23 April	31 May	61701	78	463	541	570
	2004	4	3 April	31 May	40159	97	194	291	690
	2005	4	3 April	31 May	50777	105	349	453	560
	2006	4	1 April	6 June	38232	80	267	348	550

Table 8. Research gill net catch rates at age (numbers per nights fished), of spring and autumn spawning herring for White Bay – Notre Dame Bay, 1988 to 2005 (with catch rates only for 2006).

Spring Spawners

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1							0.0	0.0	0.0	0.0	0.0	0.0	0.0
2							0.0	0.0	0.0	0.0	0.0	0.0	0.0
3							4.7	16.0	83.5	11.0	0.0	1.2	0.6
4							1.9	43.3	51.6	247.1	21.5	10.9	232.0
5							22.2	11.2	52.9	28.8	493.7	51.0	14.6
6							59.6	126.9	16.3	13.7	33.5	359.9	52.1
7							5.6	182.9	144.6	7.5	13.7	18.8	182.7
8							4.7	9.7	195.5	84.2	10.3	6.7	14.1
9							12.0	16.0	11.5	164.3	47.2	13.4	7.6
10							1.8	24.3	26.5	21.9	127.9	29.7	12.9
11+							34.1	56.4	97.1	106.1	110.8	115.9	69.1
Total							146.4	486.4	678.8	684.6	858.6	606.9	585.7

Age	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	
3	0.0	0.0	3.2	7.9	6.5	0.3	0.5	11.0	3.6	5.5	7.0	
4	18.5	0.9	0.6	117.6	70.3	2.6	44.2	3.0	65.9	11.3	30.6	
5	300.1	47.9	3.2	0.2	85.1	14.8	8.1	4.7	2.7	43.9	41.5	
6	20.2	286.0	77.1	1.2	1.0	16.8	37.5	3.6	9.5	2.8	85.3	
7	45.9	12.7	139.5	10.3	0.4	0.2	15.5	2.1	1.3	2.0	1.4	
8	104.1	21.6	8.6	43.3	9.5	0.9	0.1	0.7	4.6	1.7	0.8	
9	8.4	74.2	17.6	1.7	15.0	0.4	0.2	0.2	1.5	1.5	6.8	
10	9.5	5.2	31.0	6.9	2.8	0.6	0.6	0.5	1.2	0.6	3.3	
11+	52.1	21.1	39.4	56.8	18.0	12.1	0.1	3.0	0.7	6.1	29.7	
Total	559.8	469.5	320.0	246.0	202.1	48.7	106.8	28.9	91.1	75.6	206.6	210.4

Autumn Spawners

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1							0.0	0.0	0.0	0.0	0.0	0.0	0.0
2							0.0	0.0	0.0	0.0	0.0	0.0	0.0
3							0.0	0.1	0.0	0.0	0.0	0.0	0.0
4							0.0	0.0	2.3	1.6	0.0	0.0	0.6
5							0.7	6.8	2.5	2.7	1.7	6.8	1.8
6							1.3	1.8	2.3	1.4	14.2	17.9	9.1
7							0.7	4.4	0.9	1.6	2.2	13.8	12.0
8							0.6	4.4	1.4	1.0	0.2	2.4	11.1
9							4.5	6.3	1.9	2.9	1.2	1.3	4.0
10							0.1	19.9	0.2	0.0	0.3	0.3	0.1
11+							1.4	17.1	16.0	13.6	8.6	25.0	33.8
Total							9.4	61.0	26.8	24.8	28.4	67.4	72.4

Age	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	
4	2.3	0.0	0.6	1.2	0.2	0.0	1.5	2.0	2.4	13.6	5.3	
5	13.1	3.4	0.9	5.0	3.2	2.0	12.8	1.7	6.1	4.6	52.6	
6	6.9	29.6	2.6	2.4	5.5	2.7	10.3	2.1	0.7	10.4	4.8	
7	7.9	3.4	14.5	0.7	0.4	1.5	1.8	2.7	7.2	2.7	5.6	
8	4.3	10.4	2.0	8.9	0.2	1.3	1.8	1.3	1.5	3.5	2.4	
9	3.9	8.8	2.6	1.7	2.8	0.4	0.3	0.1	1.0	1.9	0.5	
10	4.1	4.1	1.2	1.7	0.6	0.6	0.1	0.1	0.7	5.3	4.1	
11+	10.9	11.7	8.1	4.5	1.1	0.8	0.6	0.4	0.6	3.3	19.5	
Total	53.3	71.4	32.4	26.1	14.0	9.3	29.3	10.4	20.3	45.2	94.6	96.3

Spring and Autumn Spawners

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Total							155.8	547.3	705.6	709.4	887.0	674.3	658.1
% SS							94.0	88.9	96.2	96.5	96.8	90.0	89.0
% AS							6.0	11.1	3.8	3.5	3.2	10.0	11.0

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total	613.2	541.0	352.4	272.1	216.1	58.1	136.1	39.2	111.4	120.8	301.2	306.8
% SS	91.3	86.8	90.8	90.4	93.5	83.9	78.5	73.6	81.8	62.6	68.6	68.6
% AS	8.7	13.2	9.2	9.6	6.5	16.1	21.5	26.4	18.2	37.4	31.4	31.4

Table 9. Research gill net catch rates at age (numbers per nights fished), of spring and autumn spawning herring for Bonavista Bay – Trinity Bay, 1988 to 2005 (with catch rates only for 2006).

Spring Spawners

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1							0.0	0.0	0.0	0.0	0.0	0.0	0.0
2							0.1	0.1	0.0	0.0	0.0	0.0	0.0
3							5.6	2.3	8.8	0.9	0.3	2.6	0.7
4							0.3	21.8	8.2	50.1	1.2	1.7	16.6
5							2.3	0.9	27.7	12.0	46.2	8.2	9.6
6							29.2	5.5	4.5	27.9	8.1	50.6	12.6
7							0.5	57.7	12.2	3.2	10.3	6.4	65.0
8							0.4	0.9	60.8	19.8	2.3	7.0	6.5
9							0.6	0.6	0.8	62.3	17.6	3.7	8.9
10							0.0	0.7	3.2	3.8	34.8	13.1	7.5
11+							12.2	5.5	8.9	8.3	16.8	20.2	40.1
Total							51.2	96.1	135.1	188.2	137.6	113.5	167.6

Age	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.1	0.0	
3	0.0	0.0	2.8	1.2	0.1	0.1	3.4	11.0	2.5	1.1	11.6	
4	34.3	0.9	0.0	5.7	17.6	2.6	3.3	5.8	47.3	9.3	4.6	
5	8.2	140.9	3.3	0.2	7.2	11.9	2.0	2.3	12.2	68.3	6.3	
6	1.7	20.8	181.9	1.7	0.4	5.8	10.0	0.6	2.9	13.1	40.6	
7	4.6	5.3	23.7	62.3	0.8	0.4	3.0	1.5	0.4	2.5	5.1	
8	19.9	5.5	5.6	4.6	29.8	0.2	0.5	0.5	1.5	0.8	2.5	
9	2.6	20.8	7.0	2.1	1.4	12.7	0.9	0.1	0.6	0.3	0.1	
10	3.0	3.7	16.7	1.3	0.3	4.1	3.8	0.0	0.9	0.8	1.5	
11+	25.0	31.4	38.2	5.9	2.3	2.6	5.1	1.2	3.7	2.6	2.9	
Total	99.2	229.1	278.9	83.0	59.9	40.5	32.1	23.0	72.1	98.6	75.1	117.2

Autumn Spawners

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1							0.0	0.0	0.0	0.0	0.0	0.0	0.0
2							0.0	0.0	0.0	0.0	0.0	0.0	0.0
3							0.0	0.0	0.0	0.0	0.0	0.0	0.0
4							0.0	0.1	0.0	0.1	0.0	0.1	0.2
5							0.3	0.3	0.4	3.8	0.5	1.7	1.9
6							0.2	0.3	0.2	2.1	2.5	5.0	3.7
7							0.2	1.9	0.9	1.1	1.0	3.9	5.4
8							0.0	1.3	1.2	0.7	0.5	0.8	3.2
9							0.5	0.5	1.2	2.2	0.7	0.4	0.8
10							0.0	3.3	0.1	0.7	0.4	0.1	0.4
11+							0.3	2.4	7.3	9.8	9.5	4.6	3.7
Total							1.5	10.1	11.3	20.5	15.1	16.7	19.2

Age	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	
4	0.6	0.0	0.7	0.8	0.6	0.2	0.1	0.7	1.6	7.9	19.2	
5	2.1	2.7	0.2	3.6	4.0	2.4	3.7	0.9	7.3	11.5	31.9	
6	1.3	12.3	5.1	0.7	5.9	2.9	5.5	0.8	3.3	28.9	8.7	
7	1.6	1.7	13.3	2.9	1.4	4.3	2.1	1.0	8.6	12.4	12.0	
8	2.0	3.6	2.7	7.1	2.5	2.7	1.5	0.3	5.3	6.3	2.9	
9	0.2	3.0	2.2	0.7	4.3	0.5	0.6	0.3	2.4	3.0	3.9	
10	0.1	1.9	2.0	0.8	1.0	1.3	1.5	0.1	1.6	3.3	2.1	
11+	2.6	4.2	6.9	2.2	1.3	2.0	2.7	0.1	5.3	8.9	6.4	
Total	10.4	29.5	33.1	18.7	20.9	16.2	17.7	4.2	35.5	82.4	87.2	136.0

Spring and Autumn Spawners

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Total							52.7	106.2	146.4	208.7	152.8	130.2	186.9
% SS							97.2	90.5	92.3	90.2	90.1	87.2	89.7
% AS							2.8	9.5	7.7	9.8	9.9	12.8	10.3

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total	109.7	258.6	312.0	101.7	80.9	56.7	49.8	27.2	107.6	181.0	162.3	253.2
% SS	90.5	88.6	89.4	81.6	74.1	71.4	64.4	84.5	67.0	54.5	46.3	46.3
% AS	9.5	11.4	10.6	18.4	25.9	28.6	35.6	15.5	33.0	45.5	53.7	53.7

Table 10. Research gill net catch rates at age (numbers per nights fished), of spring and autumn spawning herring for St. Mary's Bay - Placentia Bay, 1982 to 2005 (with catch rates only for 2006).

Spring Spawners

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.2	1.6	0.7	0.0	0.0	0.0	0.4	0.2	0.1	0.1	0.0	0.2	0.0
3	0.2	10.2	18.6	59.3	0.3	13.7	2.3	23.5	11.2	0.9	2.7	3.5	15.6
4	0.6	1.8	21.9	5.9	125.6	1.7	4.2	6.0	19.5	16.5	0.7	3.3	25.4
5	0.4	0.9	7.0	9.9	8.5	152.1	2.7	1.8	5.7	7.1	21.8	1.5	2.9
6	1.4	1.0	2.7	6.9	17.4	11.6	100.2	3.5	2.4	1.9	3.8	12.1	0.4
7	0.2	3.2	0.9	2.4	3.4	17.7	6.2	64.3	5.0	0.5	2.4	2.4	6.9
8	1.7	0.4	7.3	2.1	2.6	4.0	14.4	3.3	69.9	1.1	1.0	2.7	2.1
9	0.4	4.7	0.2	8.6	0.1	2.1	3.0	12.6	2.4	8.3	1.6	1.1	3.8
10	0.4	0.5	10.1	2.7	2.4	0.6	0.1	3.1	16.7	1.1	7.5	2.1	3.2
11+	6.5	19.4	47.0	45.4	12.1	7.4	7.2	4.9	6.8	4.8	13.1	17.2	45.6
Total	11.9	43.8	116.3	143.1	172.5	210.7	140.7	123.2	139.5	42.3	54.8	46.2	105.9

Age	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.6	1.1	0.2	0.3	0.8	1.2	0.9	0.4	
3	11.3	0.0	4.1	22.6	67.7	11.6	5.4	106.3	1.0	1.3	14.8	
4	49.2	54.9	0.3	5.5	21.4	74.2	5.9	1.8	117.4	3.0	0.3	
5	1.8	159.8	20.4	0.3	8.0	13.8	98.2	6.0	3.1	60.5	2.0	
6	0.4	9.3	66.7	10.1	0.0	6.1	21.4	46.1	0.3	3.4	36.0	
7	0.8	5.9	12.6	26.2	13.0	0.1	9.8	7.9	10.9	0.8	1.4	
8	1.8	1.9	2.4	4.4	31.2	2.2	6.6	1.8	2.6	2.5	3.8	
9	1.2	5.9	2.2	1.3	4.4	3.2	8.6	0.8	3.5	2.7	19.3	
10	0.3	0.8	0.5	1.0	2.1	1.5	9.8	7.1	0.1	0.5	1.9	
11+	3.5	28.0	26.8	7.9	15.1	11.6	2.5	83.3	6.8	0.9	4.3	
Total	70.3	266.3	135.8	79.8	164.3	124.7	168.4	261.9	147.1	76.5	84.1	58.4

Autumn Spawners

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
3	0.6	0.4	6.2	0.9	0.7	2.0	0.0	0.1	0.1	0.3	0.0	0.1	0.3
4	0.6	9.3	10.9	36.8	8.0	4.6	1.1	1.8	1.0	2.3	1.1	1.4	5.4
5	2.0	1.7	53.6	14.2	16.6	8.2	1.2	3.8	4.5	8.1	3.7	3.8	2.2
6	0.2	4.8	16.0	39.0	10.2	14.9	2.9	1.5	2.8	2.3	5.4	3.8	2.0
7	0.0	0.9	22.9	14.4	42.2	8.5	5.2	3.8	2.9	0.9	1.6	3.8	2.8
8	0.2	0.4	1.6	12.2	10.4	20.6	5.0	2.8	3.3	2.3	0.8	1.4	4.1
9	0.1	0.7	4.1	1.5	3.6	7.5	8.3	2.0	6.7	1.5	1.9	0.6	1.9
10	0.0	0.4	0.8	2.5	1.5	0.7	1.2	5.0	2.0	0.9	1.0	0.6	0.7
11+	0.5	2.4	13.6	10.9	4.5	4.6	4.4	4.3	29.7	6.0	16.4	9.7	16.9
Total	4.1	21.0	129.4	132.5	97.8	71.6	29.2	24.9	52.9	24.6	31.9	25.3	36.4

Age	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3	0.3	0.0	4.3	0.8	3.6	1.1	0.1	0.3	0.5	0.4	0.1	
4	5.6	0.9	3.5	12.0	10.8	22.4	3.6	3.3	1.5	5.3	9.5	
5	2.6	13.8	2.7	4.7	15.6	20.2	11.0	6.0	13.7	2.6	11.0	
6	0.1	17.8	8.9	2.6	19.8	22.8	12.9	47.7	2.0	15.1	5.1	
7	0.8	3.6	13.7	5.2	5.1	25.2	12.4	54.7	7.2	2.8	7.3	
8	1.4	5.8	2.1	7.9	4.5	8.5	18.7	11.9	11.7	3.0	4.3	
9	0.6	5.8	4.0	2.1	6.9	3.3	2.3	9.7	2.6	2.3	5.8	
10	0.1	2.6	3.0	1.3	1.8	1.4	2.0	8.4	0.3	0.5	25.0	
11+	2.3	11.1	12.6	4.4	13.8	2.2	0.4	3.2	5.8	1.1	1.7	
Total	13.8	61.3	54.7	40.9	82.0	107.1	63.3	145.4	45.2	33.1	70.0	48.5

Spring and Autumn Spawners

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Total							169.9	148.2	192.4	66.9	86.7	71.5	142.4
% SS							82.8	83.2	72.5	63.2	63.2	64.6	74.4
% AS							17.2	16.8	27.5	36.8	36.8	35.4	25.6

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total	84.1	327.6	190.5	120.8	246.3	231.7	231.7	407.2	192.3	109.6	154.1	106.9
% SS	83.6	81.3	71.3	66.1	66.7	53.8	72.7	64.3	76.5	69.8	54.6	54.6
% AS	16.4	18.7	28.7	33.9	33.3	46.2	27.3	35.7	23.5	30.2	45.4	45.4

Table 11. Research gill net catch rates at age (numbers per nights fished), of spring and autumn spawning herring for Fortune Bay, 1982 to 2005 (with catch rates only for 2006).

Spring Spawners

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
3	0.6	8.4	0.0	14.3	0.0	0.0	0.0	12.1	98.8	0.6	0.3	0.0	1.3
4	0.8	6.0	22.1	2.8	224.0	0.0	0.0	0.9	1.4	54.4	3.6	0.0	32.1
5	0.6	3.9	15.0	204.5	8.8	532.2	3.1	0.9	0.0	16.8	61.3	9.1	14.0
6	0.1	3.1	6.1	69.2	69.9	11.7	420.7	15.8	0.0	2.2	11.6	140.4	21.4
7	0.2	2.4	1.4	15.7	48.3	48.3	9.8	659.3	6.2	1.7	1.3	5.0	252.5
8	6.0	2.7	4.1	4.6	10.0	20.7	50.6	14.8	236.8	21.9	1.7	3.7	3.3
9	0.3	44.0	0.3	8.8	0.8	4.8	11.4	64.9	19.7	283.8	6.3	0.0	12.0
10	0.8	4.6	4.4	6.5	2.0	1.4	2.1	33.4	59.0	38.1	70.3	9.5	12.0
11+	0.8	53.7	102.5	135.3	35.9	71.8	19.6	124.3	56.1	141.4	175.0	245.3	319.3
Total	10.3	128.7	156.0	461.6	399.3	690.2	516.8	927.3	479.4	560.9	331.4	413.0	668.0

Age	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	
3	0.0	0.0	0.0	2.4	82.8	0.0	0.0	8.1	0.0	2.9	44.6	
4	22.6	19.0	0.0	3.7	36.7	124.2	1.1	0.9	19.0	3.1	0.7	
5	85.4	134.5	89.2	0.0	21.3	40.7	235.2	4.9	0.9	44.8	2.1	
6	8.9	112.1	193.1	514.2	15.4	8.7	49.7	194.2	5.6	7.0	40.1	
7	19.8	12.1	103.9	144.5	245.8	10.9	65.6	23.3	246.2	2.3	3.1	
8	258.4	19.0	19.6	161.6	161.3	124.2	75.8	6.3	16.7	62.1	3.8	
9	39.0	187.1	17.6	19.6	40.1	109.7	122.1	5.8	3.7	3.9	107.0	
10	12.3	19.0	104.9	28.2	21.3	55.9	117.6	11.6	0.9	2.3	9.8	
11+	237.2	360.4	451.8	350.2	230.4	251.4	463.6	192.8	169.4	65.0	137.4	
Total	683.6	862.3	980.0	1224.3	853.5	726.6	1130.6	447.4	462.8	194.1	348.6	267.3

Autumn Spawners

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.1	0.0	0.0	0.0	7.4	2.2	0.0	0.0	0.0	0.7
4	0.3	18.0	0.0	13.8	8.5	0.1	0.2	0.2	6.6	1.9	1.1	0.1	0.1
5	1.4	6.0	31.1	7.9	5.0	3.3	0.1	3.6	1.0	4.4	6.3	3.5	2.8
6	0.2	20.6	11.8	73.9	9.3	4.0	3.0	1.4	2.0	1.7	9.2	5.8	7.6
7	0.0	2.0	19.5	38.6	28.2	4.5	3.8	11.1	1.4	1.2	5.2	17.5	8.0
8	0.0	1.1	4.1	17.5	9.0	25.6	3.0	8.8	4.7	1.4	3.7	3.3	15.2
9	0.0	0.5	1.0	13.8	2.0	10.0	12.2	3.1	9.4	1.6	5.8	0.9	0.5
10	0.0	0.0	0.2	3.3	1.0	5.2	1.1	20.6	0.5	5.5	2.1	0.0	0.0
11+	0.1	0.7	3.5	5.9	1.7	17.3	13.9	24.6	19.6	18.5	17.9	18.4	11.5
Total	2.0	48.9	71.3	174.6	64.8	69.9	37.3	80.7	47.4	36.4	51.3	49.5	46.4

Age	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	
4	0.0	0.0	0.0	4.2	0.0	11.2	0.0	7.4	0.4	14.8	15.9	
5	9.5	4.7	0.0	2.1	7.7	8.1	5.3	3.4	12.6	12.1	27.3	
6	3.9	11.0	5.4	12.8	26.9	2.1	12.8	24.5	0.5	43.6	21.7	
7	16.8	3.1	32.1	4.2	28.8	53.9	9.3	23.2	19.1	1.9	15.4	
8	14.2	7.8	10.7	17.0	53.8	5.4	13.2	1.9	11.5	5.5	2.6	
9	10.9	3.1	10.7	2.1	34.6	14.4	34.6	7.5	5.5	10.1	5.9	
10	0.2	1.6	7.1	0.0	15.4	3.3	10.8	1.9	4.0	3.2	1.9	
11+	18.7	26.6	25.0	8.5	46.1	60.9	11.0	23.0	24.1	5.6	14.0	
Total	74.3	58.0	91.0	51.0	213.4	159.5	97.0	92.9	78.5	96.9	104.7	80.3

Spring and Autumn Spawners

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Total							554.1	1008.0	526.8	597.4	382.7	462.5	714.4
% SS							93.3	92.0	91.0	93.9	86.6	89.3	93.5
% AS							6.7	8.0	9.0	6.1	13.4	10.7	6.5

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total	757.8	920.3	1071.0	1275.3	1066.9	886.1	1227.6	540.4	541.2	291.0	453.4	347.6
% SS	90.2	93.7	91.5	96.0	80.0	82.0	92.1	82.8	85.5	66.7	76.9	76.9
% AS	9.8	6.3	8.5	4.0	20.0	18.0	7.9	17.2	14.5	33.3	23.1	23.1

Table 12. Parameters, catch data, catch rates, effort, and abundance indices, by stock area and year, from commercial gill net logbook data.

Stock Area	Year	Number of Fishers	Mean Fisher Age	Fishing Dates Start	Fishing Dates End	Mean Mesh Size (mm)	Mean Panel Size (sq m)	Total Logbook Catch (t)	Total Comm. Landings (t)	Catch / Std. Net / Night Fished (kg)	Effort (net nights per fisher)	Current Year Abundance Index	Previous Year Abundance Index	Current Year Spawning Index
WBNDB	1981	8	-	01-Apr	23-May	-	-	50.5	2855	68.5	825	-	-	-
	1983	38	-	18-Apr	14-Jul	-	-	68.0	406	41.8	2088	-	-	-
	1996	16	-	01-Apr	18-Jun	64.7	299	68.5	229	38.4	2970	-	5.75	-
	1997	9	45	10-May	30-Jun	63.8	205	9.2	21	36.7	1031	5.00	5.85	7.00
	1998	13	47	15-Apr	30-Jun	62.6	237	8.7	36	14.9	1832	3.00	3.33	3.91
	1999	5	38	20-Apr	30-Jun	63.3	363	9.7	57	17.3	1027	5.83	3.67	3.80
	2000	8	47	15-Apr	10-Jul	63.4	310	6.8	19	22.5	727	2.69	3.93	3.55
	2001	10	45	05-May	12-Jul	60.8	201	8.2	7	25.3	910	4.60	3.22	4.42
	2002	8	49	30-Apr	05-Jul	60.0	243	0.8	13	2.2	719	2.30	3.13	1.00
	2003	9	52	29-Apr	01-Jul	59.2	175	9.4	46	24.3	1405	4.00	3.83	2.70
	2004	8	51	22-Apr	30-Jun	62.2	161	4.9	12	21.4	710	3.86	4.56	4.80
	2005	8	50	30-Apr	18-Jun	61.9	175	6.5	12	34.3	731	5.47	4.00	6.33
	2006	6	55	07-May	29-Jun	62.8	287	5.4	3	19.1	504	4.40	-	4.00
BBTB	1981	10	-	02-Apr	04-May	-	-	33.0	1766	25.9	1291	-	-	-
	1983	18	-	18-Apr	25-Jun	-	-	11.5	69	15.5	823	-	-	-
	1996	11	-	02-Apr	05-Jun	65.3	214	51.5	378	52.6	2153	-	6.17	-
	1997	6	45	07-Apr	27-Jun	66.1	312	39.4	201	27.9	1818	8.00	5.80	8.33
	1998	6	45	02-Apr	21-Jun	66.0	245	16.3	170	13.5	1655	5.00	6.00	7.33
	1999	5	51	02-Apr	29-Jun	66.0	330	28.7	194	27.8	657	6.00	3.70	3.50
	2000	9	49	08-Apr	30-Jun	65.3	349	23.6	202	36.7	1018	4.27	4.45	3.71
	2001	10	46	13-Apr	30-Jun	66.3	298	22.3	56	33.2	964	3.82	3.44	3.60
	2002	10	53	20-Apr	21-Jun	66.5	309	6.0	38	10.2	574	2.50	3.33	2.50
	2003	4	57	01-May	30-Jun	66.7	210	4.9	56	23.4	358	4.80	3.00	4.00
	2004	5	63	21-Apr	30-Jun	64.3	169	6.8	24	16.6	608	3.57	4.80	3.67
	2005	6	52	22-Apr	22-Jun	64.9	276	14.0	315	39.5	716	5.60	4.50	5.67
	2006	6	54	11-Apr	30-Jun	65.5	167	14.8	129	42.5	744	6.29	-	4.00

Table 12 (cont.'). Parameters, catch data, catch rates, effort, and abundance indices, by stock area and year, from commercial gill net logbook data.

Stock Area	Year	Number of Fishers	Mean Fisher Age	Fishing Dates Start	Fishing Dates End	Mean Mesh Size (mm)	Mean Panel Size (sq m)	Total Logbook Catch (t)	Total Comm. Landings (t)	Catch / Std. Net / Night Fished (kg)	Effort (net nights per fisher)	Current Year Abundance Index	Previous Year Abundance Index	Current Year Spawning Index
SMBPB	1983	6	-	18-Apr	29-Jun	-	-	1.2	40	3.4	320	-	-	-
	1996	13	-	19-Mar	15-Jun	67.1	261	45.3	37	31.4	2073	-	5.50	-
	1997	6	50	12-Feb	24-Jun	68.3	265	15.4	21	20.7	2171	3.50	3.29	4.50
	1998	8	52	17-Mar	25-Jun	68.2	257	25.9	18	20.2	5361	2.57	3.38	4.83
	1999	6	51	21-Feb	29-May	65.6	319	11.9	1	12.0	2981	2.75	4.50	1.83
	2000	1	57	01-Apr	26-May	66.7	334	2.7	4	10.1	280	4.00	2.80	2.00
	2001	3	52	28-Apr	23-Jun	65.3	226	2.0	38	10.2	235	3.00	3.60	3.25
	2002	4	56	20-Feb	08-Jun	66.3	241	75	135	39.4	1692	5.00	3.40	3.50
	2003	4	56	20-Mar	17-Jun	65.7	240	9.2	84	23.9	658	3.60	4.33	5.00
	2004	2	57	08-Apr	15-Jun	64.8	259	1.1	179	5.4	332	3.67	3.80	1.50
	2005	3	57	07-Apr	10-Jun	63.3	268	1.2	134	7.9	210	5.00	2.50	5.25
	2006	3	56	03-Apr	05-Jun	64.8	245	2.0	143	12.7	262	3.33	-	3.67
FB	1996	11	-	08-Apr	10-Jun	68.6	304	60	31	37.5	3044	-	7.33	-
	1997	13	50	29-Mar	28-Jun	66.9	271	68.9	28	39.4	5919	7.60	6.55	8.43
	1998	11	49	01-Apr	17-Jun	65.2	218	41.3	0	54.7	2776	7.40	8.38	7.22
	1999	8	49	21-Mar	15-Jun	65.8	313	36.1	30	37.9	1432	8.14	8.10	7.14
	2000	11	50	25-Mar	12-Jun	66.5	263	96.5	16	83.5	2364	8.45	7.63	8.09
	2001	8	54	28-Mar	21-Jun	65.6	311	54.6	0	38.2	1668	6.75	6.86	6.00
	2002	7	53	28-Mar	29-Jun	65.5	297	35.7	0	50.6	1093	6.71	6.00	6.40
	2003	7	53	08-Apr	18-Jun	66.1	283	16.3	0	36.6	581	5.00	4.67	6.13
	2004	5	53	30-Mar	23-Jun	68.1	305	10.7	54	24.6	728	4.33	6.31	4.67
	2005	6	55	06-Apr	19-Jun	67.4	303	8.6	5	16.0	552	5.08	6.00	5.70
	2006	3	50	03-Apr	15-Jun	65.1	334	3.4	1	8.7	412	4.75	-	4.00

Table 13. Results of the 2006 telephone survey of herring commercial gill net licence and/or bait permit holders, by stock area (active fishers are fishers who fished in 2006).

	WB-NDB		BB-TB		SMB-PB		FB		Combined	
	#	%	#	%	#	%	#	%	#	%
Licences and Bait Permits	989	42.5	577	24.8	453	19.5	307	13.2	2326	100.0
Fishers Phoned	113	11.4	106	18.4	103	22.7	95	30.9	417	17.9
Fishers Contacted	84	74.3	88	83.0	79	76.7	79	83.2	330	79.1
Active Fishers	40	47.6	49	55.7	22	27.8	57	72.2	168	50.9
Fished for Bait	39	97.5	44	89.8	21	95.5	55	96.5	159	94.6
Fished Commercially	0	0.0	3	6.1	1	4.5	2	3.5	6	3.6
Fished Commercially and for Bait	1	2.5	2	4.1	0	0.0	0	0.0	3	1.8
Mean Fisher Age	52	-	49	-	54	-	51	-	52	-
Current Year Abundance Index	5.68	-	5.48	-	5.00	-	5.34	-	-	-
Previous Year Abundance Index	5.29	-	4.84	-	4.78	-	6.00	-	-	-
Current Year Spawning Index	5.54	-	4.83	-	4.80	-	6.15	-	-	-

Table 14. Parameters, landings data, discard data, effort, and abundance indices, by stock area and year, from commercial purse seine questionnaires.

Stock Area	Year	Number who Fished	Number to Respond	Mean Fisher Age	Mean Vessel Capacity (t)	Mean Seine Panel Area (sq m)	Total Estimate of Landings (t)	Total Comm. Landings (t)	Total Estimate of Discards (t)	Estimate of Discard Survival (%)	Total Estimate of Removals (t)	Effort (sets per fisher)	Current Year Abundance Index	Previous Year Abundance Index
WBNDB	1996	18	17	43	41.4	11538	392	435	446	49	620	1.5	7.88	7.83
	1997	15	14	49	32.1	10963	1801	2375	2045	97	1866	21.0	6.92	7.00
	1998	6	6	46	30.6	11639	302	606	540	93	338	18.0	6.75	3.00
	1999	7	7	52	37.2	10254	882	931	116	39	953	10.0	8.50	6.40
	2000	12	9	50	38.6	10816	651	1071	130	100	651	2.4	5.88	-
	2001	0	0	-	-	-	-	13	-	-	-	-	-	6.33
	2002	3	3	51	68.0	8187	260	304	25	93	262	4.0	8.67	9.00
	2003	4	4	53	63.5	10903	201	195	193	40	317	2.0	9.00	-
	2004	5	4	51	48.8	11257	109	163	13	0	121	1.0	8.25	9.00
	2005	4	4	48	79.3	14047	84	136	12	35	92	1.0	9.00	-
	2006	-	-	-	-	-	-	-	-	-	-	-	-	-
BBTB	1996	21	21	46	26.4	12040	738	358	209	50	842	4.4	8.62	7.38
	1997	16	15	45	25.5	10374	736	650	47	60	755	9.1	6.93	8.25
	1998	13	11	48	21.9	10080	621	708	9	50	625	10.1	7.55	7.25
	1999	14	14	47	26.8	10461	894	808	219	69	962	8.8	5.79	6.80
	2000	7	5	50	31.8	10538	344	495	264	95	358	14.6	5.00	8.25
	2001	5	4	54	31.2	11237	260	259	2030	83	615	31.5	7.75	7.00
	2002	5	4	55	43.1	15622	200	200	225	100	200	3.8	6.75	7.00
	2003	2	2	55	37.4	12040	378	343	25	20	398	17.0	6.00	-
	2004	4	1	49	34.0	12040	100	322	0	-	100	8.0	8.00	7.25
	2005	10	7	50	51.8	15478	1315	1515	59	30	1356	8.4	9.29	
	2006	-	-	-	-	-	-	-	-	-	-	-	-	-
SMBPB	1996	10	9	47	33.8	20859	460	446	225	50	572	1.8	8.67	7.92
	1997	15	15	48	31.7	21190	4401	3836	403	82	4474	21.1	8.19	7.78
	1998	15	13	47	29.4	19464	1727	2281	790	99	1736	10.8	2.60	6.00
	1999	3	2	47	17.0	16354	186	330	0	-	186	13.0	5.00	2.00
	2000	1	1	57	17.2	13796	400	447	105	90	411	24.0	5.00	7.33
	2001	2	2	59	21.2	19314	430	451	100	95	435	5.5	7.67	8.60
	2002	8	8	49	37.3	20655	1440	1397	1050	98	1458	6.9	9.13	7.00
	2003	9	4	50	39.9	20367	467	925	165	98	471	7.5	6.00	7.71
	2004	11	10	51	27.2	13565	1272	1240	2	100	1272	8.7	8.38	7.67
	2005	14	9	52	31.0	14261	975	1247	572	98	984	8.1	8.67	7.83
	2006	9	7	48	56.4	20396	1005	1185	58	100	1005	6.7	8.29	-

Table 15. Biological sampling details of herring from St. Mary's Bay – Placentia Bay, March 2005.

Stratum	Survey Date	Sample Date(s)	Sample Location	Gear Type	Sample Nos.	Sample Size	Mean Lgt. (mm)	Mean Wgt. (g)	Sigma
60D	Feb. 17	Mar. 7 and 29	Long Harbour	Comm. PS	3, 6, 7, 8, 9, 10	298	306	226	2.639E-04

Table 16. St. Mary's Bay – Placentia Bay herring biomass estimate from the 2005 acoustic survey.

Stratum	Stratum Area (m^2)	Transect Number	Transect Length (m)	Random Sampling Unit	Weighting Factor	Measured Density (Sa)	Weighted Sa	Mean Weighted Density	Stratum Biomass (t)
60C	1.25e7	51 52	3830 4101	1	1.726	0.0002	0.0003		
		53 54	1260 -	2	0.274	0.0000	0.0000	1.543e-4	636
60D	1.83e7	55 56	1946 1401	1	0.780	0.0004	0.0003		
		57 58	2558 2677	2	1.220	0.0000	0.0000	1.403e-4	579
								Total Biomass =	1215
								S.E. =	213
								C.V. =	0.175

Table 17. Comparison of herring biomass estimates from acoustic surveys conducted in St. Mary's Bay – Placentia Bay in 1998 (Wheeler et al. 1999), 2000 (Wheeler et al. 2001) and 2005 (this paper).

Area	Stratum	March-April 1998	March-April 2000	February 2005
PB	60	7758	918	1215
	67	3343	0	0
	68	0	2364	0
PB	Combined	11101	3282	1215
SMB	55	472	527	0
	Combined	11573	3809	1215

Table 18. South coast reconnaissance survey, *Newfoundland Alert*, February 2 – 8, 2006 mid-water trawl set details.

Set #	Date	Location	Start Time	Start Position	Start Depth	End Time	End Position	End Depth
1	Feb. 3	Burgeo Bank	0820 NST	47.54.71 N 57.53.94W	160 m	1020 NST	46.59.30 N 58.02.33 W	142 m
2	Feb. 4	La Poile Bay	1735 NST	47.44.50 N 58.19.49 W	168 m	1815 NST	47.41.98 N 58.20.81 W	260 m
3	Feb. 6	Hermitage Bay	1010 NST	47.35.84 N 56.15.63 W	294 m	1100 NST	47.34.56 N 56.19.39 W	294 m
4	Feb. 6	Bay D'Espoir	1455 NST	47.42.75 N 55.58.90 W	73 m	1540 NST	47.41.59 N 56.03.07 W	311 m

Table 19. South coast reconnaissance survey, *Newfoundland Alert*, February 2 – 8, 2006 mid-water catch details.

Set #	Date	Location	Species	Catch Numbers	Catch Weight (kg)	Sample Taken
1	Feb. 3	Burgeo Bank	Capelin Lumpfish	~ 300 14	- -	Yes No
2	Feb. 4	La Poile Bay	Herring Capelin Cod Redfish	93 2 2 1	14 - - -	Yes No No No
3	Feb. 6	Hermitage Bay	Redfish Jellyfish	- -	~ 135 ~ 45	No No
4	Feb. 6	Bay D'Espoir	Sticklebacks	-	~ 9	No

Table 20. Mean weights at age (g) of spring-spawning herring, from samples collected January to June, by stock area, 2000 – 2005. Sample sizes in parenthesis.

Stock	Age	2000		2001		2002		2003		2004		2005	
WB-NDB	1	-	-	-	-	-	-	-	-	30	(1)	-	-
	2	-	-	-	-	-	-	78	(1)	65	(17)	-	-
	3	116	(6)	134	(12)	126	(74)	134	(68)	127	(60)	134	49
	4	170	(37)	149	(204)	195	(26)	162	(774)	155	(175)	174	89
	5	193	(184)	185	(51)	206	(33)	198	(41)	189	(483)	208	96
	6	214	(130)	215	(325)	260	(15)	217	(98)	235	(21)	234	263
	7	261	(2)	238	(120)	276	(20)	245	(16)	250	(25)	253	16
	8	302	(2)	265	(2)	283	(15)	258	(58)	244	(3)	271	12
	9	300	(4)	330	(3)	341	(3)	266	(24)	287	(14)	291	12
	10	320	(6)	327	(2)	299	(3)	272	(10)	288	(3)	300	5
	11+	378	(44)	336	(5)	397	(49)	332	(11)	376	(18)	415	41
BB-TB	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	101	(4)	97	(1)	-	-	-	-	84	(1)	-	-
	3	139	(4)	145	(45)	136	(90)	147	(26)	129	(4)	132	(56)
	4	186	(26)	164	(44)	186	(124)	183	(793)	175	(53)	178	(41)
	5	225	(209)	194	(24)	196	(41)	218	(187)	202	(633)	212	(79)
	6	243	(122)	243	(182)	239	(19)	227	(71)	233	(114)	234	(618)
	7	251	(15)	261	(72)	269	(72)	284	(22)	256	(25)	262	(90)
	8	276	(8)	283	(12)	277	(21)	280	(52)	291	(14)	277	(13)
	9	312	(450)	288	(18)	288	(10)	294	(42)	281	(10)	284	(4)
	10	325	(50)	304	(106)	301	(9)	323	(25)	303	(10)	298	(8)
	11+	332	(53)	328	(208)	328	(165)	353	(231)	365	(26)	363	(16)
SMB-PB	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	113	(6)	79	(5)	94	(3)	120	(6)	96	(9)	95	(16)
	3	135	(56)	138	(15)	136	(225)	148	(10)	127	(14)	136	(141)
	4	170	(219)	166	(16)	175	(5)	181	(415)	166	(25)	186	(7)
	5	192	(50)	189	(170)	202	(19)	208	(17)	218	(503)	229	(18)
	6	228	(130)	244	(104)	230	(150)	240	(10)	234	(53)	269	(366)
	7	239	(7)	266	(32)	257	(41)	246	(212)	266	(12)	280	(43)
	8	271	(38)	289	(13)	278	(10)	274	(18)	277	(56)	287	(17)
	9	300	(53)	280	(25)	304	(5)	309	(14)	297	(17)	291	(61)
	10	306	(24)	312	(37)	301	(18)	322	(6)	315	(16)	310	(30)
	11+	352	(66)	341	(120)	354	(102)	368	(113)	362	(42)	359	(135)
FB	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	-	79	(10)	-	-	-	-	69	(1)	-	-
	3	-	-	128	(2)	138	(12)	134	(2)	122	(7)	126	(85)
	4	148	(94)	177	(7)	162	(2)	171	(69)	135	(14)	176	(6)
	5	186	(25)	179	(365)	175	(6)	197	(3)	193	(119)	214	(3)
	6	218	(9)	214	(69)	221	(373)	210	(19)	213	(18)	235	(88)
	7	226	(8)	251	(57)	264	(35)	241	(592)	221	(21)	272	(4)
	8	255	(126)	260	(60)	284	(15)	268	(39)	256	(476)	266	(12)
	9	296	(137)	278	(133)	307	(11)	305	(8)	282	(28)	275	(342)
	10	311	(36)	303	(75)	300	(38)	307	(3)	308	(20)	301	(49)
	11+	361	(232)	338	(287)	357	(377)	347	(335)	354	(399)	365	(344)

Table 21. Parameter estimates for length and age at maturity ogives, spring and autumn spawners, 1982-84 and 2003-05.

Parameter	Time Period	Spawning Type	Variable	Estimate	Std. Error	Chi-Square	Mu	Sigma
Length	1982-84	Autumn	Intercept	-24.3273	0.7983	928.7201	287.4120	11.8144
			Length	0.0846	0.0026	1035.8867		
Length	1982-84	Spring	Intercept	-28.9158	0.5994	2326.9436	286.8099	9.9188
			Length	0.1008	0.0020	2492.3925		
Length	2003-05	Autumn	Intercept	-22.5866	2.3115	95.4796	247.9596	10.9782
			Length	0.0911	0.0081	125.0580		
Length	2003-05	Spring	Intercept	-28.4574	1.2959	482.2035	247.6656	8.7030
			Length	0.1149	0.0049	560.4521		
Age	1982-84	Autumn	Intercept	-9.0308	0.3081	859.0208	3.5882	0.3973
			Age	2.5168	0.0756	1109.1745		
Age	1982-84	Spring	Intercept	-8.7419	0.1515	3330.2372	3.0631	0.3504
			Age	2.8540	0.0495	3326.7786		
Age	2003-05	Autumn	Intercept	-4.0071	0.7007	32.7070	2.3813	0.5943
			Age	1.6827	0.1635	105.9926		
Age	2003-05	Spring	Intercept	5.6618	0.3362	283.5788	2.2967	0.4057
			Age	2.4651	0.1058	543.2636		

Table 22. Performance report standardization parameters, ranks, and weighting factors.

Data Source	Calculation of Ranks	Minimum Rank	Maximum Rank	Weighting Factor	Indicator of:
Research Gill Net Catch Rates (year = n) - spring and autumn spawners combined	<= 20% of mean = 1 21 - 40% of mean = 2 41- 60% of mean = 3 61 - 80% of mean = 4 81 - 100% of mean = 5 101 - 120% of mean = 6 121 - 140% of mean = 7 141 - 160% of mean = 8 161 - 180% of mean = 9 > 180% of mean = 10	1	10	2.0	Current Status
Commercial Gill Net Catch Rates (year = n) - from logbooks	<= 20% of mean = 1 21 - 40% of mean = 2 41- 60% of mean = 3 61 - 80% of mean = 4 81 - 100% of mean = 5 101 - 120% of mean = 6 121 - 140% of mean = 7 141 - 160% of mean = 8 161 - 180% of mean = 9 > 180% of mean = 10	1	10	0.5	Current Status
Gill Net Fisher Observations (year = n) - 2006 from telephone surveys; 1998 to 2005 from logbooks	very poor = 1 average = 5 very good = 10	1	10	0.5	Current Status
Purse Seine Fisher Observations (year = n – 1)* * except SMBPB where year = n	very poor = 1 average = 5 very good = 10	1	10	0.5	Current Status
Research Gill Net Age Compositions (year = n - 1) (number of age 3+ groups >= 5% of catch) - spring and autumn spawners combined	very poor if n = 1 average if n = 5 very good if n = 9	1	9	1.0	Current Status
Strength of Fishery Dependent Year Classes (year classes = n – 6 and n – 7) - spring and autumn spawners combined	<= 20% of mean = 1 21 - 40% of mean = 2 41- 60% of mean = 3 61 - 80% of mean = 4 81 - 100% of mean = 5 101 - 120% of mean = 6 121 - 140% of mean = 7 141 - 160% of mean = 8 161 - 180% of mean = 9 > 180% of mean = 10	1	10	1.0	Prospects
Strength of Other Mature year Classes (year classes = n – 8, n – 9, and n – 10) - spring and autumn spawners combined	<= 20% of mean = 1 21 - 40% of mean = 2 41- 60% of mean = 3 61 - 80% of mean = 4 81 - 100% of mean = 5 101 - 120% of mean = 6 121 - 140% of mean = 7 141 - 160% of mean = 8 161 - 180% of mean = 9 > 180% of mean = 10	1	10	0.5	Prospects
Recruitment (year class = n – 5) - spring and autumn spawners combined	<= 20% of mean = 1 21 - 40% of mean = 2 41- 60% of mean = 3 61 - 80% of mean = 4 81 - 100% of mean = 5 101 - 120% of mean = 6 121 - 140% of mean = 7 141 - 160% of mean = 8 161 - 180% of mean = 9 > 180% of mean = 10	1	10	0.5	Prospects

Table 23. White Bay – Notre Dame Bay performance Table to the spring of 2006.

The Fishery	***Observation***	
Reported Landings: 2004 - 2005	Landings increased from 265 t in 2004 to 911 t in 2005; 83% of the TAC was taken in 2005; average landings of 2800 t during 1990's; peak landings of 15,700 t in 1979.	
Total Removals: 2005	In addition to reported landings in 2005, an unknown amount of herring (considered to be less than 500 t) was caught in the gill net bait fishery; mortality from discards in the purse seine fishery, due to quota restrictions, was reported by fishers to be approximately 8 t.	
Effort: 2005 and 2006	Documented effort has declined since the 1980's; purse seine effort decreased by 95% from 1997 to 2005; gill net effort has also decreased by 83% from 1996 to 2006.	
Geographic Distribution of Fishery	The 2005 purse seine fishery, in November and December, was mostly in the Fogo Island area. The 2006 gill net fishery, from early May to late June, was mostly in Notre Dame Bay.	
Abundance Indices	***Observation***	***Interpretation***
Research Gill Net Catch Rates 1988 – 2006 (numbers / nights fished)	Increased, but not significantly, from 2004 to 2006; 2006 = 307, mean = 390, maximum = 887.	Current abundance below average.
Commercial Gill Net Catch Rates 1996 – 2006 (kg / net / nights fished)	Decreased slightly, but not significantly, from 2004 to 2006; (2006 = 6 logbooks); 2006 = 20, mean = 23, maximum = 38.	Current abundance below average.
Gill Net Fisher Observations 1996 – 2006 from logbooks 2005 – 2006 from phone surveys	Abundance in 2006 perceived to be average and higher than in 2005.	Current abundance average.
Purse Seine Fisher Observations 1996 - 2005	Abundance in 2005 perceived to be above average and higher than in 2004.	Abundance in 2005 above average.
Biological Characteristics	***Observation***	***Interpretation***
2005 Research Gill Net Age Compositions (ages 3+)	The 1999 and 2000 year classes each accounted for ~30% of the catch; 3 year classes each account for >5% of catch.	Population age structure considered to be sTable due to substantial contribution of older fish.
Current Year Classes: 1995 to 2001 Series: 1982 - 2001 year classes	4 of 7 current mature year classes below average.	Most current mature year classes average or below average.
Recruitment: 2001 year class Series: 1982 to 2001 year classes	2001 year class average.	Average recruitment of the most recent estimatible year class.
Mean Weight: (ages 4 to 10) 1983 - 2005	Decreasing trend since 2002; below average in 2005 (242), mean = 255, maximum = 342.	Potential increase in fishing mortality per tonne caught.
Ecological Considerations	***Observation***	***Interpretation***
Water Temperature: 1983 - 2005 (at 20 m, Station 27 off St. John's)	Above average in 2005 (4.02); mean = 3.67, maximum = 4.71.	Recent higher temperatures may enhance recruitment.
Water Salinity: 1983 - 2005 (at 20 m, Station 27 off St. John's)	Above average in 2005 (31.89); mean = 31.80, maximum = 32.18	Recent higher salinities may enhance recruitment.

Stock Status	***Interpretation***	***Evaluation***
Current vs. Historical	Current abundance is substantially lower than historical estimates in the 1970's.	-
Current vs. Recent	Stock status has improved from 2002 to 2006.	+
Short Term Prospects	Uncertain; average recruitment of 2001 year class; most current mature year classes are average or below average and are weak compared to historical levels.	?

Status Definitions	
-	Concern for Current Status or Prospect
?	Uncertainty of Interpretation
+	Positive Evaluation

The standardized performance index indicates that stock status has improved from 2002 to 2006. However, current abundance is substantially lower than historical estimates in the 1970's. Short term prospects are uncertain; the 2001 year class is average and most mature year classes are average or below average and are weak, compared to historical levels.

Table 24. Bonavista Bay – Trinity Bay performance Table to the spring of 2006.

The Fishery	***Observation***	
Reported Landings: 2004 - 2005	Landings increased from 509 t in 2004 to 2639 t in 2005; 88% of the TAC was taken in 2005; average landings of 2600 t during 1990's; peak landings of 12,000 t in 1977.	
Total Removals: 2005	In addition to reported landings in 2005, an unknown amount of herring (considered to be less than 300 t) was caught in the gill net bait fishery; mortality from discards in the purse seine fishery, due entirely to quota restrictions, was reported to be approximately 41 t.	
Effort: 2005 and 2006	Documented effort was less in the 1990's than in the 1980's; gill net effort has continued to decline, by 65% from 1996 to 2006; purse seine effort decreased by 73% from 2001 to 2005.	
Geographic Distribution of Fishery	The 2005 purse seine fishery, in November and December, was in the northern part of Bonavista Bay and in Northwest Arm, Trinity Bay. The 2006 gill net fishery, from mid April to late June, was distributed throughout Bonavista and Trinity Bays.	
Abundance Indices	***Observation***	***Interpretation***
Research Gill Net Catch Rates 1988 – 2006 (numbers / nights fished)	Increased, but not significantly, from 2004 to 2006; 2006 = 253, mean = 140, maximum = 312.	Current abundance above average.
Commercial Gill Net Catch Rates 1996 – 2006 (kg / net / nights fished)	Increased, but not significantly, from 2004 to 2006; (2006 = 6 logbooks); 2006 = 43, mean = 29, maximum = 53.	Current abundance above average.
Gill Net Fisher Observations 1996 – 2006 from logbooks 2005 – 2006 from phone surveys	Abundance in 2006 perceived to be average and higher than in 2005.	Current abundance average.
Purse Seine Fisher Observations 1996 - 2005	Abundance in 2005 perceived to be above average and higher than in 2004.	Abundance in 2005 above average.
Biological Characteristics	***Observation***	***Interpretation***
2005 Research Gill Net Age Compositions (ages 3+)	The 1999 and 2000 year classes each accounted for 25% - 30% of the catch; 5 year classes each account for >5% of catch.	Population age structure considered to be stable.
Current Year Classes: 1995 to 2001 Series: 1982 - 2001 year classes	5 of 7 current mature year classes above average.	Most current mature year classes above average.
Recruitment: 2001 year class Series: 1982 to 2001 year classes	2001 year class above average.	Above average recruitment of the most recent estimatible year class.
Mean Weight: (ages 4 to 10) 1983 - 2005	STable since 2001; below average in 2005 (243) mean = 253, maximum = 335.	Potential increase in fishing mortality per tonne caught.
Ecological Considerations	***Observation***	***Interpretation***
Water Temperature: 1983 - 2005 (at 20 m, Station 27 off St. John's)	Above average in 2005 (4.02); mean = 3.67, maximum = 4.71.	Recent higher temperatures may enhance recruitment.
Water Salinity: 1983 - 2005 (at 20 m, Station 27 off St. John's)	Above average in 2005 (31.89); mean = 31.80, maximum = 32.18	Recent higher salinities may enhance recruitment.

Stock Status	***Interpretation***	***Evaluation***
Current vs. Historical	Current abundance is substantially lower than historical estimates in the 1970's.	-
Current vs. Recent	Stock status has improved from 2002 to 2006.	+
Short Term Prospects	Positive; above average recruitment of 2001 year class; most current mature year classes are above average but are weak compared to historical levels.	+

Status Definitions	
-	Concern for Current Status or Prospect
?	Uncertainty of Interpretation
+	Positive Evaluation

The standardized performance index indicates that stock status has improved from 2002 to 2006. However, current abundance is substantially lower than historical estimates in the 1970's. Short term prospects are positive; the 2001 year class is above average and most mature year classes are above average but weak, compared to historical levels.

Table 25. St. Mary's Bay – Placentia Bay performance Table to the spring of 2006.

The Fishery	***Observation***	
Reported Landings: 2004 - 2005	Landings increased from 1389 t in 2004 to 1426 t in 2005; 57% of the TAC was taken in 2005; average landings of 1200 t during 1990's; peak landings of 4000 t in 1997 (since large mobile purse seine fishery in 1960's).	
Total Removals: 2005	In addition to reported landings in 2005, an unknown amount of herring (considered to be less than 150 t) was caught in the gill net bait fishery; fishers reported no discard mortality in the purse seine fishery.	
Effort: 2006	Documented effort increased from the 1980's to the 1990's; purse seine effort peaked in 2000 and has since declined by 72% from 2001 to 2006; gill net effort peaked in 1998 and has since declined by 95% from 1998 to 2006.	
Geographic Distribution of Fishery	The 2006 purse seine fishery, from January to June, was along the eastern sides of Placentia Bay and St. Mary's Bay. The 2006 gill net fishery, from early April to early June, was mostly in Placentia Bay.	
Abundance Indices	***Observation***	***Interpretation***
Research Gill Net Catch Rates 1982 – 2006 (numbers / nights fished)	Decreased slightly, but not significantly, from 2004 to 2006; 2006 = 107, mean = 177, maximum = 407.	Current abundance below average.
Commercial Gill Net Catch Rates 1996 – 2006 (kg / net / nights fished)	Increased, but not significantly, from 2004 to 2006 (2006 = 3 logbooks); 2006 = 13, mean = 17, maximum = 39.	Current abundance below average.
Gill Net Fisher Observations 1996 – 2006 from logbooks 2005 – 2006 from phone surveys	Abundance in 2006 perceived to be below average and similar to 2005.	Current abundance below average.
Purse Seine Fisher Observations 1996 – 2006	Abundance in 2006 perceived to be above average and similar to 2004.	Current abundance above average.
Biological Characteristics	***Observation***	***Interpretation***
2005 Research Gill Net Age Compositions (ages 3+)	The 1999 year class accounted for 27% of the catch; 8 year classes each account for >5% of catch.	Population age structure considered to be stable.
Current Year Classes: 1995 to 2001 Series: 1976 - 2001 year classes	4 of 7 current mature year classes below average.	Most current mature year classes below average.
Recruitment: 2001 year class Series: 1976 to 2001 year classes	2001 year class below average.	Below average recruitment of the most recent estimatible year class.
Mean Weight: (ages 4 to 10) 1983 - 2005	Increasing trend since 2002; below average in 2005 (251); mean = 269, maximum = 320.	Potential increase in fishing mortality per tonne caught.
Ecological Considerations	***Observation***	***Interpretation***
Water Temperature: 1983 - 2005 (at 20 m, Station 27 off St. John's)	Above average in 2005 (4.02); mean = 3.67, maximum = 4.71.	Recent higher temperatures may enhance recruitment.
Water Salinity: 1983 - 2005 (at 20 m, Station 27 off St. John's)	Above average in 2005 (31.89); mean = 31.80, maximum = 32.18	Recent higher salinities may enhance recruitment.

Stock Status	***Interpretation***	***Evaluation***
Current vs. Historical	Current abundance is substantially lower than historical estimates in the 1970's.	-
Current vs. Recent	Stock status deteriorated from 2002 to 2004, improved slightly in 2005, and remained sTable from 2005 to 2006.	nil
Short Term Prospects	Negative; below average recruitment of 2001 year class; most current mature year classes are below average and are weak compared to historical levels.	-

Status Definitions	
-	Concern for Current Status or Prospect
?	Uncertainty of Interpretation
+	Positive Evaluation

The standardized performance index indicates that stock status deteriorated from 2002 to 2004, improved slightly in 2005, and remained sTable from 2005 to 2006. However, current abundance is substantially lower than historical estimates in the 1970's. Short term prospects are negative; the 2001 year class is below average and most mature year classes are below average and are weak, compared to historical levels.

Table 26. Fortune Bay performance Table to the spring of 2006.

The Fishery	***Observation***	
Reported Landings: 2004 - 2005	Landings decreased from 2930 t in 2004 to 2653 t in 2005; 72% of the TAC was taken in 2005; average landings of 200 t during 1990's; peak landings in 2003 (since large mobile purse seine fishery in 1960's).	
Total Removals: 2005	In addition to reported landings in 2005, an unknown amount of herring (considered to be less than 400 t) was caught in the gill net bait fishery.	
Effort: 2006	Documented effort in 1980's and 1990's was very low; gill net effort peaked in 1997 and has since declined by 93% from 1997 to 2006; there is no purse seine fishery in Fortune Bay. The current fishery is primarily by bar seines and traps for which no effort information is available. However, combined bar seine and trap landings have increased from 0 t in 1998 to 2300 t in 2006.	
Geographic Distribution of Fishery	The 2006 spring bar seine fishery was concentrated in the Long Harbour area; the gill net fishery, from early April to mid June, was distributed throughout Fortune Bay.	
Abundance Indices	***Observation***	***Interpretation***
Research Gill Net Catch Rates 1982 – 2006 (numbers / nights fished)	Increased slightly, but not significantly, from 2004 to 2006; 2006 = 348, mean = 636, maximum = 1275.	Current abundance below average.
Commercial Gill Net Catch Rates 1996 – 2006 (kg / net / nights fished)	Decreased, but not significantly, from 2004 to 2006 (2006 = 3 logbooks); 2006 = 9, mean = 39, maximum = 84.	Current abundance below average.
Gill Net Fisher Observations 1996 – 2006 from logbooks 2005 – 2006 from phone surveys	Abundance in 2006 perceived to be average and lower than in 2005.	Current abundance average.
Biological Characteristics	***Observation***	***Interpretation***
2005 Research Gill Net Age Compositions (ages 3+)	Fish aged 11+ accounted for 33% of the catch; 4 year classes each account for >5% of the catch.	Population age structure considered to be sTable due to substantial contribution of older fish.
Current Year Classes: 1995 to 2001 Series: 1976 - 2001 year classes	4 of 7 current mature year classes average or below average.	Most current mature year classes below average.
Recruitment: 2001 year class Series: 1976 to 2001 year classes	2001 year class below average.	Below average recruitment of the most recent estimatible year class.
Mean Weight: (ages 4 to 10) 1983 - 2005	STable since 2000; below average in 2005 (235); mean = 259, maximum = 321.	Potential increase in fishing mortality per tonne caught.
Ecological Considerations	***Observation***	***Interpretation***
Water Temperature: 1983 - 2005 (at 20 m, Station 27 off St. John's)	Above average in 2005 (4.02); mean = 3.67, maximum = 4.71.	Recent higher temperatures may enhance recruitment.
Water Salinity: 1983 - 2005 (at 20 m, Station 27 off St. John's)	Above average in 2005 (31.89); mean = 31.80, maximum = 32.18	Recent higher salinities may enhance recruitment.

Stock Status	***Interpretation***	***Evaluation***
Current vs. Historical	Current abundance is substantially lower than peak estimates in the late 1990's.	-
Current vs. Recent	Stock status deteriorated steadily from 2001 to 2004, improved slightly in 2005, and deteriorated again in 2006.	-
Short Term Prospects	Negative; below average recruitment of 2001 year class; most current mature year classes are below average and are weak compared to historical levels.	-

Status Definitions	
-	Concern for Current Status or Prospect
?	Uncertainty of Interpretation
+	Positive Evaluation

The standardized performance index indicates that stock status deteriorated from 2001 to 2004, improved slightly in 2005 and deteriorated again in 2006. Current abundance is substantially lower than peak estimates in the late 1990's. Short term prospects are negative; the 2001 year class is below average and most mature year classes are below average and are weak, compared to historical levels.

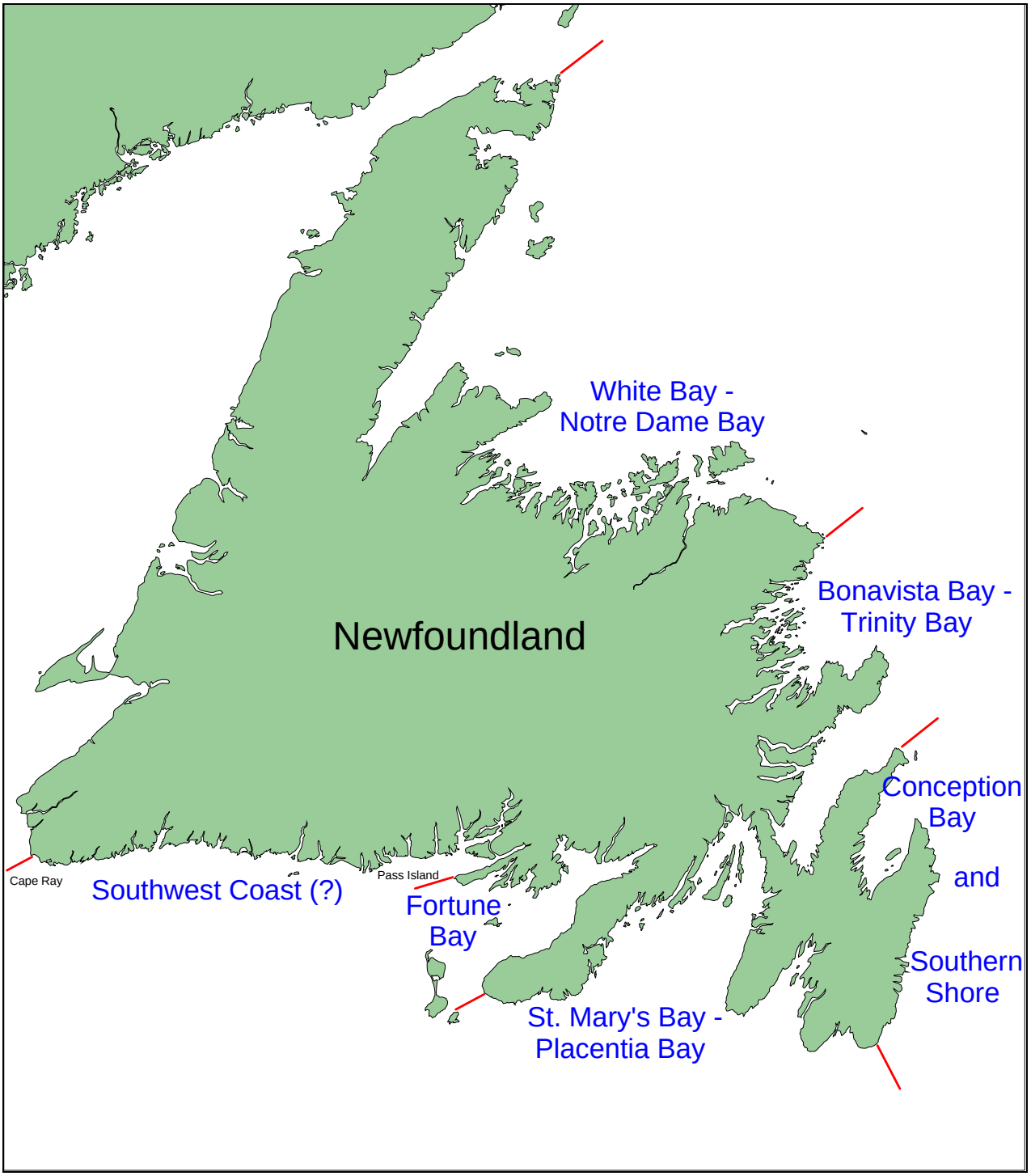


Fig. 1. Area map indicating herring stock complexes within the Newfoundland and Labrador Region.

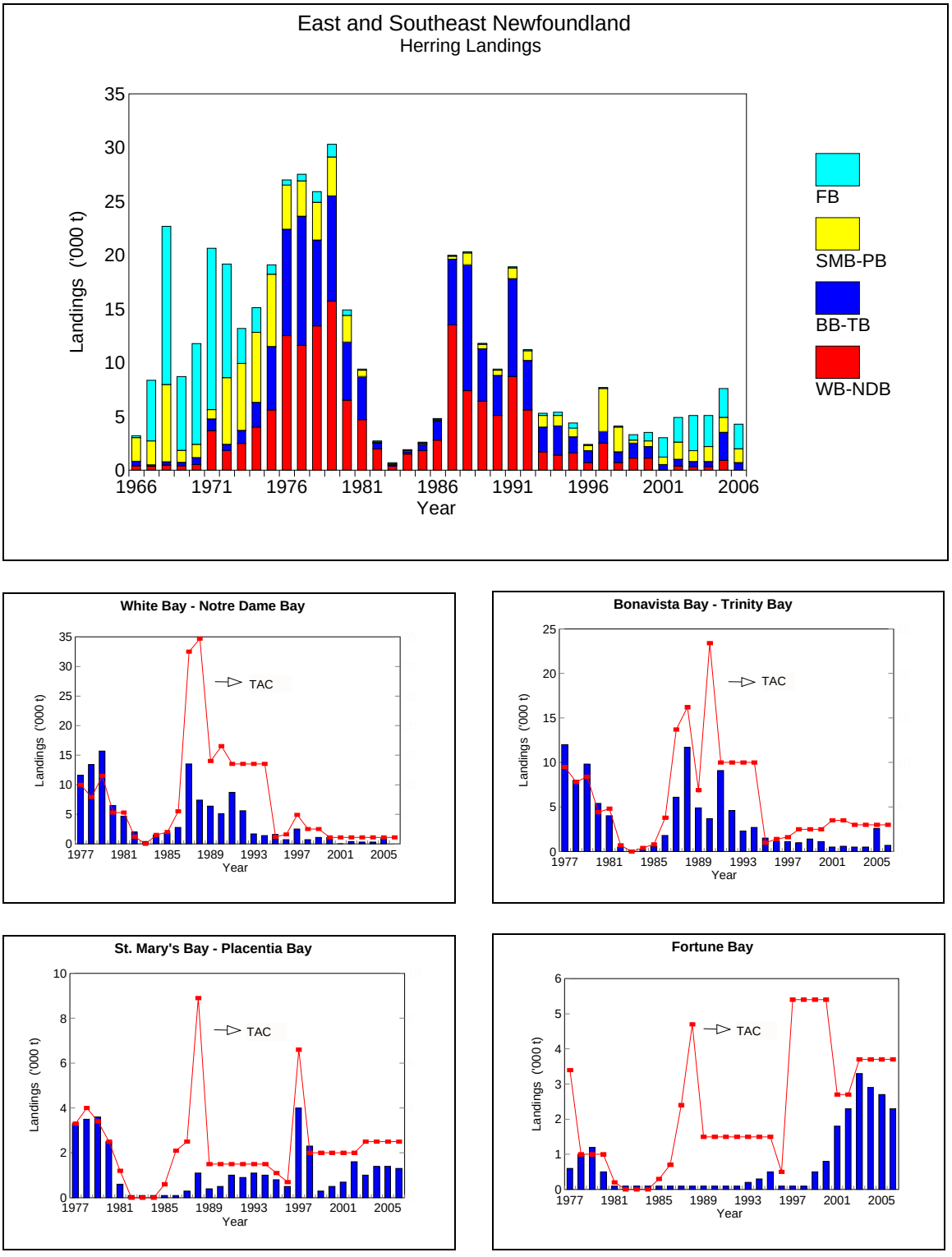


Fig. 2. East and southeast Newfoundland herring landings and TAC's, by stock area, 1966 – 2006.

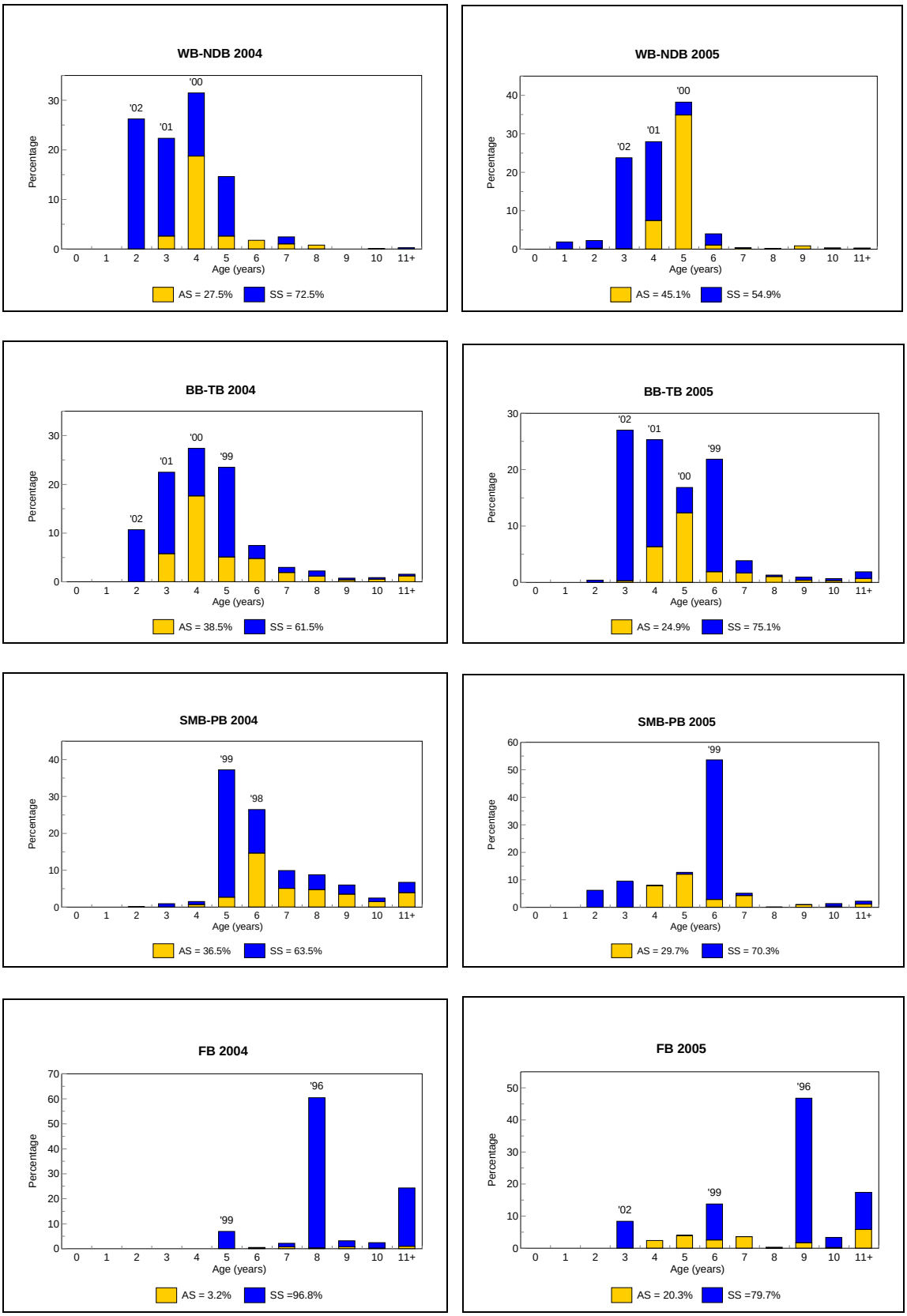


Fig. 3. Age distribution of herring from the commercial fishery, by stock area, 2004 and 2005.

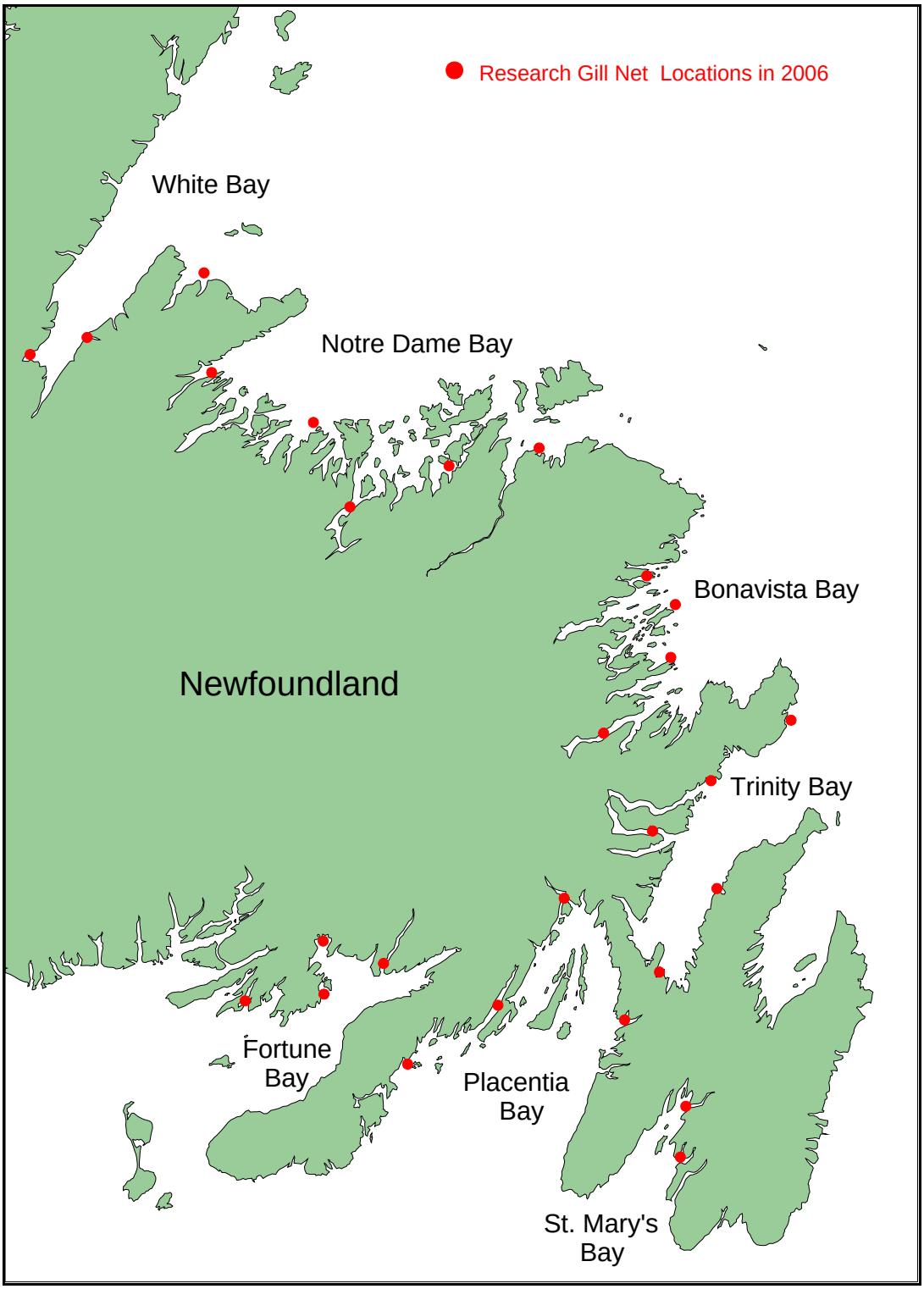


Fig. 4. Herring research gill net locations, by stock area, in 2006.

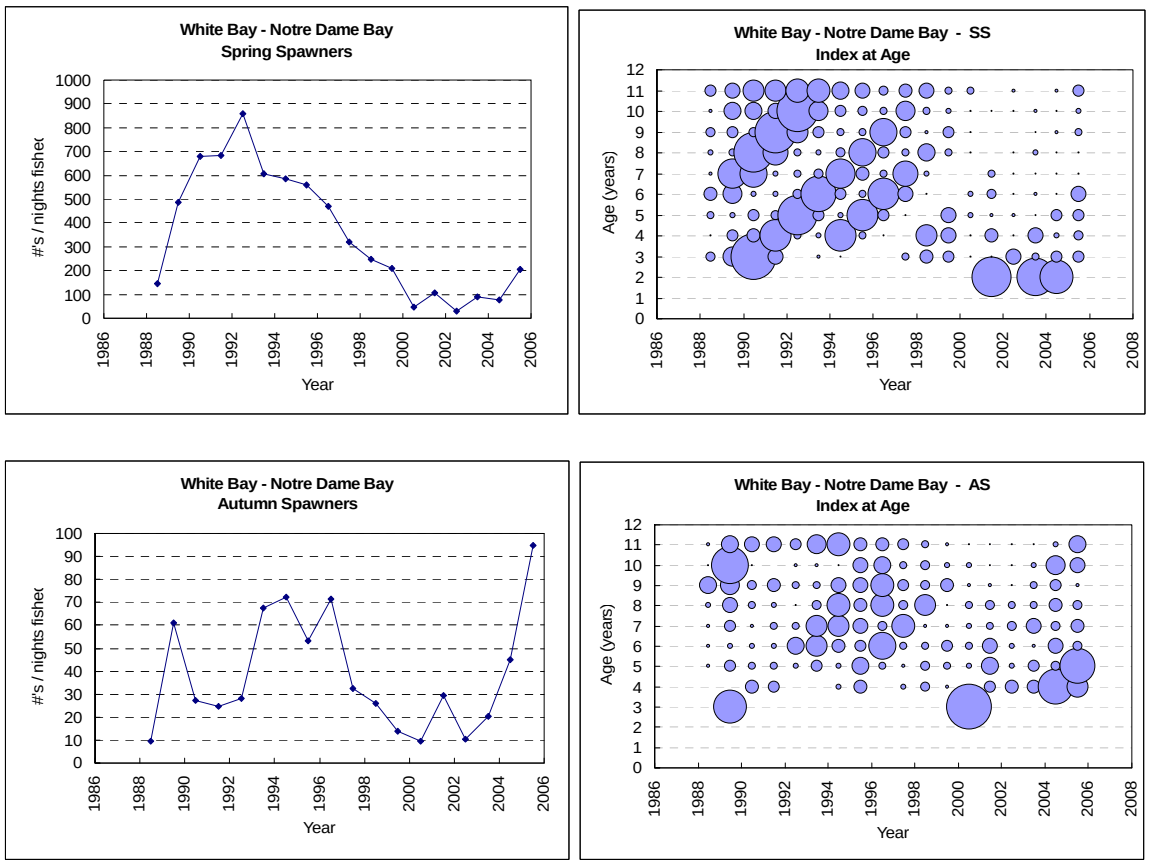


Fig. 5. Research gill net catch rates (numbers per nights fished) and indices at age (normalized by age) for White Bay – Notre Dame Bay, by spawning type, 1988 to 2005.

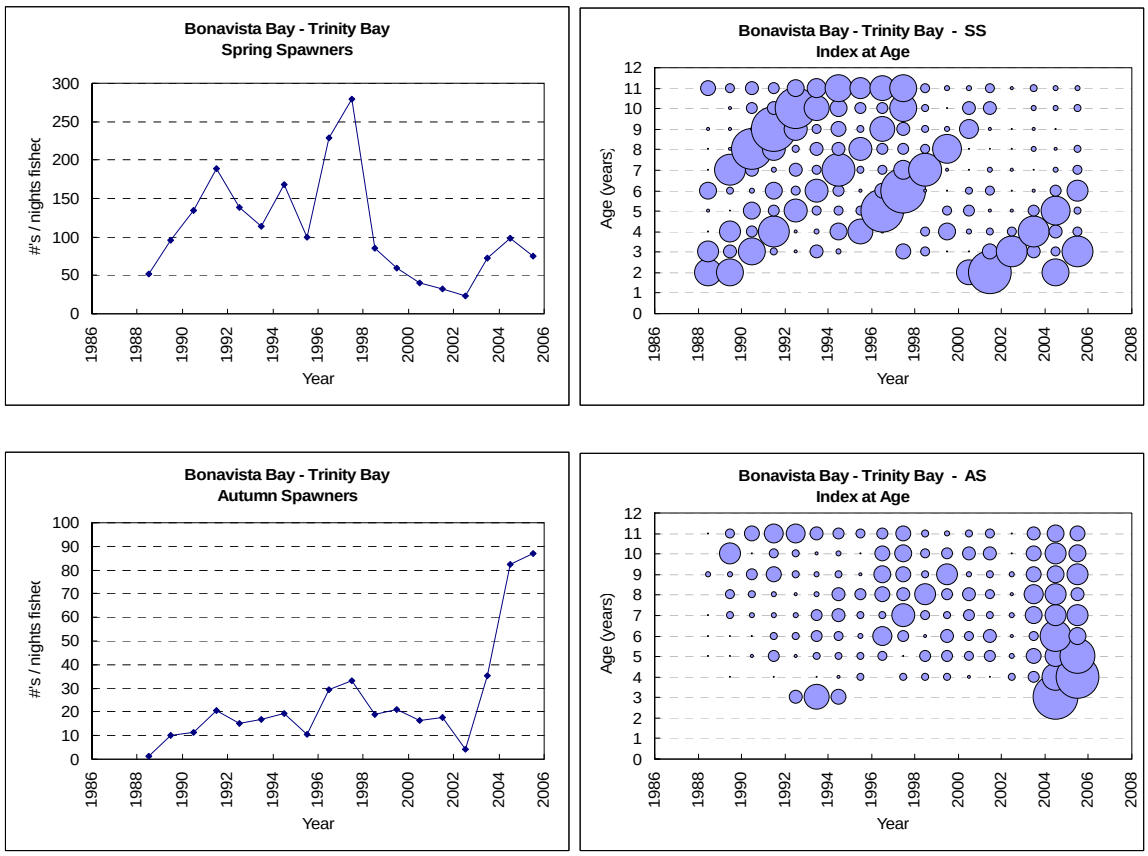


Fig. 6. Research gill net catch rates (numbers per nights fished) and indices at age (normalized by age) for Bonavista Bay – Trinity Bay, by spawning type, 1988 to 2005.

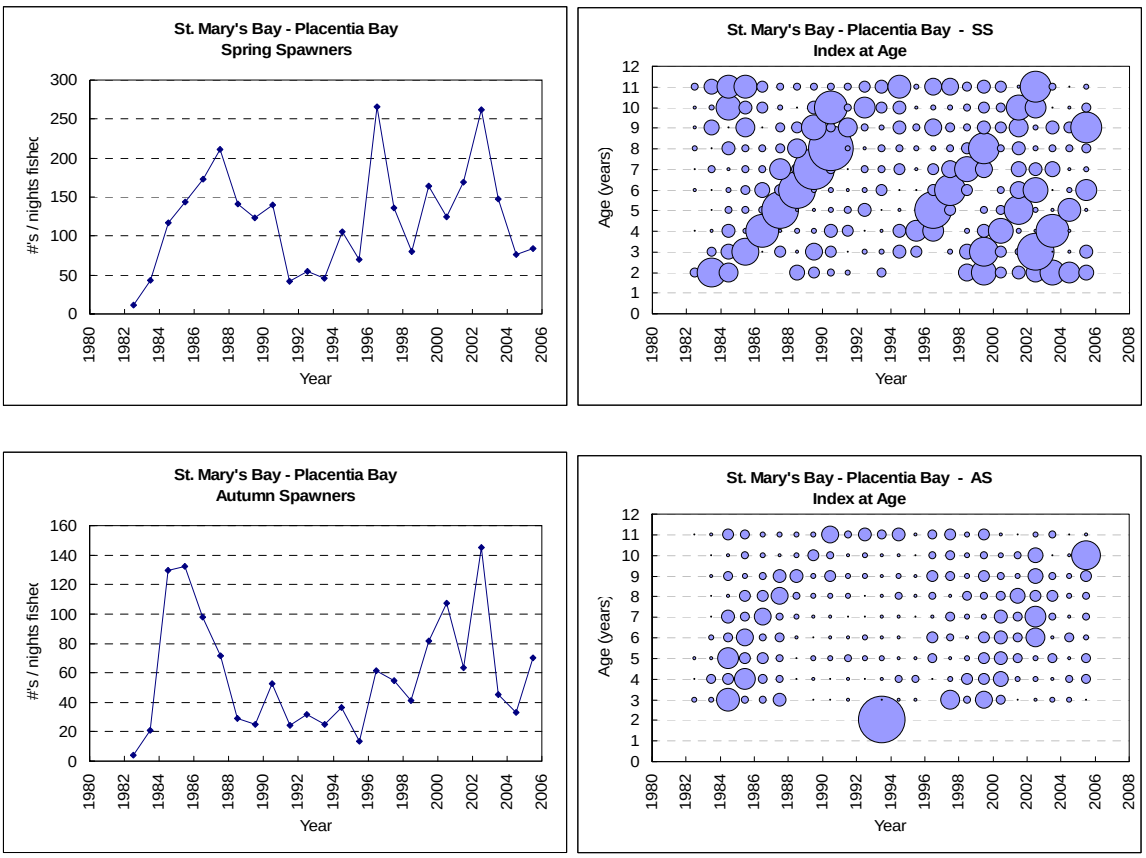


Fig. 7. Research gill net catch rates (numbers per nights fished) and indices at age (normalized by age) for St. Mary's Bay – Placentia Bay, by spawning type, 1982 to 2005.

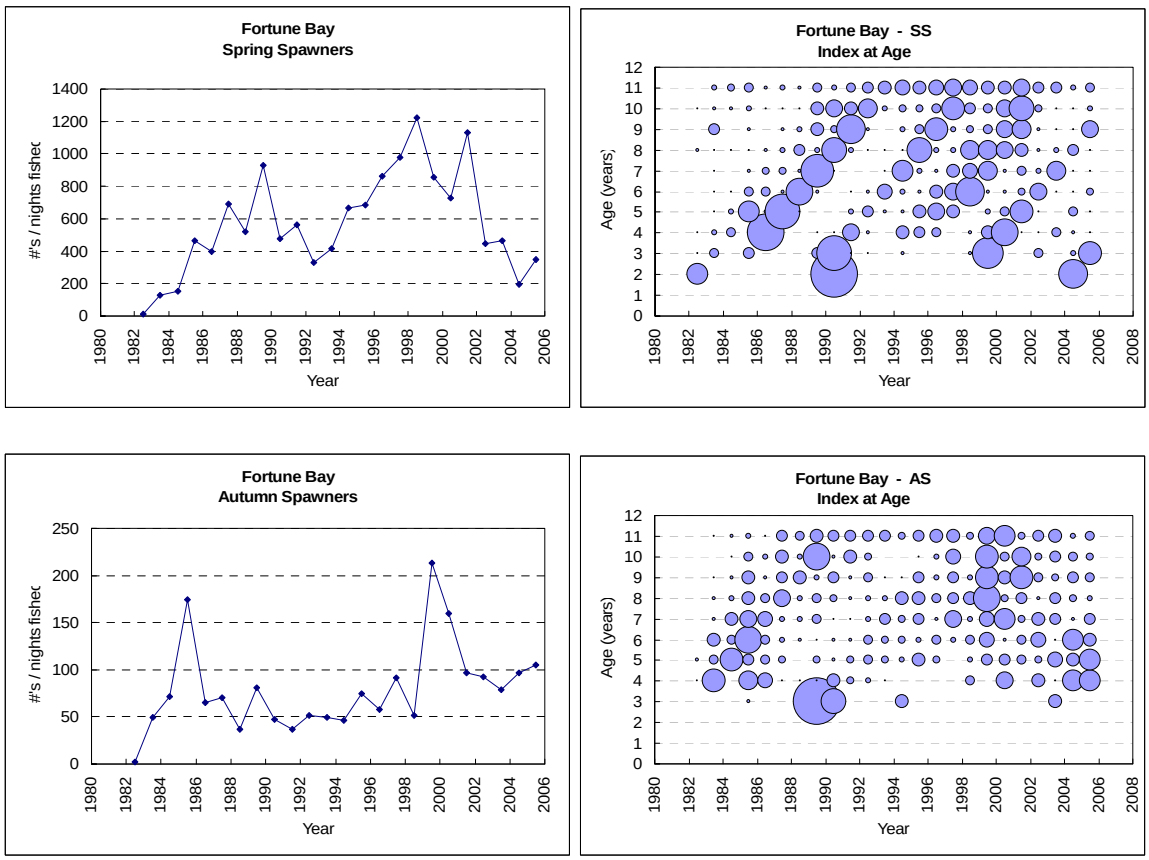


Fig. 8. Research gill net catch rates (numbers per nights fished) and indices at age (normalized by age) for Fortune Bay, by spawning type, 1982 to 2005.

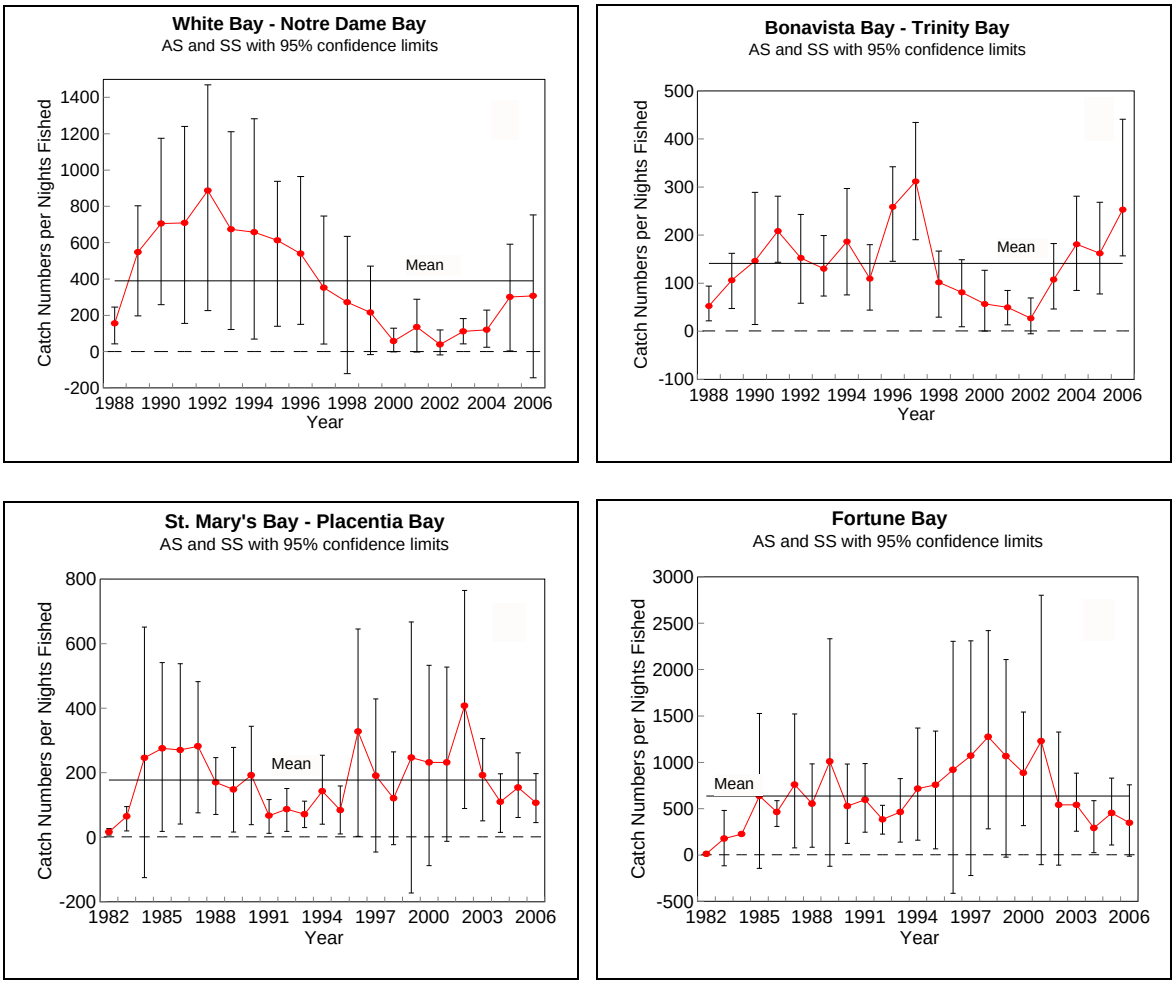


Fig. 9. Research gill net catch rates (numbers per nights fished), by stock area and year, spring and autumn spawners combined (with 95% confidence limits).

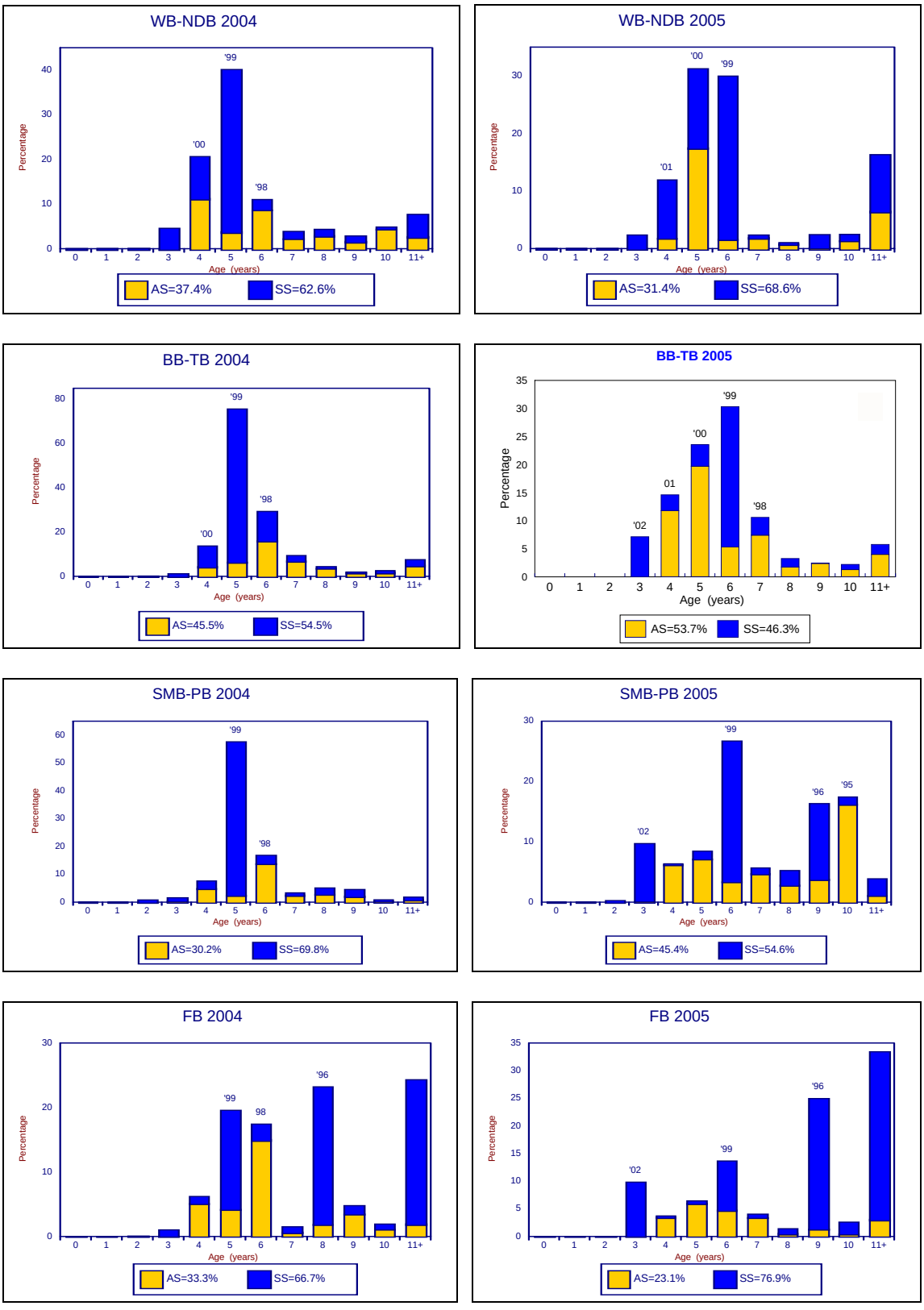


Fig. 10. Age distribution of herring from the research gill net program, by stock area, 2004 and 2005.

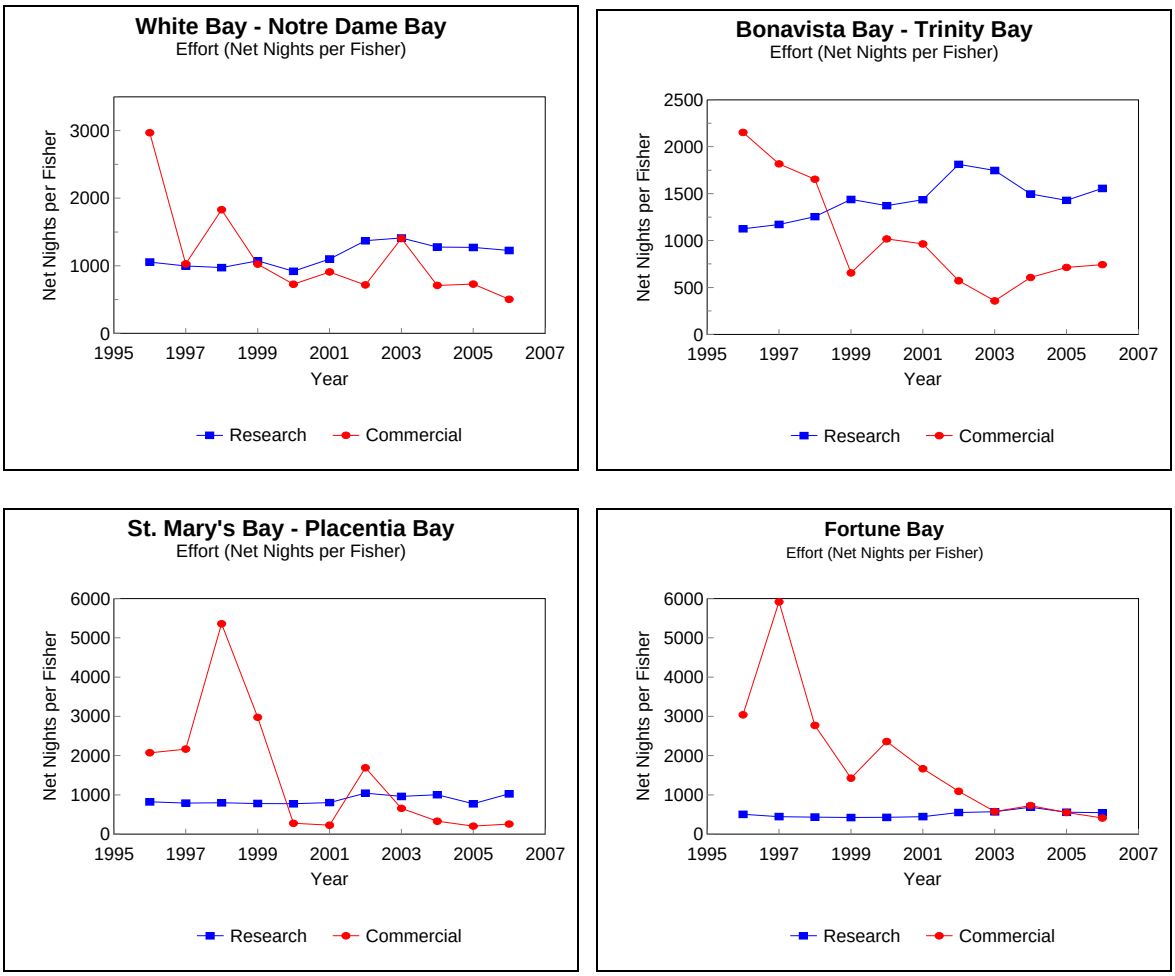


Fig. 11. Comparison of effort (net nights per fisher) for commercial and research gill net data, by stock area, 1996 – 2006.

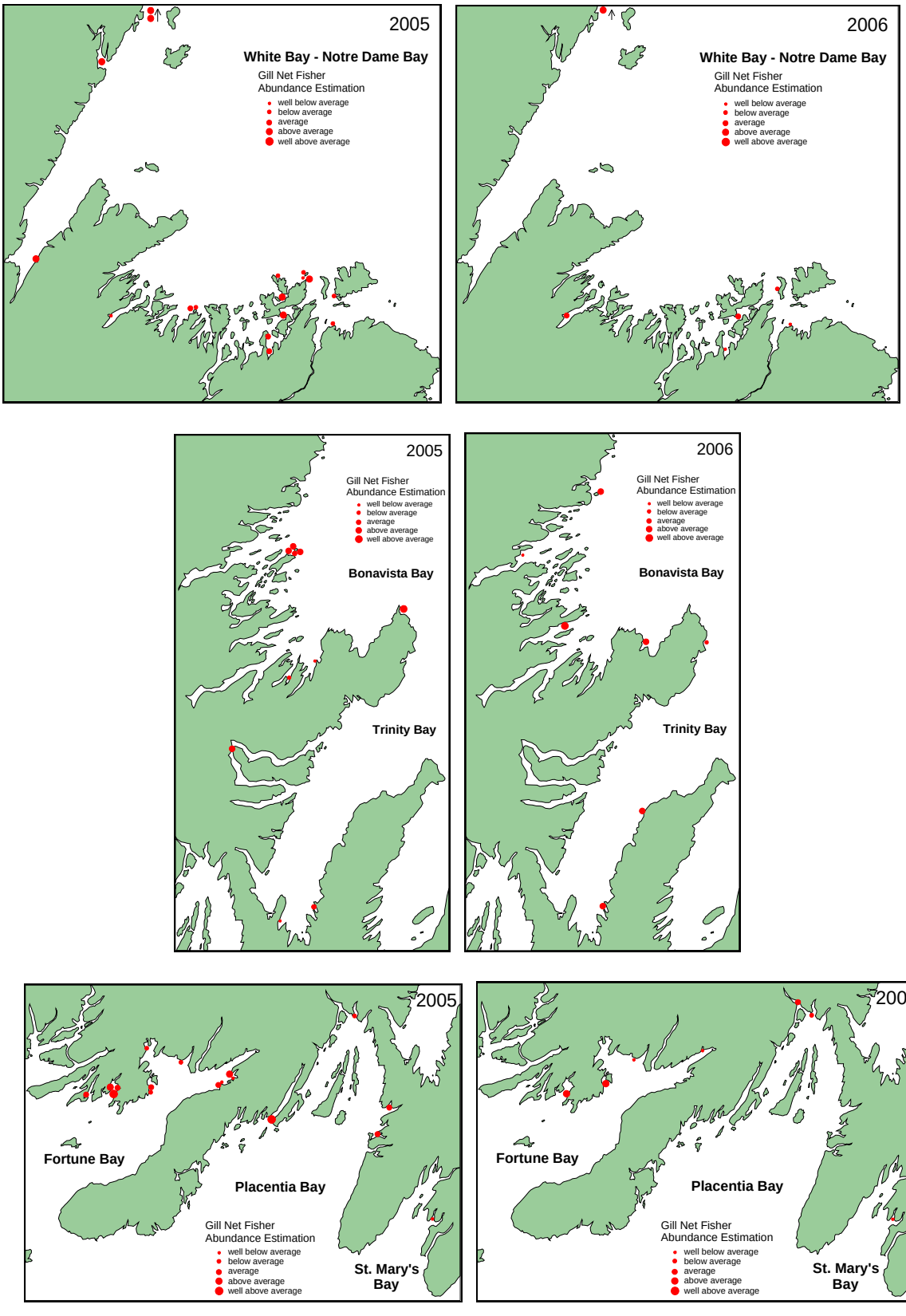
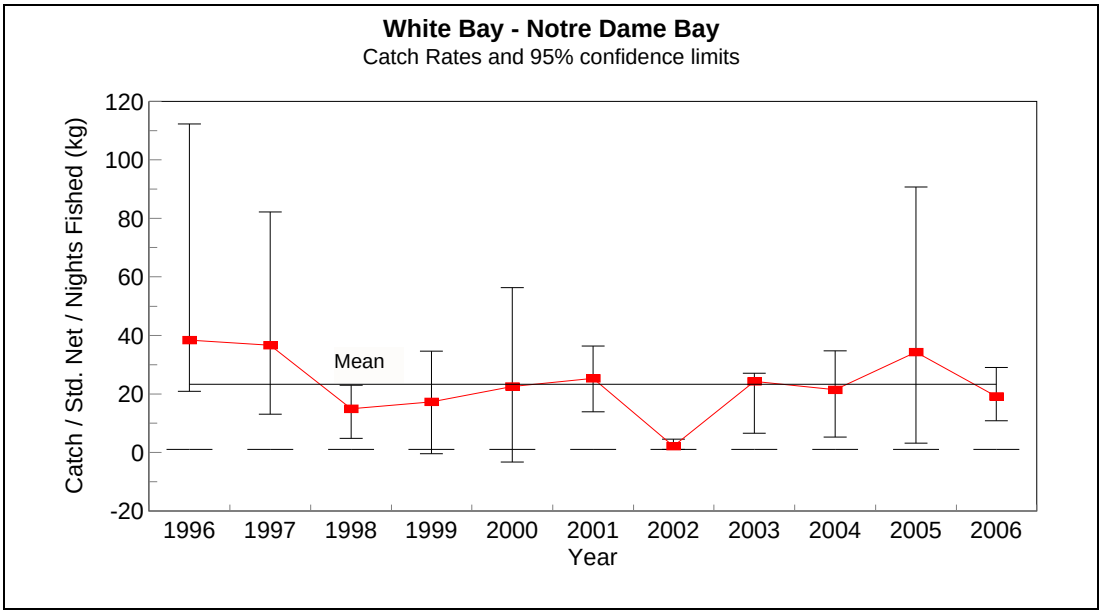


Fig. 12. Commercial herring gill net set locations and abundance estimation from logbooks, by stock area, 2004 and 2005.



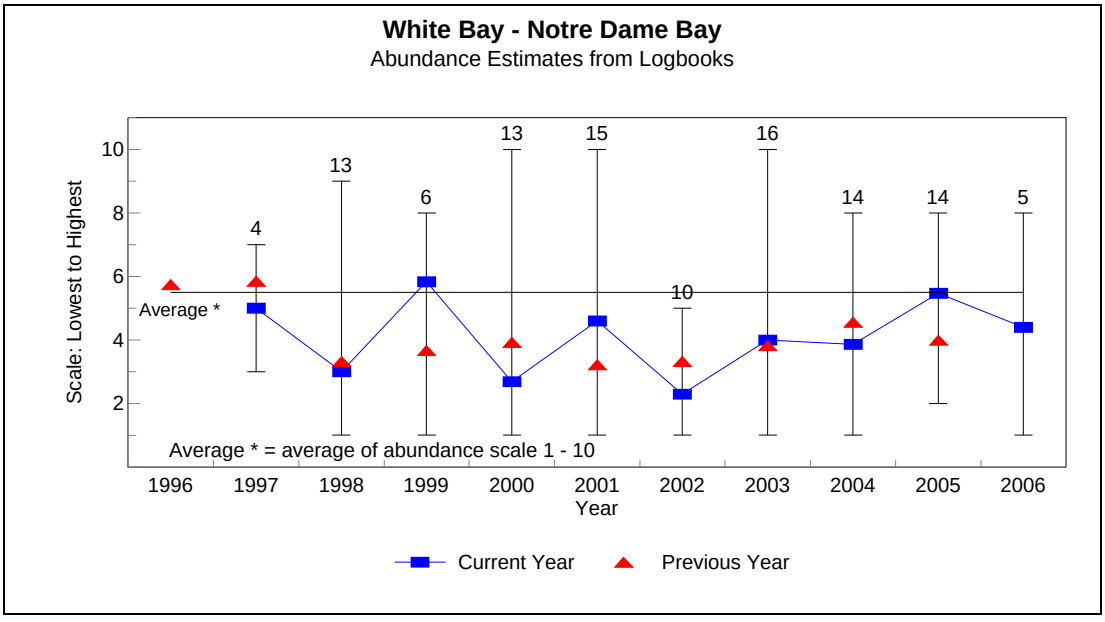
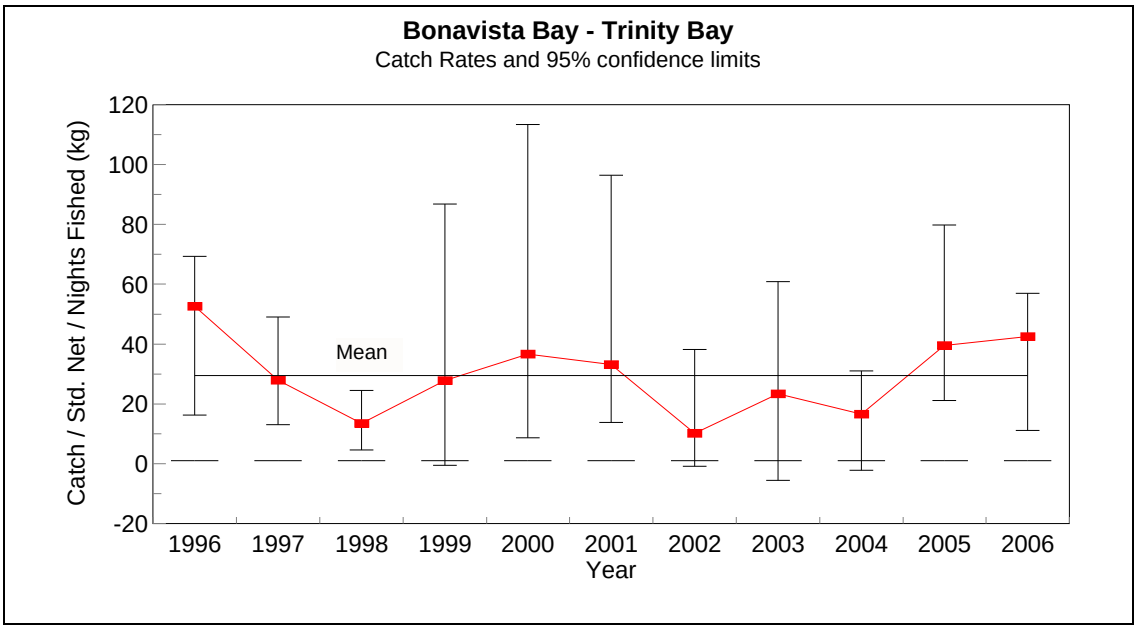


Fig. 13. Abundance indices from commercial gill net logbooks for White Bay – Notre Dame Bay, 1996 - 2006. in the lower panel, solid squares represent means, vertical lines represent the range of responses, and sample sizes are listed at the top.



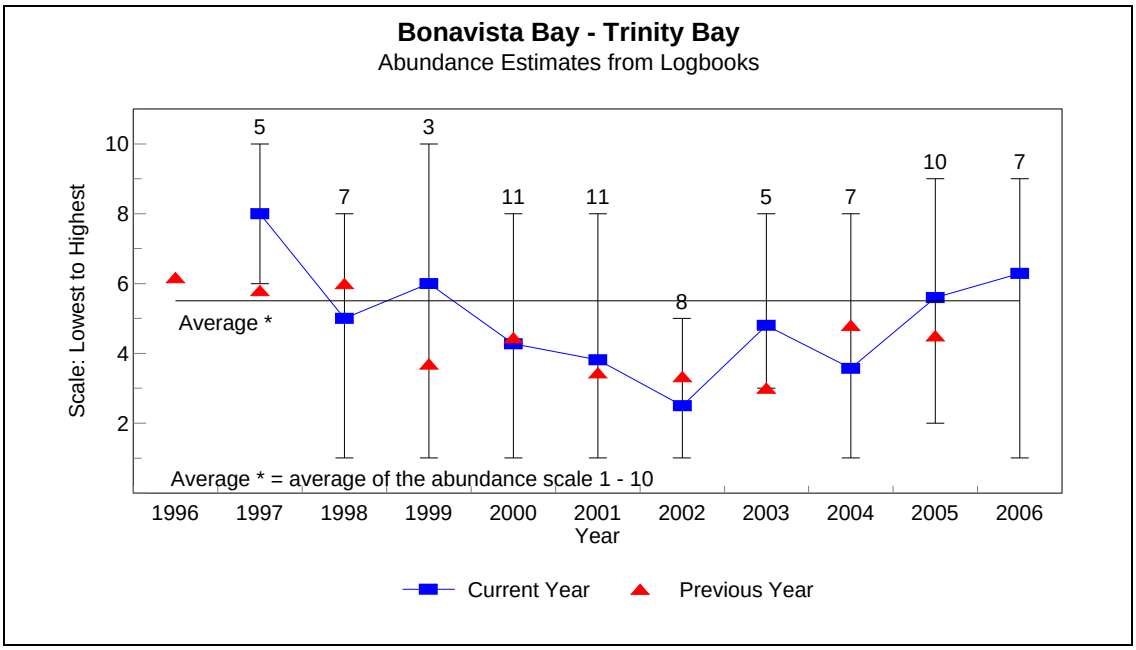
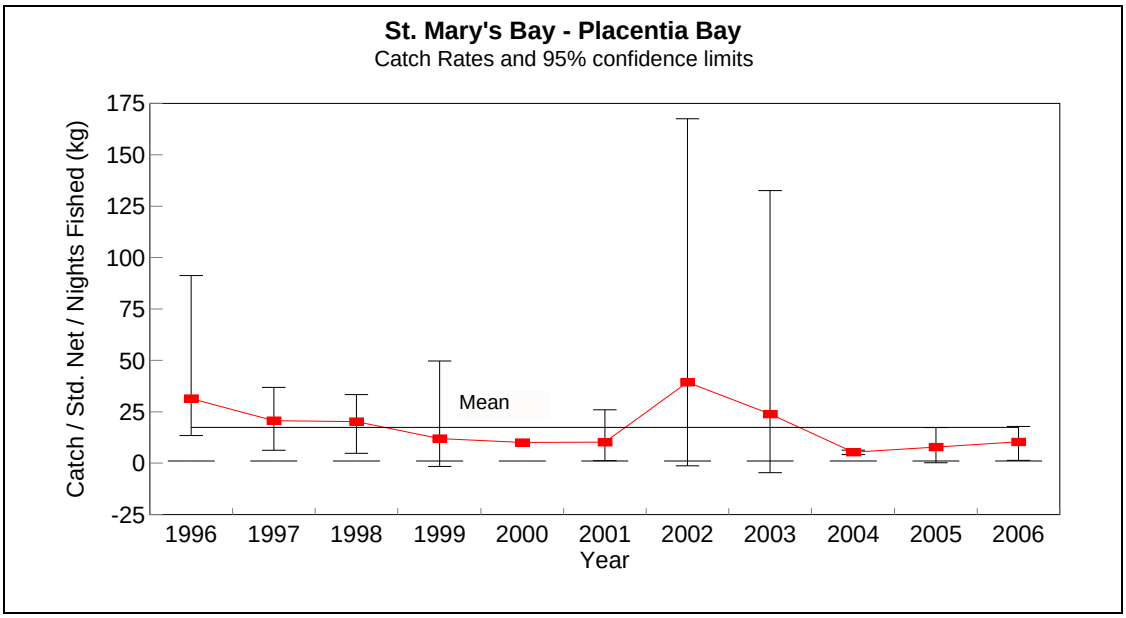


Fig. 14. Abundance indices from commercial gill net logbooks for Bonavista Bay – Trinity Bay, 1996 – 2006. In the lower panel, solid squares represent means, vertical lines represent the range of responses, and sample sizes are listed at the top.



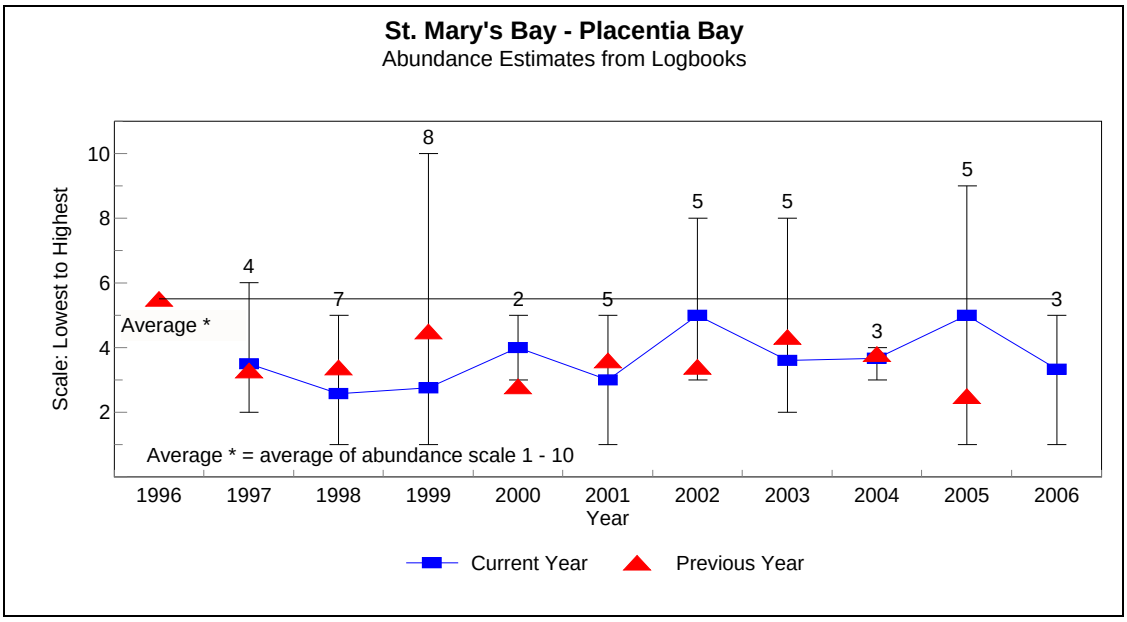


Fig. 15. Abundance indices from commercial gill net logbooks for St. Mary's Bay – Placentia Bay, 1996 – 2006. In the lower panel, solid squares represent means, vertical lines represent the range of responses, and sample sizes are listed at the top.

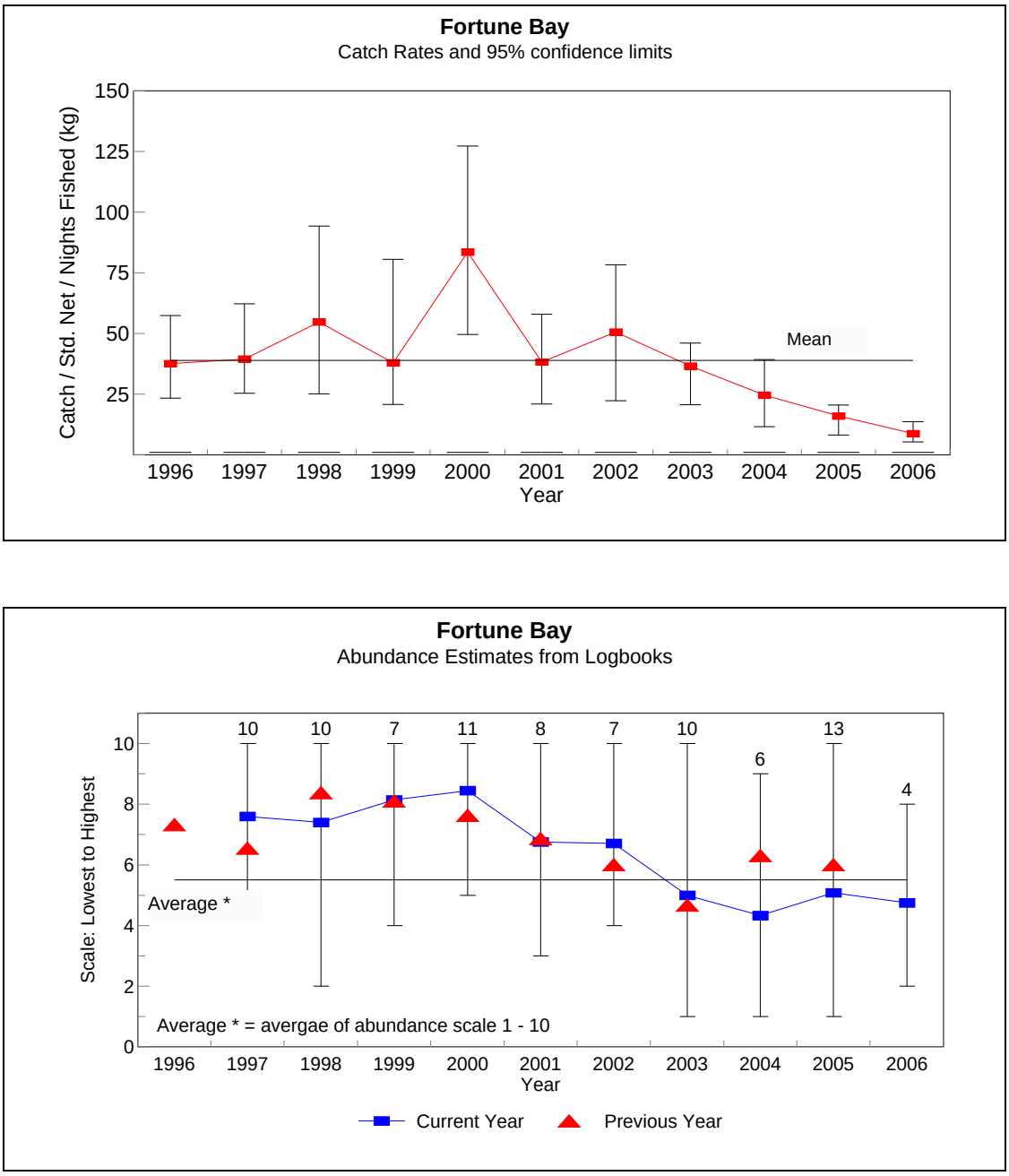


Fig. 16. Abundance indices from commercial gill net logbooks for Fortune Bay, 1996 -2006. In the lower panel, solid squares represent means, vertical lines represent the range of responses, and sample sizes are listed at the top.

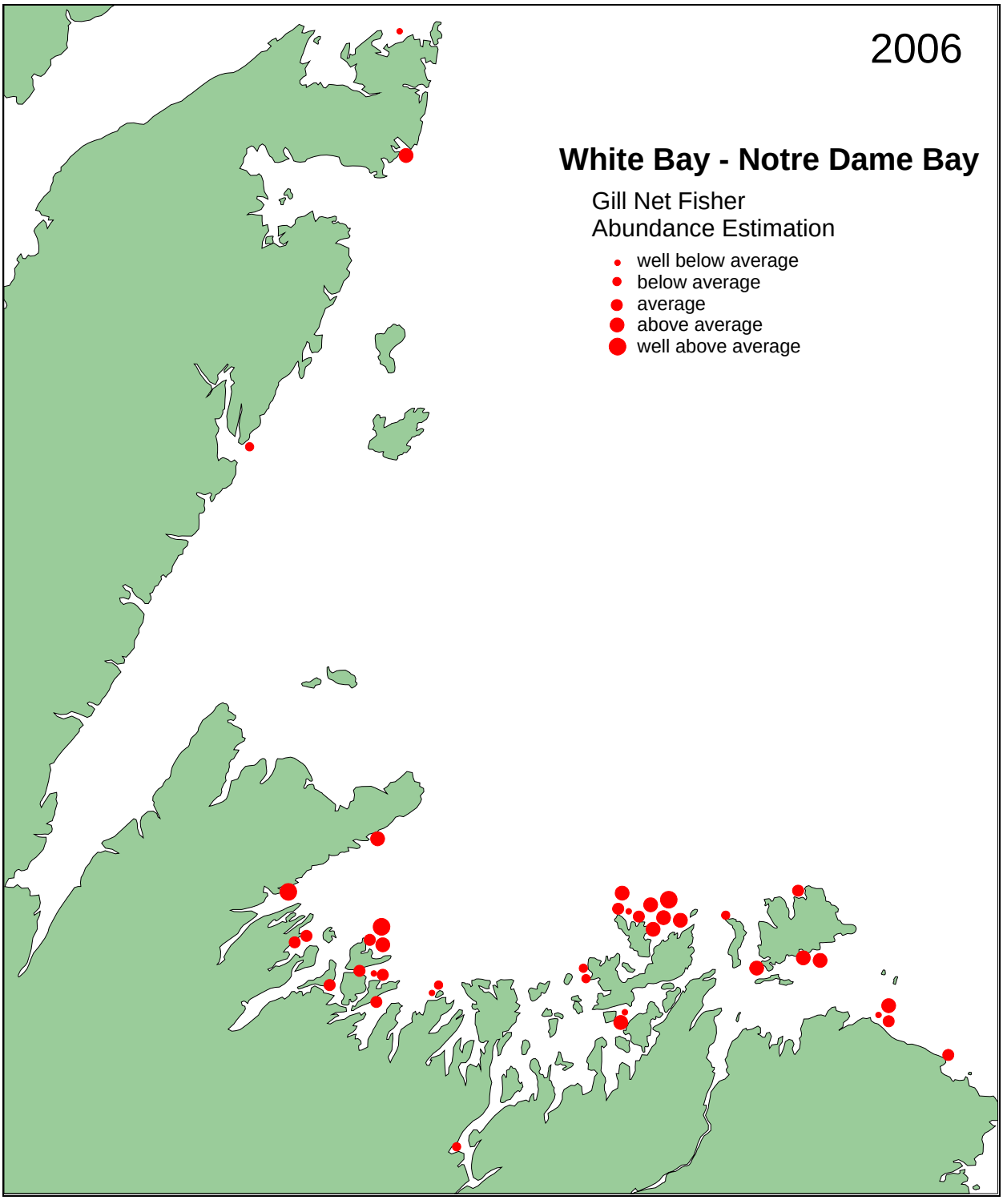


Fig. 17. White Bay – Notre Dame Bay bait and commercial gill net set locations and abundance estimation from 2006 telephone survey

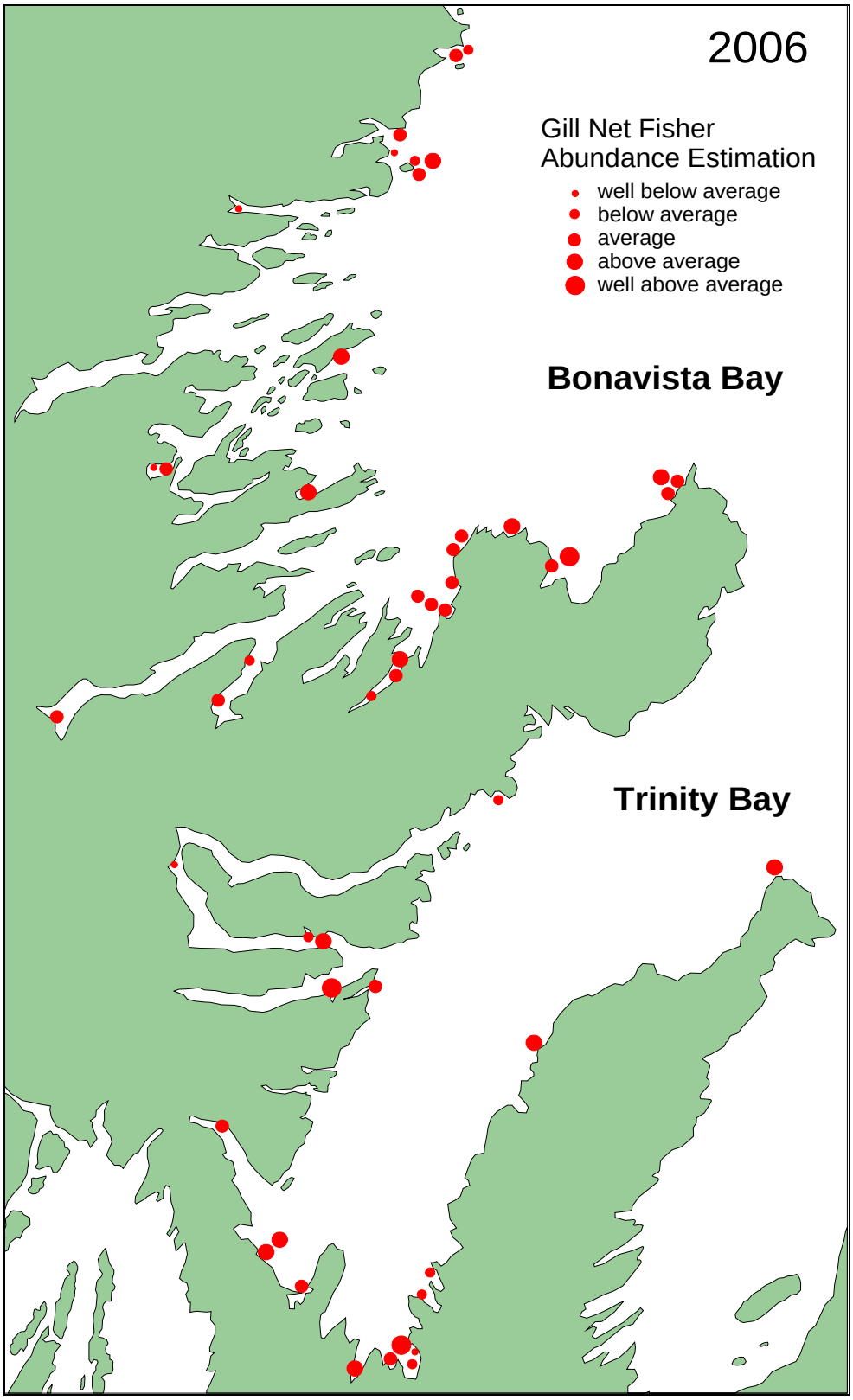


Fig. 18. Bonavista Bay – Trinity Bay bait and commercial gill net set locations and abundance estimation from 2006 telephone survey.

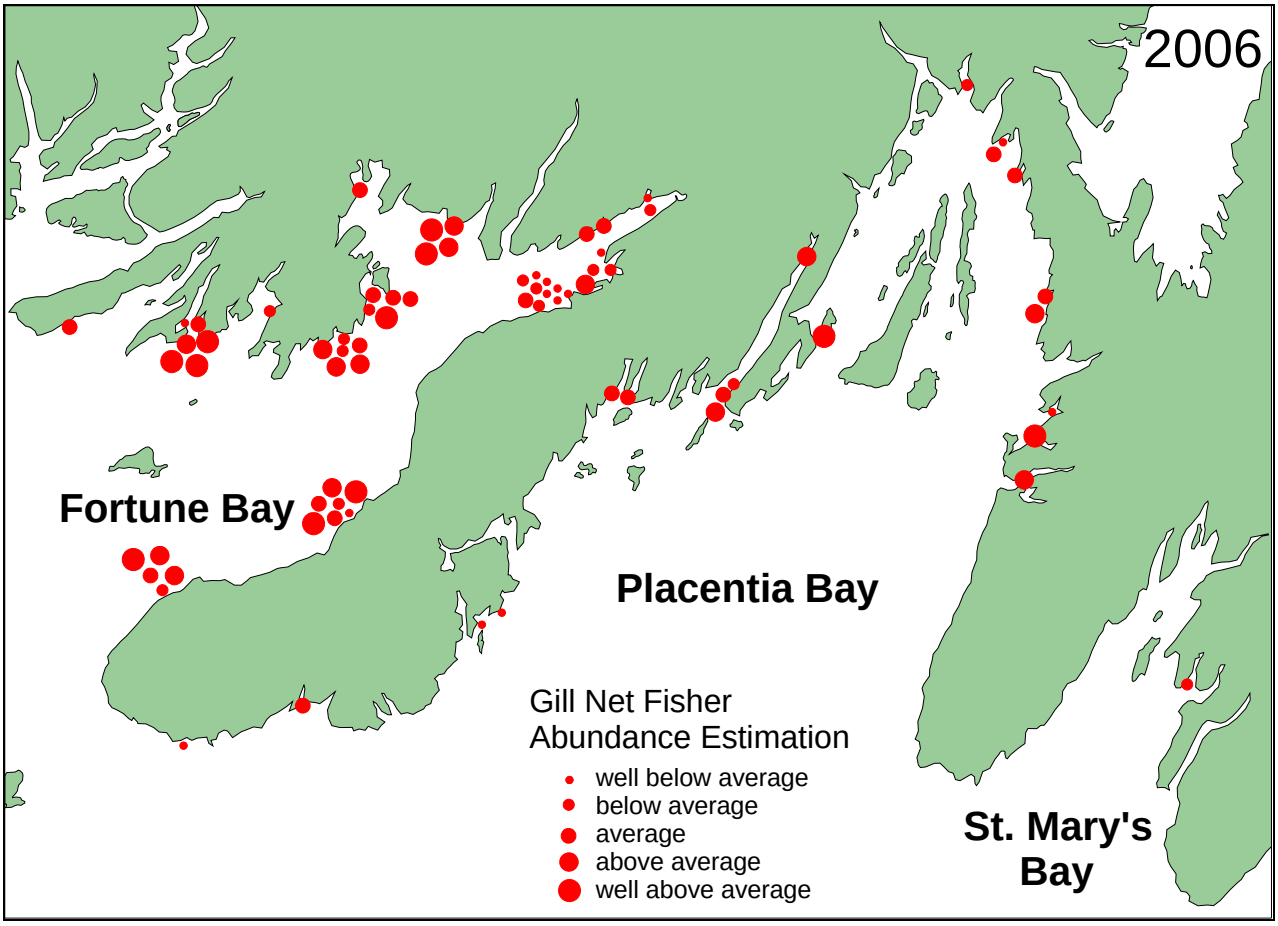


Fig. 19. St. Mary's bay – Placentia Bay and Fortune Bay bait and commercial gill net set locations and abundance estimation from 2006 telephone survey.

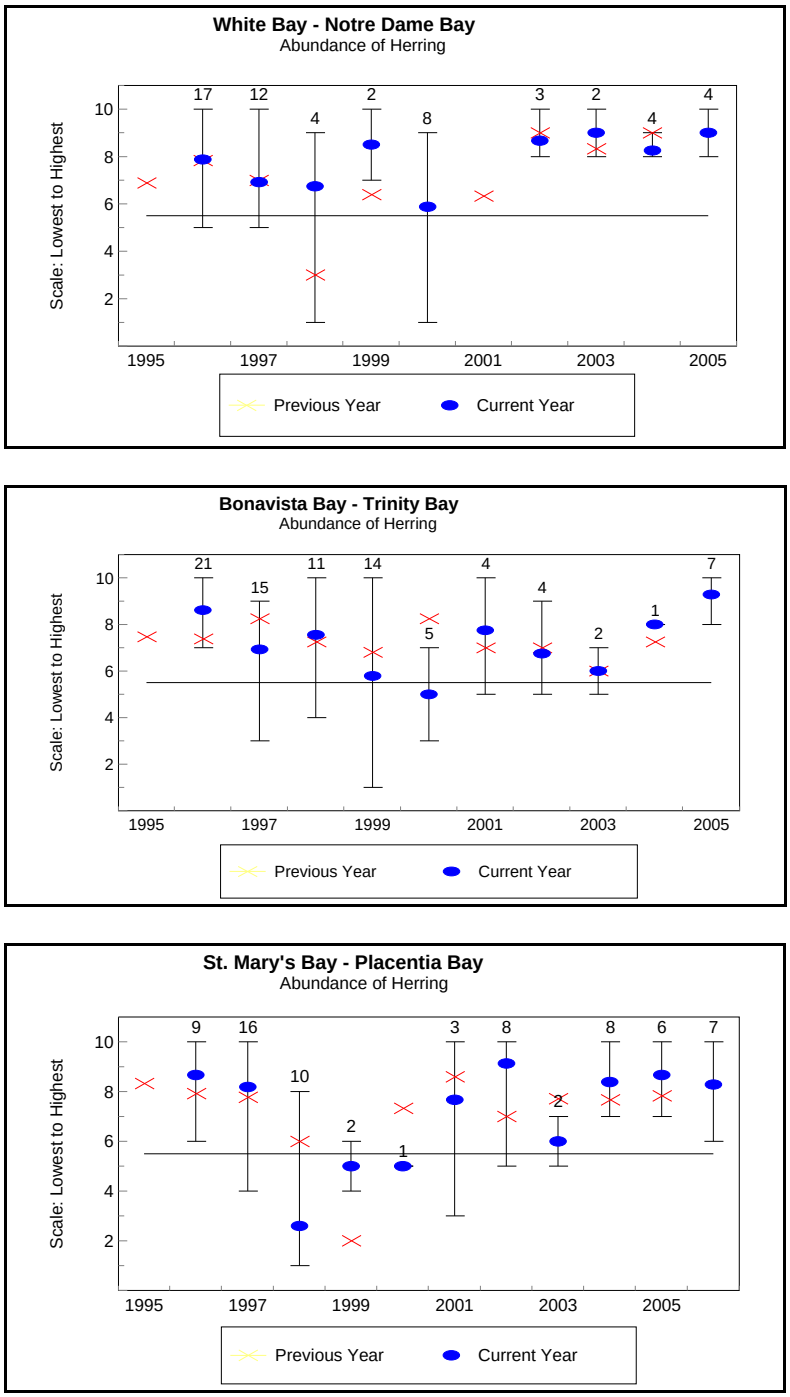


Fig. 20. Purse seine fisher's observations on herring abundance by stock are and year. Solid circles represent means for the current year; x's represent means for the previous year as estimated during the current year. Vertical lines represent range of responses; sample sizes are listed above each vertical line and bar.

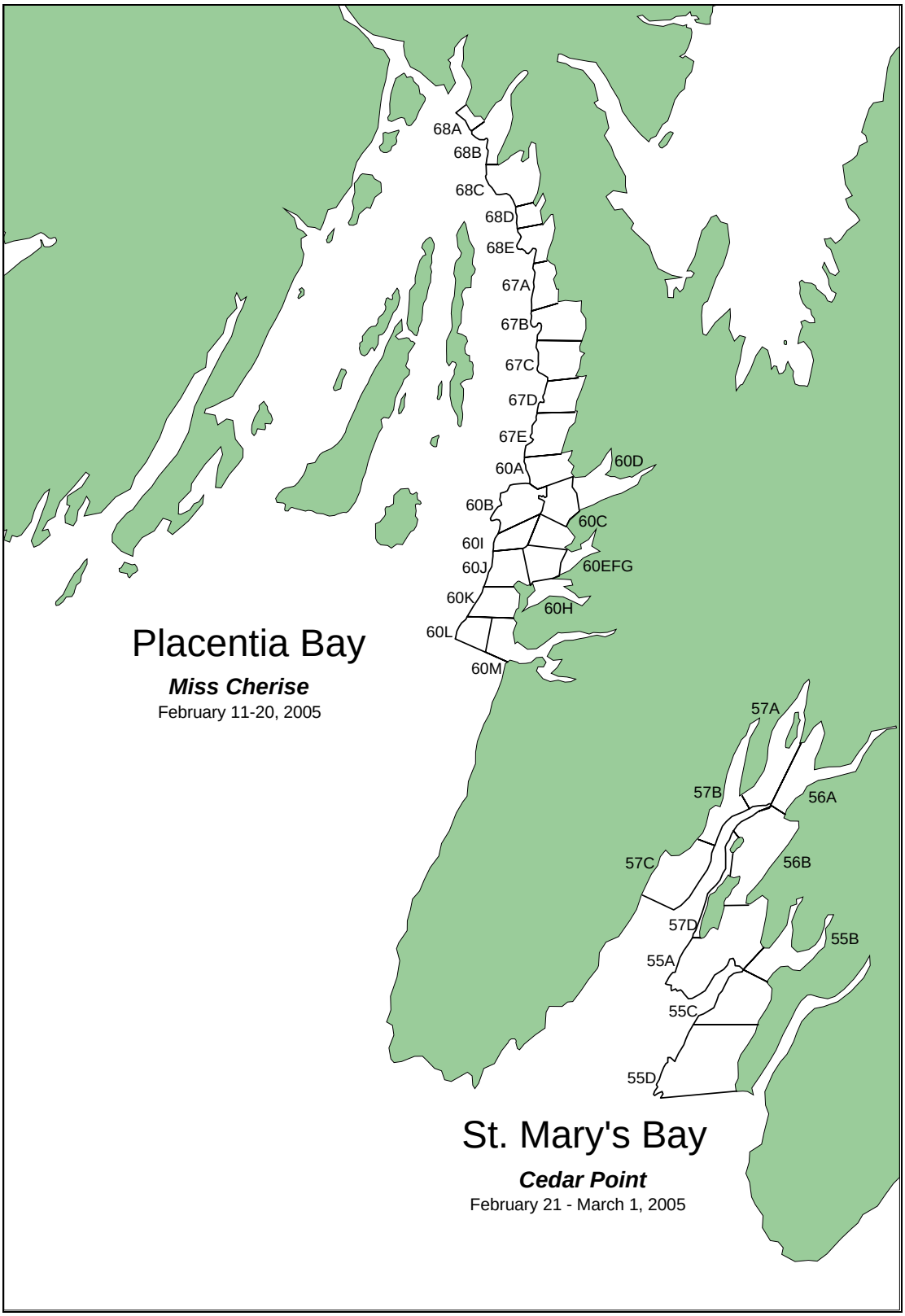


Fig. 21. Area map of Placentia and St. Mary's Bays indicating survey strata for the 2005 acoustic survey.

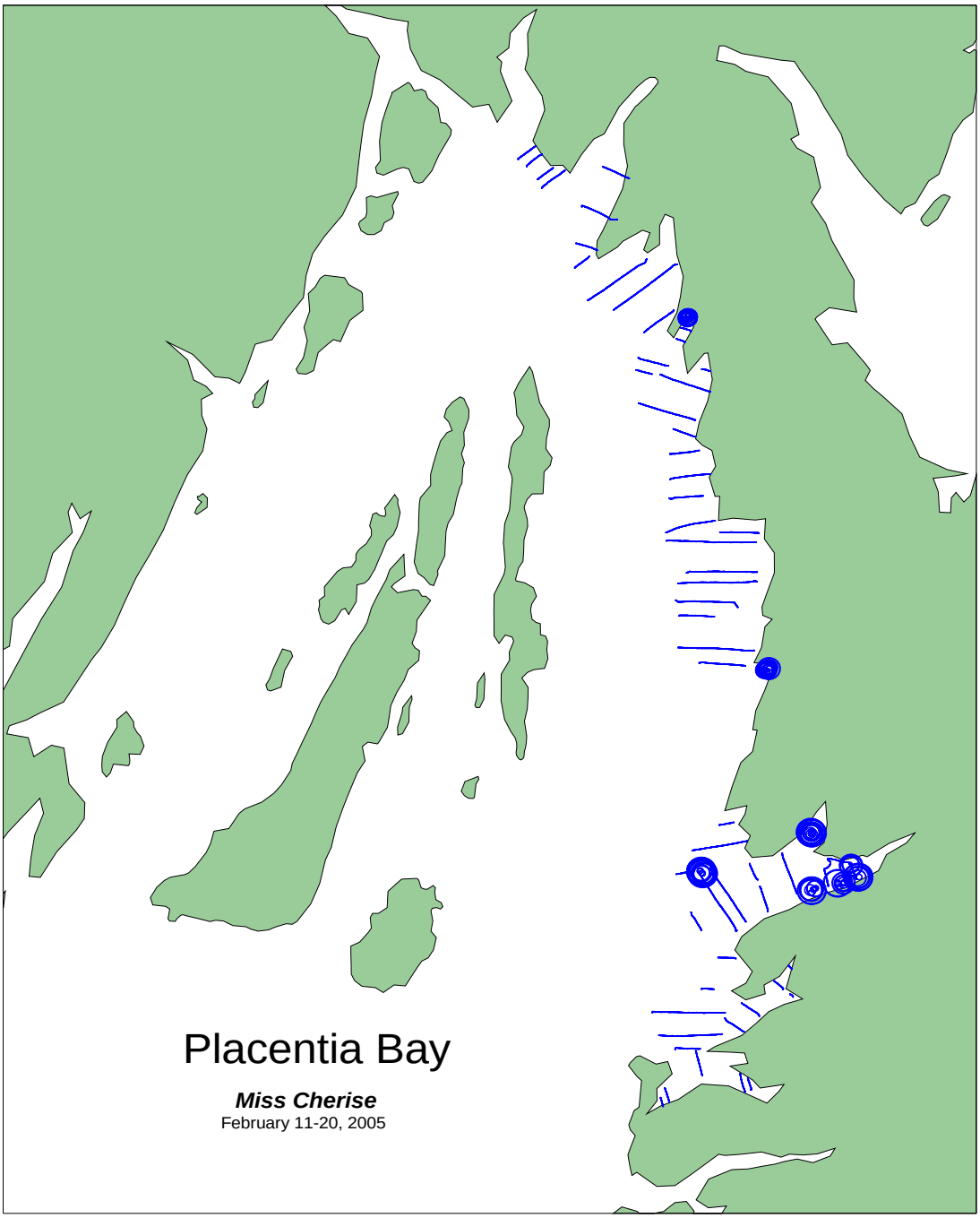


Fig. 22. Distribution and density of herring on and between transects in Placentia Bay during the 2005 acoustic survey. Relative densities are represented by expanding blue circles.

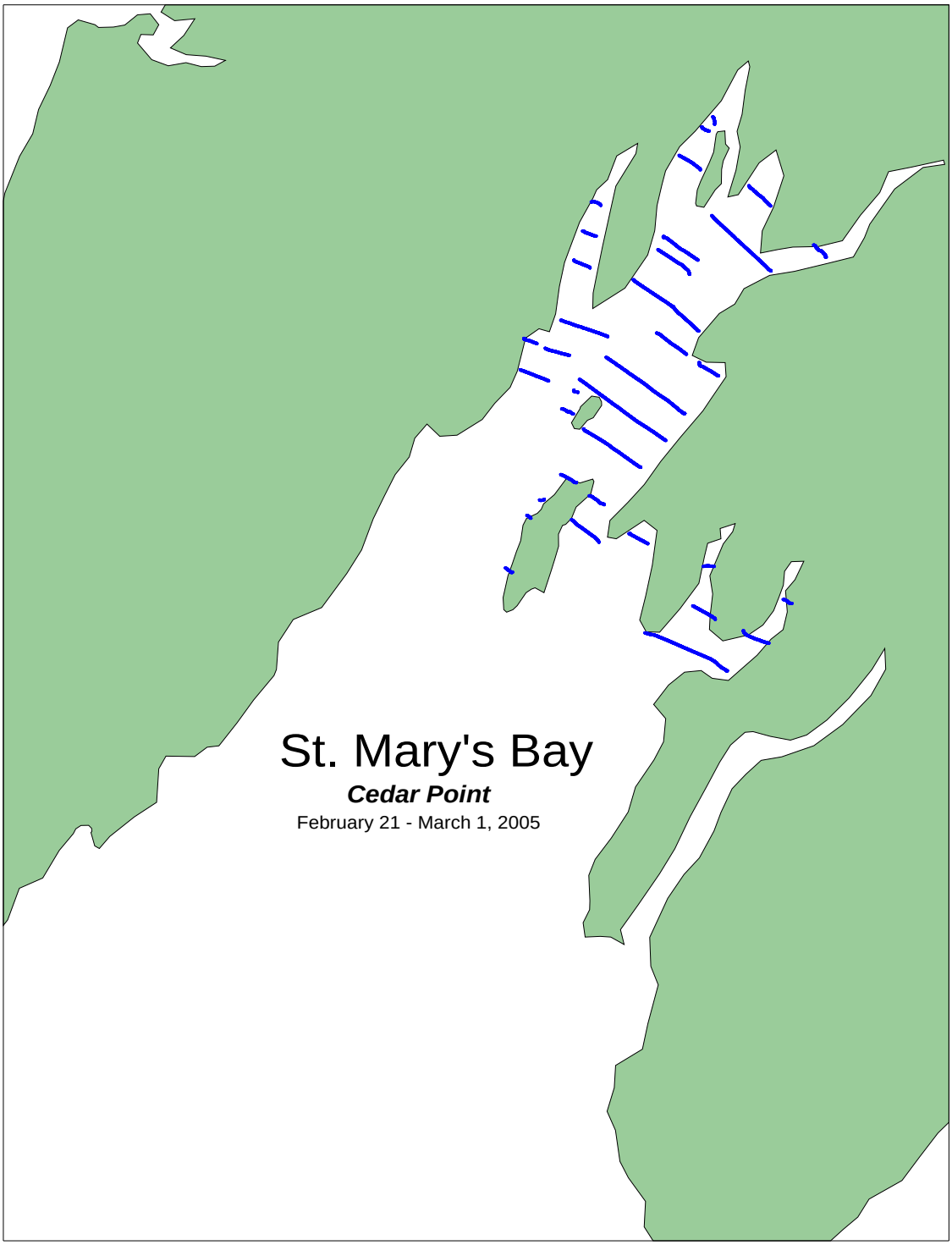


Fig. 23. Distribution and density of herring on and between transects in St. Mary's Bay during the 2005 acoustic survey; no herring were detected.

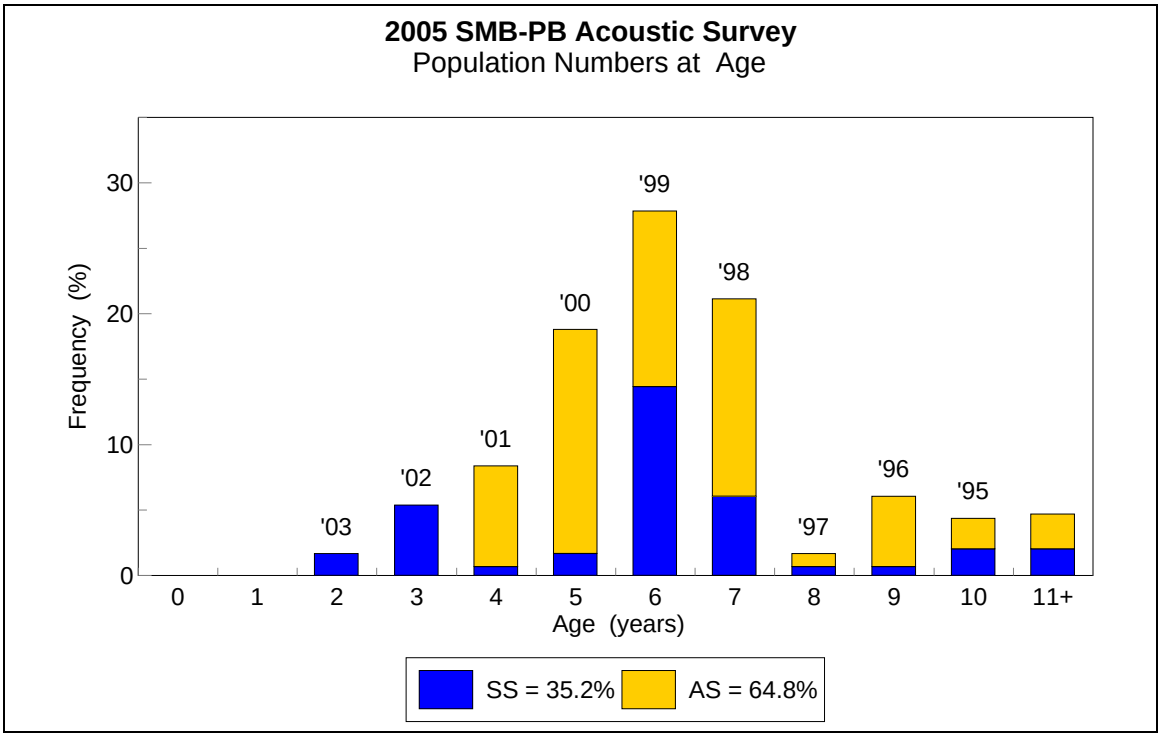


Fig. 24. Age distribution of herring from the 2005 St. Mary's Bay – Placentia Bay acoustic survey.

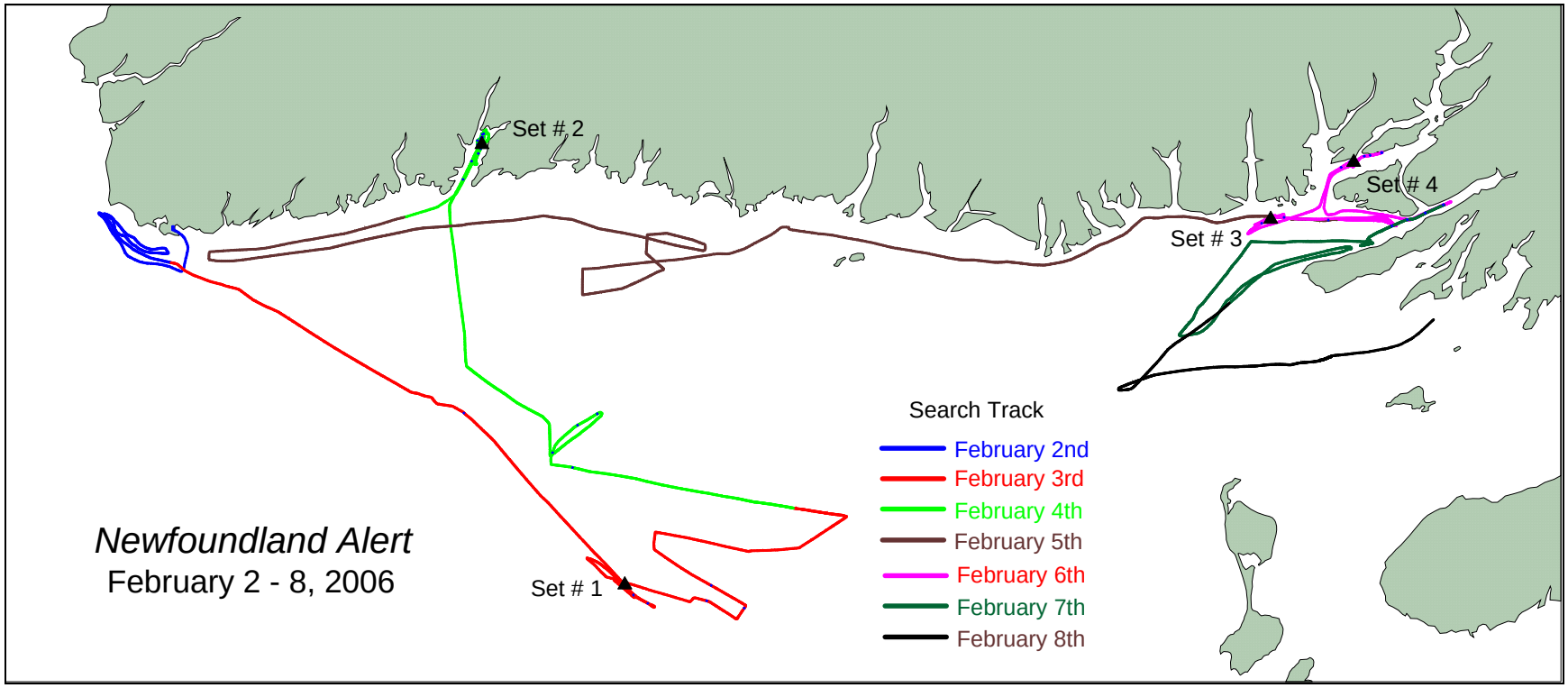


Fig. 25. South coast reconnaissance survey, *Newfoundland Alert*, February 2 – 8, 2006, search track and mid-water trawl set locations.

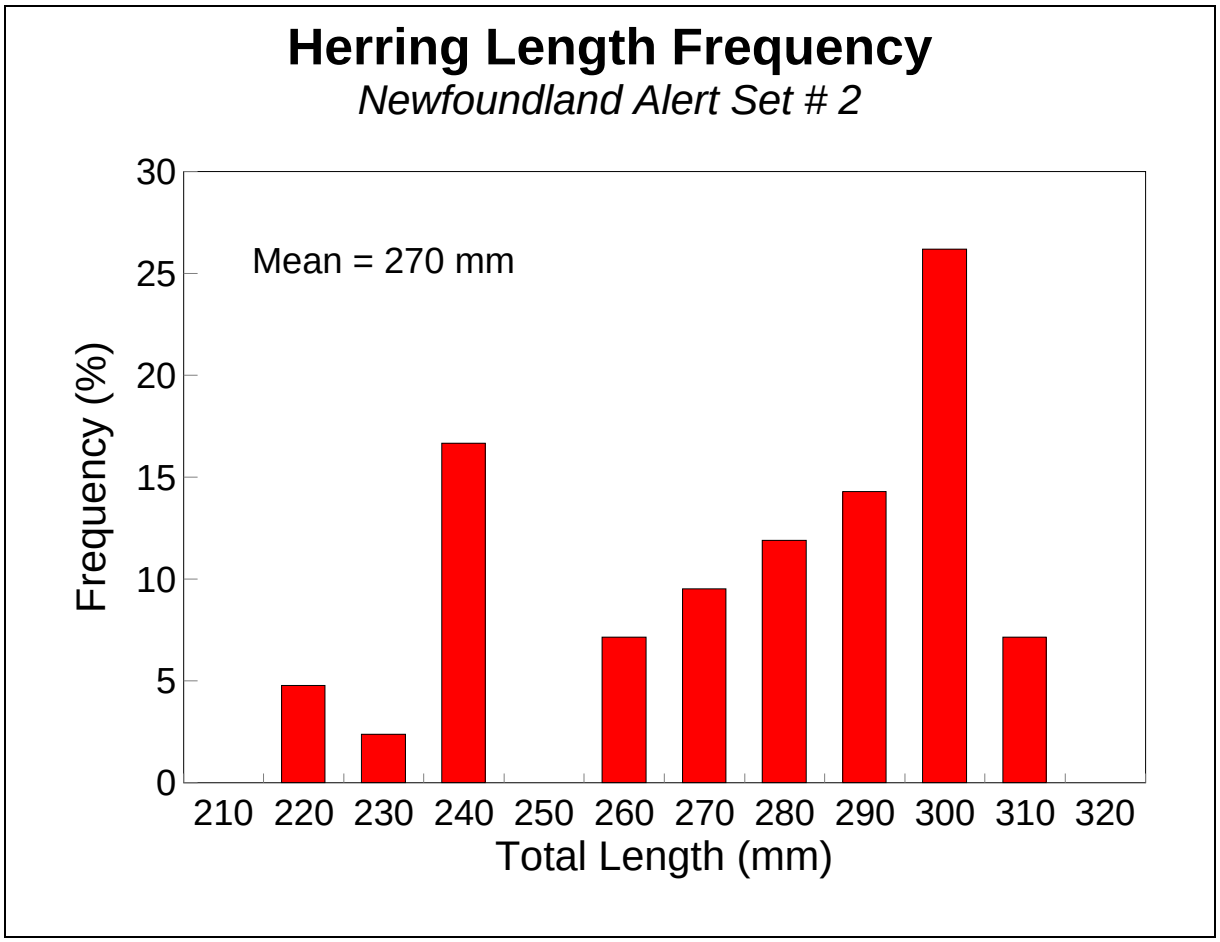


Fig. 26. Herring length frequency from south coast reconnaissance survey, *Newfoundland Alert*, mid-water trawl set #2.

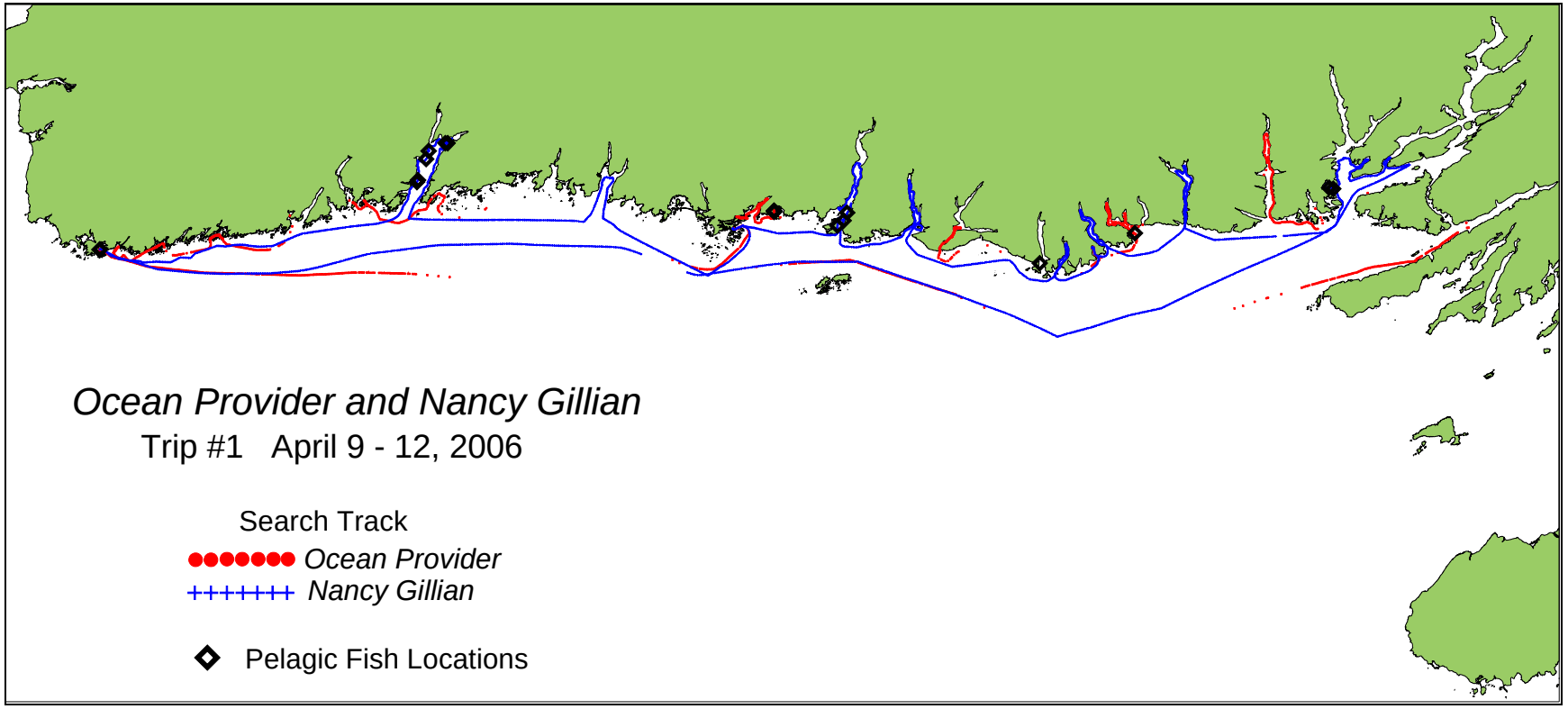


Fig. 27. South coast reconnaissance survey, *Ocean Provider* and *Nancy Gillian*, April 9 - 12, 2006, search track and pelagic fish locations.

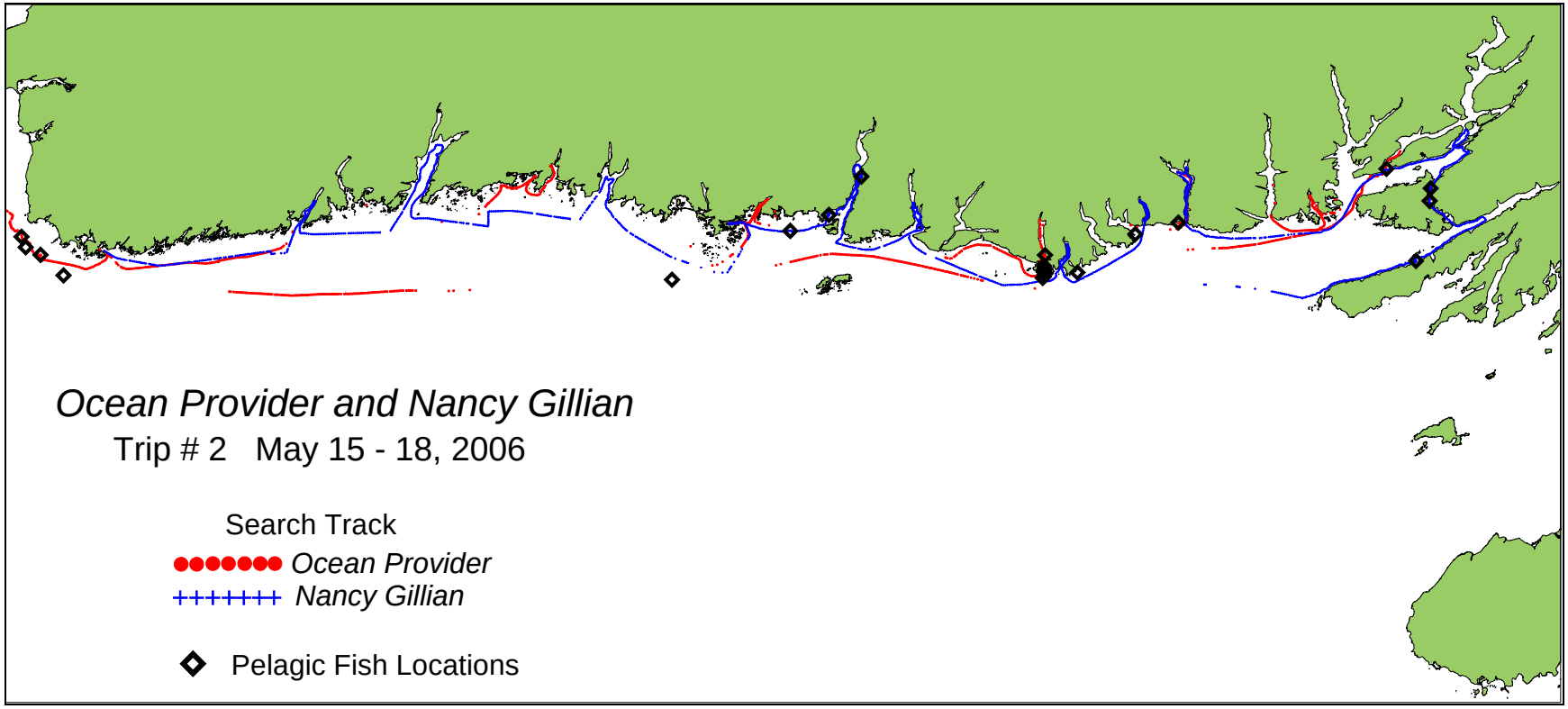


Fig. 28. South coast reconnaissance survey, *Ocean Provider* and *Nancy Gillian*, May 15 - 18, 2006, search track and pelagic fish locations.

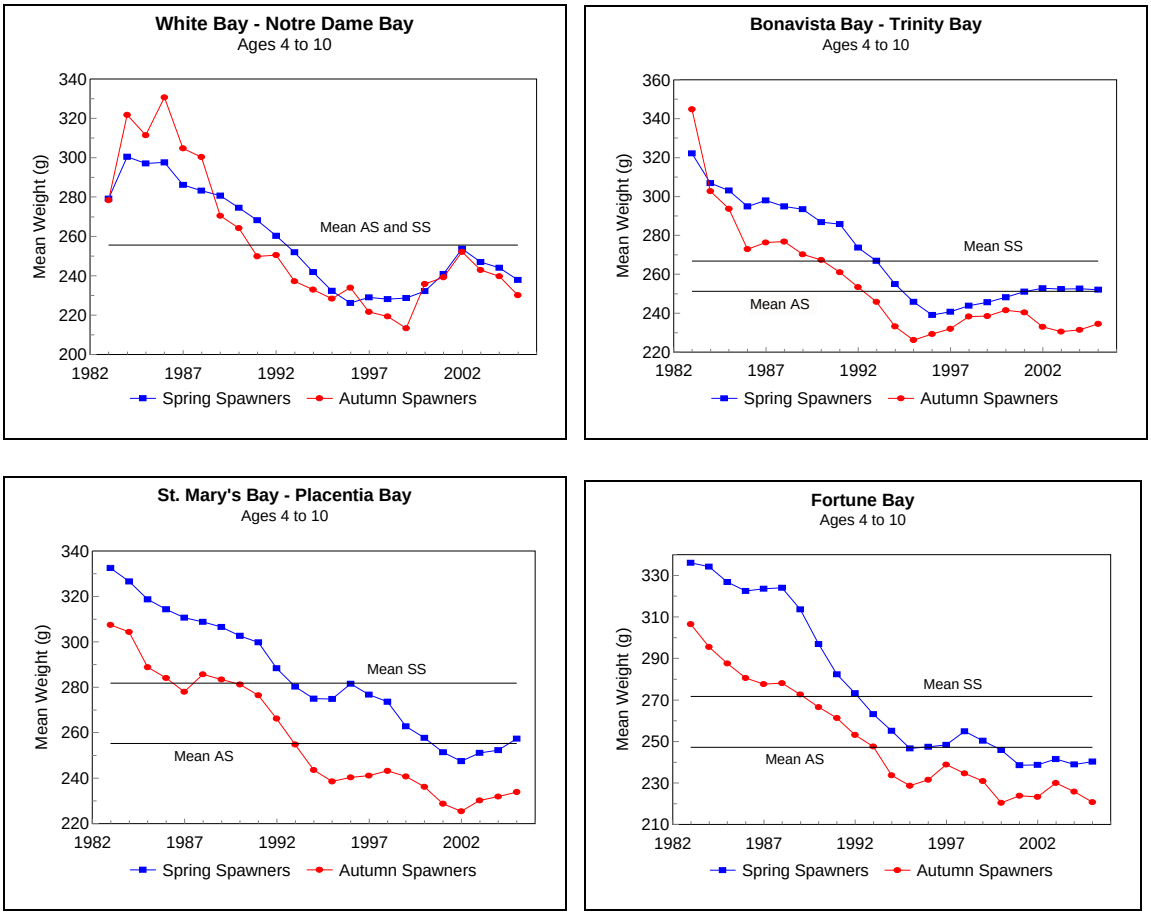


Fig. 29. Mean weights at ages 4 to 10 (three year moving average) of spring and autumn spawning herring, from samples collected January to June, 1983 – 2005.

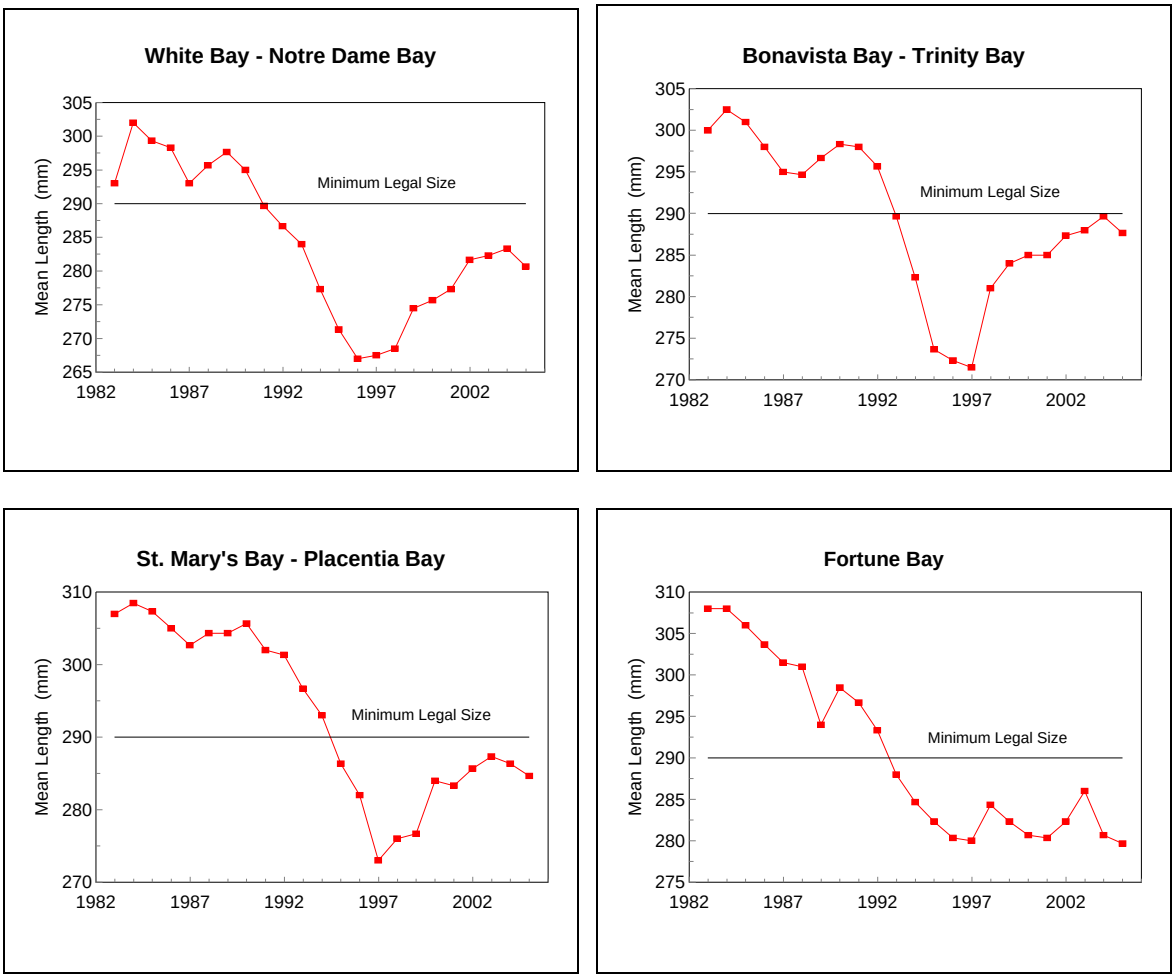
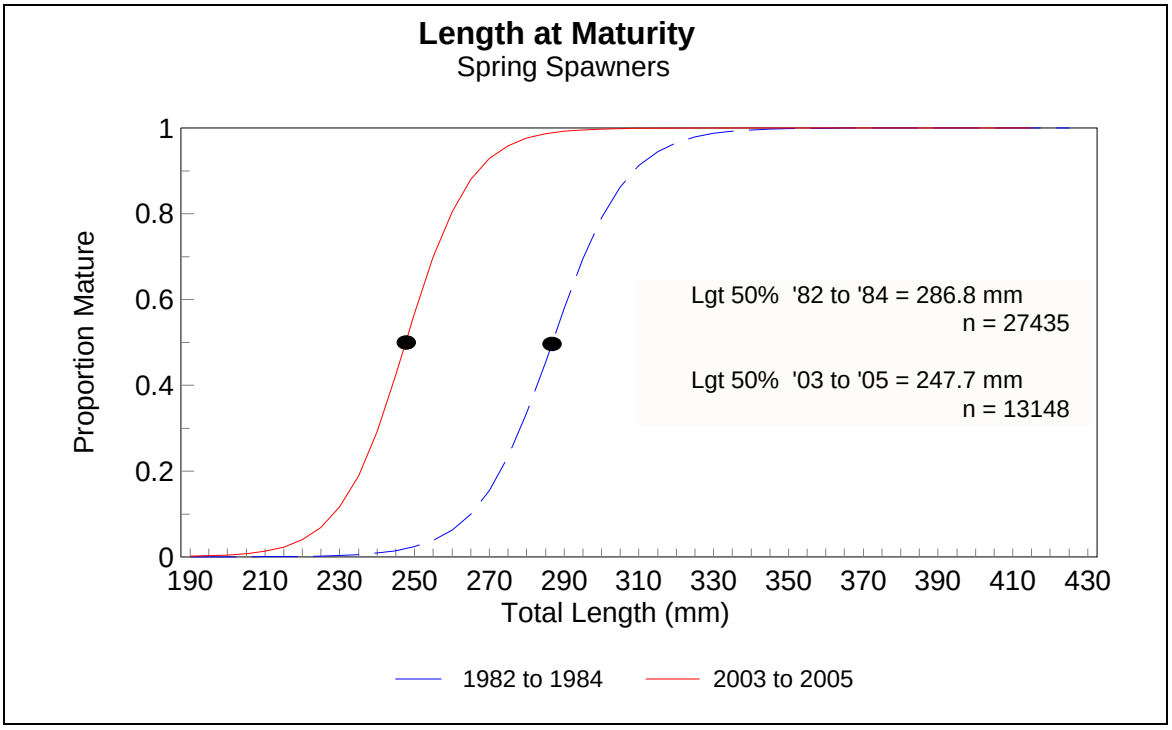


Fig. 30. Mean lengths at age 4 (three year moving average) of spring spawning herring, from samples collected January to June, by stock area, 1983 – 2005.



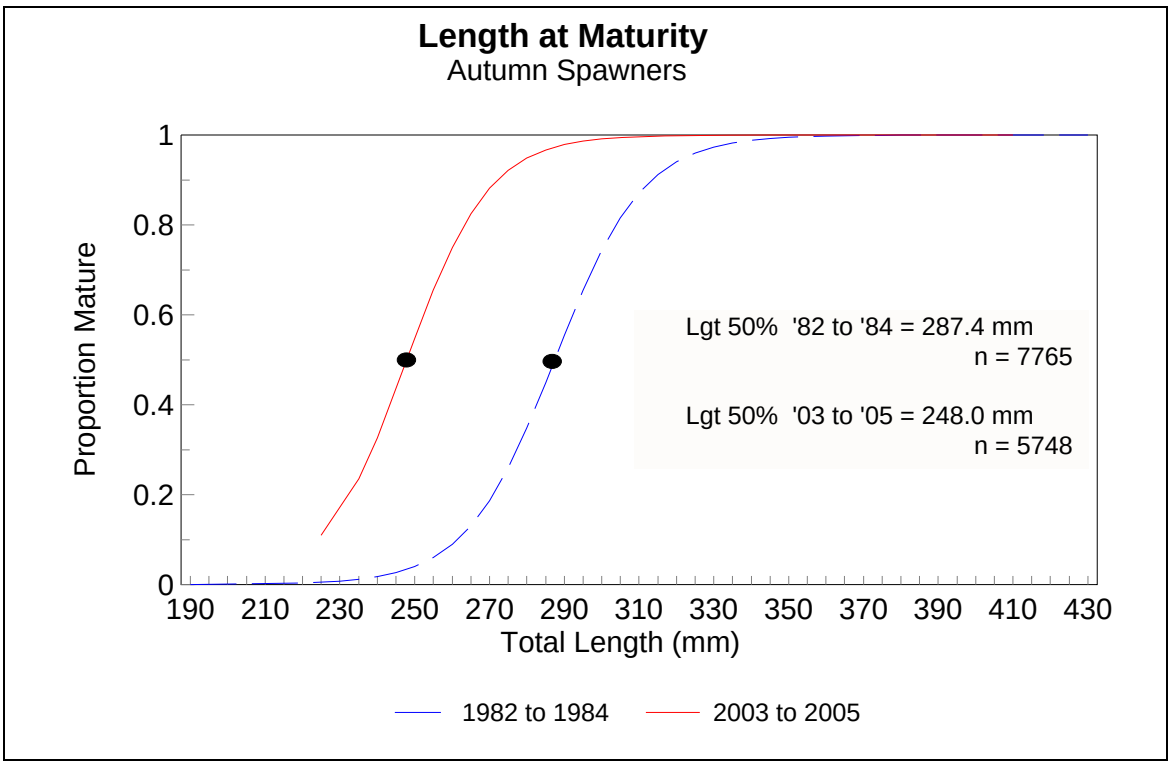
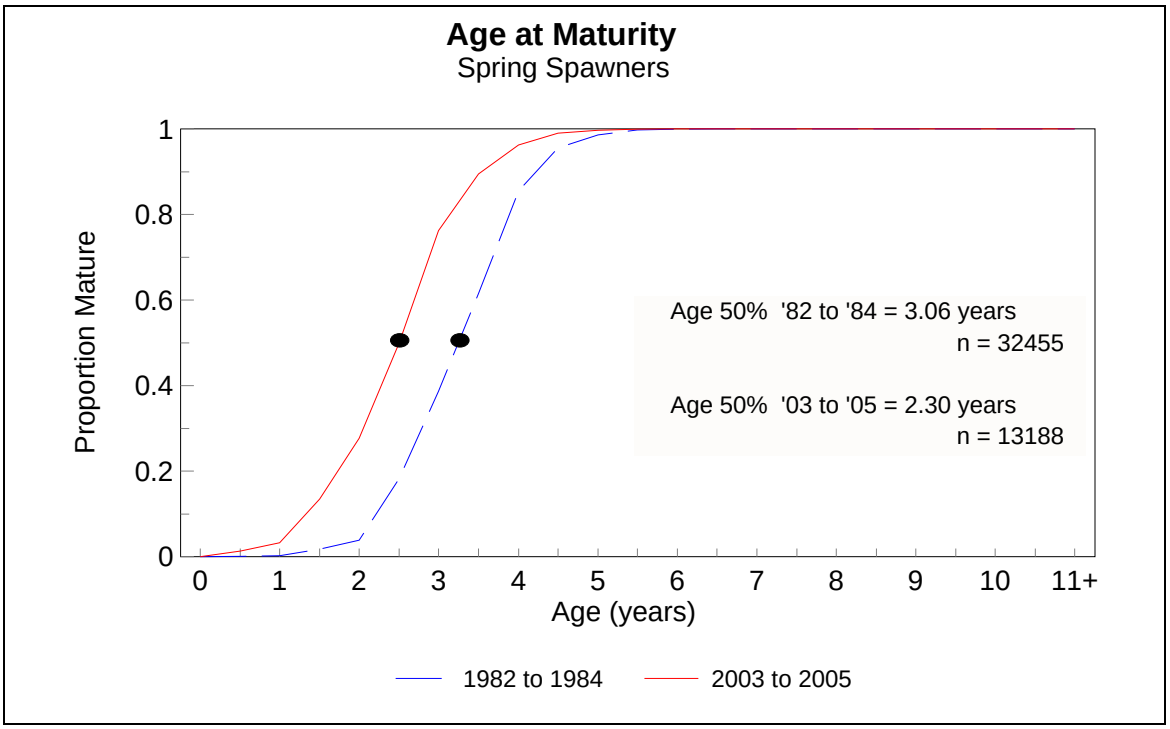


Fig. 31. Length at maturity, by spawning type, all stock areas combined, for the periods 1982 – 1984 and 2003 – 2005.



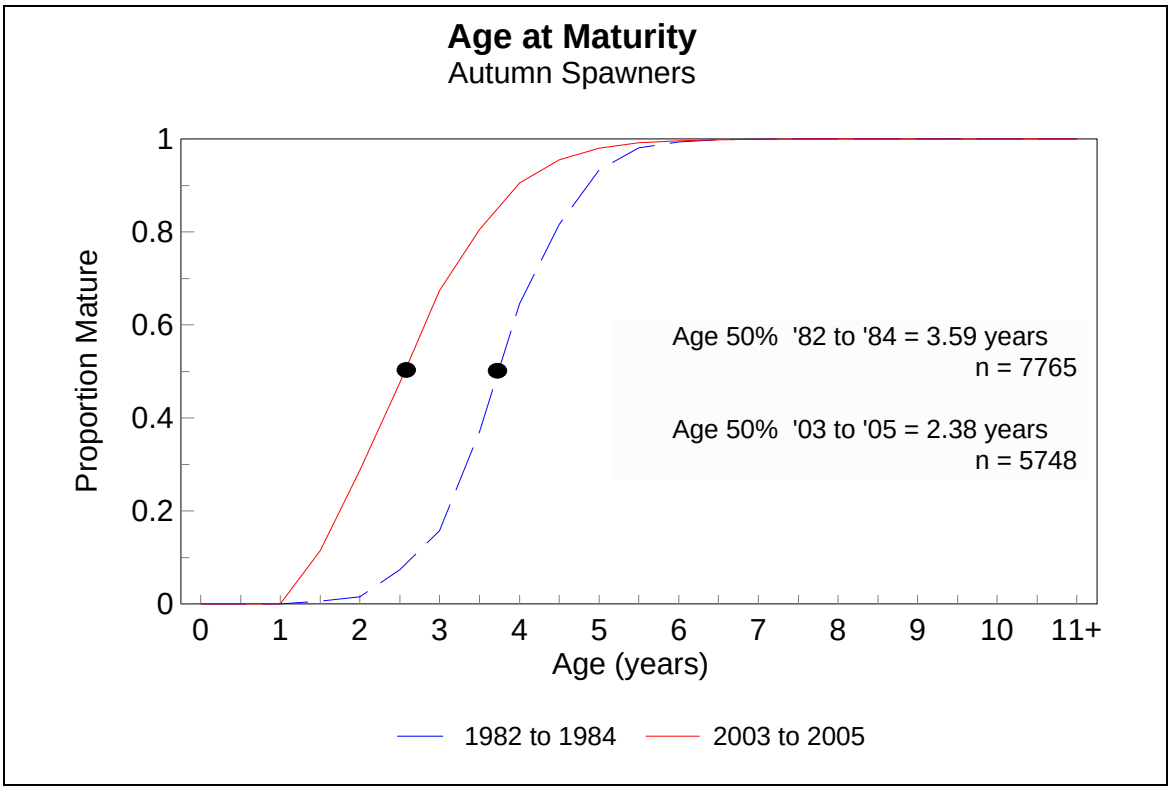


Fig. 32. Age at maturity, by spawning type, all stock areas combined, for the periods 1982 – 1984 and 2003 – 2005.

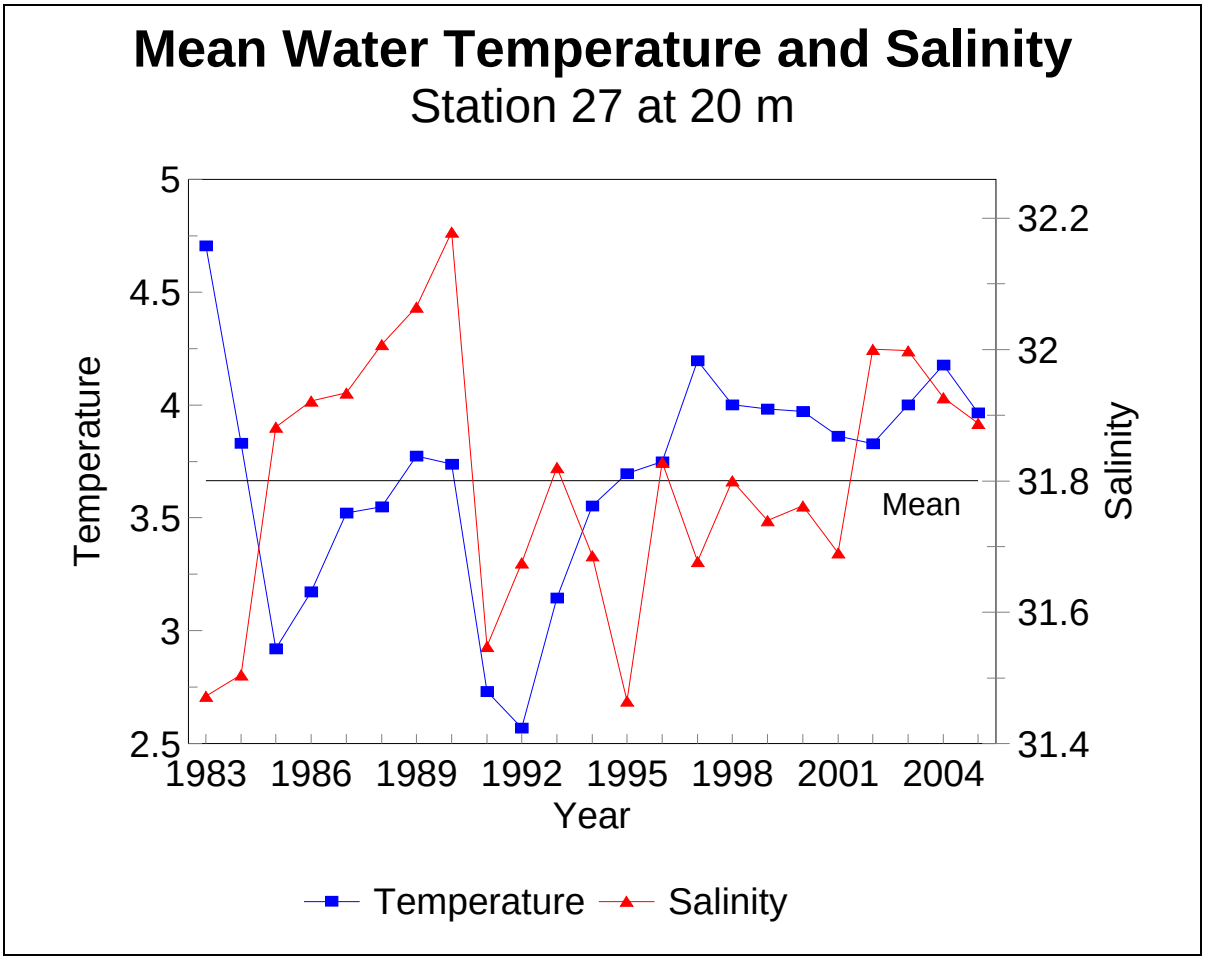


Fig. 33. Mean water temperatures and salinities (two year moving average) at 20 m from Station 27 off St. John's, 1983 – 2005.

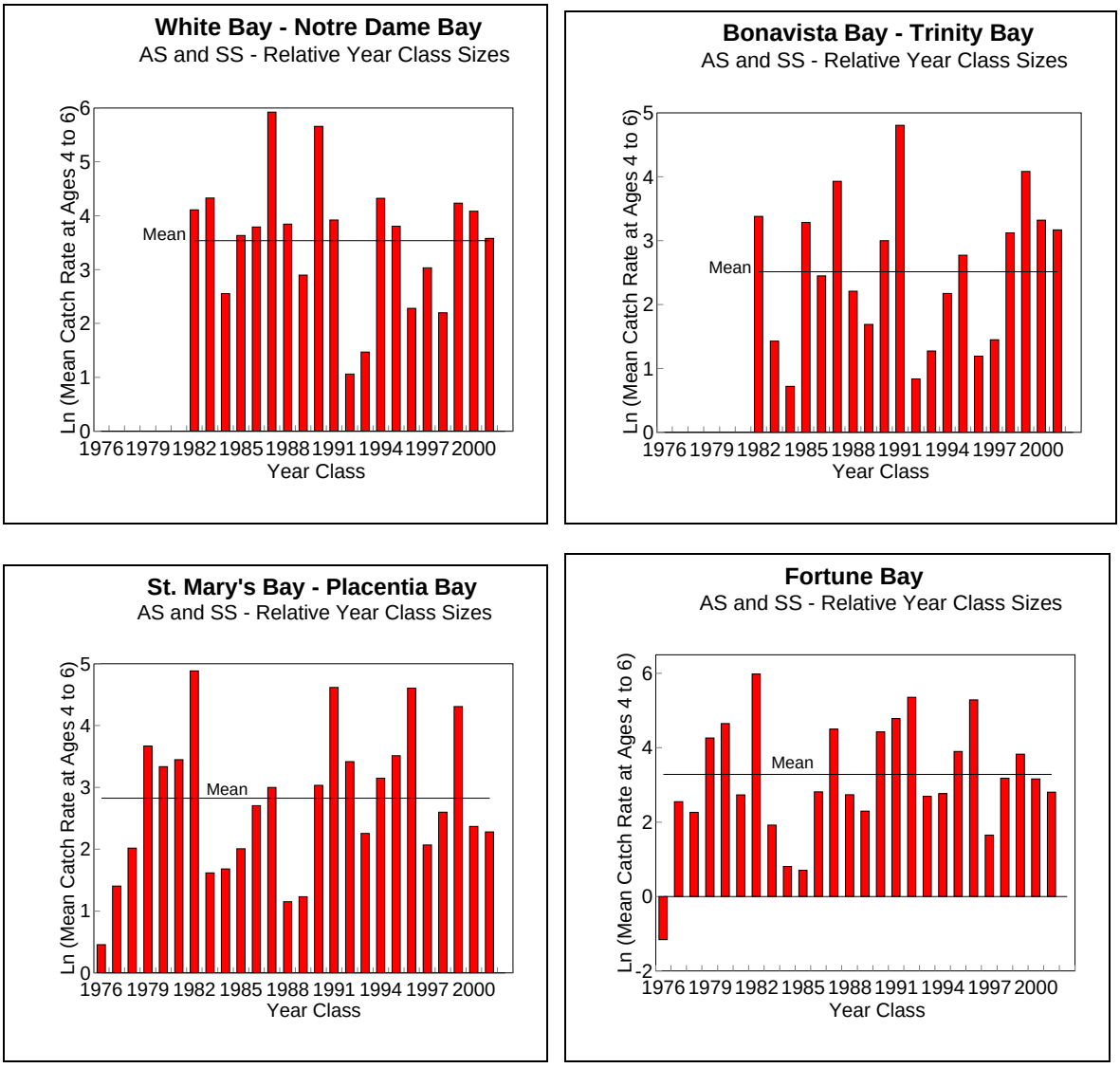


Fig. 34. Relative year class sizes estimated from mean research gill net catch rates at ages 4, 5 and 6.

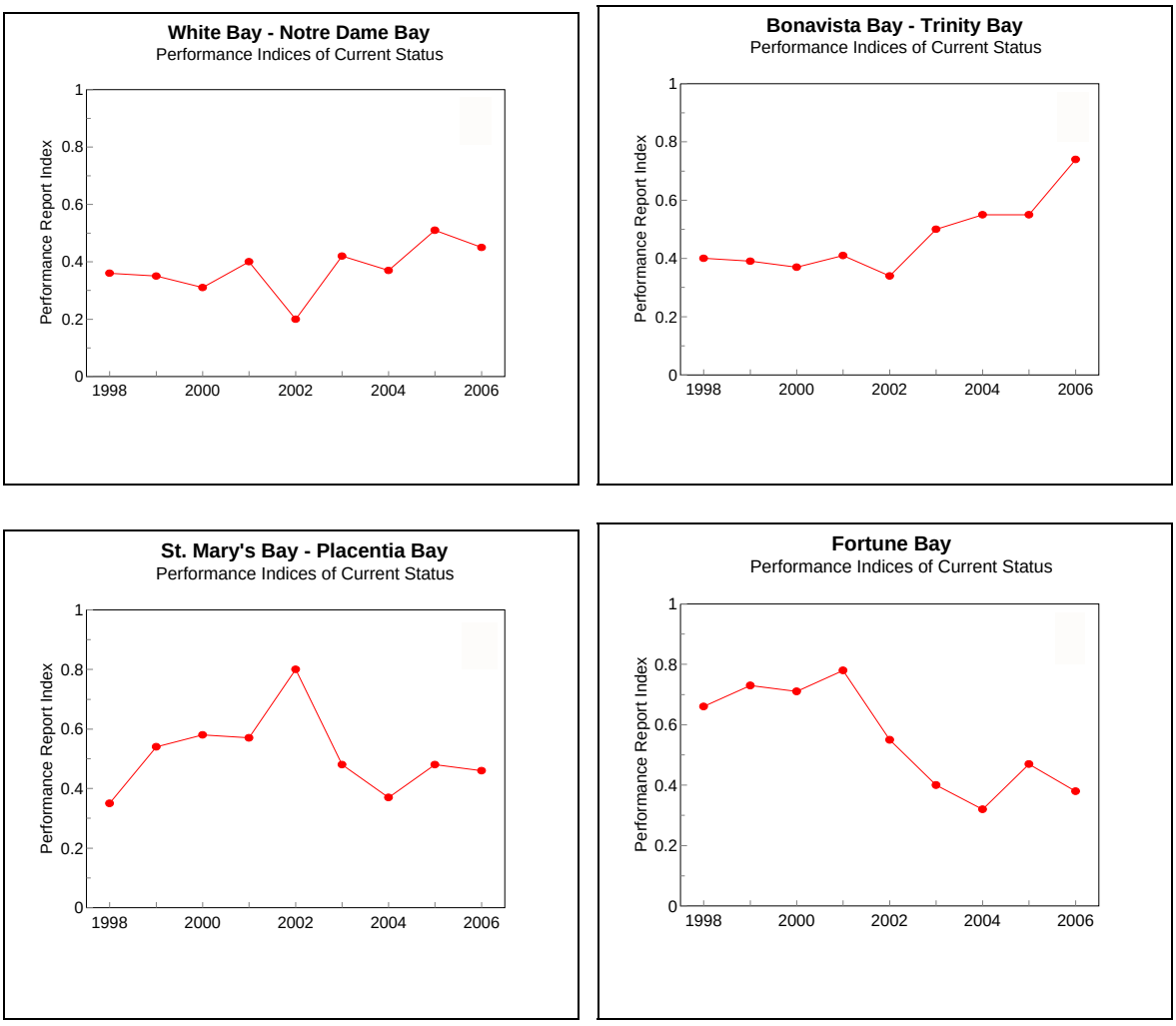


Fig. 35. Weighted performance report indices of current status, by stock area, 1998 – 2006.

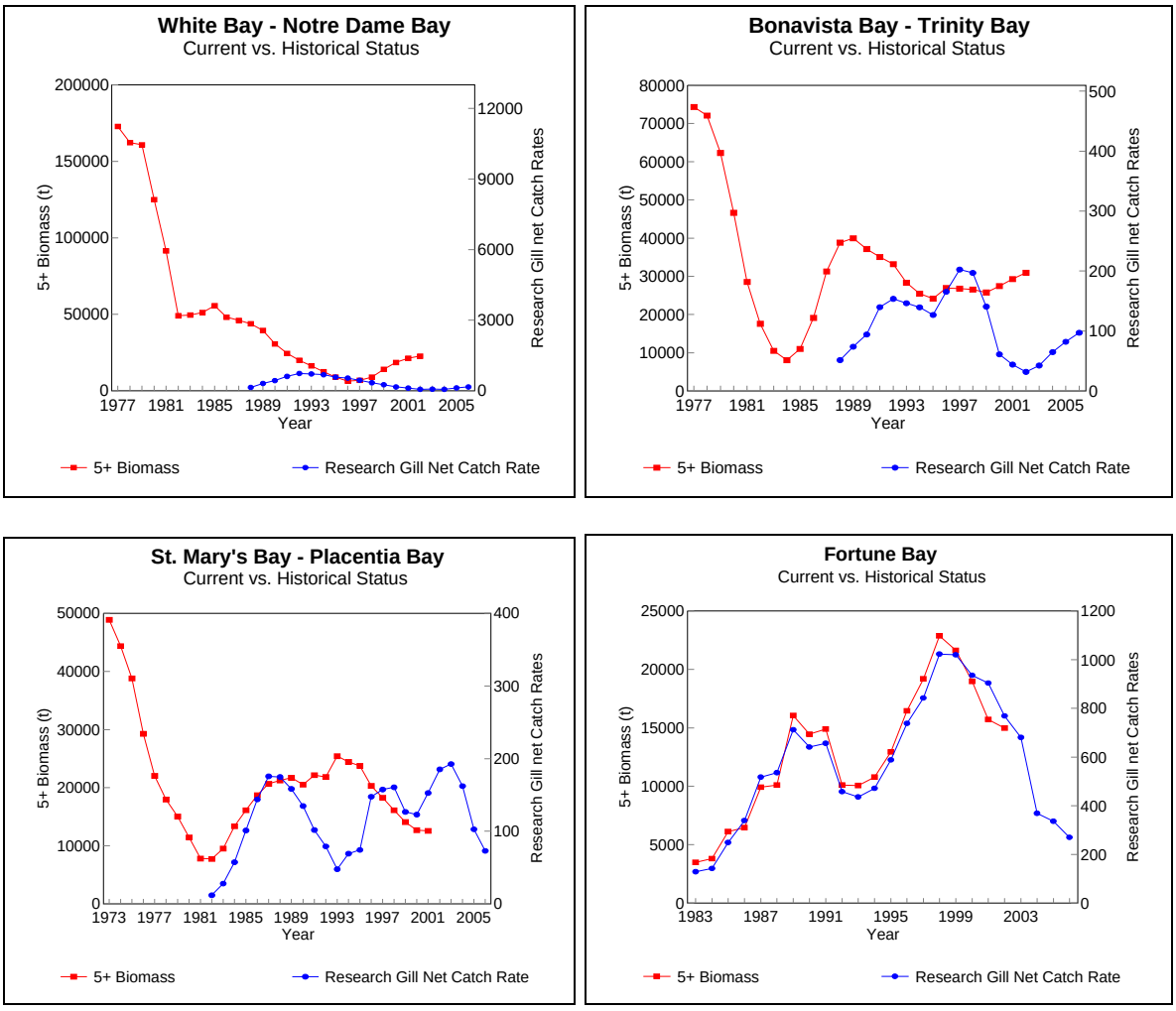


Fig. 36. Comparison of research gill net catch rates and historical biomass estimates, by stock area.