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2005 Evaluation of 4VWX Herring

Évaluation des stocks de hareng dans 4VWX en 2005

M.J. Power, R.L. Stephenson, S. Gavaris, K.J. Clark, F.J. Fife, D. Knox and L.M. Annis[1]

Marine Fish Division
Maritimes Region, Science Branch
Biological Station
531 Brandy Cove Road
St. Andrews, New Brunswick
Canada E5B 2L9

[1] Herring Science Council
35 Hawthorne St
Yarmouth, Nova Scotia
Canada B5A 4B4

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Abstract

Landings in the southwest Nova Scotia/Bay of Fundy spawning component in 2004 (78,000t) were about 10,000t lower than the previous year and near the average of the last decade. There continues to be signs of deterioration in the state of the stock. The 2004 catch was dominated by age 2 and 3 recruits and there was an absence of older fish. SSB on both Trinity Ledge and Seal Island spawning areas remain well below historical levels. The truncated catch at age and the rapid decline of individual year-classes indicates that total mortality may be considerably higher than estimated. There has also been little progress towards defined conservation objectives in recent years.

Acoustic surveys of spawning grounds indicate a relatively stable spawning stock biomass (SSB) in recent years. Combination of the absolute SSB estimate from acoustic surveys with fishery catch at age data in a virtual population analysis (VPA) implies a rapid and substantial biomass increase (5-fold over the past 5 years) which has not been seen in the surveys and is inconsistent with the truncated age composition. A VPA calibrated with the trend in acoustic surveys suggests a relatively stable SSB of less than 200kt and a high fishing mortality (F). The pattern of residuals is acceptable, and this scenario matches observations recorded in the fishery (i.e. no large increase in biomass, high fishing mortality leading to truncated age structure).

Landings of 4,050t from the 2004 offshore Scotian Shelf banks were below average since the fishery was reactivated in 1996. The 2004 fishery was dominated by catches of age 4 and 5 fish. In contrast, bottom trawl research survey catches from the past seven years have been the highest on record and herring were widely distributed on banks west of Sable Island.

Biomass estimates from acoustic surveys of the major coastal Nova Scotia spawning components were substantially lower for all surveyed areas in 2004 with large decreases for the Little Hope and Eastern Shore areas. There was no surveying from the Glace Bay area due to technical problems. Recorded landings showed a relatively large increase for the Eastern Shore area and decreases in the other main areas. The Bras d'Or lakes fishery was closed in 2004 and there was also no sampling.

There was an increase in landings in the traditional New Brunswick weir and shutoff juvenile herring fishery to 20,700t from 9,000t in 2003 but there is still a trend of decreasing landings over the past ten years.

Résumé

En 2004, les débarquements de reproducteurs capturés dans le secteur sud-ouest de la Nouvelle-Écosse / baie de Fundy se sont chiffrés à 78 000 t, soit environ 10 000 t de moins que l'année précédente et l'équivalent approximatif de la moyenne des dix dernières années. L'état du stock continue de montrer des signes de détérioration. Les prises de 2004 comprenaient principalement des recrues d'age 2 et 3. Les poissons âgés en étaient absents. La biomasse du stock reproducteur dans les frayères du récif de la Trinité et de l'île Seal demeure très inférieure à ses niveaux historiques. La répartition tronquée des prises selon l'âge et la baisse rapide de l'effectif des classes d'âge révèlent que la mortalité totale pourrait être considérablement plus élevée que prévu. Au cours des dernières années, les progrès vers les objectifs de conservation ont été insuffisants.

Les relevés acoustiques réalisés sur les frayères dénotent une stabilité relative de la biomasse génitrice, ces dernières années. Une analyse de population virtuelle (APV) fondée sur l'estimation de la biomasse génitrice absolue d'après les relevés acoustiques, combinée aux données des prises selon l'âge dans le cadre de la pêche laisse croire à une hausse rapide et importante de la biomasse (de l'ordre du quintuple sur les cinq dernières années), qui n'a pas été observée dans les relevés et qui n'est pas compatible avec la structure d'âge tronquée. Une APV étalonnée d'après la tendance observée dans les relevés acoustiques permet de penser que la biomasse génitrice est relativement stable, se chiffrant à moins de 200 kt, et que la mortalité par pêche (F) est haute. Le profil résiduel est acceptable et ce scénario concorde avec les observations provenant de la pêche (notamment faible augmentation de la biomasse, forte mortalité par pêche entraînant une structure d'âge tronquée).

En 2004, les débarquements de géniteurs capturés sur les bancs du large de la plate-forme Néo-Écossaise se sont chiffrés à 4 050 t, soit un niveau inférieur à la moyenne depuis la réouverture de la pêche en 1996. Les prises de 2004 comprenaient principalement des harengs d'âge 4 et 5. Cependant, dans les relevés de recherche au chalut de fond des sept dernières années, les prises ont atteint des sommets records et les harengs étaient très largement répartis sur les bancs situés à l'ouest de l'île de Sable.

Les estimations de la biomasse effectuées à partir des résultats des relevés acoustiques des principaux groupes de reproducteurs sur les côtes de la Nouvelle-Écosse ont été substantiellement plus faibles pour chacune des zones ayant fait l'objet d'un relevé en 2004, des baisses importantes ayant été enregistrées dans les secteurs de Little Hope et d'Eastern Shore. Des problèmes techniques ont empêché la réalisation des relevés dans le secteur de Glace Bay. Les débarquements déclarés affichent une augmentation relativement grande pour le secteur d'Eastern Shore et des baisses dans les autres principales zones. La pêche dans les lacs Bras d'Or a été fermée en 2004 et il n'y a pas eu d'échantillonnage.

Au Nouveau-Brunswick, les débarquements de la pêche traditionnelle de harengs juvéniles à la fascine et à la senne de plage ont augmenté, se hissant à 20 700 t, par rapport aux 9 000 t de 2003, mais on constate toujours une tendance à la baisse pour les dix dernières années.

2004 Evaluation of 4VWX Herring

Introduction

Atlantic herring is a pelagic species found on both sides of the North Atlantic. Herring spawn in discrete locations, to which they are presumed to home. Herring first mature and spawn at three or four years of age (23 to 28 cm or 9 to 11 in), then begin a predictable annual pattern of spawning, overwintering, and summer feeding, which often involves considerable migration and mixing with members of other spawning groups. Most fishing takes place on dense summer feeding, overwintering, and spawning aggregations.

The 4VWX management unit contains a number of spawning areas, separated to various degrees in space and time. Spawning areas in close proximity with similar spawning times, and which share a larval distribution area, are considered part of the same complex. These undoubtedly have much closer affinity than spawning areas that are widely separated in space or time, and do not share a common larval distribution. Some spawning areas are large and offshore, whereas others are small and more localized, sometimes very near shore or in small embayments. The situation is complicated further as herring migrate long distances and mix outside of the spawning period both with members considered part of the same complex and with members of other spawning groups. For the purposes of evaluation and management, the 4VWX herring fisheries are divided into four components (Figure 1):

1. SW Nova Scotia/Bay of Fundy spawning component
2. Offshore Scotian Shelf banks spawning component
3. Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia spawning component; and
4. SW New Brunswick migrant juveniles.

Each component has several spawning areas, and there is mixing of fish among spawning components. Industry and management have explored means of managing the complexity within each component (such as distributing fishing effort among spawning areas according to their relative size) and of taking appropriate account of interaction among components (such as fishing restrictions on some areas of mixing).

Fisheries in the 4VWX area in recent years have been dominated by purse seine, weir and gillnet, with relatively minor landings by shutoff, trap and midwater trawl (Table 1,2).

Since 1995, the herring stock assessment and related research has been enhanced by a number of projects undertaken with the assistance of the fishing industry. These include industry sampling of biological characteristics of the catch, acoustic surveys using industry vessels and tagging.

The Georges Bank spawning component (Figure 1) is not included in this evaluation except to document Canadian herring landings from that area (Table 1). This fishery is included in the Gulf of Maine stock complex and has been recently evaluated separately (DFO 2003a).

1) Objectives and Management

The 2003-2006 Scotia-Fundy Herring Integrated Fisheries Management Plan (DFO 2003b) sets out principles, conditions, and management measures for the 4VWX herring fisheries. The main principle stated in the plan is "the conservation of the herring resource and the preservation of all of its spawning components".

Three conservation objectives developed and reviewed by Sinclair (1997) appear in the plan:

1) To maintain the reproductive capacity of herring in each management unit through:
   - persistence of all spawning components in the management unit;
   - maintenance of biomass of each spawning component above a minimum threshold;
   - maintenance of a broad age composition for each spawning component; and
   - maintenance of a long spawning period for each spawning component.

2) To prevent growth overfishing:
   - continue to strive for fishing mortality at or below F0.1

3) To maintain ecosystem integrity/ ecological relationships ("ecosystem balance").
   - maintain spatial and temporal diversity of spawning
   - maintain herring biomass at moderate to high levels

There is evidence that most of these objectives are not being met despite the efforts that have been made in recent years. There is also a need to better define these objectives in terms of minimum thresholds and to explicitly list the spawning components in terms of spatial and temporal expectations.

An "in-season" management process, first implemented in the southwest Nova Scotia fishery during 1995, continued to be used widely within the 4VWX management area (DFO 1997, Stephenson et al. 1996, 1999a). The approach encouraged surveying using the commercial fleet under scientific direction prior to fishing ("survey, assess, then fish" protocol) to ensure that effort was distributed appropriately among various components of the stock (particularly among spawning components) according to the relative size and current state of each component. The use of this approach in recent years has improved data collection and enabled modifications to management decisions to be made with the involvement of participants and on the basis of up-to-date information.

Collaborative research efforts with the fishing industry have been important in recent years. A major portion of the herring industry (including the purse seine sector and major processors) forms the Herring Science Council (HSC), and some members of the fixed gear sector have undertaken a separate Joint Project Agreement with DFO to undertake collaborative scientific projects. The herring industry has continued to provide biological sampling and samples while the purse seine and gillnet sectors undertook key acoustic surveys. Under the auspices of the HSC a dedicated field biologist also takes part in initiatives such as tagging, summary of fleet activities (Appendix A), and analysis of acoustic records from fishing trips.

2) SW Nova Scotia/Bay of Fundy Spawning Component

2.1 The Fishery

Herring fishing locations, NAFO unit areas used for catch and sample aggregation, and fishing areas defined by groupings of 10 mile squares (i.e. 10 minute squares of latitude and longitude) are shown in Figures 2 to 5.

The 2004 catch limit for this component was 83,000t, a decrease of 10,000t from the previous year (Table 3, Figure 6). Eighty percent of the catch limit was initially allocated to the mobile gear sector and 20% to the fixed gear sector, as has been done historically. Transfer of quota to the mobile fleet occurred late in the season.

Total landings from this component in 2004 (78,030t) were 11,300t lower than the previous year, and close to the average for the last decade (Table 3). Decreased landings by the purse seine sector accounted for most the decline, with minimal landings by the gillnet sector (225t) and the Nova Scotia weirs (3,130t) showing an increase from only 900t in 2003.

The temporal and spatial distribution of the purse seine fishery was similar to that of the recent decade except for the Scots Bay area (Table 4-5). The largest purse seine fisheries occurred on the German Bank and Scots Bay spawning grounds, and on summer feeding fish off Long Island, N.S. and around Grand Manan (Figure 7). There was a substantial increase in the 2004 landings for Scots Bay to 24,900t, the highest on record for this area. The next most important area in terms of overall landings, German Bank, experienced a sharp decline in the landings from about 20,000t to 14,000t.

During the 1970's and 1980's, a large fishery took place on over-wintering aggregations in Chedabucto Bay. In recent years however, there has been no fishing effort in this area as traditional vessels have been successfully fishing elsewhere. In some years there has been a small fishery on over-wintering herring in January off Halifax Harbour (Chebucto Head), but the majority of the fall and winter herring landings for the past several years have come from the New Brunswick side of the Bay of Fundy (Figure 8-10) and take place from Oct. to Feb.

The summer purse seine fishery took place in the same areas as in previous years (Figure 9). A large part of this fishery was directed on the major spawning grounds in Scots Bay and on German Bank (Figure 11, 12) where recent catches are primarily within the pre-defined acoustic survey areas (Melvin and Power 1999). The Trinity Ledge spawning ground, which is still recovering, is closed to purse seine gear from Aug. 15 to Sept. 15 but there were acoustic surveys followed by some catch (250t) by drift gillnet gear (Figure 13). There was no drift gillnet fishery in the Spectacle Buoy area in 2004. This small fishery of <500t has occurred only sporadically in recent years during the month of June. Additional catches by drift gillnet gear occurred in Sept. to Oct. in the Little Hope/Port Mouton spawning grounds. There were also set gillnet catches along the Eastern Shore to the east of Halifax and near Glace Bay in Cape Breton (Figure 14).

Catches in the Nova Scotia weirs of 3,130t were substantially higher than the recent lows of 2000 and 2003 (Table 3; Figure 15). The annual variation has been attributed to problems in availability of fish to this fixed stationary gear as there continues to be substantial catches by purse seine in the nearby Long Island area on the Bay of Fundy side of Digby Neck. The seasonal timing of the Nova Scotia weir landings has shifted in the last 3 years with a higher proportion of landings now as late as Aug. and Sept. as compared with the traditional early fishery seen in May and June previously (Table 6). Catches in recent years for the Nova Scotia weirs have been highly variable and not as consistent in their amount or timing as in the previous decade. There has been a decline in the total number of herring weirs but the catch per weir (t) for the Nova Scotia weir fishery has remained high (Table 7).

<u>Catch and Effort</u>

Catch and effort which were examined for gillnet data in the previous assessment showed little trend and are considered unrepresentative due to the very small amount of effort (Power et al., 2004). This trend in reduced catch and effort continued in the 2004 fishing season and so this data was not reexamined.

Purse seine landings make up most of the overall catch and are allocated 80% of the TAC in the SW Nova Scotia/Bay of Fundy component under the current management plan. The purse seine catch has fluctuated between 60 and 100 thousand tones since 1989 with a steady increase in recent years reflecting increases in the TAC (Table 8, Figure 16). The overall number of boats fishing and days fished has been dropping since 1990 due to some fleet rationalizations. This has resulted in increases in catch per boat and catch per day in recent years.

2.2 Resource Status

Acoustic Surveys

Automated acoustic recording systems deployed on commercial fishing vessels were used to document the distribution and abundance of Atlantic herring in NAFO Division 4VWX through industry vessel surveys and fishing excursions (Melvin and Power 1999). Regularly scheduled surveys, at approximately 2-week intervals, were conducted on the main spawning components and the spawning stock biomass for each component was estimated by summing these results (Power et al. 2005).

In 2004, four surveys were conducted in Scots Bay, two on Trinity Ledge and three on German Bank following established protocol and providing adequate coverage of these spawning areas consistent with previous years. Additional data from fishing nights in Scots Bay and German Bank were also examined and used as appropriate.

Biomass estimates for Scots Bay, Trinity Ledge and German Bank calculated as in previous assessments were approximately 106,600t, 6,500t, and 367,600t for a total surveyed SSB of 481,700t in the traditional survey areas, a slight decrease from the previous year (Table 9). The SSB for Scots Bay was down by about 25% and is of concern, especially in light of the increased effort and landings for this area. The spawning period in Scots Bay based on catches and samples was the longest recorded. German Bank had a slight increase in SSB despite only three structured surveys over a limited time period. The duration of spawning on German Bank was contracted and no structured surveys occurred on German Bank in October.

The documented amount of spawning fish on Trinity Ledge was lower than in the past three years but survey coverage was limited. There were no surveys and no reports of spawning herring on Lurcher or Seal Island spawning grounds.

Spawning ground turnover rates

The current acoustic survey method on spawning grounds is dependent on periodic turnover of spawning fish on the grounds. Acoustic surveys are required to be separated by at least 10 to 14 days to allow for turnover and to prevent double counting (Power et al. 2002). This aspect of the assessment method was the subject of investigation in 2001 and of intensive sampling for maturity stage in since the 2002 fishing seasons. The results are summarized by Melvin et al. (2003, 2004, Power et al. 2005) and were used to assist in the evaluation of turnover timing and the inclusion or exclusion of specific acoustic surveys.

Exploitation Rates on Spawning Grounds

The acoustic surveys were explored in and attempt to estimate partial exploitation rates for spatially and temporally different spawning groups. This is useful information for assessing the impact of fishing on individual spawning units as well as for the overall stock component (Table 10). For this analysis only the three major spawning components (i.e. Scots Bay, German Bank, Trinity Ledge) that have received consistent survey effort were included. Since there are also questions about comparability of acoustic surveys, in terms of the area of survey coverage among years, only data since 1997 are shown and only data since 1999 are included in the overall averages (Table 10-A1). Catches throughout the year from the spawning grounds were assumed to be site specific (Table 10-C1), while catches from all other areas were considered non-spawning and were allocated based on the relative spawning ground SSB proportions (Table 10-A2, C2). In addition the SSB for Seal Island and Spectacle Buoy were allocated to the German Bank spawning area. The exploitation rates were calculated for both the actual catch on the spawning grounds and the overall adjusted catch as Catch / SSB (Table 10-P1, P2).

Calculation of exploitation rates by component since 1999 showed that the larger grounds (German Bank and Scots Bay) have an overall exploitation of 14 to 31% while Trinity Ledge had higher levels (up to 146%) which may be a problem of catch allocation as well as inconsistent survey effort over the period. The overall exploitation rate for the 4WX stock ranged between 14 and 18%, which are at or slightly below the target of $F_{0.1}$ = 0.22 (exploitation of 18%). These rates are dependant on the assumption that the acoustic survey SSB is correct and that catches have been properly allocated.

Fleet Activity

A summary of daily fishery information compiled by the Herring Science Council and DFO confirmed that the fishery on this component was largely as expected in location and timing, and that there were substantial amounts of herring in some areas other than spawning grounds (Appendix A). In recent years there has been an increase in market for juvenile herring for both lobster bait and to offset a shortfall in weir landings which has been a traditional source of juveniles.

Tagging

From 1998 to 2002, the Pelagics Research Council/Herring Science Council, in partnership with Fisheries and Oceans Canada, tagged herring on spawning grounds and on the major Nova Scotia overwintering grounds. Although this project has concluded, tags continue to be returned. The information on tags returned from this study has been summarized by Waters and Clark (2005).

Sampling and Catch at Age

Comprehensive biological sampling continued with substantial involvement of the fishing industry. A total of 1,485 samples comprising 172,700 fish were measured for length while 5,800 fish were sampled for age. The distribution of samples by gear and month is presented in Table 11. The sources of samples are shown in Table 12 with the bulk of samples coming from the processing industry, as has been the case since 1996. Additional samples were collected by: DFO personnel, observers deployed on purse seine vessels and from DFO research surveys. Sampling from the commercial fishery was well matched to the spatial and temporal distribution of the fishery. Additional sampling from research vessel surveys during the spring and summer resulted in widespread geographic coverage as in the past (Figure 17).

Age reading consistency tests are done in order to evaluate the accuracy and precision of age reading. In 2004 a sub-sample of 200 otoliths were selected from the 2004 collection for the purpose of a within reader test. This collection lacked the full range of ages and 20 were added to include 1 year old fish. There was good representation of the months, areas and gear types sampled during the year. The first ten otoliths were selected from each sample selected for this test. Otoliths were read and compared with previous age determinations. The results for read1 show an agreement of 88% with aged fish but did not include 1 y old fish. There was 93% agreement with aged fish for the second age reading which included 1 y old fish. The coefficient of variation was 1.9% (Table 13, Figure 18).

Consistent with previous assessments, the catch at age was constructed using the MFD ‘Catch at Age’ application (version 9beta) which is a Marine Fish Division windows based program for computing catch at age statistics as part of the stock assessment process. Data files used by ‘Catch at Age’ were created with the ‘CATCHFRM’ application that was used to select fish sample data from the Pelagic Samples Database. These data included a 2% adjustment for the shrinkage due to freezing on the length measurements for frozen samples (Hunt et al. 1986). The length-weight relationships, which are also required as input to the ‘Catch at Age’ application, were calculated using an Oracle SQL*Plus script. The catch at age statistics were then calculated from length frequency and age-length key samples expanded to total catch using appropriate monthly length-weight relationships. The data were grouped or combined and then age-length keys were applied to length frequencies to produce catch at age statistics by NAFO unit area, gear-type and month.

Age Composition of the Catch

Under $F_{0.1}$ fishing and constant average recruitment, the age composition of the population caught in the fishery would be expected to be similar to that shown in Figure 19. There would be peak abundance at age 4, substantial fish surviving older than age 6 and a buildup of fish at ages 11+. This expected or ideal age structure has been used in recent assessments for comparison with the actual catch at age which has been characterized by a predominance of younger ages 2-3 and few fish older than six years old (Stephenson et al. 1999b, 2001; Power et al. 2002, 2003,2004).

In the 2004 fishery, the 2001 year-class (at age 3) dominated the catch at age by weight (about 36% of the weight of herring landed). The 2001 and 2002 year-classes were similar by number (35-36%) in the catch (Table 14, Figure 20). The pattern of dominance by age 2 and 3 fish was seen across all gear components except gillnet where age 5 fish were most prominent by number and weight, reflecting the selectivity of the gear (Table 14, Figure 21). The catch at age was also broken down by unit area, month and fishing ground for the purse seine sector which made up the majority of the overall catch (Table 15,16,17; Figure 22-24). Once again, age 2 and 3 predominated in most areas and months, except for German Bank (area 4Xq) off southwest Nova Scotia where age 4 was the highest by number and weight.

The historical time series of catch at age was extended to include the current fishing year and is shown as total number caught as well as percent by age (Table 18-19). The series shows very few fish older than age 7 in recent years and has been dominated by ages 2 through 4 since 1998 (Figure 25). The series is primarily made up of fish age 6 and younger but older ages were a feature when strong year-classes (i.e. 1976 and 1983) were progressing through the fishery (Figure 26).

Age composition in the fishery deteriorated further in 2004, and remains a concern. The proportion of age 4+, 5+ and 7+ were derived from the catch at age in numbers to determine trends in the older fraction of the catch (Figure 27). Age 7+ has shown a declining trend since 1990 corresponding to the demise of the 1983 year-class, which was the last very strong year-class in this component. Age 5+ is more variable but has also exhibited a declining trend in recent years. Age 4+ has declined since 1996 except for 2002 with recruitment of the strong 1998 year-class. There are few old fish (few age 7+; only 10% age 5+ by number) and the proportion of age 4+ in the catch has declined to about 20%. The rapid decline of year-classes (including the strong 1998 year-class) implies a high total mortality.

The trend toward catches at younger ages results in reduced yield and is reflected as an increase in the average number per ton from the overall catch at age (Figure 28). This indicator has doubled from about 6000 fish per ton (average fish of 167g) in the 1980's and 1990's to about 12,000 fish per ton (average fish of 83g) in the current year. These levels of removals per ton have not been observed since 1975, which was just prior to the closure of the meal fishery, the implementation of individual boat quotas and the conversion to a food fishery by the industry (Iles 1993). There is cause for concern for a recruitment fishery on younger ages when there is a lack of knowledge on the size of these incoming year-classes.

Weight at Age

The average weights at age showed little change for all ages in the most recent years (Table 20 and Figure 29), and were within the range of data observed historically (Power and Iles 2001). The most recent 5 year and 10 year average weights at age are consistently lighter than the overall series average (Figure 30) and reflect a general decline in weight at age that occurred for all ages in the mid 1980's.

VPA Analysis

Acoustic survey results have been used in previous assessments as absolute estimates of SSB and approximately 500kt have been recorded in each of the past six years. However, there are several indicators that SSB is not this high. An SSB of about 500kt would have been expected to result in substantial growth of the population since the late 1990s, improved age composition and low fishing mortality, given reasonable recruitment and the landings of recent years (less than 80kt in 2004). Such growth in the population and expansion of age composition has not been observed in the surveys or fishery. In recent assessments, it has been noted that the declining proportion of older fish in the population suggested that the total mortality on this stock was much higher than that implied by the ratio of catches to acoustic SSB.

Age specific indices of abundance were constructed from the acoustic survey data using samples appropriate for each survey conducted by area and year for 1999 to 2004 and applying the biomass estimates that were determined (Table 11, Figure 31-32). These indices were then used as the primary input for tuning or calibration of the VPA. The catch at age from the fishery is also used to reconstruct the population history using virtual population analysis (VPA) (Table 18, Figure 26). Population reconstruction from the catch at age requires some assumptions to be made about conditions in the terminal year. One assumption is about the exploitation pattern at age (partial recruitment); examination of this pattern since 1990 suggests that an exploitation pattern at age of 0.2, 0.4, 0.7 and 0.9 for ages 2-5 and 1.0 for age 6 and older is a reasonable approximation (Figure 33). Other assumptions for the population reconstruction follow traditional approaches, i.e. M=0.2 and F_{10}=population weighted average for ages 6-9.

The remaining specification required to conduct a population reconstruction is the magnitude of the population abundance at age 7 in 2004; two illustrative reconstructions were initially completed.

a) Illustrative VPA absolute: the population abundance at age 7 was chosen such that the spawning biomass in the terminal year approximated the absolute magnitude of the acoustic survey biomass index, about 500,000 mt.

b) Illustrative VPA flat trend: the population abundance at age 7 was chosen such that the trend in spawning biomass was flat, corresponding to the flat trend displayed by the acoustic survey biomass trend.

These results were then used as a starting point for a calibrated or tuned VPA using the acoustic index as either an absolute index or as a proportional index. The acoustic survey estimates may be used as absolute estimates of spawning biomass or for the relative trends in biomass. In the initial analysis, the acoustic index in absolute terms was related to population numbers. The results were very similar to the illustrative absolute with population numbers and fishing mortality (Table 22-23, Figure 34-35) showing an SSB of about 600kt. Combination of the absolute SSB estimate from acoustic surveys with fishery catch at age data in a virtual population analysis (VPA) implies a rapid and substantial biomass increase (5-fold over the past 5 years) which has not been seen in the surveys and is inconsistent with the truncated age composition. SSB levels of over 400kt have only been seen a few times over the 40 year history of this fishery. It is therefore apparent that the absolute SSB from acoustic surveys result in an overestimate. Potential reasons for an overestimate of SSB include uncertainty regarding the residence time on spawning grounds, as well as the possibility of double counting and inappropriate target strength coefficient for converting backscatter signal to biomass. The diagnostics for this run shows an unacceptable pattern of residuals with large negative residuals for ages 2 and 3 for all years and large positive residuals for ages 4 to 9 for all years (Figure 36-37).

Use of the acoustic survey data as a relative or proportional index of abundance resulted in a more consistent analysis. Acoustic surveys of spawning grounds indicate a relatively stable spawning stock biomass (SSB) in recent years. A VPA was calibrated with the trend in age structured acoustic survey results, using fishery catch statistics and sampling for size and age composition of the catch for the years 1965-2004 as basic input. These VPA results suggest a relatively stable SSB of less than 200kt and a high F (much greater than F0.1) in recent years. This scenario matches observations from the survey (relatively constant SSB) and the fishery (including little increase in biomass and a reduced age composition). The results were very similar to the Illustrative flat trend with population numbers and fishing mortality (Table 24-25, Figure 38-39) showing an SSB of less than 200kt and high F. The pattern of residuals is acceptable with a mixture of moderate size positive and negative residuals (Figure 40-41). This scenario matches more closely what has been recorded in the fishery with little increase in biomass and high fishing mortality leading to reduced age composition.

Diagnostics for the VPA as proportional include results for the parameters being estimated by the model (Table 26). The population abundance at age 7 in 2005 was estimated as 4,874 million with a moderately high standard error of 47% and a low bias of 9%. The other parameters estimated were the Q's or catchabilities for ages 2 to 9 which also had moderate SE's of 36-40% and low bias of 6-8%. The trend of increasing Q's at age and the lack of the typical dome or flat-top trend at older ages is unusual and may be due to the short time series and lack of older fish in the population (Figure 42).

Calculations of total mortality (Z = Fishing mortality + Natural mortality) were calculated using the acoustic and fishery catch at age data. Z calculations are typically quite variable but can often be used to detect broad patterns and for confirmation of VPA results. The Z values were calculated using ages 4 to 8 compared with ages 5 to 9 in the following year.

The acoustic age composition is assumed to be representative of the overall spawning biomass. The results for 2000 to 2004 have high values of Z between 0.5 and 1.5 with one negative value (Figure 43). There is no apparent trend as the series is very short; however these values appear consistent with the higher F's estimated from the proportional VPA.

Total mortality may also be derived from the fishery catch at age but requires the assumption that effort has been stable over the period being analyzed. This assumption may be valid for the recent decade with catches in the range of 60 to 90kt (Figure 16). Similar to the acoustic series, the Z values are high and variable but with no trend in recent years (Figure 44).

Projection results and risk analysis are provided in terms of the consequences of various catch quotas (yield) (Table 27, Figure 45). To have a low to neutral risk of exceeding F=0.2 requires a catch of about 25,000t or less. Because of the incoming recruitment, catches as high as 40,000t still have a neutral to high chance for 40% biomass increase. These results are also shown in terms of exploitation rate and expected biomass change for various yields (Figure 46).

Fishery catches are considered reasonably reliable and it is not thought that large amounts of unreported catch have occurred in recent years. Age interpretation appears to track strong and weak year-classes historically and there is consistency of age interpretation between and within readers across years. Acceptance of the absolute acoustic survey biomass implies a rapid and substantial biomass increase, five fold over the past 5 years, with an associated reduction in fishing mortality rate from over 1.0 to 0.3 (Figure 35)

There is strong support for the interpretation of stock status that the trend in biomass has been flat over recent years and the total biomass is less than half of the acoustic survey estimate (Figure 38). It should be emphasized that the acoustic index only provides information on about 50% of the total biomass with younger ages estimated with average partial recruitment. In addition, biomass levels of over 400kt have only been seen a few times over the 40 year history of this fishery. About half of the catch biomass in recent years was comprised of ages 2 and 3 and there is no information about the 2003 year-class (age 2 in 2005) and the estimate of the 2002 year-class (age 3 in 2005) is very dependent on the assumed partial recruitment of 0.2.

2.3 Sources of Uncertainty

The evaluation of stock status in this area relies in large part on the spawning stock biomass estimates derived from industry acoustic surveys. There is considerable variability around individual acoustic survey estimates (standard errors are in the range of 10-60%) although studies of individual weir catches indicate that acoustic biomass estimates are within 15% of the amount of fish harvested. Uncertainty may also arise from assumptions concerning the residence time of herring on spawning grounds, target strength estimates and the temporal coverage of surveys in relation to the extent of spawning.

2.4 Ecosystem Considerations

Herring is prominent in the diet of many fish, seabirds and marine mammals, and should be managed with these interactions in mind. At present, use of a natural mortality rate of 0.2 and maintenance of SSB at moderate to high levels are assumed to account for these interactions.

Recent management initiatives to protect spawning components are intended to maintain the spatial and temporal diversity of herring spawning. Increased fishing on juveniles, which are of mixed or unknown stock affinity, is inconsistent with this objective.

2.5 Outlook

Recent assessments of the SWNS/BOF spawning component suggested that fishing mortality should remain below F0.1 (about 20% exploitation rate) for a number of years in order to rebuild spawning stock biomass in all spawning areas and to expand the age composition so as to meet the explicit biological objectives of management.

The 2004 fishery was 11,000t less than in the previous year. Although acoustic surveys continue to show an SSB of approximately 500,000t, there continues to be deterioration in the state of the stock and some of the conservation objectives specified for this fishery are not being met. There is an absence of older fish in the population and increased targeting of juveniles. While there is spawning on Trinity Ledge and a small amount of spawning has been observed in recent years near Seal Island, the SSB on both Trinity Ledge and Seal Island spawning areas remain well below historical levels.

The rapid decline in year-classes (failure to reach older ages), even in the strong recent 1998 year-class, indicates high total mortality. It seems that the current catch is substantially higher than what would be consistent with a moderate F. Although these high exploitation rates have not resulted in a reduction of surveyed spawning biomass (presumably due to reasonable recruitment), the rebuilding that these recruits may have represented has been lost.

Recent catches have been mostly consistent with the survey, assess, fish protocol of less than 20% of surveyed biomass. However the catch at age indicates that total mortality may be considerably higher. The increased trend to catch juveniles could compromise SSB, expansion of age composition and reoccupation of spawning grounds.

2.6 Management Considerations

An evaluation of progress against biological objectives in the management plan (DFO 2003b) indicate that most objectives are not being met (Table 28). In particular there are limited signs of recovery for the Trinity Ledge and Seal Island spawning components and there are few fish older than age 7 in the catch indicating high total mortality and the rapid decline of year classes. Also there is apparent high total mortality and targeting on 2 year olds. Although there has been limited fishing on Trinity Ledge in recent years, the current high exploitation rate (including the catch of these fish outside of the spawning area) appears to be impairing recovery. Some objectives appear to have been met, in particular on spawning components like German Bank and Scots Bay, where the SSB is apparently at stable levels in recent years.

The in-season management approach, which spreads the effort in the fishery spatially and temporally among spawning components, is seen as beneficial in achieving the conservation objectives. The “survey, assess, then fish” protocol is effective in spreading the catch appropriately among spawning components in proportion to their relative size and is considered an important safeguard.

Acoustic surveys have become critical to stock status evaluation. Surveys conducted in 2004 conformed to the proposed survey design. It is important that there be continued attention to coverage and survey design in order to assure year-to-year consistency in all spawning areas.

This assessment has confirmed a further deterioration in the state of the resource noted in the previous assessment. However, the change in use of acoustics as a relative rather than absolute abundance index has resulted in large change in the perception of the resource. As indicated earlier, the apparent absolute SSB is inconsistent with most other information. Possible reasons for the overestimate of SSB by the acoustic surveys have been proposed but more work is required.

3) Offshore Scotian Shelf Banks Spawning Component

3.1 The Fishery

A foreign fishery during 1963-1973 is estimated to have removed as much as 60,000t per year from the offshore Scotian Shelf banks (Stephenson et al. 1987). Few herring were caught after the extension of jurisdiction in 1977 until 1996, when a fishery was initiated by the 4WX purse seine fleet and 11,700t was taken (Table 3).

Since 1996 a fishery has taken place on feeding aggregations on the offshore banks primarily in May and June with catches ranging from 2,000 to 20,000t (Table 3). The variability in catch levels was often due to problems of fish being too deep, weather and market conditions rather than in the abundance of herring in these areas.

In 2004, fishing took place in June, in the vicinity of the Patch, the Bullpen and MacKenzie Spot. (Table 1, Figure 47). Landings of 4,000t from the 2004 fishery on the Scotian Shelf Banks were below the nine year average (approx. 9,000t) (Figure 48).

In 2004, herring continued to be caught as by-catch in the domestic bottom trawl fishery on the Scotian Shelf edge and slope with 110t reported (Table 1). There was no midwater trawl activity on the offshore Scotian Shelf banks in 2004.

The 1999 to 2001 year-classes (ages 3 to 5) made up most of the age composition of the Scotian Shelf fishery with age 5 dominating in both number and weight (Table 29, Figure 49).

3.2 Research and Industry Surveys

Industry Surveys

Fleet activity/catch in the spring/early summer fishery on the offshore banks of the Scotian Shelf continued to decrease in 2004. Acoustic recorders were activated on a few occasions but insufficient quantities of fish were observed to warrant analysis. Consequently there were no industry surveys of the area in 2004 and no acoustic biomass estimates were available from the Scotian Shelf (Power et al. 2005).

July Bottom Trawl Survey

Previous results from the summer bottom trawl survey showed few herring on the Scotian Shelf during the 1970’s, increasing amounts during the 1980’s and a relatively widespread distribution in recent years (Harris and Stephenson 1999, Power et al. 2004, Stephenson et al. 2001).

Offshore herring catches from this survey in 2004 were the highest in the 35-year time series, with an average of over 350 fish per standard tow for strata 55 through 78 (Table 30, Figure 50). Survey catches of the past seven consecutive years have been the highest on record. It should be noted, however, that in 2004 a replacement survey vessel (*Teleost)* was used while following standard survey methods. As of yet there have been no inter-vessel conversion factors established for differences in fishing efficiency by species and results for 2004 need to be used with caution.

Increasing trends are also similar for the combined strata from each of the areas 4W and 4X (Table 30, Figure 51). The strata areas used for selection of trawling stations in this bottom trawl survey series are shown in Figure 52. Herring were again widely distributed on banks west of Sable Island (Figure 53) and were comparable to average catches from the last ten years (Figure 54). The overall size distribution for catches from all strata in 4WX shows that the bottom trawl catches a complete spectrum of herring from 5cm up to 40cm (Figure 55); however there are few fish larger than 35cm in recent years.

The survey data for areas 4WX combined were also analysed by age to produce stratified mean numbers per tow over the series (Table 31, Figure 56). There was a lack of consistency with the large year-classes observed in the fishery and a lack of tracking of these year-classes from year to year. There have been two major changes in the catch rates by bottom trawl over the series; the first is with to the introduction of the Alfred Needler in 1987 and a second large increase since 1994. There is also the issue of using uncalibrated Teleost catches for 2004. The plot by age and year shows a lack of older ages in the catch over the past decade but does not appear to track strong year classes consistently (Figure 57).

The proportion of age 4+ and 7+ were derived from the bottom trawl catch at age to determine trends in the older fraction of the catch (Figure 58). Similar to the trend seen in the fishery catch at age the 7+ fraction has shown a declining trend since 1990 corresponding to the demise of the 1983 year-class, which was the last very strong year-class in this component. Age 4+ is highly variable and does not follow the declining trend observed in the catch.

Fall Herring Research Survey

There has been no fall herring research survey on the Scotian Shelf since 2002 when the research vessel *Alfred Needler* was used.

3.3 Outlook and Management Considerations

The summer bottom trawl research survey demonstrates that there is a considerable abundance of herring widely spread over the offshore banks of the Scotian Shelf. Information from previous assessments indicated the presence of at least some autumn spawning on Western Bank in recent years. There is very little new information to add and no reason to change the previous outlook:

- Recorded landings in the foreign fisheries of 13,000t to 60,000t between 1969 and 1973 did not appear to be sustainable.
- The initial catch allocation for 2004 should not exceed the 12,000t reference value used in the recent fishing plans.

There continues to be insufficient documentation of stock size, distribution and spawning behaviour for this component. Industry, DFO Science and Management are encouraged to continue to work together to improve the biological basis for management. There continues to be the need for industry surveys to estimate abundance.

4) Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia Spawning Component

4.1 The Fishery and Resource Status

In addition to traditional coastal fixed gear fisheries for subsistence and personal bait, there has been an increase in the number of active gillnet licenses in recent years aimed at spawning herring for the roe market (Clark et al. 1999). This was the ninth year for a fishery on spawning fish off Halifax/Eastern Shore and the eighth year of gillnet roe fisheries off Little Hope/Port Mouton and Glace Bay.

The recorded landings (7,000t) in 2004 in the four major gillnet fisheries along the coast of Nova Scotia were higher for the Eastern Shore, but lower for Little Hope/Port Mouton and Glace Bay. The Bras d’Or Lakes fishery remained closed (Table 32).

Biomass estimates from surveys of the major coastal Nova Scotia spawning components were much lower in 2004 with a large decrease in the estimated SSB for both the Little Hope (4Xo) and Eastern Shore (4Wk) areas (Table 33) (Power et al. 2005). In both areas, the reduction was partly attributed to difficulties of surveying in adverse weather conditions in 2004. There was no biomass estimate for the Glace Bay (4Vn) area because of equipment problems and there was no acoustic survey effort in the Bras d’Or Lakes. Although the results of acoustic surveys are reported here as absolute abundance, the discussion in the SW Nova Scotia/Bay of Fundy component suggests that they may overestimate SSB.

Management of these spawning components using “survey, assess, then fish (<10%)” protocol is considered useful when the components are considered to be healthy and of sufficient size. The history of the application of this protocol has had some mixed success due to some occasional problems in executing surveys (Table 33).

Exploitation rates for the coastal areas with acoustic survey estimates have been calculated as the proportion of landings against estimated SSB (Table 34).

Little Hope

The fishery in the Port Mouton/Little Hope area occurred primarily in October with a total of 1,270t of herring landed (Figure 59). Length samples were taken from October 2-4 with a mean size of 28 to 30cm (Figure 60). Only one sample of spawning fish was available from Oct. 2 most in spawning condition (Figure 61). Sampling indicated that the catch was composed primarily of the 1999 year-class at age 5 (Table 35, Figure 62).

A total of two acoustic surveys took place on the spawning ground on Oct. 2 and Oct. 13, 2004 (Power et al. 2005). The overall acoustic estimate for this area was 15,600t (15% SE).

East of Halifax (4W Eastern Shore)

The roe fishery for the Eastern Shore area in September and October landed 4,200t an increase of about 1,500t from 2003 (Figure 63). Sampling was limited to the two survey nights that took place and indicated that the catch was composed of large spawning fish mainly of the 1997 - 1999 year-classes (age 5-7) (Figure 64-66, Table 35).

Acoustic surveys undertaken by the Eastern Shore Fishermen's Protective Association in September and October 2004 estimated an SSB of 18,200t (9% SE), substantially lower (decrease of 58,300t) than recent years (Table 33) (Power et al. 2005).

Glace Bay

The fishery off Glace Bay, Cape Breton took place in October with total landings of 1,500t, which was a slight decrease from the previous year (Table 32, Figure 67). Length samples indicated large herring, mostly over 30 cm in total length (Figure 68), while maturity samples taken in September were primarily of spawning fish. Fish aged 7 (1997 year-class) dominated the catch (Figure 69, Table 35).

As a result of equipment problems, no acoustic survey information was available for 2004. This problem will be rectified in 2005.

Bras d'Or Lakes

The fishery was closed in 2004. No sampling or acoustic surveys were undertaken in the Bras d'Or lakes to document the size distribution or abundance of herring.

4.2 Outlook and Management Considerations

There is no overall quota for the coastal Nova Scotia spawning component and apart from the areas mentioned above; the size and historical performance of various spawning groups are poorly documented. In addition to traditional fisheries for bait and personal use, there have been directed roe fisheries on the spawning grounds in recent years. As the inshore roe fisheries off Glace Bay, East of Halifax and Little Hope have developed, participants have contributed to sampling and surveying and the fisheries have attempted to follow the ‘survey, assess, fish’ protocol.

Management approaches and recent research efforts have improved knowledge in these three areas (Little Hope/Port Mouton, Halifax/Eastern Shore and Glace Bay), but there has been no increase in knowledge in adjacent areas. Individual spawning groups within this component are considered vulnerable to fishing because of their relatively small size and proximity to shore. As in the past five years, it is recommended that no coastal spawning areas should experience a large effort increase until much more information is available on the state of that spawning group, and there should be no new fisheries developed when there is uncertainty regarding stock composition and degree of mixing.

It has been noted since 1997 that the status of herring in the Bras d’Or Lakes is cause for concern. Spawning is still absent from some traditional areas and the observed biomass of spring spawners is very low. It is therefore appropriate to reiterate from a biological perspective, that no fishing take place on this spawning component.

5) SW New Brunswick Migrant Juveniles

The southwest New Brunswick weir and shutoff fisheries have relied, for over a century, on the aggregation of large numbers of juvenile herring (ages 1-3) near shore at the mouth of the Bay of Fundy. These fish have been considered to be a mixture of juveniles, dominated by those originating from NAFO Subarea 5 spawning components, and have therefore been excluded from the 4WX quota.

The number and distribution of active weirs have decreased over the past decade, due in part to the conversion of sites to aquaculture, as well as the reduction in landings over the past decade in the Passamaquoddy Bay area (Table 3, 7). In the previous season (2003) there was a large drop in landings in the traditional New Brunswick weir and shutoff fishery to 9,000t - the lowest since 1983 – and there was concern expressed for this fishery. In 2004 weir landings increased to 20,600t (Table 1, Figure 70), the highest since 1994, but there is still a trend of decreasing landings in this fishery in the past decade (Table 3, Figure 71).

The 2004 catch was dominated by the 2002 year-class (age 2) in number and the 2001 year-class (age 3) by weight. Mature herring (ages 4+) taken in this fishery are considered to be of 4WX origin (Table 36, Figure 72).

In 2002 the Fundy Weir Fishermen Association, Inc., in partnership with the New Brunswick Department of Agriculture, Fisheries and Aquaculture, the Grand Manan Fishermen's Association, Connors Brothers Ltd. and Fisheries and Oceans, Canada, initiated a tagging program, to be conducted over a three year period. The purpose of this project is to investigate the seasonal movements and migration of herring in the Bay of Fundy with the long-term goal of providing information on stock structure. Since the start of this project a total of 77,957 herring have been tagged and 2,741 tags have been recovered. The latest results to date are summarized by Waters and Clark (2005).

Preliminary results from tagging studies conducted on weir fish since August 2002 have indicated a link between the fish caught in the weir fishery and those caught in the fall and winter purse seine fishery off Grand Manan. The juvenile fish caught in the purse seine fishery are counted against the 4VWX quota, whilst those caught in the weirs are considered to be of Subarea 5 origin. The recent US management plans (NEFSC 1998, 2004) assumes that all of the juvenile herring from this fishery originate from the US "coastal complex" (5Y + 5Z) which is reported to be at record high levels of abundance.

6) 5Z Georges Bank

The activities of a single midwater trawler on the Canadian portion of Georges Bank (area 5Z) have also been included (Table 1). There were a total of only 16t reported from Aug. and Sept. from two landings. These catches were dominated by the 1999 year-class at age 5 in numbers and weight (Table 37).

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Table 1. 4VWX herring fishery landings (t) by month, gear sector and management unit for 2003-2004 quota year.

	Area	Gear	1	2	3	4	5	6	7	8	9	10	11	12	Total
S.W. Nova Scotia	4W	Fall/Winter P. Seine													-
	4X	Fall P. Seine (2003)										2,554	1,555	57	4,166
		Winter P. Seine (2004)	1,311	182											1,493
		Summer P. Seine (2004)					4,754	6,961	13,106	21,180	14,951	8,063			69,015
		Gillnet "Stock"									225				225
		N.S. Weirs						667	873	1,370	219				3,130
S.W. Nova Scotia Total			1,311	182			4,754	7,628	13,979	22,550	15,395	10,617	1,555	57	78,029
Coastal Nova	4Vn	Trap						9			50				59
(South Shore,		Glace Bay Gillnet									0	1,481			1,481
Eastern Shore,	4W	Eastern Shore Gillnet									1,511	2,666			4,176
Cape Breton)	4X	Little Hope Gillnet									2	1,264	1		1,267
Coastal Nova Scotia Total								9	-	-	1,562	5,411	1		6,984
Offshore S.S.	4WX	Offshore P. Seine						4,054							4,054
		Midwater Trawl													-
		Bottom Trawl + Misc.	2	2	0	2	12	22	13	14	24	17	3	0	111
Offshore S.S. Total			2	2	0	2	12	4,076	13	14	24	17	3	0	4,165
Migrant	4X	N.B. Weirs					21	336	2,694	8,354	8,298	913	3		20,620
Juveniles		N.B. Shutoff								11	16	25		15	66
Migrant Juveniles Total							21	336	2,694	8,366	8,314	938			20,686
Georges Bank	5ZE	5Z Purse Seine													-
		Midwater Trawl								14	2				16
Georges Bank Total										14	2				16

Total 2003-04	109,880

Table 2. 4WX herring fishery landings (t) by month, gear sector for 2004-2005 quota year (as of Mar. 1, 2005).

			Month												
	Area	**Gear**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total**
2004-05 quota year	4X	Fall 2004 P. Seine										1,404	518		1,922
		Winter 2005 P. Seine	571												571
	4WX	Bottom Trawl													-
2004-05 Total (to date)			571									1,404	518		2,493

Table 3. Historical series of nominal and adjusted annual landings (t) by major gear components and seasons of the 4WX herring fishery, 1963-2005 (the 1963-73 Offshore Scotian Shelf landings are from Stephenson et al. (1987)).

Year^	4W Winter Purse Seine	4Xs Fall&Winter Purse Seine	4Xqr Summer Purse Seine	4X Summer Gillnet	4Xr Nova Scotia Weir	4WX Stock Nominal Landings	4WX Stock Adjusted Landings*	4WX Stock TAC	Non-Stock 4Xs N.B. Weir & Shutoff	Offshore Scotian Shelf Banks	Total 4WX Adjusted Landings
1963		6,871	15,093	2,955	5,345	30,264	30,264		29,366	3,000	62,630
1964		15991	24,894	4,053	12,458	57,396	57,396		29,432	2,000	88,828
1965		15,755	54,527	4,091	12,021	86,394	86,394		33,346	6,000	125,740
1966		25,645	112,457	4,413	7,711	150,226	150,226		35,805	2,000	188,031
1967		20,888	117,382	5,398	12,475	156,143	156,741		30,032	1,000	187,773
1968		42,223	133,267	5,884	12,571	193,945	196,362		33,145	18,000	247,507
1969	25,112	13,202	84,525	3,474	10,744	137,057	150,462		26,539	121,000	298,001
1970	27,107	14,749	74,849	5,019	11,706	133,430	190,382		15,840	87,000	293,222
1971	52,535	4,868	35,071	4,607	8,081	105,162	129,101		12,660	28,000	169,761
1972	25,656	32,174	61,158	3,789	6,766	129,543	153,449		32,699	21,000	207,148
1973	8,348	27,322	36,618	5,205	12,492	89,985	122,687		19,935	14,000	156,622
1974	27,044	10,563	76,859	4,285	6,436	125,187	149,670		20,602		170,272
1975	27,030	1,152	79,605	4,995	7,404	120,186	143,897		30,819		174,716
1976	37,196	746	58,395	8,322	5,959	110,618	115,178		29,206		144,384
1977	23,251	1,236	68,538	18,523	5,213	116,761	117,171	109,000	23,487		140,658
1978	17,274	6,519	57,973	6,059	8,057	95,882	114,000	110,000	38,842		152,842
1979	14,073	3,839	25,265	4,363	9,307	56,847	77,500	99,000	37,828		115,328
1980	8,958	1,443	44,986	19,804	2,383	77,574	107,000	65,000	13,525		120,525
1981	18,588	1,368	53,799	11,985	1,966	87,706	137,000	100,000	19,080		156,080
1982	12,275	103	64,344	6,799	1,212	84,733	105,800	80,200	25,963		131,763
1983	8,226	2,157	63,379	8,762	918	83,442	117,400	82,000	11,383		128,783
1984	6,336	5,683	58,354	4,490	2,684	77,547	135,900	80,000	8,698		144,598
1985	8,751	5,419	87,167	5,584	4,062	110,983	165,000	125,000	27,863		192,863
1986	8,414	3,365	56,139	3,533	1,958	73,409	100,000	97,600	27,883		127,883
1987	8,780	5,139	77,706	2,289	6,786	100,700	147,100	126,500	27,320		174,420
1988	8,503	7,876	98,371	695	7,518	124,653	199,600	151,200	33,421		233,021
1989	6,169	5,896	68,089	95	3,308	83,557	97,500	151,200	44,112		141,612
1990	8,316	10,705	77,545	243	4,049	102,627	172,900	151,200	38,778		211,678
1991	17,878	2,024	73,619	538	1,498	97,010	130,800	151,200	24,576		155,376
1992	14,310	1,298	80,807	395	2,227	100,227	136,000	125,000	31,967		167,967
1993	10,731	2,376	81,478	556	2,662	98,464	105,089	151,200	31,573		136,662
1994	9,872	3,174	64,509	339	2,045	80,099	80,099	151,200	22,241		102,340
1995	3,191	7,235	48,481	302	3,049	62,499	62,499	80,000	18,248		80,747
1996	2,049	3,305	42,708	6,340	3,476	58,068	58,068	57,000	15,913	11,745	85,726
1997	1,759	2,926	40,357	6,816	4,019	56,117	56,117	57,000	20,552	20,261	96,930
1998	1,405	1,494	67,433	2,231	4,464	77,027	77,027	90,000	20,091	5,591	102,709
1999	1,235	4,764	64,432	1,660	5,461	77,552	77,552	105,000	18,644	12,646	108,842
2000	1,012	4,738	78,010	823	701	85,284	85,284	100,000	16,829	2,182	104,295
2001	0	4,001	62,004	1,857	3,708	71,570	71,570	78,000	20,209	12,503	104,282
2002	367	5,257	69,894	393	1,143	77,054	77,054	78,000	11,874	7,039	95,967
2003	0	8,860	79,140	439	921	89,360	89,360	93,000	9,003	998	99,361
2004	0	5,659	69,015	225	3,130	78,029	78,029	83,000	20,686	4,165	102,880
2005		2,493				2,493	2,493	TBA			2,493

^Annual landings by purse seiners are defined for the period from October 15 of the preceding year to October 14 of the current year.

*Adjusted totals includes misreporting adjustments for 1978-84 (Mace 1985) and for 1985-93 (Stephenson 1993, Stephenson et al 1994)

All landings by other gear types are for the calendar year.

Table 4. Summary of herring purse seine catches (t) from 1984 to 2004 by fishing grounds for 4WX stock and non-stock areas.

	Year																					
Stock Areas	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Avg 92-03
Browns Bank			732						86		1903	1554	40	14	3139	2197	1137	486			45	1173
Chedabucto Bay	490	4216	7498	6374	7523	8325	12470	12596	3084	1378	1407	2049	1759		1583	1151	10					1553
Gannet,Dry Ledge		5675	2187	1474	14901	2010	4213	6294	18527	2935	2588	2693	1963	4590	4156	10296	12674	3877	9047	6965	4456	6692
German Bank		15522	13346	16547	18392	8087	11744	23193	3235	4045	9662	19549	15898	13576	20556	24660	25631	24139	22355	21573	14175	17073
Grand Manan	372	4989	5823	4298	4440	4300	5442	4225	2722	783	6846	5297	6005	5312	15983	7912	18185	10545	17753	17258	7542	9550
Long Island		974	3365	7499	10722	21719	18484	9470	3213	2814	7666	7906	4385	3557	12360	18286	11199	12904	6642	12639	13115	8631
Lurcher		476	132		2928	18	65	151	2141	1560	530	382	243	599	57		715	227	7683	1872	7268	1455
N.B. Coastal	384	188	621	960	1031	3033	2347	488	992	598	99	1502	271	1176	782	1867	361	1250	3113	3914	2707	1327
Pollock Point																		1563				1563
S.W. Grounds		558	1108	184	181	276	56	521	225	2961	3444	6205	3035	797	1239	3241	1879	53	791	73		1995
Scots Bay			36	3822	4145	6583	9003	7982	7987	5258	10840	980	8984	4894	8210	1789	10926	10739	8202	19196	24869	8167
Seal Island		13818	8894	11560	19019	23420	25344	12740	10455	3874	2820	465	1567	492	617	567	206	101	238	1096		1875
Trinity		35860	13505	18744	18539	266	1113	3259	4612	1348	2366	370	3448	5308	2825	1220	103	113	1609		370	2120
Yankee Bank					194	250	3647	817	119	10	175	323	9	4	159	82	133	8	78			100
Unknown	45	184	500	200			200	579	494	140		73			62	84	27			1103	127	283
4WX Stock Total	1291	82458	57745	71661	102015	78287	94127	82314	57888	27703	50345	49348	47606	40319	71727	73350	83186	66005	77511	85689	74674	60890
Nonstock Areas	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2003	Avg 92-03
Georges Bank							91	64			266		2491	79			265					775
Liverpool								13		4067	4177											4122
Shelburne				59				64		526	161		56									248
Halifax										652	1945		585	455			1002	472	367			685
Offshore Banks													11800	18770	4284	8669	1645	3977	5078	722	4054	6868
Western Hole			41	154				213	3451	2255	1495	108	127	691	1012	1057	47	7712	1884	156		1666
Sydney Bight		3511	4250	1751	2100	1330	3591	3606		396		3951	4267		52							2166
Nonstock Total		3511	4291	1964	2100	1330	3682	3959	3451	7896	8044	4059	19325	19995	5348	9726	2958	12161	7329	878	4054	8431
Overall Total	1291	85968	62036	73625	104116	79617	97809	86273	61339	35598	58389	53407	66931	60314	77075	83076	86144	78166	84840	86567	78728	69321

Table 5. Summary of the percentage of herring purse seine catches from 1984 to 2004 by fishing grounds for 4WX stock and non-stock areas.

Summary of the percentage of purse seine catches from 1984 to 2004 by year and grounds

Stock Areas	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Avg 92-03
Browns Bank			1%						0%		3%	3%	0%	0%	4%	3%	1%	1%			0%	1%
Chedabucto Bay	38%	5%	12%	9%	7%	10%	13%	15%	5%	4%	2%	4%	3%		2%	1%	0%					2%
Gannet,Dry Ledge		7%	4%	2%	14%	3%	4%	7%	30%	8%	4%	5%	3%	8%	5%	12%	15%	5%	11%	8%	6%	10%
German Bank		18%	22%	22%	18%	10%	12%	27%	5%	11%	17%	37%	24%	23%	27%	30%	30%	31%	26%	25%	18%	24%
Grand Manan	29%	6%	9%	6%	4%	5%	6%	5%	4%	2%	12%	10%	9%	9%	21%	10%	21%	13%	21%	20%	10%	13%
Long Island		1%	5%	10%	10%	27%	19%	11%	5%	8%	13%	15%	7%	6%	16%	22%	13%	17%	8%	15%	17%	12%
Lurcher		1%	0%		3%	0%	0%	0%	3%	4%	1%	1%	0%	1%	0%		1%	0%	9%	2%	9%	2%
N.B. Coastal	30%	0%	1%	1%	1%	4%	2%	1%	2%	2%	0%	3%	0%	2%	1%	2%	0%	2%	4%	5%	3%	2%
Pollock Point																		2%				0%
S.W. Grounds		1%	2%	0%	0%	0%	0%	1%	0%	8%	6%	12%	5%	1%	2%	4%	2%	0%	1%	0%		3%
Scots Bay			0%	5%	4%	8%	9%	9%	13%	15%	19%	2%	13%	8%	11%	2%	13%	14%	10%	22%	32%	12%
Seal Island		16%	14%	16%	18%	29%	26%	15%	17%	11%	5%	1%	2%	1%	1%	1%	0%	0%	0%	1%		3%
Trinity		42%	22%	25%	18%	0%	1%	4%	8%	4%	4%	1%	5%	9%	4%	1%	0%	0%	2%		0%	3%
Yankee Bank					0%	0%	4%	1%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%			0%
Unknown	4%	0%	1%	0%			0%	1%	1%	0%		0%			0%	0%	0%			1%	0%	0%
Total	100%	96%	93%	97%	98%	98%	96%	95%	94%	78%	86%	92%	71%	67%	93%	88%	97%	84%	91%	99%	95%	87%

Stock Areas	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2002	2003	Avg 92-03
Georges Bank							0%	0%			0%		4%	0%			0%					0%
Liverpool								0%		11%	7%											2%
Shelburne				0%				0%		1%	0%		0%									0%
Halifax										2%	3%		1%	1%			1%	1%	0%			1%
Offshore Banks													18%	31%	6%	10%	2%	5%	6%	1%	5%	7%
Western Hole			0%	0%				0%	6%	6%	3%	0%	0%	1%	1%	1%	0%	10%	2%	0%		3%
Sydney Bight		4%	7%	2%	2%	2%	4%	4%		1%		7%	6%		0%							1%
Misc Nonstock Tota		4%	7%	3%	2%	2%	4%	5%	6%	22%	14%	8%	29%	33%	7%	12%	3%	16%	9%	1%	5%	13%

Table 6. Monthly weir landings (t) for weirs located in New Brunswick and Nova Scotia; 1978 to 2004.

PROVINCE	YEAR	1	2	3	4	5	6	7	8	9	10	11	12	Year Total
N.B.	1978	3				512	802	5,499	10,275	10,877	4,972	528	132	33,599
	1979	535	96			25	1,120	7,321	9,846	4,939	5,985	2,638	74	32,579
	1980					36	119	1,755	5,572	2,352	1,016	216		11,066
	1981					70	199	4,431	3,911	2,044	2,435	1,686	192	14,968
	1982		17			132	30	2,871	7,311	7,681	3,204	849	87	22,181
	1983					65	29	299	2,474	5,382	3,945	375		12,568
	1984					6	3	230	2,344	2,581	3,045	145		8,353
	1985					22	89	4,217	8,450	6,910	4,814	2,078	138	26,718
	1986	43				17		2,480	10,114	5,997	6,233	2,564	67	27,516
	1987	39	21	6	12	10	168	2,575	10,893	6,711	5,362	703	122	26,621
	1988		12	1	90	657	287	5,993	11,975	8,375	8,457	2,343	43	38,235
	1989		24		95	37	385	8,315	15,093	10,156	7,258	2,158		43,520
	1990					93	20	4,915	14,664	12,207	7,741	168		39,808
	1991					57	180	4,649	10,319	6,392	2,028	93		23,717
	1992				15	50	774	5,477	10,989	9,597	4,395	684		31,981
	1993					14	168	5,561	14,085	8,614	2,406	470	10	31,328
	1994				18		55	4,529	10,592	3,805	1,589	30		20,618
	1995					15	244	4,517	8,590	3,956	896	10		18,228
	1996					19	676	4,819	7,767	1,917	518	65		15,781
	1997				8	153	1,017	6,506	7,396	5,316				20,396
	1998					560	713	3,832	8,295	5,604	525			19,529
	1999					690	805	5,155	9,895	2,469	48			19,063
	2000					10	7	2,105	7,533	4,940	1,713	69		16,376
	2001					35	478	3,931	8,627	5,514	1,479			20,064
	2002					84	20	1,099	6,446	2,878	1,260	20		11,807
	2003					257	250	1,423	3,554	3,166	344	10		9,003
	2004					21	336	2,694	8,354	8,298	913	3		20,620
NB Average Catch (t)		155	34	3	40	140	345	3,970	8,717	5,877	3,176	778	96	22,824
N.S.	1978				1	490	3,704	2,990	239	46	111	198	79	7,858
	1979					811	3,458	1,418	420	39	136	57		6,339
	1980					69	647	1,271	395					2,383
	1981					50	437	983	276	37		41		1,824
	1982					16	267	468	195	172	12			1,130
	1983				2	286	141	188	208	53		18		896
	1984					113	1,032	736	602	220				2,702
	1985					378	1,799	1,378	489			11		4,055
	1986					385	403	71	704	390	5			1,957
	1987					1,503	2,526	1,215	1,166	367				6,776
	1988					1,217	2,976	1,696	1,204	386				7,480
	1989					340	1,018	870	843	226				3,296
	1990					208	973	1,482	879	538	52			4,132
	1991				3	23	149	719	342	262				1,498
	1992					35	659	405	754	371				2,224
	1993					226	908	608	867	53				2,662
	1994					111	736	499	519	180				2,045
	1995					236	1,255	1,059	470	29				3,049
	1996					430	1,267	1,232	358	188				3,476
	1997					70	1,874	1,739	271	65				4,019
	1998					1,304	1,677	390	359	317				4,048
	1999					1,958	1,513	547	488	31				4,537
	2000						16	151	326	191				683
	2001					105	1,439	1,565	391	207				3,708
	2002					23	95	240	558	228				1,143
	2003					98	126	68	344	284				921
	2004						667	873	1,370	219				3,130
NS Average Catch (t)					2	419	1,176	921	557	204	63	65	79	3,258

Table 7. Overall effort from New Brunswick and Nova Scotia weirs for catch (t), number of active weirs and the catch per weir (t) for the period 1978 to 2004.

	Annual Catch (t)			No. Active Weirs			Catch per weir (t)		
Year	NB	NS	Total Catch	NB	NS	Total No.	NB	NS	Average
1978	33,599	7,858	41,458	208	31	239	162	253	173
1979	32,579	6,339	38,918	210	27	237	155	235	164
1980	11,066	2,383	13,449	120	29	149	92	82	90
1981	14,968	1,824	16,793	147	28	175	102	65	96
1982	22,181	1,130	23,311	159	19	178	140	59	131
1983	12,568	896	13,464	143	23	166	88	39	81
1984	8,353	2,702	11,056	116	13	129	72	208	86
1985	26,718	4,055	30,774	156	14	170	171	290	181
1986	27,516	1,957	29,473	105	18	123	262	109	240
1987	26,621	6,776	33,397	123	21	144	216	323	232
1988	38,235	7,480	45,715	191	21	212	200	356	216
1989	43,520	3,296	46,817	171	20	191	255	165	245
1990	39,808	4,132	43,940	154	22	176	258	188	250
1991	23,717	1,498	25,216	143	20	163	166	75	155
1992	31,981	2,224	34,206	151	12	163	212	185	210
1993	31,328	2,662	33,990	145	10	155	216	266	219
1994	20,618	2,045	22,662	129	11	140	160	186	162
1995	18,228	3,049	21,277	106	10	116	172	305	183
1996	15,781	3,476	19,257	101	12	113	156	290	170
1997	20,396	4,019	24,415	102	15	117	200	268	209
1998	19,529	4,048	23,577	108	15	123	181	270	192
1999	19,063	4,537	23,600	100	14	114	191	324	207
2000	16,376	683	17,058	77	3	80	213	228	213
2001	20,064	3,708	23,772	101	14	115	199	265	207
2002	11,807	1,143	12,950	83	9	92	142	127	141
2003	9,003	921	9,924	78	8	86	115	115	115
2004	20,620	3,130	23,750	84	8	92	245	391	258
Average	22,824	3,258	26,082	130	17	147	176	210	179

Table 8. Purse seine effort, catch and CPUE levels for 1989 to 2004.

Purse Seiner Fishery

Year	No. Days Fished	No. of Boats Fishing	Total Catch t	CPUE (catch/slip)	CPUE (catch/boat)
1989	2198	40	87,383	40	2185
1990	2390	42	103,537	43	2465
1991	2333	40	88,830	38	2221
1992	2431	39	95,072	39	2438
1993	2542	36	92,828	37	2579
1994	2227	36	75,652	34	2101
1995	1682	32	56,441	34	1764
1996	1781	32	60,038	34	1876
1997	1731	30	61,769	36	2059
1998	2290	28	70,931	31	2533
1999	1775	28	78,574	44	2806
2000	1572	28	78,727	50	2812
2001	1826	21	75,343	41	3588
2002	1838	19	76,210	41	4011
2003	1652	18	85,499	52	4750
2004	1358	18	76,361	56	4242

Table 9. Summary of the minimum observed spawning stock biomass for each of the surveyed spawning grounds in the Bay of Fundy/SW Nova component of the 4WX stock complex (from Power et al. 2005).

Location/Year	1997*	1998*	1999	2000	2001	2002	2003	2004	Average 1999-2004
Scots Bay	160,200	72,500	41,000	106,300	163,900	141,000	133,900	107,600	115,617
Trinity Ledge	23,000	6,800	3,900	600	14,800	8,100	14,500	6,500	8,067
German Bank	370,400	440,700	460,800	356,400	190,500	393,100	343,500	367,600	351,983
Spectacle Buoy									
- Spring	15,000	1,300	0	0	1,100		1,400		625
- Fall					87,500				87,500
Sub-Total	568,600	521,300	505,700	463,300	457,800	542,200	493,300	481,700	490,667
Seal Island					3,300	1,200	12,200		5,567
Browns Bank					45,800				45,800
Total	568,600	521,300	505,700	463,300	506,900	543,400	505,400	481,700	501,067
Overall SE t	n/a	n/a	94,600	64,900	50,800	49,500	86,100	74,200	70,017
Overall SE %	n/a	n/a	19	14	10	9	17	15	14

*Biomass estimates prior to 1999 are not considered comparable due to variation in the coverage area.

Table 10. Partial exploitation rates (%) by major spawning grounds and for the overall Bay of Fundy/SW Nova component of the 4WX stock complex with (A1) acoustic survey SSB, (A2) acoustic survey proportion of total SSB, (C1) allocated catch by spawning component, (C2) adjusted catch including non-spawning area catches, exploitation rate as percentage of acoustic SSB for (P1) spawning area catch and (P2) adjusted catch.

A1) Acoustic Survey SSB (t)	1997	1998	1999	2000	2001	2002	2003	2004	Avg 99-04
Scots Bay	160,168	72,473	40,972	106,316	163,900	141,000	133,900	107,600	115,615
Trinity	23,000	6,762	3,885	621	14,800	8,100	14,500	6,500	8,068
German Bank	385,400	442,033	460,823	356,372	282,400	394,357	357,100	367,600	369,775
Total SSB	568,568	521,268	505,680	463,309	461,100	543,457	505,500	481,700	493,458

A2) Acoustic Survey Proportions	1997	1998	1999	2000	2001	2002	2003	2004	Avg 99-04
Scots Bay	28%	14%	8%	23%	36%	26%	26%	22%	24%
Trinity	4%	1%	1%	0%	3%	1%	3%	1%	2%
German Bank	68%	85%	91%	77%	61%	73%	71%	76%	75%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

C1) Catch by Spawn Area	1997	1998	1999	2000	2001	2002	2003	2004	Avg 99-04
Scots Bay	4,894	8,210	1,789	10,926	10,739	8,202	19,196	24,869	12,620
Trinity (purse seine+gillnet)	8,820	4,512	2,526	843	1,271	1,865	369	595	1,245
German Bank	13,576	20,556	24,660	25,631	24,139	22,355	21,573	14,175	22,089
Spawn Area Total	27,290	33,278	28,974	37,400	36,149	32,422	41,138	39,639	35,954
Overall SW Nova Catch	56,117	77,027	77,552	85,284	71,570	77,054	89,461	78,029	79,825

C2) Adjusted Catch by Area	1997	1998	1999	2000	2001	2002	2003	2004	Avg 99-04
Scots Bay	13,015	14,293	5,725	21,914	23,330	19,782	31,996	33,444	22,699
Trinity	9,986	5,080	2,899	907	2,408	2,530	1,755	1,113	1,935
German Bank	33,116	57,655	68,929	62,462	45,832	54,742	55,710	43,472	55,191
Adjusted Catch Total	56,117	77,027	77,552	85,284	71,570	77,054	89,461	78,029	79,825
Overall SW Nova Catch	56,117	77,027	77,552	85,284	71,570	77,054	89,461	78,029	79,825

P1) Percentage (C1/SSB)	1997	1998	1999	2000	2001	2002	2003	2004	Avg 99-04
Scots Bay	3%	11%	4%	10%	7%	6%	14%	23%	11%
Trinity	38%	67%	65%	136%	9%	23%	3%	9%	41%
German Bank	4%	5%	5%	7%	9%	6%	6%	4%	6%
Overall (C1/SSB)	5%	6%	6%	8%	8%	6%	8%	8%	7%

P2) Percentage adjusted (C2/SSB)	1997	1998	1999	2000	2001	2002	2003	2004	Avg 99-04
Scots Bay	8%	20%	14%	21%	14%	14%	24%	31%	20%
Trinity	43%	75%	75%	146%	16%	31%	12%	17%	50%
German Bank	9%	13%	15%	18%	16%	14%	16%	12%	15%
Overall Adjusted (C2/SSB)	10%	15%	15%	18%	16%	14%	18%	16%	16%

Table 11. Summary of biological samples by gear and month as collected during the 2004 4VWX herring fisheries. ‘NO_LF’ is the number of length frequency samples collected, ‘NO_MEAS’ is the number of length frequency fish measured and ‘Aged’ is the number of detail fish with age determined.

		Month											
Gearname	Data	1	2	3	5	6	7	8	9	10	11	12	Grand Total
4Vn Trap	Sum of NO_LF				1	2							3
	Sum of NO_MEAS				210	427							637
	Sum of Aged				49	84							133
4W Purse Seine	Sum of NO_LF					32							32
	Sum of NO_MEAS					4364							4364
	Sum of Aged					121							121
5Y CAN P.Seine	Sum of NO_LF				8	10	3			1			22
	Sum of NO_MEAS				950	1251	477			4			2682
	Sum of Aged				37	0	0			4			41
5Y USA P.Seine/MWT	Sum of NO_LF	2					3				10	2	17
	Sum of NO_MEAS	258					393				1172	248	2071
	Sum of Aged	0					0				0	0	0
5Z CAN MW Trawl	Sum of NO_LF								1				1
	Sum of NO_MEAS								153				153
	Sum of Aged								0				0
5Z USA P.Seine/MWT	Sum of NO_LF	23	23	6							4	6	62
	Sum of NO_MEAS	2768	2615	724							470	750	7327
	Sum of Aged	0	0	0							0	0	0
Gillnet	Sum of NO_LF								4	7			11
	Sum of NO_MEAS								211	807			1018
	Sum of Aged								199	225			424
N.B. Purse Seine	Sum of NO_LF	17	3		7	3	24	13	10	16	1		94
	Sum of NO_MEAS	2087	361		939	366	2989	1524	1222	2271	115		11874
	Sum of Aged	54	0		0	0	57	66	16	36	16		245
N.B. Shut-off	Sum of NO_LF							1	4				5
	Sum of NO_MEAS							120	489				609
	Sum of Aged							0	16				16
N.B. Weirs	Sum of NO_LF				2	17	79	231	200	33			562
	Sum of NO_MEAS				233	1856	9479	27845	24561	3824			67798
	Sum of Aged				0	70	276	700	323	110			1479
N.S. Purse Seine	Sum of NO_LF				38	69	96	159	102	46			510
	Sum of NO_MEAS				4676	8058	12527	21102	13702	6621			66686
	Sum of Aged				44	136	415	574	590	205			1964
N.S. Weirs	Sum of NO_LF					26	25	7	2				60
	Sum of NO_MEAS					3002	3186	864	301				7353
	Sum of Aged					171	122	61	51				405
Resrch. Otter Trawl	Sum of NO_LF		24				81						105
	Sum of NO_MEAS												
	Sum of Aged		148				840						988
USA Weirs	Sum of NO_LF							1					1
	Sum of NO_MEAS							123					123
	Sum of Aged							0					0
Total Sum of NO_LF		42	50	6	56	159	311	412	323	103	15	8	1485
Total Sum of NO_MEAS		5113	2976	724	7008	19324	29051	51578	40639	13527	1757	998	172695
Total Sum of Aged		54	148	0	130	582	1710	1401	1195	580	16	0	5816

Table 12. Number of herring samples collected by DFO personnel from commercial fisheries (Commercial), by members of the fishing industry (Industry), observer program (Observer), independent observers on foreign vessels (OSS) and DFO research surveys (Research).

	Sample Source					
Year	**Commercial**	**Industry**	**Observer**	**OSS**	**Research**	**Total**
1990	422			185		607
1991	448			167	1	616
1992	330			205	1	536
1993	183			421		604
1994	223			228	14	465
1995	138			244	108	490
1996	127	868	49		69	1,113
1997	78	1,443			114	1,635
1998	225	1,376			98	1,699
1999	49	1,388	89		198	1,724
2000	34	1,387	108		177	1,706
2001	47	1,455	96		190	1,788
2002	17	1,339	84		181	1,621
2003	58	1,292	56		199	1,605
2004	50	1,270	60		105	1,485
Average	**162**	**1,313**	**77**	**242**	**112**	**1,180**

Table 13. Agreement in 2004 age determinations between aged and re-aged herring.

	Read 1											
Initial	1	2	3	4	5	6	7	8	9	10	11	Total
1												0
2		14	1									15
3			59	3								62
4			6	30	3							39
5				1	44	1						46
6					3	10						13
7						4	8	1				13
8								5				5
9									2			2
10									1	2		3
11											2	2
Total	0	14	66	34	50	15	8	6	3	2	2	200

% Agreement = 88%

	Read 2											
Initial	1	2	3	4	5	6	7	8	9	10	11	Total
1	8											8
2		24										24
3			62	1								63
4			7	31	1							39
5				1	45							46
6					4	9						13
7							12	1				13
8								5				5
9									2			2
10										3		3
11											2	2
Total	8	24	69	33	50	9	12	6	2	3	2	218

% Agreement = 93%

Table 14. Herring catch at age for the 2004 purse seine, gillnet and weir fisheries conducted on the SW Nova Scotia/Bay of Fundy spawning component (4WX stock).

SW Nova Scotia Stock	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**	**Age 7**	**Age 8**	**Age 9**	**Age 10**	**Age 11+**	**Total**
Numbers (x1,000)	3,142	320,628	347,693	132,570	79,884	9,351	3,226	339	36	1	-	896,870
% numbers	0%	36%	39%	15%	9%	1%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	34	11,147	30,193	18,365	15,185	2,147	842	102	12	0	-	78,028
% catch wt.	0%	14%	39%	24%	19%	3%	1%	0%	0%	0%	0%	100%
Avg. len (cm)	12.3	17.0	23.3	26.5	28.9	30.7	31.8	33.1	34.8	34.5		22.1
Avg. wt. (g)	10.8	34.8	86.8	138.5	190.1	229.6	260.9	300.1	344.0	333.3		87.0

Catch Numbers (000's)	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**	**Age 7**	**Age 8**	**Age 9**	**Age 10**	**Age 11+**	**Total**
Fall P. Seine (2003)	0	1,098	65,082	8,344	579	270	20	11	1	0	0	75,406
Winter P. Seine (2004)	0	37,788	14,296	0	0	0	0	0	0	0	0	52,085
P. Seine (2004)	3,142	261,079	250,751	120,811	77,131	8,725	2,997	319	35	1	0	724,991
Gillnet "Stock"	0	36	367	260	425	126	145	3	0	0	0	1,362
N.S. Weirs	0	20,626	17,197	3,155	1,749	230	64	6	0	0	0	43,027
Total Numbers by Age	3,142	320,628	347,693	132,570	79,884	9,351	3,226	339	36	1	0	896,870

% Numbers	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**	**Age 7**	**Age 8**	**Age 9**	**Age 10**	**Age 11+**	**Total**
Fall P. Seine (2003)	0%	1%	86%	11%	1%	0%	0%	0%	0%	0%	0%	100%
Winter P. Seine (2004)	0%	73%	27%	0%	0%	0%	0%	0%	0%	0%	0%	100%
P. Seine (2004)	0%	36%	35%	17%	11%	1%	0%	0%	0%	0%	0%	100%
Gillnet "Stock"	0%	3%	27%	19%	31%	9%	11%	0%	0%	0%	0%	100%
N.S. Weirs	0%	48%	40%	7%	4%	1%	0%	0%	0%	0%	0%	100%
Percent Numbers by Age	0%	36%	39%	15%	9%	1%	0%	0%	0%	0%	0%	100%

Catch Weight (t)	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**	**Age 7**	**Age 8**	**Age 9**	**Age 10**	**Age 11+**	**Total**
Fall P. Seine (2003)	0	22	3,261	744	83	48	4	3	0	0	0	4,166
Winter P. Seine (2004)	0	807	686	0	0	0	0	0	0	0	0	1,493
P. Seine (2004)	34	9,579	24,671	17,144	14,681	2,015	782	96	12	0	0	69,015
Gillnet "Stock"	0	2	34	38	81	30	38	1	0	0	0	225
N.S. Weirs	0	737	1,540	439	339	54	17	2	0	0	0	3,129
Total Weight (t) by Age	34	11,147	30,193	18,365	15,185	2,147	842	102	12	0	0	78,028

% Catch Weight	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**	**Age 7**	**Age 8**	**Age 9**	**Age 10**	**Age 11+**	**Total**
Fall P. Seine (2003)	0%	1%	78%	18%	2%	1%	0%	0%	0%	0%	0%	100%
Winter P. Seine (2004)	0%	54%	46%	0%	0%	0%	0%	0%	0%	0%	0%	100%
P. Seine (2004)	0%	14%	36%	25%	21%	3%	1%	0%	0%	0%	0%	100%
Gillnet "Stock"	0%	1%	15%	17%	36%	13%	17%	0%	0%	0%	0%	100%
N.S. Weirs	0%	24%	49%	14%	11%	2%	1%	0%	0%	0%	0%	100%
Percent Weight by Age	0%	14%	39%	24%	19%	3%	1%	0%	0%	0%	0%	100%

Table 15. Herring catch at age by NAFO unit area for the 2004 summer purse seine fishery conducted on the SW Nova Scotia/Bay of Fundy spawning component (4WX stock).

Summer Purse - overall	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	3,142	261,079	250,751	120,811	77,131	8,725	2,997	319	35	1	-	724,991
% numbers	0%	36%	35%	17%	11%	1%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	34	9,579	24,671	17,144	14,681	2,015	782	96	12	0	-	69,015
% catch wt.	0%	14%	36%	25%	21%	3%	1%	0%	0%	0%	0%	100%
Avg. len (cm)	12.3	17.4	23.6	26.5	28.9	30.7	31.8	33.1	34.8	34.5		22.5
Avg. wt. (g)	10.8	36.7	98.4	141.9	190.3	230.9	261.1	301.8	345.8	333.4		95.2

5Yb Purse	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	5,580	14,043	1,909	948	82	23	0	-	-	-	22,585
% numbers	0%	25%	62%	8%	4%	0%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	-	205	1,131	260	174	19	6	0	-	-	-	1,796
% catch wt.	0%	11%	63%	14%	10%	1%	0%	0%	0%	0%	0%	100%
Avg. len (cm)	-	17.5	22.2	26.2	28.7	30.7	31.5	32.1	-	-		21.7
Avg. wt. (g)	-	36.8	80.6	136.2	184.1	233.2	257.1	272.6	-	-		79.5

4Xs Purse	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	44	44,304	20,963	2,261	251	5	-	-	-	-	-	67,829
% numbers	0%	65%	31%	3%	0%	0%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	1	1,673	1,888	292	45	1	-	-	-	-	-	3,900
% catch wt.	0%	43%	48%	7%	1%	0%	0%	0%	0%	0%	0%	100%
Avg. len (cm)	12.9	17.6	23.0	25.7	28.4	30.5	-	-	-	-		19.6
Avg. wt. (g)	12.8	37.8	90.1	129.0	179.4	218.9	-	-	-	-		57.5

4Xr Purse	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	3,098	132,328	145,818	58,078	40,853	4,310	1,516	202	-	-	-	386,203
% numbers	1%	34%	38%	15%	11%	1%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	33	5,199	14,418	8,335	7,958	1,008	409	61	-	-	-	37,421
% catch wt.	0%	14%	39%	22%	21%	3%	1%	0%	0%	0%	0%	100%
Avg. len (cm)	12.3	17.9	23.6	26.5	29.0	30.6	31.9	32.8	-	-		22.7
Avg. wt. (g)	10.8	39.3	98.9	143.5	194.8	233.9	269.5	299.4	-	-		96.9

4Xq Purse	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	78,867	69,927	58,563	35,079	4,328	1,457	117	35	1	-	248,374
% numbers	0%	32%	28%	24%	14%	2%	1%	0%	0%	0%	0%	100%
Catch wt. (t)	-	2,501	7,233	8,257	6,504	986	368	36	12	0	-	25,898
% catch wt.	0%	10%	28%	32%	25%	4%	1%	0%	0%	0%	0%	100%
Avg. len (cm)	-	16.4	24.1	26.6	28.9	30.8	31.7	33.5	34.8	34.5		23.1
Avg. wt. (g)	-	31.7	103.4	141.0	185.4	227.9	252.4	306.1	345.8	333.4		104.3

Table 16. Herring catch at age by month for the 2004 summer purse seine fishery conducted on the SW Nova Scotia/Bay of Fundy spawning component (4WX stock).

Summer Purse - overall

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	3,142	261,079	250,751	120,811	77,131	8,725	2,997	319	35	1	-	724,991
% numbers	0%	36%	35%	17%	11%	1%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	34	9,579	24,671	17,144	14,681	2,015	782	96	12	0	-	69,015
% catch wt.	0%	14%	36%	25%	21%	3%	1%	0%	0%	0%	0%	100%
Avg. len (cm)	12.3	17.4	23.6	26.5	28.9	30.7	31.8	33.1	34.8	34.5		22.5
Avg. wt. (g)	10.8	36.7	98.4	141.9	190.3	230.9	261.1	301.8	345.8	333.4		95.2

May - P. Seine	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	99,466	24,594	1,074	482	21	-	-	-	-	-	125,636
% numbers	0%	79%	20%	1%	0%	0%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	-	2,795	1,730	139	85	4	-	-	-	-	-	4,754
% catch wt.	0%	59%	36%	3%	2%	0%	0%	0%	0%	0%	0%	100%
Avg. len (cm)	-	15.8	21.3	26.0	28.8	30.5	-	-	-	-		17.0
Avg. wt. (g)	-	28.1	70.4	129.1	176.7	211.1	-	-	-	-		37.8

June - P. Seine	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	15,552	37,355	13,364	5,787	414	40	3	-	-	-	72,516
% numbers	0%	21%	52%	18%	8%	1%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	-	529	3,446	1,827	1,054	93	10	1	-	-	-	6,961
% catch wt.	0%	8%	50%	26%	15%	1%	0%	0%	0%	0%	0%	100%
Avg. len (cm)	-	17.1	23.2	26.4	28.8	30.8	32.1	33.0	-	-		22.9
Avg. wt. (g)	-	34.0	92.3	136.7	182.1	225.8	259.1	282.9	-	-		96.0

July - P. Seine	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	16,359	56,507	24,573	15,439	2,060	690	34	-	-	-	115,662
% numbers	0%	14%	49%	21%	13%	2%	1%	0%	0%	0%	0%	100%
Catch wt. (t)	-	704	5,494	3,391	2,865	470	172	10	-	-	-	13,106
% catch wt.	0%	5%	42%	26%	22%	4%	1%	0%	0%	0%	0%	100%
Avg. len (cm)	-	18.3	23.5	26.3	28.9	30.8	31.6	32.9	-	-		24.3
Avg. wt. (g)	-	43.0	97.2	138.0	185.6	228.0	249.6	287.0	-	-		113.3

Aug - P. Seine	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	12,728	72,524	38,516	30,506	3,000	1,242	195	-	-	-	158,711
% numbers	0%	8%	46%	24%	19%	2%	1%	0%	0%	0%	0%	100%
Catch wt. (t)	-	540	7,880	5,643	6,012	709	337	59	-	-	-	21,180
% catch wt.	0%	3%	37%	27%	28%	3%	2%	0%	0%	0%	0%	1.0
Avg. len (cm)	-	18.5	24.4	26.6	29.1	30.6	31.9	32.9	-	-		25.5
Avg. wt. (g)	-	42.4	108.7	146.5	197.1	236.3	271.6	301.9	-	-		133.5

Sept - P. Seine	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	74,956	35,746	28,316	18,163	2,255	621	68	27	-	-	160,154
% numbers	0%	47%	22%	18%	11%	1%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	-	3,184	3,620	4,027	3,415	515	159	21	10	-	-	14,951
% catch wt.	0%	21%	24%	27%	23%	3%	1%	0%	0%	0%	0%	100%
Avg. len (cm)	-	18.5	23.9	26.6	28.9	30.7	31.7	33.6	34.8	-		22.5
Avg. wt. (g)	-	42.5	101.3	142.2	188.0	228.5	256.7	310.9	349.4	-		93.4

Oct - P. Seine	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	3,142	42,017	24,025	14,968	6,753	975	404	19	8	1	-	92,312
% numbers	3%	46%	26%	16%	7%	1%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	34	1,826	2,500	2,117	1,250	223	103	6	3	0	-	8,063
% catch wt.	0%	23%	31%	26%	16%	3%	1%	0%	0%	0%	0%	100%
Avg. len (cm)	12.3	18.6	24.2	26.6	28.9	30.8	31.8	33.4	34.5	34.5		22.1
Avg. wt. (g)	10.8	43.5	104.1	141.5	185.2	228.9	255.0	298.7	333.4	333.4		87.3

Table 17. Herring catch at age by fishing ground for the 2004 summer purse seine fishery conducted on the SW Nova Scotia/Bay of Fundy spawning component (4WX stock).

Fishing Ground	Data Type	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Gannet,Dry Ledge	Numbers (x1,000)	-	41,505	13,044	5,157	4,787	798	211	2	-	-	-	65,504
GermanBank	Numbers (x1,000)	-	8,327	36,934	36,674	20,099	2,662	904	62	8	2	-	105,672
Grand Manan	Numbers (x1,000)	-	50,197	31,447	3,855	680	23	2	0	-	-	-	86,204
Long Island	Numbers (x1,000)	4,104	128,772	62,967	7,585	2,070	211	51	11	-	-	-	205,771
Lurcher	Numbers (x1,000)	-	18,997	28,150	14,472	7,161	782	183	7	-	-	-	69,753
NB Coastal	Numbers (x1,000)	23	4,351	1,426	189	7	-	-	-	-	-	-	5,995
ScotsBay	Numbers (x1,000)	-	440	77,199	48,446	38,103	4,510	1,582	188	-	-	-	170,470
Trinity Ledge	Numbers (x1,000)	-	8,070	160	-	-	-	-	-	-	-	-	8,230
Gannet,Dry Ledge	Catch wt. (t)	-	1,320	1,207	746	916	187	53	0	-	-	-	4,430
GermanBank	Catch wt. (t)	-	291	4,028	5,247	3,750	610	232	18	3	1	-	14,179
Grand Manan	Catch wt. (t)	-	1,918	2,787	517	127	5	1	0	-	-	-	5,355
Long Island	Catch wt. (t)	46	5,175	5,508	1,032	392	49	14	3	-	-	-	12,218
Lurcher	Catch wt. (t)	-	878	2,777	2,008	1,338	182	47	2	-	-	-	7,232
NB Coastal	Catch wt. (t)	0	179	137	23	1	-	-	-	-	-	-	341
ScotsBay	Catch wt. (t)	-	27	8,779	7,073	7,448	1,054	426	56	-	-	-	24,864
Trinity Ledge	Catch wt. (t)	-	359	11	-	-	-	-	-	-	-	-	370
Gannet,Dry Ledge	Avg. len (cm)	-	15.9	23.1	26.6	28.9	30.7	31.4	32.5	-	-		19.3
GermanBank	Avg. len (cm)	-	16.5	24.4	26.6	28.8	30.7	31.8	33.2	34.5	34.5		25.6
Grand Manan	Avg. len (cm)	-	17.3	22.7	25.9	28.5	30.5	31.7	32.5	-	-		19.8
Long Island	Avg. len (cm)	12.5	18.0	22.7	26.1	28.8	30.6	31.9	32.9	-	-		19.7
Lurcher	Avg. len (cm)	-	18.8	23.5	26.4	28.8	30.8	31.6	33.1	-	-		23.5
NB Coastal	Avg. len (cm)	12.9	18.3	23.7	25.5	28.2	-	-	-	-	-		19.8
ScotsBay	Avg. len (cm)	-	20.4	24.7	26.6	29.0	30.6	31.9	32.8	-	-		26.4
Trinity Ledge	Avg. len (cm)	-	18.8	21.1	-	-	-	-	-	-	-		18.8
Gannet,Dry Ledge	Avg. wt. (g)	-	31.8	92.5	144.7	191.4	234.0	252.7	284.4	-	-		67.6
GermanBank	Avg. wt. (g)	-	34.9	109.1	143.1	186.6	229.2	256.2	298.0	333.4	333.4		134.2
Grand Manan	Avg. wt. (g)	-	38.2	88.6	134.1	186.7	238.2	261.6	284.4	-	-		62.1
Long Island	Avg. wt. (g)	11.3	40.2	87.5	136.0	189.2	230.0	263.1	296.5	-	-		59.4
Lurcher	Avg. wt. (g)	-	46.2	98.6	138.7	186.8	232.2	256.0	303.6	-	-		103.7
NB Coastal	Avg. wt. (g)	12.8	41.1	96.4	123.0	171.4	-	-	-	-	-		56.9
ScotsBay	Avg. wt. (g)	-	61.2	113.7	146.0	195.5	233.7	269.0	297.0	-	-		145.9
Trinity Ledge	Avg. wt. (g)	-	44.5	66.0	-	-	-	-	-	-	-		45.0

Table 18. Catch at age (thousands) for the SW Nova Scotia / Bay of Fundy herring spawning component, 1965-2004.

	Age											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11+**	**Total**
1965	270,378	1,084,719	34,835	234,383	49,925	10,592	1,693	561	54	37	1	1,687,178
1966	154,323	914,093	448,940	73,382	321,857	45,916	13,970	7,722	1,690	215	1	1,982,109
1967	722,208	613,970	153,626	266,454	110,051	159,203	57,948	4,497	409	296	148	2,088,810
1968	164,703	2,389,061	224,956	83,109	290,285	73,087	90,617	31,977	15,441	5,668	1,175	3,370,079
1969	108,875	290,329	531,812	132,319	162,439	112,631	62,506	22,595	6,345	2,693	722	1,433,266
1970	699,720	576,896	76,532	286,278	201,215	120,280	111,937	41,257	21,271	7,039	2,674	2,145,099
1971	87,570	404,224	183,896	106,630	113,566	75,593	93,620	50,022	36,618	7,536	5,695	1,164,970
1972		649,254	71,984	148,516	77,207	75,384	49,065	48,700	26,055	13,792	11,679	1,171,636
1973	1,018	167,454	781,061	130,851	40,128	30,334	22,046	20,249	23,871	11,630	13,386	1,242,028
1974	18,411	766,064	93,606	803,651	68,276	19,093	10,232	6,565	12,786	7,102	9,031	1,814,817
1975	3,199	317,641	239,827	124,599	514,605	66,302	12,298	4,409	4,778	3,847	6,225	1,297,730
1976	240	55,596	206,535	153,782	68,804	268,839	21,460	5,571	3,951	2,059	3,446	790,283
1977	1,170	153,921	31,572	218,478	119,234	51,173	177,247	13,977	3,170	1,415	3,894	775,251
1978	35,381	383,611	40,887	12,906	122,108	68,410	31,088	108,975	11,082	2,425	1,676	818,549
1979	342	183,982	250,393	54,620	5,430	23,142	18,255	11,836	41,389	4,527	2,411	596,327
1980	2,339	12,503	80,518	474,091	27,930	4,373	4,692	6,560	2,985	10,641	2,739	629,371
1981		103,051	50,883	102,743	451,482	32,978	2,418	2,767	1,917	538	2,149	750,926
1982	3,589	102,133	150,764	22,640	98,206	211,043	14,627	2,080	1,354	1,250	1,014	608,700
1983	5,488	191,682	150,328	244,007	24,483	60,678	89,982	10,352	1,728	642	1,324	780,694
1984		88,433	243,542	224,354	146,096	22,716	21,654	28,299	9,515	2,183	9,000	795,792
1985	9,022	216,740	337,591	302,782	147,670	42,404	14,075	18,178	7,997	1,201	470	1,098,130
1986	63	125,300	275,903	292,792	56,937	31,599	10,770	4,320	2,942	1,356	349	802,331
1987	2,300	82,940	126,436	527,443	242,597	45,933	19,481	7,292	3,361	3,120	650	1,061,553
1988	151	148,399	113,208	195,096	434,192	236,089	42,533	21,208	4,186	3,797	2,845	1,201,704
1989	8	101,788	114,095	61,842	79,451	169,023	76,684	18,303	8,270	3,814	3,057	636,335
1990		178,532	130,176	171,560	89,922	101,066	201,901	116,788	31,466	10,572	6,848	1,038,831
1991		96,960	179,463	183,647	88,431	41,352	50,380	80,732	45,516	18,291	13,524	798,296
1992	9	168,561	132,642	286,923	126,510	75,473	34,458	35,369	59,136	34,558	20,653	974,292
1993	166	76,405	43,766	194,198	130,713	67,708	33,820	21,481	21,893	20,684	11,175	622,009
1994	151	103,885	142,260	53,700	118,015	72,512	36,059	14,889	8,706	10,447	15,533	576,157
1995	1,831	113,457	219,777	112,245	36,784	36,402	22,127	6,474	4,217	2,957	3,566	559,837
1996		37,496	37,715	256,063	54,534	16,862	9,151	3,300	1,782	1,310	1,605	419,818
1997	356	56,561	87,395	78,098	131,062	18,917	5,131	3,636	894	620	874	383,544
1998	137	264,901	62,322	138,751	97,065	97,464	20,679	3,856	1,730	1,288	398	688,591
1999	2,694	112,893	223,283	147,840	131,463	57,291	10,044	613	212	70	13	686,415
2000	841	364,078	75,330	108,560	124,083	60,754	25,829	4,454	251	33	23	764,236
2001	51	73,368	325,273	57,175	60,409	31,891	15,509	2,203	304	8	4	566,193
2002	15,500	303,723	98,597	210,620	75,258	27,973	12,846	1,577	70	23	3	746,188
2003	459	486,345	342,592	114,850	96,847	13,111	7,136	435	23			1,061,798
2004	3,142	320,628	347,693	132,570	79,884	9,351	3,226	339	36	1		896,870

Table 19. Catch at age (%) for the SW Nova Scotia / Bay of Fundy herring spawning component, 1965-2004.

	Age											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11+**	**Total**
1965	16	64	2	14	3	1	0	0	0	0	0	100
1966	8	46	23	4	16	2	1	0	0	0	0	100
1967	35	29	7	13	5	8	3	0	0	0	0	100
1968	5	71	7	2	9	2	3	1	0	0	0	100
1969	8	20	37	9	11	8	4	2	0	0	0	100
1970	33	27	4	13	9	6	5	2	1	0	0	100
1971	8	35	16	9	10	6	8	4	3	1	0	100
1972	-	55	6	13	7	6	4	4	2	1	1	100
1973	0	13	63	11	3	2	2	2	2	1	1	100
1974	1	42	5	44	4	1	1	0	1	0	0	100
1975	0	24	18	10	40	5	1	0	0	0	0	100
1976	0	7	26	19	9	34	3	1	0	0	0	100
1977	0	20	4	28	15	7	23	2	0	0	1	100
1978	4	47	5	2	15	8	4	13	1	0	0	100
1979	0	31	42	9	1	4	3	2	7	1	0	100
1980	0	2	13	75	4	1	1	1	0	2	0	100
1981	-	14	7	14	60	4	0	0	0	0	0	100
1982	1	17	25	4	16	35	2	0	0	0	0	100
1983	1	25	19	31	3	8	12	1	0	0	0	100
1984	-	11	31	28	18	3	3	4	1	0	1	100
1985	1	20	31	28	13	4	1	2	1	0	0	100
1986	0	16	34	36	7	4	1	1	0	0	0	100
1987	0	8	12	50	23	4	2	1	0	0	0	100
1988	0	12	9	16	36	20	4	2	0	0	0	100
1989	0	16	18	10	12	27	12	3	1	1	0	100
1990	-	17	13	17	9	10	19	11	3	1	1	100
1991	-	12	22	23	11	5	6	10	6	2	2	100
1992	0	17	14	29	13	8	4	4	6	4	2	100
1993	0	12	7	31	21	11	5	3	4	3	2	100
1994	0	18	25	9	20	13	6	3	2	2	3	100
1995	0	20	39	20	7	7	4	1	1	1	1	100
1996	-	9	9	61	13	4	2	1	0	0	0	100
1997	0	15	23	20	34	5	1	1	0	0	0	100
1998	0	38	9	20	14	14	3	1	0	0	0	100
1999	0	16	33	22	19	8	1	0	0	0	0	100
2000	0	48	10	14	16	8	3	1	0	0	0	100
2001	0	13	57	10	11	6	3	0	0	0	0	100
2002	2	41	13	28	10	4	2	0	0	0	0	100
2003	0	46	32	11	9	1	1	0	0	-	-	100
2004	0	36	39	15	9	1	0	0	0	0	-	100

Table 20. Average weights at age (g) for the SW Nova Scotia/Bay of Fundy component of the 4WX herring fishery (weighted by fishery) for 1965-2004 (values for 1979-83 are averages for the period 1968-78 as in Iles et al. 1984).

	Age									
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1965	10	41	112	172	218	254	286	323	354	389
1966	10	41	112	172	218	254	286	323	354	389
1967	10	41	112	172	218	254	286	323	354	389
1968	10	33	112	148	185	244	276	399	338	410
1969	10	37	105	162	207	242	282	306	334	390
1970	10	32	119	169	211	257	292	332	369	389
1971	10	66	143	199	230	254	293	329	362	388
1972	10	44	138	192	223	262	292	322	345	380
1973	10	29	106	143	225	252	279	331	360	389
1974	10	48	110	175	206	240	277	322	342	352
1975	10	21	94	179	216	240	268	333	358	379
1976	10	33	114	159	233	249	277	317	382	404
1977	10	65	113	174	214	274	293	325	328	416
1978	10	28	112	181	229	259	302	330	351	397
1979	10	41	112	172	218	254	286	323	354	389
1980	10	41	112	172	218	254	286	323	354	389
1981	10	41	112	172	218	254	286	323	354	389
1982	10	41	112	172	218	254	286	323	354	389
1983	10	41	112	172	218	254	286	323	354	389
1984	10	38	132	191	229	259	280	296	309	364
1985	10	53	118	204	249	278	315	334	344	440
1986	10	55	124	182	239	271	306	329	360	400
1987	12	50	98	153	199	245	274	290	318	350
1988	13	21	88	154	196	242	281	304	327	341
1989	7	33	79	162	207	238	274	303	324	353
1990	10	31	92	161	200	234	255	287	319	336
1991	10	48	100	147	186	217	251	270	303	322
1992	9	25	100	148	181	216	252	275	295	313
1993	18	29	108	153	188	215	251	279	302	324
1994	12	37	79	131	175	203	223	253	289	304
1995	15	42	76	136	187	223	247	293	300	326
1996	10	33	98	137	168	228	266	308	332	355
1997	19	34	80	161	190	238	284	314	358	376
1998	10	38	76	131	177	210	251	296	308	337
1999	20	42	75	120	172	220	263	304	344	378
2000	26	61	95	138	171	206	235	269	316	360
2001	22	58	108	150	190	227	268	293	327	370
2002	18	45	106	148	185	221	255	285	334	398
2003	21	42	85	149	182	225	259	294	316	
2004	11	35	87	139	190	230	261	300	344	333

Table 21. Acoustic age composition for the overall SW Nova Scotia/Bay of Fundy component from 1999 to 2004.

Year and Area	Type Data	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
1999 Acoustics Overall	% catch wt.	0%	0%	0%	13%	44%	32%	9%	0%	0%	0%	0%	100%
2000 Acoustics Overall	% catch wt.	0%	2%	4%	21%	35%	23%	12%	2%	0%	0%	0%	100%
2001 Acoustics Overall	% catch wt.	0%	1%	40%	15%	20%	14%	8%	2%	0%	0%	0%	100%
2002 Acoustics Overall	% catch wt.	0%	1%	10%	53%	20%	9%	6%	1%	0%	0%	0%	100%
2003 Acoustics Overall	% catch wt.	0%	1%	33%	28%	29%	5%	3%	0%	0%	0%	0%	100%
2004 Acoustics Overall	% catch wt.	0%	0%	26%	35%	30%	6%	3%	0%	0%	0%	0%	100%
1999 Acoustics Overall	% numbers	0%	0%	0%	18%	48%	27%	7%	0%	0%	0%	0%	100%
2000 Acoustics Overall	% numbers	0%	6%	6%	25%	34%	18%	8%	1%	0%	0%	0%	100%
2001 Acoustics Overall	% numbers	0%	3%	51%	15%	16%	9%	5%	1%	0%	0%	0%	100%
2002 Acoustics Overall	% numbers	0%	2%	13%	57%	17%	6%	4%	1%	0%	0%	0%	100%
2003 Acoustics Overall	% numbers	0%	4%	43%	26%	22%	3%	2%	0%	0%	0%	0%	100%
2004 Acoustics Overall	% numbers	0%	1%	34%	37%	23%	4%	1%	0%	0%	0%	0%	100%
1999 Acoustics Overall	Avg. len (cm)	-	23.5	24.1	25.8	27.8	30.1	31.9	33.1	34.5	35.5		28.4
2000 Acoustics Overall	Avg. len (cm)	17.5	20.8	24.8	26.7	28.5	30.4	31.9	33.2	34.2	36.0		28.0
2001 Acoustics Overall	Avg. len (cm)	-	21.1	25.1	26.9	28.7	30.4	31.9	32.7	34.1	-		26.7
2002 Acoustics Overall	Avg. len (cm)	15.7	19.8	25.2	27.1	28.8	30.6	31.8	32.7	34.0	35.5		27.4
2003 Acoustics Overall	Avg. len (cm)	-	19.4	24.6	27.3	28.7	30.6	31.8	33.2	35.5	-		26.3
2004 Acoustics Overall	Avg. len (cm)	-	20.5	24.7	26.6	29.0	30.8	31.7	33.3	35.0	-		26.7
1999 Acoustics Overall	Avg. wt. (g)	2.0	104.5	113.2	140.7	176.4	226.9	272.4	304.6	349.2	383.2		190.8
2000 Acoustics Overall	Avg. wt. (g)	2.0	62.1	111.0	141.7	176.3	215.7	252.1	289.3	325.1	387.9		171.6
2001 Acoustics Overall	Avg. wt. (g)	2.0	66.7	121.0	153.5	191.1	229.3	269.8	293.8	331.2	-		154.5
2002 Acoustics Overall	Avg. wt. (g)	2.0	52.6	117.3	150.0	183.7	225.8	261.2	289.1	308.6	399.6		158.6
2003 Acoustics Overall	Avg. wt. (g)	2.0	52.0	109.8	155.3	184.4	226.8	257.9	295.4	375.0	-		142.2
2004 Acoustics Overall	Avg. wt. (g)	2.0	60.1	111.7	143.2	190.6	231.9	257.3	302.8	355.1	-		148.1
1999 Acoustics Overall	Catch wt. (t)	-	2	1,340	65,702	222,154	164,425	47,128	1,759	2,321	360	488	505,680
2000 Acoustics Overall	Catch wt. (t)	6	9,970	18,896	97,401	164,048	107,143	53,938	10,782	656	68	401	463,309
2001 Acoustics Overall	Catch wt. (t)	-	5,816	181,463	70,313	89,288	64,184	38,563	7,473	721	-	-	457,820
2002 Acoustics Overall	Catch wt. (t)	59	4,268	53,164	290,700	108,883	49,212	31,696	5,019	247	154	-	543,401
2003 Acoustics Overall	Catch wt. (t)	-	7,078	167,908	143,848	146,842	23,783	15,357	615	0	-	-	505,432
2004 Acoustics Overall	Catch wt. (t)	-	1,542	123,285	170,922	144,816	27,229	12,172	991	807	-	-	481,764
1999 Acoustics Overall	Numbers (x1,000)	-	22	11,837	466,939	1,259,696	724,815	173,021	5,775	6,645	941	1,091	2,650,782
2000 Acoustics Overall	Numbers (x1,000)	179	160,418	170,220	687,340	930,573	496,803	213,924	37,273	2,019	175	1,000	2,699,924
2001 Acoustics Overall	Numbers (x1,000)	-	87,170	1,499,796	457,975	467,332	279,943	142,956	25,436	2,178	-	-	2,962,785
2002 Acoustics Overall	Numbers (x1,000)	2,376	81,122	453,103	1,938,353	592,580	217,955	121,346	17,362	799	385	-	3,425,381
2003 Acoustics Overall	Numbers (x1,000)	-	136,238	1,528,559	926,469	796,381	104,841	59,548	2,081	1	-	-	3,554,118
2004 Acoustics Overall	Numbers (x1,000)	-	25,675	1,103,423	1,193,644	759,611	117,403	47,312	3,275	2,271	-	-	3,252,614

Table 22. Beginning of year population abundance (numbers 000's) from ADAPT run using the acoustic index as an Absolute estimate of population numbers.

Pop #s Bias Adj(analytical)	1	2	3	4	5	6	7	8	9	10	11
1965	3,503,534	3,848,688	995,990	1,312,007	348,049	92,556	44,658	4,104	1,354	406	500
1966	2,737,874	2,624,572	2,177,169	784,001	863,223	239,988	66,231	35,035	2,855	1,060	707
1967	6,078,739	2,102,325	1,329,624	1,378,701	575,717	418,512	155,171	41,661	21,740	836	1,253
1968	1,286,168	4,325,977	1,170,158	950,142	889,042	372,334	200,109	75,150	30,056	17,430	1,311
1969	1,754,254	904,620	1,415,817	755,635	702,962	467,578	239,085	82,892	32,938	10,845	9,244
1970	2,304,087	1,338,027	480,252	682,955	499,558	429,512	281,595	139,599	47,575	21,258	13,377
1971	7,460,417	1,258,574	579,796	324,285	303,152	228,973	243,661	130,382	77,266	19,947	19,640
1972	1,138,007	6,028,985	667,899	309,749	169,889	146,502	119,687	115,682	61,966	30,575	20,551
1973	2,336,523	931,722	4,350,854	481,941	121,063	70,132	52,761	54,102	51,165	27,434	19,153
1974	1,625,829	1,912,063	612,115	2,859,195	277,069	63,139	30,305	23,481	26,162	20,577	15,921
1975	247,148	1,314,489	880,008	416,859	1,619,372	165,491	34,561	15,639	13,330	10,013	15,485
1976	721,820	199,458	790,742	505,119	229,479	864,256	76,167	17,278	8,846	6,633	11,863
1977	4,140,081	590,760	113,384	461,878	275,572	126,138	466,414	43,093	9,149	3,712	10,203
1978	1,346,539	3,388,555	345,406	64,483	183,136	119,041	57,492	223,170	22,748	4,650	6,640
1979	449,147	1,070,508	2,428,553	245,946	41,184	41,880	36,645	19,392	85,497	8,737	5,577
1980	1,572,597	367,422	710,839	1,762,596	152,252	28,826	13,695	13,722	5,372	33,069	5,530
1981	1,669,558	1,285,420	289,532	509,412	1,017,308	99,518	19,663	7,007	5,380	1,742	19,616
1982	2,302,838	1,366,918	959,467	191,249	324,646	429,491	51,910	13,919	3,261	2,687	15,067
1983	4,078,526	1,882,162	1,027,010	649,785	136,177	177,675	163,382	29,368	9,523	1,459	12,505
1984	5,027,282	3,334,258	1,368,174	705,445	313,499	89,457	91,079	53,687	14,768	6,242	9,665
1985	1,831,381	4,115,990	2,650,014	900,962	376,337	126,231	52,832	55,107	18,746	3,661	3,339
1986	1,059,694	1,491,259	3,174,295	1,865,457	466,203	175,953	65,334	30,614	28,818	8,199	4,231
1987	1,397,308	867,547	1,107,935	2,350,078	1,263,651	330,385	115,618	43,794	21,173	20,942	8,641
1988	1,401,917	1,141,942	635,504	793,142	1,449,860	816,306	229,118	77,122	29,291	14,308	20,824
1989	1,744,614	1,147,656	801,233	418,412	474,051	797,404	456,413	149,310	44,098	20,211	22,791
1990	1,185,719	1,428,362	847,830	553,220	286,868	316,593	500,847	304,643	105,751	28,662	29,020
1991	579,910	970,785	1,008,567	576,914	299,026	154,203	168,557	229,416	144,866	58,343	31,602
1992	824,079	474,790	707,394	664,216	307,618	165,457	89,111	92,791	115,487	77,777	45,143
1993	1,669,815	674,690	237,693	459,804	287,340	138,696	68,056	42,113	44,305	41,843	51,315
1994	877,071	1,366,979	483,524	155,220	202,812	118,503	53,150	25,557	15,331	16,747	47,773
1995	1,031,505	717,948	1,025,481	268,195	78,955	61,164	32,668	11,627	7,693	4,810	29,629
1996	914,103	842,871	485,642	641,945	119,202	31,801	17,745	7,177	3,759	2,545	22,358
1997	1,195,477	748,404	656,241	363,592	296,448	48,890	11,017	6,373	2,929	1,487	17,773
1998	656,685	978,452	561,722	458,546	227,450	125,597	23,094	4,439	1,984	1,596	14,426
1999	1,784,769	537,525	563,190	403,723	250,922	99,441	17,224	1,005	282	121	11,630
2000	1,347,293	1,458,812	338,552	261,287	198,118	88,315	30,486	5,176	279	44	9,547
2001	2,424,405	1,102,311	867,234	209,451	116,832	52,161	18,609	2,436	360	11	7,803
2002	5,922,805	1,984,889	836,304	418,756	120,140	41,820	14,402	1,689	91	30	6,387
2003	7,715,938	4,835,182	1,351,567	595,848	155,052	31,619	9,488	663	30	13	5,231
2004	1,000,000	6,316,861	3,520,239	798,765	384,501	41,049	14,161	1,488	158	4	4,293
2005	1,000,000	815,893	4,882,452	2,568,647	534,620	242,951	25,201	8,694	914	97	3,518

Table 23. Fishing mortality rate from ADAPT run using the acoustic index as an Absolute estimate of population numbers.

F Bias Adj(analytical)	1	2	3	4	5	6	7	8	9	10	11	F5-8(wtd)	F6-8(wtd)
1965	0.09	0.37	0.04	0.22	0.17	0.13	0.04	0.16	0.04	0.11	0.00	0.15	0.11
1966	0.06	0.48	0.26	0.11	0.52	0.24	0.26	0.28	1.03	0.25	0.00	0.45	0.25
1967	0.14	0.39	0.14	0.24	0.24	0.54	0.53	0.13	0.02	0.49	0.14	0.38	0.51
1968	0.15	0.92	0.24	0.10	0.44	0.24	0.68	0.62	0.82	0.44	2.94	0.43	0.42
1969	0.07	0.43	0.53	0.21	0.29	0.31	0.34	0.36	0.24	0.32	0.09	0.31	0.32
1970	0.40	0.64	0.19	0.61	0.58	0.37	0.57	0.39	0.67	0.45	0.25	0.49	0.44
1971	0.01	0.43	0.43	0.45	0.53	0.45	0.54	0.54	0.73	0.53	0.38	0.51	0.51
1972	0.00	0.13	0.13	0.74	0.68	0.82	0.59	0.62	0.61	0.68	0.96	0.69	0.69
1973	0.00	0.22	0.22	0.35	0.45	0.64	0.61	0.53	0.71	0.62	1.40	0.54	0.60
1974	0.01	0.58	0.18	0.37	0.32	0.40	0.46	0.37	0.76	0.47	0.96	0.34	0.41
1975	0.01	0.31	0.36	0.40	0.43	0.58	0.49	0.37	0.50	0.54	0.58	0.44	0.55
1976	0.00	0.36	0.34	0.41	0.40	0.42	0.37	0.44	0.67	0.42	0.38	0.41	0.41
1977	0.00	0.34	0.36	0.73	0.64	0.59	0.54	0.44	0.48	0.54	0.54	0.57	0.54
1978	0.03	0.13	0.14	0.25	1.28	0.98	0.89	0.76	0.76	0.84	0.32	0.98	0.84
1979	0.00	0.21	0.12	0.28	0.16	0.92	0.78	1.08	0.75	0.83	0.64	0.68	0.90
1980	0.00	0.04	0.13	0.35	0.23	0.18	0.47	0.74	0.93	0.43	0.78	0.27	0.39
1981	0.00	0.09	0.21	0.25	0.66	0.45	0.15	0.57	0.49	0.41	0.13	0.63	0.41
1982	0.00	0.09	0.19	0.14	0.40	0.77	0.37	0.18	0.60	0.71	0.08	0.59	0.71
1983	0.00	0.12	0.18	0.53	0.22	0.47	0.91	0.49	0.22	0.65	0.12	0.55	0.67
1984	0.00	0.03	0.22	0.43	0.71	0.33	0.30	0.85	1.19	0.48	3.75	0.59	0.44
1985	0.01	0.06	0.15	0.46	0.56	0.46	0.35	0.45	0.63	0.45	0.17	0.51	0.43
1986	0.00	0.10	0.10	0.19	0.14	0.22	0.20	0.17	0.12	0.20	0.10	0.17	0.21
1987	0.00	0.11	0.13	0.28	0.24	0.17	0.20	0.20	0.19	0.18	0.09	0.22	0.18
1988	0.00	0.15	0.22	0.31	0.40	0.38	0.23	0.36	0.17	0.34	0.16	0.38	0.35
1989	0.00	0.10	0.17	0.18	0.20	0.27	0.20	0.14	0.23	0.23	0.16	0.23	0.23
1990	0.00	0.15	0.18	0.42	0.42	0.43	0.58	0.54	0.39	0.52	0.30	0.51	0.53
1991	0.00	0.12	0.22	0.43	0.39	0.35	0.40	0.49	0.42	0.42	0.63	0.41	0.42
1992	0.00	0.49	0.23	0.64	0.60	0.69	0.55	0.54	0.82	0.66	0.69	0.61	0.61
1993	0.00	0.13	0.23	0.62	0.69	0.76	0.78	0.81	0.77	0.77	0.27	0.73	0.77
1994	0.00	0.09	0.39	0.48	1.00	1.09	1.32	1.00	0.96	1.13	0.44	1.07	1.14
1995	0.00	0.19	0.27	0.61	0.71	1.04	1.32	0.93	0.91	1.10	0.14	0.94	1.11
1996	0.00	0.05	0.09	0.57	0.69	0.86	0.82	0.70	0.73	0.82	0.08	0.74	0.83
1997	0.00	0.09	0.16	0.27	0.66	0.55	0.71	0.97	0.41	0.61	0.06	0.65	0.62
1998	0.00	0.35	0.13	0.40	0.63	1.79	2.93	2.56	2.60	1.99	0.03	1.17	1.98
1999	0.00	0.26	0.57	0.51	0.84	0.98	1.00	1.08	1.66	0.99	0.00	0.89	0.99
2000	0.00	0.32	0.28	0.60	1.13	1.36	2.33	2.46	3.01	1.64	0.00	1.33	1.64
2001	0.00	0.08	0.53	0.36	0.83	1.09	2.20	3.09	2.29	1.44	0.00	1.06	1.44
2002	0.00	0.18	0.14	0.79	1.13	1.28	2.88	3.83	1.75	1.75	0.00	1.34	1.75
2003	0.00	0.12	0.33	0.24	1.13	0.60	1.65	1.23	1.72	0.00	0.00	1.07	0.85
2004	0.00	0.06	0.12	0.20	0.26	0.29	0.29	0.29	0.29	0.29	0.00	0.26	0.29

Table 24. Beginning of year population abundance (numbers 000's) from ADAPT run using acoustic index as Proportional to population numbers.

Pop #s Bias Adj(analytical)	1	2	3	4	5	6	7	8	9	10	11
1965	3,503,534	3,848,688	995,990	1,312,007	348,049	92,556	44,658	4,104	1,354	406	500
1966	2,737,874	2,624,572	2,177,169	784,001	863,223	239,988	66,231	35,035	2,855	1,060	707
1967	6,078,739	2,102,325	1,329,624	1,378,701	575,717	418,512	155,171	41,661	21,740	836	1,253
1968	1,286,168	4,325,977	1,170,158	950,142	889,042	372,334	200,109	75,150	30,056	17,430	1,311
1969	1,754,254	904,620	1,415,817	755,635	702,962	467,578	239,085	82,892	32,938	10,845	9,244
1970	2,304,087	1,338,027	480,252	682,955	499,558	429,512	281,595	139,599	47,575	21,258	13,377
1971	7,460,417	1,258,574	579,796	324,285	303,152	228,973	243,661	130,382	77,266	19,947	19,640
1972	1,138,007	6,028,985	667,899	309,749	169,889	146,502	119,687	115,682	61,966	30,575	20,551
1973	2,336,523	931,722	4,350,854	481,941	121,063	70,132	52,761	54,102	51,165	27,434	19,153
1974	1,625,829	1,912,063	612,115	2,859,195	277,069	63,139	30,305	23,481	26,162	20,577	15,921
1975	247,148	1,314,489	880,008	416,859	1,619,372	165,491	34,561	15,639	13,330	10,013	15,485
1976	721,820	199,458	790,742	505,119	229,479	864,256	76,167	17,278	8,846	6,633	11,863
1977	4,140,081	590,760	113,384	461,878	275,572	126,138	466,414	43,093	9,149	3,712	10,203
1978	1,346,539	3,388,555	345,406	64,483	183,136	119,041	57,492	223,170	22,748	4,650	6,640
1979	449,147	1,070,508	2,428,553	245,946	41,184	41,880	36,645	19,392	85,497	8,737	5,577
1980	1,572,597	367,422	710,839	1,762,596	152,252	28,826	13,695	13,722	5,372	33,069	5,530
1981	1,669,558	1,285,420	289,532	509,412	1,017,308	99,518	19,663	7,007	5,380	1,742	19,616
1982	2,302,838	1,366,918	959,467	191,249	324,646	429,491	51,910	13,919	3,261	2,687	15,067
1983	4,078,526	1,882,162	1,027,010	649,785	136,177	177,675	163,382	29,368	9,523	1,459	12,505
1984	5,027,282	3,334,258	1,368,174	705,445	313,499	89,457	91,079	53,687	14,768	6,242	9,665
1985	1,831,381	4,115,990	2,650,014	900,962	376,337	126,231	52,832	55,107	18,746	3,661	3,339
1986	1,059,694	1,491,259	3,174,295	1,865,457	466,203	175,953	65,334	30,614	28,818	8,199	4,231
1987	1,397,308	867,547	1,107,935	2,350,078	1,263,651	330,385	115,618	43,794	21,173	20,942	8,641
1988	1,401,917	1,141,942	635,504	793,142	1,449,860	816,306	229,118	77,122	29,291	14,308	20,824
1989	1,744,614	1,147,656	801,233	418,412	474,051	797,404	456,413	149,310	44,098	20,211	22,791
1990	1,185,719	1,428,362	847,830	553,220	286,868	316,593	500,847	304,643	105,751	28,662	29,020
1991	579,910	970,785	1,008,567	576,914	299,026	154,203	168,557	229,416	144,866	58,343	31,602
1992	824,078	474,790	707,394	664,216	307,618	165,457	89,111	92,791	115,487	77,777	45,143
1993	1,669,808	674,690	237,693	459,804	287,340	138,696	68,056	42,113	44,305	41,843	51,315
1994	877,054	1,366,973	483,523	155,220	202,812	118,503	53,150	25,557	15,331	16,747	47,773
1995	1,031,476	717,935	1,025,477	268,195	78,955	61,164	32,668	11,627	7,693	4,810	29,629
1996	913,469	842,847	485,631	641,941	119,202	31,801	17,745	7,177	3,759	2,545	22,358
1997	1,191,214	747,885	656,222	363,582	296,445	48,890	11,017	6,373	2,929	1,487	17,773
1998	626,148	974,962	561,297	458,530	227,442	125,595	23,094	4,439	1,984	1,596	14,426
1999	1,711,516	512,523	560,339	403,376	250,909	99,435	17,222	1,005	282	121	11,630
2000	804,529	1,398,837	318,107	258,964	197,835	88,305	30,481	5,174	279	44	9,547
2001	1,467,543	657,933	818,218	192,735	114,942	51,934	18,601	2,433	359	11	7,803
2002	2,316,235	1,201,477	472,538	378,825	106,486	40,291	14,220	1,683	88	29	6,387
2003	2,258,738	1,882,373	710,799	298,200	122,758	20,744	8,273	538	26	11	5,230
2004	1,000,000	1,848,883	1,104,250	276,248	141,331	15,536	5,360	563	60	2	4,291
2005	1,000,000	815,893	1,225,121	592,196	107,867	44,664	4,417	1,524	160	17	3,514

Table 25. Fishing mortality rate from ADAPT run using acoustic index as Proportional to population numbers.

F Bias Adj(analytical)	1	2	3	4	5	6	7	8	9	10	11	F5-8(wtd)	F6-8(wtd)
1965	0.09	0.37	0.04	0.22	0.17	0.13	0.04	0.16	0.04	0.11	0.00	0.15	0.11
1966	0.06	0.48	0.26	0.11	0.52	0.24	0.26	0.28	1.03	0.25	0.00	0.45	0.25
1967	0.14	0.39	0.14	0.24	0.24	0.54	0.53	0.13	0.02	0.49	0.14	0.38	0.51
1968	0.15	0.92	0.24	0.10	0.44	0.24	0.68	0.62	0.82	0.44	2.94	0.43	0.42
1969	0.07	0.43	0.53	0.21	0.29	0.31	0.34	0.36	0.24	0.32	0.09	0.31	0.32
1970	0.40	0.64	0.19	0.61	0.58	0.37	0.57	0.39	0.67	0.45	0.25	0.49	0.44
1971	0.01	0.43	0.43	0.45	0.53	0.45	0.54	0.54	0.73	0.53	0.38	0.51	0.51
1972	0.00	0.13	0.13	0.74	0.68	0.82	0.59	0.62	0.61	0.68	0.96	0.69	0.69
1973	0.00	0.22	0.22	0.35	0.45	0.64	0.61	0.53	0.71	0.62	1.40	0.54	0.60
1974	0.01	0.58	0.18	0.37	0.32	0.40	0.46	0.37	0.76	0.47	0.96	0.34	0.41
1975	0.01	0.31	0.36	0.40	0.43	0.58	0.49	0.37	0.50	0.54	0.58	0.44	0.55
1976	0.00	0.36	0.34	0.41	0.40	0.42	0.37	0.44	0.67	0.42	0.38	0.41	0.41
1977	0.00	0.34	0.36	0.73	0.64	0.59	0.54	0.44	0.48	0.54	0.54	0.57	0.54
1978	0.03	0.13	0.14	0.25	1.28	0.98	0.89	0.76	0.76	0.84	0.32	0.98	0.84
1979	0.00	0.21	0.12	0.28	0.16	0.92	0.78	1.08	0.75	0.83	0.64	0.68	0.90
1980	0.00	0.04	0.13	0.35	0.23	0.18	0.47	0.74	0.93	0.43	0.78	0.27	0.39
1981	0.00	0.09	0.21	0.25	0.66	0.45	0.15	0.57	0.49	0.41	0.13	0.63	0.41
1982	0.00	0.09	0.19	0.14	0.40	0.77	0.37	0.18	0.60	0.71	0.08	0.59	0.71
1983	0.00	0.12	0.18	0.53	0.22	0.47	0.91	0.49	0.22	0.65	0.12	0.55	0.67
1984	0.00	0.03	0.22	0.43	0.71	0.33	0.30	0.85	1.19	0.48	3.75	0.59	0.44
1985	0.01	0.06	0.15	0.46	0.56	0.46	0.35	0.45	0.63	0.45	0.17	0.51	0.43
1986	0.00	0.10	0.10	0.19	0.14	0.22	0.20	0.17	0.12	0.20	0.10	0.17	0.21
1987	0.00	0.11	0.13	0.28	0.24	0.17	0.20	0.20	0.19	0.18	0.09	0.22	0.18
1988	0.00	0.15	0.22	0.31	0.40	0.38	0.23	0.36	0.17	0.34	0.16	0.38	0.35
1989	0.00	0.10	0.17	0.18	0.20	0.27	0.20	0.14	0.23	0.23	0.16	0.23	0.23
1990	0.00	0.15	0.18	0.42	0.42	0.43	0.58	0.54	0.39	0.52	0.30	0.51	0.53
1991	0.00	0.12	0.22	0.43	0.39	0.35	0.40	0.49	0.42	0.42	0.63	0.41	0.42
1992	0.00	0.49	0.23	0.64	0.60	0.69	0.55	0.54	0.82	0.66	0.69	0.61	0.61
1993	0.00	0.13	0.23	0.62	0.69	0.76	0.78	0.81	0.77	0.77	0.27	0.73	0.77
1994	0.00	0.09	0.39	0.48	1.00	1.09	1.32	1.00	0.96	1.13	0.44	1.07	1.14
1995	0.00	0.19	0.27	0.61	0.71	1.04	1.32	0.93	0.91	1.10	0.14	0.94	1.11
1996	0.00	0.05	0.09	0.57	0.69	0.86	0.82	0.70	0.73	0.82	0.08	0.74	0.83
1997	0.00	0.09	0.16	0.27	0.66	0.55	0.71	0.97	0.41	0.61	0.06	0.65	0.62
1998	0.00	0.35	0.13	0.40	0.63	1.79	2.93	2.56	2.60	1.99	0.03	1.17	1.98
1999	0.00	0.28	0.57	0.51	0.84	0.98	1.00	1.08	1.66	0.99	0.00	0.89	0.99
2000	0.00	0.34	0.30	0.61	1.14	1.36	2.33	2.47	3.01	1.65	0.00	1.33	1.64
2001	0.00	0.13	0.57	0.39	0.85	1.10	2.20	3.12	2.32	1.45	0.00	1.08	1.44
2002	0.01	0.32	0.26	0.93	1.44	1.38	3.07	3.95	1.89	1.89	0.00	1.59	1.89
2003	0.00	0.33	0.75	0.55	1.87	1.15	2.49	2.00	2.57	0.00	0.00	1.80	1.54
2004	0.00	0.21	0.42	0.74	0.95	1.06	1.06	1.06	1.06	1.06	0.00	0.97	1.06

Table 26. Parameter estimate and Q's from ADAPT formulation with acoustic index as Proportional to population numbers.

	Parameter	Estimate	Standard Error	Bias	%SE	% Bias
1	N[2005 7]	4874.94	2284.64	457.94	47%	9%
2	q age 2	0.08	0.03	0.01	41%	8%
3	q age 3	0.64	0.24	0.04	37%	6%
4	q age 4	3.23	1.18	0.20	37%	6%
5	q age 5	8.28	3.03	0.53	37%	6%
6	q age 6	10.00	3.65	0.64	36%	6%
7	q age 7	23.45	8.55	1.51	36%	6%
8	q age 8	24.93	9.08	1.60	36%	6%
9	q age 9	47.60	18.84	3.74	40%	8%

Table 27. Deterministic projection inputs for SW Nova Scotia/Bay of Fundy spawning component.

M	1	2	3	4	5	6	7	8	9	10	11
2005	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
PR	1	2	3	4	5	6	7	8	9	10	11
2005	0	0.2	0.4	0.7	0.9	1	1	1	1	1	1
Beg wt	1	2	3	4	5	6	7	8	9	10	11
2005	0.010	0.032	0.078	0.126	0.167	0.205	0.240	0.276	0.313	0.361	0.361
2006	0.010	0.032	0.078	0.126	0.167	0.205	0.240	0.276	0.313	0.361	0.361
Avg wt	1	2	3	4	5	6	7	8	9	10	11
2005	0.020	0.048	0.096	0.145	0.184	0.222	0.255	0.288	0.327	0.367	0.367
Maturity	1	2	3	4	5	6	7	8	9	10	11
2005	0	0	0.5	0.9	1	1	1	1	1	1	1
2006	0	0	0.5	0.9	1	1	1	1	1	1	1

Table 28. An evaluation of 2003-2004 fishery observations for the SW Nova Scotia/Bay of Fundy spawning component progress against biological objectives in the management plan for the fishery.

	Objective	**2003: Met**	**2003: Not Met**	**2004: Observations**
1	**Maintain reproductive capacity**			
1a	Persistence of all spawning components	German Bank and Scots Bay OK; Trinity recovering	Limited signs of Seal Island component Increased fishing on juveniles of mixed origin inconsistent with this objective	Trinity reduced from 2003; no reports from Seal or Lurcher areas
1b	Maintain biomass of each component	German Bank and Scots Bay	Trinity Ledge and Seal Island	No change
1c	Maintain broad age composition		Not met in all areas Few fish older than age 7; only 20% 4+. Rapid decline of year-classes (including strong 1998 year-class)	Further decline in proportion of older ages
1d	Maintain long spawning period	German Bank and Scots Bay	Trinity and Seal Island	Longer period for Scots
2	**Prevent growth over-fishing**			
2a	Fishing mortality at or below F0.1	Landings in recent years less than 20% of surveyed SSB	High total mortality and targeting of 2 year olds	High exploitation rate for Scots Bay. May be higher than F0.1 if survey SSB is overestimated.
3	**Maintain ecosystem integrity / ecological relationships**			
3a	Maintain spatial and temporal diversity of spawning	German Bank and Scots Bay	Insufficient spawning at Seal Island and Trinity Ledge	No change.
3b	Maintain biomass at moderate to high levels	Acoustic surveys indicate moderate SSB		Apparently no change but discrepancy with VPA results

Table 29. 2004 4WX offshore herring fisheries catch at age in number (thousands) and weight (t).

4WX Offshore Purse Seine

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	-	6,410	8,731	9,313	955	377	65	18	-	-	25,869
% numbers	0%	0%	25%	34%	36%	4%	1%	0%	0%	0%	0%	100%
Catch wt. (t)	-	-	741	1,244	1,726	220	98	18	6	-	-	4,054
% catch wt.	0%	0%	18%	31%	43%	5%	2%	0%	0%	0%	0%	100%
Avg. len (cm)	-	-	25.0	26.7	28.9	31.0	32.2	33.1	34.5	-		27.3
Avg. wt. (g)	-	-	115.7	142.5	185.3	230.1	261.1	285.8	326.9	-		156.7

4WX Misc. gears

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	6	940	432	137	87	13	7	1	0	0	0	1,623
% numbers	0%	58%	27%	8%	5%	1%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	0	32	38	19	16	3	2	0	0	0	0	111
% catch wt.	0%	29%	34%	17%	15%	3%	2%	0%	0%	0%	0%	100%
Avg. len (cm)	12.2	16.9	22.8	26.4	29.0	30.8	32.1	33.3	34.6	35.5		20.1
Avg. wt. (g)	10.7	34.0	88.4	139.6	188.0	230.2	264.3	297.8	333.8	357.5		68.4

Table 30. Herring abundance indices from the July bottom trawl survey (stratified numbers per tow): 1970-2004.

	July ground trawl survey by-catch for herring (stratified mean numbers)														
	4WX area combined strata 453/495				4W Only strata 453/466		4X Only strata 470/495		4X BOF strata 480/495		4V only strata 442/452		Offshore Banks strata 455/478	
Year	Cruise	Mean#	SE	N	Mean#	SE	Mean#	SE	Mean#	SE	Mean#	SE	Mean#	SE
1970	A175/176	4.1	1.5	95	4.9	2.4	1.6	0.6	1.0	0.6	12.8	9.8	5.7	2.4
1971	A188/189	4.0	1.9	86	2.6	1.2	3.6	2.6	1.4	1.0	4.4	4.4	5.3	2.8
1972	A200/201	1.4	0.6	105	1.7	1.0	0.5	0.1	0.3	0.1	4.5	3.7	2.0	1.0
1973	A212/213	0.9	0.3	96	0.4	0.3	1.0	0.4	1.0	0.4	19.2	19.2	0.9	0.4
1974	A225/226	0.7	0.3	102	0.2	0.0	1.0	0.4	1.4	0.6	0.0	0.0	0.5	0.2
1975	A236/237	0.9	0.4	104	0.8	0.4	0.7	0.4	1.3	0.7	2.2	2.2	0.7	0.4
1976	A250/251	0.4	0.2	103	0.1	0.1	0.5	0.3	0.9	0.6	0.0	0.0	0.1	0.1
1977	A265/266	0.5	0.3	106	0.0	0.0	0.8	0.5	1.5	0.9	1.6	1.4	0.1	0.1
1978	A279/280	0.3	0.3	103	0.5	0.5	0.1	0.0	0.1	0.0	0.0	0.0	0.5	0.5
1979	A292/293	0.6	0.5	106	0.0	0.0	1.0	0.7	1.5	1.3	0.0	0.0	0.2	0.2
1980	A306/307	0.5	0.5	105	0.0	0.0	0.8	0.8	1.6	1.6	0.0	0.0	0.0	0.0
1981	A321/322	1.5	1.4	104	0.0	0.0	2.3	2.1	4.6	4.1	0.0	0.0	0.0	0.0
1982	H080/081	1.5	0.9	108	0.5	0.3	1.9	1.4	0.8	0.3	0.0	0.0	2.5	1.7
1983	N012/013	2.4	0.8	106	2.6	1.2	2.2	1.0	3.1	1.6	0.1	0.0	2.1	1.0
1984	N031/032	7.0	3.5	102	3.3	1.2	10.5	6.8	4.6	2.5	4.0	2.9	8.5	5.4
1985	N048/049	3.4	1.8	111	6.6	3.8	0.3	0.1	0.4	0.2	0.0	0.0	5.0	2.9
1986	N065/066	23.2	14.9	118	30.8	26.7	16.0	14.3	24.9	22.3	0.5	0.4	23.4	20.3
1987	N85/86/87	10.4	5.6	135	17.0	11.3	4.0	1.8	6.3	2.8	117.4	90.5	12.9	8.6
1988	N105/106	2.1	0.6	127	2.7	1.2	1.5	0.5	2.3	0.8	0.3	0.2	2.0	0.9
1989	N123/124	8.4	1.8	124	11.8	3.4	4.5	1.2	4.9	1.4	3.6	3.1	9.8	2.7
1990	N139/140	5.6	1.9	156	7.4	3.6	3.4	1.0	3.4	0.8	0.3	0.2	6.5	2.9
1991	N154/H231	10.6	5.8	137	13.0	8.8	5.0	1.8	4.9	2.3	10.2	9.9	14.3	9.0
1992	N173/174	16.5	4.9	136	16.2	6.6	40.8	15.7	41.8	22.2	0.2	0.1	23.6	7.4
1993	N189/190	18.7	4.5	137	6.3	2.5	30.4	8.5	27.6	10.3	1.0	0.6	15.0	4.7
1994	N221/222	76.4	30.2	140	108.4	58.9	45.9	18.4	51.1	26.0	25.7	22.0	91.1	45.1
1995	N226/227	63.5	24.2	140	100.5	47.9	28.4	12.8	11.4	5.4	7.9	6.1	92.7	37.6
1996	N246/247	40.2	14.2	135	53.2	24.5	27.1	14.1	32.1	20.8	0.2	0.1	46.5	19.5
1997	N726/734	31.8	15.3	137	34.6	10.1	51.3	39.3	72.8	60.9	0.2	0.1	29.3	7.7
1998	N827/832	99.52	20.65	131	147.6	39.92	54.76	14.5	45.6	19.4	0.8	0.3	130.3	30.3
1999	N925/929	229.8	83.8	133	264.2	101.0	199.4	130.2	251.4	203.6	24.9	15.2	226.2	74.4
2000	N426/431	90.6	20.0	146	146.3	40.6	38.7	7.4	29.5	9.1	2.0	0.6	124.7	30.5
2001	N2001-032/037	145.9	47.7	139	152.7	81.3	139.5	52.5	181.3	80.9	53.9	49.2	132.4	60.9
2002	N2002-037/040	161.9	48.6	147	172.7	81.3	151.9	55.6	170.9	85.3	4.9	2.6	162.6	61.1
2003	N2003-036/042	130.6	70.5	153	207.8	145.4	58.7	14.5	50.3	14.0	4.9	2.0	175.8	108.6
2004	TEL2004-529/530	295.9	100.2	205	307.6	134.5	285.0	147.4	198.0	170.9	1.4	0.4	355.6	127.6

Table 31. Stratified mean numbers per tow by age of herring for NAFO unit areas 4WX (strata 53/95) from the DFO July bottom trawl research survey, 1970-2004.

Year	1	2	3	4	5	6	7	8	9	10	11+	Unkown	TOTAL
1970			0.1	1.6	1.2	0.8	0.2	0.1	0.0				4.0
1971			0.4	0.8	1.3	0.7	0.5	0.0	0.0	0.0	0.0	0.1	3.9
1972		0.1	0.0	0.2	0.3	0.4	0.2	0.1	0.0	0.0	0.0	0.1	1.4
1973			0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.1	0.9
1974		0.0	0.1	0.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.8
1975		0.0	0.1	0.2	0.3	0.1	0.0	0.0	0.0	0.0	0.1		0.9
1976		0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0		0.4
1977		0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0			0.3	0.5
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0		0.4
1979		0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.6
1980	0.0	0.0	0.0	0.0	0.0	0.0						0.5	0.5
1981	0.1	0.1	0.4	0.7	0.2	0.0	0.0	0.0	0.0	0.0		0.0	1.5
1982		0.1	0.3	0.3	0.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.9
1983	0.0	0.6	0.2	0.6	0.1	0.3	0.3	0.1	0.0	0.0	0.0	0.0	2.4
1984	0.0	0.1	0.4	0.8	1.2	0.3	0.3	0.3	0.0	0.1	3.5	0.0	7.0
1985		0.1	0.2	1.1	1.0	0.6	0.2	0.2	0.1	0.0	0.0	0.0	3.4
1986		0.2	7.2	7.2	4.7	2.4	1.1	0.2	0.1	0.1	0.1	0.0	23.4
1987	0.0	1.0	3.7	2.7	1.1	0.8	0.4	0.3	0.2	0.1	0.1		10.4
1988		0.3	0.1	0.4	0.7	0.4	0.1	0.0	0.0	0.0	0.0	0.0	2.1
1989	0.2	0.2	0.4	0.8	1.0	2.9	1.7	0.3	0.1	0.1	0.1	0.1	8.0
1990	0.1	0.2	0.6	0.8	0.7	0.7	1.3	0.7	0.1	0.0	0.1	0.0	5.3
1991		0.1	0.5	1.6	1.9	1.1	1.6	2.7	0.9	0.2	0.1	0.0	10.9
1992		11.6	1.3	1.8	2.8	4.1	2.1	1.9	2.6	0.6	0.3	0.1	29.1
1993		0.1	0.8	3.1	4.2	4.1	3.1	1.3	0.9	0.8	0.4		18.8
1994		0.1	5.1	9.5	23.2	18.4	7.0	0.5	1.4	3.4	1.2	6.1	75.9
1995	0.0	0.5	10.7	13.1	9.4	13.8	9.2	3.3	1.6	1.0	1.3	0.1	63.9
1996	0.0	0.3	1.8	19.1	7.9	5.3	3.2	1.1	0.3	0.2	0.2	0.0	39.4
1997	1.2	20.0	1.8	5.7	9.1	2.0	1.2	0.6	0.2	0.1	0.3	0.9	43.2
1998	0.1	1.5	2.4	22.0	37.8	28.4	5.2	1.4	0.4	0.2	0.2	0.0	99.5
1999	0.2	7.3	59.5	32.6	92.9	29.8	2.3	0.1	0.0	0.0		0.1	224.7
2000	0.1	1.2	9.1	31.7	30.8	13.2	4.0	0.4	0.0	0.0		0.0	90.6
2001		5.3	95.0	14.1	22.7	7.2	1.3	0.1	0.0			0.0	145.8
2002	1.8	34.9	41.8	56.9	18.4	5.1	2.4	0.4	0.0	0.0		0.2	161.9
2003	0.2	4.5	23.5	56.8	37.5	5.5	1.9	0.0				0.7	130.6
2004	47.5	2.2	64.3	99.7	69.5	4.1	2.6	0.2	0.0			5.9	295.9

Table 32. Recorded landings (t) of herring from gillnet fisheries on the Coastal Nova Scotia Spawning component, 1996-2004.

Landings (t)	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**Avg. Catch Last 5 yr.**	**Avg. Catch All Years**
Little Hope/Port Mouton		490	1,170	2,919	2,043	2,904	3,982	4,526	1,267	2,944	2,413
Halifax/Eastern Shore	1,280	1,520	1,100	1,628	1,350	1,898	3,334	2,727	4,176	2,697	2,113
Glace Bay		170	1,730	1,040	834	1,204	3,058	1,905	1,481	1,696	1,428
Bras d'Or Lakes	170	160	120	31	56	0	1	4	0	12	60
Total	1,450	2,340	4,120	5,618	4,283	6,006	10,375	9,162	6,924	7,350	5,586

Table 33. Summary of the estimated spawning biomass of herring from gillnet fisheries in the Coastal Nova Scotia Spawning component from 1998-2004. Total SSB is rounded to nearest 100t.

Survey SSB (t)	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**10% SSB Last 5 yr.**	**10% SSB All Years**
Little Hope/Port Mouton	14,100	15,800	5,200	21,300	56,000	63,700	15,600	3,236	2,739
Halifax/Eastern Shore	8,300	20,200	10,900	16,700	41,500	77,400	18,200	3,294	2,760
Glace Bay (mapping only)		2,000		21,200	7,700	31,500		2,013	1,560
Bras d'Or Lakes		530	70					7	30

Table 34. Summary of the exploitation of herring from major gillnet fisheries in the Coastal Nova Scotia Spawning component from 1998-2004. Exploitation is calculated percent landings / SSB.

Exploitation (% Landings/SSB)	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**Average % Last 5 yr.**	**Average % All Years**
Little Hope/Port Mouton	8%	18%	39%	14%	7%	7%	8%	15%	15%
Halifax/Eastern Shore	13%	8%	12%	11%	8%	4%	23%	12%	11%
Glace Bay		52%		6%	40%	6%		17%	26%
Bras d'Or Lakes		6%	80%					80%	43%

Table 35. Catch at age for herring from the coastal Nova Scotia fisheries in 2004.

4X Little Hope/Port Mouton Gillnet

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	-	193	1,385	3,785	805	437	16	-	-	-	6,621
% numbers	0%	0%	3%	21%	57%	12%	7%	0%	0%	0%	0%	100%
Catch wt. (t)	-	-	25	209	730	184	114	4	-	-	-	1,267
% catch wt.	0%	0%	2%	17%	58%	15%	9%	0%	0%	0%	0%	100%
Avg. len (cm)	-	-	26.1	27.2	29.2	30.8	32.0	32.5	-	-		29.1
Avg. wt. (g)	-	-	131.6	151.2	192.8	228.7	260.8	273.3	-	-		191.4

4W Halifax/Eastern Shore Gillnet

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	-	55	883	8,646	4,086	3,984	978	40	-	-	18,672
% numbers	0%	0%	0%	5%	46%	22%	21%	5%	0%	0%	0%	100%
Catch wt. (t)	-	-	7	139	1,711	945	1,071	291	13	-	-	4,177
% catch wt.	0%	0%	0%	3%	41%	23%	26%	7%	0%	0%	0%	100%
Avg. len (cm)	-	-	25.8	27.4	29.4	30.9	32.3	33.3	34.0	-		30.5
Avg. wt. (g)	-	-	127.5	157.2	197.9	231.4	268.9	297.3	317.6	-		223.7

4Vn Gillnet Glace Bay

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	-	0	22	1,083	1,673	1,722	548	504	46	-	5,598
% numbers	0%	0%	0%	0%	19%	30%	31%	10%	9%	1%	0%	100%
Catch wt. (t)	-	-	0	4	245	413	470	167	166	16	-	1,481
% catch wt.	0%	0%	0%	0%	17%	28%	32%	11%	11%	1%	0%	100%
Avg. len (cm)	-	-	27.0	27.6	30.1	31.0	32.2	33.6	34.6	35.3		31.8
Avg. wt. (g)	-	-	169.8	180.4	226.5	246.9	272.7	304.0	329.8	348.4		264.5

4Vn Trap

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	9	108	90	77	19	16	14	18	7	1	358
% numbers	0%	2%	30%	25%	21%	5%	4%	4%	5%	2%	0%	100%
Catch wt. (t)	-	0	12	12	14	4	4	4	6	3	0	59
% catch wt.	0%	0%	20%	21%	24%	7%	7%	7%	10%	4%	0%	100%
Avg. len (cm)	-	17.0	24.6	26.5	29.0	31.0	32.3	33.6	34.9	36.3		27.6
Avg. wt. (g)	-	32.8	107.6	135.9	181.0	223.5	254.9	288.1	325.7	367.3		164.7

Table 36. New Brunswick weir and shutoff catch at age for herring in 2004.

NB Weir and Shutoff combined

Catch at age (numbers and weight)

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	6,023	182,578	102,063	22,935	4,551	378	88	4	-	-	-	318,619
% numbers	2%	57%	32%	7%	1%	0%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	65	6,905	9,636	3,124	843	88	23	1	-	-	-	20,685
% catch wt.	0%	33%	47%	15%	4%	0%	0%	0%	0%	0%	0%	100%
Avg. len (cm)	12.2	17.7	23.3	26.2	28.7	30.7	31.7	32.5	-	-		20.2
Avg. wt. (g)	10.7	37.8	94.4	136.2	185.3	232.4	259.0	287.4	-	-		64.9

NB Weirs (only)

Catch at age (numbers and weight)

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	6,023	180,991	101,963	22,923	4,551	378	88	4	-	-	-	316,920
% numbers	2%	57%	32%	7%	1%	0%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	65	6,849	9,628	3,123	843	88	23	1	-	-	-	20,619
% catch wt.	0%	33%	47%	15%	4%	0%	0%	0%	0%	0%	0%	100%
Avg. len (cm)	12.2	17.7	23.3	26.2	28.7	30.7	31.7	32.5	-	-		20.2
Avg. wt. (g)	10.7	37.8	94.4	136.2	185.3	232.4	259.0	287.4	-	-		65.1

NB Shutoff (only)

Catch at age (numbers and weight)

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	1,587	100	12	-	-	-	-	-	-	-	1,700
% numbers	0%	93%	6%	1%	0%	0%	0%	0%	0%	0%	0%	100%
Catch wt. (t)	-	56	9	2	-	-	-	-	-	-	-	66
% catch wt.	0%	84%	13%	2%	0%	0%	0%	0%	0%	0%	0%	100%
Avg. len (cm)	-	17.4	22.9	25.7	-	-	-	-	-	-		17.8
Avg. wt. (g)	-	35.0	88.5	126.9	-	-	-	-	-	-		38.8

Table 37. 5Z Georges Bank (Canadian portion) midwater trawl fishery catch at age for 2004.

5Ze Midwater Trawl

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11+	Total
Numbers (x1,000)	-	-	4	21	39	8	8	2	1	1	-	83
% numbers	0%	0%	5%	26%	47%	9%	9%	2%	1%	1%	0%	100%
Catch wt. (t)	-	-	1	3	8	2	2	1	0	0	-	16
% catch wt.	0%	0%	3%	20%	47%	11%	13%	3%	1%	1%	0%	100%
Avg. len (cm)	-	-	25.8	27.0	29.1	30.8	31.9	33.8	34.5	36.0		29.0
Avg. wt. (g)	-	-	127.4	149.1	191.4	233.0	259.4	315.6	338.5	390.2		192.2

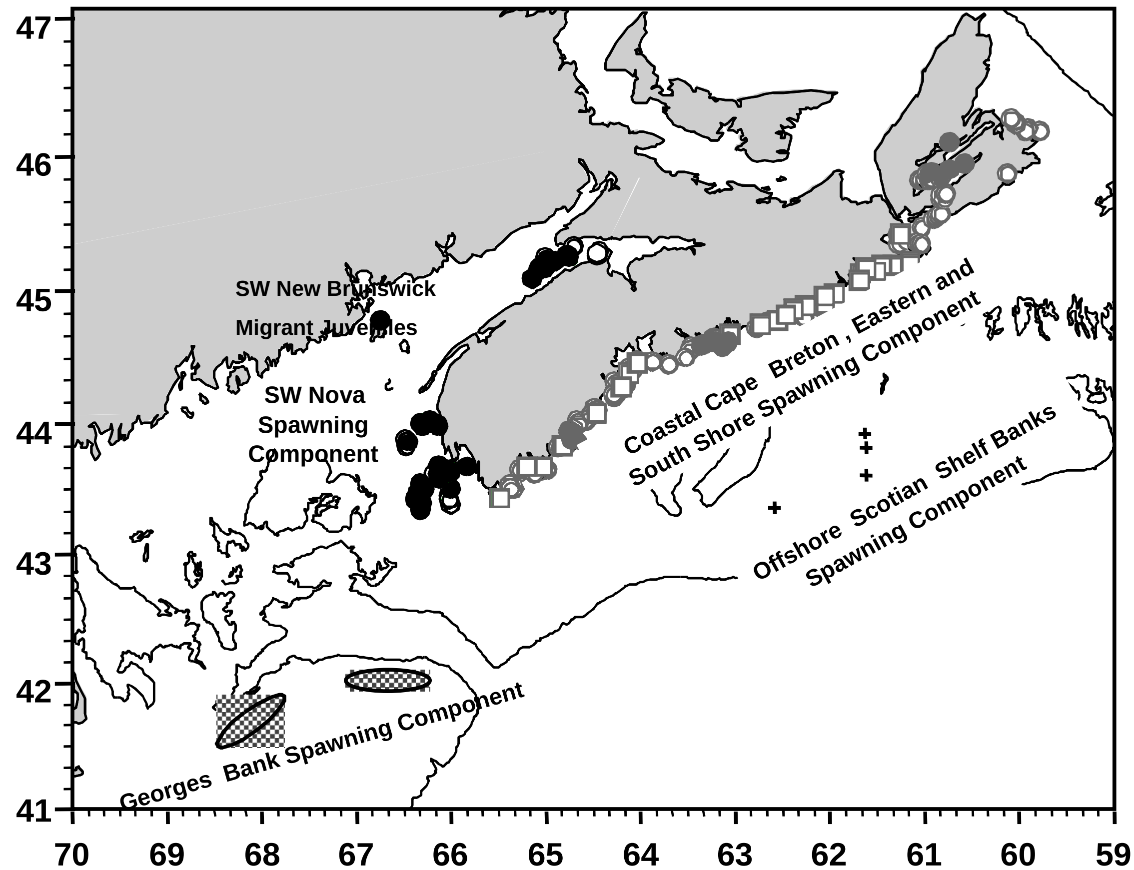


Figure 1. Management units for herring in areas 4VWX and 5YZ showing locations of known current (solid) and historical (open) spawning locations.

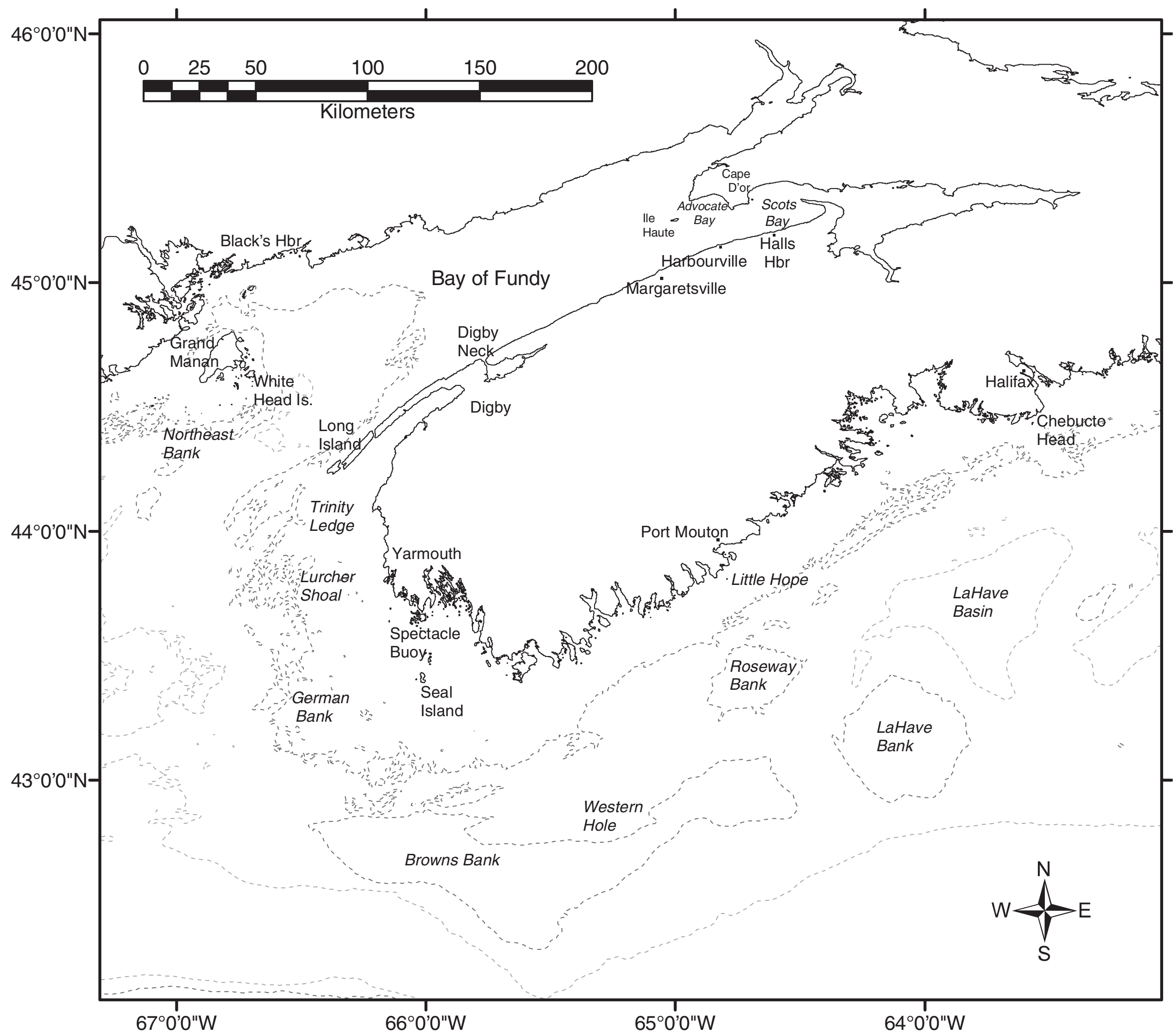


Figure 2. Fishing locations for herring in southwest and coastal Nova Scotia.

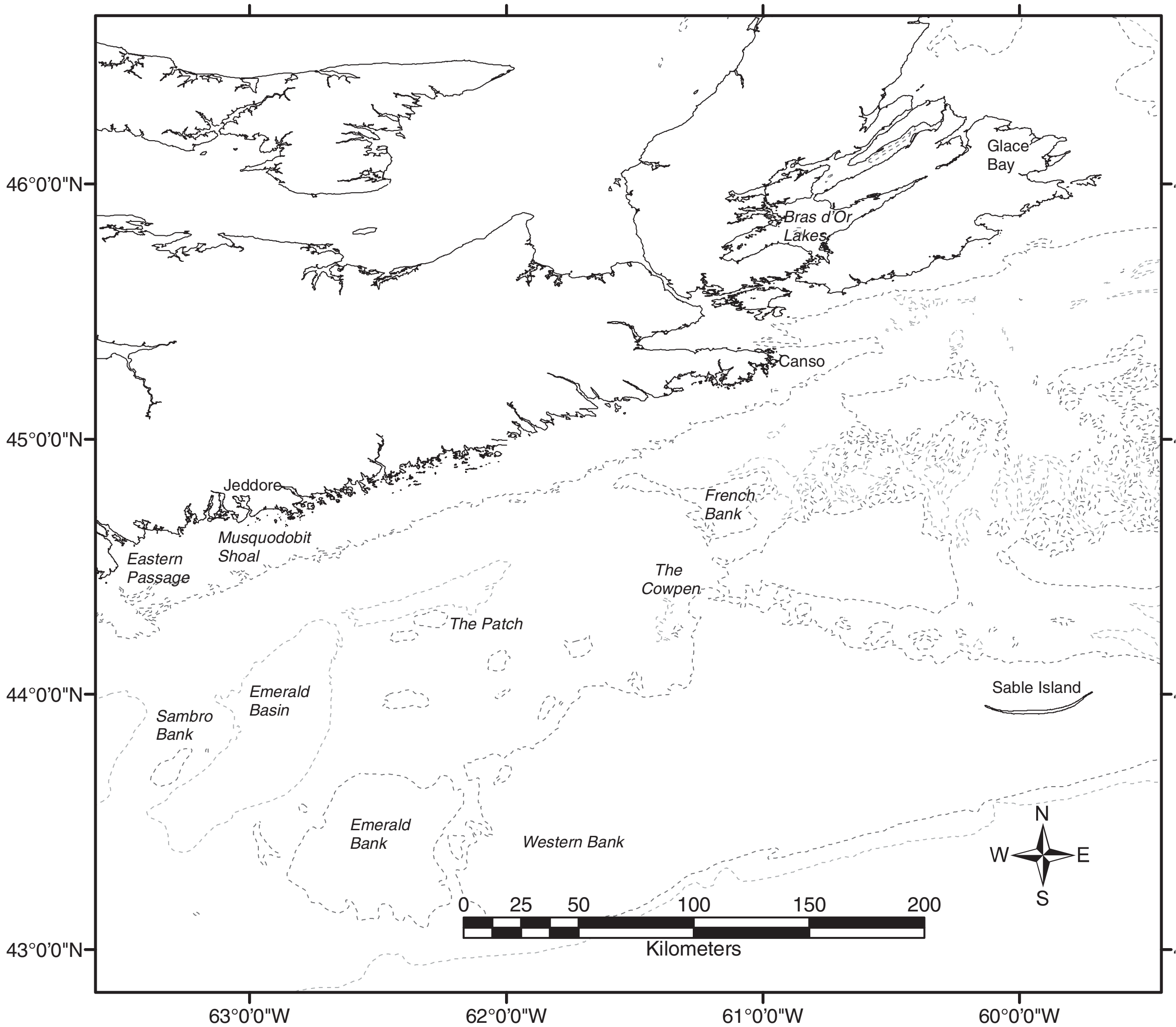


Figure 3. Fishing locations for herring on the eastern Scotian Shelf and offshore banks.

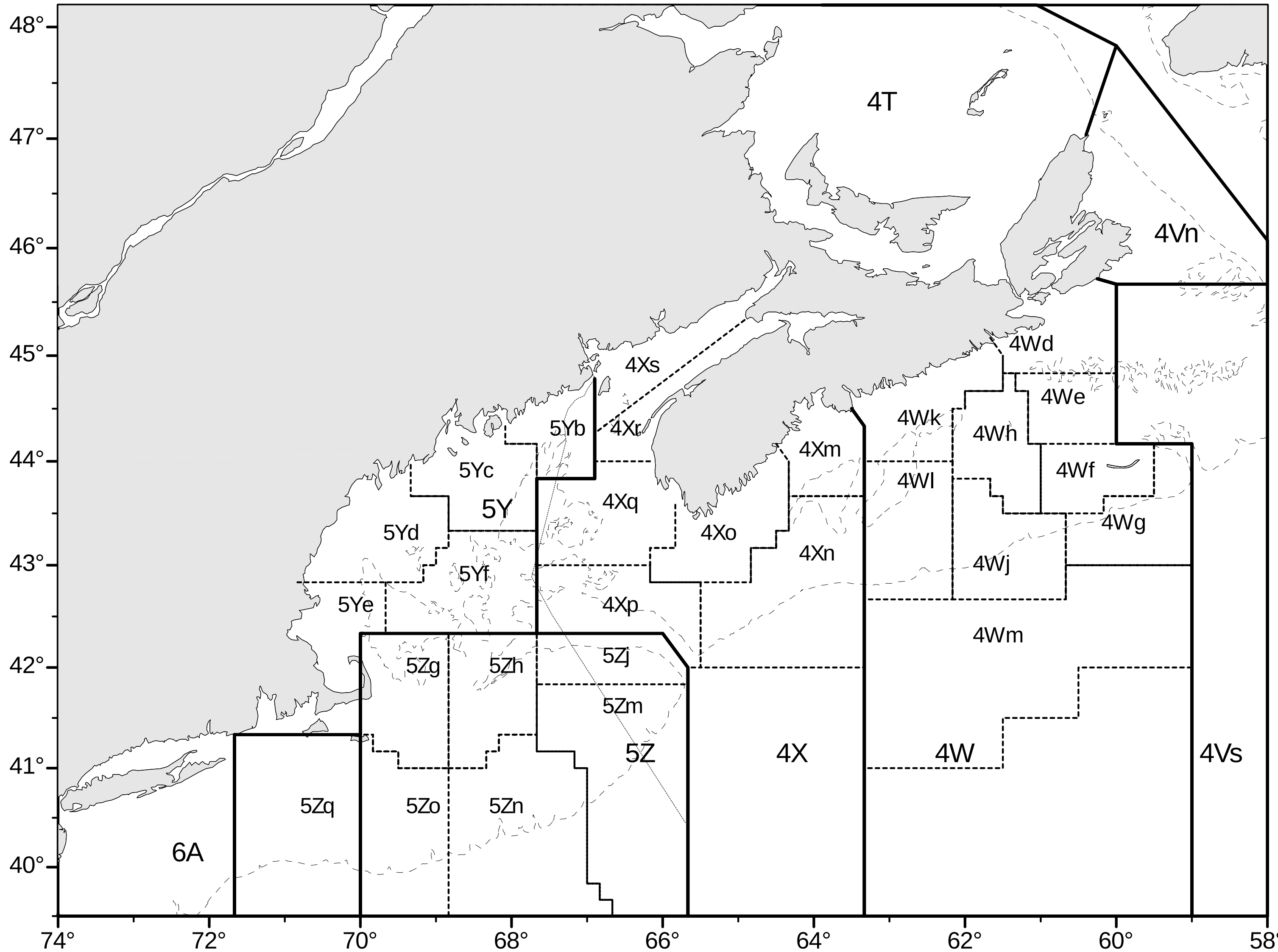


Figure 4. Major and minor NAFO unit areas used for sample and catch data aggregation.

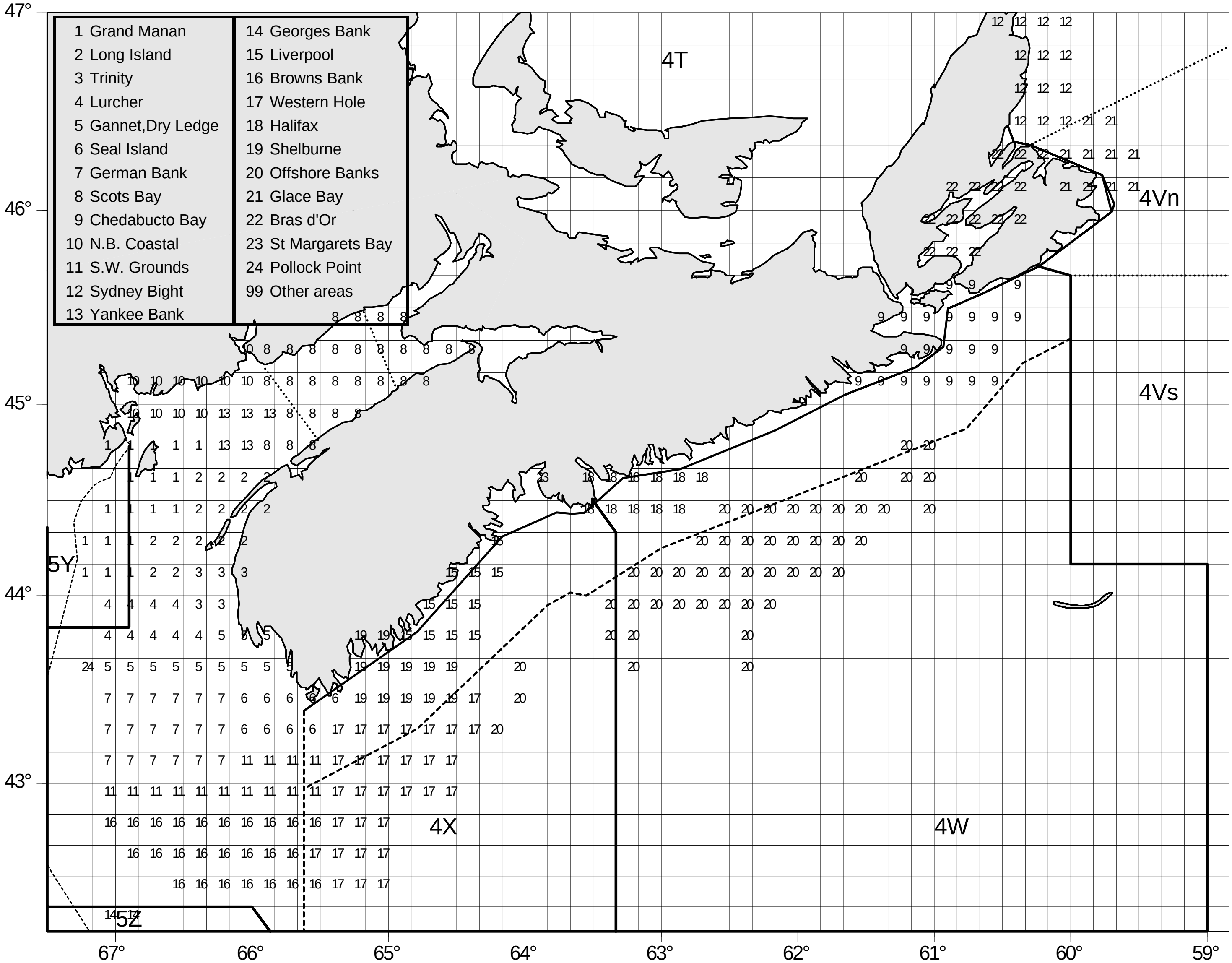


Figure 5. Herring fishing ground areas and management lines.

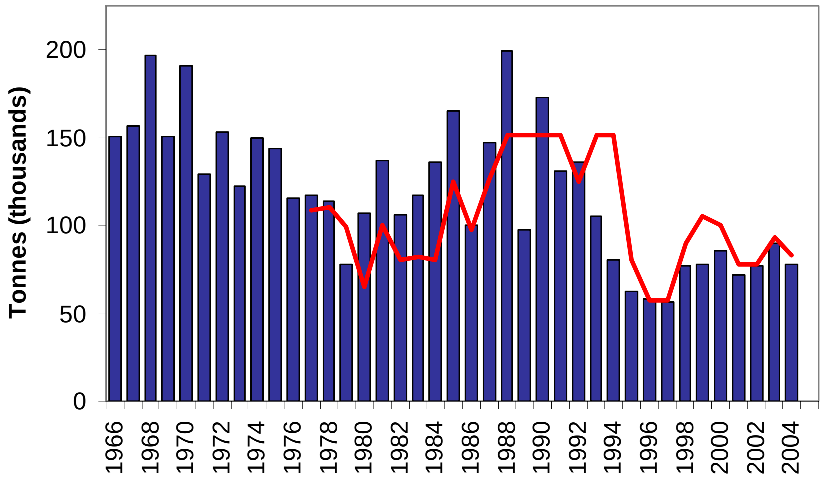


Figure 6. Annual herring landings [bars] and TAC [solid line] (quota) for the southwest Nova Scotia spawning component (4WX stock).

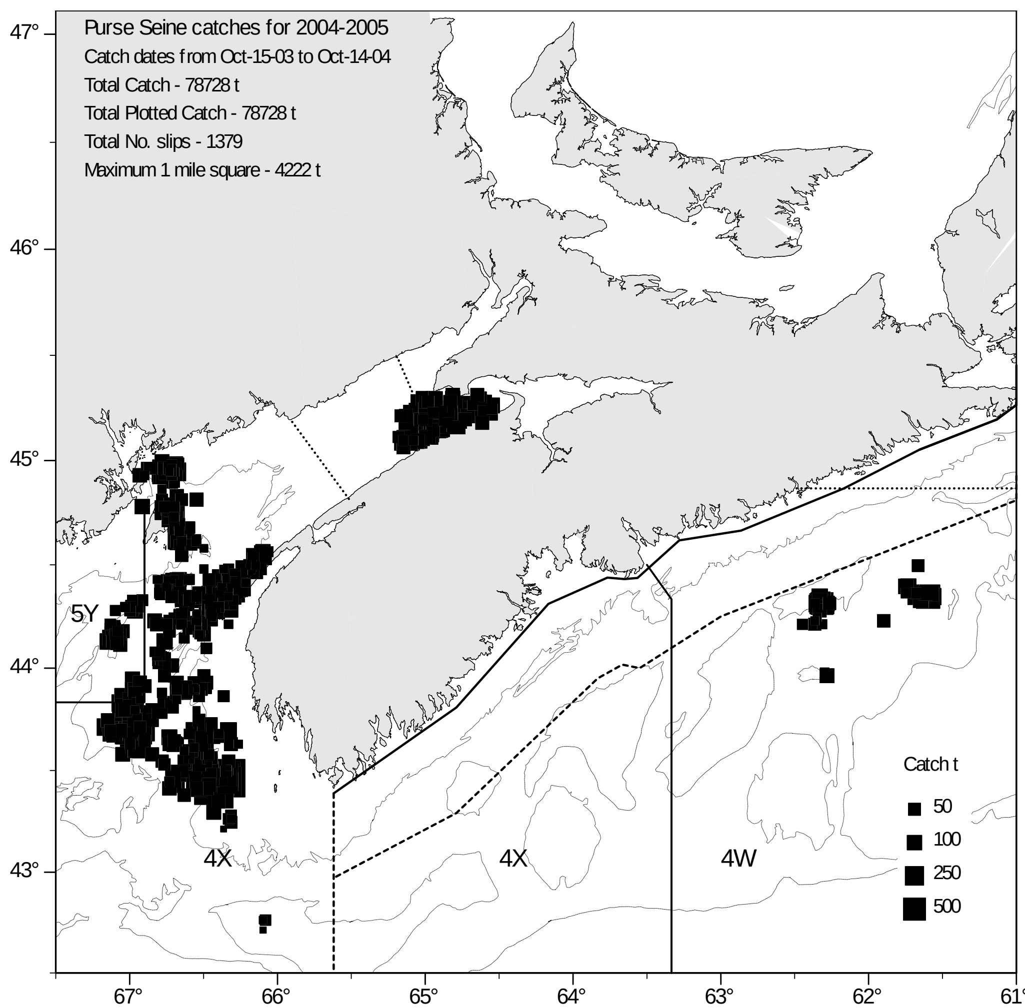


Figure 7. Overall 2003-2004 quota year herring purse seine catches (t) for NAFO areas 4WX (from Statistics Division MARFIS database).

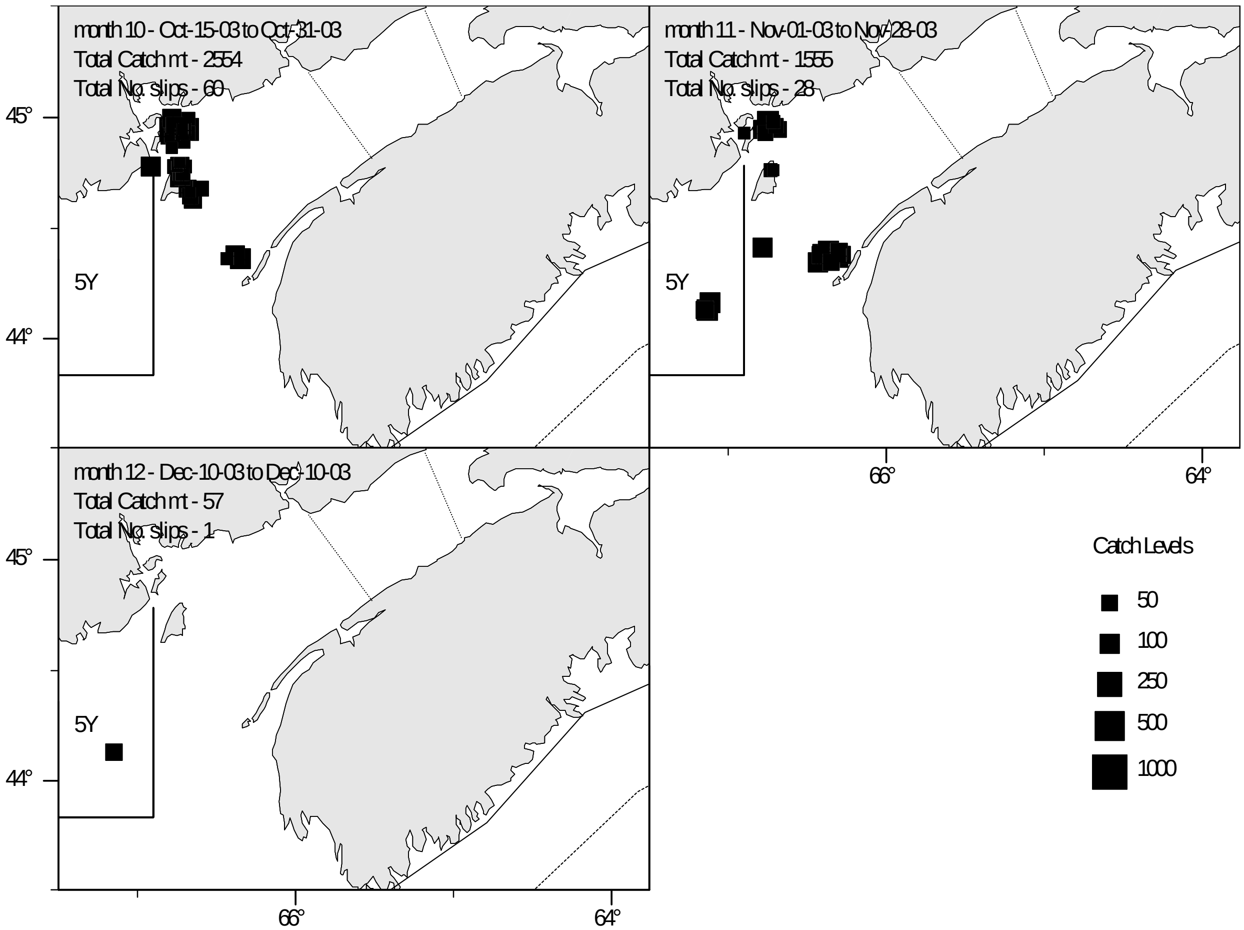


Figure 8. 2003 fall fishery herring purse seine catches (t) by month in NAFO areas 4WX from 2003-2004 quota year (from Statistics Division MARFIS database).

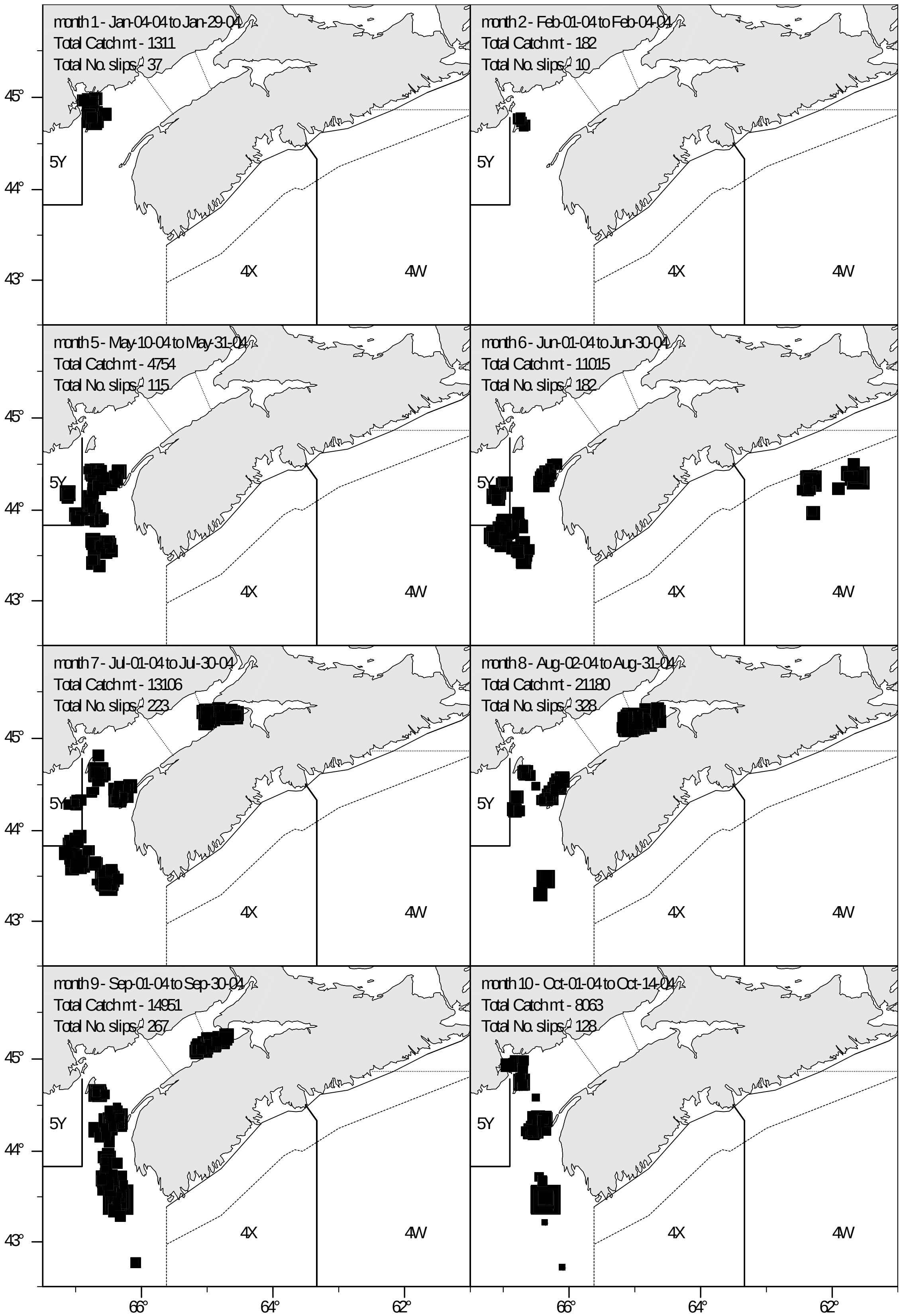


Figure 9. 2004 herring purse seine catches (t) by month in NAFO areas 4WX from 2003-2004 quota year (from Statistics Division MARFIS database).

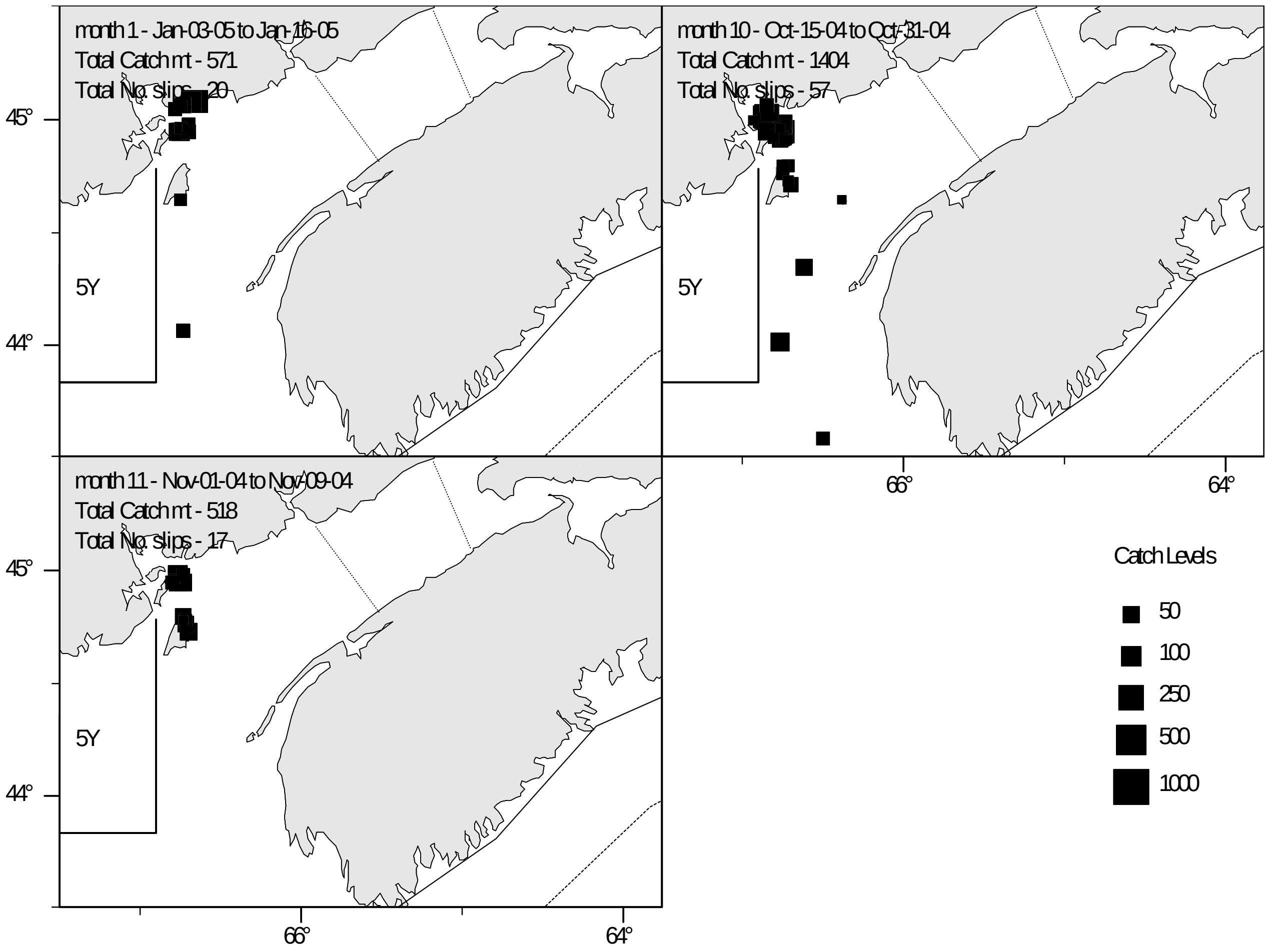


Figure 10. Herring purse seine catches (t) by month in NAFO areas 4WX for 2004-2005 quota year (From Statistics Division MARFIS database as of March 1, 2005).

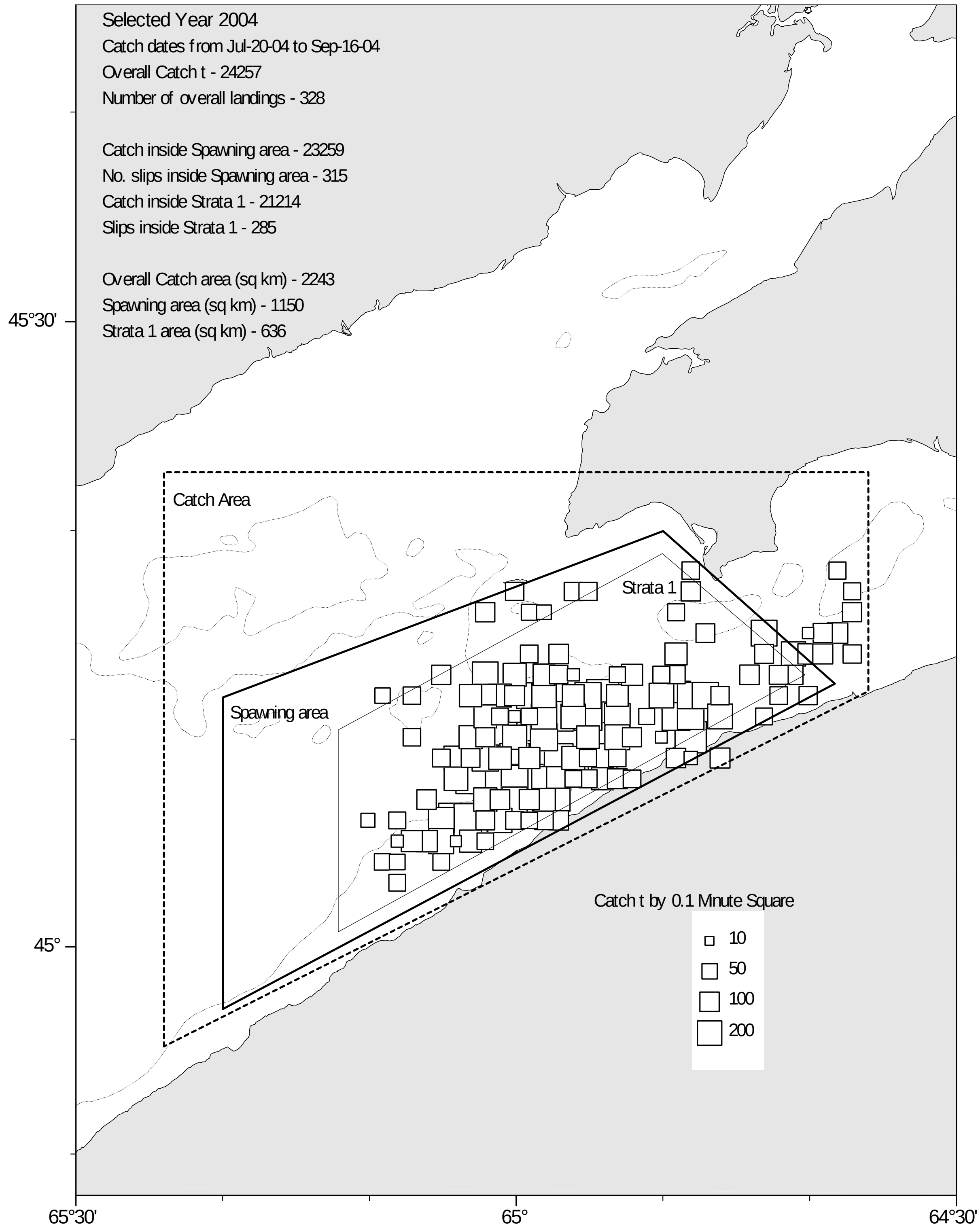


Figure 11. 2004 Scots Bay spawning fishery (catches t and area in km^2) for the entire fishing period in the selected 'Catch Area', 'Spawning Area' and the primary acoustic survey area (Strata 1).

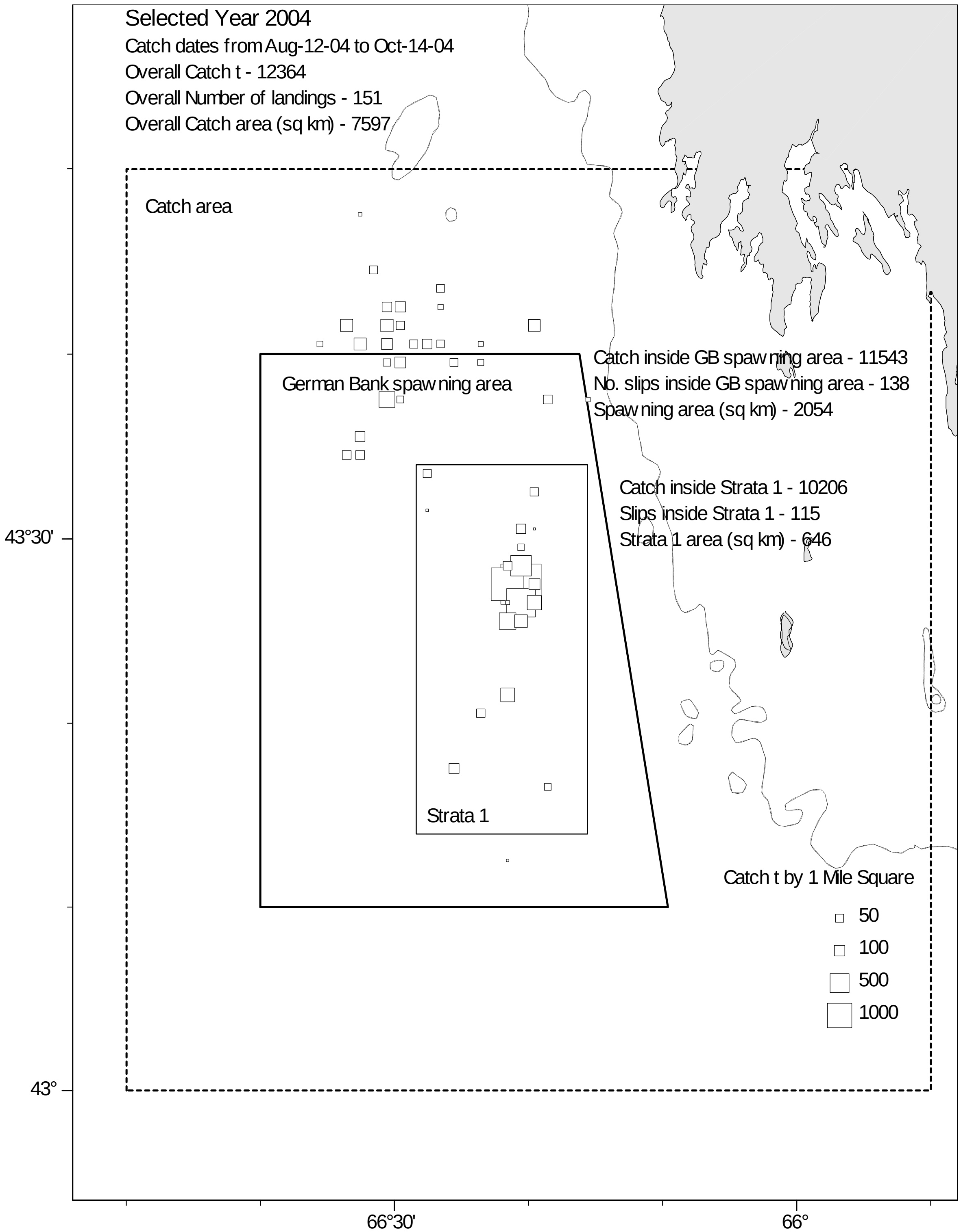


Figure 12. 2004 German Bank spawning fishery (catches t and area in km^2) for the spawning period Aug. 1 to Oct. 15, 2004 in the selected 'Catch Area', 'Spawning Area' and the primary acoustic survey area (Strata 1).

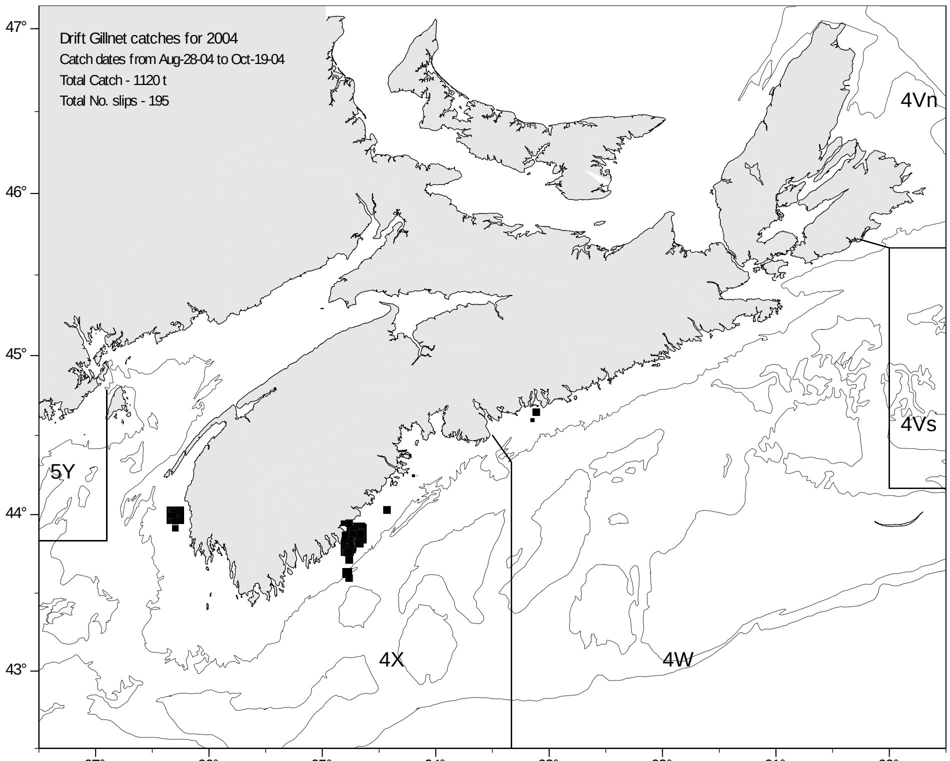


Figure 13. Herring drift gillnet catches (t) for 2004 calendar year for NAFO areas 4VWX (data from Statistics Division MARFIS database).

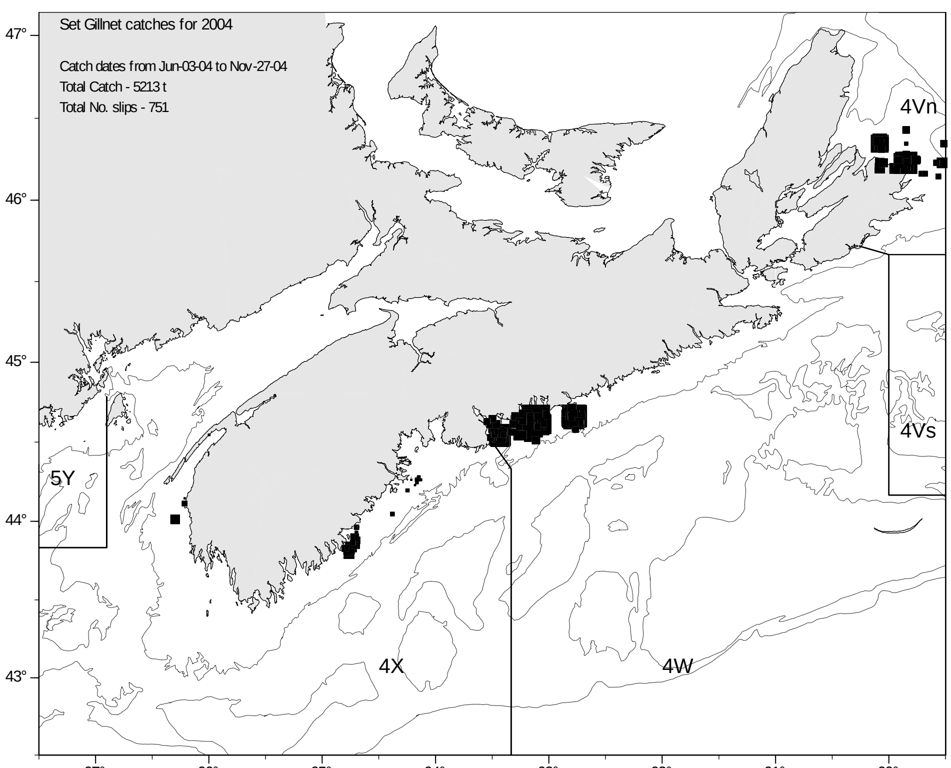


Figure 14. Herring set gillnet catches (t) for 2004 calendar year for NAFO areas 4VWX (data from Statistics Division MARFIS database).

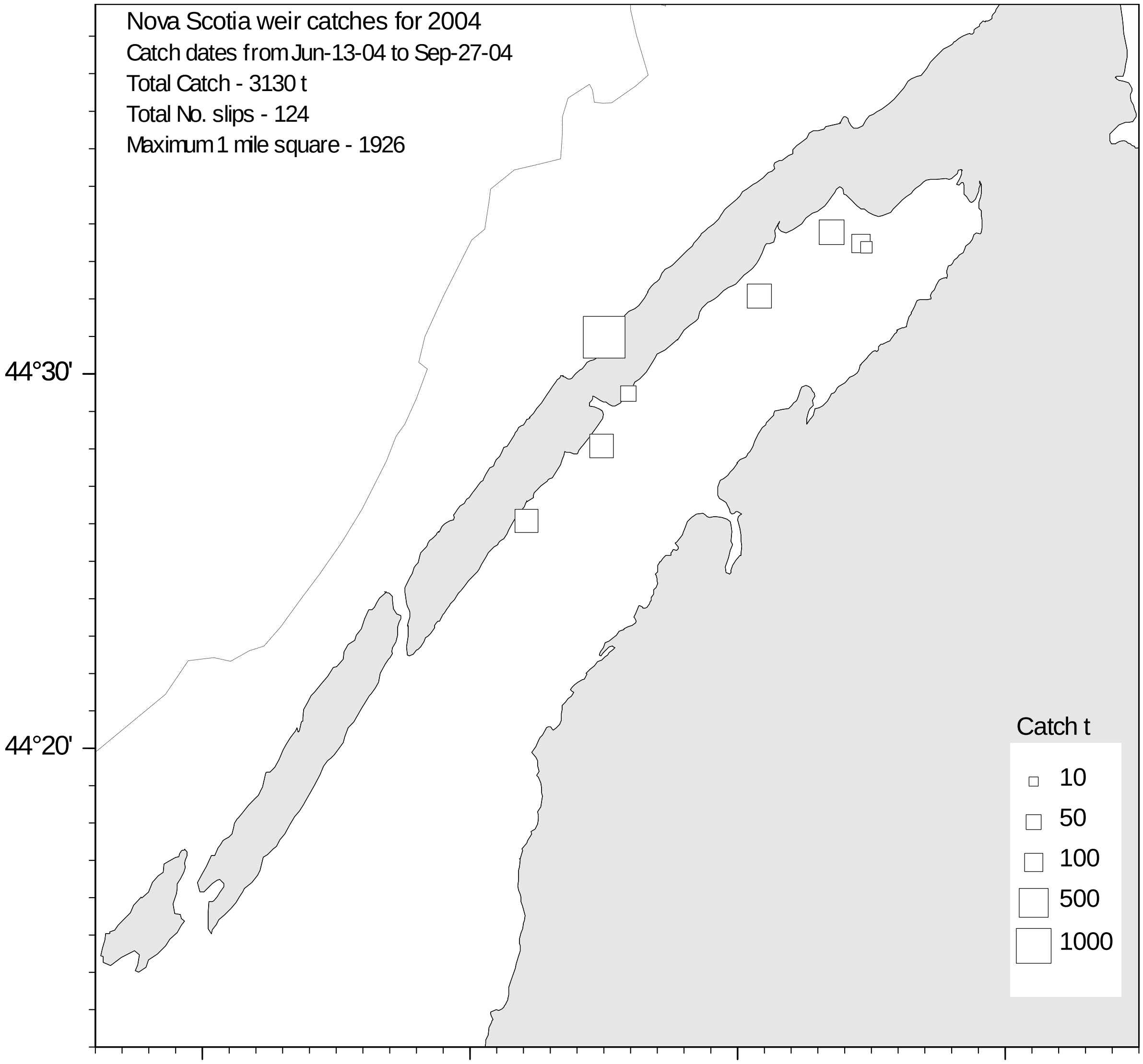


Figure 15. Nova Scotia herring weir catches for the 2004 calendar year.

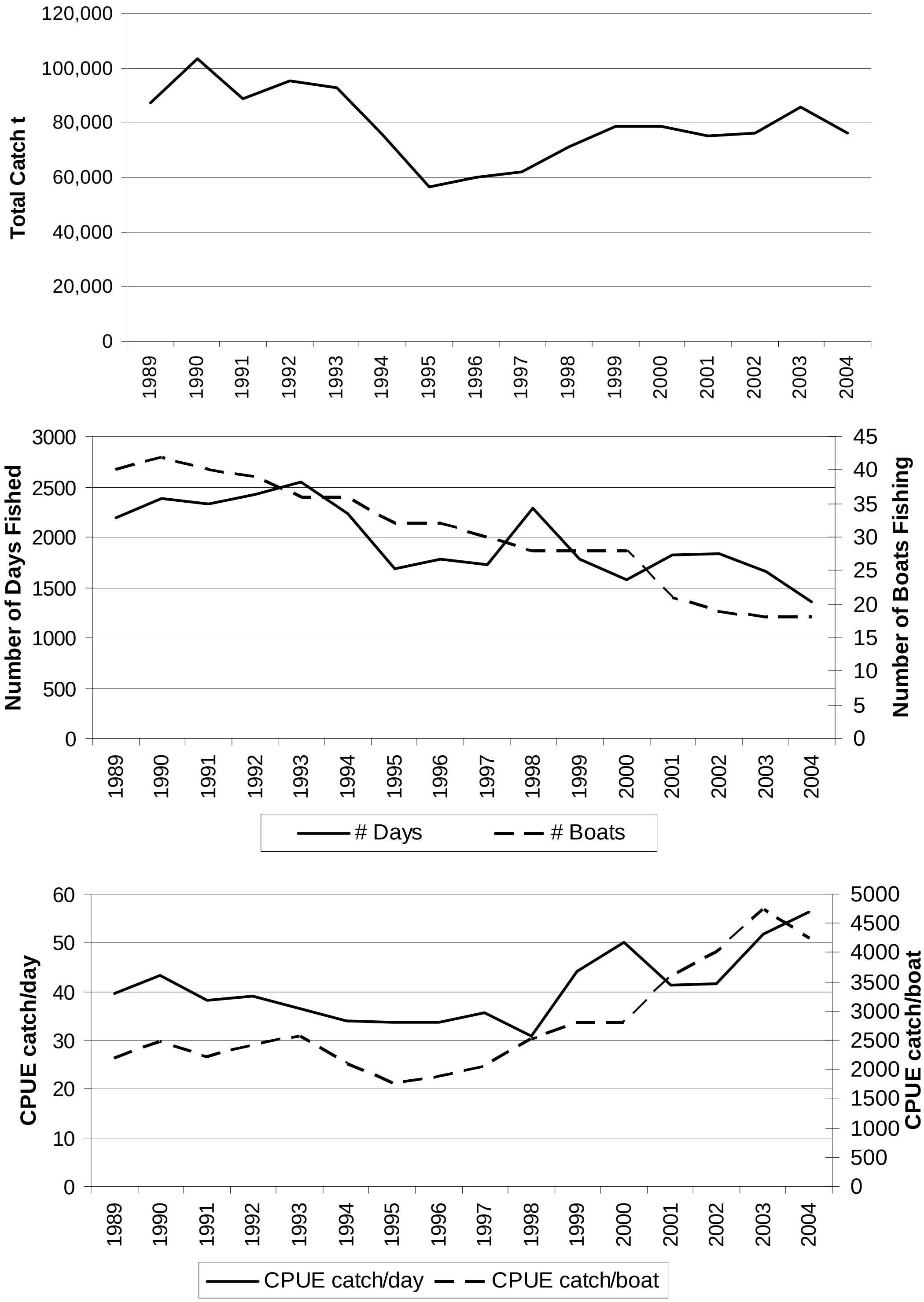


Figure 16. Purse seine catch (top panel), effort (middle panel) and CPUE (bottom) from 1989 to 2004 annual 4WX herring landings data for the SW Nova Scotia/Bay of Fundy spawning component.

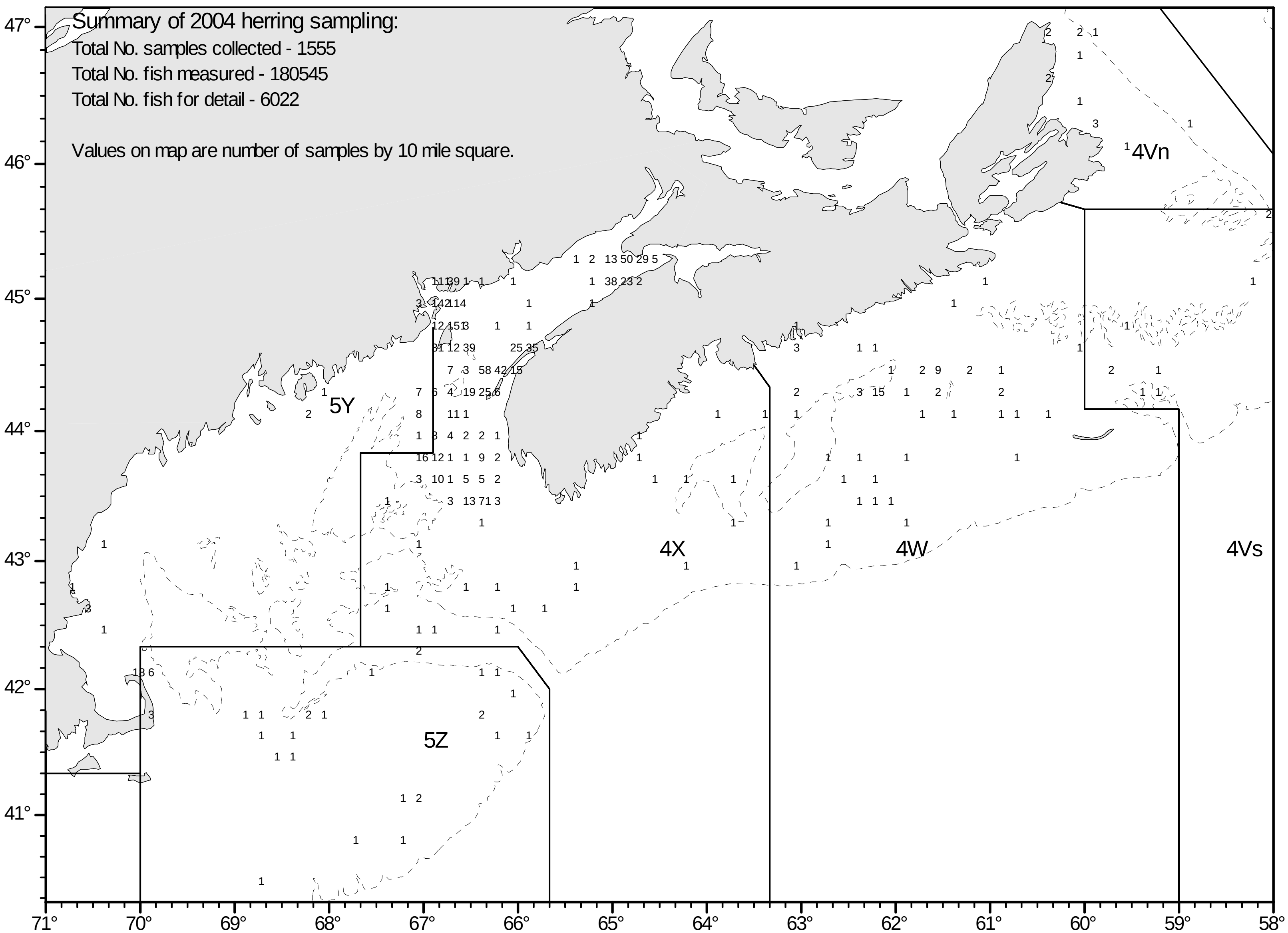
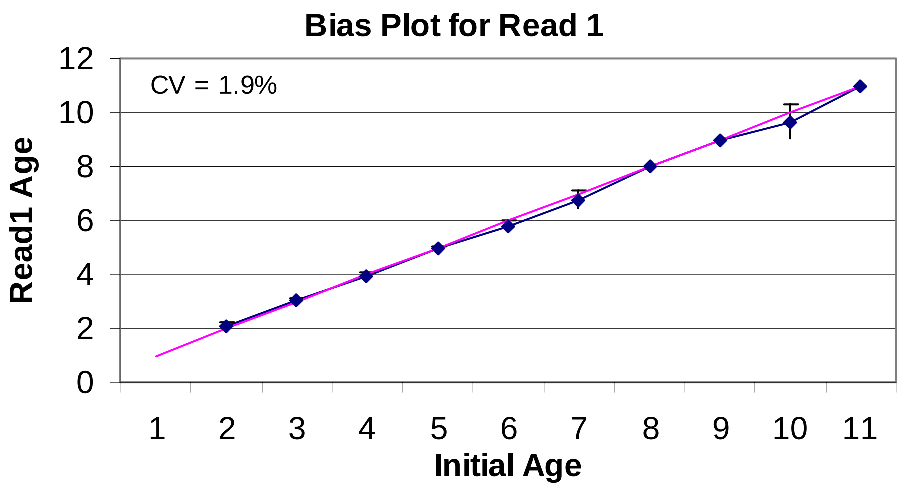


Figure 17. 2004 herring sampling coverage from all sources (number of length frequency samples by 10 mile square).



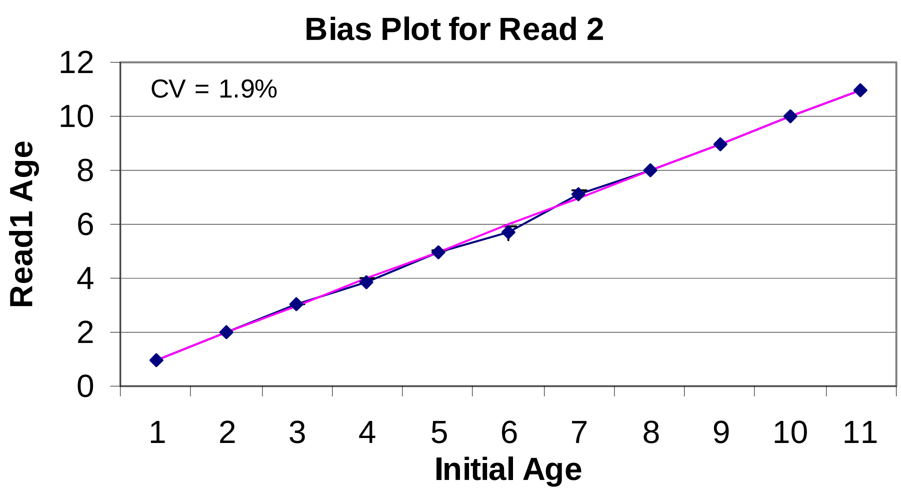


Figure 18. Bias plots of the first and second reading of herring otoliths from the 2004 4VWX fishery (random sample of 200 otoliths).

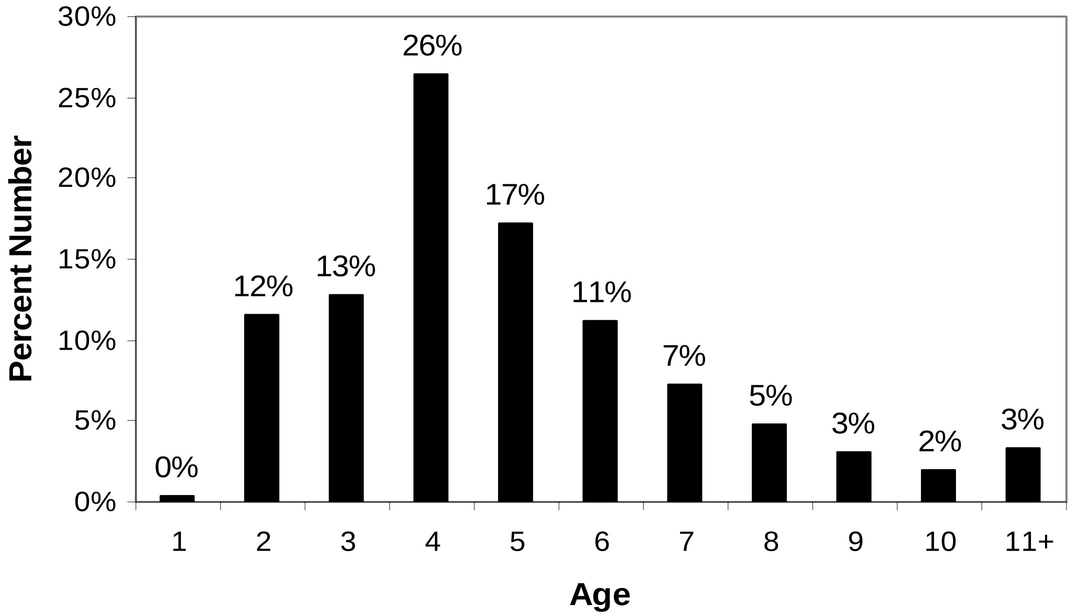


Figure 19. Expected age structure in the fishery with fishing at $F_{0.1}$ and constant average recruitment. Parameters: long-term F=0.23, annual recruitment=1.8 billion, natural mortality=0.2, partial recruitment vector=0.006, 0.235, 0.339 and 1.

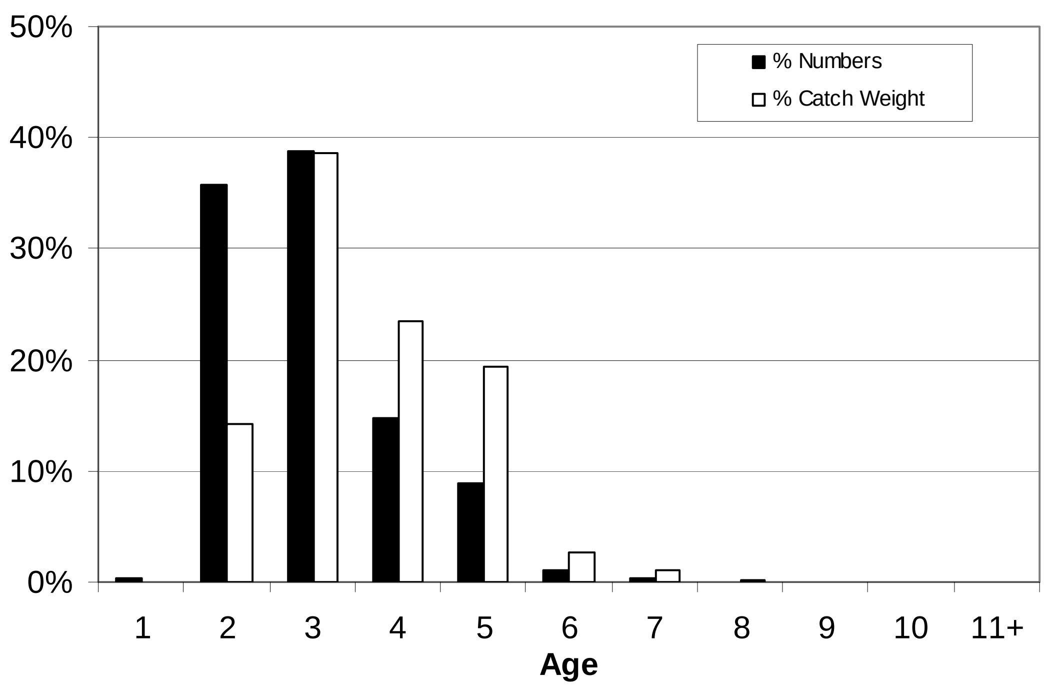


Figure 20. Catch at age for 2004 for the overall SW Nova Scotia / Bay of Fundy spawning component (% numbers and % weight).

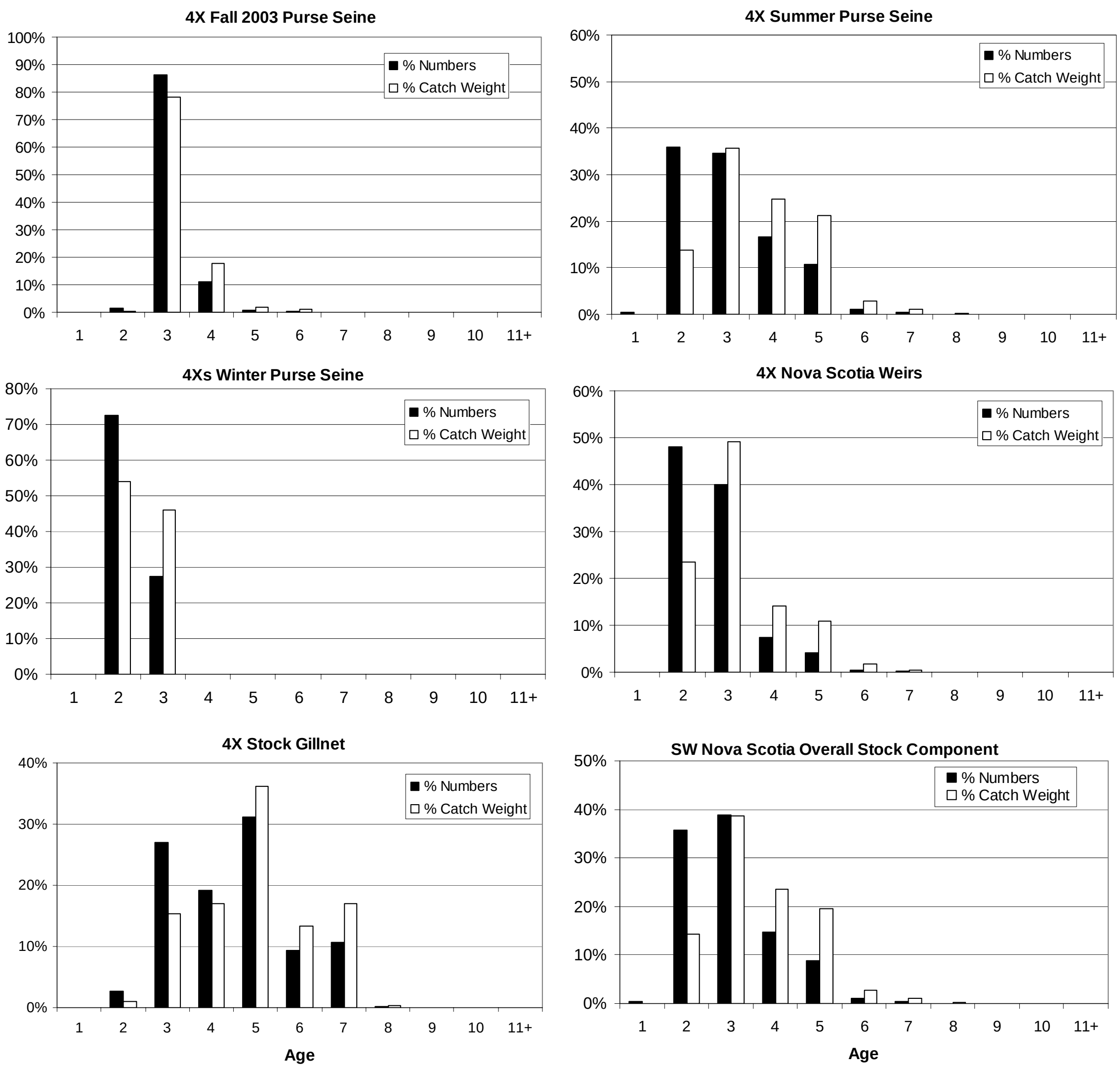


Figure 21. Catch at age for the 2004 SW Nova Scotia / Bay of Fundy spawning component (% numbers and % weight) by gear type.

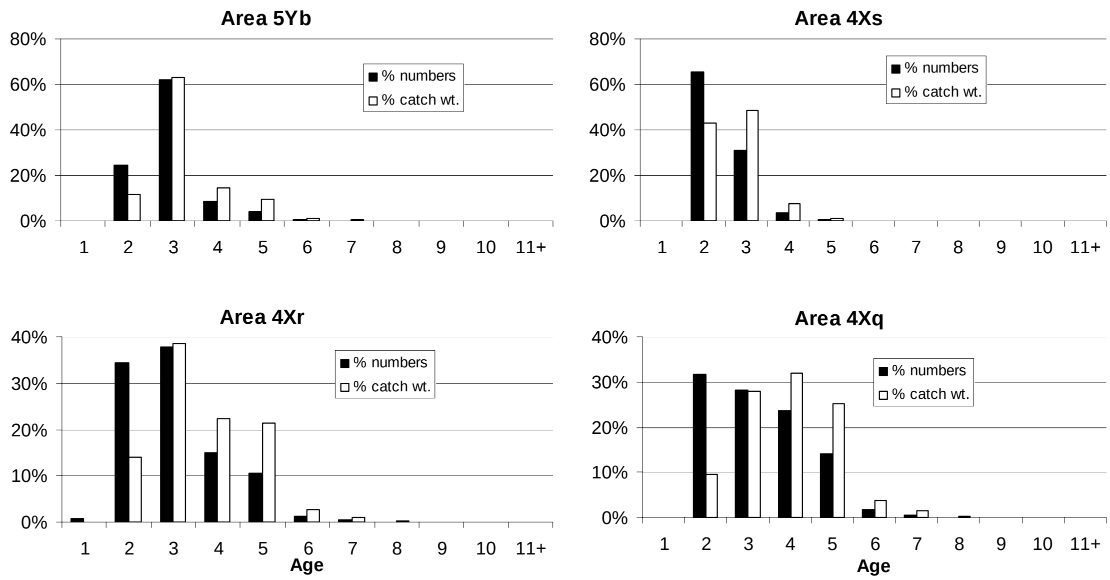


Figure 22. Herring catch at age by NAFO unit area for the 2004 summer purse seine fishery conducted on the SW Nova Scotia / Bay of Fundy spawning component.

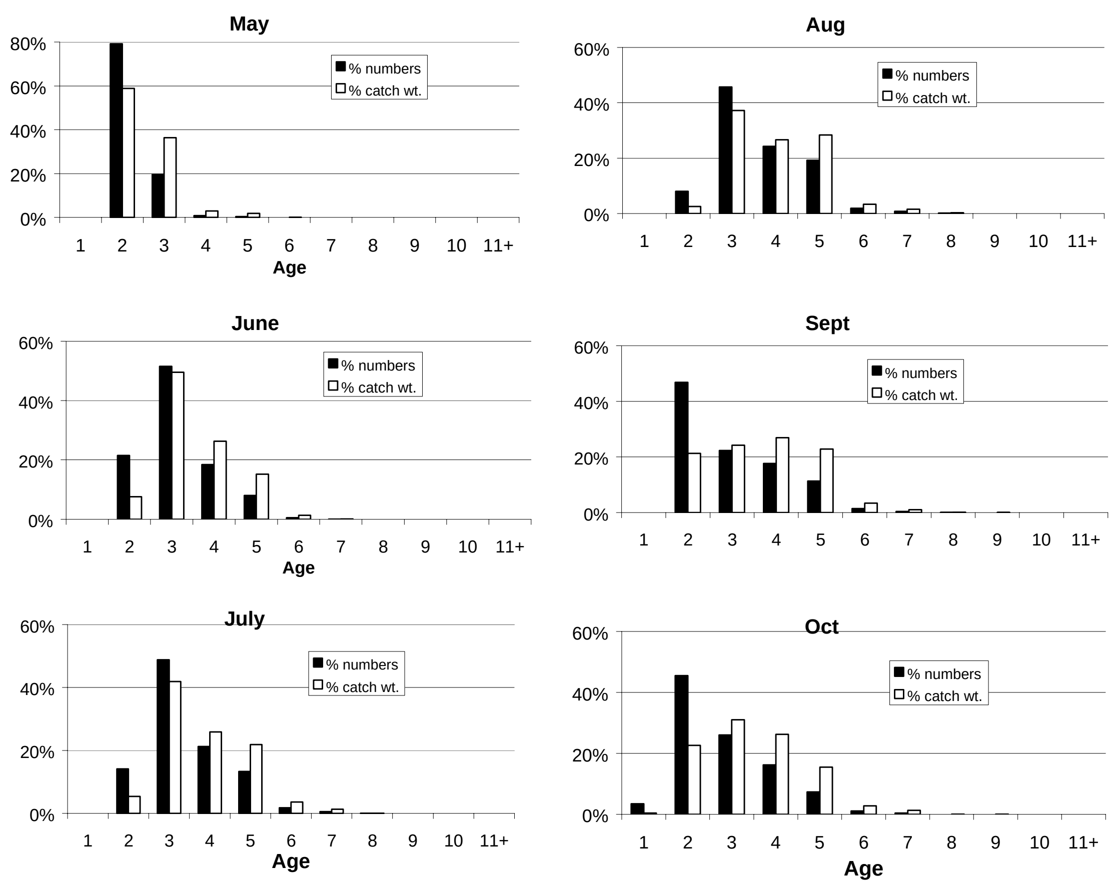


Figure 23. Herring catch at age by month for the 2004 summer purse seine fishery conducted on the SW Nova Scotia / Bay of Fundy spawning component.

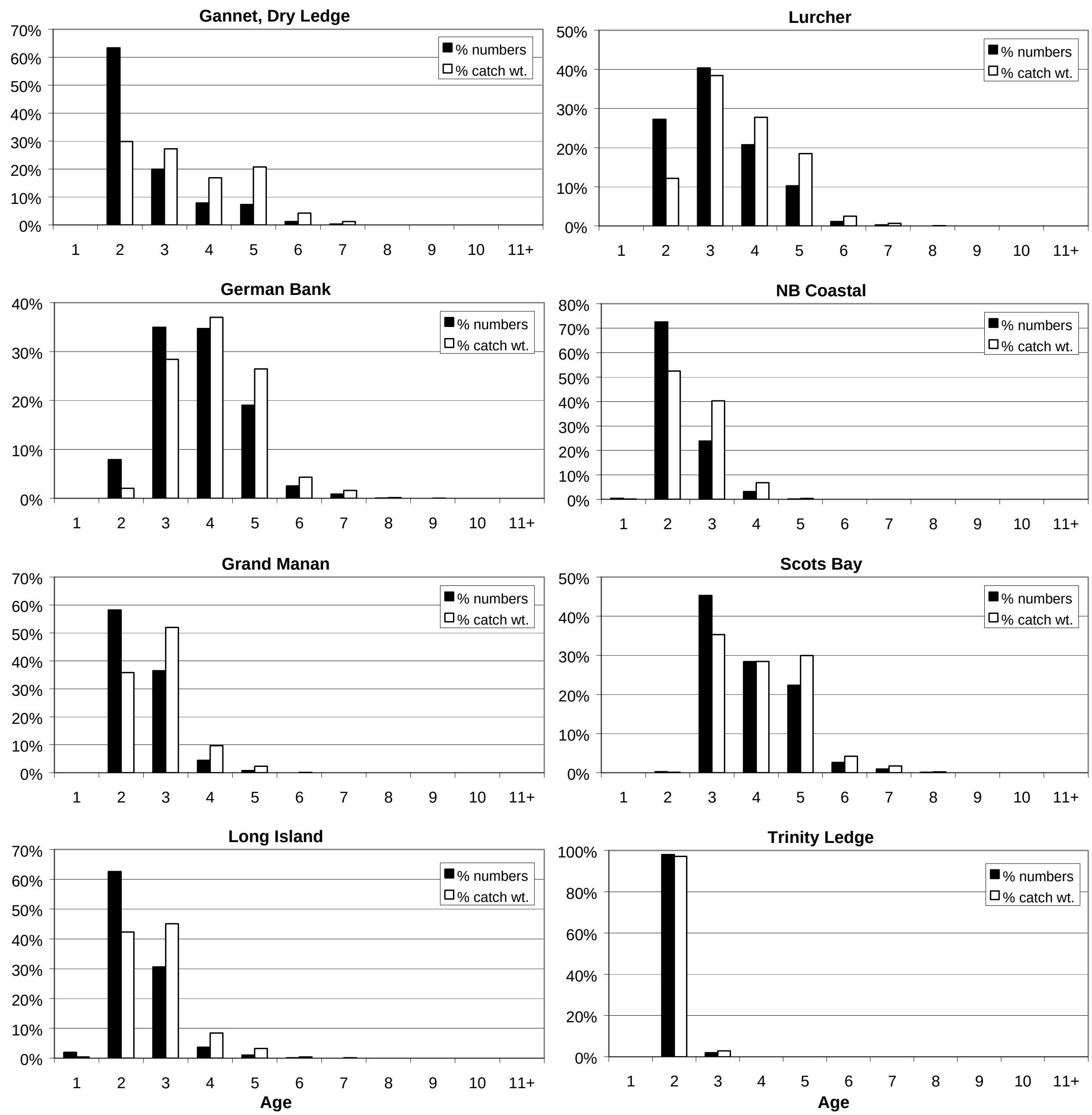


Figure 24. Herring catch at age by fishing ground for the 2004 summer purse seine fishery conducted on the SW Nova Scotia / Bay of Fundy spawning component.

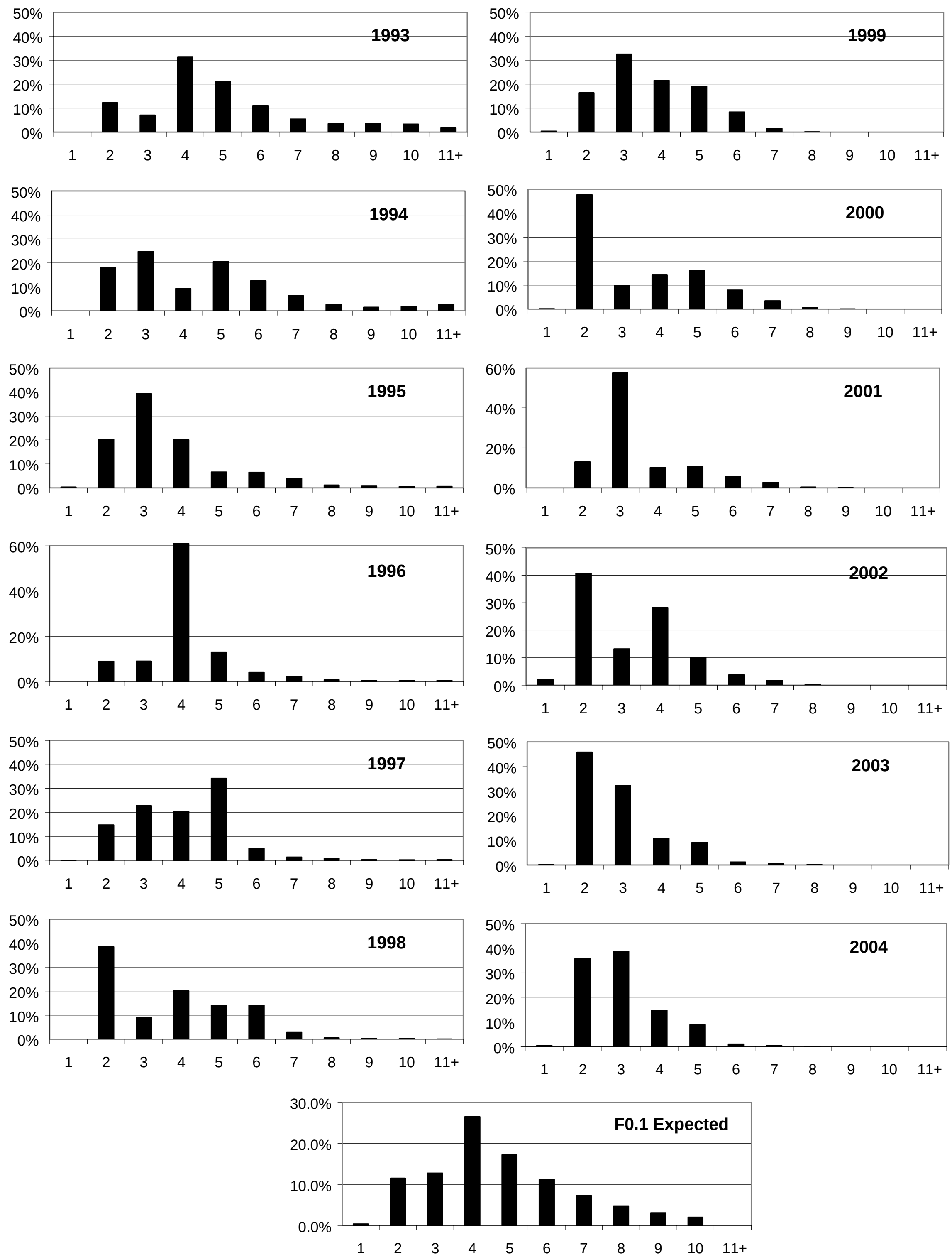


Figure 25. Catch at age (% numbers) for the SW Nova Scotia / Bay of Fundy spawning component (4WX stock) from 1993 to 2004. The bottom plot for comparison is the expected age structure in the fishery with fishing at $F_{0.1}$ and constant average recruitment.

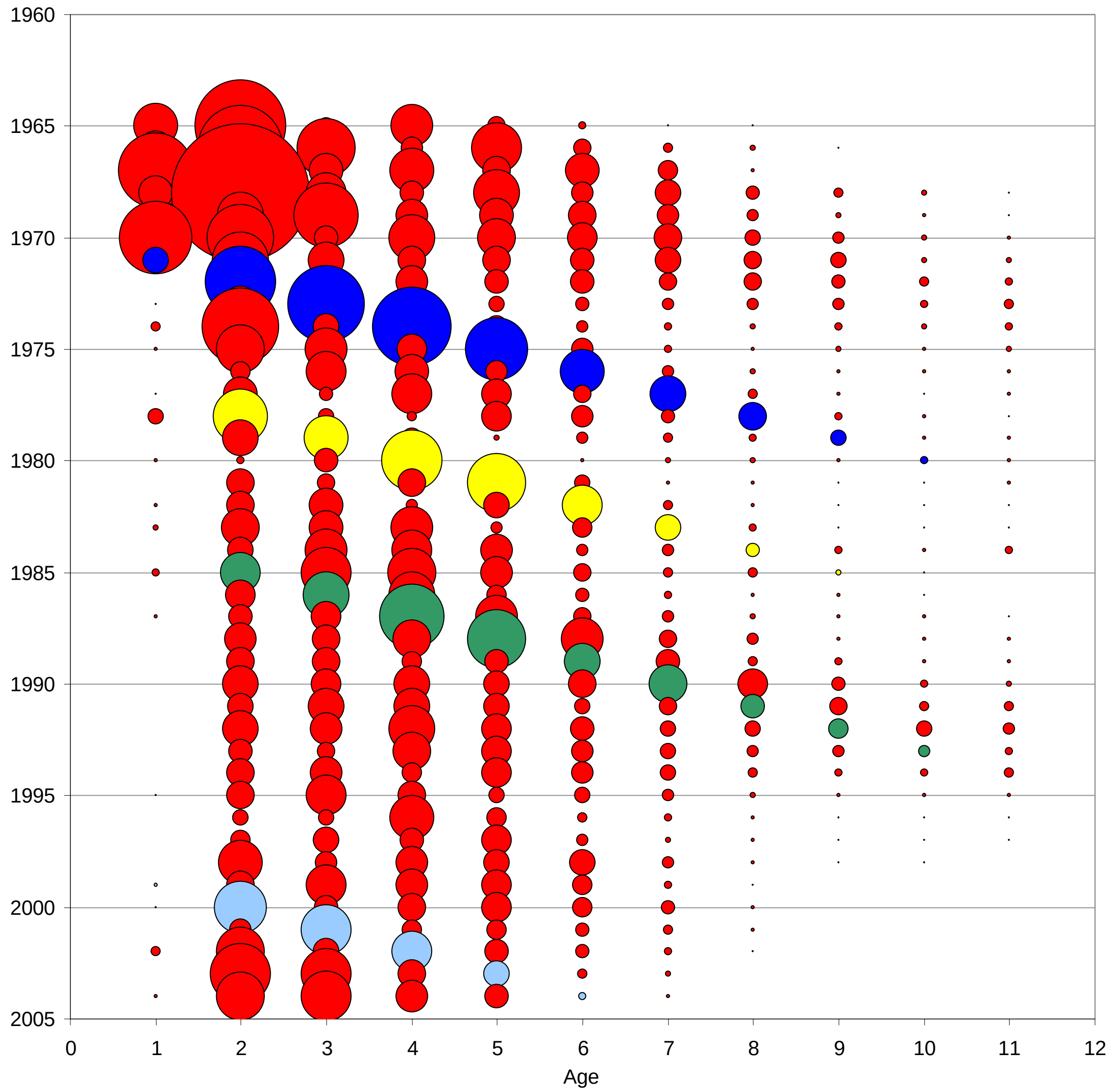


Figure 26. Historical catch at age (numbers) for the SW Nova Scotia / Bay of Fundy spawning component. Refer to Table 14 for actual numbers represented by symbol size. The value for 1968 at age 2 represents the maximum in the series of 2,389 million. Several of the stronger year-classes are highlighted including the 1970, 1976, 1983 and 1998 year-class.

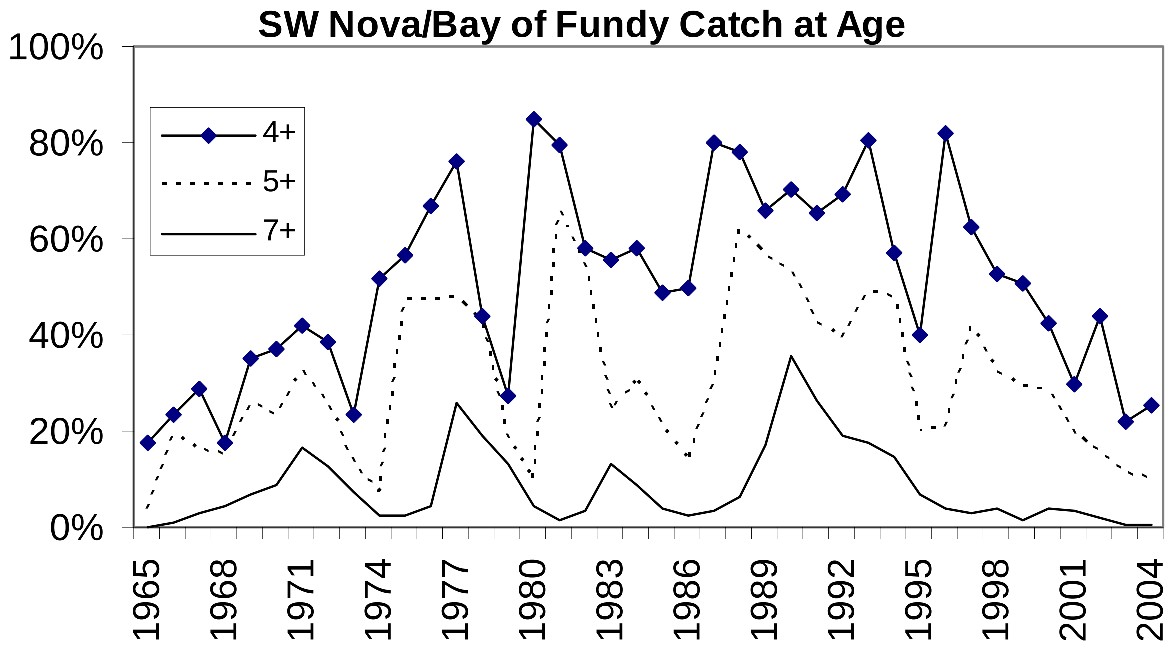


Figure 27. Overall proportions (percent numbers) of ages 4+, 5+ and 7+ in the catch at age for the SW Nova Scotia / Bay of Fundy spawning component for the period 1965 to 2004.

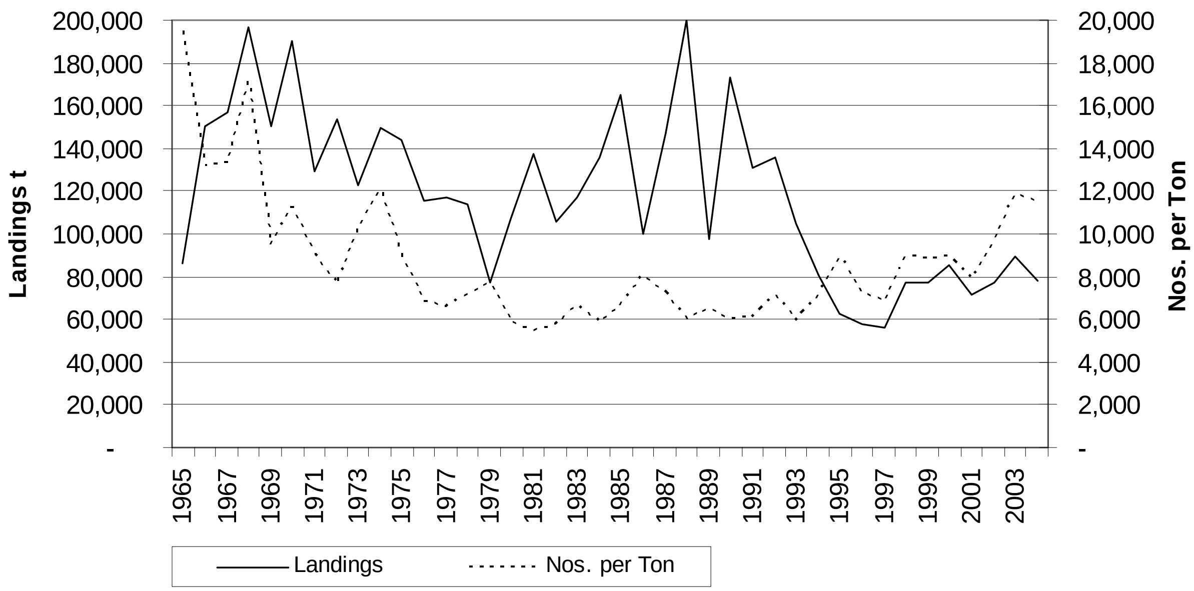


Figure 28. SW Nova Scotia / Bay of Fundy spawning component overall landings (t) and average catch numbers per ton for the period 1965 to 2004.

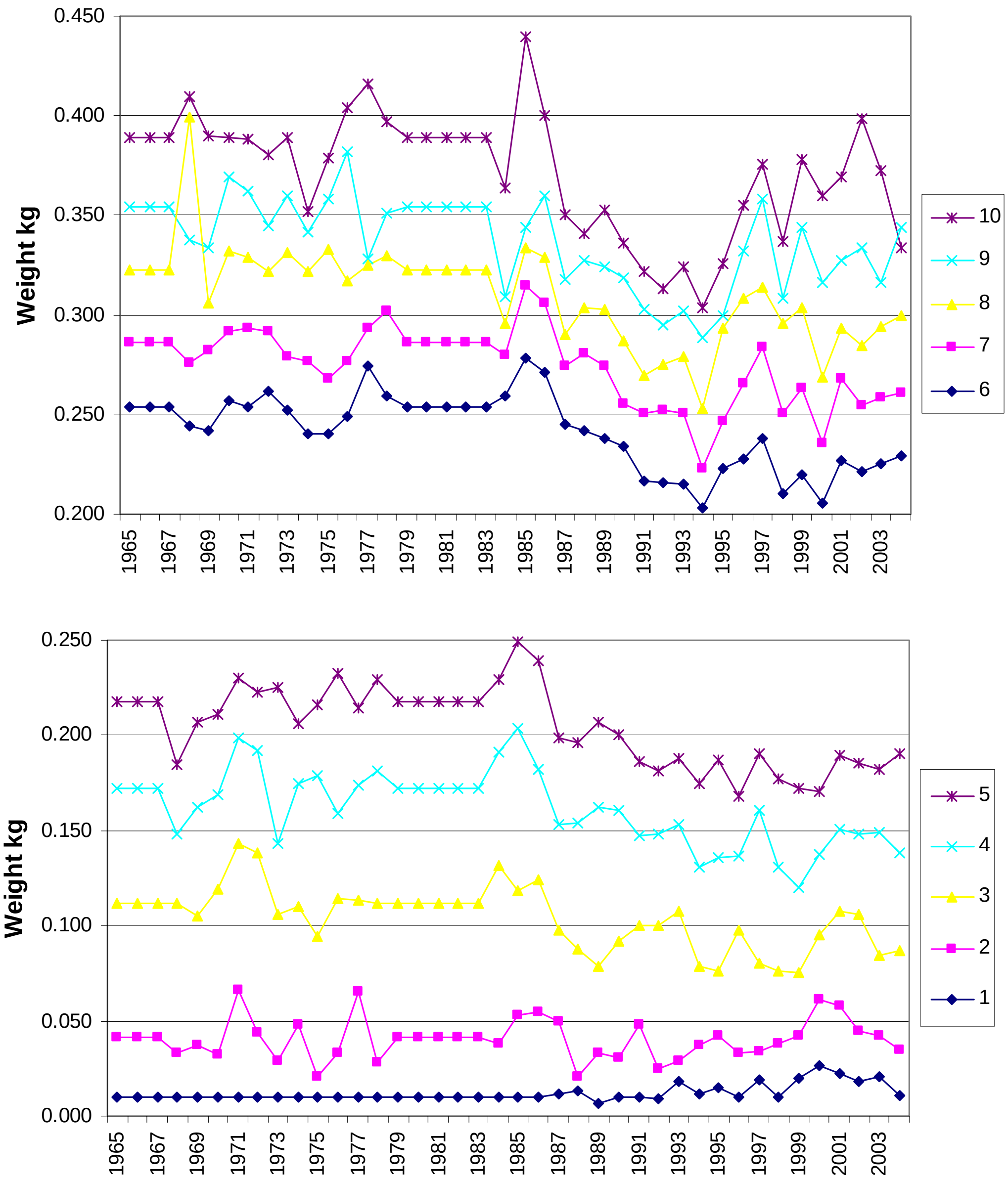


Figure 29. Average weights at age (g) for the SW Nova Scotia / Bay of Fundy component of the 4WX herring fishery (fishery weighted) for 1965-2004.

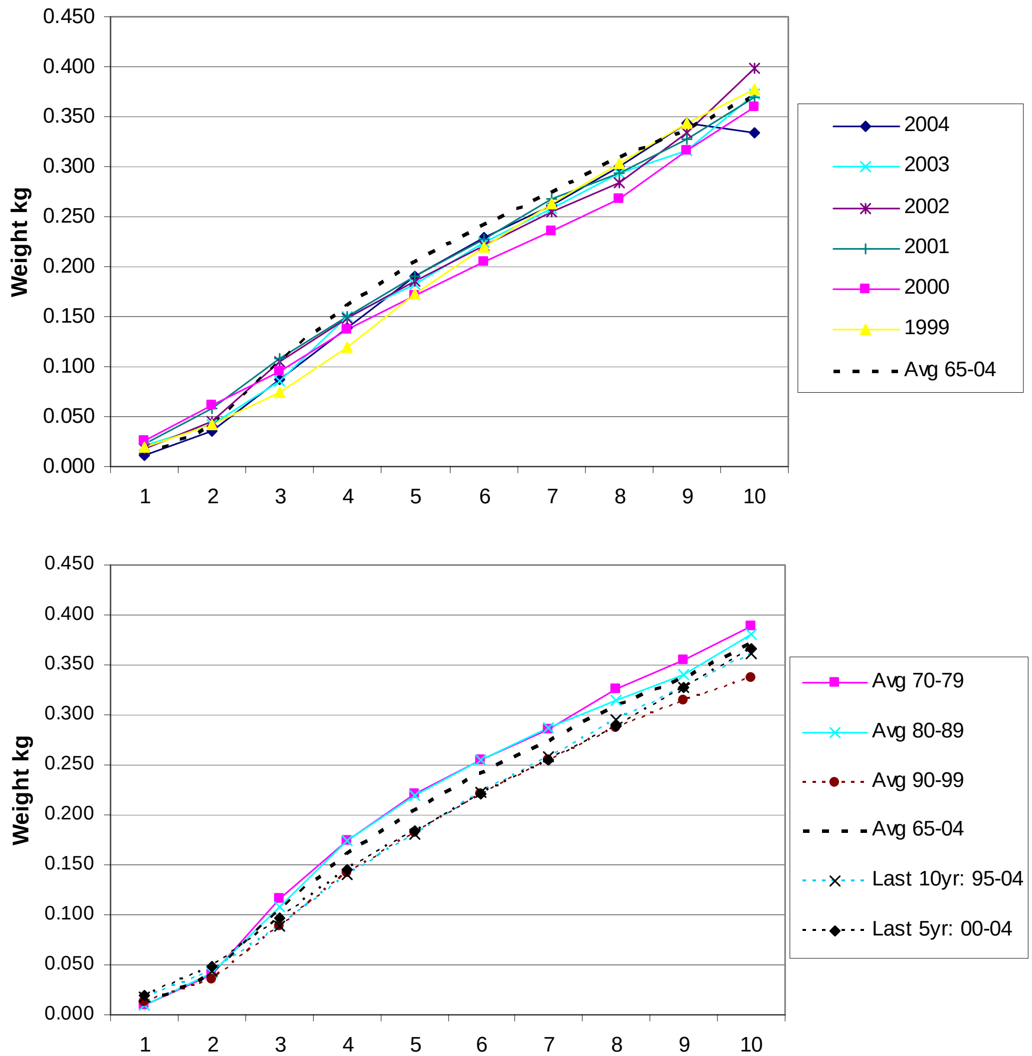


Figure 30. Average weights at age (g) for the SW Nova Scotia / Bay of Fundy component of the 4WX herring fishery (fishery weighted) for a) most recent 5 years individually (top panel) and b) for 10 year time periods since 1970 and also the most recent 5 and 10 year periods.

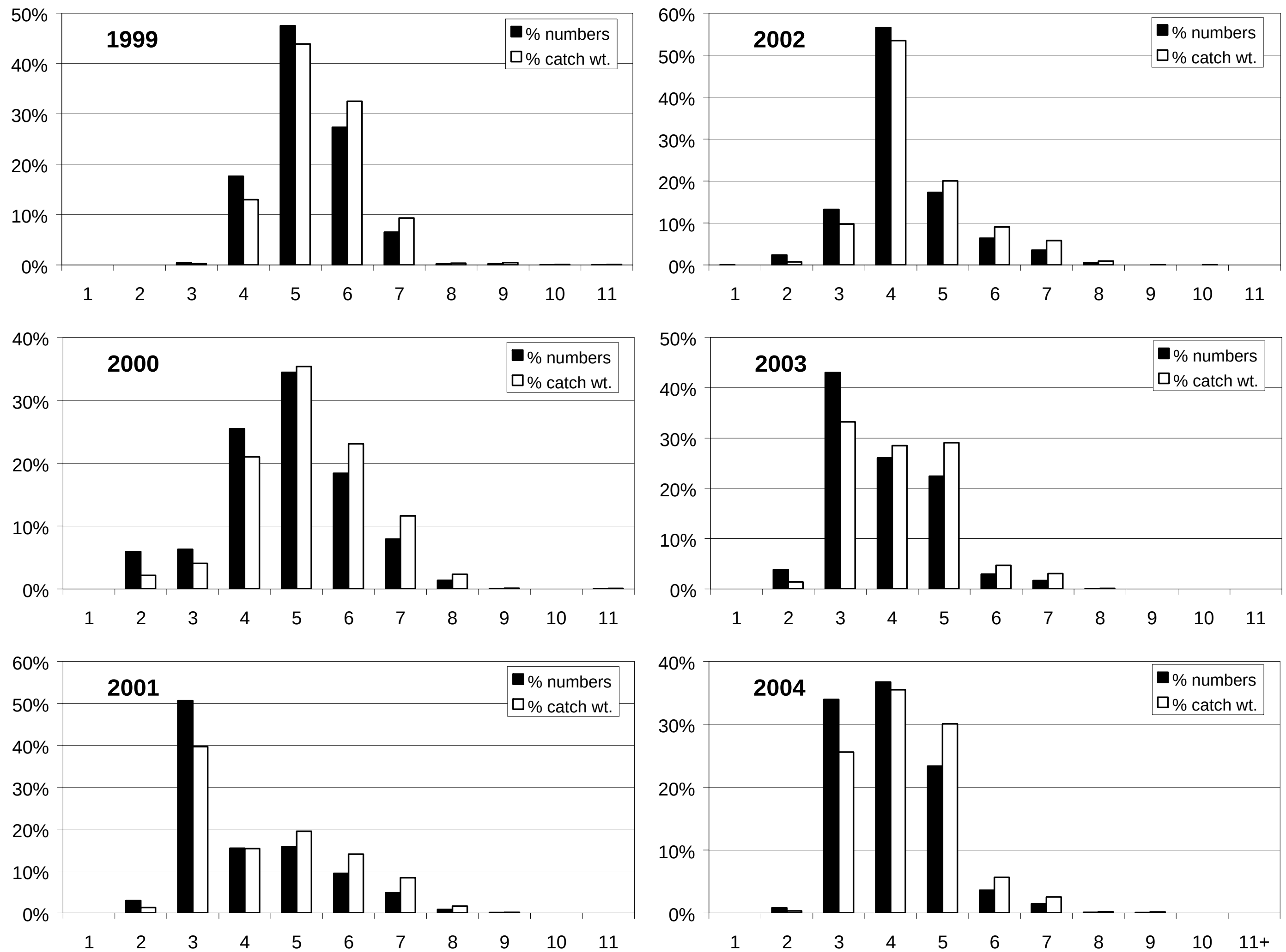


Figure 31. Catch at age by year from the herring acoustic surveys for the overall SW Nova Scotia/Bay of Fundy spawning component.

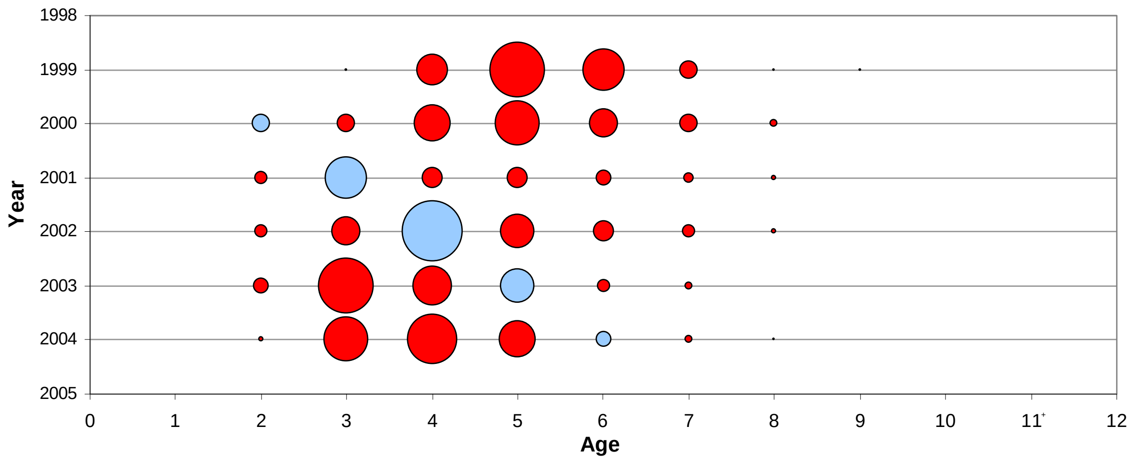


Figure 32. Acoustic survey catch at age (numbers) for the SW Nova Scotia / Bay of Fundy spawning component.

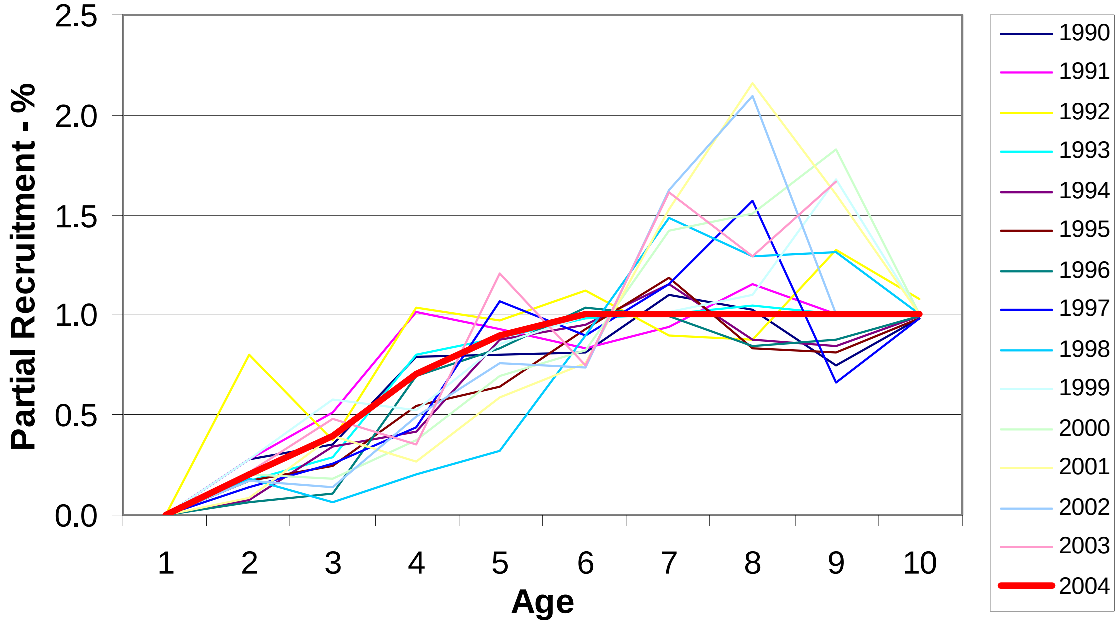


Figure 33. Exploitation pattern at age. The 2004 line represents the assumptions made in the terminal year.

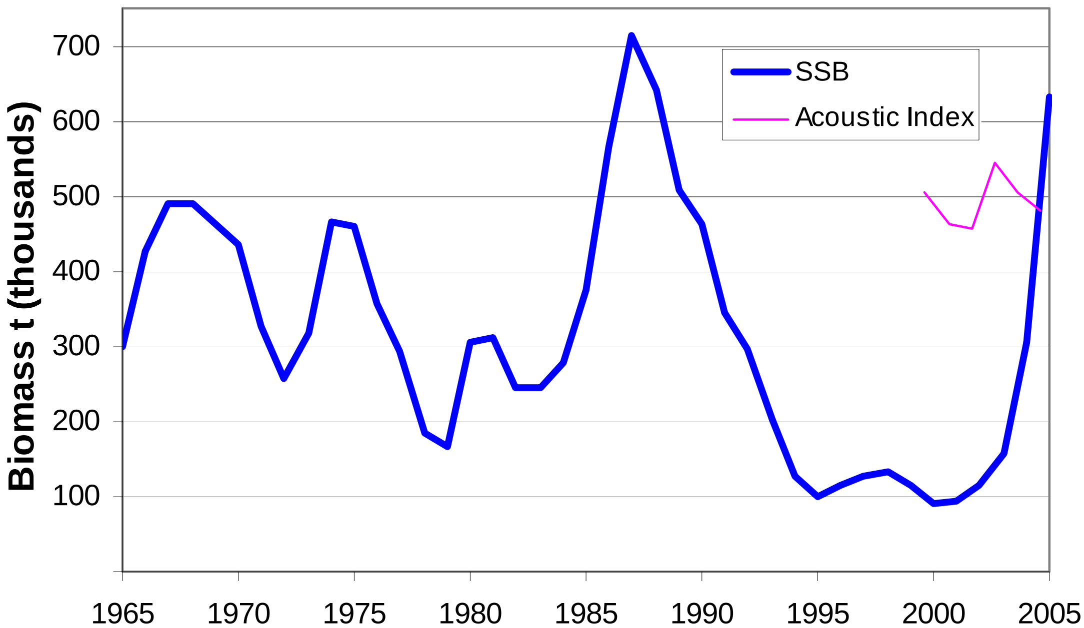


Figure 34. Spawning stock biomass from tuned VPA with index as Absolute.

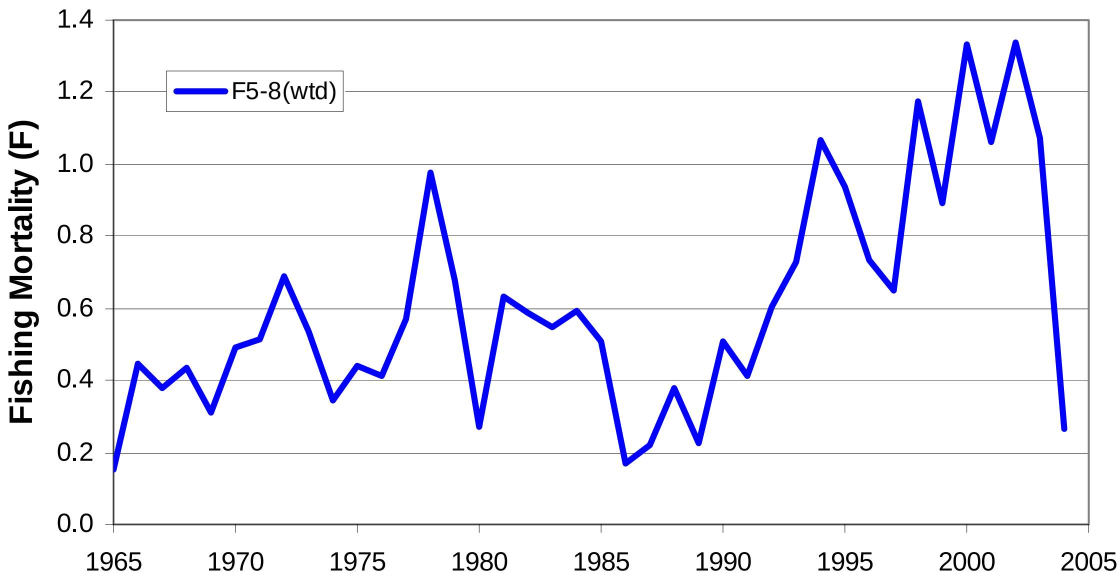


Figure 35. Fishing mortality from tuned VPA with index as Absolute.

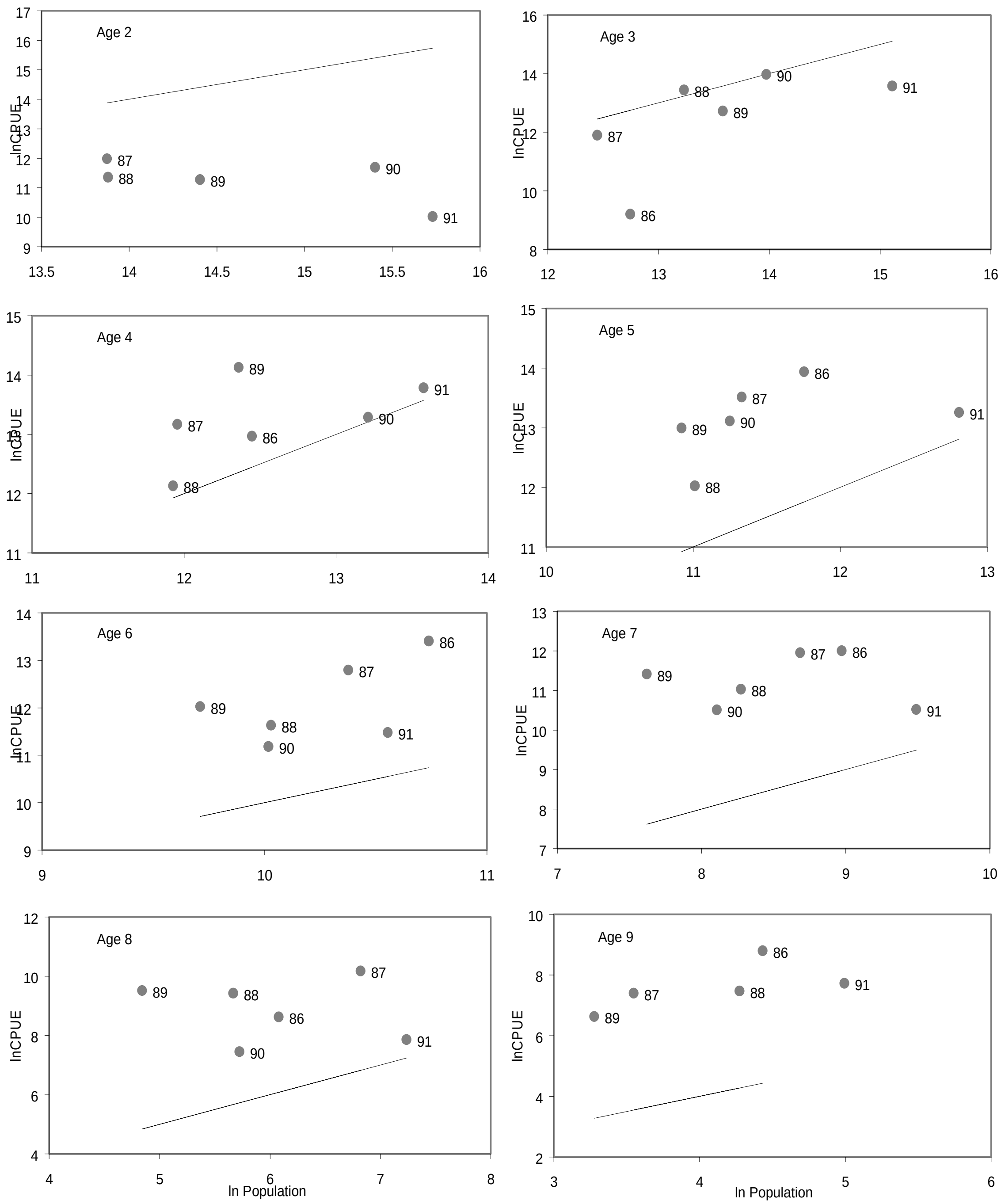


Figure 36. Age by age plots of the observed and predicted ln abundance index versus ln population numbers from a VPA with the acoustic index treated as Absolute.

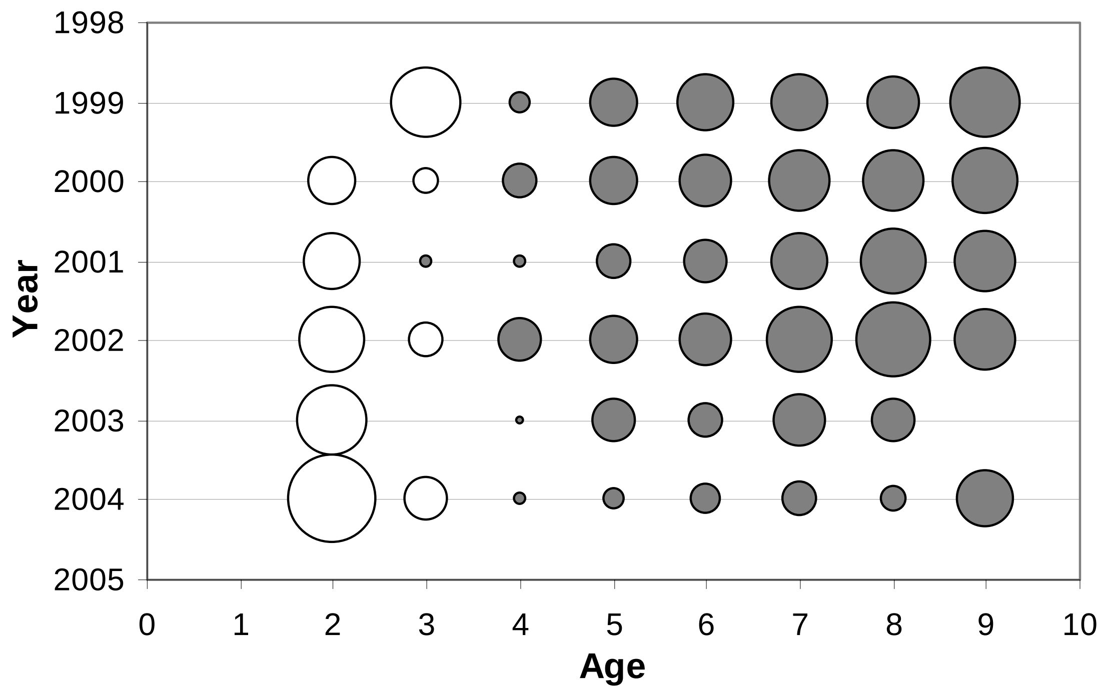


Figure 37. Residuals by age and year from a VPA with the acoustic index treated as Absolute. The open symbols indicate negative values, the solid symbols indicate positive values and the circle size is proportional to the magnitude of the residual from the predicted value.

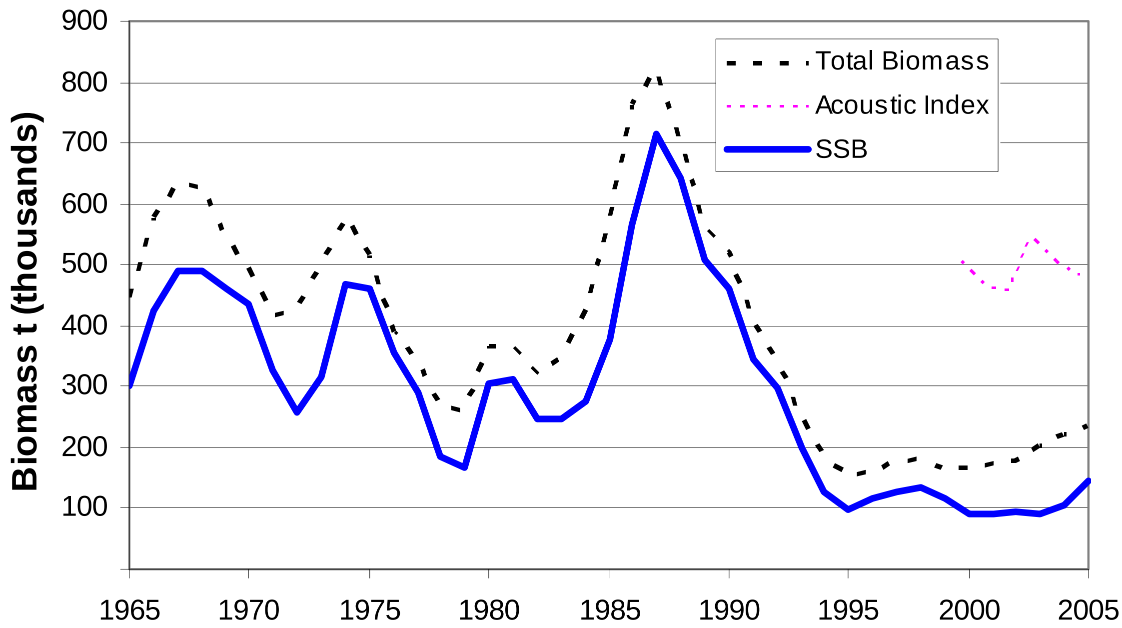


Figure 38. Spawning stock biomass and total biomass from tuned VPA with index as Proportional to population numbers.

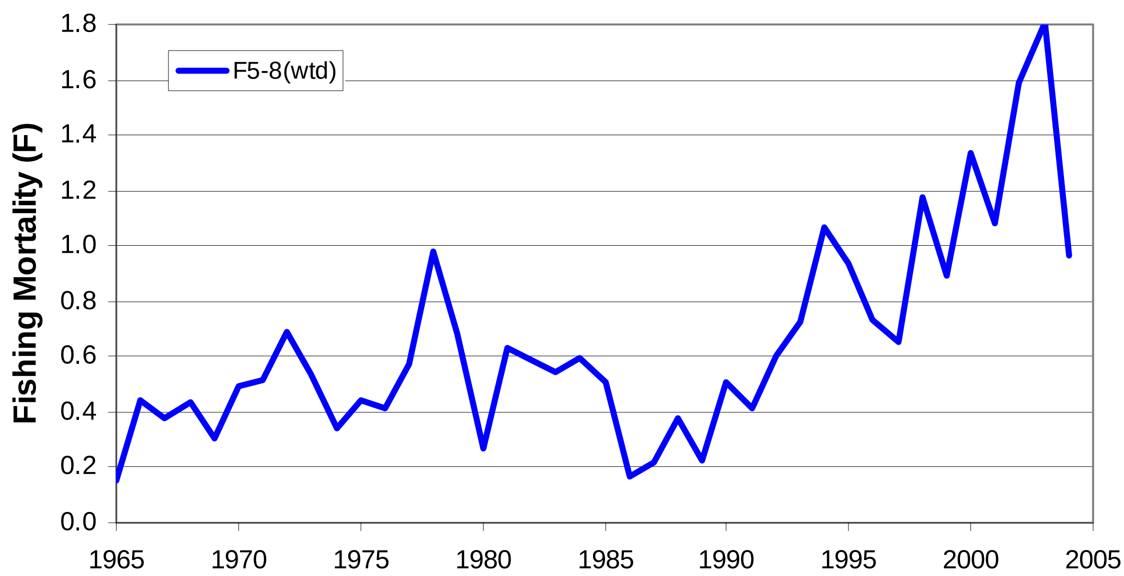


Figure 39. Fishing mortality from tuned VPA with index as Proportional to population numbers.

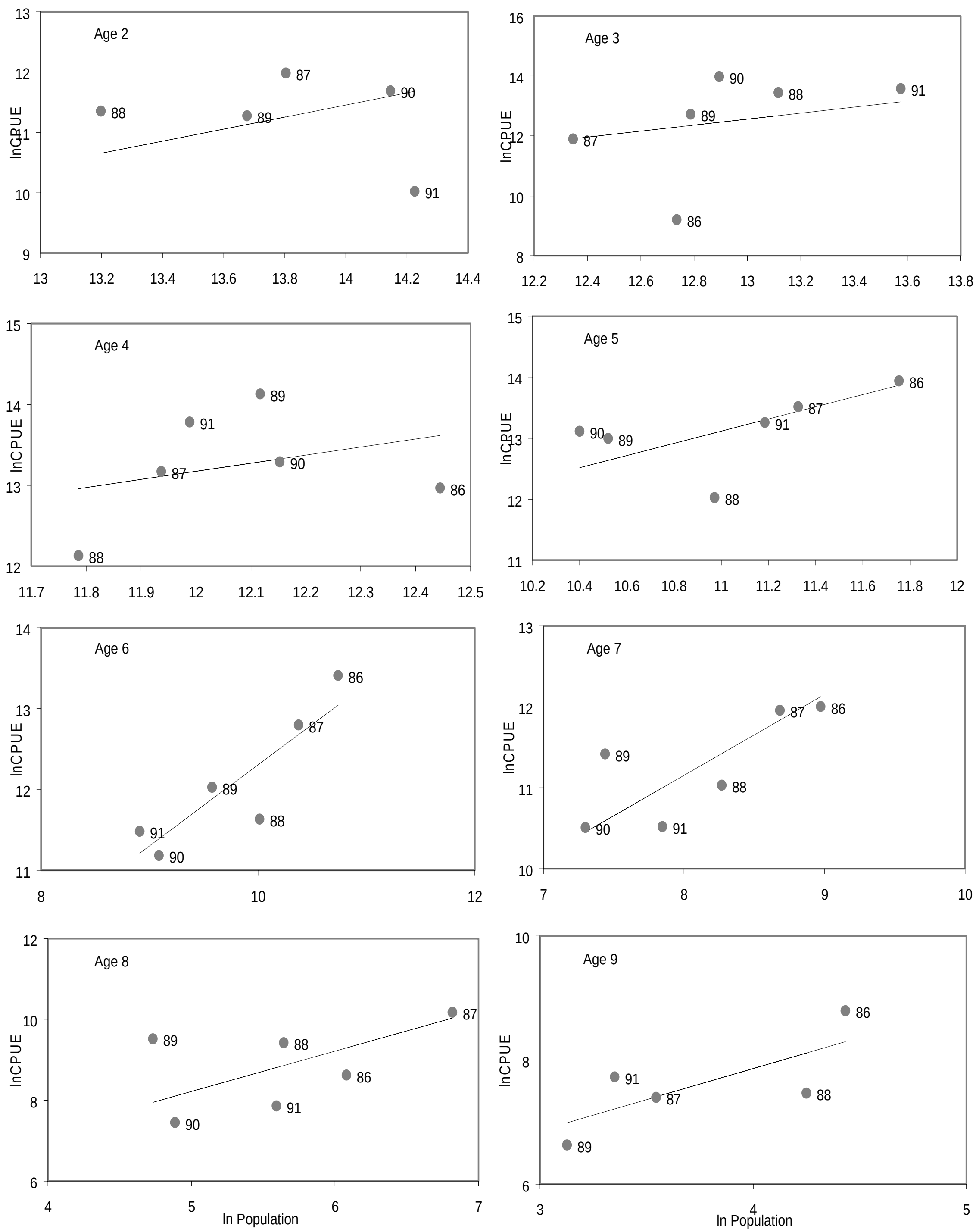


Figure 40. Age by age plots of the observed and predicted ln abundance index versus ln population numbers from a VPA with the acoustic index treated as Proportional to population numbers.

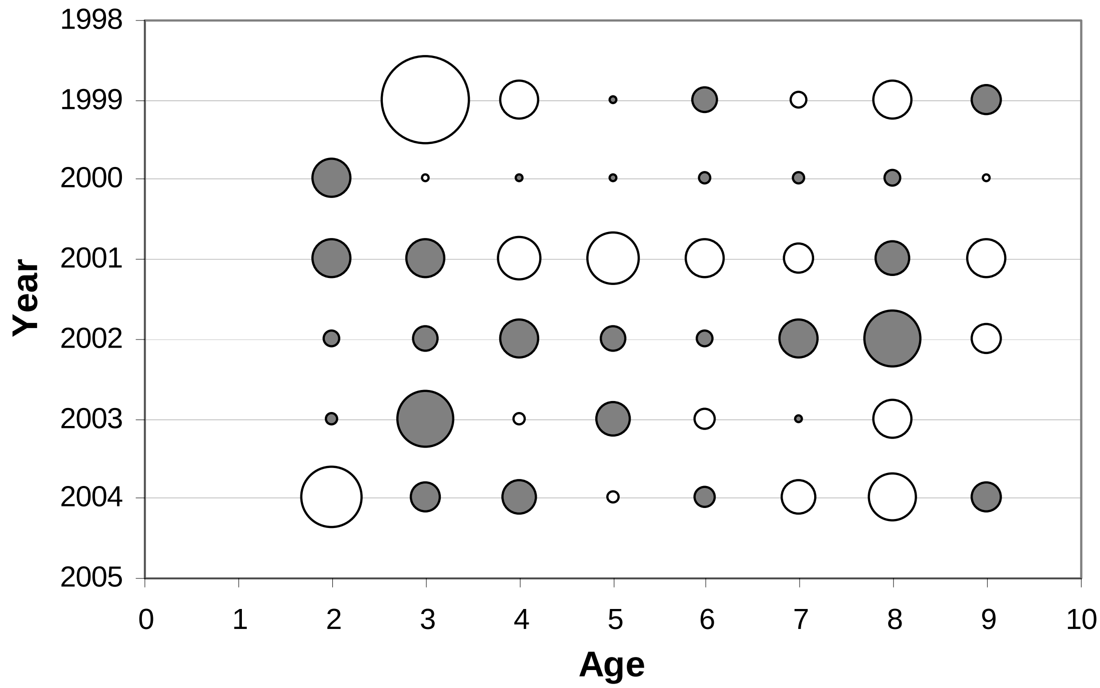


Figure 41. Residuals by age and year from a VPA with the acoustic index treated as proportional to population numbers. The open symbols indicate negative values, the solid symbols indicate positive values and the circle size is Proportional to the magnitude of the residual from the predicted value.

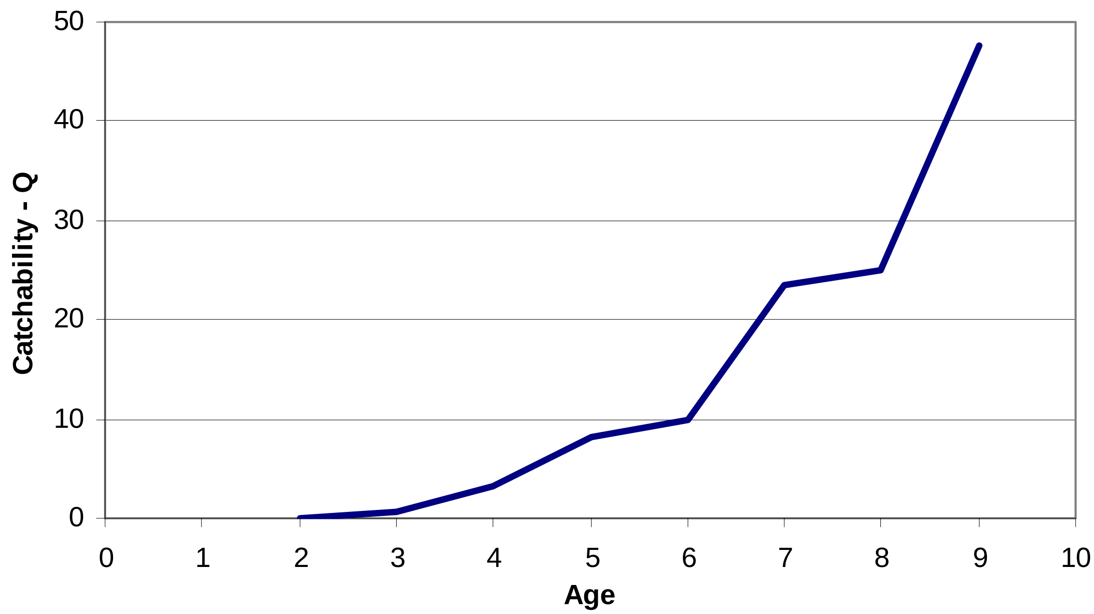


Figure 42. Parameter estimate for q's from VPA with index treated as Proportional to population numbers.

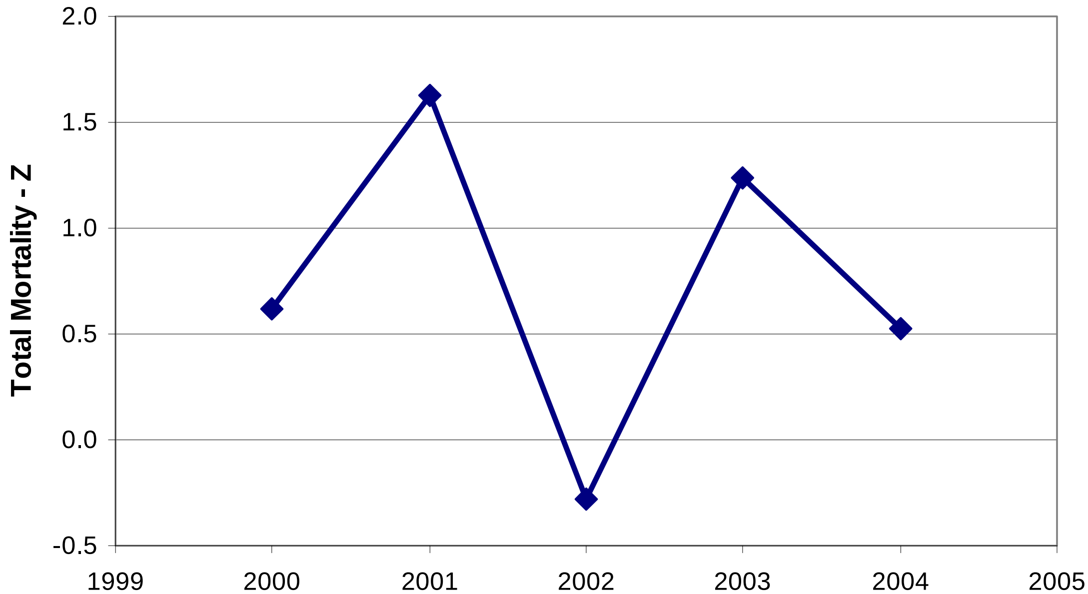


Figure 43. Total mortality estimates (Z=F+M) from acoustic catch at age data for ages 4 to 8 compared with ages 5 to 9 in the following year.

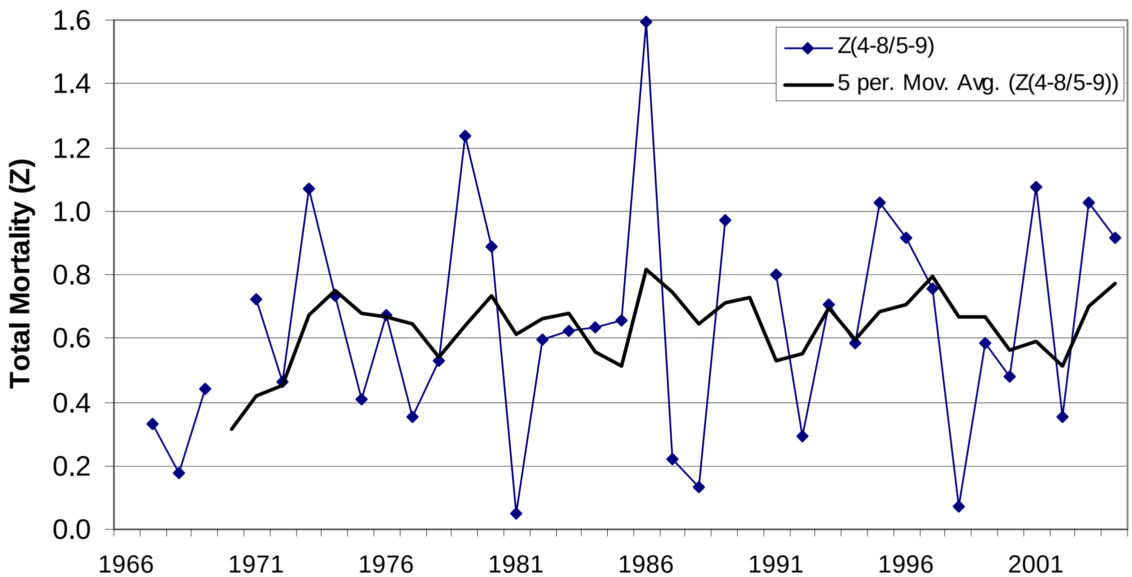


Figure 44. Total mortality estimates (Z=F+M) from the fishery catch at age for ages 4 to 8 compared ages 5-9 in the following year. The negative values have been excluded and a 5 year running average is shown for the series.

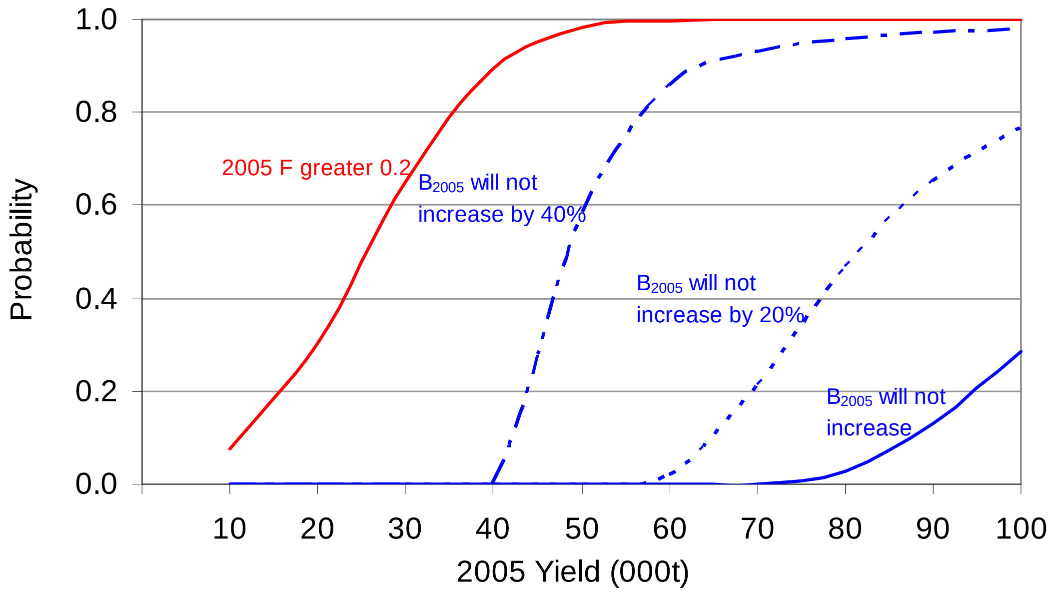


Figure 45. Probability (risk) of the 2005 fishing mortality exceeding the F=0.2 and of the 2006 ages 1+ biomass being greater than the 2005 biomass by 0%, 20% and 40% at various quotas.

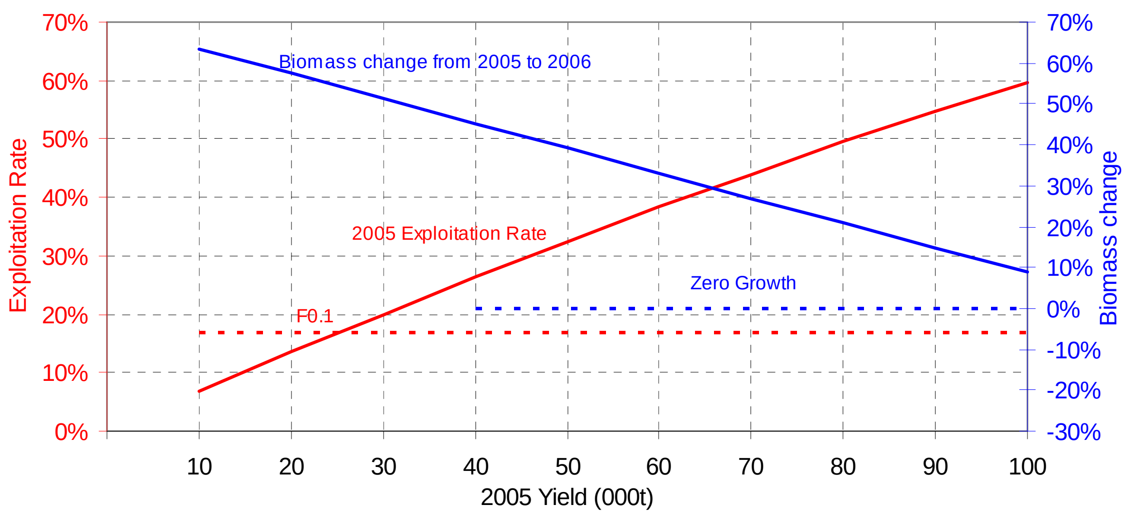


Figure 46. Exploitation rates (%) and ages 1+ biomass change from 2005 to 2006 for various quotas (yield) in 2005. The F0.1 reference level (F=0.2 or 17% exploitation) and zero growth levels are also indicated.

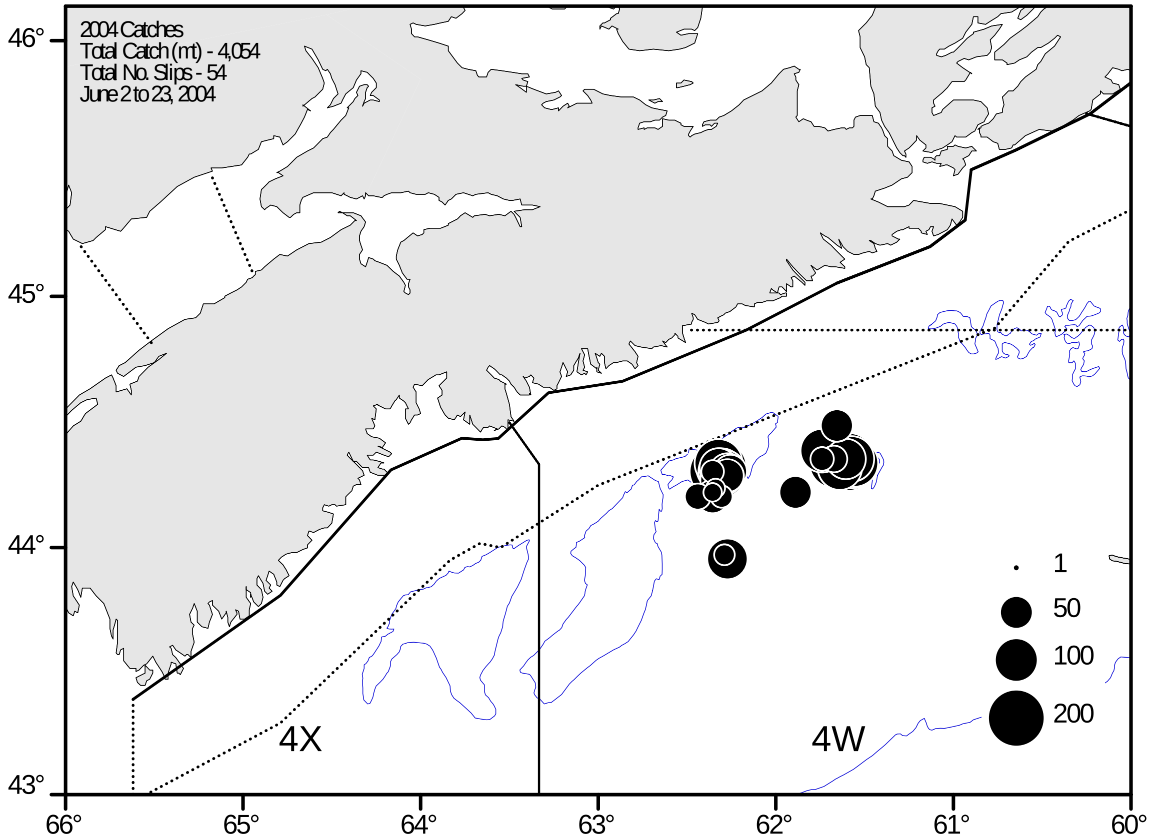


Figure 47. Herring purse seine catches on the offshore Scotian Shelf banks for 2004 with embayment and offshore 25 mile lines shown.

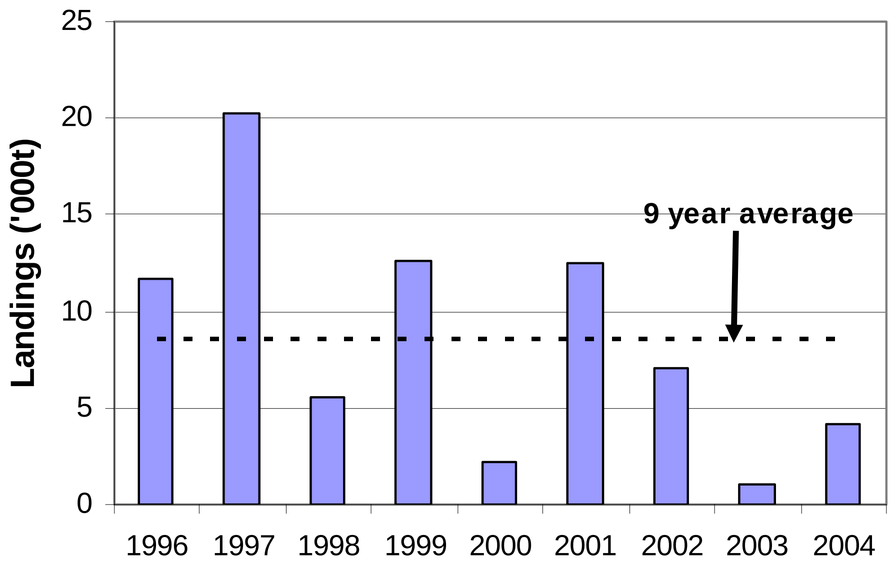


Figure 48. Scotian Shelf Banks landings from purse seine since 1996 with the average for the period.

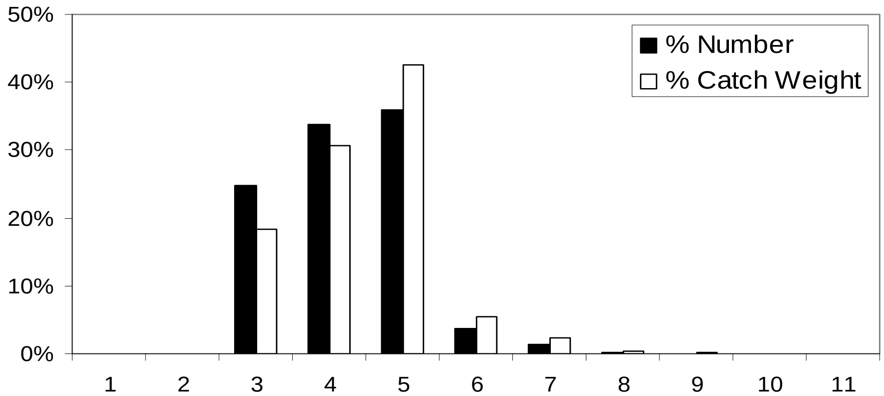


Figure 49. Catch at age for 2004 for the offshore Scotian Shelf banks purse seine fishery (% numbers and % weight).

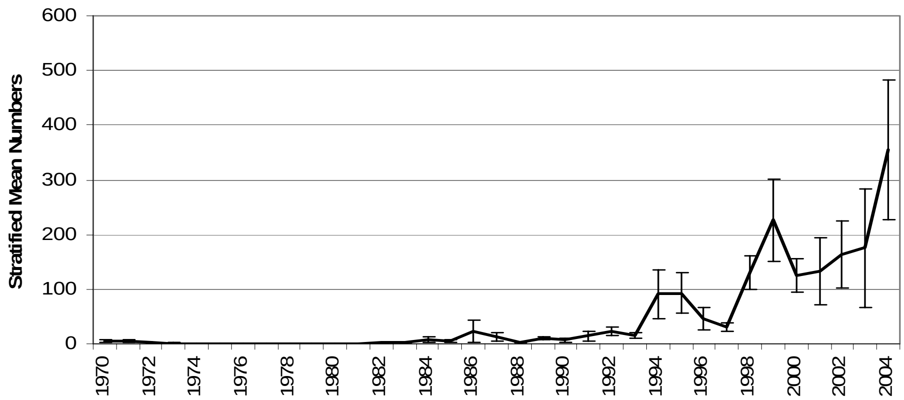


Figure 50. Number of herring caught per standard tow in the DFO summer bottom trawl survey of the offshore Scotian Shelf Banks, 1983 to 2004 (strata 55-78; from Sable Island to Baccaro Line).

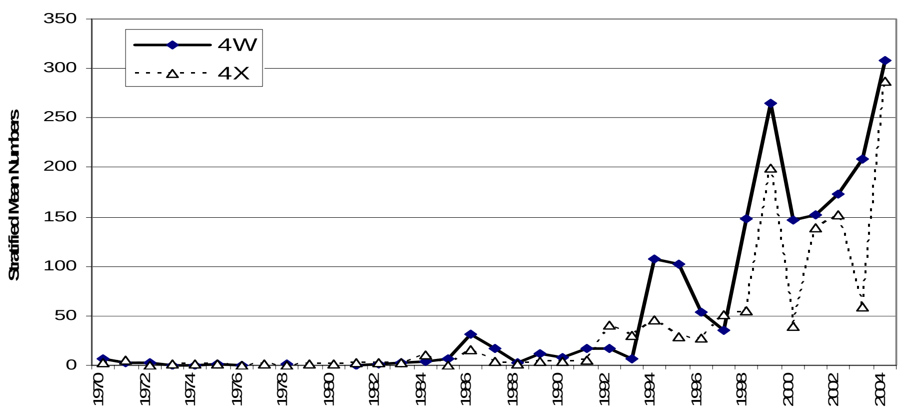


Figure 51. Number of herring caught per standard tow in the DFO summer bottom trawl research survey for 1970 to 2004 for area 4W (strata 53-66) and area 4X (strata 70-95).

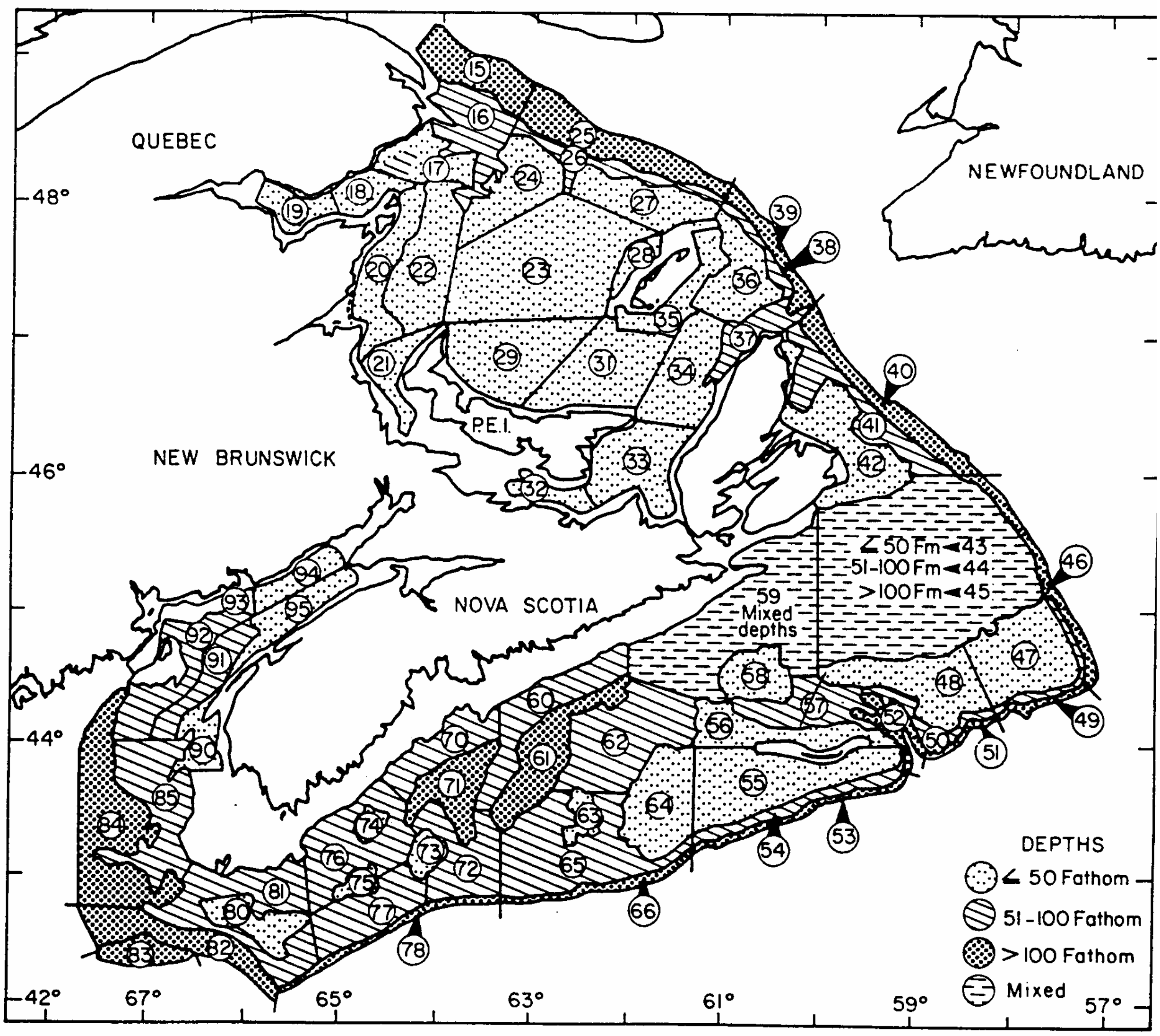


Figure 52. Research bottom trawl survey strata in NAFO Divisions 4T, 4V, 4W and 4X (from Doubleday, 1981).

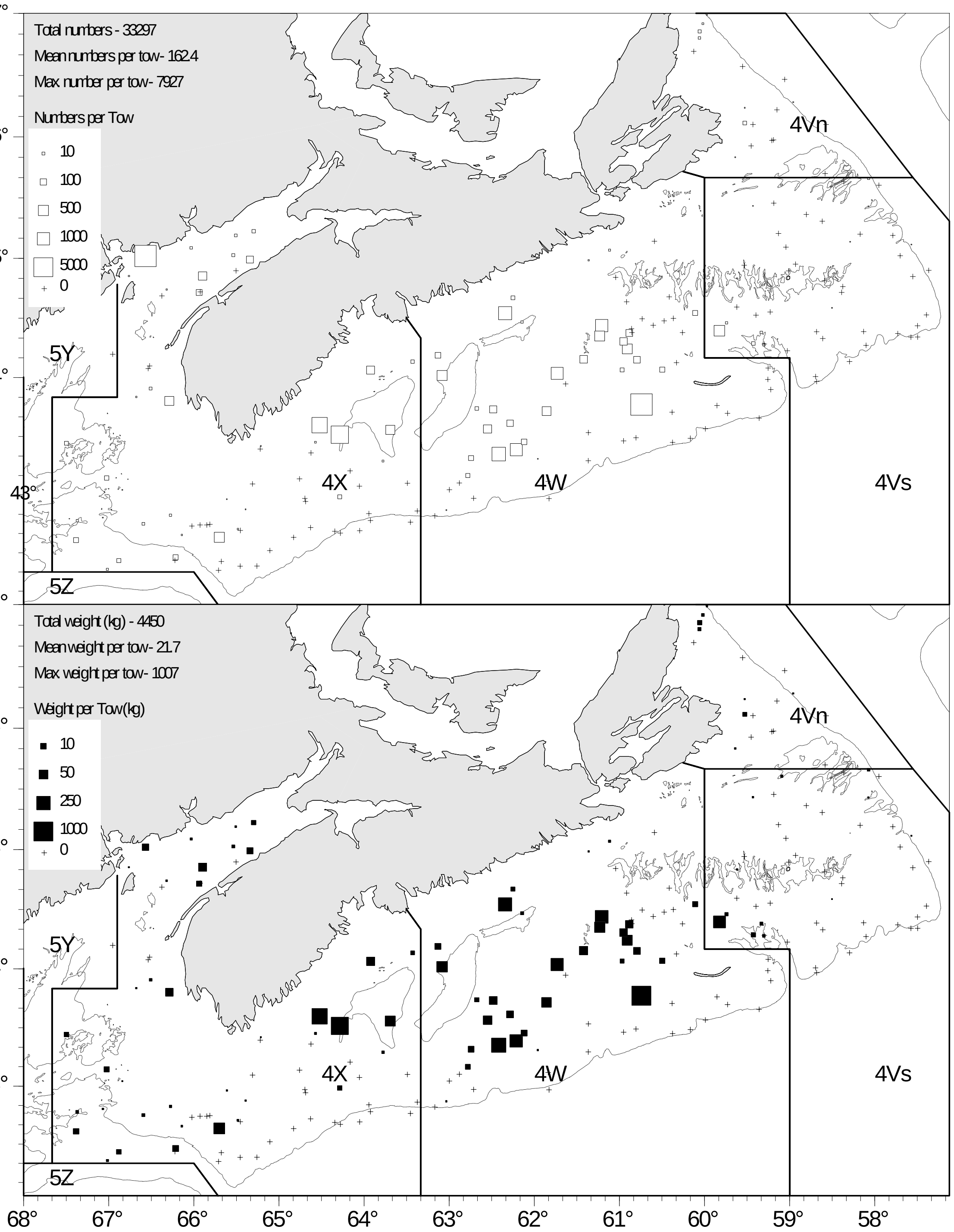


Figure 53. Herring catches in number and weight per tow for the 2004 DFO summer bottom trawl research survey (TEL2004-529/530: July 5-30, 2004).

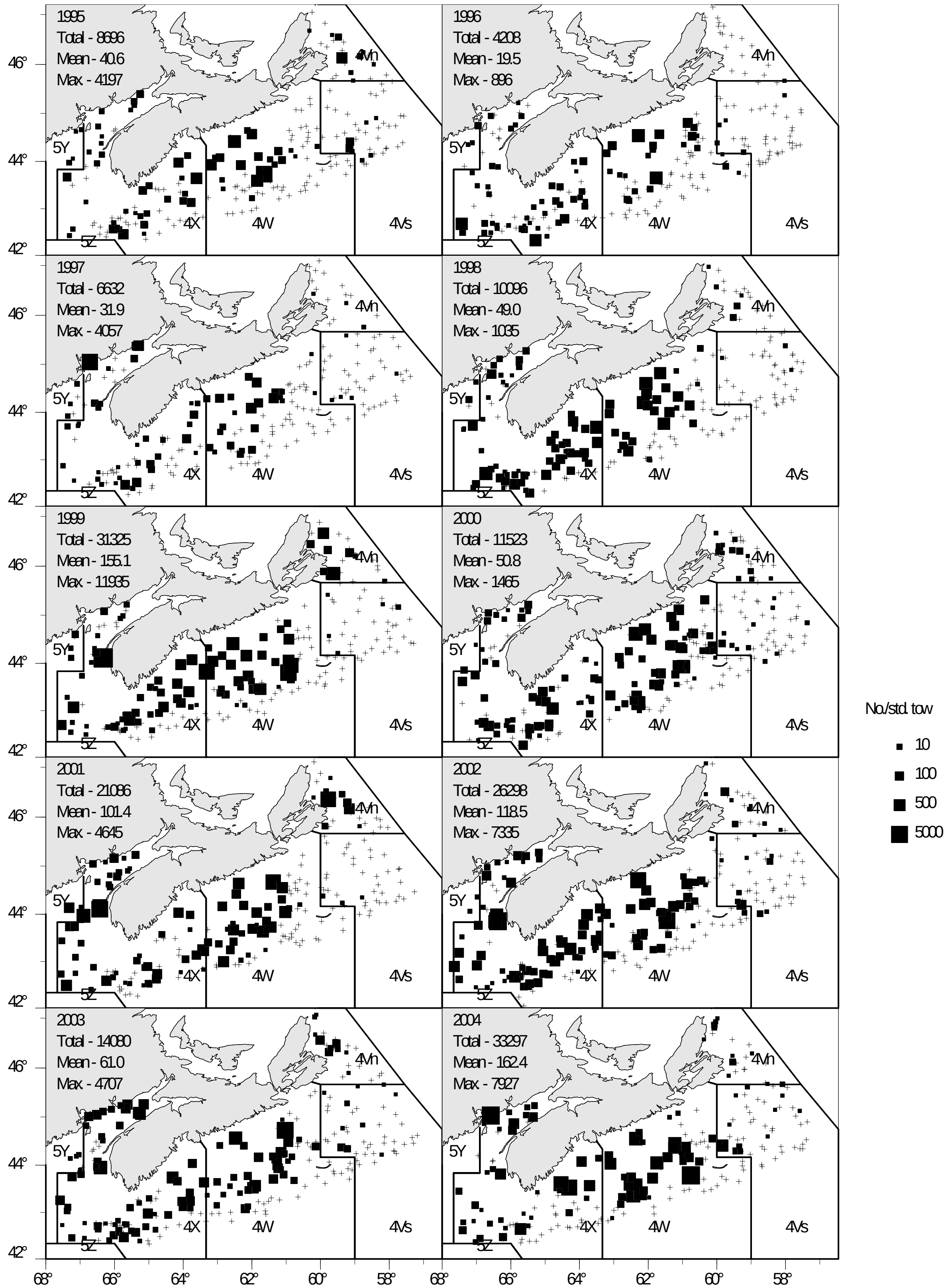


Figure 54. Herring catches (numbers per standard tow) from the DFO summer bottom trawl research survey for 1995-2004.

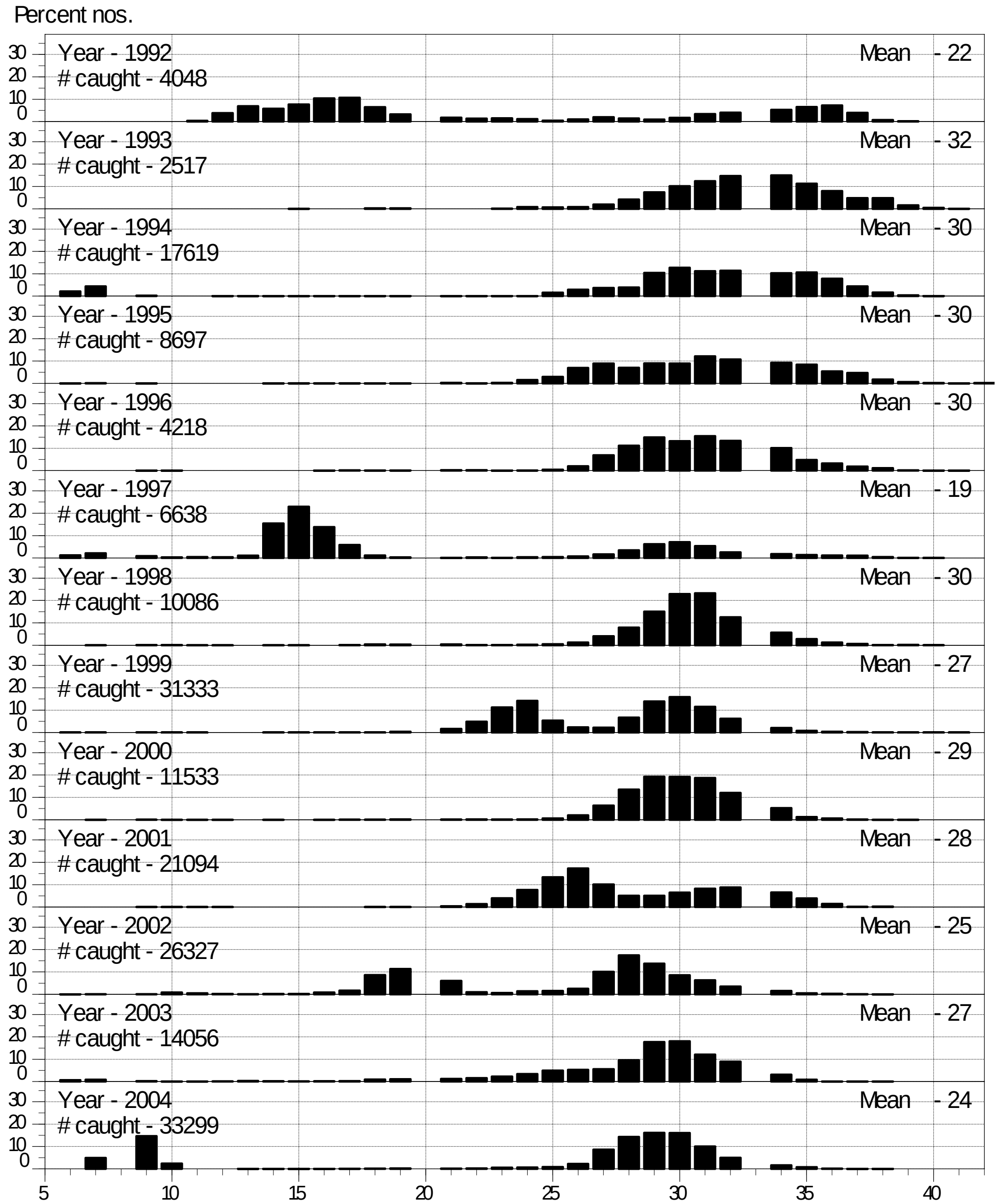


Figure 55. Overall herring size distribution for all strata combined in the DFO summer bottom trawl research surveys from 1992 to 2004 (sizes converted from fork length to total length in cm).

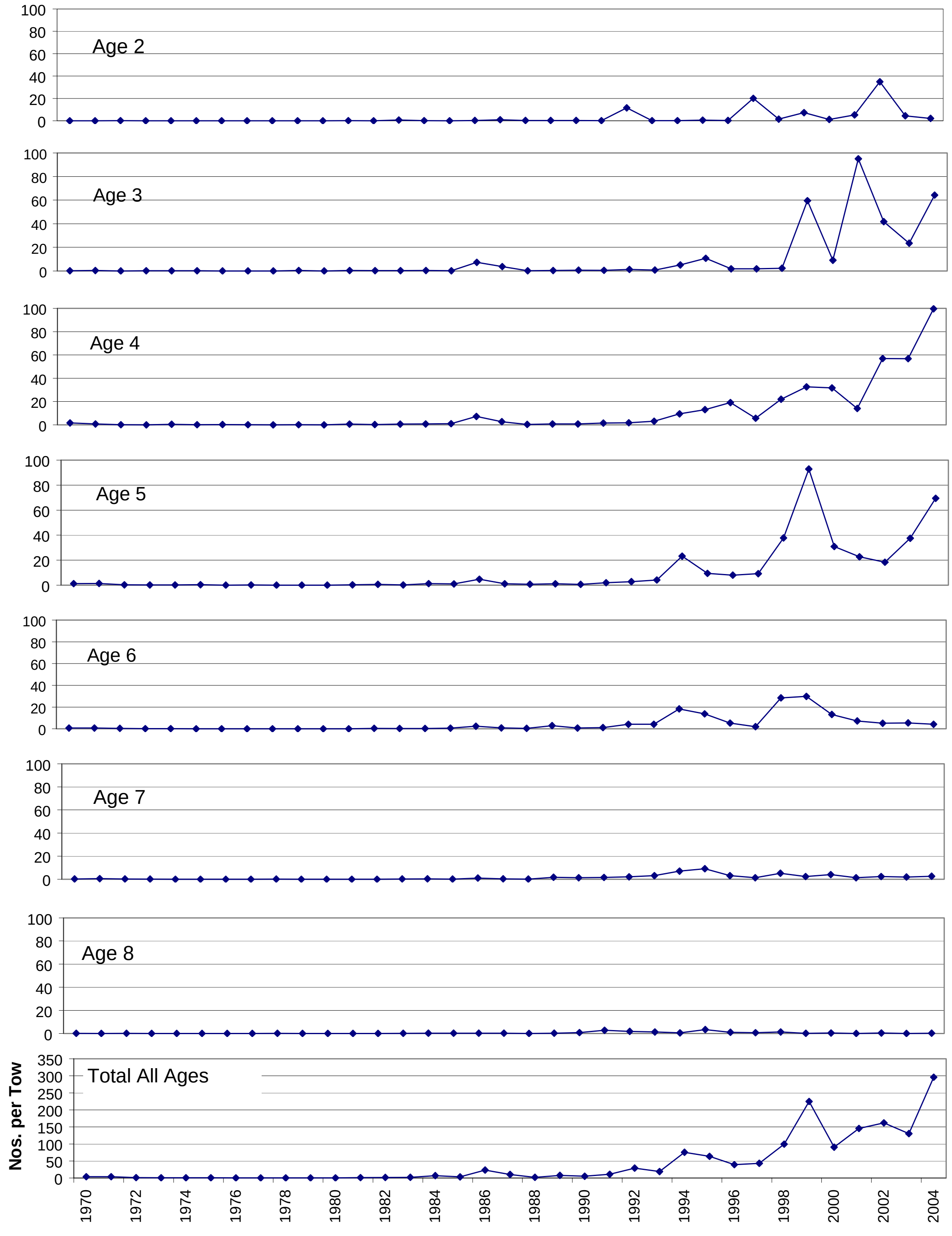


Figure 56. Stratified herring abundance by age and overall for all ages combined (numbers per tow) from the DFO summer bottom trawl research survey for areas 4WX (strata 53 to 95).

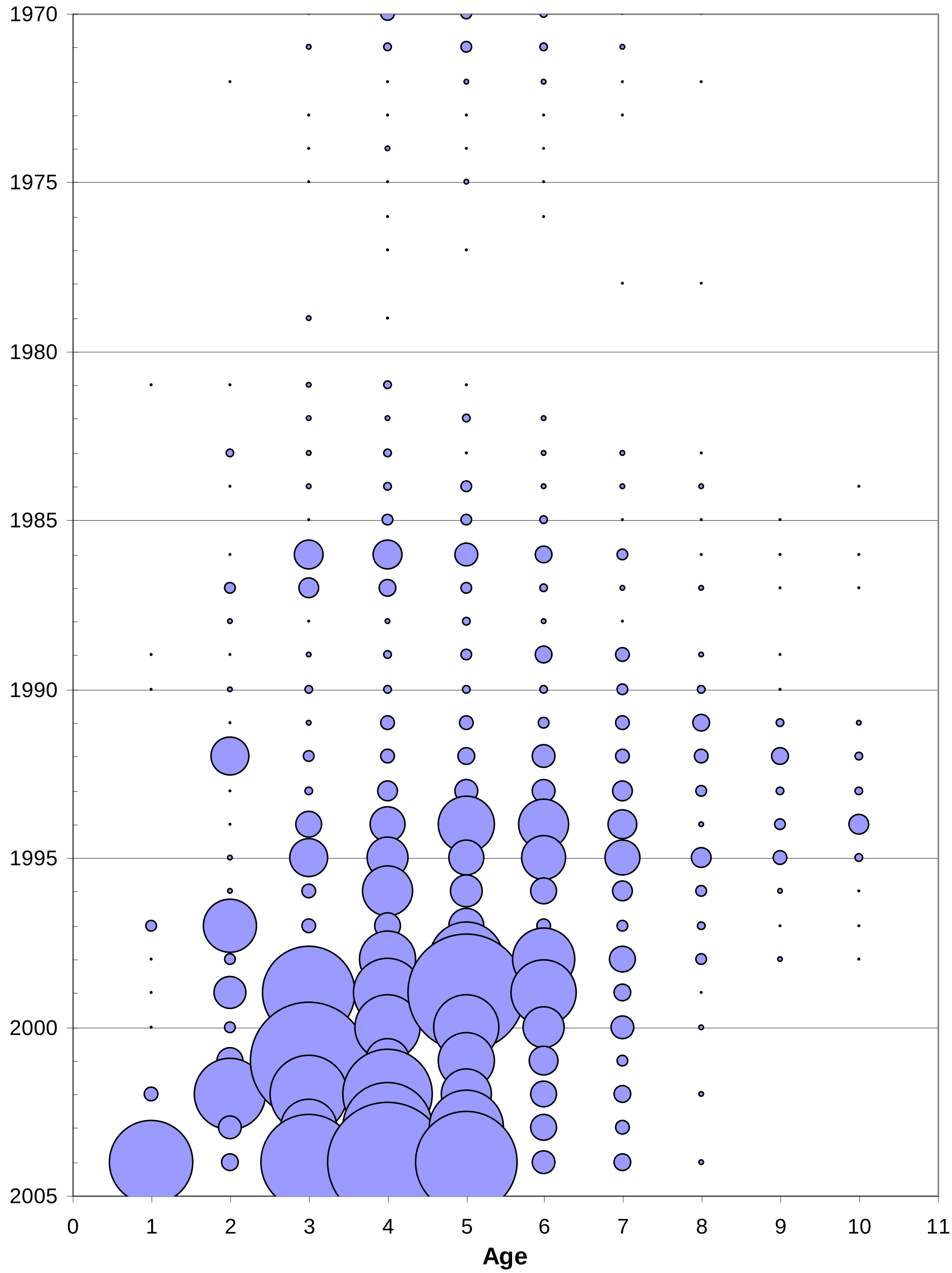


Figure 57. Stratified herring abundance by age from 1970 to 2004 (stratified numbers per tow) from the DFO summer bottom trawl survey for areas 4WX (strata 53 to 95).

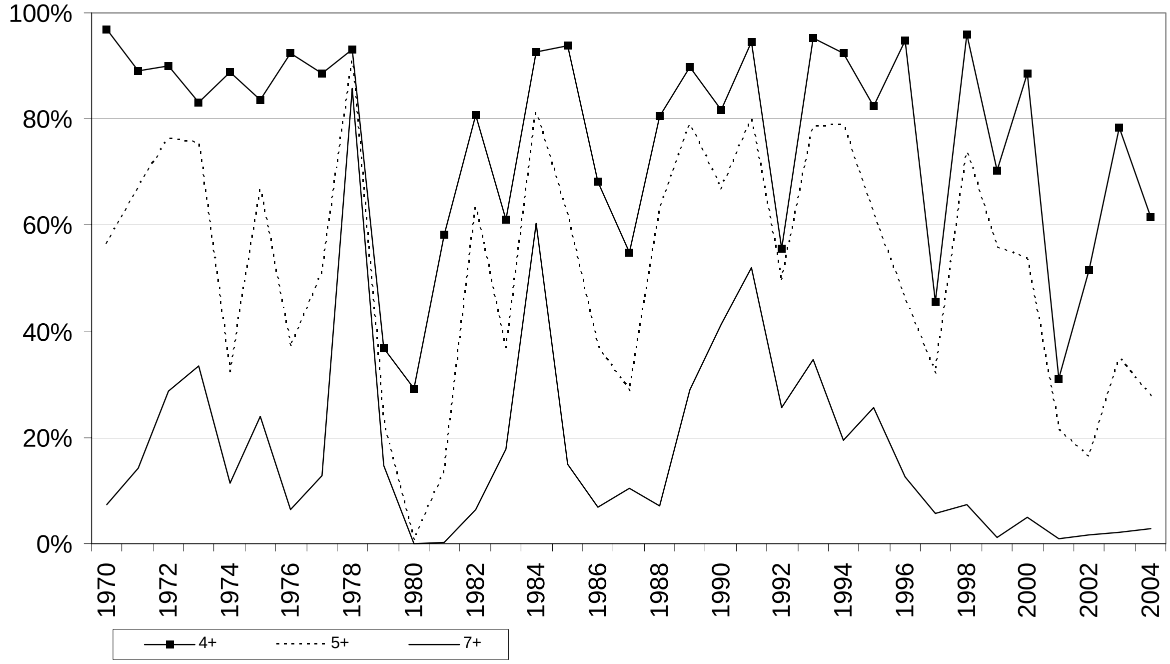


Figure 58. Overall proportions (percent numbers) of ages 4+ and 7+ from the DFO summer bottom trawl research survey for areas 4WX (strata 53 to 95) for the period 1970 to 2004.

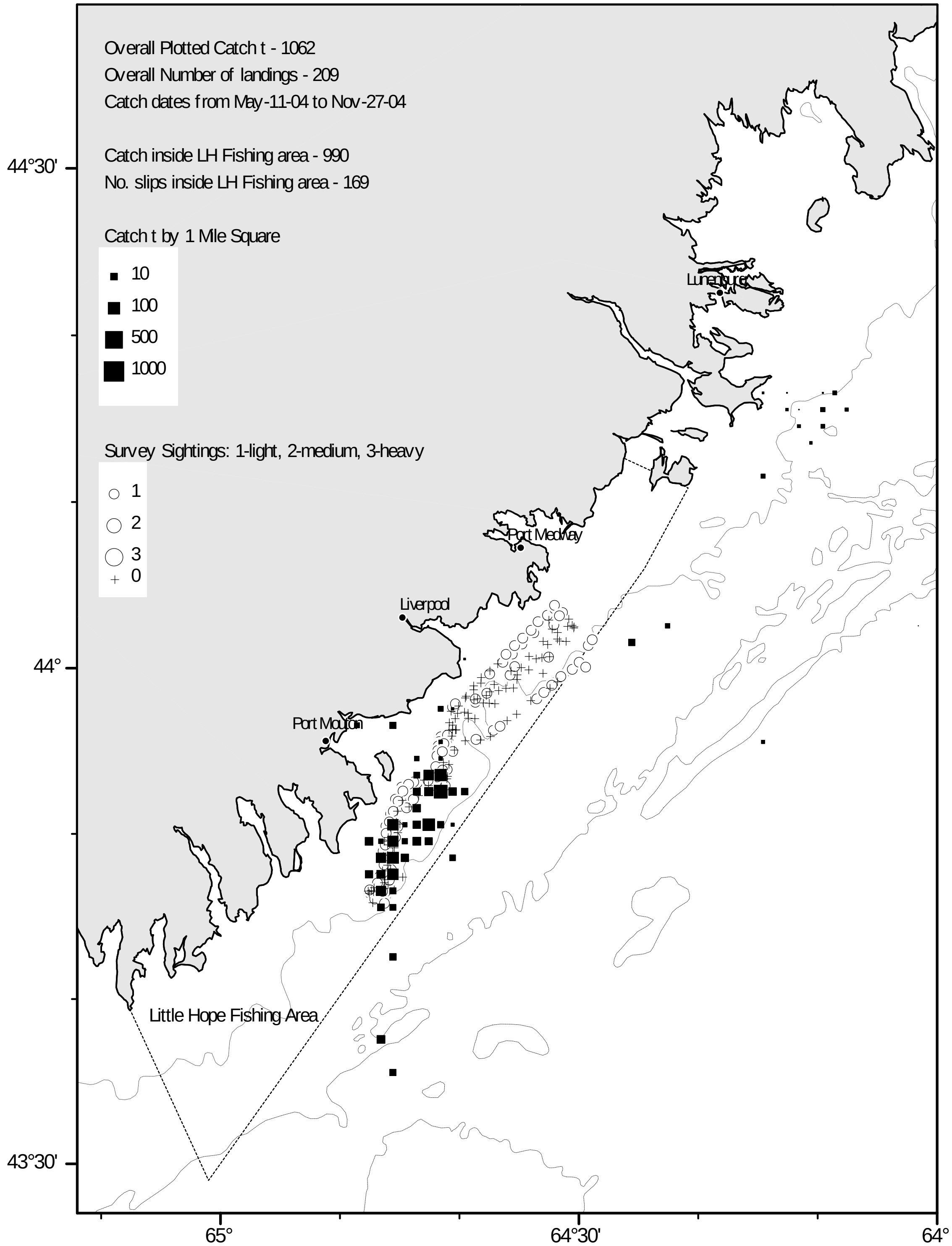


Figure 59. Little Hope/Port Mouton area herring gillnet catches (filled boxes) and survey observations (open circles) for the 2004 spawning fishery. Overall catches and catches inside the Little Hope Fishing area are determined separately.

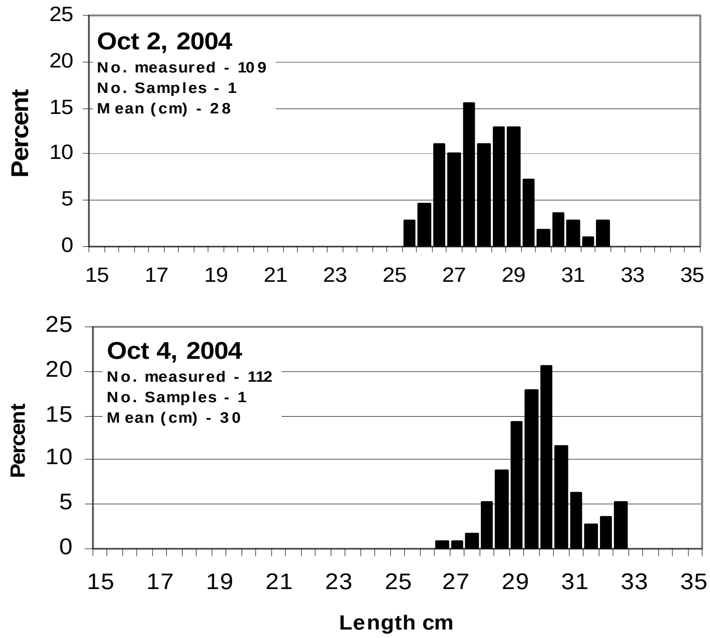


Figure 60. Length frequency herring samples from the Little Hope/Port Mouton area in 2004.

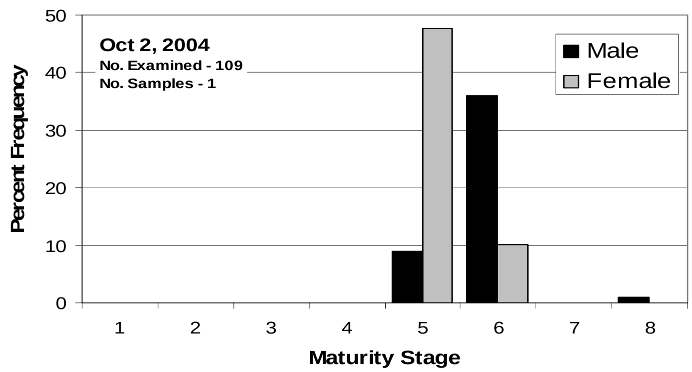


Figure 61. Maturity stages of herring sampled from the Little Hope/Port Mouton area in 2004.

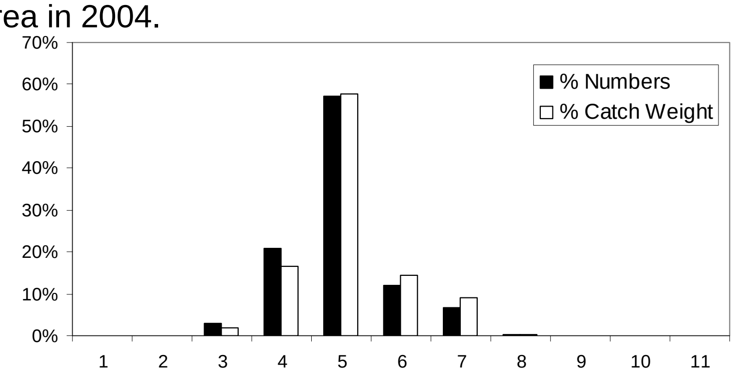


Figure 62. Catch at age (% numbers and % weight) of herring from the Little Hope/Port Mouton gillnet fishery in 2004.

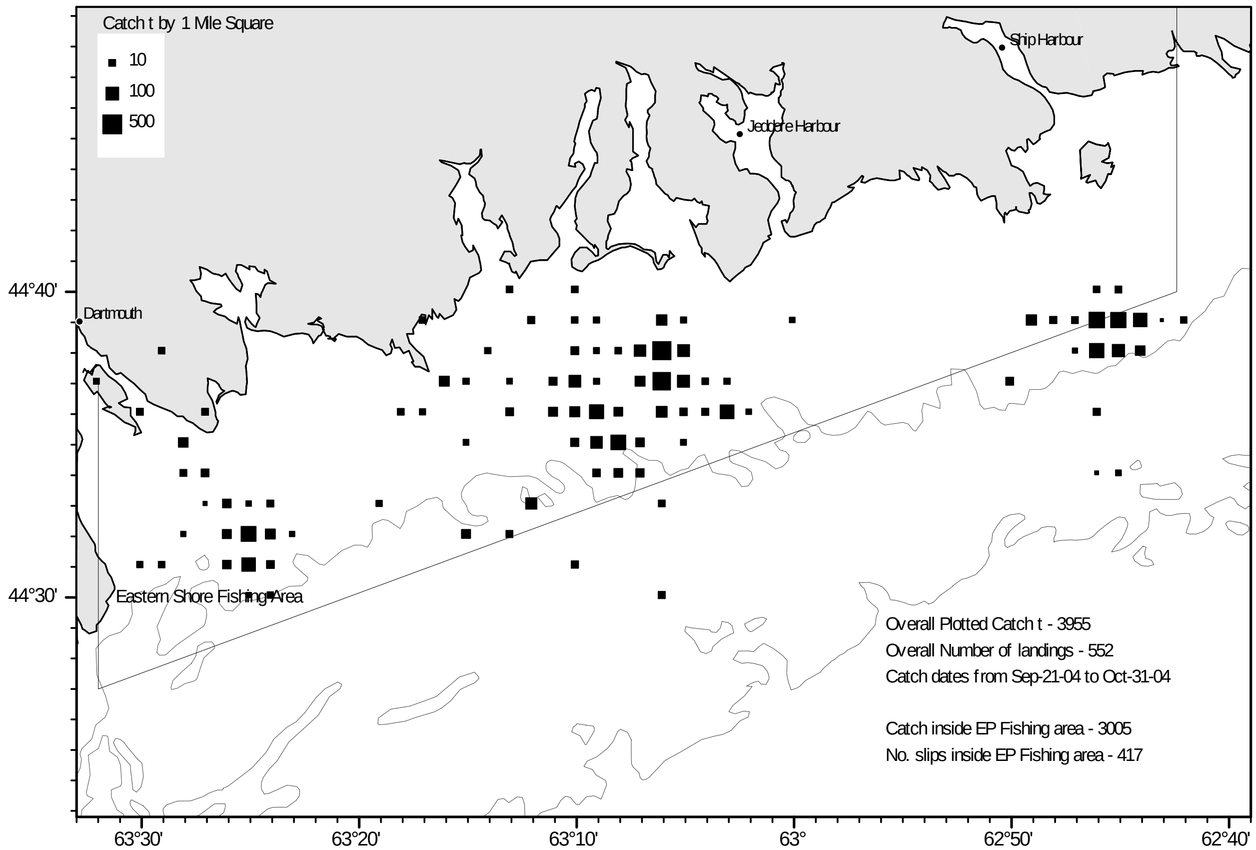


Figure 63. Eastern Shore/Halifax herring gillnet catches (filled boxes) and survey observations (open circles) for the 2004 spawning fishery. Overall catches and catches inside the Eastern Shore Fishing area are determined separately.

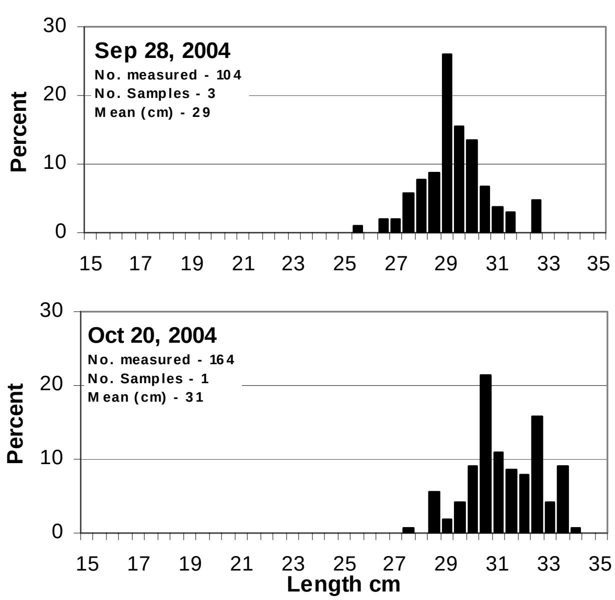


Figure 64. Daily length frequency of herring sampled from the Eastern Shore (east of Halifax) area in 2004.

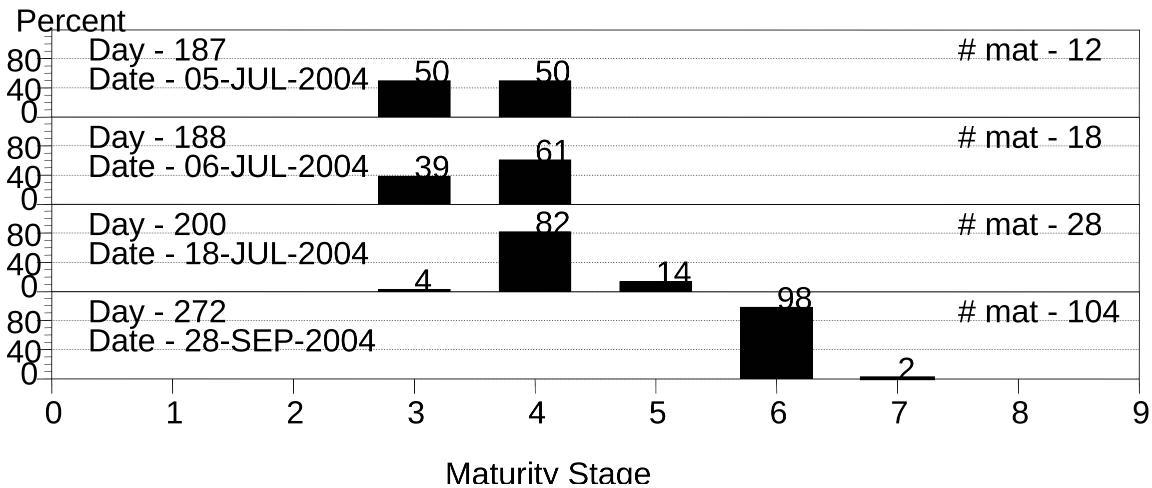


Figure 65. Daily maturity stages of herring sampled from the Eastern Shore and offshore banks (NAFO area 4Wk) in 2004.

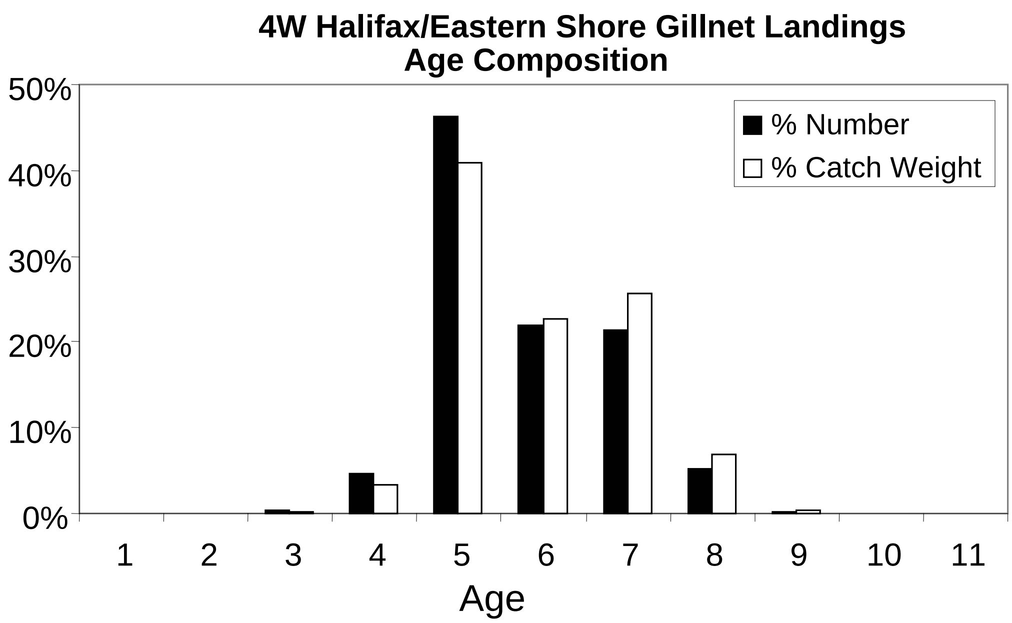


Figure 66. Herring catch at age (% numbers and % weight) for the 2004 Eastern Shore gillnet fishery.

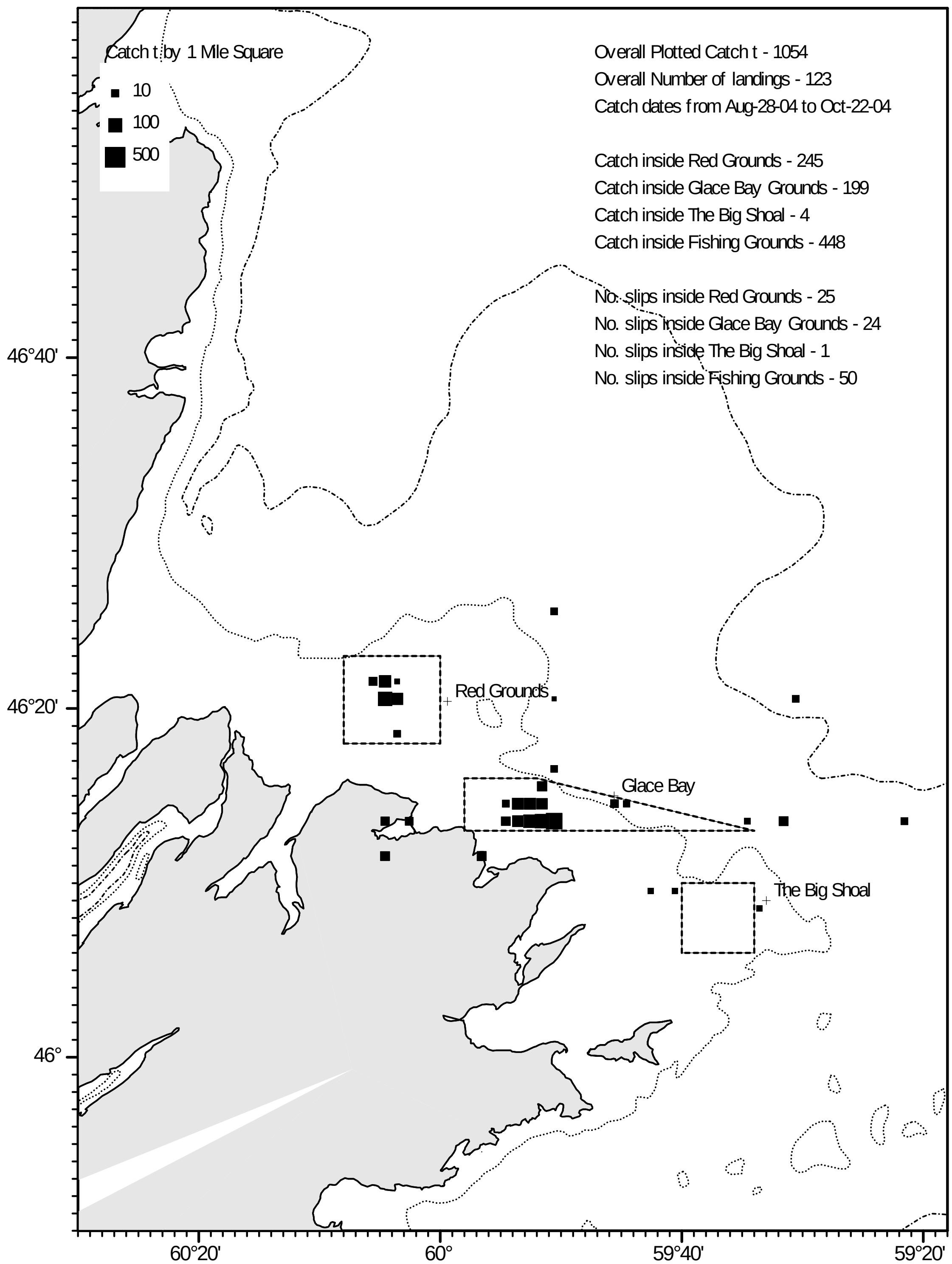


Figure 67. Glace Bay herring gillnet catches (filled squares) for the 2004 spawning fishery with catches inside each of the defined fishing areas determined separately.

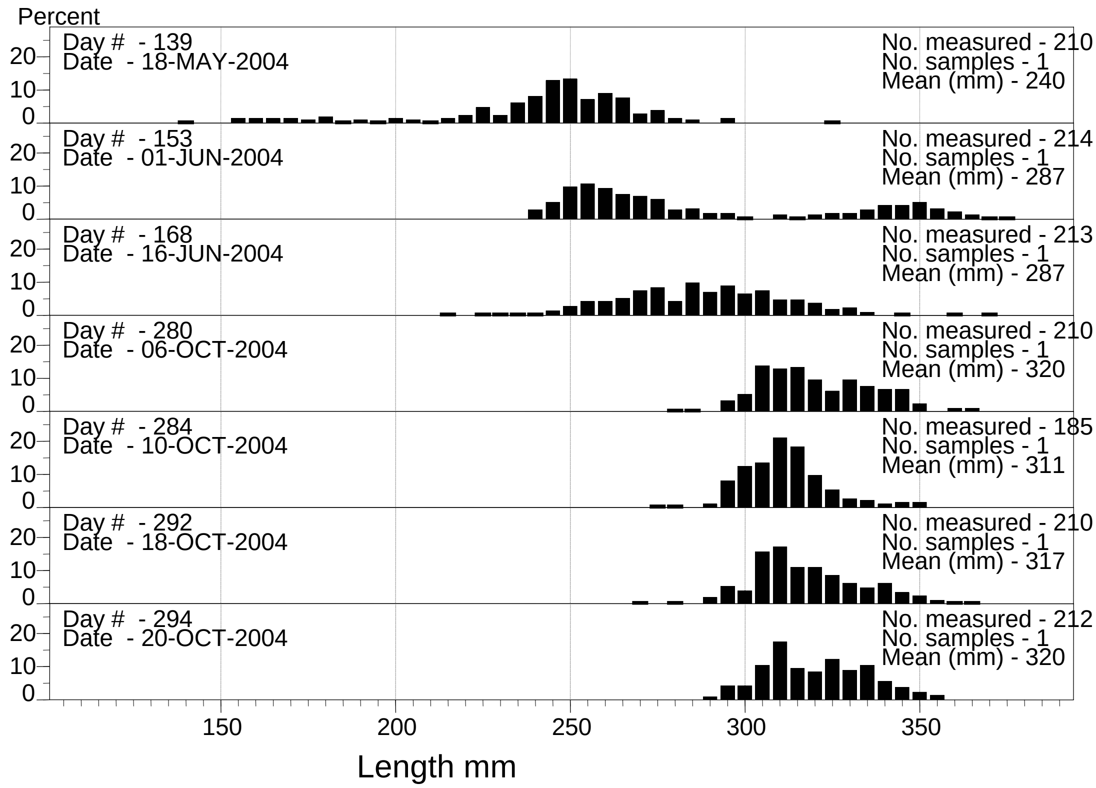


Figure 68. Daily size frequency of herring sampled from the Cape Breton area in 2004.

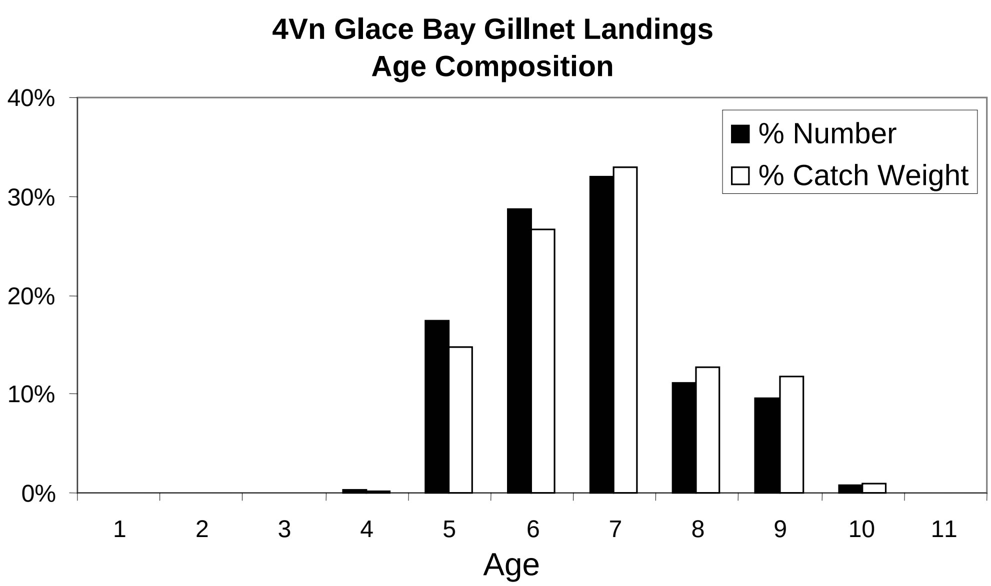


Figure 69. Herring catch at age (% numbers and % weight) for the 2004 Glace Bay gillnet fishery.

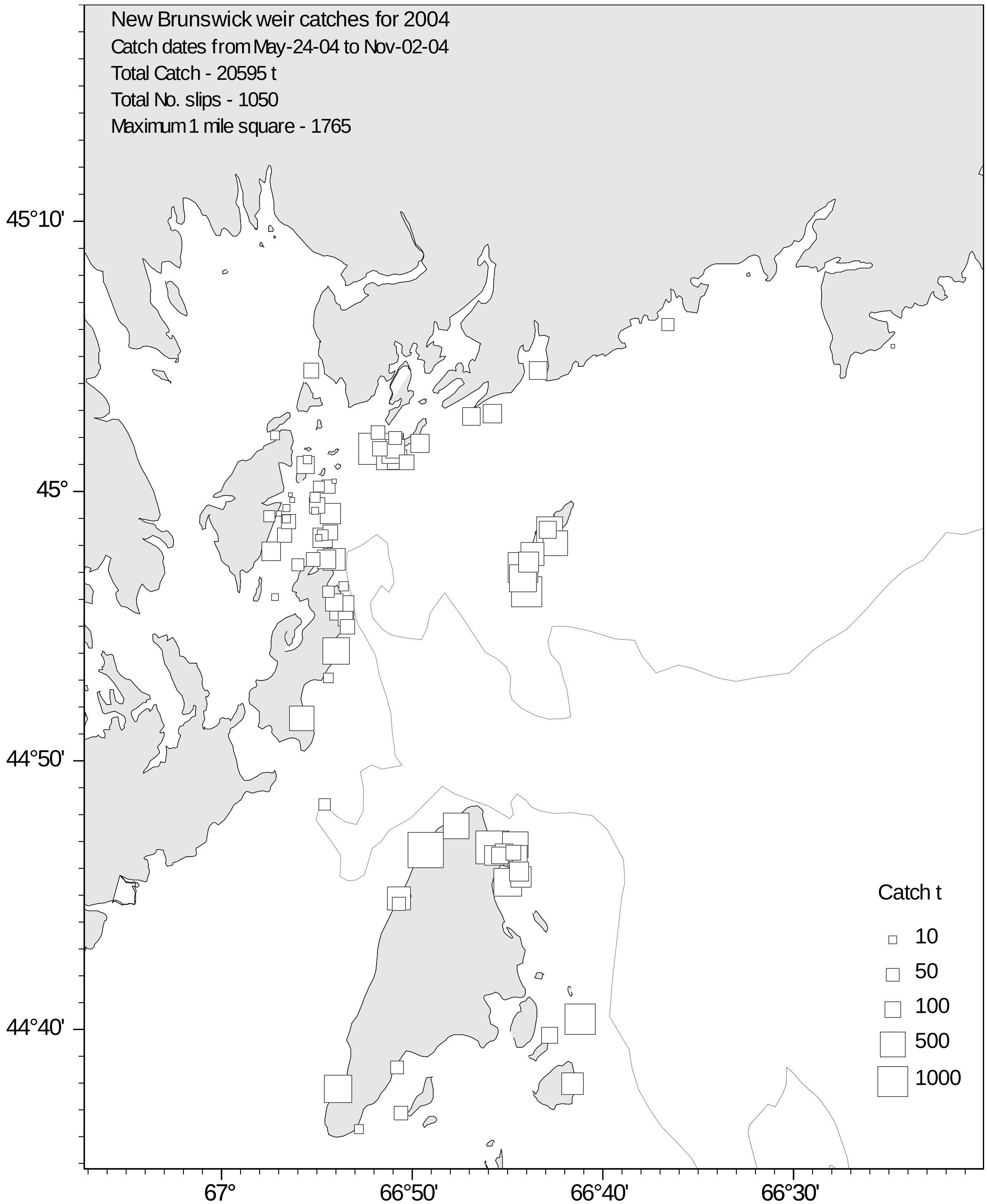


Figure 70. New Brunswick herring weir catches for the 2004 fishing season.

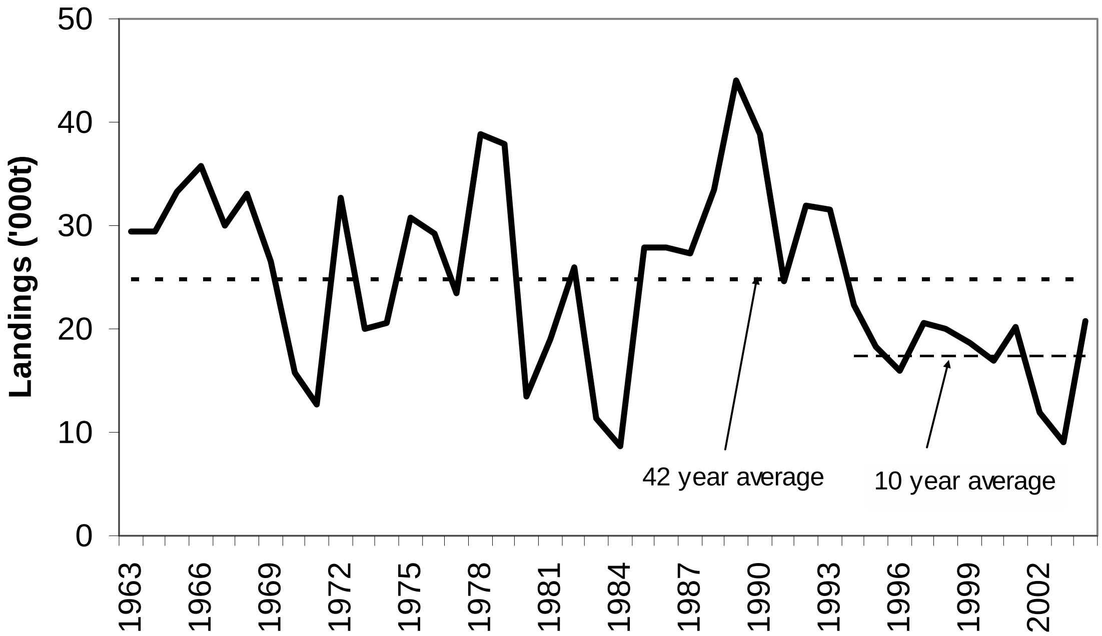


Figure 71. Herring landings from the southwest New Brunswick weir and shutoff fishery, 1963-2004 with overall time period average and recent 10 year average.

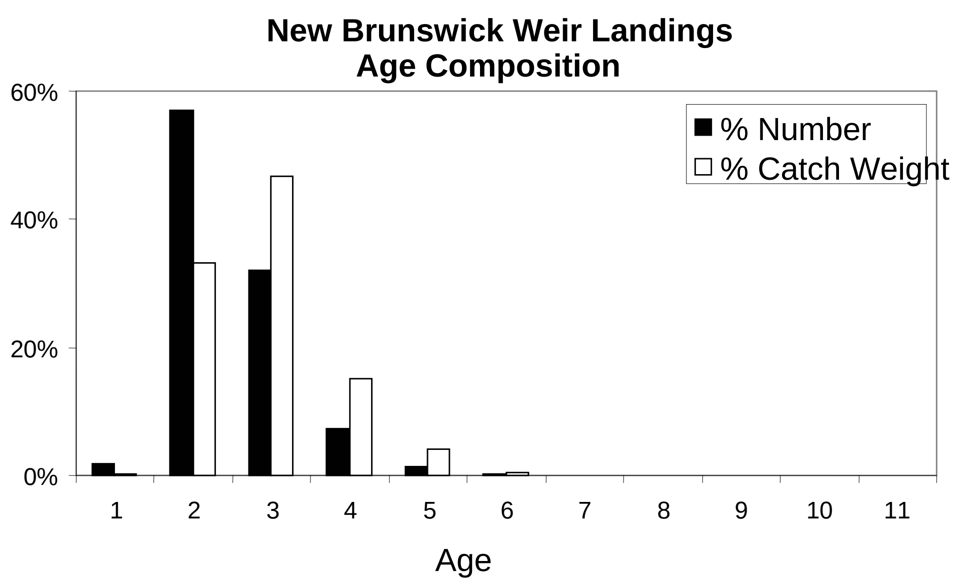


Figure 72. Catch at age (% numbers and % weight) of herring from the 2004 southwest New Brunswick weir and shutoff fisheries.

2004 4WX Herring Fishery: Report of Fleet Activity

L.M. Annis
Herring Science Council
P.O. Box 517, Yarmouth, NS, B5A 4B4

The herring industry in association with the Herring Science Council provides an annual summary of seiner fleet activity throughout the fishing season. This gives a general overview of the activities of the purse seine fleet and highlights important anecdotal information that may otherwise be lost. Information was gathered through association records, captain's reports and comments, through HSC and DFO staff, and from DFO landings and sample databases. The following is a summary of the activities for the 2003-2004 quota year purse seine fisheries.

<ins>Offshore/ Scotian Shelf Banks</ins>

Summary

- Reactivated fishing area since 1996
- The 2004 Offshore/Scotian Shelf purse seine fishery took place on Weeks 22, 23, 24, 25.
- A grand total of 4,054 t of herring was caught on the offshore banks, which was an increase from 2003 at 722 t caught.
- Weather was described as poor for the majority of the 2004 Offshore/Scotian Shelf fishery.

Week 22: May 30- June 5
Several boats fished the Offshore Banks this week. The fish were staying up in the water in this area. 151 t was landed from 3 slips this week on the Offshore Banks. Earlier in the week the weather was not that good. Fish size was reported to be between 10.5 and 12 inches.

Week 23: June 6 - June 12
The week started out with many boats making landings. In some parts of the week, the fish were staying on bottom and then the weather was not great again. 1987 t of herring was landed from 25 slips on the Offshore Banks

Week 24: June 13 - June 19
Eight seiners fished the Offshore Banks this week. The weather was quite windy. It was noted that fish were staying deep in the water column this week. 668 t was landed from 11 slips on the Offshore Banks. The fish caught ranged in size from 10-11 inches, and were for the food market. This week it was discussed if a survey could be done on the Offshore Banks, there was not a survey conducted this year.

Week 25: June 20 - June 26
Nine to ten boats fished the Offshore Banks this week. The week began with poor weather. Fish were again staying deep in the water. The fish size was between 10-11 inches and in food condition. 1248 t was landed from 15 slips on the Offshore Banks.

South West Nova Scotia Component

The quota year for South West Nova is from the period October 15 to the following October 14, and so catches from October 15 to December 31, 2003 are included in the quota total. The 2004-year fishing weeks are summarized separately below.

Summary

- The purse seine fleet concentrated their efforts on pre-spawning aggregations mainly on the Long Island Shore, the Grand Manan Banks, Gannett Dry Ledge, and Lurcher.
- Spawning aggregations were targeted on German Bank and Scots Bay.
- Weeks 1-5 showed activity in NB Coastal and the Grand Manan Banks. This was different from 2003, where activity was shown in weeks 1-8.
- Fishing started later in the spring at week 19: May 9-May 15, compared to 2003 when they started in Week 18: April 27- May 3, and 2002 when the fishery started at Week 16: April 13-19.
- The weather varied across the season with good weather and poor weather throughout.
- In May about 29% of landings came from the Gannet Dry Ledge, June the majority of landings were from Lurcher Shoal at 32%, July the greatest was 29% from German Bank. In August 85% of the landings came from Scots Bay. September the majority was from Scots Bay at 39% with landings from German Bank at 30%. The month of October had 54.3% of landings were from the German Bank.

2003 Fishing Weeks

Week 42: October 19- October 25
This week 8 landings (331 t) were made from Grand Manan, 221 t were caught from 4 landings on the Long Island Shore, and 670t from 12 landings were made from NB Coastal. Four landings of herring were made from German Bank, resulting in 153t.

Week 43: October 26- November 1
114 t of herring was landed from four landings at Grand Manan, and 509t was landed from 16 landings in NB Coastal.

Week 44: November 2- November 8
545 t of herring was landed from 13 landings at Grand Manan, and 465t was obtained from 8 landings in NB Coastal.

Week 45: November 9- November 15
This week 25 t was obtained from one landing at Grand Manan, 103 t landed from one landing on the Long Island Shore, and 245 t from 5 landings in NB Coastal.

Week 47: November 23- November 29
99 t were landed from one landing at Grand Manan, and 352 t were landed from four landings on the Long Island Shore.

Week 48: November 30- December 6
5 landings were made on the Long Island Shore this week which resulted in 257 t of herring.

Week 50: December 14- December 20
One landing was made this week at Grand Manan which resulted in 57 t of herring.

2004 Fishing Weeks

Week 1: January 4- January 10
662 t of herring were landed at Grand Manan from 20 landings and 336 t of herring was landed from 6 landings in NB Coastal.

Week 2: January 11- January 17
172 t of herring was landed from 7 landings that were made at Grand Manan.

Week 3: January 18- January 24
One landing was made this week in NB Coastal that resulted in 40 t of herring.

Week 4: January 25- January 31
89 t of herring were landed from one landing in NB Coastal this week.

Week 5: February 1- February 7
182 t of herring was landed from 10 landings made at Grand Manan, and 12 t of herring was obtained from one landing in NB Coastal.

Week 19: May 9- May 15
This week seining activity resumed in 4WX. 853 t was landed from a total of 19 slips from Gannet Dry Ledge.

Week 20: May 16- May 22
Two landings were made from Grand Manan (166 t), 11 landings were made from the Long Island Shore (503 t), 9 landings were made from Lurcher Shoal (363 t), 6 landings came from Gannet Dry Ledge (263 t), and 5 landings came from German Bank (242 t).

Week 21: May 23- May 29
This week 828 t of herring was landed from Grand Manan (21 slips), 495 t was obtained from the Long Island Shore (15 slips), and 173 t was caught from Lurcher (3 slips).

Week 22: May 30- June 5
845 t was obtained from Grand Manan this week from a total of 21 landings. 486 t was landed from the Long Island Shore (14 landings), and one landing was made at Lurcher to yield 75 t of herring.

Week 23: June 6- June 12
Eight landings were made this week, seven from Grand Manan (220 t) and one from Lurcher (72 t).

Week 24: June 13- June 19
Eight landings on Lurcher this week caught a total of 458 t of herring. 12 landings on the Long Island Shore were to yield 295 t of herring, and two landings on Gannet Dry Ledge

Week 25: June 20- June 26
21 landings (837 t) were made from Long Island Shore, 4 landings (203 t) from Gannet Dry Ledge, and 7 landings (373 t) from German Bank.

Week 26: June 27- July 3
2 landings (167 t) was made from Gannet Dry Ledge, 17 landings (526 t) were made from the Long Island Shore. 35 landings (3187 t) were made from Lurcher Shoal and nine or ten boats were active in this area. Fish ranged in size from 10-12 inches. Water temperature was about 53 degrees Fahrenheit. Most boats got the fish they needed this week. There were repots this week that 3-4 miles of herring was located in Bay Lobster and Pubnico Point in the shoal water. SW winds provided good weather this week.

Week 27: July 4- July 10
This week two landings were made from Grand Manan resulting in 41 t of herring. 448 t was caught from 14 landings on the Long Island Shore, 1589 t of herring was also caught from 20 slips from Lurcher, 1493 t was caught of 17 landings on Gannet Dry Ledge, and one landing was made from German Bank of 5 t. Toward the start of the week most boats got their fish. Fish were ranging in size from 10-12 inches. On July 7, the fish moved out of the area, heading North. There was between 15 and 25 % small fish in landings on various days this week. Overall, the weather was good this week.

Week 28: July 11- July 17
This week German Bank was very active with 38 landings and 3351 t of herring landed. Between nine and eleven boats fished German Bank this week. Fish were showing on bottom in the daytime and then moving up in the water at night. As many as 20 whales were reported in this area. Fish size was between 10-12 inches. 117 t from 2 landings were landed from Gannet Dry Ledge, 163 t was landed from 8 landings on Long Island Shore, and 207 t was landed from 7 landings on Grand Manan. It was reported that there was a good body of fish in the shoal water inside of German Bank. There was

some windy weather this week, and on July 13th many boats did not go out for the night. Also toward the end of the week, fish were staying deep in the water at night.

Week 29: July 18- July 24
Herring was staying deep on German Bank this week, making them impossible to catch. The weather was also a factor on several days this week with high winds. One landing of 84 t was made on Gannet Dry Ledge, 17 landings (581 t) was made on Grand Manan, 6 landings (159 t) were made on the Long Island Shore, and Scots Bay was targeted with 7 landings resulting in 435 t of catch. However it was reported that there was 4-6 miles of fish on bottom all over the rip on July 20th. Fish was both lean and in food condition. Fish size ranged from 10-11 inches. Sets in Scots Bay showed the herring was mixed.

Week 30: July 25- July 31
One landing was made on German Bank which resulted in a catch of 32 t. 530 t from 15 landings was caught in Grand Manan, and 884 t from 19 landings were caught on the Long Island Shore. 22 landings were made in Scots Bay which resulted in 1678 t of herring caught. Up to eight boats fished Scots Bay this week. The fish were showing up at surface in small bunches. The larger fish were good roe fish, and the smaller fish in the sets were hard. The weather was good this week.

Week 31: August 1- August 7
One landing of 15 t was made in Grand Manan, and 25 landings were made on the Long Island Shore which resulted in 834 t of herring. Eleven boats fished Scots Bay this week. 39 landings were made in Scots Bay with a total amount of 3103 t of herring caught. The weather was good for fishing. There was not a lot of fish showing, and they were showing up in small bunches. Again, the catches were mixed with larger roe fish and smaller hard fish. Due to rough weather, the first survey of Scots Bay was postponed from August 1st to August 2nd this week. During the survey the fish were showing in small bunches, and the survey, there seemed to be more fish showing. All boats were able to land fish after the survey.

Week 32: August 8- August 14
102 t of herring was landed from 4 landings on Grand Manan, and 32 landings were made on the Long Island Shore which resulted in 944 t of herring. Scots Bay was fished with a total of 46 slips and 3181 t of herring caught.

Week 33: August 15- August 21
286 t of herring was landed from 14 landings on Grand Manan, 219 t of herring was landed from 10 landings on the Long Island Shore, and 3 landings were made on German Bank resulting in 124 t of herring. 45 slips were from Scots Bay with a total of 4018 t of herring. Fish on German Bank were staying on bottom, and the seawater temperature was cold, at 48.9 degrees Fahrenheit. Fish caught on German Bank were mixed and small at 7-10 inches. In Scots Bay this week there was a good amount of fish, and all boats were able to make their sets in the area. The fish were bigger, and they are saying there was more fish on Aug 18th than on the survey. Fish were still

mixed this week. Up to 12 boats fished Scots Bay this week. The second survey of Scots Bay was cancelled for the night of August 15th due to poor weather, but was carried out on the night of August 16th.

Week 34: August 22- August 23
Six landings (103 t) were made on Grand Manan, five landings (217 t) were made on the Long Island Shore, and 68 landings (5465 t) were made in Scots Bay. Up to 15 boats fished Scots Bay this week. Fish were again mixed, some roe fish and some hard. Fish size ranged from 10-11 inches. A few boats searched German Bank this week, and reported that the fish are staying hard on bottom or not coming there at all.

Week 35: August 30- September 4
The weather was good for fishing this week. 40 t (3 landings) were landed from Grand Manan, 20t (2 landings) from the Long Island Shore, 402 t (3 landings) from German Bank, and 3655 t (54 landings) from Scots Bay were landed this week. The third survey of Scots Bay was held this week. After the survey all boats landed fish. Reports from German Bank were that there was lots of fish on bottom at the spawn tow. The first survey of German Bank was held this week, the fish on German Bank was reported as roe fish with some hard. A good showing of fish was seen on the normal 'tow' area and everybody was able to catch their market. There was also some fish seen in the southern portion of the survey area and a large but narrow band (1-2 fathoms) of fish on bottom in the northwest portion of the survey area.

Week 36: September 5- September 11
3 landings (86 t) were made on the Long Island Shore, 1 landing (41 t) was made on Lurcher Shoal, 5 landings (187 t) were made from Gannet Dry Ledge, 9 landings (567 t) were made from German Bank, and 21 landings (1040 t) were made from Scots Bay.

Week 37: September 12- September 18
11 landings (344 t) were made on Grand Manan, 1 landing of 17 t was made on the Long Island Shore, 2 landings of 120 t was made at Trinity Ledge, 14 landings (527t) were made on Lurcher Shoal, and one landing of 44t was made on Gannet Dry Ledge. 27 landings resulted in 2005 t of herring from Scots Bay. German Bank had 7 landings of a total of 527 t of herring, and 3 landings of a total of 40 t of herring were made from Browns Bank. The second survey of German Bank was conducted this week, September 16th.

Week 38: September 19- September 25
13 landings (288 t) were made on Grand Manan, 13 landings (512 t) were made on the Long Island Shore, 4 landings (212 t) were made at Trinity, 8 landings (747 t) were made at Lurcher Shoal, 9 landings (718 t) were made at Gannet Dry Ledge, 15 landings (1496 t) were made on German Bank, and 8 landings resulted in 289 t being caught from Scots Bay.

Appendix A: Report of Fleet Activity

Week 39: September 26- October 2
37 t of herring was landed from 2 landings in Grand Manan, 1401 t was landed from 36 landings on the Long Island Shore, one landing of 38 t was made at Trinity, 218 t from 4 landings was made from Gannet Dry Ledge, and 2270 t was landed from a total of 26 slips on German Bank this week. The third survey of German Bank was conducted this week on September 30th. Some seiners fished through the weekend, with some companies taking fish from seiners though the weekend.

Week 40: October 3- October 9
There was very good roe fishing on German. This was primarily on the spawn tow area at the start of the week but as the week progressed it extended further south to the tongue ground area. Two landings (161) were made from Grand Manan, 61 landings (3022 t) were made from the Long Island Shore, one landing of 19 t was made from Lurcher, and 2332 t was caught from 23 landings on German Bank.

Week 41: October 10- October 14
Some seiners fished over the Thanksgiving weekend. The focus became more on small fish than roe fish as the season end neared. There were also fewer boats in the fishery as some reached the end of their quota. This week there were no visible large aggregations of herring on German Bank. Where boats went to look for small fish, some small fish was caught. 561 t was landed from 14 slips on Grand Manan, 36 t was landed from 3 slips on the Long Island Shore, and 25 landings on German Bank produced 2301 t of herring. One landing of 5 t was also made on Browns Bank.

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