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2014 Assessment of Newfoundland East and South Coast Atlantic Herring (*Clupea harengus)*

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Foreword

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ABSTRACT

The assessment of Newfoundland east and south coast Atlantic Herring (*Clupea harengus*) stock complexes considered data to the spring of 2014. A stock status index was provided for the Bonavista Bay-Trinity Bay (BBTB) and Fortune Bay (FB) stock areas where an annual research gillnet program provides an ongoing index of abundance; stock updates were provided for the White Bay-Notre Dame Bay (WBNDB) and St. Mary's Bay-Placentia Bay (SMBPB) stock areas based on commercial samples, fisher observations and when applicable, abundance indices from adjacent stock areas. During the 2000s the spawning stock composition of most stock complexes has shifted toward a higher proportion of fall spawners, and spring spawning times have peaked later in the season and in early summer. In addition, there has been an increasing occurrence of herring during spring offshore surveys on the Grand Banks over the past decade. It is suspected that these changes are largely environmentally driven.

Stock status was considered positive in both WBNDB and BBTB in 2014. In both areas the 2008 fall spawner and 2009 spring spawner year classes accounted for a large proportion of landings and fall spawners comprised 65 % of the catch. Fishers in both areas reported an increasing perception of abundance from 2012 to 2013 and research gillnet catch rates in BBTB were the highest in 7 years in 2014. Recruitment of age 4 fish in BBTB was average for fall spawners and high for spring spawners in 2013. Stock status in SMBPB was given an uncertain evaluation as a relatively inactive commercial fishery has led to a low number of biological samples and therefore a high degree of uncertainty in the catch at age. Purse seine fishers in the area reported increasing abundance in 2013 whereas fixed gear fishers reported a decrease. The stock status of the FB complex was negative as commercial landings and research gillnet catch rates have declined in recent years, fixed gear fishers consistently indicate decreasing abundance and the age distribution of fish caught in both the commercial fishery and research gillnet program is highly skewed toward older (age 11+ spring spawners). In addition, there has been extremely poor recruitment of both spring and fall spawners in the area since 2002.

Évaluation des stocks de hareng de l'Atlantique (*Clupea harengus*) des côtes est et sud de Terre-Neuve-et-Labrador de 2014

RÉSUMÉ

L'évaluation des complexes de stocks de hareng de l'Atlantique (*Clupea harengus*) des côtes est et sud de Terre-Neuve-et-Labrador prenait en compte les données jusqu'au printemps 2014. Un indice de l'état des stocks a été soumis pour les zones de stock de la baie de Bonavista – baie de la Trinité (BBBT) et de la baie Fortune (BF) où un programme annuel de recherche avec filet maillant fournit un indice continu de l'abondance; des mises à jour des stocks ont été soumises pour les zones de stocks de la baie White – baie Notre Dame (BWBND) et de la baie St. Mary's – baie Placentia (BSMBP) en fonction d'échantillons commerciaux, d'observations de pêcheurs et, le cas échéant, d'indices d'abondance des zones de stocks adjacentes. Au cours des années 2000, la composition du stock reproducteur de la plupart des complexes de stocks a connu une proportion plus élevée de reproducteurs d'automne, et les périodes de frai du printemps ont eu leur pic plus tard dans la saison et au début de l'été. En outre, il y a eu une présence croissante de hareng dans le cadre des relevés effectués au printemps dans les eaux du large des Grands Bancs au cours de la dernière décennie. On croit que ces changements dépendent largement de l'environnement.

L'état des stocks a été considéré comme positif dans les deux zones BWBND et BBBT en 2014. Dans les deux zones, les classes d'âge des reproducteurs d'automne 2008 et de printemps 2009 représentaient une grande partie des débarquements, et les reproducteurs d'automne constituaient 65 % des prises. Les pêcheurs dans les deux zones ont déclaré une augmentation de leur perception d'abondance de 2012 à 2013 et les taux de prise du programme de recherche au filet maillant dans la zone BBBT en 2014 étaient les plus élevés en 7 ans. Le recrutement de poissons à l'âge 4 dans la zone BBBT était moyen pour les reproducteurs d'automne et élevé pour les reproducteurs de printemps en 2013. L'évaluation de l'état des stocks dans la zone BSMBP était incertaine, car une pêche commerciale relativement inactive a entraîné un faible nombre d'échantillons biologiques et, par conséquent, un haut degré d'incertitude concernant les prises selon l'âge. Les pêcheurs à la senne coulissante dans la zone ont signalé une abondance croissante en 2013, tandis que les pêcheurs utilisant des engins fixes ont signalé une diminution. L'état des stocks du complexe de la zone BF était négatif, car les débarquements commerciaux et les taux de prise du programme de recherche au filet maillant ont baissé au cours des dernières années; les pêcheurs utilisant des engins fixes indiquent invariablement une abondance décroissante et la répartition selon l'âge du poisson dans le cadre de la pêche commerciale et du programme de recherche au filet maillant est extrêmement faussée en faveur des poissons plus âgés (reproducteurs de printemps âgés de plus de 11 ans). En outre, depuis 2002, le recrutement dans la zone est extrêmement mauvais tant chez les reproducteurs du printemps que chez ceux d'automne.

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INTRODUCTION

Atlantic herring are distributed in the Northeast Atlantic from Cape Hattaras to the coast of Labrador. The stock complexes found on the east and south coasts of Newfoundland exist at the northern extent of the species' range and are subjected to highly variable environmental conditions, which are thought to have a strong influence on recruitment and population dynamics (Winters and Wheeler 1987). Herring within these stocks are considered to be coastal and migratory, aggregating into large schools during spring spawning, mixing during summer feeding and overwintering in nearby bays. Historically, herring stocks in the region were comprised largely of spring spawners, with a small percentage of fall-spawning fish. During the 1990s spring spawners declined and in the 2000s the proportion of fall spawners in most areas increased, at times comprising more than 80 % of the catch.

HERRING STOCK COMPLEXES

STOCK STRUCTURE AND DISTRIBUTION

Herring on the south and northeast coasts of Newfoundland are divided into five stock complexes (Fig. 1): White Bay-Notre Dame Bay (WBNDB), Bonavista Bay-Trinity Bay (BBTB), Conception Bay-Southern Shore (CBSS), St. Mary's Bay-Placentia Bay (SMBPB), and Fortune Bay (FB). These complexes were defined based on tagging studies conducted in the late 1970s and early 1980s (Wheeler and Winters 1984a). While there is extensive mixing within the complexes during summer feeding and overwintering, the results of the tagging experiments showed that Newfoundland herring have a strong homing tendency and that they return to the same bay each year to spawn; stock complexes were delineated based on these spring spawning areas (Winters and Wheeler 1984b). Herring also occur along the south coast from Cape Ray to Pass Island and along the southern shore of Labrador, the stock affinities of these herring are uncertain. It is not known if these stock complex delineations are still appropriate as it is possible that with reduced population numbers since the time of the tagging experiments, migration patterns and distribution may have changed; however, it is not feasible to conduct another tagging study at this time. As an alternative, other methods to investigate stock delineation are being investigated including genetic and otolith analyses.

During the 2013 framework meeting it was decided that given the reductions to the research gillnet program, full assessments would be conducted for the BBTB and FB stock complexes only, with updates being provided for WBNDB and SMBPB (Bourne et al. 2015). This document contains all available data to the winter of 2014 for all four stock areas, including commercial landings and industry input. Updates have not been provided for CBSS for several years due to a lack of data (no research gillnet fishery and low commercial landings) but given the recent increases in fishing activity in this area, an update will be provided at the next assessment.

STOCK COMPOSITION

Historically, stock complexes in the region were composed predominantly of spring spawning herring, which spawned between April and June. Fall spawners accounted for a small percentage (typically < 10%) of the population and spawned between September and October. There were also some indications of continuous spawning throughout the summer months (Winters et al. 1986), but with no summer fishery and low occurrences of summer spawning, this portion of the population was not given consideration in past stock assessments.

Throughout the 2000s the spawning stock composition of Newfoundland herring shifted, with the proportion of fall spawners increasing to as high as 90 % in some areas and years

(Figs. 2-3). A similar change has been observed in other areas of the Northwest Atlantic; Melvin et al. (2009) found that the increase in fall spawners was correlated with warming ocean temperatures, which are likely a proxy for more complex environmental drivers. A recent analysis of oceanographic conditions and zooplankton dynamics on the west coast of Newfoundland (area 4R) established a correlation with the recruitment dynamics of herring in the area, where spring spawners have also declined in recent years (DFO 2014). It is suspected that environmental conditions are also driving herring recruitment on the south and northeast coasts of Newfoundland, as has been hypothesized in the past (Winters et al. 1986, Winters and Wheeler 1987), and preliminary analysis of these relationships has shown a correlation between increasing fall spawner recruitment and warming sea temperatures (Fig. 4). These relationships will be further explored in the near future.

These changes in spawning stock composition have had impacts on the assessment of Newfoundland herring, as methods in the past were largely focused on the spring spawning component. An assessment framework meeting was held in 2013 (Bourne et al. 2015) to address this issue and several recommendations were made which have been addressed during this assessment.

REVISION OF SPAWNING GROUP ASSIGNMENT

During the 2000s an apparent increase in summer spawning (July and August) was noted by herring fishers and detected in the research gillnet program. This led to the recommendation that spawning group assignment methods for Newfoundland herring be re-examined (Bourne et al. 2015), as there were no clear decision rules for the designation of spawning fish caught outside of the ‘typical’ spring (April-June) and fall (September-November) spawning periods.

Spawning group assignment of Newfoundland herring has primarily been based on otolith structure, as there are usually clear differences between the spring and fall spawner otolith nuclei. Maturity stage, gonad size, timing and location of capture may also be considered, but otolith structure has historically been the primary determinant. An analysis of herring collected during the summers from 1980 to 2013 showed that there was a ‘cross over’ of spawning group designation occurring with July-spawning fish; some were being designated as spring spawners and others as fall, despite being caught at the same time and maturity stage. In addition, maturing herring caught in late July were sometimes being designated as spring spawners, despite the fact that these fish would likely be spawning in August or possibly later (Fig. 5).

While Winters et al. (1986) did note that “spawning is virtually continuous from spring through summer” and that there was potential for misclassification, this issue of spawning ‘cross over’ was not addressed in past assessments, presumably because summer spawners composed such a small portion of the spawning stock biomass. However given the recent changes in spawning stock composition and reduction in abundance, the classification of summer spawners may play a more important role in future stock assessments.

In other regions, otolith structure is used to determine the spawning group of juvenile fish, where the designation of mature fish is done based on maturity stage and timing of capture. In the southern Gulf of St. Lawrence, a gonadosomatic index (GSI) is used to aid in the determination of maturity stage (McQuinn 1989), and a set of decision rules then employed to determine spawning group (LeBlanc et al. 2012). A similar approach was considered for the reclassification of Newfoundland herring prior to this assessment; however there were issues distinguishing between herring of maturity stages 3 and 8 which need to be addressed before moving forward with the analysis.

An alternate, simplified approach was used for this assessment to conduct an exploratory analysis of the potential impacts of spawning group re-designation. Fish were reclassified according to the following rules:

- All maturing (maturity stage 3 and 4) herring caught between July 1-14 ('early July') were classified as fall spawners;
- All maturing and mature fish (maturity stages 3-6) caught between July 15-31 ('late July') were classified as fall spawners; and
- Mature fish (maturity stages 5 and 6) caught in August were classified as fall spawners.

This resulted in the reclassification of 3,423 herring from spring to fall spawners, representing just 0.8 % of the total number of fish sampled in the time series (Fig. 6).

THE FISHERY

FISHERY OVERVIEW

Herring are fished along the south and northeast coasts of Newfoundland both commercially and for bait. The herring fishery peaked in the late 1970s at over 30,000 t when the presence of several strong year classes and the introduction of purse seiners allowed intensive exploitation. All stocks were placed under quota regulation by the early 1980s; since then the combined Total Allowable Catch (TACs) for all stock areas have not been met or exceeded (Fig. 7). The current combined TAC is 12,700 t. In 2013 and 2014 an experimental herring fishery with a TAC of 500 t took place in Labrador (area 2J) after reports of high numbers of herring in the area.

The commercial fishery is carried out using both fixed and mobile gear, with purse and bar seines accounting for the majority of landings during the 2000s, though tuck seines have been more prevalent over the past several years; small proportions of landings are from traps and gillnets (Fig. 8). The fishery typically takes place in both the spring and late summer through the fall, with the exception of Fortune Bay where only a spring fishery occurs.

The herring bait fishery takes place each spring prior to the summer lobster season; however bait landings have not been included in commercial statistics since 1996. To account for this potentially significant proportion of removals, a herring fixed gear telephone survey was implemented in 2006. The survey is conducted each fall with a random subset of fishers being contacted and their average bait landings extrapolated for the entire stock area in which they fished (see Bourne et al. 2015) for detailed methodology). These estimates are included in the calculation of commercial catch at age.

LANDINGS AND CATCH AT AGE

Commercial fishery data are obtained from Strategic Services Branch and sorted by bay, month and gear type. Data for the three most recent years are considered preliminary as statistics may not have been finalized. The 2014 landings presented in this assessment were updated on January 6, 2015 at which time all fall landings may not have been accounted for; these numbers will be updated for the next assessment. Total commercial landings in 2013 were 6,749 t, 53% of the overall total TAC (Fig. 7). The commercial catch was once again composed more than 50 % fall spawners on the northeast coast, but spring spawners were dominant on the south coast in FB where no significant increase in fall spawners has been observed (Fig. 2).

Catch at age is calculated using samples from the commercial fishery; an effort is made to collect a sample of 55 randomly selected fish per 500 t of landings by gear, month and bay (sampling methods are detailed in Bourne et al. 2015). An annual commercial catch

numbers-at-age vector, by stock area and spawning type, is calculated by converting the catch (t) to fish numbers using the mean whole weight from the appropriate sample (separated by spawning type), and then apportioning those numbers by age using the sample numbers-at-age.

In WBNDB, 47 % of the 2,640 t TAC was taken in 2013, similar to the landings in 2011 and 2012. Most herring landings in recent years have been by purse seines and traps during both a spring and fall fishery; total landings for 2014 at the time of this assessment were low, at only 363 t (Table 1, Fig. 9), due to poor market conditions. Bait estimates derived from the fixed gear telephone survey were 282 t in 2013 and 311 t in 2014; WBNDB was the only stock area where bait estimates did not decline in 2014 (Table 6a). As with previous years, the majority of the catch in 2013 was composed of fall spawners (65 %) with a strong age 5 cohort; most spring spawners were age 4 fish, the second strongest year class in the fishery (Figs. 10-11). Age and spawning group distributions were not available for the 2014 commercial fishery at the time of this assessment as samples were still being collected and processed.

In 2013, 83 % of the 4,950 t TAC was landed in BBTB, the highest landings since the early 1990s. Most of the landings were by purse and tuck seines, with the majority of the catch coming from the fall fishery (Table 2, Fig. 9). At the time of this assessment, 3,862 t of landings had been recorded for 2014, representing 78 % of the TAC. The bait estimate for 2013 was 509 t, and 173 t in 2014 – the lowest estimate of the time series (Table 6b). The age and spawning type distribution in the fishery was similar to that of WBNDB, with 69% fall spawners, a strong age 5 year class and age 4 year class (Figs. 10-11).

In 2014 commercial landings in CBSS were the highest in over a decade, at 408 t, representing 68 % of the 600 t TAC. All landings in this area in recent years have been in CB and most are attributable to purse and tuck seines (Table 3). Catch at age has not been analysed for this stock area in recent years, but given the increase in fishing activity, it will be included in future assessments.

Commercial landings in SMBPB were low in 2011 and 2012, with no purse seining occurring and less than 3 % of the 2,250 t TAC being taken (by gillnets). Purse seiners were active in Placentia Bay in 2013 and landings increased slightly to 212 t (9 % of the TAC); in 2014, 337 t were landed exclusively by purse seiners (Table 4, Fig. 9). Total landings for 2014 may be higher as the fishery continued to late December and all landings may not have been included in the data obtained for this assessment. Estimated bait landings in 2013 were 112 t, accounting for a third of all removals; bait landings in 2014 were estimated to be much lower at just 29 t (Table 6c). As in 2012, the commercial catch at age in SMBPB was composed largely of age 11 + fish in 2013; spring spawners accounted for 64.9 % of the catch (Figs. 10-11). There is a high degree of uncertainty in the commercial catch at age for this area due to the small commercial fishery and thus low sample size.

In FB, commercial landings have declined overall since 2009 (Fig. 9). Due to concerns regarding declining stock status and an extremely truncated age distribution in the area, the TAC was reduced by 25 % in 2013. In that year only 989 t were landed, 43 % of the reduced TAC; landings were even lower in 2014 at 797 t (Table 5). Bait estimates for FB were 118 t in 2013 and 58 t in 2014, the lowest in the time series (Table 6d). Once again the commercial catch at age in this stock area was highly skewed, with age 11 + fish composing more than 80 % of the catch, and age 10s accounting for much of the remainder. As in previous years, fall spawners account for only a small proportion of the catch, unlike other stock areas where they have increased (Figs. 10-11).

In 2013, 145 t of the 500 t experimental TAC were taken in Labrador, just 45 t were taken in 2014; the fishery in both years took place between August and October. The age distribution of

the catch in 2013 resembled that of WBNDB and BBTB, with a strong age 4 spring cohort and age 5 fall cohort; fall spawners accounted for 65% of the catch (Fig. 11).

DISCARDS

The majority of herring discards occur in the purse seine fishery. In recent years this has largely been due to the presence of undersized herring; if more than 10 % of the fish in a purse seine set are under the designated size limit, the catch must be released. This percentage is determined by a sample taken by fishers before a set is taken aboard.

Currently estimates of discards and survival are obtained from the annual purse seine telephone survey, which has been conducted since 1996. The ratio of landings to discards has varied substantially throughout the time series, which may be attributable to strong year classes entering the fishery as small/undersized fish and comprising greater than 10 % of the catch for several years as they mature. During this survey fishers also provide estimates of discard survival, which can be highly variable (Table 7a-c, Fig. 12) and in general is difficult to estimate (Olsen et al. 2012, Tenningen et al.2012).

Historically the minimum size of herring in the commercial fishery was based on the size at which 50 % of the herring were mature (L50). This minimum size was questioned in 2012 when discarding due to undersized fish was a major issue, with fishers in some areas estimating that discards were exceeding landings (Fig. 12). To address these concerns, an exploratory analysis was done to re-examine the L50; however, it was found that sample sizes of small fish (ages 2-4) were insufficient to obtain L50 estimates. To address this issue, a pilot program was implemented in 2013 which lowered the minimum fork length of herring in the fishery from 265 mm to 240 mm and required purse seine fishers to provide samples of the smallest herring in their catches. This program was extended in 2014 to obtain additional samples. In 2013, 23 samples were collected; of these, 25 % were below the size limit and processed for use in L50 analysis. Approximately 20 samples were obtained in 2014; some were still being collected at the time of this assessment and processing was ongoing. Results of the L50 analysis up to 2013 are detailed in the Biological and Ecological Data portion of this document, along with preliminary results for SMBPB in 2014.

INDUSTRY INPUT

PURSE SEINE TELEPHONE SURVEY

The purse seine telephone survey has been conducted since 1996, with attempts made to contact all fishers who reported landings each year; generally, response rates have been quite high (Table 7a-c). The survey is conducted twice per year, after the spring and fall fisheries have concluded in all areas where purse seine landings have occurred. Fortune Bay has not historically been included in the survey as there is no purse seine fishery in the area. Fishers are asked about their estimated landings, discards, effort and opinions of abundance. A removal to landing ratio is calculated based on these estimates (1.0 indicating no dead discards).

In 2013 there was no spring purse seine fishery or survey. During the fall survey, all active purse seine fishers were contacted – 3 in WBNDB, 7 in BBTB and 2 in SMBPB. In 2014, 3 purse seine fishers were active during the spring fishery, 1 in WBNDB and 2 in SMBPB, all of whom were contacted (Table 7, Fig. 12). A substantially larger fall fishery occurred in 2014 but the fall survey was not completed prior to this assessment

Landings in WBNDB have generally been increased in recent years and were the highest of the past decade in 2013; discards were also high in 2013, with a removal to landing ratio of 1.24.

Most fishers commented that discarding was due to size (too many small herring). In BBTB, landings in 2013 were at their highest in the time series; estimated discards in 2013 were low, giving a removal to landing ratio of 1.01. In SMBPB the purse seine fishery has been inactive in recent years, and landings in 2013 were low; the removal to discard ratio was 1.04 (Table 7a-c, Fig. 12).

FIXED GEAR TELEPHONE SURVEY

The fixed gear telephone survey has been conducted each fall since 2006, with the exception of 2010. A random subset of herring fixed gear licence and bait permit holders is selected for each stock area, those who are successfully contacted are asked a series of questions about their fishing activity prior to the survey. The primary objectives of the survey are to determine the percentage of active bait fishers and derive estimates of bait landings for each stock area. Survey methodology is detailed in Bourne et al. (2015).

The number of licence and permit holders has declined steadily throughout the survey time series, as has the percentage of active fishers in all stock areas (Table 8). This decline is likely due to a combination of retirement and changes in herring population dynamics. Herring has historically been caught during the spring inshore spawning migration and used as bait in the July lobster fishery; however in recent years, herring gillnet landings have been low during the spring, with peak spawning occurring in July (see below). This mismatch in timing has led to the usage of other species for bait (winter flounder, squid, cod), an increase in fall fishing, and more fishers buying their bait.

In 2014 the survey achieved a response rate of 79 % with 307 fishers contacted, of these 29 % were active and 92 % of those were fishing solely for bait (Table 8). Fishers were primarily active between April and July, though in WBNDB some did fish during the fall; in addition, six fishers indicated that they would be fishing before the end of the calendar year (in November/ December). Estimated bait catches were significantly lower than previous years in all stock areas except WBNDB (Table 6a-d). Reported bycatch was also generally low (less than 100 lbs), with most fishers reporting small catches of sculpin, Greenland and Atlantic cod and cunner; there were two reports of salmon bycatch, each of single fish.

Some fishers on the northeast coast commented that they did not fish herring or lobster because of late sea ice in 2014 and that herring were arriving later than in the past; fishers in most areas commented that purse seiners were taking too many fish and doing damage to the population. As in previous years, the majority of fishers in Fortune Bay commented that the tuck seine fishery in Long Harbour is damaging the stock and needs to be closed, there were also requests for a new acoustic survey in the area.

LOGBOOKS

Since 1996, fixed gear logbooks have been sent annually to all herring fishers who hold a fixed gear or commercial herring licence (up to 2,500 fishers) and are completed voluntarily. Originally the logbooks were designed to provide a standardized Catch per Unit of Effort (CPUE) index through collecting detailed catch records per net, but due to low return rates and potential issues with recording effort, the format was simplified in 2012. Currently, fishers who complete logbooks are required to provide the total number of nets fished and the combined weight of herring caught per day.

An ongoing issue with the logbook program has been poor participation. There were 53 logbooks returned in 2013, but based on telephone survey estimates, 530 fishers were active that year; only 16 logbooks were returned in 2014; however they were still being received at the time of this assessment (Fig. 13). It is important that the logbook program continue, particularly

in areas where there is no spring research gillnet program, as the data obtained can provide insight into the migration and spawning movements of stock complexes. Methods to increase returns will be investigated in the coming year, including the possibility of mandatory logbooks or targeted mail-outs to active fishers.

CUMULATIVE CHANGE INDEX

Fishers who return logbooks and complete telephone surveys are all asked to answer 2 questions regarding herring abundance in their area, using a scale of 1 to 10 (1 being lowest, 10 highest):

- how abundant were herring in your fishing area in (the current year) compared to (the previous year)?
- how abundant were herring in your fishing area in (current year) compared to the ten year period prior?

The answers are then used to calculate the cumulative change index similar to that has been used in Div. 4T herring assessments (LeBlanc et al. 2012). The 1 to 10 scale of abundance is converted to a scale of -4.5 to +4.5, where 0 is average. A fisher's observation of abundance from year "n-1" to year "n" is recorded as a "plus" or "minus" on the scale. An average is derived for all fishers (by stock area); this is then added to or subtracted from the previous year's value. For this assessment the indices derived from fixed gear logbooks and telephone surveys were combined into a single fixed gear index by taking a weighted average (by sample size).

In WBNDB purse seine fishers indicated in 2013 that abundance had increased from the previous year, as has been the case since 2005; the fixed gear index in 2014 indicated that for the third consecutive year abundance had increased. In BBTB purse seine fishers also reported increasing abundance for most years in the 2000s, except for a decline in 2010; fixed gear fishers in the area also reported low abundance in 2010 and increases since then. In SMBPB purse seine fishers in 2013 indicated that abundance was slightly higher since the last estimate in 2010; fixed gear fishers in the area have reported declining abundance since 2010. Fixed gear fishers in FB continue to report declining abundance in the stock area, there is no purse seine fishery in FB to provide an index (Fig. 14).

RESEARCH GILLNET PROGRAM

OVERVIEW

The research gillnet program began in 1980 and in the years since has taken place in all stock areas at some point, during the spring and/or fall. Most recently the spring program had been run in four stock areas, but after program reductions in 2012, this was reduced to BBTB and FB only (see Bourne et al. 2015) for a detailed history of the program).

Currently, four fishers are contracted in each active bay (BB, TB and FB) for a 45 day period to fish a fleet of five standardized gillnets of different mesh sizes between April 1 and July 31; start and end dates vary by area (Table 9a-d). Each fisher collects two samples per week of 50 fish (provided herring are caught) during the 45 days. From these samples, 25 fish are processed, selected proportionately from the various mesh sizes according to the catch per mesh at the time of the sample. The biological data from these samples is then used to calculate mesh disaggregated catch rates at age by spawning type, and to derive a recruitment index based on the catch rate of age 4 fish.

It has been recommended that a catch at age model be developed from this data which accounts for mesh selectivity. This is currently being investigated but was not available for this assessment.

SPRING SPAWNING TIMES

The onset of spring spawning of Newfoundland herring has historically occurred in April and May, with a high degree of variation in timing and duration from year to year (Winters and Wheeler 1996). However, in recent years fishers have commented that the onset of spring spawning seems to be later than in the past, with herring arriving at spawning locations later in the spring, and spawning occurring well into the summer (July and August).

During the 2013 framework meeting, the analysis of spring spawning onset times done by Winters and Wheeler (1996) was extended through the 2000's using data obtained from the spring research gillnet program. The results confirmed that spawning did occur later in the 2000's (Bourne et al. 2015). This analysis was repeated for the current assessment using the revised spawning designations described above, which changed some onset estimates during the 2000's slightly and reduced the sample sizes of spring spawners.

Overall, estimates of spawning times in the 2000s are highly uncertain. This is largely due to an increase in the percentage of research gillnet program fishing days with no catch, which made calculating the change in gonad weights per week for the entire fishing period impossible (Fig. 15). When the available data was plotted for years and weeks with adequate sample sizes, the clear pattern of maturation, onset and spawning that had been observed in previous years was not obvious; instead, gonad weights tended to fluctuate, but not show a single sharp decline (Fig. 16).

This change in spawning behavior coincides with the decline in spring spawners observed during the late 1990s/ early 2000s (Fig. 10) and the onset of an ocean warming period in the region (Fig. 17). This pattern disagrees with the prediction made by Winters and Wheeler (1996) that spawning times would be earlier with warmer January temperatures. Using the relationship established in their analysis, predictions show that spawning onset should have occurred in April during most of the past decade (Fig. 17). While some spawning may still be occurring in early spring, fisher observations and research gillnet catch rates indicate that most 'spring' spawning activity is happening in late spring and early summer.

The cause of this apparent shift in spawning times is not currently known. It is possible that with the sharp decline in spring spawner numbers in the late 1990s, summer spawners began to constitute a larger proportion of the stock complexes. Further analysis of spawning times demonstrated that when estimated onset dates were split between pre and post 2000 (corresponding to the point of the shift in timing), a physical environment composite index which included temperature, salinity, ice, meteorological and CIL anomalies (Colbourne et al. 2012) was correlated with spawning onset time (Fig. 18). This indicates that as was previously predicted, environmental conditions likely do play a role in the maturation cycle of herring, though the precise nature of the interactions is unknown.

CATCH RATES AND CATCH AT AGE

In BBTB, combined catch rates in the spring research gillnet program have remained near the time series and decadal average for the past several years, and rose above average in 2014; fall spawners continued to account for the majority of the catch (66 %) in 2013 (Table 10, Fig. 19). The strong 2008 fall and 2009 spring year classes that were detected in 2012 were also prominent in the 2013 age distribution as age 4 and 5 fish, accounting for over 50 % of the

catch as the previously dominant 2001 and 2002 year classes exit the fishery (Table 10, Figs. 20-21a).

In FB, catch rates have been at their lowest level in the time series for the past four years after falling below both the time series and decadal means in 2011; unlike other stock areas, spring spawners continue to dominate the catch in FB, accounting for 76 % in 2012 and 93% in 2013 (Table 10, Fig. 19). The age distribution in FB continues to be a concern; in 2012 the age distribution was dominated by age 10 and 11 spring spawners, as the 2002 cohort moved into the age 11 + grouping. In 2013, the age distribution became highly skewed, comprised of nearly 80 % age 11 + fish (Table 10, Figs. 20-21b).

RECRUITMENT

In BBTB the recruitment index (natural logarithm of age 4 catch rates) of spring spawners had declined since 2002, but rose in 2008 and again in 2009, potentially indicating a strong cohort entering the fishery in 2013; otherwise most mature spring year classes (in age 4-6 catch rates) were below the series average. Fall spawner recruitment increased in 1998 and has remained relatively high since, with 2008 showing the highest value in the time series and 2009 slightly lower; all mature fall year classes are above the series average, but smaller than the early 2000s (Fig. 22).

In FB the recruitment of spring spawners has been below average since the last strong year class in 2002, which is now exiting the fishery. Unlike other stock areas, fall spawner recruitment did not show a sharp increase in FB during the 2000s and the proportion of spring spawners in the catch remains quite high (Fig. 22).

BIOLOGICAL AND ECOLOGICAL DATA

REVISION OF L50

The minimum length of herring in the commercial fishery has historically been fixed at the length at 50 % maturity (L50), based on the rationale that this would allow at least 50 % of herring to spawn once before being exploited by the fishery. Due to issues with high percentages of undersized herring in recent years, a request was made in 2013 for Science to re-examine the L50 in all stock areas. To facilitate this analysis, a pilot program was run from 2013-14 which lowered the minimum size of herring from 290 mm (total length) to 262 mm and required the collection of small herring samples by commercial fishers for analysis.

The L50 was last evaluated by Wheeler et al. (2009), who found that length at maturity had remained generally stable for year classes from 1965 to 1989, after which it declined by approximately 15%, and then increased again in the early 2000s, but not to previous levels. Length at maturity for this assessment was updated using a generalized linear model (GLM) with a logit-link function in R. Gear selectivity was accounted for by excluding samples from selective gear (gillnets). Sample sizes were insufficient during the 2000s to calculate L50 by region, but exploratory analysis showed that the differences between the northeast and south coasts were small for years when sufficient samples were available to estimate both, and overall trends remained the same between regions, as was also found by Wheeler et al. (2009); therefore all regions were combined for this assessment.

The analysis of L50 by year class showed the same trend observed by Wheeler et al. (2009) for spring spawner cohorts from 1966-2002. Extending this time series into the 2000's was difficult due to small sample sizes and the L50 could only be calculated for the 2002, 2003, 2008 and 2009 year classes (the 2010 cohorts were not fully recruited in the samples available for this

assessment). The size at maturity increased to 259 mm in 2003, decreased to 250 mm in 2008 and then went up to 272 mm for the 2009 cohort, slightly above the pilot program commercial size limit of 262 mm and below the former commercial fishery limit of 290 mm (Fig. 23). An analysis could not be conducted for fall spawners due to insufficient sample sizes of ag 2-4 herring.

When L50 was examined by decade, spring spawners averaged 277 mm in the 1980s, declined to 240 mm in the 1990s, then increased to 257 mm during the 2000s and again to 271 mm (248 mm fork length) since 2010, which is slightly above the commercial size limit set for the pilot project. Sample sizes were large enough to calculate L50 values for fall spawners during the 1990s and 2010s; this analysis showed that the mean L50 was 271 mm in the 1990s and 278 mm (254 mm fork length) in the 2010s – also above the pilot project limit but slightly below the former commercial fishery size limit (Table 11, Fig. 24).

Small herring samples from 2014 were being processed at the time of this assessment and will be used to further update the L50 when completed. Preliminary results are available for samples which were collected by purse seine in Placentia Bay in December 2014; 739 small herring (under the pilot project size limit) were partially processed in January 2015 (ages and spawning types have yet to be determined). An examination of maturity stage of these fish showed that only 2 % were mature (stage three or above), implying that the pilot project size limit may be below the L50.

WEIGHT AND LENGTH AT AGE

Herring weights and lengths at age were calculated by spawning group for the northeast coast (WBNDB-BBTB) and south coast (SMBPB-FB); ages for which there were fewer than 20 fish per year, spawning group and area were excluded from the analysis.

Both weights and lengths at age of spring spawners in all areas declined after the 1980s. On the northeast coast, there was little variation through the 1990s and 2000s to present, however on the south coast weights at age declined again in the 2000's. Age 9 and 10 fish were lower again in 2012 compared to the rest of the series (Fig. 25-26). Spring spawners on the south coast were larger than those on the northeast coast through the 1980s and 1990s, but weights and lengths at age have been similar or lower through the 2000's to present (Table 12).

Fall spawners show similar trends to springs, with reduced weights at age in all areas after the 1980s, and further reductions on the south coast in the 2000s (Fig. 25-26). As with spring spawners, fall spawners on the south coast had higher weights at age until the 2000s. Throughout the time series spring spawners in all areas have had higher weights at age than fall spawners, although on the south coast the difference between the two has decreased over time (Table 12).

OFFSHORE DISTRIBUTION

During the 2000's an increase in the number of herring caught in spring offshore multispecies trawl surveys was noted, particularly in NAFO division 3Ps (Fig. 27). As of 2011 herring samples were collected from the surveys, with up to 55 fish per set being frozen for processing. An effort is made to process at least 1 sample per each 20 square nautical mile area where herring were caught (Fig. 28). Data from these samples is used to calculate catch at age by spawning type per NAFO division.

The proportion of fall spawners in offshore samples in 2013 was lower in all areas than the previous two years; only one sample was processed from Div. 3L and it consisted entirely of spring spawners. In 3O the age distribution reflected that of the previous year, with the 2008 fall

spawner and 2009 spring spawner year classes accounting for high proportions of the catch; age 1 spring spawners were also present. In 3Ps the year classes detected in 2011 and 2012 also continued to track through in 2013, with the strong 2009 spring spawner age group comprising a large proportion of the catch. A high number of age 1 spring spawners were observed in this division, accounting for 15 % of the herring caught (Fig. 29).

The stock affinities of these fish are currently unknown as is the cause of the distribution shift. The strong year classes detected over the past three years in these offshore aggregations have been reflected in the research gillnet catch at age for all areas except FB (Fig. 21).

STOCK STATUS

Stock status during the 2000s was reported via performance reports, using a 'traffic light' approach of red (-), yellow (?) or green (+) 'lights' to categorize indicators as 'cause for concern', 'uncertain', or 'positive.' Values for current stock status were calculated based on a standardized (but arbitrary) evaluation of all available abundance indices and the age composition of mature year classes. These indices were weighted on their perceived importance and reliability in assessing current stock status and a final value was obtained.

The indices included in stock status calculation and their weightings were examined at the 2013 framework meeting and changes were suggested (Bourne et al. 2015). Specifically, it was recommended that the cumulative change index be removed from stock status reporting, and that stock status only be calculated going forward in areas with a research gillnet program (BBTB and FB). For areas without a research gillnet program the traffic light approach would be used with no calculated stock status and when appropriate, comments regarding trends in adjacent stock areas would be included. It was recommended that stock status would be based on weighted values of catch rates, number of cohorts above average and the mean catch rate of older fish, with the weighting scheme to be decided during the current assessment. In addition, catch rates from the research gillnet program (age 4-6) were to be used to report on short term (2-3 years) stock status. During this assessment meeting it was determined that because the three indices chosen for calculating stock status are related and derived from the same catch data, they would be assigned equal weighting. This method was used to update the stock status for both BBTB and FB.

In BBTB the stock status index has remained stable for the last three years, giving an overall positive evaluation for the area (Table 4, Fig. 30). Research gillnet catch rates increased to above average in 2014 (Fig. 19) and several strong year classes are present, with thee mature spring and eight mature fall year classes above average (Fig. 22). The recruitment of fall spawners in 2012 and spring spawners in 2013 was high and the catch rates of age 4-6 herring of both spawning components has increased over the past several years, indicating positive short term prospects.

The stock status index in FB reached its lowest point in the time series in 2013, giving an evaluation of negative current stock status (Table 16, Fig. 30). Catch rates in the research gillnet program have been extremely low since 2010 (Fig. 19), and only one mature spring year class was above average (age 11 +), which is a concern as this spawning component still comprises the majority of the catch in this stock area (Figs. 19 and 22). Short term prospects in FB are also negative as the catch rates of age 4-6 herring of both spawning components have been at historical low levels for the past several years and there are no indications of strong recruitment.

In WBNDB the stock status index had shown a decline from 2009 to 2011, but an increase in 2012, the last year in which the research gillnet program took place in the area. Information from

the commercial fishery and the adjacent BBTB stock area were used to provide an update of this stock for the current assessment (Table 13). Commercial landings in WBNDB have remained near 50 % of the TAC since 2011; fishers indicated that in 2013 the TAC was not taken due to poor market conditions and the presence of small fish. Fixed gear and purse seine fishers in the area indicated increasing abundance through the cumulative change index. Age 4 spring spawners and age 5 fall spawners in 2013 accounted for over 50 % of the commercial catch, and fall spawners comprised 65 % of the catch overall. These trends are similar to those observed in the adjacent stock area of BBTB where stock status is positive; given that there are no indications of a decline in abundance and that strong year classes are present in the commercial fishery in this area, the evaluation of stock status is positive.

The stock status index in SMBPB was stable from 2008 to 2010, increased in 2011 and decreased in 2012, the final year of the research gillnet program. An evaluation of current stock status in this area could not be provided with certainty, due to the low activity in the commercial fishery in recent years and thus a lack of samples to compile the commercial catch at age. Fixed gear fishers in the area have reported a decreasing trend in abundance through the cumulative change index, where mobile gear fishers indicated an increase. Unlike the northeast coast, adjacent stock complexes on the south coast do not tend to show the same degree of similarity so information from FB was not used to evaluate SMBPB; therefore the evaluation of stock status for this area is uncertain (Table 15).

AREAS OF UNCERTAINTY

The inability to estimate spawning stock biomass and exploitation rates continues to be a major source of uncertainty in this stock assessment.

The lack of a fishery-independent abundance index in several areas makes it impossible to update the standardized current stock status index; instead stock status is derived using information from the commercial fishery which may not accurately reflect population dynamics.

There has been an apparent change in spawning behavior, with an increase in summer spawning. This may impact the validity of the spring research gillnet program results and the designation of spring and fall spawners using the historical method based largely on otolith structure.

The proportion of fall spawning herring has increased in most stock areas but there is no fall research gillnet program to provide a comparable index to the current spring program that runs in the BBTB and FB stock areas, which would provide a better indication of fall spawner abundance trends.

Distribution of herring has likely changed since stock complexes were delineated in the late 1970s and early 1980s, but it is unknown how migration patterns have changed and what impact this may have had on stock complex structure.

The evaluation of trends within abundance indices is dependent, among other things, upon the uncertainties associated with each index. Due to the limited fishery and research data, sample sizes for most indices in these assessments, with the exception of the gill net fisher index from telephone surveys, are generally small resulting in higher uncertainties.

The inability to estimate population sizes has precluded (to date) the calculation of stock status zones and reference points. This severely limits the implementation of the precautionary approach in fisheries management decisions.

SUMMARY AND RESERCH RECOMMONDATIONS

Both the spawning stock composition and spawning times of herring in the region changed during the 2000s, with an increasing proportion of fall spawners in most areas and spring spawning times shifting from May-June to July. These changes coincided with rising ocean temperatures and it is suspected that varying environmental conditions have an impact on stock dynamics. The lengths and weights at age of both spring and fall spawning herring also decreased during the 2000s on the south coast, after a general decline in all stock areas during the 1990s. The length at 50 % maturity (L50) of spring cohorts in all areas decreased through the late 1980s and 1990s, but showed an increasing trend from 1996 to 2009. The average L50 of spring spawners in the commercial fishery from 2010 to 2013 was 248 mm and for fall spawners was 254 mm (fork length); this is below the previous commercial size limit which is intended to be at or above the population L50. An increase in the frequency of occurrence of herring in spring multispecies offshore trawl surveys has indicated a change in distribution. Year class composition in the 2011-13 surveys was similar to that of the commercial and research gillnet fisheries, but it is unknown which stock complexes herring found offshore belong to.

Stock status in both the WBNDB and BBTB stock complexes is positive, with strong 2008 and 2009 year classes in the fishery, good recruitment in BBTB (there is no recruitment index in WBNDB) and no indications of declines in abundance. There was uncertainty in interpretation of the stock status in SMBPB due to too few samples being collected in recent years to adequately assess the age structure of the population. The stock status in FB remains negative, with a population that is highly skewed toward older spring spawners, declining catch rates and no indications of good recruitment.

RESEARCH RECOMMODATIONS

- Reinstate the acoustic survey to get an estimation of biomass and reinstate the gill net survey in SMBPB and WBNDB.
- Implement a stock complex migration study; investigate most appropriate method to obtain information on migration patterns.
- Develop a GSI to identify spring and autumn stock spawning components.
- Instate an exploratory quota for the month of August to gain scientific and fishery knowledge for this month.
- Investigate the potential impact of net position on catch rates in the research gillnet program.
- Use a fixed reference period when calculating average catch rate numbers for each stock area.
- Provide updates for the CBSS stock area.
- Conduct phone survey for bar seine fishery in FB.
- Consider methods to increase the return of logbooks which will supplement stock status information in the areas where there is no research gillnet program.

REFERENCES CITED

Bourne, C.B., Mowbray, F., Squires, B. and Croft, C. 2015. An assessment framework meeting and review of Newfoundland east and south cost herring stocks to the spring of 2013. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/029.

Colbourne, E., Craig, J., Fitzpatrick, C., Senciall, D., Stead, P. and Bailey, W. 2012. An assessment of the physical oceanographic environment on the Newfoundland and Labrador Shelf during 2011. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/044.

DFO. 2014. Assessment of the West Coast of Newfoundland (Division 4R) herring stocks in 2013. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/056.

LeBlanc, C.H., Mallet, A., MacDougall, C., Bourque, C. and Swain, D. 2012. Assessment of the NAFO Division 4T southern Gulf of St. Lawrence herring stocks in 2011. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/111.

Melvin, G.D., Stephenson, R.L. and Power, M.J. 2009. Oscillating reproductive strategies of herring in the western Atlantic in response to changing environmental conditions. ICES Journal of Marine Science. 66:1784-1792.

McQuinn, I.H. 1989. Identification of spring- and autumn-spawning herring (*Clupea harengus harengus*) using maturity stages assigned from a gonadosomatic index model. Can. J. Fish. Aquat. Sci. 46:969-980.

Olsen, R.E., Oppedal, F., Tenningen, M., and Vold, A. 2012. Physiological response and mortality caused by scale loss in Atlantic herring. Fish. Res. 129-130: 21-27.

Tenningen, M., Vold. A. and Olsen, R.E. 2012. The response of herring to high crowding densities in purse seines: survival and stress reactions. ICES Jour. Mar. Sci. 69(8): 1523-1531.

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

Wheeler, J.P., and Winters, G.H. 1984b. Homing of Atlantic Herring (*Clupea harengus harengus*) in Newfoundland waters as indicated by tagging data. Can. J. Fish. Aquati. Sci. 41:108-117.

Wheeler, J.P., Purchase, C.F., Macdonald, P.D.M., Fill, R., Jacks, L., Wang, H. and Ye, C. 2009. Temporal changes in maturation, mean length-at-age, and condition of spring-spawning Atlantic herring (*Clupea harengus*) in Newfoundland waters. ICES J. Mar. Sci. 66:1800-1807.

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

Winters, G. H. and Wheeler, J.P. 1996. Environmental and phenotypic factors affecting the reproductive cycle of Atlantic herring. ICES Journal of Marine Science. 53:73-88.

Winters, G.H., Wheeler, J.P. and Dalley, E.L. 1986. Survival of a herring stock subjected to a catastrophic event and fluctuating environmental conditions. J. Cons. Int. Explor. Mer. 43:26-42.

APPENDIX I

Table 1. WBNDB herring landings and TACs (t), by gear, 1999-2014 (up to December 8, 2014). Landings do not include herring discards or herring used as bait.

Year	Area	Purse Seine	Bar Seine	Tuck Seine	Gillnet	Trap	Total	TAC	% TAC Landed
1999	WB	0	0	-	4	30	34	-	-
1999	NDB	931	0	-	53	0	984	-	-
1999	Combined	931	0	-	57	30	1018	2500	41
2000	WB	74	0	-	3	2	79	-	-
2000	NDB	997	0	-	16	1	1014	-	-
2000	Combined	1071	0	-	19	3	1093	2500	44
2001	WB	13	0	-	7	5	25	-	-
2001	NDB	0	0	-	0	1	1	-	-
2001	Combined	13	0	-	7	6	26	1100	2
2002	WB	0	13	-	6	5	23	-	-
2002	NDB	303	0	-	7	23	333	-	-
2002	Combined	300	13	-	13	28	357	1100	32
2003	WB	0	0	-	22	0	22	-	-
2003	NDB	195	87	-	24	4	310	-	-
2003	Combined	195	87	-	46	4	332	1100	30
2004	WB	11	2	-	4	28	45	-	-
2004	NDB	152	48	-	8	13	220	-	-
2004	Combined	163	50	-	12	40	265	1100	24
2005	WB	39	174	115	2	174	505	-	-
2005	NDB	97	259	2	10	17	386	-	-
2005	Combined	136	433	117	12	190	891	1100	81
2006	WB	56	16	21	8	49	150	-	-
2006	NDB	83	58	0	19	0	159	-	-
2006	Combined	139	74	21	27	49	309	1100	28
2007	WB	13	8	0	0	9	31	-	-
2007	NDB	320	7	0	0	4	331	-	-
2007	Combined	333	15	0	0	13	362	1700	21
2008	WB	211	0	3	0	2	216	-	-
2009	NDB	228	246	19	4	1	498	-	-
2009	Combined	439	246	22	4	3	714	1700	42
2009	WB	4	0	0	0	6	10	-	-
2009	NDB	414	0	0	1	0	415	-	-
2009	Combined	418	0	0	1	6	425	2200	19
2010	WB	203	0	0	0	82	285	-	-
2010	NDB	210	22	0	2	7	239	-	-
2010	Combined	413	22	0	2	89	524	2640	20
2011	WB	721	0	75	43	415	1255	-	-
2011	NDB	43	0	0	0	1	44	-	-
2011	Combined	764	0	75	43	416	1299	2640	49
2012	WB	47	0	61	5	346	458	-	-
2012	NDB	602	0	136	20	12	770	-	-
2012	Combined	649	0	197	25	358	1228	2640	43
2013*	WB	213	0	18	13	224	468	-	-
2013*	NDB	731	0	39	1	0	770	-	-
2013*	Combined	944	0	57	14	224	1238	2640	47
2014**	WB	0	0	0	0	236	236	-	-
2014**	NDB	127	0	0	0	0	124	-	-
2014**	Combined	127	0	0	0	236	363	2640	14

* provisional **updated January 6, 2015

Table 2. BBTB herring landings and TACs (t), by gear, 1999-2014 (up to December 8, 2014). Landings do not include herring discards or herring used as bait.

Year	Area	Purse Seine	Bar Seine	Tuck Seine	Gillnet	Trap	Total	TAC	% TAC Landed
2000	BB	493	195	-	135	8	831	-	-
2000	TB	2	190	-	67	0	259	-	-
2000	Combined	495	385	-	202	0	1090	2500	44
2001	BB	241	16	-	37	0	294	-	-
2001	TB	18	155	-	19	0	192	-	-
2001	Combined	259	171	-	56	0	486	3500	14
2002	BB	0	297	-	25	7	329	-	-
2002	TB	200	4	-	13	20	237	-	-
2002	Combined	200	301	-	38	27	566	3500	16
2003	BB	343	1	-	48	90	482	-	-
2003	TB	0	0	-	8	0	8	-	-
2003	Combined	343		-	56	90	490	3000	16
2004	BB	188	139	-	3	2	322	-	-
2004	TB	134	19	-	21	2	177	-	-
2004	Combined	322	158	-	24	5	509	3000	17
2005	BB	910	456	21	154	82	1623	-	-
2005	TB	604	103	142	163	5	1017	-	-
2005	Combined	1515	559	162	317	87	2640	3000	88
2006	BB	703	467	63	33	4	1270	-	-
2006	TB	340	129	62	103	0	636	-	-
2006	Combined	1043	596	125	136	4	1906	3000	64
2007	BB	465	381	301	22	0	1169	-	-
2007	TB	784	197	473	132	23	1608	-	-
2007	Combined	1249	578	774	154	23	2777	4000	69
2008	BB	1138	197	405	10	0	1750	-	-
2008	TB	777	21	221	34	0	1079	-	-
2008	Combined	1915	218	626	44	0	2829	4000	71
2009	BB	1276	37	720	254	23	2310	-	-
2009	TB	452	182	215	24	0	873	-	-
2009	Combined	1728	219	935	278	23	3183	4500	71
2010	BB	1104	31	853	29	43	2060	-	-
2010	TB	40	0	25	5	0	70	-	-
2010	Combined	1144	31	878	34	43	2131	4950	43
2011	BB	74	0	82	8	40	204	-	-
2011	TB	4	0	56	63	0	123	-	-
2011	Combined	78	0	138	71	40	327	4950	7
2012	BB	1320	0	429	48	0	1797	-	-
2012	TB	248	0	140	66	4	458	-	-
2012	Combined	1568	0	559	114	4	2255	4950	46
2013*	BB	1403	0	786	21	0	2210	-	-
2013*	TB	1170	0	664	59	8	1902	-	-
2013*	Combined	2575	0	1450	80	8	4112	4950	83
2014**	BB	1119	0	788	9	0	1916	-	-
2014**	TB	1294	0	634	18	0	1946	-	-
2014**	Combined	2413	0	1422	27	0	3862	4950	78

* provisional **updated January 6, 2015

Table 3. CBSS herring landings and TACs (t), by gear, 1999 – 2014 (up to December 8, 2014). Landings do not include herring discards or herring used as bait.

Year	Area	Purse Seine	Bar Seine	Tuck Seine	Gillnet	Trap	Total	TAC	% TAC Landed
2000	CB	0	0	-	0	0	0	-	-
2000	SS	0	0	-	0	0	0	-	-
2000	Combined	0	0	-	0	0	0	600	0
2001	CB	0	0	-	0	0	0	-	-
2001	SS	0	0	-	0	0	0	-	-
2001	Combined	0	0	-	0	0	0	600	0
2002	CB	0	0	-	0	0	0	-	-
2002	SS	0	0	-	0	0	0	-	-
2002	Combined	0	0	-	0	0	0	600	0
2003	CB	0	0	-	0	0	0	-	-
2003	SS	0	0	-	0	0	0	-	-
2003	Combined	0	0	-	0	0	0	600	0
2004	CB	0	0	-	0	0	0	-	-
2004	SS	0	0	-	0	0	0	-	-
2004	Combined	0	0	-	0	0	0	600	0
2005	CB	1	3	0	3	1	8	-	-
2005	SS	0	0	0	0	3	3	-	-
2005	Combined	1	3	0	3	4	11	600	2
2006	CB	0	0	0	7	0	7	-	-
2006	SS	0	0	0	0	0	0	-	-
2006	Combined	0	0	0	7	0	7	600	1
2007	CB	94	0	0	0	0	94	-	-
2007	SS	0	0	0	0	0	0	-	-
2007	Combined	94	0	0	0	0	94	600	16
2008	CB	258	0	0	0	0	258	-	-
2008	SS	0	0	0	0	0	0	-	-
2008	Combined	258	0	0	0	0	258	600	43
2009	CB	29	0	0	0	0	29	-	-
2009	SS	0	0	0	0	0	0	-	-
2009	Combined	29	0	0	0	0	29	600	5
2010	CB	24	0	15	1	0	40	-	-
2010	SS	0	0	0	0	0	0	-	-
2010	Combined	24	0	15	1	0	40	600	7
2011	CB	9	0	0	0	0	9	-	-
2011	SS	0	0	0	0	0	0	-	-
2011	Combined	9	0	0	0	0	9	600	2
2012	CB	0	0	0	5	0	5	-	-
2012	SS	0	0	0	0	0	0	-	-
2012	Combined	0	0	0	5	0	5	600	1
2013*	CB	216	0	0	6	0	222	-	-
2013*	SS	0	0	0	0	0	0	-	-
2013*	Combined	216	0	0	6	0	222	600	37
2014**	CB	313	0	95	6	0	408	-	-
2014***	SS	0	0	0	0	0	0	-	-
2014**	Combined	313	0	95	6	0	408	600	68

*provisional **updated January 6, 2015

Table 4. SMBPB herring landings and TACs (t), by gear, 1999-2014 (up to December 8, 2014). Landings do not include herring discards or herring used as bait.

Year	Area	Purse Seine	Bar Seine	Tuck Seine	Gillnet	Trap	Total	TAC	% TAC Landed
2000	SMB	0	0	-	0	0	0	-	-
2000	PB	447	41	-	4	0	492	-	-
2000	Combined	447	41	-	4	0	492	2000	25
2001	SMB	57	0	-	0	0	57	-	-
2001	PB	394	213	-	38	0	645	-	-
2001	Combined	451	213	-	38	0	702	2000	35
2002	SMB	100	0	-	0	0	100	-	-
2002	PB	1297	0	-	135	36	1468	-	-
2002	Combined	1398	0	-	135	36	1568	2000	78
2003	SMB	0	0	-	11	0	11	-	-
2003	PB	925	19	-	74	0	1018	-	-
2003	Combined	925	19	-	84	0	1029	2500	41
2004	SMB	342	0	-	79	0	421	-	-
2004	PB	897	71	-	1	0	968	-	-
2004	Combined	1240	71	-	179	0	1389	2500	56
2005	SMB	1101	43	0	0	2	1146	-	-
2005	PB	146	0	0	134	0	280	-	-
2005	Combined	1247	43	0	134	2	1426	2500	57
2006	SMB	729	0	0	0	0	729	-	-
2006	PB	649	0	0	150	0	799	-	-
2006	Combined	1378	0	0	150	0	1528	2500	61
2007	SMB	528	0	34	0	0	562	-	-
2007	PB	30	0	0	167	0	197	-	-
2007	Combined	558	0	34	167	0	759	2500	30
2008	SMB	236	0	0	0	0	236	-	-
2008	PB	831	0	0	79	2	912	-	-
2008	Combined	1067	0	0	79	2	1148	2500	46
2009	SMB	700	0	0	0	0	700	-	-
2009	PB	605	0	0	102	0	707	-	-
2009	Combined	1305	0	0	102	0	1407	2250	63
2010	SMB	264	0	0	0	0	264	-	-
2010	PB	740	0	0	2	0	742	-	-
2010	Combined	1004	0	0	2	0	1006	2250	45
2011	SMB	0	0	0	0	0	0	-	-
2011	PB	0	0	0	19	0	19	-	-
2011	Combined	0	0	0	19	0	19	2250	1
2012	SMB	0	0	0	0	0	0	-	-
2012	PB	0	0	0	56	0	56	-	-
2012	Combined	0	0	0	56	0	56	2250	2
2013*	SMB	0	0	0	0	0	0	-	-
2013*	PB	193	0	0	19	0	212	-	-
2013*	Combined	193	0	0	19	0	212	2250	9
2014**	SMB	0	0	0	0	0	0	-	-
2014**	PB	337	0	0	0	0	337	-	-
2014**	Combined	337	0	0	0	0	337	2250	15

* provisional **updated January 6, 2015

Table 5. FB herring landings and TACs (t), by gear, 1999-2014 (up to December 8, 2014). Landings do not include herring discards or herring used as bait.

Year	Purse Seine	Bar Seine	Tuck Seine	Gillnet	Trap	Total	TAC	% TAC Landed
2000	0	791	-	16	35	842	5400	16
2001	0	1592	-	0	190	1782	2700	66
2002	0	1895	-	0	364	2259	2700	84
2003	0	2427	-	0	880	3307	3700	89
2004	0	1655	-	54	1221	2930	3700	79
2005	0	2084	0	4	564	2652	3700	72
2006	0	2027	0	4	310	2341	3700	63
2007	0	1987	0	2	459	2448	3200	77
2008	29	1760	133	2	626	2550	3200	80
2009	0	1857	0	6	498	2361	2880	82
2010	0	1708	0	7	909	2624	2880	91
2011	0	1469	0	1	55	1525	2880	53
2012	0	1509	0	15	161	1685	2880	58
2013*	0	952	0	15	0	968	2260	43
2014**	0	797	0	0	0	797	2260	35

* provisional **updated January 6, 2015

Table 6. Herring bait estimates derived from the annual fixed gear telephone survey and total reported herring landings by stock area – WBNDB.

Bait estimates and commercial landings	2008	2009	2010*	2011	2012	2013	2014**
n fishers contacted	32	37	-	19	32	22	24
Mean bait/fisher (kg)	1420	1127	-	585	836	1243	1456
Total reported landings (t) without bait estimate	714	425	524	1299	1228	1237	237
Stock area bait estimate (t)	474	408	287	165	308	282	311

Table 6b. Herring bait estimates derived from the annual fixed gear telephone survey and total reported herring landings by stock area – BBTB.

Bait estimates and commercial landings	2008	2009	2010*	2011	2012	2013	2014**
n fishers contacted	41	41	-	31	32	35	32
Mean bait/fisher (kg)	1725	2026	-	1324	1475	2087	948
Total reported landings (t) without bait estimate	2829	3183	2131	327	2255	4112	1507
Stock area bait estimate (t)	451	547	428	309	322	509	173

Table 6c. Herring bait estimates derived from the annual fixed gear telephone survey and total reported herring landings by stock area – SMBPB.

Bait estimates and commercial landings	2008	2009	2010*	2011	2012	2013	2014**
n fishers contacted	17	17	-	16	15	12	11
Mean bait/fisher (kg)	1315	1501	-	1380	1801	1946	569
Total reported landings (t) without bait estimate	1148	1407	1006	19	56	222	338
Stock area bait estimate (t)	127	138	155	172	142	112	29

Table 6d. Herring bait estimates derived from the annual fixed gear telephone survey and total reported herring landings by stock area – FB.

Bait estimates and commercial landings	2008	2009	2010*	2011	2012	2013	2014**
n fishers contacted	50	45	-	40	36	22	23
Mean bait/fisher (kg)	2184	1709	-	1517	3818	996	641
Total reported landings (t) without bait estimate	2550	2361	2624	1525	1685	968	797
Stock area bait estimate (t)	395	315	293	271	630	118	58

*there was no telephone survey in 2010, bait estimates derived from 2009 and 2011 survey means

**2014 commercial landings to early December (preliminary)

Table 7a. Parameters, landings, discard, survival and effort data from commercial purse seine telephone survey – WBNDB.

Year	n fishers	% response	Estimated Landings (t)	Total Reported Landings (t)	Estimated Discards (t)	Estimate Discard Survival (%)	Estimated Total Removals (t)	Removal to Landing Ratio	Effort (total sets)
1996	18	94	392	435	446	49	620	1.58	26
1997	15	93	1801	2375	2045	97	1866	1.04	294
1998	6	100	302	606	540	93	338	1.12	108
1999	7	100	882	931	116	39	953	1.08	70
2000	12	75	651	1071	130	100	651	1.00	29
2001	0	-	-	13	-	-	-	-	-
2002	3	100	260	300	25	93	262	1.01	12
2003	4	100	201	195	193	40	317	1.58	8
2004	5	80	109	163	13	0	121	1.11	4
2005	4	100	84	136	12	35	92	1.10	4
2006	6	67	160	139	15	10	174	1.09	4
2007	2	100	325	333	0	-	325	1.00	17
2008	7	100	575	439	25	90	577.5	1.00	37
2009	4	100	545	418	215	45	663.3	1.22	26
2010	6	83	260	413	50	100	260	1.00	17
2011	10	90	1025	910	353	45	1219	1.19	63
2012	6	83	595	649	147.5	37.5	687	1.15	30
2013	3	100	825	944	460	57.5	1020.5	1.24	84
2014*	1	100	100	127	25	100	100	1.00	10

Table 7b. Parameters, landings, discard, survival and effort data from commercial purse seine telephone survey – BBTB.

Year	n fishers	% response	Estimated Landings (t)	Total Reported Landings (t)	Estimated Discards (t)	Estimate Discard Survival (%)	Estimated Total Removals (t)	Removal to Landing Ratio	Effort (total sets)
1996	21	100	738	358	209	50	842	1.14	93
1997	16	94	736	650	47	60	755	1.03	136
1998	13	85	621	708	9	50	625	1.01	111
1999	14	100	894	808	219	69	962	1.08	123
2000	7	71	344	495	264	95	358	1.04	73
2001	5	80	260	259	2030	83	615	2.37	126
2002	5	80	200	200	225	100	200	1.00	15
2003	2	100	378	343	25	20	398	1.05	34
2004	4	25	100	322	0	-	100	1.00	8
2005	10	70	1315	1515	59	30	1356	1.03	59
2006	12	83	1100	1043	765	86	1209	1.10	74
2007	18	83	1474	1249	0	-	1474	1.00	83
2008	18	83	2077	1915	25	70	2084	1.00	109
2009	29	93	1822	1728.8	668	86	1918	1.05	127
2010	19	89	1242	1144.75	62.5	100	1242	1.00	104
2011	5	100	372.5	289	435	76	475	1.28	82
2012	22	91	1534	1568	1930	29	2890	1.88	140
2013	7	100	1202.5	2575	57.5	75	1216.9	1.01	77
2014*	0	-	-	-	-	-	-	-	-

Table 7c. Parameters, landings, discard, survival and effort data from commercial purse seine telephone survey – SMBPB.

Year	n fishers	% response	Estimated Landings (t)	Total Reported Landings (t)	Estimated Discards (t)	Estimate Discard Survival (%)	Estimated Total Removals (t)	Removal to Landing Ratio	Effort (total sets)
1996	10	90	460	446	225	50	572	1.24	16
1997	15	100	4401	3836	403	82	4474	1.02	316
1998	15	87	1727	2281	790	99	1736	1.01	141
1999	3	67	186	330	0	-	186	1.00	26
2000	1	100	400	447	105	90	411	1.03	24
2001	2	100	430	451	100	95	435	1.01	11
2002	8	100	1440	1398	1050	98	1458	1.01	55
2003	9	44	467	925	165	98	471	1.01	30
2004	11	91	1272	1240	2	100	1272	1.00	87
2005	14	64	975	1247	572	98	984	1.01	73
2006	9	78	1005	1378	58	100	1005	1.00	47
2007	3	100	601	558	25	65	610	1.01	30
2008	6	67	1044	1067	50	95	1046	1.00	32
2009	6	100	1440	1305	16	92	1441	1.00	51
2010	6	83	704	1005	2.5	95	704	1.00	40
2011	1	100	20	24	0	-	3.5	0.18	0
2012	0	-	-	-	-	-	-	-	-
2013	2	100	170	193	60	90	176	1.04	16
2014*	2	100	375	337	20	95	420	1.12	70

*2014 results include spring fishery only

Table 8. Results of the annual telephone survey of commercial fixed gear licence and or/herring bait permit holders by stock area – WBNDB.

Year*	# Licences and Bait Permits	% of total fishers - Licences and Bait Permits	# Fishers Phoned	% Fishers (stock area)	#	% of fishers phoned	# Active Fishers	% of fishers contacted	# Fished for Bait	% of active fisher - Fished for Bait
2006	989	43	113	11	84	74	40	48	39	39
2007	969	42	113	12	103	91	42	41	42	42
2008	959	41	113	12	92	81	32	39	32	32
2009	930	40	113	12	95	84	37	35	37	37
2011	876	38	83	9	59	71	19	32	19	19
2012	891	38	112	13	92	82	38	41	32	32
2013	770	33	111	14	85	77	25	29	22	22
2014	765	33	107	14	86	80	24	28	21	21

Table 8b. Results of the annual telephone survey of commercial fixed gear licence and or/herring bait permit holders by stock area – BBTB.

Year*	# Licences and Bait Permits	% of total fishers - Licences and Bait Permits	# Fishers Phoned	% Fishers (stock area)	#	% of fishers phoned	# Active Fishers	% of fishers contacted	# Fished for Bait	% of active fisher - Fished for Bait
2006	577	25	106	18	88	83	49	56	44	90
2007	562	24	106	19	88	83	50	57	44	88
2008	560	24	106	19	92	87	43	47	41	95
2009	547	24	106	19	89	84	44	49	41	93
2011	527	23	95	18	79	83	35	44	29	83
2012	533	23	105	20	88	84	36	41	32	89
2013	476	20	103	22	82	80	42	51	35	83
2014	472	20	98	21	83	85	32	39	30	94

Table 8c. Results of the annual telephone survey of commercial fixed gear licence and or/herring bait permit holders by stock area – SMBPB.

Year*	# Licences and Bait Permits	% of total fishers - Licences and Bait Permits	# Fishers Phoned	% Fishers (stock area)	#	% of fishers phoned	# Active Fishers	% of fishers contacted	# Fished for Bait	% of active fisher - Fished for Bait
2006	453	19	103	23	79	77	22	28	21	95
2007	445	19	102	23	83	81	19	23	17	89
2008	444	19	102	23	78	76	17	22	17	100
2009	415	18	101	24	86	85	19	22	17	89
2011	375	16	62	17	48	77	16	33	16	100
2012	378	16	98	26	72	73	15	21	15	100
2013	343	15	97	28	78	80	13	17	12	92
2014	340	15	94	28	73	78	11	15	11	100

Table 8d. Results of the annual telephone survey of commercial fixed gear licence and or/herring bait permit holders by stock area – FB.

Year*	# Licences and Bait Permits	% of total fishers - Licences and Bait Permits	# Fishers Phoned	% Fishers (stock area)	#	% of fishers phoned	# Active Fishers	% of fishers contacted	# Fished for Bait	% of active fisher - Fished for Bait
2006	307	95	95	31	79	83	57	72	55	96
2007	304	94	94	31	81	86	52	64	51	98
2008	304	94	94	31	84	89	50	60	50	100
2009	298	94	94	32	76	81	47	62	45	96
2011	278	74	74	27	67	91	43	64	38	88
2012	275	91	91	33	70	77	42	60	36	86
2013	260	90	90	35	57	63	27	47	22	81
2014	255	88	88	35	65	74	23	35	21	91

Table 9a. Research gillnet program parameters, catch data, and catch rates (numbers (#)/night fished) by stock area – WBNDB.

Year	n fishers	Fishing Start Date	Fishing End Date	Total Catch #'s	Fall Spawner catch rate	Spring Spawner catch rate	Combined catch rate
1988	5	14 May	17 June	17759	9	146	156
1989	7	25 April	24 June	99614	61	486	547
1990	7	25 April	22 June	121218	27	679	706
1991	7	8 May	31 July	117333	25	685	709
1992	6	6 May	7 July	139253	28	859	887
1993	6	3 May	9 July	104251	67	607	674
1994	7	2 May	18 July	110697	72	586	658
1995	7	15 May	27 July	103011	53	560	613
1996	7	7 May	11 July	114465	71	470	541
1997	7	13 May	11 July	70338	32	320	352
1998	7	5 May	10 July	53055	26	246	272
1999	7	5 May	16 July	46465	14	202	216
2000	6	25 April	22 July	10681	9	49	58
2001	7	8 May	20 July	29934	29	107	136
2002	9	21 April	31 July	10768	10	29	39
2003	9	19 April	31 July	31444	20	91	111
2004	8	23 April	31 July	30881	45	76	121
2005	8	22 April	31 July	76674	95	207	301
2006	8	24 April	31 July	75281	155	152	307
2007	7	14 May	25 July	70388	143	198	341
2008	8	5 May	31 July	57306	126	109	233
2009	8	29 April	30 July	74184	116	101	218
2010	8	16 Apr	29 Jul	41809	47	67	114
2011	8	12 Apr	19 Jul	10474	11	19	30
2012	8	05 May	20 Jul	64808	69	129	198

Table 9b. Research gillnet program parameters, catch data, and catch rates (numbers (#) /night fished) by stock area – BBTB.

Year	n fishers	Fishing Start Date	Fishing End Date	Total Catch #'s	Fall Spawner catch rate	Spring Spawner catch rate	Combined catch rate
1988	7	9 May	17 June	6554	1	51	53
1989	8	18 April	12 June	25250	10	96	106
1990	7	10 April	6 June	28748	11	135	146
1991	8	30 April	26 June	40320	20	188	209
1992	8	20 April	18 June	35196	15	138	153
1993	8	23 April	15 June	28373	17	113	130
1994	8	18 April	21 June	45863	19	168	187
1995	7	9 May	27 June	20836	10	99	110
1996	7	11 April	18 June	58278	29	229	259
1997	8	16 April	26 June	73135	33	279	312
1998	8	21 April	29 June	25564	19	83	102
1999	8	15 April	26 June	23290	21	60	81
2000	8	3 April	26 June	15579	16	41	57
2001	8	4 May	20 July	14303	18	32	50
2002	10	15 April	18 July	9859	4	23	27
2003	10	9 April	12 July	37597	36	72	108
2004	9	14 April	17 July	54260	82	99	181
2005	9	14 April	17 July	46422	87	75	162
2006	9	5 April	15 July	78838	115	138	253
2007	9	13 April	23 July	101092	218	147	364
2008	8	18 April	14 July	52531	108	78	186
2009	9	19 April	8 July	61376	85	62	147
2010	9	03-Apr	16-Jul	47478	60	57	117
2011	9	07-Apr	12-Jul	52446	74	49	123
2012	9	27-Apr	25-Jul	66157	111	58	169
2013	8	17-Apr	28-Jul	53061	102	53	155
2014	8	19-Apr	22-Jul	71317	-	-	223

Table 9c. Research gillnet program parameters, catch data, and catch rates (numbers (#)/nights fished) by stock area – SMBPB.

Year	n fishers	Fishing Start Date	Fishing End Date	Total Catch #'s	Fall Spawner catch rate	Spring Spawner catch rate	Combined catch rate
1982	4	17 April	15 May	1905	4	12	16
1983	5	6 April	3 June	9174	21	44	65
1984	4	5 April	14 June	34405	129	116	246
1985	4	10 April	6 June	35835	133	143	276
1986	5	10 April	13 June	37840	98	172	270
1987	5	1 April	31 May	43693	72	211	282
1988	5	2 April	29 May	23140	29	141	170
1989	5	4 April	7 June	21634	25	123	148
1990	5	9 April	6 June	28591	53	139	192
1991	5	3 April	12 June	9971	25	42	67
1992	5	8 April	10 June	13264	32	55	87
1993	5	5 April	11 June	10727	25	46	72
1994	5	7 April	7 June	22350	36	106	142
1995	5	5 April	3 June	12861	14	70	84
1996	5	2 April	12 June	54047	61	266	328
1997	5	4 April	4 June	30290	55	136	191
1998	5	1 April	5 June	19392	41	80	121
1999	5	1 April	27 May	38665	82	164	246
2000	5	4 April	3 June	36152	107	125	232
2001	5	5 April	8 June	37536	63	168	232
2002	6	1 April	14 June	85521	145	262	407
2003	6	4 April	12 June	37122	45	147	192
2004	6	5 April	18 June	22115	33	77	110
2005	6	5 April	14 June	24036	70	84	154
2006	6	1 April	2 June	22020	28	79	107
2007	6	2 April	13 June	14294	48	24	72
2008	6	8 April	7 June	12553	45	20	65
2009	6	4 April	13 June	33919	88	39	127
2010	6	01 Apr	16 Jul	21329	35	46	81
2011	6	01 Apr	04 Jul	17224	21	44	65
2012	6	09 Apr	25 Jun	30334	54	61	115

Table 9d. Research gillnet program parameters, catch data, and catch rates (numbers (#) /nights fished) by stock area – FB.

Year	n fishers	Fishing Start Date	Fishing End Date	Total Catch #'s	Fall Spawner catch rate	Spring Spawner catch rate	Combined catch rate
1982	2	16 April	22 May	799	4	19	23
1983	2	11 April	16 May	10653	8	22	30
1984	1	19 April	18 May	5908	71	156	227
1985	2	16 April	17 May	38301	307	810	1117
1986	3	15 April	6 June	44175	66	409	475
1987	3	8 April	22 May	63850	104	1029	1133
1988	3	13 April	23 May	46435	45	619	664
1989	3	11 April	23 May	84066	124	1426	1550
1990	3	17 April	24 May	48466	65	656	721
1991	3	9 April	28 May	50778	45	687	732
1992	3	16 April	12 June	30235	66	430	496
1993	3	13 April	5 June	39774	77	644	721
1994	3	13 April	10 June	62870	75	1083	1158
1995	3	18 April	23 June	56079	118	1084	1202
1996	3	3 April	27 May	93868	84	1257	1341
1997	3	7 April	31 May	96821	137	1473	1610
1998	3	7 April	30 May	111464	85	2039	2124
1999	3	1 April	26 May	90685	281	1125	1406
2000	3	1 April	30 May	76734	223	1018	1241
2001	3	6 April	1 June	110487	149	1742	1891
2002	4	3 April	31 May	60195	134	647	781
2003	4	23 April	31 May	61701	99	586	685
2004	4	3 April	31 May	40159	122	244	366
2005	4	3 April	31 May	50777	134	445	579
2006	4	1 April	6 June	38232	84	265	349
2007	4	2 April	11 June	27116	48	235	283
2008	4	13 April	16 June	42305	106	373	479
2009	4	4 April	24 June	67497	89	421	510
2010	4	01 Apr	04 Jul	49867	138	239	377
2011	4	02 Apr	14 Jun	11141	3	83	86
2012	4	22 Apr	16 Jun	20326	35	110	144
2013	3	14 Apr	15 Jun	15787	15	80	96
2014	4	12 Apr	22 Jun	25208	NA	NA	158

Table 10. Spring research gillnet catch at age (number per day fished) 2002-12 – WBNDB.

Age	Spawning Type	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	spring	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	spring	0.0	0.1	0.1	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.1
3	spring	11.0	3.6	5.5	7.0	0.3	0.2	32.8	2.4	1.1	1.2	28.4
4	spring	3.0	65.9	11.3	30.6	69.4	6.9	6.7	7.1	16.6	6.1	41.3
5	spring	4.7	2.7	43.9	41.5	10.0	137.1	1.3	5.1	8.4	1.7	7.1
6	spring	3.6	9.5	2.8	85.3	8.3	17.0	54.2	15.7	23.3	0.9	1.7
7	spring	2.1	1.3	2.0	1.4	36.5	7.3	2.4	52.5	12.9	1.5	2.5
8	spring	0.7	4.6	1.7	0.8	2.3	17.4	2.9	5.0	25.5	1.3	1.7
9	spring	0.2	1.5	1.5	6.8	0.0	0.0	2.5	4.5	4.6	4.6	3.2
10	spring	0.5	1.2	0.6	3.3	1.1	5.3	2.3	4.4	3.0	0.0	12.3
11+	spring	3.0	0.7	6.1	29.7	23.3	5.7	3.5	3.3	4.7	1.3	30.5
Total	spring	28.9	91.1	75.6	206.6	151.5	197.6	108.6	58.9	64.7	18.7	129.0
1	fall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	fall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	fall	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1
4	fall	2.0	2.4	13.6	5.3	1.4	9.3	0.5	5.1	7.0	2.2	4.8
5	fall	1.7	6.1	4.6	52.6	17.9	30.2	21.7	15.3	26.5	0.9	5.4
6	fall	2.1	0.7	10.4	4.8	88.5	34.1	12.9	8.3	9.2	1.7	6.9
7	fall	2.7	7.2	2.7	5.6	5.7	37.8	42.2	13.9	6.5	1.1	12.9
8	fall	1.3	1.5	3.5	2.4	8.1	6.2	37.3	26.7	14.2	0.5	7.0
9	fall	0.1	1.0	1.9	0.5	0.2	0.1	7.0	22.5	12.0	0.6	2.7
10	fall	0.1	0.7	5.3	4.1	4.2	10.4	1.0	5.1	20.1	1.1	1.2
11+	fall	0.4	0.6	3.3	19.5	29.2	14.7	1.7	3.2	4.4	2.3	28.2
Total	fall	10.4	20.3	45.2	94.6	155.2	143.1	124.5	158.6	47.1	10.4	69.2

Table 10b. Spring research gillnet catch at age (number per day fished) 2002-12 – BBTB.

Age	Spawning Type	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	spring	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	spring	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2
3	spring	11.0	2.5	1.1	11.6	1.1	2.2	4.6	0.0	0.2	1.0	9.1
4	spring	5.8	47.3	9.3	4.6	53.5	6.8	4.1	4.6	7.0	1.0	4.4
5	spring	2.3	12.2	68.3	6.3	11.1	69.6	1.7	2.8	10.4	4.2	2.9
6	spring	0.6	2.9	13.1	40.6	8.0	14.1	37.3	14.7	5.9	23.1	2.3
7	spring	1.5	0.4	2.5	5.1	52.4	9.5	4.4	36.7	21.1	1.7	0.7
8	spring	0.5	1.5	0.8	2.5	2.8	38.9	2.5	6.7	28.8	2.6	0.3
9	spring	0.1	0.6	0.3	0.1	1.7	1.5	13.3	8.8	5.9	19.8	0.7
10	spring	0.0	0.9	0.8	1.5	1.9	0.9	5.5	13.0	12.4	5.5	0.9
11+	spring	1.2	3.7	2.6	2.9	5.9	3.7	4.7	12.7	8.3	10.7	11.8
Total	spring	23.0	72.1	98.6	75.1	138.2	146.9	78.0	56.6	61.3	48.6	33.0
1	fall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	fall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
3	fall	0.0	0.0	0.2	0.0	0.2	0.0	1.9	0.3	0.0	0.0	0.3
4	fall	0.7	1.6	7.9	19.2	1.3	0.0	5.7	2.7	1.4	0.7	15.1
5	fall	0.9	7.3	11.5	31.9	21.6	5.9	5.7	7.1	8.8	4.3	6.2
6	fall	0.8	3.3	28.9	8.7	51.6	71.8	9.1	9.8	14.0	17.4	8.4
7	fall	1.0	8.6	12.4	12.0	8.6	105.1	34.5	13.8	11.5	10.1	10.7
8	fall	0.3	5.3	6.3	2.9	13.9	10.4	38.3	31.4	12.1	10.8	3.8
9	fall	0.3	2.4	3.0	3.9	2.5	7.8	4.8	23.7	24.0	1.3	1.0
10	fall	0.1	1.6	3.3	2.1	2.5	7.6	2.8	6.8	19.6	11.8	1.1
11+	fall	0.1	5.3	8.9	6.4	12.8	8.7	5.1	4.4	8.6	18.5	16.7
Total	fall	4.2	35.5	82.4	87.2	114.9	217.6	108.2	90.3	56.1	74.4	63.3

Table 10c. Spring research gillnet catch at age (number per day fished) 2002-12 – SMBPB.

Age	Spawning Type	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	spring	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
2	spring	0.8	1.2	0.9	0.4	0.4	0.0	0.0	0.8	1.1	0.0	0.2
3	spring	106.3	1.0	1.3	14.8	0.5	0.2	0.1	6.4	4.3	1.7	32.2
4	spring	1.8	117.4	3.0	0.3	41.2	1.2	0.1	2.3	9.4	2.0	2.4
5	spring	6.0	3.1	60.5	2.0	0.2	17.4	0.7	1.1	2.0	3.1	1.2
6	spring	46.1	0.3	3.4	36.0	2.4	0.6	12.3	13.3	2.1	1.6	1.7
7	spring	7.9	10.9	0.8	1.4	21.5	1.9	3.5	58.3	9.6	0.5	1.8
8	spring	1.8	2.6	2.5	3.8	0.2	1.9	2.0	7.3	4.1	0.8	0.6
9	spring	0.8	3.5	2.7	19.3	2.7	0.2	0.6	7.0	0.9	25.1	0.1
10	spring	7.1	0.1	0.5	1.9	3.1	0.2	0.7	2.7	1.0	0.7	3.7
11+	spring	83.3	6.8	0.9	4.3	4.7	0.0	0.0	0.8	0.3	8.4	17.2
Total	spring	261.9	147.1	76.5	84.1	79.0	23.7	19.9	82.5	46.5	44.1	61.1
1	fall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	fall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	fall	0.3	0.5	0.4	0.1	0.1	0.5	2.1	0.0	0.7	0.2	0.0
4	fall	3.3	1.5	5.3	9.5	2.0	6.7	2.7	20.1	10.8	3.8	1.0
5	fall	6.0	13.7	2.6	11.0	7.6	8.0	5.9	11.3	24.0	8.4	1.6
6	fall	47.7	2.0	15.1	5.1	9.3	13.8	5.3	8.0	17.0	5.9	4.2
7	fall	54.7	7.2	2.8	7.3	1.1	15.2	15.8	18.0	9.5	3.3	1.8
8	fall	11.9	11.7	3.0	4.3	4.8	3.0	12.2	23.9	11.3	3.9	0.8
9	fall	9.7	2.6	2.3	5.8	0.5	0.1	0.2	14.1	10.3	3.6	2.0
10	fall	8.4	0.3	0.5	25.0	1.3	0.3	0.8	4.1	15.9	5.6	2.4
11+	fall	3.2	5.8	1.1	1.7	1.3	0.1	0.2	0.5	0.5	0.2	6.9
Total	fall	145.4	45.2	33.1	70.0	27.9	47.8	45.1	44.1	34.9	34.9	20.7

Table 10d. Spring research gillnet catch at age (number per day fished) 2002-12 – FB.

Age	Spawning Type	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	spring	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	spring	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	spring	8.1	0.0	2.9	44.6	3.4	0.5	0.0	0.2	0.5	0.0	3.3
4	spring	0.9	19.0	3.1	0.7	167.5	2.9	0.0	0.0	10.5	0.6	7.2
5	spring	4.9	0.9	44.8	2.1	9.0	102.6	0.0	11.1	30.6	0.5	1.6
6	spring	194.2	5.6	7.0	40.1	2.9	2.2	108.5	15.2	34.6	0.3	1.8
7	spring	23.3	246.2	2.3	3.1	15.6	3.4	9.0	41.4	25.1	0.1	1.3
8	spring	6.3	16.7	62.1	3.8	1.8	4.2	15.5	15.9	73.5	1.2	0.2
9	spring	5.8	3.7	3.9	107.0	6.9	1.4	1.8	4.1	22.5	34.1	16.6
10	spring	11.6	0.9	2.3	9.8	16.1	0.9	3.2	10.4	40.4	1.2	39.2
11+	spring	192.8	169.4	65.0	137.4	40.9	62.6	125.9	1.7	38.9	25.9	39.4
Total	spring	447.4	462.8	194.1	348.6	264.1	180.9	263.3	309.4	276.4	63.2	110.6
1	fall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	fall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	fall	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
4	fall	7.4	0.4	14.8	15.9	4.7	2.8	0.7	7.9	10.5	0.6	10.3
5	fall	3.4	12.6	12.1	27.3	13.9	3.3	7.8	2.0	15.6	0.0	2.9
6	fall	24.5	0.5	43.6	21.7	28.4	11.0	1.2	3.8	10.3	0.0	4.3
7	fall	23.2	19.1	1.9	15.4	9.9	10.7	9.9	5.9	13.5	0.0	8.5
8	fall	1.9	11.5	5.5	2.6	5.9	4.2	36.3	46.4	69.3	0.6	3.6
9	fall	7.5	5.5	10.1	5.9	2.7	1.0	2.1	13.6	9.4	34.0	0.7
10	fall	1.9	4.0	3.2	1.9	5.8	1.1	3.0	15.7	21.3	0.6	2.5
11+	fall	23.0	24.1	5.6	14.0	12.2	3.0	14.1	4.7	24.7	25.5	1.9
Total	fall	92.9	78.5	96.9	104.7	83.4	37.1	75.1	65.6	175.0	60.7	34.6

Table 11. Mean length at 50 % maturity by decade and spawning type.

Decade	Spring spawner total length (mm)	Spring spawner fork length (mm)	Fall spawner total length (mm)	Fall spawner fork length (mm)
1980s	277	253	-	-
1990s	240	220	271	248
2000s	257	235	-	-
2010s	271	248	278	254

Table 12a. Mean weights at age (g) of herring by spawning group and area – spring spawners.

age	Northeast coast 2012	Northeast coast 2000's	Northeast coast 1990's	Northeast coast 1980's	South Coast 2012	South Coast 2000's	South Coast 1990's	South Cost 1980's
3	139.64	140.56	111.16	133.86	137.51	136.57	127.69	166.08
4	172.85	179.32	164.22	205.44	173.20	169.09	181.35	226.56
5	196.32	206.27	200.89	240.38	198.70	203.01	227.50	269.93
6	232.25	236.01	230.58	280.93	220.29	226.75	248.95	300.16
7	268.28	258.67	254.66	303.83	258.48	257.12	276.35	331.73
8	282.36	279.33	273.15	318.77	-	271.43	302.59	357.39
9	282.80	293.78	294.03	341.10	242.36	279.47	322.75	366.69
10	289.90	306.81	308.32	347.75	262.84	295.43	330.99	385.11

Table 12b. Mean weights at age (g) of herring by spawning group and area – fall spawners.

age	Northeast coast 2012	Northeast coast 2000's	Northeast coast 1990's	South Coast 2012	South Coast 2000's	South Coast 1990's	South Cost 1980's
3	-	-	-	-	-	-	-
4	166.51	172.64	-	164.35	162.09	158.85	192.62
5	194.59	192.70	192.13	186.44	187.09	200.98	226.70
6	213.02	217.12	218.03	210.05	206.57	228.70	262.95
7	246.10	237.80	240.05	229.12	233.69	254.88	290.16
8	267.47	255.51	267.44	244.48	250.51	279.29	316.30
9	277.05	274.45	298.20	-	268.83	298.14	336.77
10	284.09	292.27	298.14	280.76	289.16	319.29	331.64

Table 13a. White Bay-Notre Dame Bay performance table – the fishery.

The Fishery	***Observation***
Reported Landings: 2013	Reported landings in 2013 were 1238 t, 47% of the TAC, similar to 2011 and 2012.
Total Removals: 2013	In addition to reported landings, 282 t were estimated to have been taken for bait in 2013. Purse seine fishers estimated f460 t of discards in 2013 with 56% survival.
Effort: 2013	Documented purse seine effort (total sets) in 2013 was 84, the highest since 1997; 28% of fishers contacted in the fixed gear phone survey were active, the lowest percentage in the time series.

Table 13b. White Bay-Notre Dame Bay performance table – cumulative indices.

Cumulative Indices	***Observation***	***Interpretation***
Fixed gear fisher observations from telephone surveys and logbooks: 1996-2014	Fixed gear fishers reported decreasing abundance from 2009-2011 and increasing abundance since	Increasing trend in abundance.
Purse Seine Fisher Observations 1996 - 2013	Abundance has been increasing through the 2000's	Increasing trend in abundance.

Table 13c. White Bay-Notre Dame Bay performance table – biological characteristics.

Biological Characteristics	***Observation***	***Interpretation***
Commercial catch at age	Age 4 spring spawners and age 5 fall spawners in 2013 accounted for over 50% of the catch; fall spawners comprised 65% of landings.	Population age structure stable
Length and weight at age	Have not changed significantly since the 1990's	Size at age is stable.

Table 13d. White Bay-Notre Dame Bay performance table – stock status.

Stock Status	***Evaluation***
Positive. There are no indications of a decline in abundance, and several strong year classes are present in the commercial catch at age.	**+**

Table 14a. Bonavista Bay-Trinity Bay performance table – the fishery.

The Fishery	***Observation***
Reported Landings: 2013	Reported landings in 2013 were 4112 t, 83% of the TAC, the highest landings since 1992.
Total Removals: 2013	In addition to reported landings, 509 t were estimated to have been taken for bait in 2013. Purse seine fishers estimated fishers estimated 58 t of discards in 2013 with 75% survival.
Effort: 2013	Documented purse seine effort (total sets) in 2013 was 77; 39% of fishers contacted in the fixed gear phone survey were active, the lowest percentage in the time series.

Table 14b. Bonavista Bay-Trinity Bay performance table – cumulative indices.

Cumulative Indices	***Observation***	***Interpretation***
Fixed Gear Fisher Observations 1996-2014 from telephone surveys and logbooks	Fixed gear fishers reported increasing abundance since 2011	Increasing trend in abundance.
Purse Seine Fisher Observations 1996 - 2013	Abundance has been increasing since 2011	Increasing trend in abundance.

Table 14c. Bonavista Bay-Trinity Bay performance table – biological characteristics.

Biological Characteristics	***Observation***	***Interpretation***
Commercial catch at age	Age 4 spring spawners and age 5 fall spawners in 2013 accounted for over 50% of the catch; fall spawners comprised 65% of landings.	Population age structure is stable.
Length and weight at age	Have not changed significantly since the 1990's	Size at age is stable.

Table 14d. Bonavista Bay-Trinity Bay performance table – research gillnet program.

Research Gillnet Program	***Observation***	***Interpretation***
Research gillnet catch rates	Average in recent years; above average in 2014.	Increasing trend in abundance
Research gillnet age composition and recruitment	Recruitment of age 4 fish was high for spring spawners in 2013; high for fall spawners in 2012, and average in 2013. Age distribution well distributed with strong 2008 and 2009 year classes.	Population structure stable, good recruitment.

Table 14e. Bonavista Bay-Trinity Bay performance table – stock status.

Stock Status	***Evaluation***
Positive. There are no indications of a decline in abundance and several strong year classes are present in the commercial and research gillnet catch at age, and recruitment is average or above average.	+

Table 15a. St. Mary's Bay- Placentia Bay performance table – the fishery.

The Fishery	***Observation***
Reported Landings: 2013	Reported landings in 2013 were 212 t, 9% of the TAC, up from just 1 and 2% in 2011 and 2012, respectively.
Total Removals: 2013	In addition to reported landings, 112 t were estimated to have been taken for bait in 2013. Purse seine fishers estimated fishers estimated 60 t of discards in 2013 with 90% survival.
Effort: 2013	Documented purse seine effort (total sets) in 2013 was 16; 15% of fishers contacted in the fixed gear phone survey were active, the lowest percentage in the time series.

Table 15b. St. Mary's Bay- Placentia Bay performance table – cumulative indices.

Cumulative Indices	***Observation***	***Interpretation***
Fixed Gear Fisher Observations 1996-2014 from telephone surveys and logbooks	Fixed gear fishers reported decreasing from 2011 to 2014.	Decreasing trend in abundance.
Purse Seine Fisher Observations 1996 - 2013	Abundance has been increasing through the 2000's	Increasing trend in abundance.

Table 15c. St. Mary's Bay- Placentia Bay performance table – biological characteristics.

Biological Characteristics	***Observation***	***Interpretation***
Commercial catch at age	The 2013 age distribution was largely composed of age 11+ herring, but sample sizes were small so uncertainty in these estimates are high.	Population age structure is uncertain
Length and weight at age	Declined in the 1990's and again during the 2000's	Size at age has declined.

Table 15d. St. Mary's Bay- Placentia Bay performance table – stock status.

Stock Status	***Evaluation***
Uncertain. Due to low activity in the commercial fishery and no current research gillnet program, few samples were available for the calculation of catch at age in this area and there is a high level of uncertainty in reporting age structure.	?

? = Uncertainty of Interpretation

Table 16a. Fortune Bay performance table – the fishery.

The Fishery	***Observation***
Reported Landings: 2013	Reported landings in 2013 were 968 t, 43% of the TAC, which was reduced by 25% from previous levels in response to concerns about the stock's age distribution.
Total Removals: 2013	In addition to reported landings, 118 t were estimated to have been taken for bait in 2013.
Effort: 2013	47% of fishers contacted in the fixed gear phone survey were active, the lowest percentage in the time series.

Table 16b. Fortune Bay performance table– cumulative index.

Cumulative Index	***Observation***	***Interpretation***
Fixed Gear Fisher Observations 1996-2014 from telephone surveys and logbooks	Fixed gear fishers reported continual decreasing abundance through the 2000's	Decreasing trend in abundance.

Table 16c. Fortune Bay performance table – biological characteristics.

Biological Characteristics	***Observation***	***Interpretation***
Commercial catch at age	Age 11+ fish comprised more than 80% of the catch, spring spawners accounted for 97% of landings	Population age structure is skewed toward older fish and largely comprised of spring spawners.
Length and weight at age	Declined in 1990's and again in 2000's	Size at age has decreased.

Table 16d. Fortune Bay performance table – research gillnet program.

Biological Characteristics	***Observation***	***Interpretation***
Research gillnet catch rates	Declined through the 2000s, extremely low since 2010.	Decreasing trend in abundance.
Research gillnet age composition and recruitment	There are no indications of strong recruitment in either the spring or fall spawning component; age distribution is highly skewed toward age 11+ spring spawners.	Population structure is highly skewed toward older fish with very poor recruitment.

Table 16e. Fortune Bay performance table – stock status.

Stock Status	***Evaluation***
Negative. Recruitment is extremely poor, the standardized recruitment index is at its lowest point in the time series and mean catch rates of age 4-6 herring of both spawning components are at historical low levels.	-

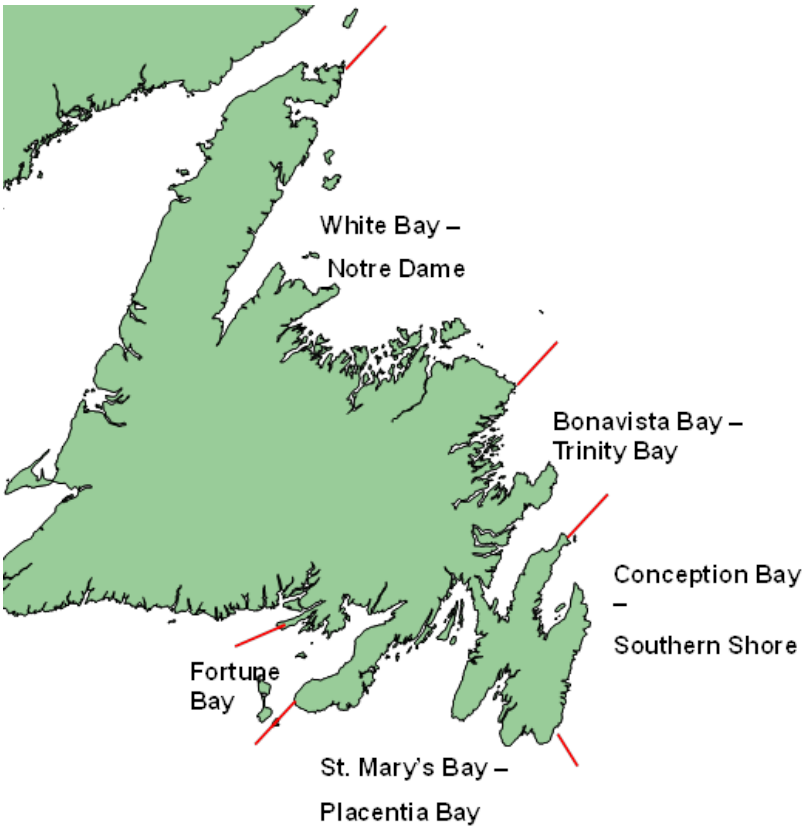

Figure 1. Herring stock complexes on the south and northeast coasts of Newfoundland.

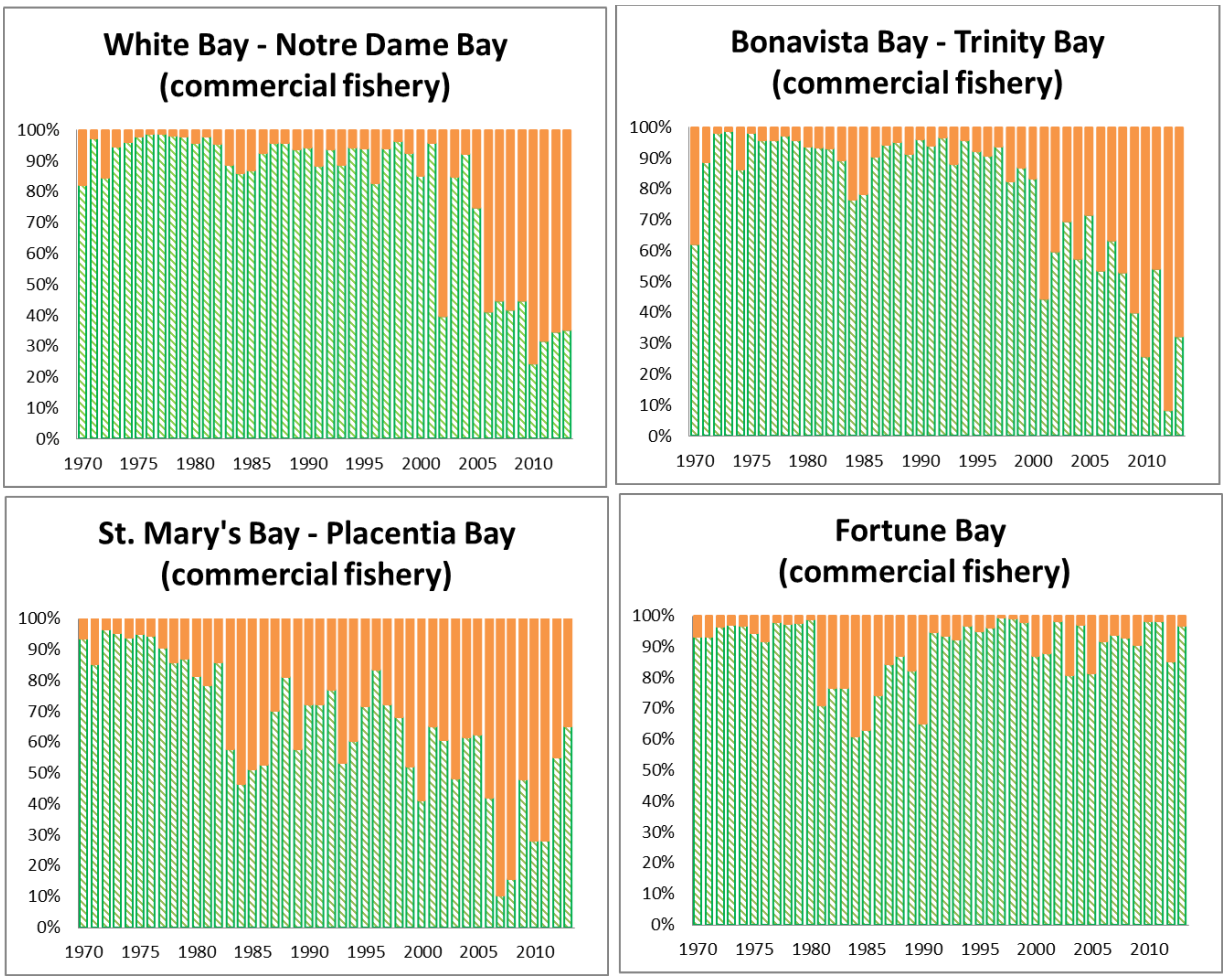

Figure 2. Percentage of spring (lined/green bars) and fall spawners (solid/orange bars) in commercial fishery landings by area and year.

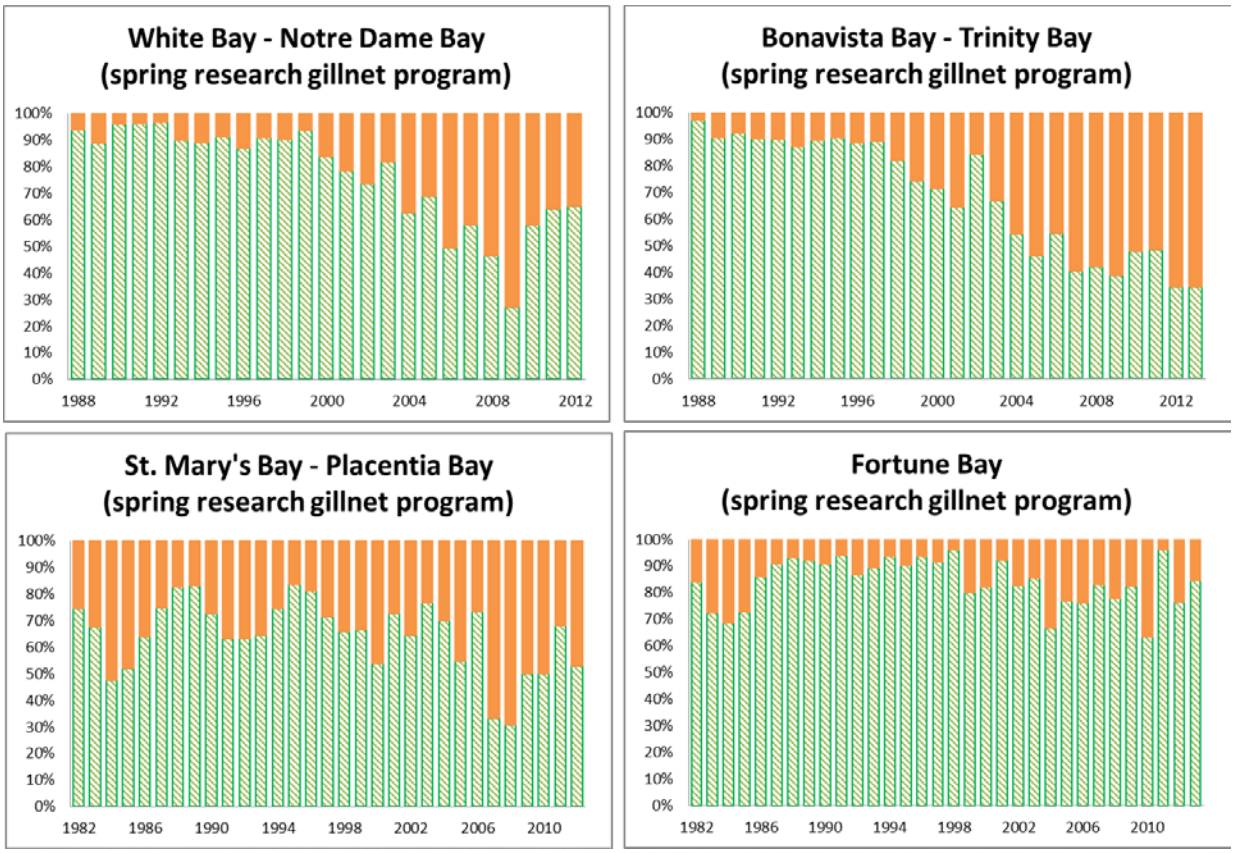

Figure 3. Percentage of spring (lined/green bars) and fall spawners (solid/orange bars) in the spring research gillnet program by area and year.

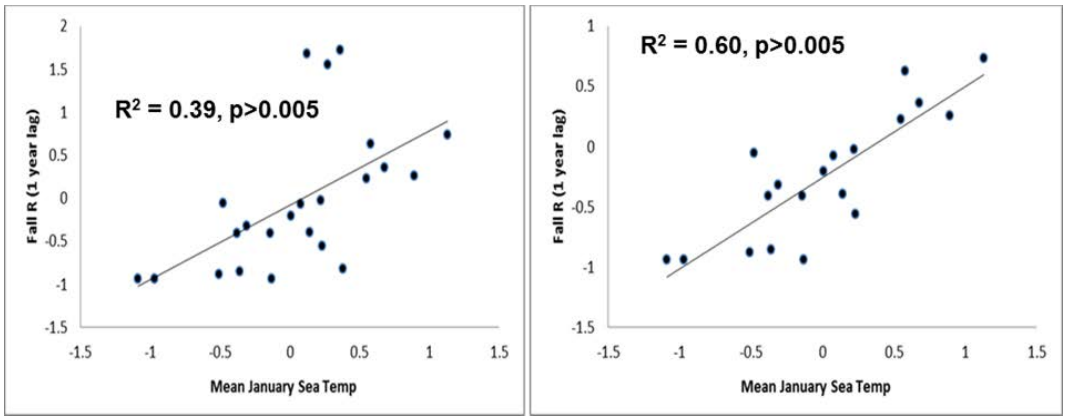

Figure 4. Fall spawner recruitment of northeast coast (WBNDB and BBTB) herring vs mean January sea temperatures; outliers are removed in right panel.

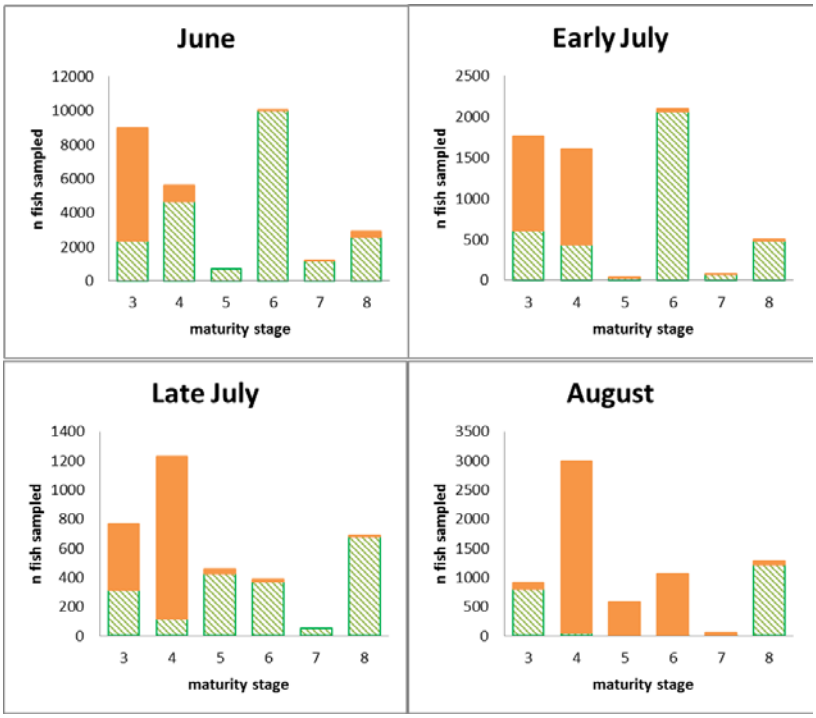

Figure 5. Spawning designation of mature sampled herring by maturity stage between June and August from 1980-2013 (solid/orange bars =fall spawners; striped/green bars = spring spawners).

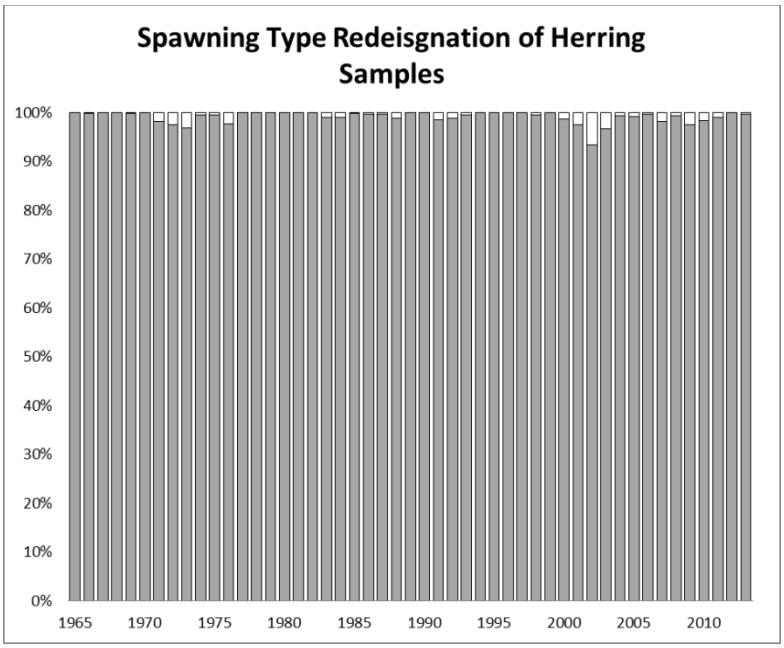

Figure 6. Percentage of sampled herring redesignated as fall spawners when new spawning desingation rules were applied (unchanged=grey, redesignated=transparent).

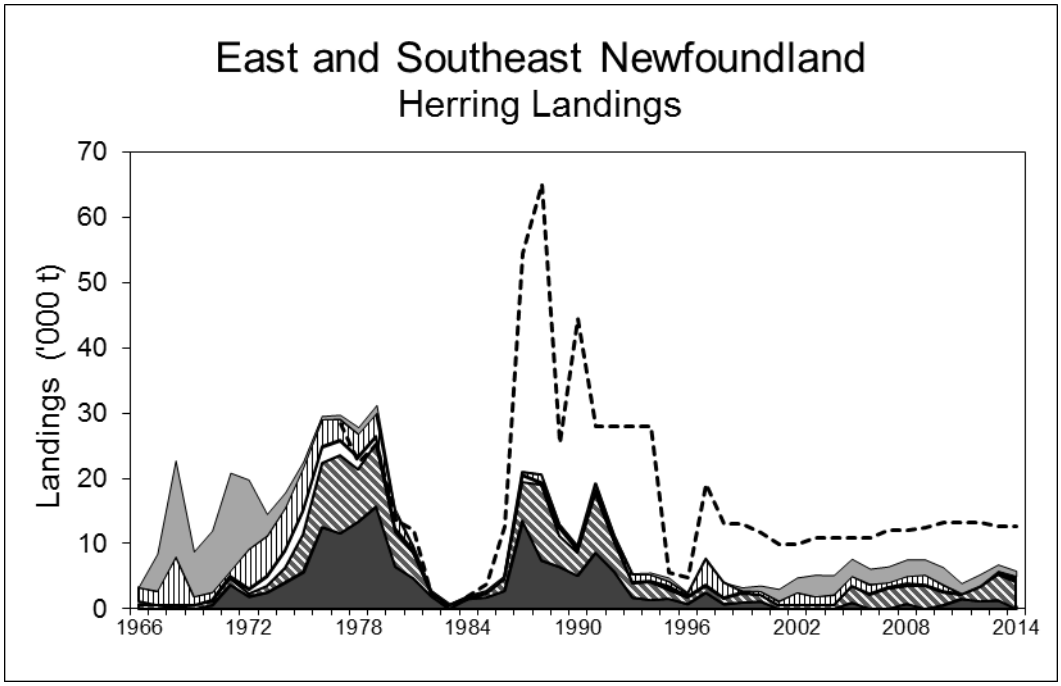

Figure 7. Commercial landings by stock area (WBNDB=solid black, BBTB = diagonal lines, CBSS = white, SMBPB=vertical lines, FB=solid grey) and total TAC (dashed line); 2014 landings are preliminary.

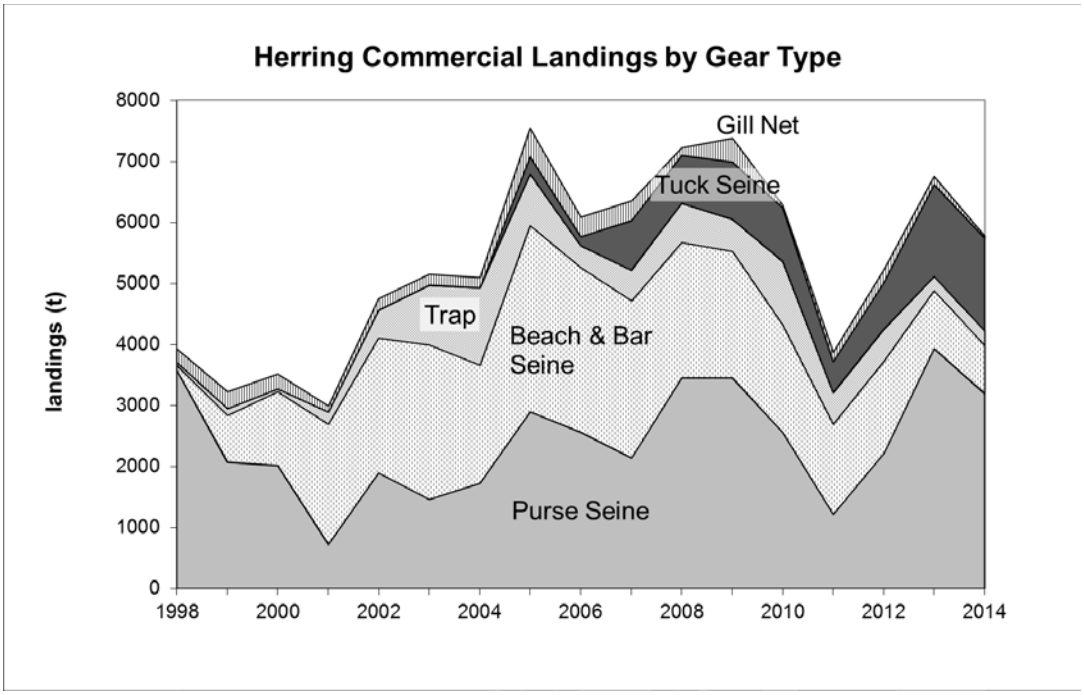

Figure 8. Total landings in all areas by gear from 1998-2014 (2014 landings are preliminary).

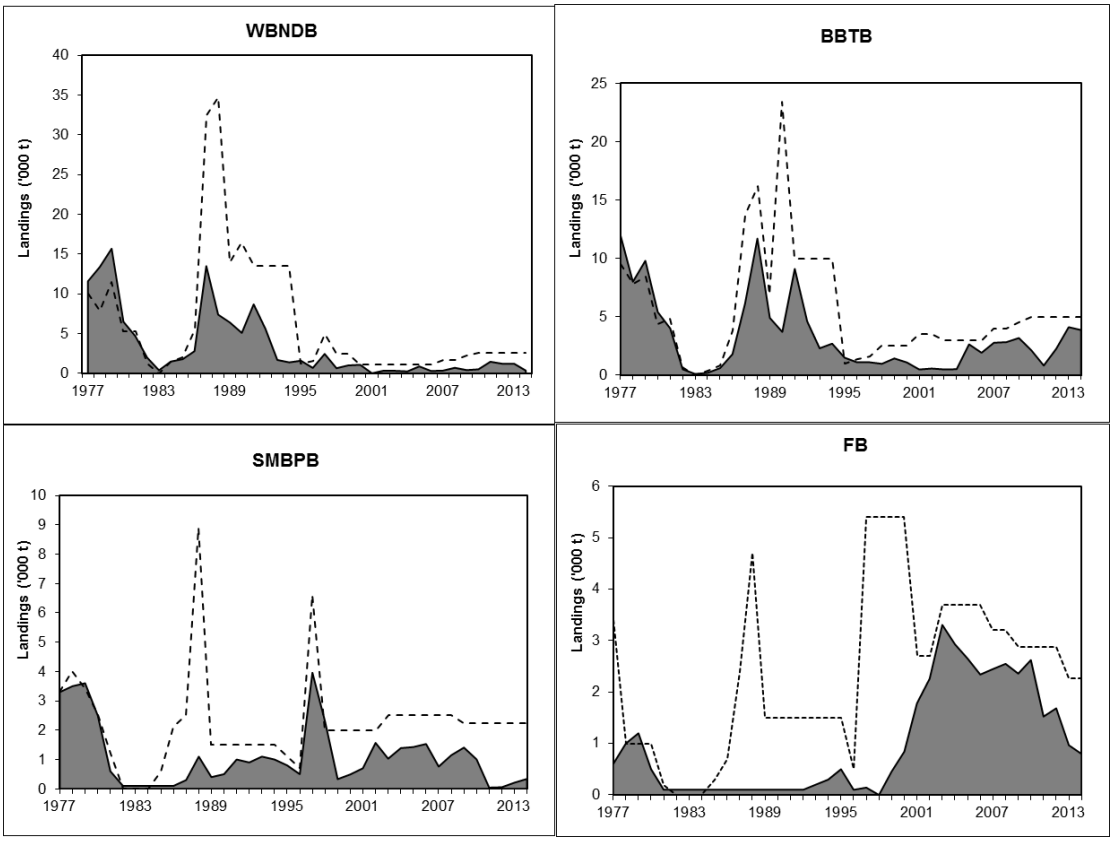

Figure 9. Commercial herring landings (grey) and TAC (dashed line) by stock area (2014 landings are preliminary).

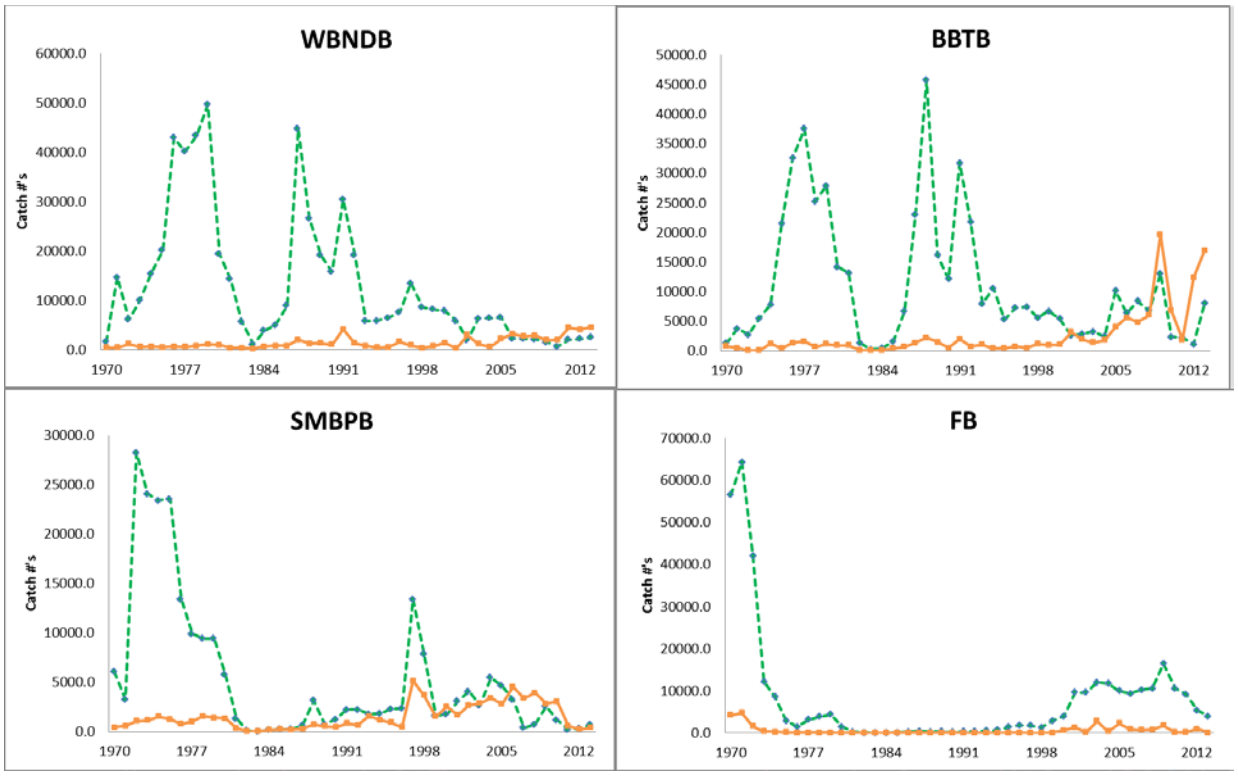

Figure 10. Estimated catch numbers of spring (green/dashed line) and fall (orange/solid line) spawning herring in the commercial fishery by year and stock area.

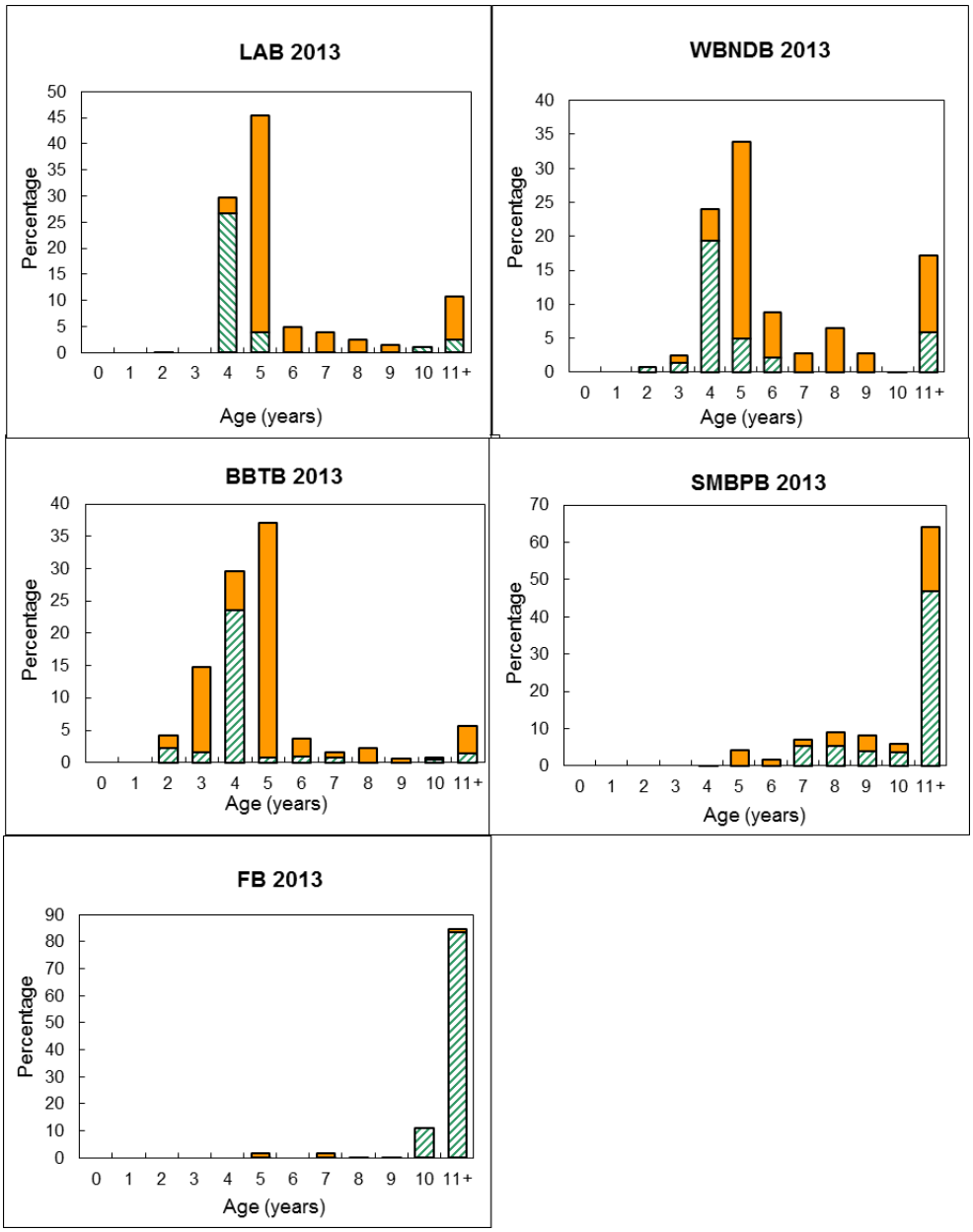

Figure 11. Age distribution of samples taken from 2013 commercial fishery, by spawning type (spring = striped/green bars; fall = solid/orange bars).

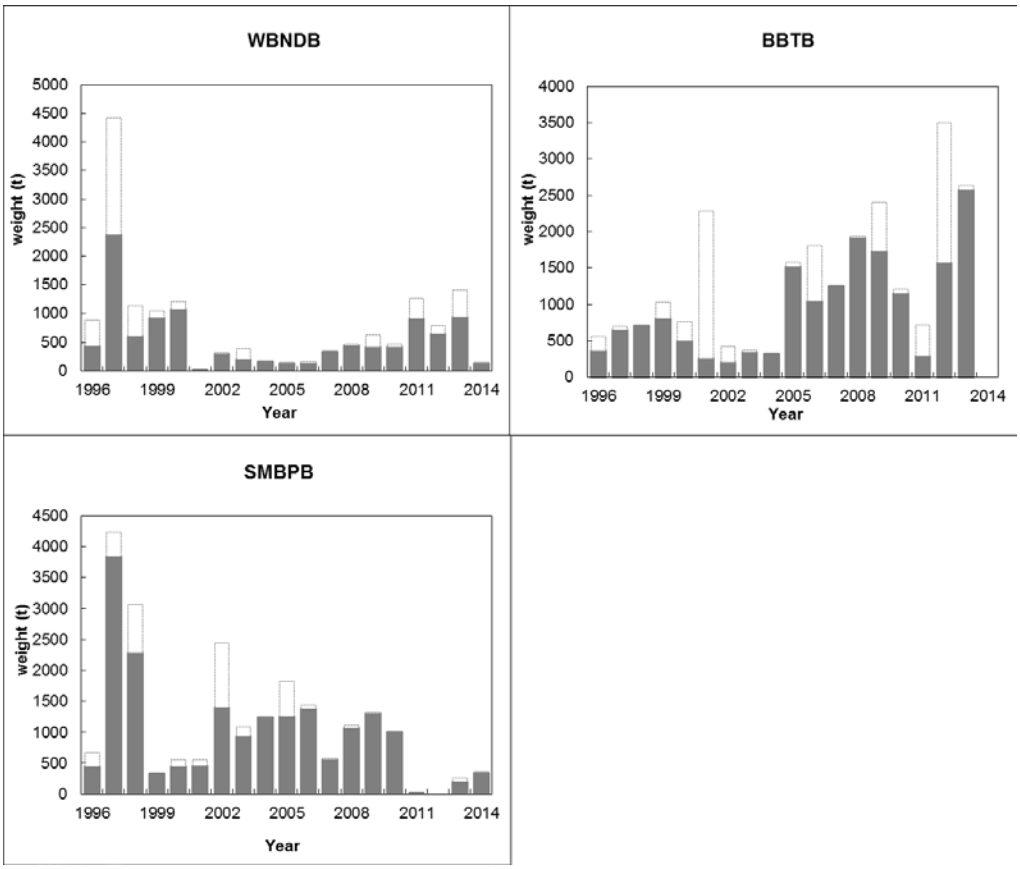

Figure 12. Purse seine landings (grey bars) and estimated discards (transparent bars) by stock area.

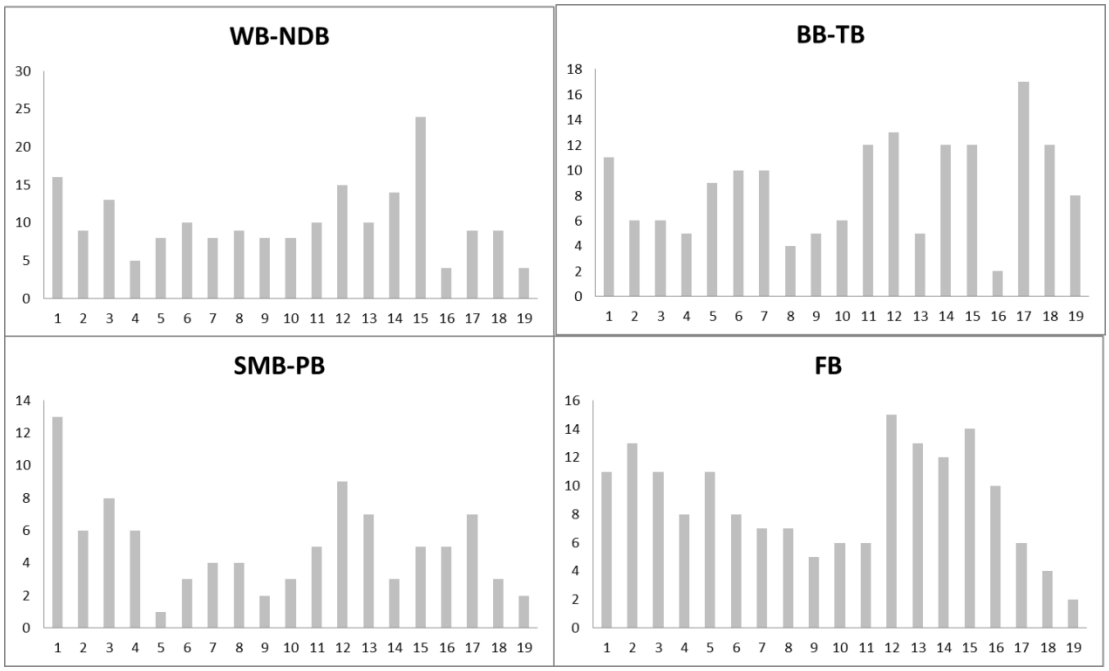

Figure 13. Number of fixed gear logbooks returned by stock area and year (2014 results preliminary).

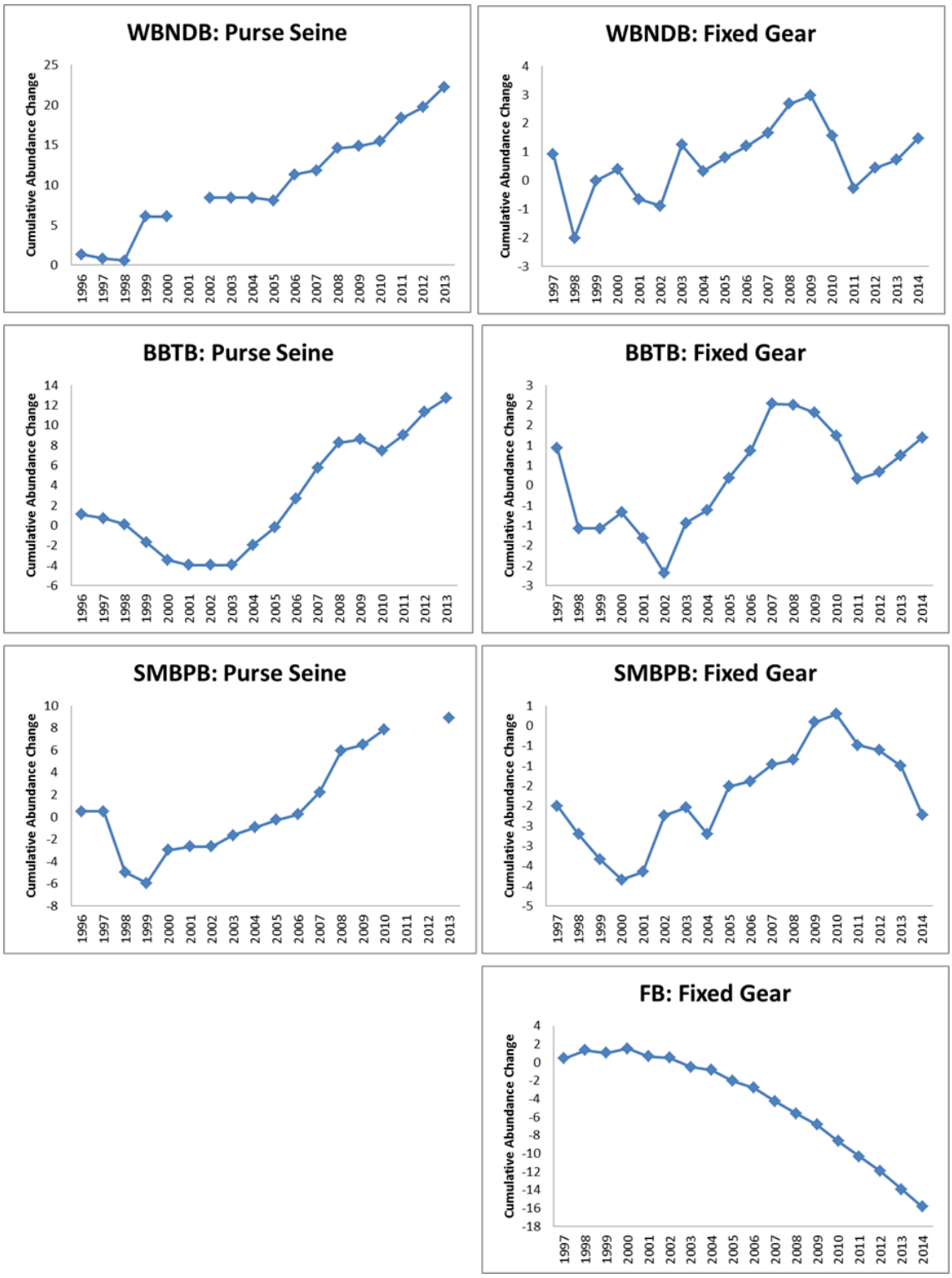

Figure 14. Cumulative abundance change index by gear type and stock area.

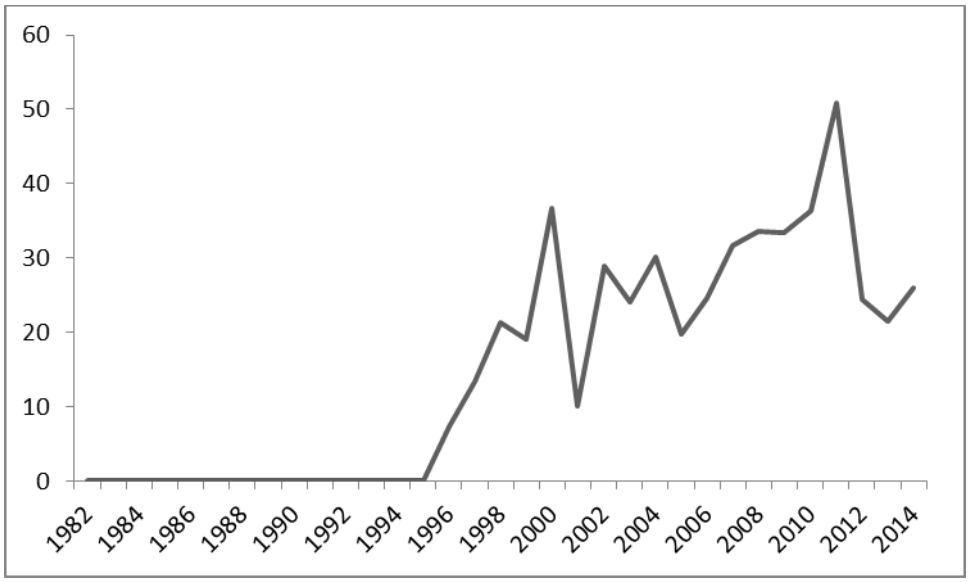

Figure 15. Percent days fished in the spring research gillnet program with zero catch (all areas combined).

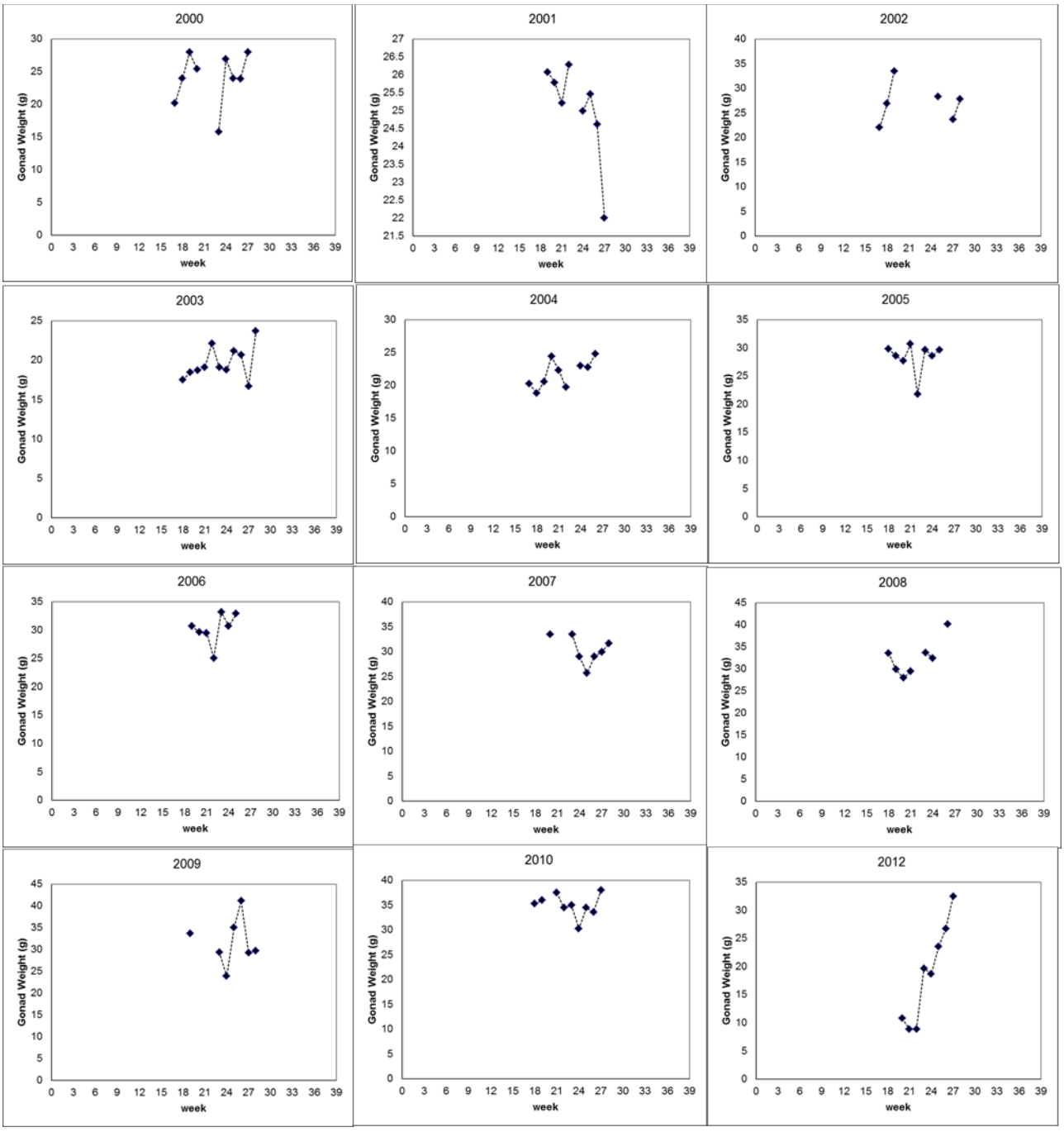

Figure 16. Change in gonad weights at a common length by week in the research gillnet program on the northeast coast during the 2000s.

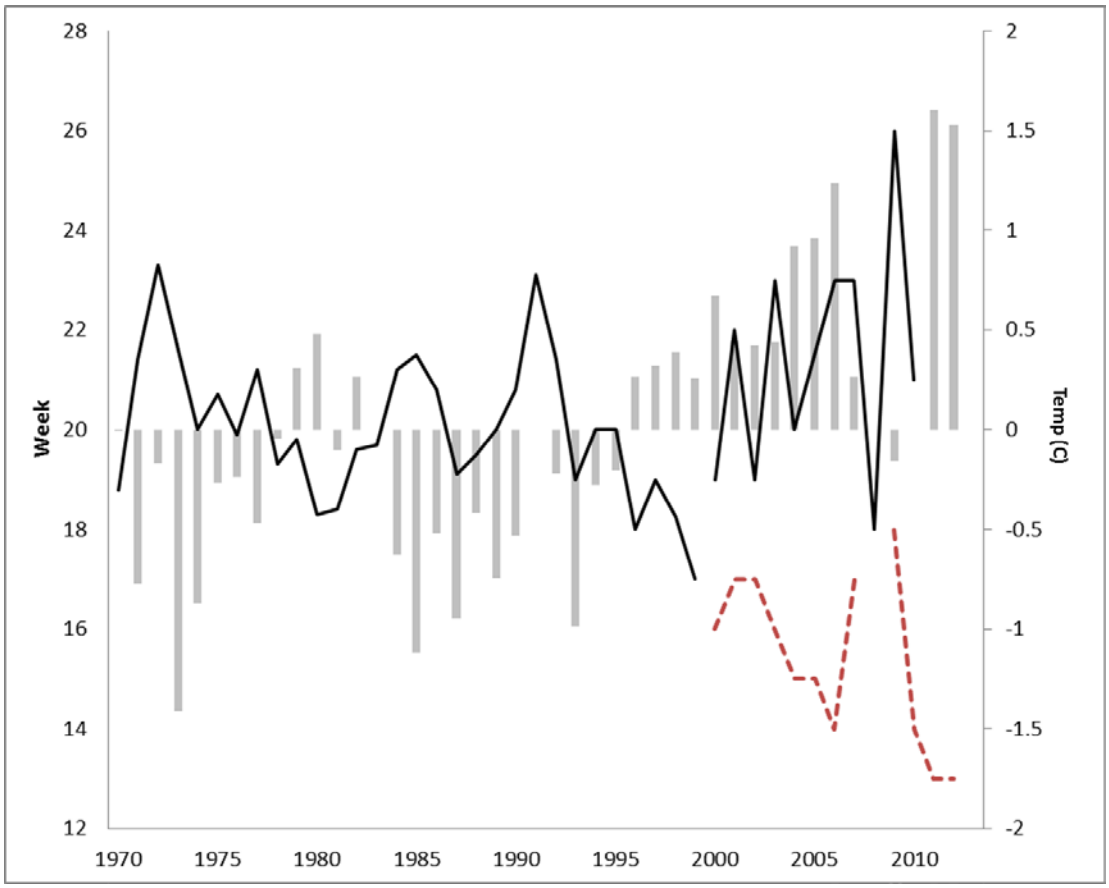

Figure 17. Estimated week of spring spawning onset in the research gillnet fishery based on change in gonad weights at a common length (solid line), predicted spawning onset week based on possible relationship between winter temperatures and spawning times (dashed line), and mean January sea temperature (grey bars).

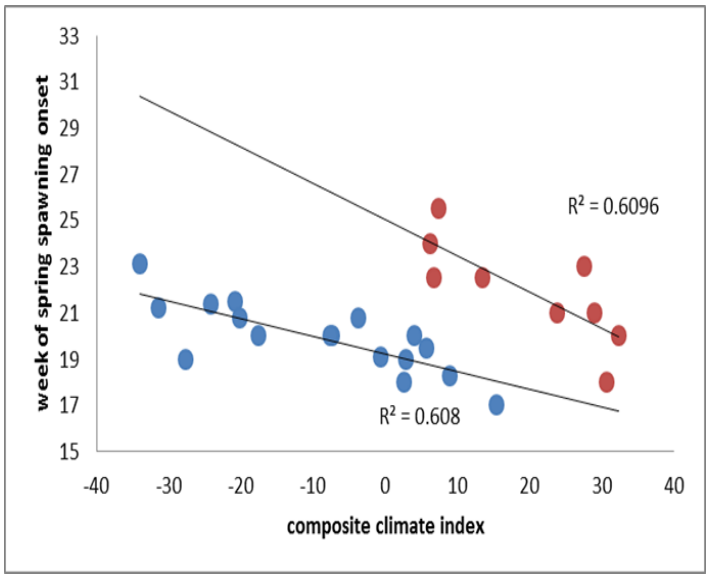

Figure 18. Relationship between estimated week of spring spawning onset pre (lower series/blue) and post (upper series/red) 2000 with physical environment composite index.

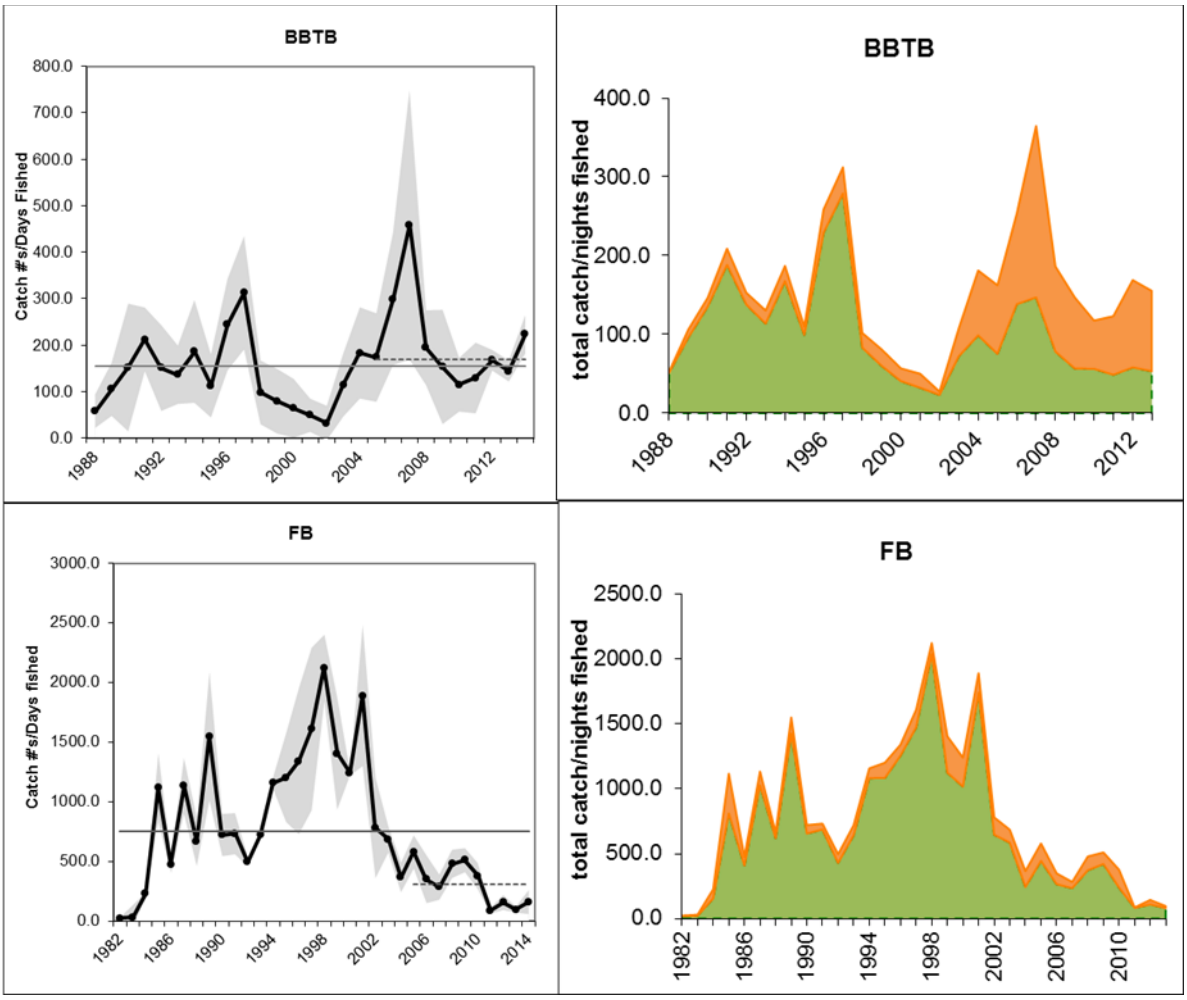

Figure 19. Combined catch rates (left panels; solid grey line=time series mean, dashed grey line = decadal mean) and catch rates by spawning group (right panels; green/lower series = spring spawners, upper/orange series = fall spawners) in the spring research gillnet program.

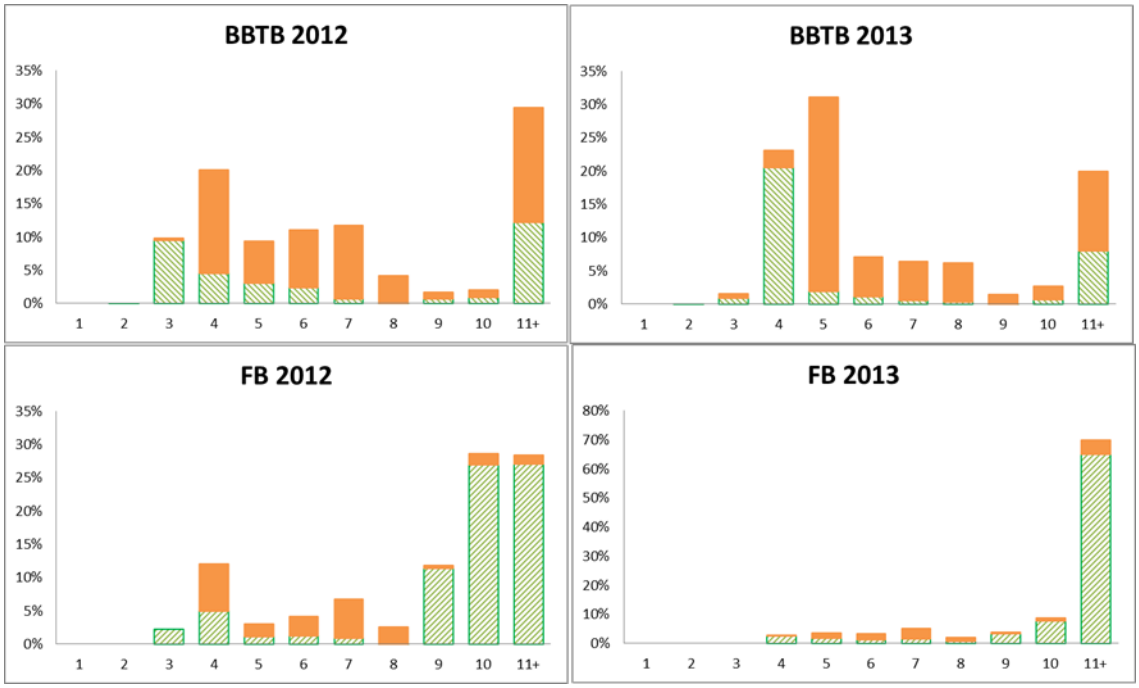

Figure 20. Age and spawning group distribution of herring caught in the spring research gillnet program in 2012 and 2013 by stock area (striped/green = spring spawners, solid/orange = fall spawners).

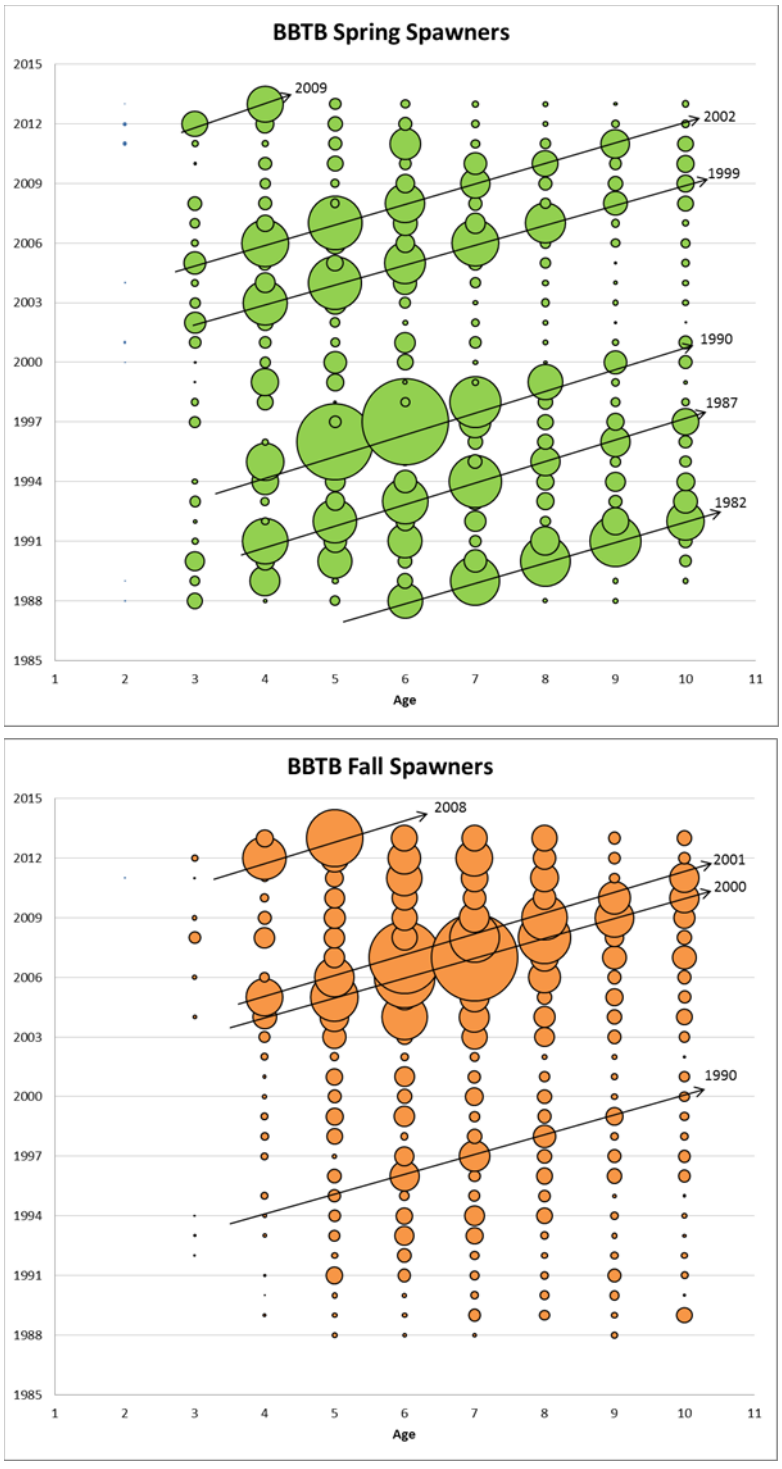

Figure 21a. Catch rates (numbers/night fished) at age by spawning type in the research gillnet program by stock area – BBTB.

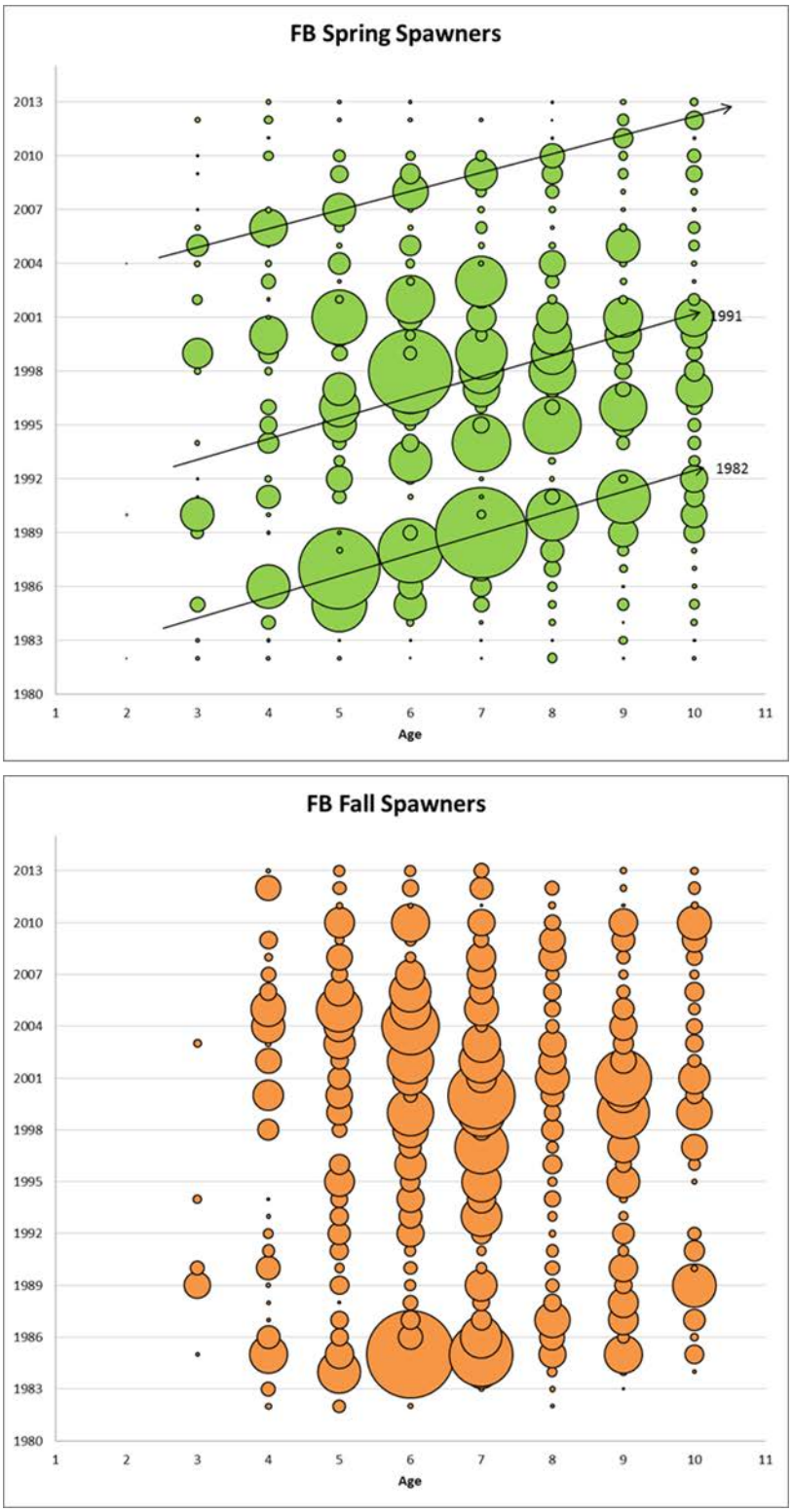

Figure 21b. Catch rates (numbers/night fished) at age by spawning type in the research gillnet program by stock area – FB.

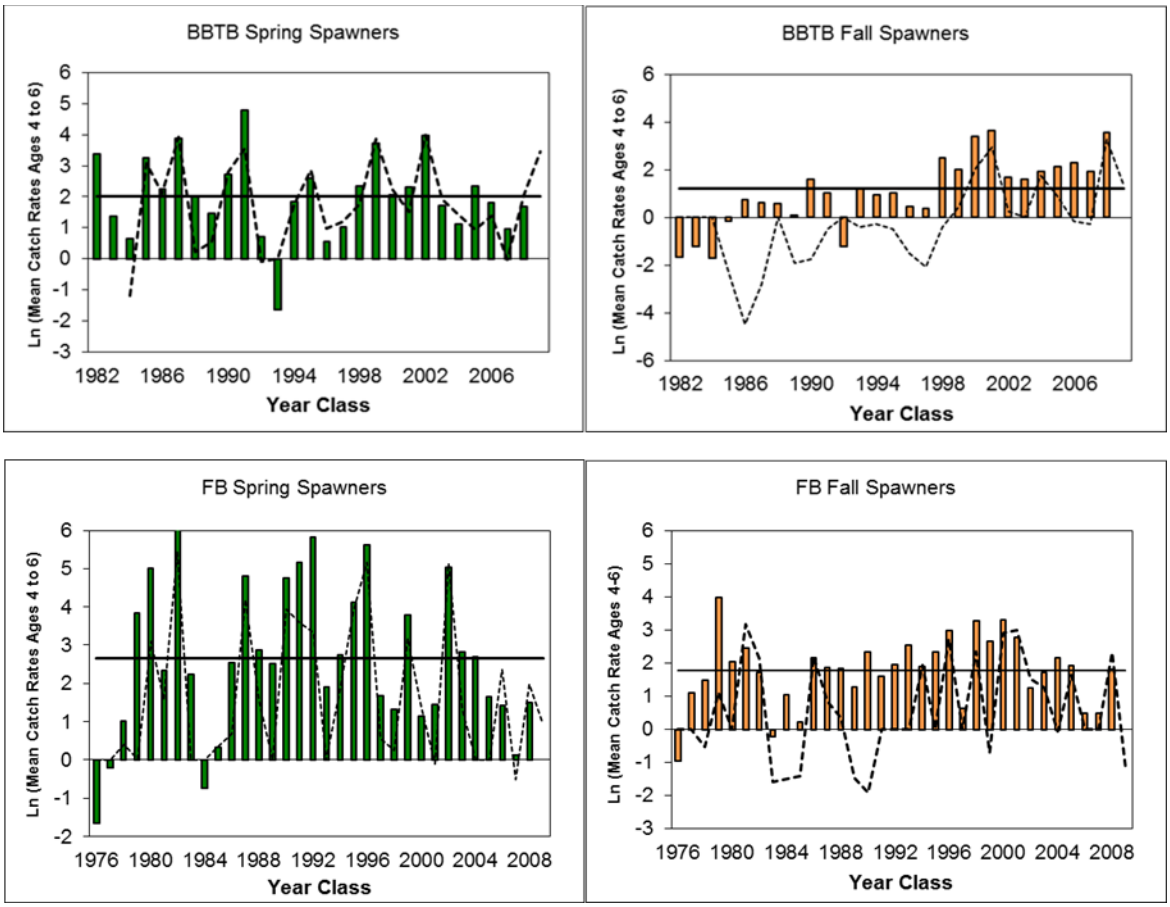

Figure 22. Relative year class size (bars), geometric mean of year class size (solid line) and recrutiment (dashed line) by spawning type and stock area.

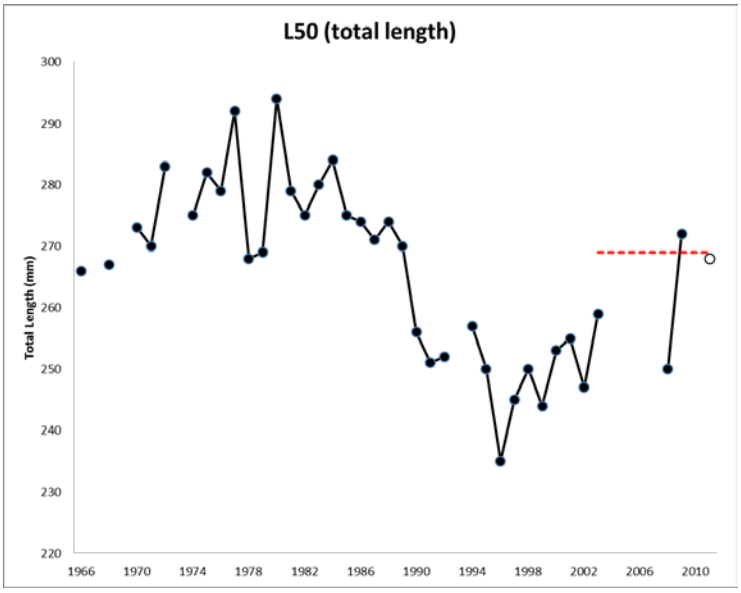

Figure 23. L50 estimates of spring spawner cohorts (closed circles), fish caught in the fishery from 2010-2013 (open circle), and current (2014) minimum commercial size (dashed line), all stock areas combined.

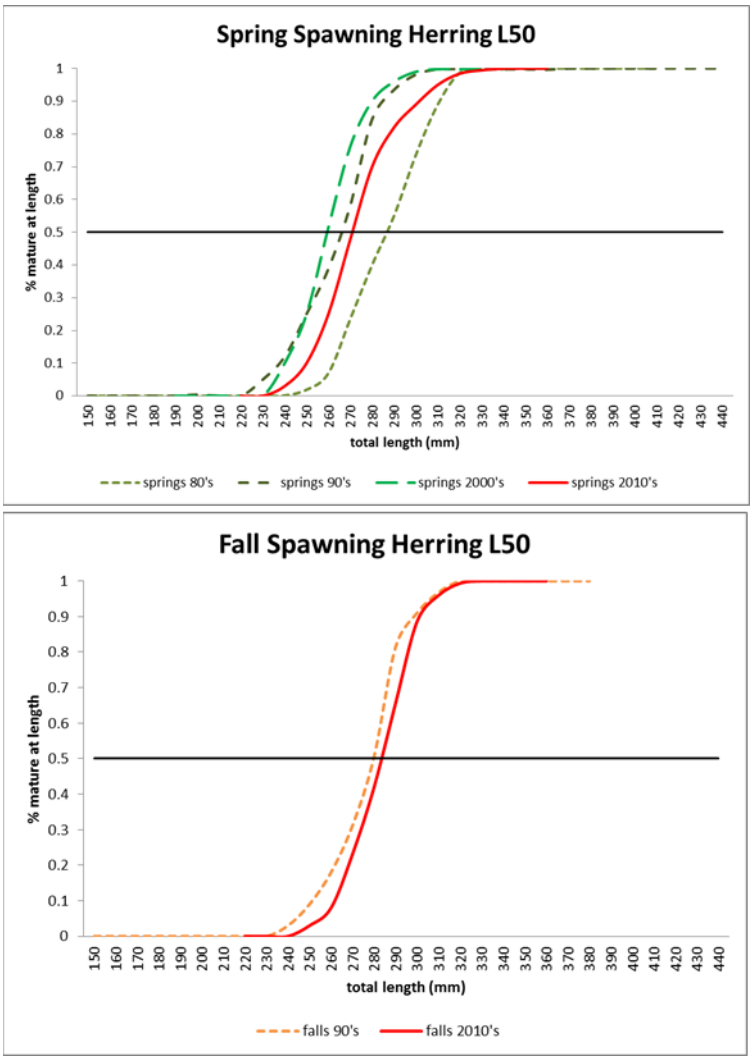

Figure 24. Mean L50 by decade for spring and fall spawning herring, all stock areas combined (insufficient data to obtain estimates for all decades for fall spawners).

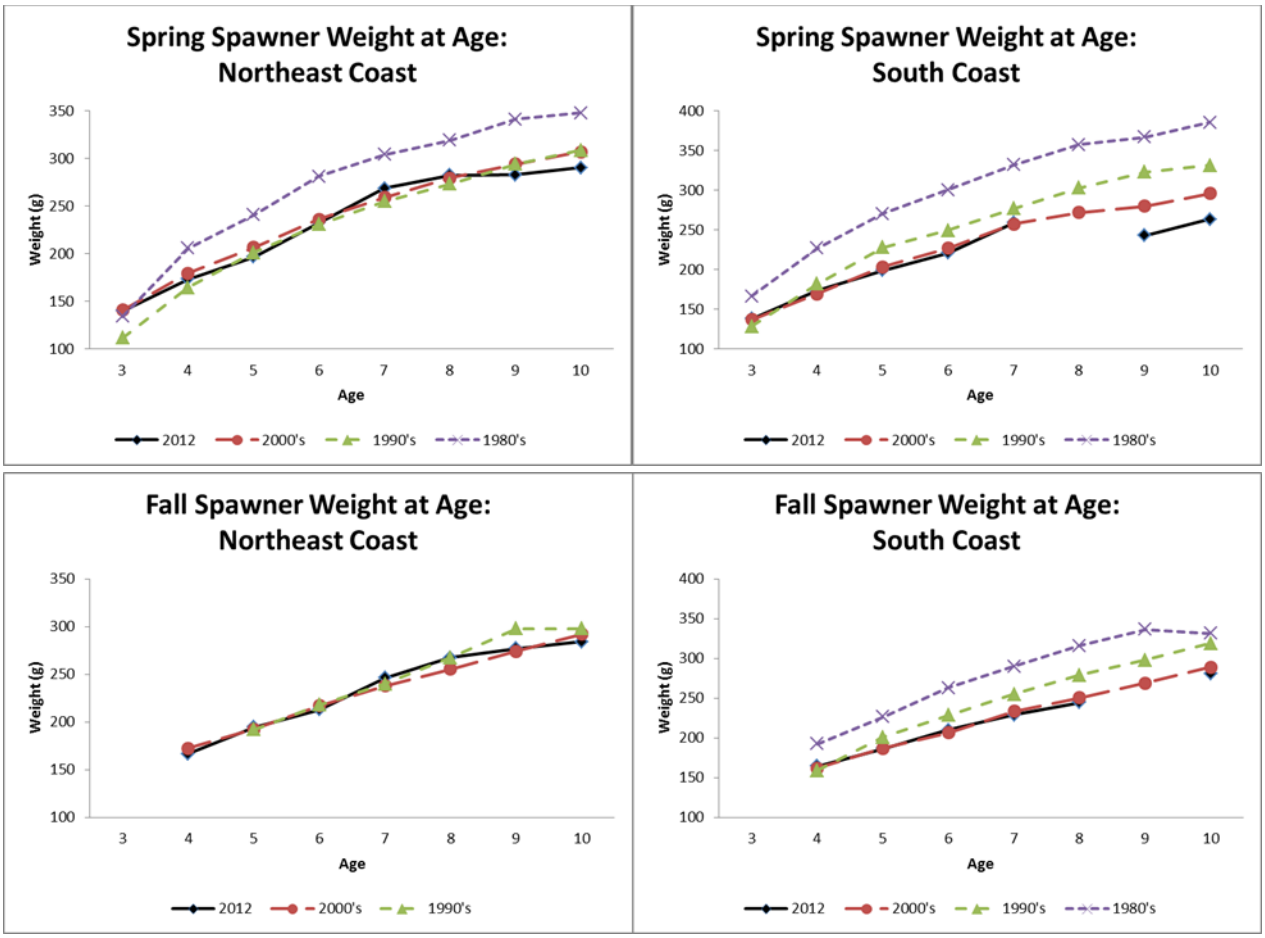

Figure 25. Mean weight at age of NL herring by decade, spawning type and area (northeast and south coast).

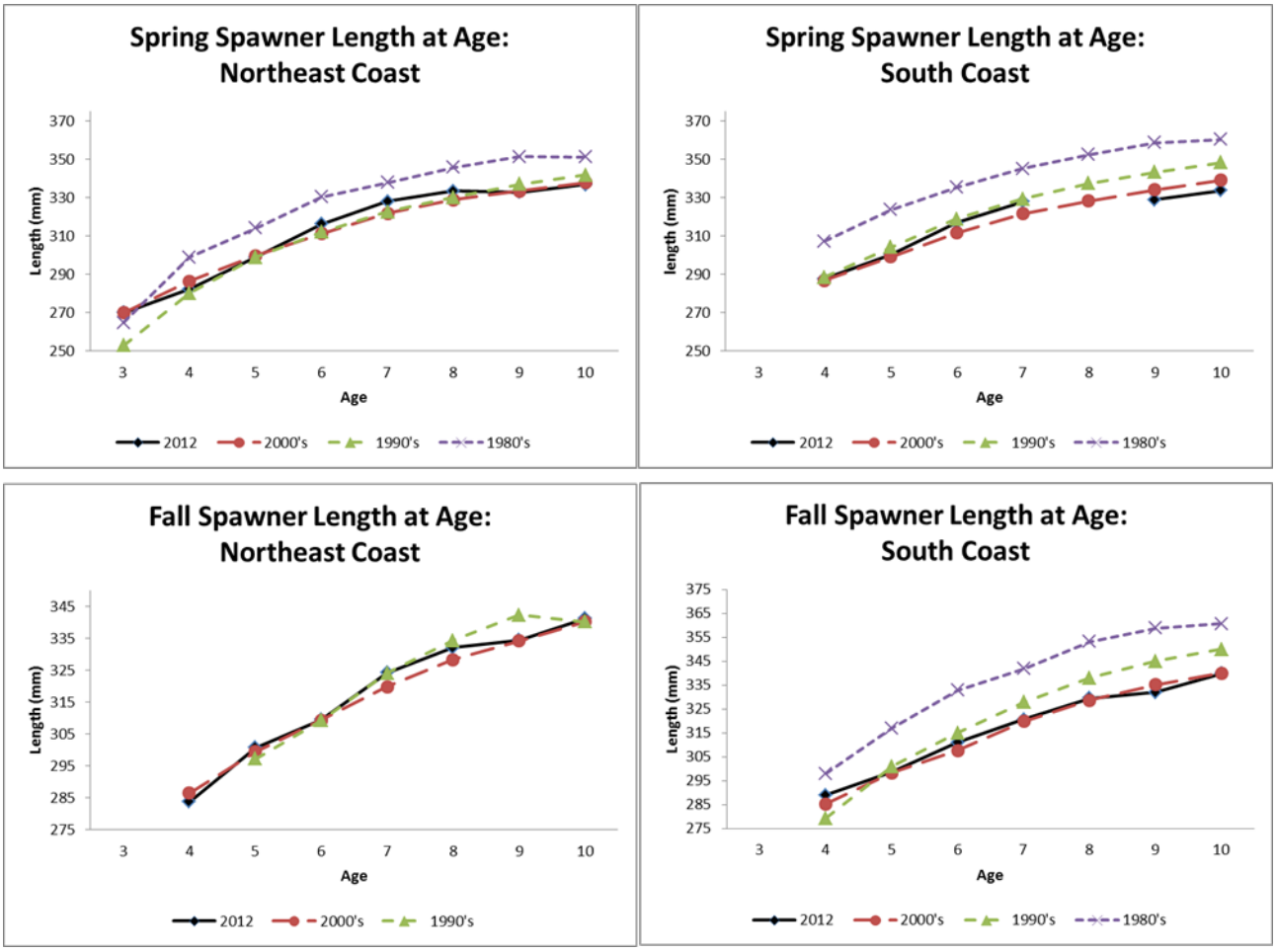

Figure 26. Mean length at age of NL herring by decade, spawning type and area (northeast and south coast).

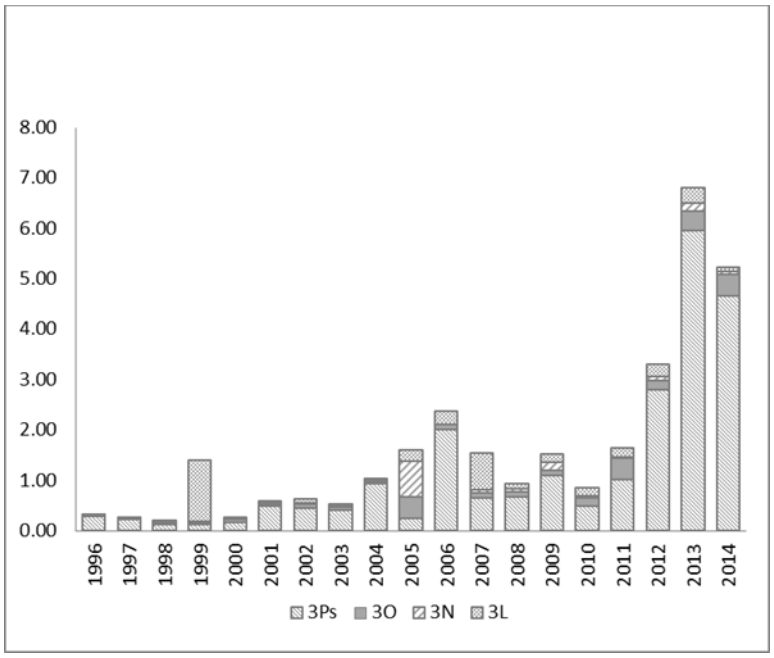

Figure 27. Mean weight (kg) of herring caught per successful fishing set in spring multispecies offshore surveys by NAFO division.

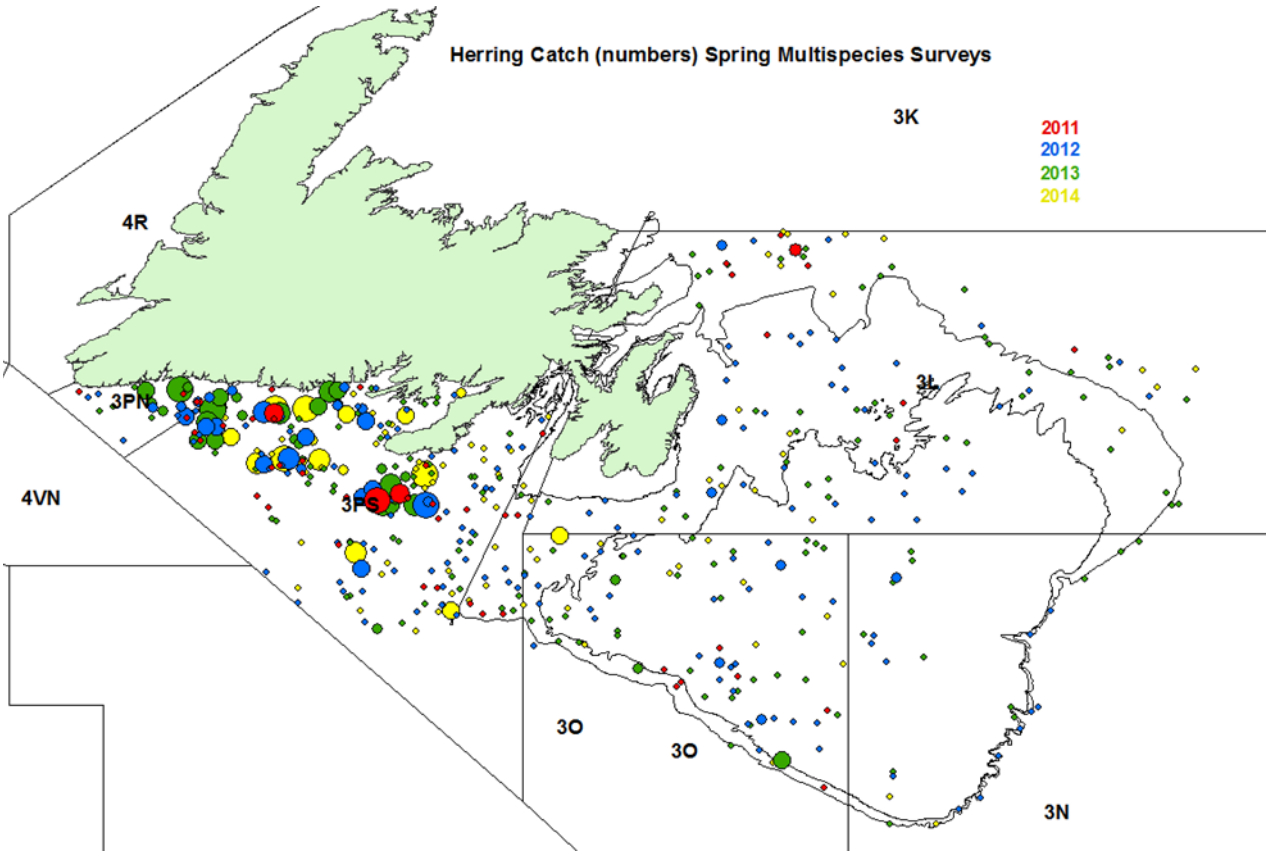

Figure 28. Location of fishing sets where herring were caught in spring multispecies surveys from 2011-2014, circle size is proportionate to catch numbers.

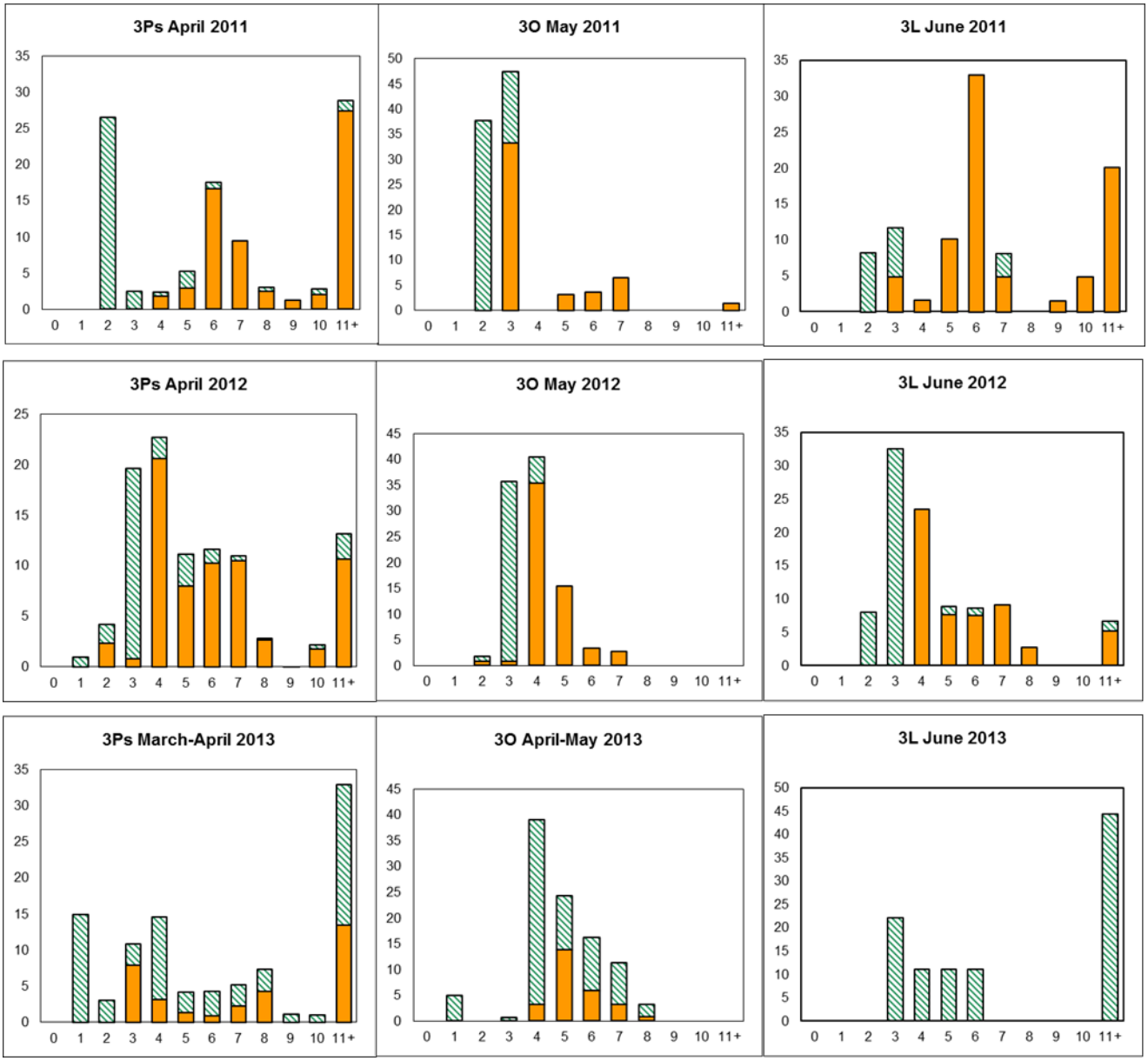

Figure 29. Age and spawning type (striped/green=spring spawners, solid/orange=fall spawners), distribution of herring caught in spring multispecies surveys by NAFO division, month and yea.r

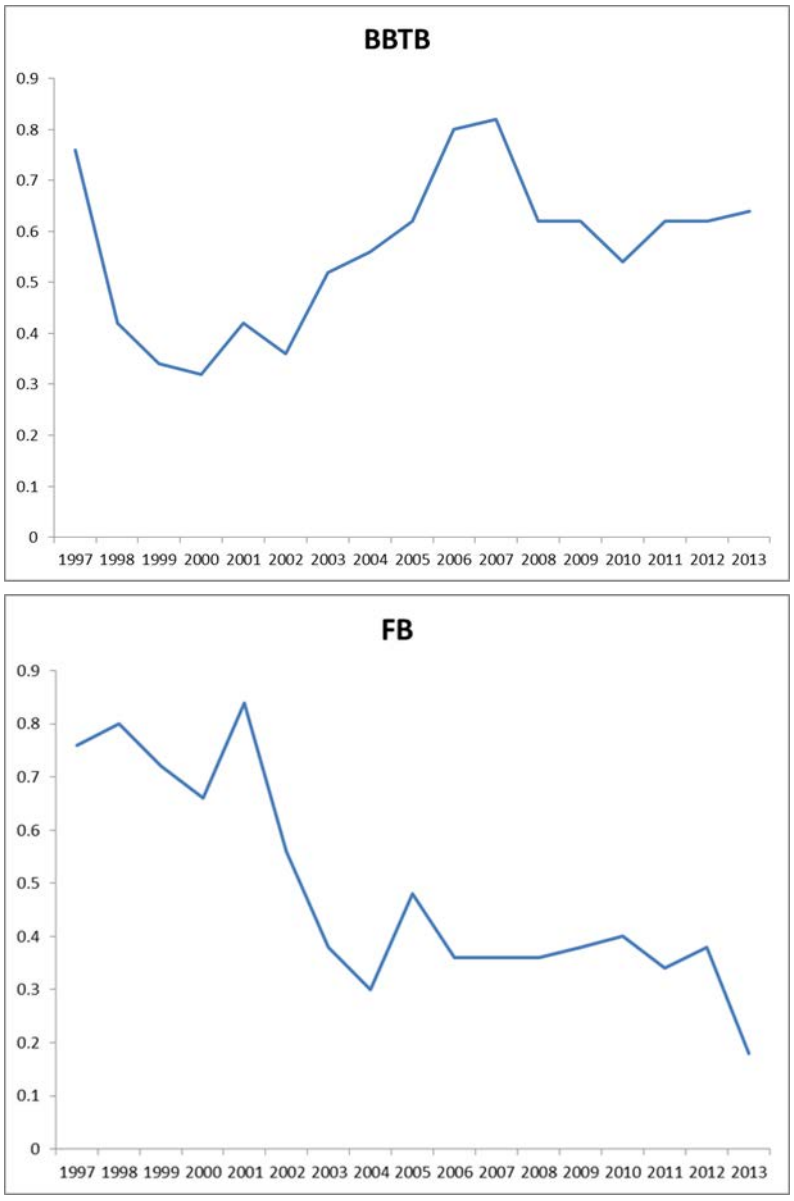

Figure 30. Stock stock status index based on catch rates and age distribution from the spring research gillnet program in BBTB and FB.