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Assessing the status of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in 2013 and 2014

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

The status of the cod stock in the Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps was assessed during a Fisheries and Oceans Canada (DFO) Regional Peer Review Process meeting held October 14-16, 2014. Stock status was updated based upon information collected up to spring 2014. Principal sources of information available for the assessment were: a time series of abundance and biomass indices from Canadian winter/spring research vessel (RV) bottom trawl surveys, inshore sentinel surveys, science logbooks from vessels < 35 ft., logbooks from vessels > 35 ft., reported landings from commercial fisheries, oceanographic data, and tagging studies.

Total landings for the 2013-14 management year (April 1 March 31) were 5,428 t or just 47% of the Total Allowable Catch (TAC), and this marks the fifth consecutive season that the TAC has not been fully taken. The 2014-15 fishery was still in progress at the time of the meeting. The removals through recreational fishing are unknown since 2007, but based on previous estimates are thought to be a small fraction (~ 1%) of the commercial landings.

The abundance and biomass indices from the DFO RV spring survey increased substantially in 2013 but declined in 2014. In 2014, the abundance index was about average (average of 1997 2014 as survey area was expanded in 1997) whereas the biomass index was below average. The survey was dominated by young fish which are not yet of commercial size. Sentinel gillnet catch rates have been very low and stable since 1999. Sentinel linetrawl catch rates have been below average for the past five years and the 2013 catch rate was the lowest in the time series. Gillnet catch rates from logbooks of vessels < 35 ft. have been stable since 1999. Linetrawl catch-rates decreased over 2006 10, but subsequently increased and are presently at the time series average.

Spawning Stock Biomass (SSB) increased considerably over 2009-12 and has since been relatively stable. The 2014 estimate is approximately 1.6 times higher than the LRP, and the stock is currently in the ‘cautious zone’ according to DFO’s Precautionary Approach (PA) Framework. The probability of being below the LRP in 2014 is very low (~ 0.01). Projection of the stock to 2015 was conducted assuming mortality rates will be within ± 20% of current values (2011-13 average). All projection scenarios indicate that the 2015 SSB will remain stable or increase from the 2014 estimate. In each of the scenarios, the probability of being below the LRP in 2015 is very low (< 0.01).

Évaluation de l'état du stock de morue (*Gadus morhua*) dans la sous-division 3Ps de l'OPANO en 2013 et 2014

RÉSUMÉ

L'état du stock de morue dans la sous-division 3Ps de l'Organisation des pêches de l'Atlantique Nord-Ouest (OPANO) a fait l'objet d'une évaluation lors d'une réunion du processus régional d'examen par les pairs de Pêches et Océans Canada (MPO) qui s'est tenue du 14 au 16 octobre 2014. L'état du stock a été mis à jour à partir des données recueillies jusqu'au printemps 2014. Voici les principales sources de données utilisées dans l'évaluation : une série chronologique d'indices d'abondance et de biomasse obtenus par des relevés au chalut de fond effectués à l'hiver et au printemps au moyen d'un navire de recherche canadien, des relevés par pêches sentinelles côtières, les journaux de bord scientifiques des navires de moins de 35 pi, les journaux de bord des navires de plus de 35 pi, les débarquements déclarés des pêches commerciales, des données océanographiques, ainsi que des études de marquage.

Les débarquements de l'année de gestion de 2013-2014 (du 1er avril au 31 mars) ont totalisé 5428 t, soit juste 47% du total autorisé des captures (TAC). Il s'agit de la cinquième saison consécutive où le TAC n'est pas atteint. L'activité de pêche de 2014-2015 était toujours en cours au moment de la réunion. Les prélèvements par la pêche récréative sont inconnus depuis 2007, mais selon les estimations précédentes, on pense qu'ils représentent une petite fraction (environ 1 %) des débarquements commerciaux.

Les indices d'abondance et de biomasse du relevé du printemps effectué par les navires de recherche du MPO ont beaucoup augmenté en 2013, mais ont baissé en 2014. En 2014, l'indice d'abondance était à peu près égal à la moyenne (moyenne de 1997 à 2014, car la zone de relevé a été agrandie en 1997) et l'indice de biomasse était inférieur à la moyenne. Lors du relevé, le nombre de jeunes poissons n'ayant pas encore atteint la taille commerciale surpassait les autres classes d'âge. Les taux de prise des pêches sentinelles au filet maillant sont très faibles et stables depuis 1999. Les taux de prise des pêches sentinelles à la palangre ont été inférieurs à la moyenne ces cinq dernières années et le taux de prise de 2013 était le plus bas de la série chronologique. Les taux de prise au moyen de filets maillants établis d'après les journaux de bord des navires de moins de 35 pi sont stables depuis 1999. Les taux de prise des pêches à la palangre ont diminué de 2006 à 2010, mais ont augmenté par la suite et sont actuellement égaux à la moyenne de la série chronologique.

De 2009 à 2012, la biomasse du stock reproducteur (BSR) a considérablement augmenté et elle est demeurée depuis relativement stable. Selon les estimations pour 2014, la BSR est environ 1,6 fois supérieure au point de référence limite, et l'état du stock se situe actuellement dans la zone de prudence, selon le cadre intégrant l'approche de précaution (AP) établi par Pêches et Océans Canada. La probabilité qu'elle se situe sous le point de référence limite en 2014 est très faible (environ 0,01). Les projections relatives au stock de 2015 ont été faites en supposant que les taux de mortalité varieront d'environ 20 % par rapport aux valeurs actuelles (moyenne de 2011 à 2013). Tous les scénarios de projection indiquent que la BSR de 2015 restera stable ou augmentera par rapport à l'estimation de 2014. Dans chacun des scénarios, la probabilité que la BSR se situe sous le point de référence limite en 2015 est très faible (moins de 0,01).

INTRODUCTION

This document gives an account of the 2014 assessment of the Atlantic cod (*Gadus morhua*) stock in North Atlantic Fisheries Organization (NAFO) Subdiv. 3Ps located off the south coast of Newfoundland (Figs. 1 and 2). The history of the cod fishery in NAFO Subdiv. 3Ps and results from other recent assessments of this stock are described in previous documents (e.g. see Brattey et al. 2008; Healey et al. 2013 and references therein). A regional assessment meeting was conducted during October 2014 (DFO 2015) with participation from Fisheries and Oceans Canada (DFO) scientists, a scientist from IFREMER (France), DFO fisheries managers, academia, fishing industry representatives from Canada and France, and representatives from the province of Newfoundland and Labrador and a non-government organization.

Various sources of information on 3Ps cod were available to update the status of this stock. Commercial landings through September 2014 were available. The results of the 2014 DFO RV survey were reviewed in detail and compared to previous survey results. Additional sources of information included logbooks for vessels > 35 ft., science logbooks for vessels < 35 ft., inshore sentinel surveys and exploitation rates estimated from cod tagging conducted in 3Ps during 1997-2013. A survey-based assessment model (Cadigan 2010) was used to smooth signals in the RV survey, and provided estimates of biomass, total mortality and recruitment for the stock as covered by the DFO RV survey. Short-term projections of these estimates under total mortality levels similar to current levels were also evaluated to advise on the management of this stock.

The French overseas territory of St. Pierre et Miquelon is within the boundaries of NAFO Subdiv. 3Ps. Following extension of jurisdiction by each country to 200 miles in the late 1970s, only Canada and France have fished in this area. This stock is jointly managed by Canada and France through formal agreements.

ASSESSMENT

TOTAL ALLOWABLE CATCHES AND COMMERCIAL CATCH

Total Allowable Catch

The cod stock in Subdiv. 3Ps was subject to a moratorium on all fishing from August, 1993 to the end of 1996. Excluding these years, the magnitude of the Total Allowable Catch (TAC) has varied considerably over time, ranging from 70,500 t in 1973, the initial year of TAC regulation, to 10,000 t in 1997 (Fig. 3). Beginning in 2000, TACs have been established for seasons beginning April 1 and ending March 31 of the following year (During January-March 2000, an interim TAC was set to facilitate this change). The TAC was set at 11,500 t for five consecutive management years (2009/10-2013/14) and was subsequently increased to 13,225 t for the 2014/15 management year. Under the terms of the 1994 Canada France agreement, the Canadian and French shares of the TAC are 84.4% and 15.6%, respectively.

Commercial Catch

Prior to the moratorium, Canadian landings for vessels < 35 ft (see “Can-NL fixed” in Table 1) were estimated mainly from purchase slip records collected and interpreted by Statistics Division, DFO. Shelton et al. (1996) emphasized that these data may be unreliable. Post moratorium landings for Canadian vessels < 35 ft come mainly from a dock side monitoring program initiated in 1997. Landings for Canadian vessels > 35 ft come from logbooks. Non-Canadian landings (only France since 1977) were compiled from national catch statistics reported by individual countries to NAFO. In recent years, provisional information for landings by France have been provided directly by French government officials.

Cod in the 3Ps management unit were heavily exploited in the 1960s and early 1970s by non-Canadian fleets, mainly from Spain and Portugal, with reported landings peaking at about 87,000 t in 1961 (Fig. 3a). After extension of Canadian jurisdiction in 1977, cod catches averaged between 30,000 t and 40,000 t until the mid-1980s when increased fishing effort by France led to increased total reported landings, with catches increasing to about 59,000 t in 1987. Subsequently, reported catches declined gradually to 36,000 t in 1992. Catches exceeded the TAC throughout the 1980s and into the 1990s. The Canada France boundary dispute at this time led to fluctuations in the French catch during the late 1980s. Under advice from the Fisheries Resource Conservation Council, a moratorium was imposed on all directed cod fishing in August 1993 after only 15,216 t had been landed. Access by French vessels to Canadian waters was restricted in 1993.

Total landings for the 2013-14 management year (April 1–March 31) were 5,428 t, or 47% of the 11,500 t TAC. This marks the fifth consecutive year in which the landings have been less than the TAC, and the portion of unutilized TAC has been increasing. Industry participants have indicated multiple reasons contributing to this change, including reduced availability of fish, poor marketing conditions, and the closure of a processing facility in St. Pierre. Prior to the 2009-10 season, the TAC had been fully utilized if not exceeded in each year since Canadian jurisdiction was extended in 1977. Furthermore, excluding the moratorium years, current landings are the lowest of the available time series. Preliminary landings data for 2014 to October 9 totaled 2,447 t. Although the 2014-15 fishing season is incomplete, these totals to date are again relatively low and it is unlikely that the full TAC will be landed.

Since 1997, most of the TAC has been landed by Canadian inshore fixed gear fishermen (where inshore is typically defined as unit areas 3Psa, 3Psb, and 3Psc; refer to Fig. 1), with remaining catch taken mainly by the mobile gear sector fishing the offshore, i.e., unit areas 3Psd, 3Pse, 3Psf, 3Psg, and 3Psh (Table 1, Figs. 3a, and 3b).

Line trawl (i.e. longline) catches dominated the fixed gear landings over the period 1977-93, reaching a peak of over 20,000 t in 1981 and typically accounting for 40-50% of the annual total for fixed gear (Table 2, Fig. 4). In the post moratorium period, line trawls have accounted for 16-26% of the fixed gear landings. Gillnet landings increased steadily from about 2,300 t in 1978 to a peak of over 9,000 t in 1987, and remained relatively stable until the moratorium. Gillnets have been the dominant gear used for the inshore catch since the fishery reopened in 1997, with gillnet landings exceeding 50% of the TAC for the first time in 1998. Gillnets have typically accounted for 70-80% of the fixed gear landings since 1998. Gillnets accounted for a lower percentage of the fixed gear landings in 2001 (60%), partly due to a temporary management restriction in their use that was removed part way through the fishery following extensive complaints from industry. Gillnets have also been used extensively in offshore areas in the post moratorium period. Cod trap landings from 1975 up until the moratorium varied considerably, ranging from approximately 1,000-7,000 t. Since 1998, trap landings have been reduced to negligible amounts (< 120 t). Hand line catches were a small component of the inshore fixed gear fishery prior to the moratorium (about 10-20%) and accounted for about 5% of landings on average for the post moratorium period. However, hand line catch for 2001 shows a substantial increase (to 17% of total fixed gear) and this may reflect the temporary restriction in use of gillnets described above. Increases in the proportion of hand-line catch in some years (e.g. 2009, 2013) are likely due to buyers paying a higher price for hook-caught fish than for gillnet landings.

The spatial-temporal pattern of reported landings for 2012, 2013 and 2014 (to the end of September) was generally similar to those of other recent years but some interesting differences are worth noting (Table 3). Monthly landings continue to be variable among offshore unit areas. As in previous years, the majority of the offshore catch is taken in 3Psh during January-March and from 3Psf over September-November, which combined account for > 70% of the offshore catch in 2012 and 2013. Low effort through spring and summer typically result in less than 5% of offshore landings being taken between April-August. However, in 2013 that number reached 14% due to high catches in 3Psh in April and May. The 2014 fishing year was not complete at the time of this assessment but indications are that spring and summer months were again important, with offshore catches in April-May (312 t) nearly equaling catches for January-March (367 t).

Inshore landings are low early in the year (Table 3), arising mostly from by-catch of cod in other fisheries. The vast majority of landings from the inshore areas (3Psa, 3Psb, and 3Psc) are taken in June-November, with highest landings in June and July, particularly in 3Psc. The inshore (3Psa, 3Psb, and 3Psc) has consistently accounted for most of the reported landings. These have typically been highest in Placentia Bay (3Psc), ranging from 1,500 t to almost 11,650 t with 26-55% of the annual 3Ps catch coming from this unit area alone. In 2013 the landings from 3Psc were 1673 t and the proportion of the 3Ps total that this represents was the highest observed over the post-moratorium period. The high proportion was not attributable to an increased catch in 3Psc (it has been relatively stable over the last three years) but rather decreased catch in other areas (Fig. 5). Most of the offshore landings have come from 3Psh and 3Psf (Halibut Channel and the southeastern portion of St. Pierre Bank). Unit areas 3Psd, 3Pse and 3Psg have accounted for a very small portion of the total catch in recent years. However, the preliminary landings data for the ongoing 2014 year indicate ~ 180 t taken from 3Psg in February-March (Table 3). This increased catch is partially related to the fact that the start of the spawning closure (see below), which has typically started in March in recent years, was delayed until the start of April in 2014. The breakdown of landings by unit area excludes landings by France from 2009 to present. Resource managers from France have reported that the majority of these landings are taken in either 3Psf or 3Psh, but the exact unit area is unavailable.

The 2013-14 (April 1 to March 31) conservation harvesting plan places various seasonal and gear restrictions on how the 3Ps cod fishery in Canadian waters could be pursued. For example, unit areas 3Psa and 3Psd were closed from November 15-April 15 of the following year to avoid potential capture of migrating cod from the Northern Gulf stock (NAFO Divisions 3Pn4RS) and all of 3Ps was closed from April 1 to May 14, a closure intended to protect spawning aggregations. Full details of these and other measures, which may differ among fleet sectors, are available from the DFO Fisheries and Aquaculture Management (FAM) branch in St. John’s.

CATCH AT AGE

Samples of length and age composition of Canadian catches were obtained from the inshore gillnet, line-trawl and hand-line fisheries and the offshore otter trawl, gillnet, and line-trawl fisheries by port samplers and fishery observers. Additional sampling was obtained from the sentinel fishery. Length and age sampling of French catches (St. Pierre and Miquelon, SPM) are performed by IFREMER. These data are used to age-disaggregate the total landings into numbers of removals by age. During 2011, 2012 and 2013, more than 27,500 length measurements of Canadian and French catches were taken annually. In addition, between 3,200 and 5,000 otoliths from Canadian catches were taken annually to determine the age composition of the catches (Table 4). All age determinations for 2011-13 catch-at-age were made by Canadian technical staff. A workshop held in 2009 identified a key source of inconsistency between the interpretations by Canadian and French staff (Healey et al. 2011b) that has been addressed but age determinations were not available from France for the current assessment.

Canadian sampling totals are lower than in previous years and resulted from both reduced landings and reduced sampling efforts. Sampling was reasonably well distributed temporally across the gear sectors in unit areas 3Psa-c. However in 2012 there was no sampling from unit area 3Psd, 3Pse and 3Psg (catch from these areas represent < 5% of total Canadian catch). In 2013 there was no sampling from 3Psd, 3Pse and 3Psf (catch from these areas represent 15% of total Canadian catch). Sampling of lengths and ages of the Canadian and French catches during January-March 2014 was also undertaken, but data were not available at the time of the assessment and will be considered in future years.

The age composition and mean length-at-age of commercial catches were calculated as described in Gavaris and Gavaris (1983). Where possible, monthly landings for each gear type were age dis-aggregated using length and age samples from that quarter of the year (from the same gear type) to yield the age composition of each component of the catch. The average weights were derived from a standard length-weight (wt) relationship where:

$$\log(wt)=3.0879*\log(length)-5.2106.$$

Catch-at-age for all gears combined based on sampling of Canadian and French vessels in 2011 to 2013 is summarized in Table 4 and also Fig. 6. As described previously, these data exclude recreational catches, the magnitude of which has been unknown since 2007. Previous estimates of recreational catches indicated the total was relatively low compared to commercial landings.

The 2011-13 landings from all gears combined include a wide range of ages (ages 2-18). In 2011, much of the catch was comprised of younger, smaller fish, with 55% of the numbers caught aged 6 or younger (Table 5, Fig. 6a). The modal age in the 2011 catch was age 7, with approximately 0.9 million individuals taken (26% of total by numbers; Fig. 6b). In 2012 and 2013, the youngest ages comprised less of the catch than in 2011, with 42% and 45% respectively of the numbers caught aged 6 or younger (Table 5, Fig. 6b). Modal ages were age 6 (0.7 million individuals, 31% of total numbers) in 2012 and age 7 (0.5 million individuals, 24% of total numbers) in 2013 (Table 5, Fig. 6b).

Annual contributions to the catch-at-age are illustrated using a standardized proportion at age plot (Fig. 6c). In this figure, cohorts which are strongly indicated in the commercial catch are large grey circles, while those which are not well represented in the catches are large black circles. The plot demonstrates that the 1989, 1997 and 1998 cohorts have all tracked strongly through the fishery. Following the 1998 cohort there were several successive below average year-classes. More recently the 2004 and 2006 cohorts have tracked relatively strong through the fishery (although the relative contribution of the 2004 cohort was slightly less than average in 2013). Most of the 2013 catch was comprised of the 2005 to 2008 cohorts (Fig. 6a, b).

As noted in recent assessments (e.g. Brattey et al. 2008), there are discrepancies in the ratio of the sum of the product to landings over the 1959-76 period and attempts have been made to clarify these discrepancies by checking for missing catch and by adding plus group catch, but neither of these adequately explained the discrepancies. Until these discrepancies are resolved, it is recommended that catch at age prior to 1977 not be used in population analyses. For 2011, 2012 and 2013, the ratio of the sum-of-products (catch numbers and catch weights) to the total reported landings is 0.95, 0.95, and 0.96 respectively.

A time series of catch numbers-at-age (ages 3-14 shown) for the 3Ps cod fishery from 1959 to 2013 is given in Table 6. The catch-at-age data indicate that in the pre-moratorium period the landings were dominated by young fish, typically aged 4-6, whereas in the post moratorium period slightly older ages (i.e., ages 5-8) have been more common which likely reflects the switch in dominant gears from line-trawl and traps to gillnet. Linetrawl and trap typically select younger fish than gillnets.

WEIGHT AT AGE

Mean weights-at-age in the 3Ps fishery (including landings from the commercial and food fisheries and the sentinel surveys) are given in Table 7a and Fig. 7. Beginning of the year weights-at-age are given in Table 7b and Fig. 8. The mean weights-at-age are derived from the sampling of catches taken by several gears in various locations at various times of the year; the weights-at-age may therefore vary with season and gear, and possibly by geographic area.

For young cod (ages 3-6), weights-at-age computed in recent years tend to be higher than those in the 1970s and early 1980s (Table 7a; Fig. 7). The converse is generally true for older fish. Sample sizes for the oldest age groups (> 10) have been low in recent years due to the relative scarcity of old fish in the catch. The extremely low weights-at-age for ages greater than 10 could be related to these low sample sizes. Interpretation of trends in weights-at-age computed from fishery data is difficult because of among-year variability in the proportion at age caught by gear, time of year, and location.

SENTINEL SURVEY

The sentinel survey has been conducted in 3Ps since 1995 and there are now nineteen complete years of catch and effort data. Sentinel activity for 2014 was ongoing at the time of the assessment; this data will be reviewed in subsequent years. The sentinel survey continues to produce a time series of catch/effort data and biological information collected by trained fish harvesters at various inshore sites along the south coast of Newfoundland. Sentinel fishers typically fish a control and an experimental site; the location of the control site is fixed, whereas the location of the experimental site can change only within the local area. In 2014, there were 13 active sites in 3Ps, using predominantly gillnets (5½" mesh) in unit area 3Psc (Placentia Bay) and line trawls in 3Psb and 3Psa (Fortune Bay and west). One 3¼" gillnet was also fished at each of 3 sites in Placentia Bay one day per week. Fishing effort was less in 1999 (6 weeks), 2003 and 2004 (8 weeks each), than most other years (9-12 weeks), but since 2005 an average of 10 weeks has been maintained. Most fishing takes place in fall/early winter. Catch rates for 5½" gillnets in 2014 remained low and were similar to those recorded since 2003. Line trawl catch rates have declined and have been below the series average for the past 5 years.

As in previous assessments, an age disaggregated index of abundance was produced for gillnet (5½" mesh) and line trawl sampling. There is insufficient data from the 3¼" gillnets to develop a standardized index for this gear.

STANDARDIZED SENTINEL CATCH RATES

The catch from 3Ps was divided into cells defined by gear type (5½" mesh gillnet and line trawl), area (unit areas 3Psa, 3Psb, and 3Psc), year (1995-2011) and quarter. Age length keys (ALKs) were generated for each cell using fish sampled from both the fixed and experimental sites; however, only fish caught at the fixed sites were used to derive the catch rate indices. Length frequencies and ALKs were combined within cells. The numbers of fish at length are assigned an age proportional to the number at age for that particular cell length combination. Fish that were not assigned an age because of lack of information within the initial cell were assigned an age by aggregating cells until the data allowed an age to be assigned. For example, if there are no sample data in a quarter then quarters are combined to half year, half years are combined to year; if an age still cannot be assigned then areas are combined for the year. Since 2002, there are considerably fewer otoliths available for aging; annual sample sizes range between 248 and 464 otoliths per year from gillnet catches (compared to an average of 1050 otoliths during 1995-2002). Sample sizes for linetrawl are more variable, averaging 1100 otoliths from 1996-2002, but were considerably lower in 2003-04 and from 2007 onward. These variations are generally reflective of annual differences in the numbers of fish caught and decreased sentinel effort over time. However, there have been some changes in the proportion of sampled fished aged over the duration of the Sentinel program. Despite these decreases, there have been no major difficulties in aging the sampled catch. Further, the fraction of the catch sampled for age in recent years is comparable to earlier years.

Catch at age and catch per unit effort (CPUE) data were standardized using a generalized linear model to remove site and seasonal effects. Only data from fixed sites collected between June-November were included. For gillnets, only sets with a soak time between 12 and 32 hours were included, and for line trawl, soak times less than or equal to 24 hours were used in the analysis. Prior to modeling, data are aggregated within a gear/division/site/month/year/age cell. Zero catches were generated for ages not observed in a set as sets with effort and no catch are valid entries in the model.

A generalized linear model (McCullagh and Nelder 1989) was applied to the sentinel catch and effort data for each gear type. The number of fish caught in each set is assumed to have a Poisson distribution. A log link function was chosen, and the factors included in the model were both “nested effects”: month is nested within site and age is nested within year. Fishing effort is included as an offset term in the model. In the present assessment, the model adequately fitted data from gillnets and line trawls, and all effects included in the model were significant. Note that catch rates from the sentinel fishery are expressed in terms of numbers of fish, rather than catch weight as was used in the analyses of logbook data, as sentinel catches are usually not weighed (unavailability of scales). This complicates direct comparisons of the trends from Sentinel surveys to commercial catch rates.

Trends in standardized total (ages 3 10 combined) annual catch rates, expressed in terms of numbers of fish, are shown in Fig. 9a. Gillnet catch rates declined rapidly from 1997 to 1999 then remained stable but low from 1999 through to 2013. For line trawls, catch rates declined from 1995-97, remained relatively stable with no clear trend from 1997 to 2008, and have declined since that time with the 2013 value being the lowest in the time series.

Two standardized annual catch rate at age indices were also produced in the present assessment, one for each gear type. The standardized gillnet and line trawl catch rate at age indices for 1995-2013 are given in Table 8 and Fig. 9b. For gillnets, several year classes were well-represented in catches during 1995-97 but these are replaced by mostly weaker year classes. It has been noted that the 1997 and 1998 year-classes contributed significantly to both the fishery and RV index for several years. However, these year classes did not yield improvements in the magnitude of sentinel gillnet catch rates over 2002-06, when these year-classes would have been within the peak selection range of 5½” gillnets, and were a major contributor to inshore fisheries.

For line trawls, catch rates-at-age in the beginning of the time-series were higher due to the strong 1989 and 1990 year classes. In 2000-02, sentinel line trawl catch rates improved for younger fish (3 and 4 year olds) as the 1997 and 1998 year classes recruited to this index. Catch rates for older fish continued to decline. Both the 1997 year class, and in particular, the 1998 year class were consistently measured by sentinel linetrawl. As noted previously, these year-classes contributed strongly to commercial catches for several years. In addition, the 1999 year class also appears reasonably strong at ages 4-5 then is generally below average for older ages. This year class is weak in sentinel gillnet and in other (mobile gear) indices. These year-classes were followed by several successive year-classes which were weaker; but catch rates of the 2004 year-class at ages 3-5 (in 2007-09) are higher (Table 8). In 2006, linetrawl catch rates for all ages (3-10) increased, suggesting a year effect in the data rather than a change in stock size (Fig. 9b). Similarly, the 2013 gillnet index shows catch rates for most ages were also higher than in the previous year.

Although the sentinel indices did not increase in magnitude as the 1997 and 1998 year-classes were available to these gears, the age composition of the standardized estimates indicates that the 1997 year-class was consistently detected as relatively strong in the sentinel gillnets (Fig. 9b). Conversely, the 1998 year-class was consistently tracked by linetrawl sampling.

As described in previous 3Ps cod assessments, interpretation of the sentinel catch rate indices is difficult. Sentinel fisheries were free from competitive influences during 1995-96 as the commercial fishery was closed. However, commercial fisheries may have had some disruptive influence on the execution of the sentinel fishery since 1997, particularly in Placentia Bay. The concentration of fishing effort in Placentia Bay during the late-1990s, primarily with gillnets, may have had a negative influence on the sentinel gillnet catch rates. Competition with commercial fishers for fishing sites, local depletion, inter annual changes in the availability of fish to inshore, and shifts in the timing of sentinel fishing to accommodate periods of commercial fishing could all influence mean catch rates between years. The extents to which such effects influence catch rates are not fully understood. These issues also complicate the interpretations of relative year-class strength over the time-series. The decline in sentinel gill net catch rates after the fishery reopened in 1997 are consistent with the inshore catch rate data from science log books and the high estimates of exploitation from tagging in Placentia Bay. More recently, the index is consistently tracking the 2006 year-class, though the overall index has not shown increase. The linetrawl index indicates a strong contribution from the 2004 year-class but the 2006 year-class is estimated as one of the weakest over the time-series. This differs from the RV index, in which the 2006 year-class is well above average for ages 3 and 4, but near average for ages 5 and 6.

SCIENCE LOGBOOKS (< 35 FT SECTOR)

A science logbook was introduced to record catch and effort data for vessels < 35 ft in the re-opened fishery in 1997. Return of this logbook at season’s end is mandatory (pers. comm., L. Slaney, Resource Management Branch-DFO). Prior to the moratorium, the only data for vessels < 35 ft came from purchase slips, which provided limited information on catch and no information on effort. Since the moratorium, catch information comes from estimated weights and/or measured weights from the dockside monitoring program. Catch rates have the potential to provide a relative index of temporal and spatial patterns of fish density, which may relate to the overall biomass of the stock. Prior to the fall assessment meeting, there were about 171,000 records in the database. As with the analysis of results from the Sentinel program, we consider data to 2013 only, and exclude the current (in-progress) year. The number of annual logbook records has declined over time, even over multi-year periods having common TAC. In addition, the percentage of the total cod catch for the < 35 ft sector represented in the logbooks has decreased over time, from about 70% in 1997 to about 50% in recent years.

We present a catch rate index for data pertaining to the inshore fishery, i.e., unit areas 3Psa, 3Psb, and 3Psc. An initial screening of the data was conducted and observations were not used in the analysis if the amount of gear or location was not reported (or reported as offshore / outside of 3Psa, 3Psb or 3Psc), more than 30 gillnets were used, or < 100 or > 4,000 hooks were used on a line trawl. Upper limits for the amount of gear considered are applied to eliminate outlying records and exclude < 1% of the available data for each gear type. As reported in previous assessments, soak time for gillnets is most commonly 24 hours with 48 hours the next most common time period. In comparison, line trawls are typically in the water for a much shorter period of time, typically 2 hours with very few sets more than 12 hours.

The screening criteria described above have resulted in a substantial fraction of < 35 ft catch not being available for analysis. For example, in 2013 only 36% of the < 35 ft gillnet catch and 34% of the < 35 ft. linetrawl catch is included in the CPUE standardization. A major contributor to this loss of information is a high portion of logbook records with invalid entries for the location fished. This occurs when logbook entries do not record a fishing location as shown on the map included in the logbook. (These are denoted as fishing areas 29-37 and illustrated in Fig. 10a). Most of these instances are generated from logbooks which report the location fished as either "10" or "11", corresponding to "species fishing areas" (e.g., Lobster Area 10) which are relatively large and include more than one of the fishing locations illustrated in Fig. 10a. Therefore it is not possible to resolve these entries to the finer-scale areas indicated in the logbook, and, consequently, a substantial fraction of the catch and effort data from smaller vessels is excluded by our selection criteria.

As in previous assessments, effort was treated as simply the number of gillnets, or hooks for line trawls (1000s), deployed in each set of the gear; soak times were not adjusted as the relationship between soak time, gear saturation and fish density is not known. Catch rates from science logbooks are expressed in terms of weight (whereas those from the sentinel fishery are expressed in terms of numbers); commercial catches are generally landed as head on gutted and recorded in pounds; these were converted to whole weight (in kg) by multiplying by a gutted-to-whole weight conversion factor (1.2) and converting pounds to kilograms (2.203).

The catch from 3Ps was divided into cells defined by gear type (gillnet and line trawl), location (numbered 29-37, as described above) and year (1997-2013).

Initially, unstandardized CPUE results were computed and examined; in this preliminary analysis, plots of median annual catch rate for gillnets and line trawl were examined for each year location. Gillnet catch rates historically tend to be higher in areas 29-32 (Placentia Bay and south of Burin Peninsula) than elsewhere. The number of vessels fishing gillnet in the logbook database declined from 114 in 2012 to 82 in 2013. Gillnet catch rates in 2013 appeared to be improved in areas 31-35 but were very poor in areas 29-30 (eastern Placentia Bay) and 36 (Hermitage Bay) (Fig. 10b). No data were available for area 37 in 2013. For line trawl, most data historically comes from areas west of the Burin Peninsula and the results in areas 29-33 tend to be based on low sample sizes and show more annual variability. The number of vessels fishing line trawl dropped considerably in the logbook database from 73 in 2012 to 37 in 2013. Line trawl catch rates in 2013 were highly variable among areas with no discernable patterns, but it should be noted that the median catch rate in area 30 (inner Placentia Bay) represented a time series high value.

Prior to modeling, the data were aggregated within each gear/year/month/location cell, and the aggregated data were weighted by its associated cell count. Catch per unit effort data were standardized to remove site (fishing area) and seasonal (month, year) effects. Note that sets with effort and no catch are valid entries in the model.

In the present assessment, the model adequately fitted data from gillnets and line trawls and two standardized annual catch rate indices were produced, one for each gear type. All effects included in the model were significant.

Standardized gillnet catch rates declined over 1998-2000 and have subsequently been low but stable at approximately 19 kg/net (Fig. 10c). For linetrawls, temporal patterns differ from those of gillnets, with more inter-annual variation. After peaking in 2006, linetrawl catch rates generally declined to 2010, and have since been relatively steady near the time-series average of 266 kg/ 1000 hooks.

The observed trends in commercial catch rate indices for the inshore fishery are influenced by many factors. There have been substantial annual changes in the management plans in the post moratorium period (Brattey et al. 2003). In addition, gillnets and line trawls can at times be deployed to target local aggregations. For inshore fisheries, catch rates can also be strongly influenced by annual variability in the extent and timing of inshore as well as along shore cod migration patterns. Similarly, the changes in management regulations, particularly the switch from a competitive fishery to Individual Quotas (IQs) and for some vessels the need to fish cod as bycatch to maximize financial return, can have a strong influence on catch rates that is unrelated to stock size (DFO 2006). Consequently, inshore commercial catch rate data must be interpreted with caution. Despite these issues, the initial declines in gillnet and line trawl catch rates following the re-opening of the fishery in 1997 were cause for concern. The remarkable consistency in gillnet catch rates since 1998, despite the changes in resource abundance and management regulations, has not yet been explained. The decrease in modeled catch rates for line trawls since 2006 may in part be reflecting the reduced availability of the 1997 and 1998 year classes in the inshore catch, as the numbers of fish in these cohorts decline. Subsequent year-classes have generally not been as strong, and catches would be more comprised of younger (and hence lighter) fish.

INDUSTRY LOGBOOKS (> 35 FT SECTOR)

The spatial distributions of both landings and catch rates for the larger vessels (> 35 ft fleet) during 1998 to 2013 were examined using logbook data. Landings and catch rates for otter trawls, gillnets and linetrawls were summarized at the resolution of 10 by 10 degree blocks of latitude and longitude where there was sufficient data (arbitrarily minimum of five per cell). The number of logbook records available for analyses has been variable over time. However, numbers were considerably lower in 2013 than in previous years (Table 9), reflecting reduced overall effort. For all three gears, there was substantial spatial concentration in landings and a reduction in the number of areas reporting high landings over the time-series (Fig. 11a-c). Median catch rates per block were calculated for those logbook records including duration (soak time) and limited to soak times typically observed for each gear type, based on analyses of observed frequency distributions. From 1998 to 2010, median catch rates in otter trawls were consistently high in the Halibut Channel and they were also high in areas of St. Pierre Bank during most years (Fig. 11d). Otter trawl catch rates declined in the Halibut Channel from 2010 to 2012. During 2013, limited effort was reported by otter trawlers in the Halibut Channel and only moderate catch rates were reported on St. Pierre Bank. Median catch rates in gillnets (Fig. 11e) were highest in Placentia Bay and on St. Pierre Bank from 1998 to 2007, but since 2007 the highest catch rates were typically reported only on the bank. Spatial trends in catch rates differed between gillnets and linetrawls. The number of locations reporting high catch rates by linetrawls generally increased from 1998 to 2010, but subsequently declined to one location in Placentia Bay during 2013 (Fig. 11f).

TAGGING EXPERIMENTS / EXPLOITATION RATE

Tagging of adult (> 45 cm fork length) cod in Subdiv. 3Ps was initiated in 1997 and has continued through 2014. The objectives of the tagging study are to provide information on movement patterns of 3Ps cod as well as obtain ongoing estimates of exploitation rates (% harvested) on different components of the stock. Tagging efforts in 3Ps were reduced during 2005-11 with releases only in Placentia Bay (3Psc) during 2008-11 and there has been no tagging in the offshore regions of 3Ps since 2005 (Table 10a). However, during 2012-13 efforts were made to expand the tagging program under the auspices of a Fisheries Improvement Program (FIP) conducted by various levels of Government, Industry, and the WWF. The number of tags released was increased to 2,340 during 2012 and further to 3,951 during 2013, with coverage expanded to include a broader portion of the stock area (3Psa, 3Psb, 3Psc). Attempts to tag in the offshore were also made but these proved unsuccessful. A brief synopsis of results from recent tagging is provided below.

Over 2008-10, approximately 300 tags were returned annually (Table 10b). Fewer tags were returned in 2011 and 2012 (133 & 190, respectively), resulting from both reductions in landings and the restricted spatial extent of releases, but returns have increased in 2013 (238) as a consequence of increased tagging effort. The percentage of returns coming from participants in the recreational fishery ranged from 4-11% during 2007-13 (Table 10b). Sufficient numbers of tags have been returned to estimate annual tag reporting rates (fraction of captured tags returned) using mixed-effects logistic regression (Cadigan and Brattey 2008). Inter-annual variations are relatively small with no trends over time (Fig. 12). Reporting rate for the offshore portion of 3Ps in 2013 was 0.62 and for the inshore was 0.72.

The methods and estimates of the average annual exploitation rates (harvest rates, in percent) for cod tagged in different regions of 3Ps are described in detail elsewhere (Brattey and Cadigan 2004; Brattey and Healey 2003-06; Cadigan and Brattey 2003, 2006, 2008). Estimated mean exploitation rates for cod tagged in Placentia Bay have all been less than 15% over 2008-11 (Table 10c). However, results on size-specific exploitation rate from recent releases showed that although exploitation has been low in Placentia Bay, exploitation rate increases considerably with fish length, particularly for those sizes which are fully selected by the fishery (approximately 65 cm). In the previous assessment, a comparison of exploitation rates across various size groups indicated that despite an overall low exploitation rate, larger cod (> 65 cm) were subject to higher exploitation rates. The exploitation rate in 2012 for cod tagged in Placentia Bay tended to increase with fish size from 14% among cod > 50 cm at tagging to 22% among those > 60 cm. These exploitation rates are modest, but given that only less than half of the TAC was taken, harvest rates would have been higher if the full TAC was taken. In 2013 harvest rates for cod tagged in Placentia Bay were broadly similar among cod size groups ranging from 13-16%; for those tagged in Fortune Bay the range was 10-25%. Again less than half of the TAC was taken in 2013 and harvest rates would be expected to be higher if the full TAC had been taken.

With respect to migratory patterns and stock distribution, recent tagging results (not shown) generally agree with previous findings (Brattey and Healey 2004, 2005, 2006), and indicate restricted mixing of cod from different portions of the 3Ps stock area. In particular, cod tagged in western 3Psa tended to show strong association with 3Pn, whereas those tagged on the eastern side of the Hermitage Channel of 3Psa tended to move eastwards into Fortune Bay (3Psb). Among cod tagged in Placentia Bay a small percentage (1.8% of 852 recaptures) was recaptured from the neighbouring stock area in Divs. 3KL. Cod tagged inshore tended to show limited movement to offshore portions of the stock area. The limited mixing of inshore cod in particular make it difficult to determine whether inshore stock indices (Sentinel survey) are reflecting trends in the stock as a whole or mainly of inshore components of the stock. Trends in the indices differ between inshore and offshore and are difficult to reconcile with the tagging results. Previous tagging results suggested lower exploitation in the offshore than most inshore areas, yet the DFO RV indices declined for several years over 2001-08. In contrast, inshore indices (sentinel) have been stable for several years (albeit at a lower level than when the fishery opened in 1997), whereas tagging suggests that in some inshore areas such as Placentia Bay exploitation was relatively high (~ 25%) for several years. The discrepancy between trends in inshore/offshore abundance indices and tagging estimates of exploitation was previously noted in recent assessments and remains enigmatic and difficult to explain.

RESEARCH VESSEL SURVEY

Stratified-random surveys have been conducted in the offshore areas of Subdiv. 3Ps during the winter-spring period by Canada since 1972 and by France over 1978-92. The two surveys were similar with regard to the stratification scheme used, sampling methods and analysis, but differed in the type of fishing gear and the daily timing of trawls (daylight hours only for French surveys). Canadian surveys were conducted using the research vessels A.T. Cameron (1972-82), Alfred Needler (1983-84; 2009-present), and Wilfred Templeman (1985-2008). From the limited amount of comparable fishing data available, it has been concluded that the three vessels had similar fishing power and no adjustments were necessary to achieve comparable catchability factors, even though the A.T. Cameron was a side trawler. The CCGS Teleost has also been used during exceptional events (e.g. severe mechanical issues on regular survey vessel), and any potential vessel effect is unaccounted for. Cadigan et al. (2006) found no significant differences in catchability for several species, including cod, between the Wilfred Templeman and Alfred Needler research vessels. Surveys by France were conducted using the research vessels Cyros (1978-91) and Thalassa (1992) and the results are summarized in Bishop et al. (1994).

The Canadian research vessel surveys from 1983 to 1995 employed an Engel 145 high-rise bottom trawl. In 1996, research surveys began using the Campelen 1800 shrimp trawl. The Engel trawl catches for 1983-95 were converted to Campelen 1800 shrimp trawl-equivalent catches using a length-based conversion formulation derived from comparative fishing experiments (Warren 1996; Warren et al. 1997; Stansbury 1996, 1997).

The stratification scheme used in the DFO RV bottom-trawl survey in 3Ps is shown in Fig. 13. Canadian surveys have covered strata ranging down to 300 fathoms (ftm) in depth (1 fathom = 1.83 meters) since 1980. Five new inshore strata were added to the survey in 1994 (stratum numbered 779-783) and a further eight inshore strata were added in 1997 (numbered 293-300) resulting in a combined 18% increase in the surveyed area. Beginning in the 2007 assessment, new indices using survey results from the augmented survey area were presented for the first time. Two survey time series are constructed from the catch data from Canadian surveys. The index from the expanded surveyed area that includes new inshore strata is referred to as the “All Strata < 300 ftm” index and the time series extends from 1997 onwards. The original smaller surveyed area is referred to as the “Offshore” survey index and the time series that incorporates a random stratified design extends from 1983-present.

The timing of the survey has varied considerably over the period (Table 11, Fig. 14). In 1983 and 1984 the mean date of sampling was in April, in 1985 to 1987 it was in March, and from 1988 to 1992 it was in February. Both a February and an April survey were carried out in 1993; subsequently, the survey has generally been carried out in April. The change to April was aimed at reducing the possibility of stock mixing with cod from the adjacent northern Gulf (3Pn4RS) stock in the western portion of 3Ps. The stock mixing issue is described in more detail in previous assessments (e.g., Brattey et al. 2007). Due to extensive mechanical problems with the research vessel, the survey in 2006 was not completed: only 48 of 178 planned sets were completed. Therefore, results for 2006 for the full survey area are not considered comparable to the remainder of the time-series. All subsequent surveys were considered complete. The 2014 survey completed only 156 of the intended 178 fishing sets. All index strata except stratum 708 were covered, although there were a reduced number of sets in some strata. The impact of not sampling stratum 708 in 2014 is unknown but it has been a minor contributor to overall stock indices in recent years (Tables 12 and 13).

Abundance, Biomass, and Distribution

Trends in the abundance index and biomass index from the RV survey are shown for the offshore (i.e. index strata only: those strata of depth ≤ 300 ftm, excluding the new inshore strata) and the all strata area (Fig. 15). The trawlable abundance index declined from 88.2 million in 2001 to 38.7 million in 2008, the longest period of consistent decline in the entire time-series. However, the index has generally been higher during 2009-14. The 2013 estimate was particularly high, but was followed by a subsequent large decline for the 2014 estimate which is at the 1997-2014 average. The trawlable biomass estimate has been variable for much of the post-moratorium period, but as with abundance, the biomass index generally declined over 2001 to 2008. Generally, the biomass index has been near or below the time series average of 57,138 t since 2009, but there was a peak in 2013 at 83,000 t and a subsequent decline to 30,000 t in 2014.

The trends and degree of variability in the combined inshore/offshore survey are almost identical to those of the offshore survey in spite of the 18% increase in surveyed area; the only exception is in 2005 when the combined inshore/offshore survey shows higher biomass and abundance due mainly to a large estimate from inshore stratum 294 (see Tables 12 and 13).

Survey indices of cod in 3Ps are at times influenced by “year-effects”, an atypical survey result that can be caused by a number of factors (e.g., environmental conditions, movement, degree of aggregation, etc.) which may be unrelated to absolute stock size. The time series for abundance and biomass from 1983 to 1999 show considerable variability, with strong year effects, for example, the 1995, 1997 and 1998 surveys when compared to those from adjacent years. The 1995 estimate is influenced by a single large catch contributing 87% of the total biomass index and therefore has a very large standard deviation. The 1997 survey values were the lowest observed in the time series, which goes back to 1983, being less than half of the 1996 index. The size composition of fish in the 1997 RV survey suggested that this survey did not encounter aggregations of older fish, yet these fish were present in the 1996 survey and in subsequent commercial, sentinel, and survey catches. It is also likely that either the 2008 or 2009 results (possibly both results) are influenced by year-effects. In 2009, survey indices increased for several cohorts. Increases in cohort strength cannot occur for fully recruited sizes, which suggests that the 2013 survey result is largely influenced by a year-effect. For example, comparison of the 2012 to 2013 survey results suggest that the number of individuals within multiple cohorts increased between years, indicative of a year effect. Also, the 2013 survey indices were largely influenced by a single unusually large catch on Burgeo Bank. This large set (composed primarily of ages 4+) resulted in 53% of the biomass estimate and 27% of the abundance estimate being allocated to stratum 309 on Burgeo Bank (Fig. 16). This observation was very unusual relative to historic trends and was not repeated in 2014, when abundance and biomass estimates for stratum 309 made up less than 1% of the total estimates for 3Ps. It is more typical that stratum 319 in Halibut Channel accounts for a substantial portion of the total biomass and abundance indices and the remainder of the index is spread across the other strata with no individual strata containing more than 7% of the total. Stratum 319 represented an important component of the stock in all recent years (Fig. 16) but the importance of stratum 309 in 2013 was unusual.

To further investigate whether there have been annual shifts in the distribution of the stock at the time of the survey, trends in the proportion of the total abundance observed in three different regions of the stock area were compared. The areas were (see Fig. 17): the inshore (strata 293-298, and 779-783), the Burgeo area (Hermitage strata 306-309, and 714-716), and the eastern area (remaining strata). Data from the combined inshore/offshore survey were used and the Campelen trawl was fished in all these surveys. The proportions were variable (Fig. 18), with typically 30-70% observed in the larger eastern area, 15-60% in the Burgeo area, and around

10-25% in the inshore area. Part of the variation in the spatial composition of the index is due to year effects, often resulting from a small number of survey sets with very large catches. For example, the value for 1998 is high due to several large catches on Burgeo Bank and vicinity that may have included fish from the neighbouring northern Gulf (3Pn4RS) cod stock.

The spatial distribution of catches of cod during the 2014 survey was examined, for all ages combined (Fig. 19a, b, also includes 2011 to 2013 survey results for comparison) and separately for ages 1-12 (Fig. 19c). Previously it has been demonstrated (Healey et al. 2011a, Brattey et al. 2007) that cod tend to be caught over a considerable portion of NAFO Subdiv. 3Ps with the largest catches typically in the southern Halibut Channel area, on Burgeo Bank and vicinity, and within Fortune Bay. However, cod tend to be consistently scarce in the deep water below the mouth of Placentia Bay and in the inner reaches of Hermitage Channel. Increased catches of cod on Burgeo Bank were evident in 2013 but not 2014. There were multiple tows on Burgeo Bank in 2013 with high abundance but only a single tow with high biomass. Sets that appear in the distribution plots as large in terms of abundance but small in terms of biomass are indicative of large catches of small fish.

Distribution plots of age-disaggregated survey catches from the 2014 survey (Fig. 19c) indicate that 1 year old cod were caught mainly in nearshore areas. It is important to note that due to their small size, one-year old cod are not fully selected by the trawl. Cod aged 2 and 3 years old were found over most of the surveyed area, with catches of these age groups taken in Placentia Bay, Fortune Bay and in and around the Halibut Channel. Distribution of cod aged 4-10 is similar to that of younger ages, though the magnitude of catches decreases considerably with age. Cod aged older than 10 years are encountered less frequently. Catches of these older cod are mainly in the vicinity of the outer Halibut Channel.

Age Composition

Survey numbers at age are obtained by applying an ALK to the numbers of fish at length in the samples. The current sampling design for cod in Subdiv. 3Ps requires that an attempt be made to obtain 2 otoliths per centimeter from each of the following locations: Northwest St. Pierre Bank (strata 310-314, 705, 713), Burgeo Bank (strata 306-309, 714-716), Green Bank-Halibut Channel (strata 318 319, 325 326, 707-710), Placentia Bay (strata 779-783) and remaining area (strata 315-317, 320-324, 706, 711-712). This spatial stratification ensures sampling is distributed over the surveyed area. The otoliths are then combined into a single ALK and applied to the survey data. These data can be transformed into trawlable population abundance at age by multiplying the mean numbers per tow at age by the number of trawlable units in the survey area. This is obtained by dividing the area of the survey by the number of trawlable units. For the “offshore” survey in 3Ps, the survey area is 16,732 square nautical miles including strata out to 300 ftms (and excluding the relatively recent inshore strata added in 1997). The swept area for a standard 15 min tow of the Campelen net is 0.00727 square nautical miles. Thus, the number of Campelen trawlable units in the 3Ps survey is $16{,}732 \div 0.00727 = 2.3 \times 10^6$. For the expanded survey area, there are approximately 2.7×10^6 trawlable units.

The mean numbers per tow at age in the DFO RV survey are given in Table 14 and results for ages 1-15 are shown in the form of standardized “bubble” plots in Fig. 20. Cod up to 20 years old were not uncommon in survey catches during the 1980s, but the age composition became more contracted through the late 1980s and early 1990s. In fact, over 1995-2000, no cod ages 15 or older were sampled during surveys. Although catches of older cod remain quite low, the age composition has expanded slightly in recent years to include some cod that are 16-18 years of age. In recent years, much attention has been focused on the 2006 year-class. Over 2007-11, survey results for this year-class were much greater than average (at ages 1 through 5). However, subsequent surveys have suggested the numbers at age for the 2006 year-class at older ages to be near or below average. The age 1 survey index for the 2012 survey, representing the 2011 year-class, was much greater than the time-series average. This year-class continued to look strong in the 2013 (age 2) and 2014 (age 3) surveys.

Size-At-Age (Mean Length and Mean Weight)

The sampling protocol for obtaining lengths-at-age and weights-at-age has varied over time (Lilly 1998), but has consistently involved stratified sampling by length. For this reason, calculation of mean lengths and weights included weighting observations by population abundance at length (Morgan and Hoenig 1997), where the abundance at length (3 cm size groups) was calculated by areal expansion of the stratified arithmetic mean catch at length per tow (Smith and Somerton 1981). Only data from 1983 onward are presented.

Mean lengths-at-age were updated using the 2014 survey data. For fish aged four and older there was a general decline in length-at-age from the early 1980s to the mid-1990s (Table 15, Fig. 21a). For most ages there was an increase in length-at-age from the mid-1990s through the mid-2000s, followed by a period of lower length-at-age in recent years. In 2014 length-at-age increased compared to 2013 for many of the ages examined.

Annual variation in mean length at age was examined using deviation from the average as a proportion over the time series for each age. The average mean length at age from 1983 to 2014 was calculated for each age. Deviation was calculated for each age in each year by subtracting the mean for the age for the time series from the annual observation for that age and then dividing this by the mean for that age. Ages 3 to 9 were included. Mean length at age was greater than average in the mid-1980s. It showed a declining trend until the mid-1990s when it was below average. Mean length-at-age subsequently increased. Length-at-age has been lower than average in 6 of the last 7 years, and remains well below average in 2014 (Fig. 21b).

Values for mean weight-at-age were updated with data from the 2014 survey (Table 16, Fig. 22a). There was an increase in weight-at-age from the mid-1990s through the mid-2000s, but data from 2007-14 surveys suggest that mean weight-at-age was lower than the mid-2000s. Mean weight-at-age was greater than average in the mid-1980s and generally declined until the mid-1990s (Fig. 22b). As with mean length-at-age, mean weights-at-age increased after that time to about 2000. Weight-at-age since 2005 has been generally lower and the values in the last two years are amongst the lowest in the time series.

Condition

Relative gutted condition (relative K) and relative liver condition (relative LK) were calculated from survey data. It has been shown that the timing of the survey affects estimates of condition for 3Ps cod (Lilly 1998) and so only estimates from April surveys beginning in 1993 were estimated. A length gutted weight relationship was estimated, and the condition index is calculated as observed condition divided by the condition predicted from the length weight regression for a fish of that length. Relative liver condition was calculated in a similar fashion using a liver weight - body length regression. Both gutted and liver condition increased to about 1998 and then were lower until 2004 with a spike in 2005 (Fig. 23). Gutted condition reached a low in 2008 but increased steadily since that time to reach above average levels in 2013, however it declined again in 2014. Liver condition has been generally below average in recent years except for a spike in 2013, followed by a substantial decline in 2014.

In conclusion, length-at-age has been generally lower in the recent years. Weight-at-age since 2005 has been generally lower. Although there was some improvement in condition in recent years, both gutted and liver condition have been mostly lower than observed from the late-1990s to the mid-2000s.

Maturity

The sampling design used to gather biological data to study maturation trends and an overview of maturity and fecundity research relating to 3Ps cod can be found in Brattey et al. (2008).

Annual estimates of age at 50% maturity (A50) for females from the 3Ps cod stock, collected during annual winter/spring DFO RV surveys, were calculated as described by Morgan and Hoenig (1997). Trends in age at 50% maturity are shown in Fig. 24a (only cohorts with a significant slope and intercept term are shown); parameter estimates and associated standard errors for the 1954 to 2009 cohorts are given in Table 17, and the model did not adequately fit data for subsequent cohorts as most of these fish remain immature. Age at 50% maturity declined rapidly for cohorts from the 1980s and remained low for cohorts from the 1990s. There was a slight increase in A50 to ~ 5.5 years for cohorts of the early 2000s but values for the most recent cohorts have once again dropped below 5 years (Fig. 24a). Given that the estimation is conducted by cohort, estimates for the most recent cohorts may be revised slightly in future years as additional data are collected. Males show a similar trend in A50 over time (data not shown), but tend to mature about one year earlier than females.

Annual estimates of the proportion mature at age are shown in Table 18; these were obtained from the cohort model parameter estimates in Table 17. The estimates of proportion mature for ages 4-7 show a similar increasing trend (i.e., increasing proportions of mature fish at young ages) through the late 1970s and 1980s, particularly for ages 5, 6, and 7 (Fig. 24b). Due to the low age at 50% maturity, the proportions mature at age are quite high.

The time series of maturities for 3Ps cod shows a long-term trend as well as considerable annual variability. Such variations can have substantial effects on estimation of spawner biomass. Further, the age composition of the spawning biomass may have important consequences in terms of producing recruits (see Brattey et al. 2008).

Cohort Analyses

During the 2006 assessment of this stock, it was agreed that sequential population analyses of 3Ps cod should be discontinued, primarily due to inconsistent trends in the index data available (poor correlations within and between surveys) and poor model fit (strong year-effects and poor precision in estimated parameters). (For additional discussion, refer to DFO (2006, 2007) as well as Brattey et al. 2008.) In addition, the accuracy of the total landings captured by the commercial catch data has been questioned during assessment meetings (e.g., Shelton et al. 1996, DFO 2010). In the 2007 assessment of this stock, Brattey et al. (2008) provided estimates of instantaneous rates of total mortality (Z) for 1997-2007 as computed directly from the combined DFO RV survey. A debate on smoothing these annual estimates of total mortality during the winter 2009 zonal assessment meeting led to the exploration of cohort modeling of the survey data to provide structure to the smoothing. Consequently, a survey-based (SURBA) model based upon the work of Cook (1997) was implemented and it provides estimates of total mortality, relative recruitment strength, and relative estimates of total and spawning biomass from the DFO RV survey (see Cadigan 2010).

Data for ages 1-12 from the DFO RV expanded index were used in the SURBA, including an adjustment for the 1983-96 survey indices to account for the inshore area that was not sampled in these years. However, data for ages 1 and 2 over 1983-95 are zero-weighted in estimation, due to concerns of potential biases in RV data conversion of these age groups. (This conversion accounts for a change in the trawl gear after the 1995 survey) The age-specific adjustment is the ratio of the average survey index for the expanded area (1997-present) to the average offshore survey index over the same period (see Fig. 25). These adjustment factors are applied to the survey index at age over 1983-96. As younger fish are generally found in greater abundance in the near-shore, this ratio exceeds one at ages 1-3. For fish older than age 3, the adjustment is less than 1 and generally declines with age.

The age-disaggregated cohort model assumes that total mortality experienced by the population can be separated into vectors of age effects s_a and year effects f_y (such that $Z_{a,y} = s_a \times f_y$). Estimation (lognormal likelihood) minimizes the difference between the predicted and observed survey index over all ages and years, with penalties applied to impose a degree of smoothing on the estimated age and year effects. However, the model was speculative in that it could not reliably estimate survey selectivity, and fixed values are applied. Survey selectivity is assumed to be constant for ages 4 +, that is, selectivity is “flat-topped”. The age effects estimated in deriving a recruitment index from the age 1-4 survey data during a previous assessment of this stock (Healey et al. 2013) were used to provide some objectivity in the survey catchabilities supplied to the model for the ages which are not fully-recruited. An alternate assumption assuming “domed” selectivity was explored in a previous assessment (Healey et al. 2011a). It has been argued that best-practice is to assume flat-topped selectivity (Northeast Fisheries Science Center 2008) unless there is evidence otherwise.

Detailed model specification, sensitivities of results to modeling assumptions, and estimation procedures applied in developing this model are documented in Cadigan (2010). PROC NLMIXED in SAS/STAT™ software is used to estimate parameter values and associated uncertainty.

An updated run of the previous assessment model formulation was presented. Estimated age-specific patterns in mortality indicate an increasing trend in relative total mortality to age 8, after which relative mortality decreases slightly (Fig. 26). Cohort analyses of the RV data indicated that SSB declined by 60% over 2004-09 (Fig. 27a). Median SSB was estimated to be below the LRP in 2008 and 2009. SSB increased considerably over 2009-12 and has since been relatively stable. The 2014 estimate is approximately 1.6 times higher than the LRP. The probability of being below the LRP in 2014 is very low (~ 0.01). As a result of improved recruitment and recent increases in the proportion mature-at-age, 81% of the 2014 SSB is comprised of fish of ages 5-8.

In the previous assessment the SSB demonstrated a steadily increasing trend from 2009-13 with the 2013 estimate being twice the level of the LRP. In the current assessment, however, SSB levels off after 2012, with the 2013 estimate being 1.6 times the level of the LRP. Retrospective revisions are not uncommon in cohort models which use annual information to predict the abundance of multiple cohorts. The relatively large revision to the SSB estimates is owing to the fact that 2014 survey estimates have decreased considerably from the large (and unexpected) values of the 2013 survey. Several recent year-classes were revised downwards, with the greatest revision to the 2011 year-class. In addition, changes in average mortality and the estimated proportions mature at age have also contributed to the revision in SSB.

Total mortality rates reflect mortality due to all causes, including fishing. Estimated total mortality from the cohort model (Fig. 27b) for ages 5-10 declined from 2006-11 but has increased again in the last two years, with an average 2011-13 value of 0.53 (41% annual mortality). This value is weighted by population number at each of ages 5-10. Current mortality estimates are well above the time-series average. This is of particular concern given that less than half of the TAC has been taken annually over the last three years. It remains unclear whether or not these mortality rates are sustainable over the longer term.

Recruitment (Fig. 27c) has improved over the last decade with most cohorts at or above the time series (1983--2013) average. In particular, the 2006 cohort is estimated to be quite strong. Preliminary indications are that the 2011 and 2012 cohorts are among the strongest in the time-series. However, it should be noted that the uncertainty around the estimates for these recent cohorts is quite high and the estimates may be revised as additional data are collected.

Model diagnostics are similar to results obtained during the previous assessment. There is evidence of the year-effects as described in the survey results section, particularly those during the mid-1990s (multiple years of almost all negative residuals). Otherwise, there are no indications of systematic model fit issues (Fig. 28).

Projection of the stock to 2015 was conducted assuming mortality rates will be within ± 20% of current values (2011-13 average). More specifically, five projection scenarios were conducted, scaling current total mortality by each of 0.8, 0.9, 1.0, 1.1, and 1.2. A three year geometric mean of recruitment and three year average of weight-at-age were used. The proportions mature at age were projected forward from the cohort-specific model estimates.

Projection scenarios indicate that the 2015 SSB will remain stable or increase from the 2014 estimate (Fig. 29). In each case, the probability of being below the LRP in 2015 is very low (< 0.01). In recent assessments, three year projections were provided to advise management decisions. However, in the current assessment, projection estimates of SSB beyond 2015 are considered unreliable given the heavy influence of the uncertain and exceptionally large 2011 and 2012 year classes. These two year classes are currently estimated to be very strong and by 2015, when very few of these fish would be mature at ages 3 and 4, they would constitute 20% of the projected SSB. As they mature in subsequent years, these year classes will dominate the projected SSB. Therefore, more reliable estimates of the 2011 and 2012 year classes are required to project the stock beyond 2015.

CONCLUSIONS AND ADVICE

Reported combined landings by Canada and France have been below the TAC since the 2009/10 season. During the 2013/14 season, less than half (47%) of the 11,500 t TAC was landed.

Consistent with recent assessments, a cohort model (SURBA) based on the spring DFO survey was used to infer overall stock trends.

Some of the other sources of information not included in the assessment model (i.e. Sentinel, log book data) show trends that differ from the SURBA results, and these differences are not fully understood. The DFO survey is considered the most appropriate index of stock status because it covers most of the stock area.

The stock is currently in the cautious zone as defined by the DFO Precautionary Approach (PA) Framework. SSB has increased since 2009 and is currently estimated to be 60 percent above the limit reference point (LRP; $B_{Recovery}$ = SSB1994). The probability of being below the LRP in 2014 is very low (~ 0.01).

Estimated total mortality over 2011-13 averaged 0.53 (41% annual mortality), which is relatively high considering that less than half of the TAC was taken annually over this time period.

Recruitment has improved over the last decade with most cohorts at or above the time-series (1983-2013) average. In particular, the 2006 cohort is strong, and preliminary indications are that the 2011 and 2012 cohorts are also strong.

Projection of the stock to 2015 was conducted assuming mortality rates will be within ± 20% of current values (2011-13 average). Projected SSB remains stable or increases and remains within the cautious zone.

OTHER CONSIDERATIONS

Management Considerations

The Conservation Plan and Rebuilding Strategy (CPRS) received Ministerial approval during the late stages of the current assessment meeting and will now guide Canada's management position on this co-managed stock. Based on the CPRS, TAC advice for 2015/16 would be 13,495 t, a 2% increase over the previous year. An initial evaluation of the CPRS found it to be PA compliant and to lead to a sustainable fishery over the long-term (but with yield lower than historical catch levels of 40-60 kt). Further work is planned to continue this evaluation. Discussion is needed between DFO Science and Fisheries Management to determine how future Terms of Reference and requests for advice should be structured in order to correspond to the newly approved CPRS.

The level of total removals is uncertain but less so in the post-moratorium period. In assessing stock status, it would be useful to better understand the accuracy of total removals. Accurate estimates of recreational fishery landings are also required.

Estimation of maximum sustainable yield (MSY)-based reference points (F_{MSY} and B_{MSY}) will require an assessment framework review including further peer review of the modeling approach used to quantify these reference points.

Management should recognize that cod which overwinter in 3Ps are also exploited in adjacent stock areas (Div. 3L and Subdiv. 3Pn). Hence management actions in these stock areas should consider potential impacts on 3Ps cod. Consequences of area/time closures should be carefully considered as these may result in higher exploitation rates on the components of the stock that remain open to fishing. The fishery should be managed such that catches are not concentrated in ways that result in high exploitation rates on any stock components.

Management should be aware of within-year variations in the individual weight of cod. Greatest individual yield can be gained when fish are in peak condition, typically in late fall/early winter, while minimizing the total number of individuals removed from the stock.

When average fish size (age) in commercial catches is reduced through either depletion of older cohorts or recruitment of younger cohorts, the numbers of fish removed per ton of landed catch is increased.

A seasonal closure of the entire 3Ps stock area (typically from March 1 to mid-May) occurs annually and is intended to prevent fishing during the cod spawning season. Spawning closures of various forms have been used for numerous cod stocks throughout the North Atlantic but the efficacy of such closures is difficult to evaluate due to potentially confounding effects of other simultaneously implemented management measures and a general lack of clear objectives. Closures that span too narrow a time period or geographic area can be ineffective because spawning fish are not entirely protected and/or displacement of effort to other times/areas can result in no overall reduction in fishing mortality. The 3Ps spawning closure covers the entire stock area and so spatial coverage is not a concern. However, the current timing of cod spawning in 3Ps is not well understood and cannot be fully ascertained via the DFO RV survey due to its short temporal coverage of the area each year. Therefore, the timing of the closure relative to the timing of spawning cannot be evaluated.

SOURCES OF UNCERTAINTY

The level of total removals is uncertain. It is likely that historical landings have been biased both upwards (e.g., due to misreporting of catch by area and/or species) and downwards (e.g., due to discarding). In addition, commercial catch accounting procedures pre- and post-moratorium are radically different, with current measures likely to provide improved estimates of removals. Estimates of recreational fishery landings have not been available since 2006. In assessing stock status, it would be useful to better understand the accuracy of total removals, especially in the post-moratorium period. Given these uncertainties and the variability in the reliability of removals estimates, they are not used in the current analytical assessment. Assessment models do exist that are capable of handling uncertainty in the catch estimates but some information would still be needed in order to place reasonable bounds on the landings.

Comparison of sentinel catch rates and the RV index at times show inconsistent age-compositions. The differences in cohort strength between stock components could be due to changing stock distribution within the year, gear selectivity, or the spatial coverage of each index. As an example, the sentinel gillnet data consistently measured the 1992 cohort as being an above average fraction of the annual catch. This cohort was also important to the commercial gillnet catch, but was not notable in the RV index. A similar phenomenon exists for the 2004 cohort (detected by sentinel line-trawl but not sentinel gillnet or RV index).

There is uncertainty regarding the origins of fish found in 3Ps at various times of the year. Tagging and telemetry experiments show that there is mixing with adjacent stocks (southern 3L and 3Pn4RS) and this may vary over time. However, results indicate that exploitation of fish tagged within Placentia Bay has been predominantly within that area, even after several years at liberty.

The geographical coverage of tagging since 2007 is limited to inshore areas; during 2008-11 cod were only tagged in Placentia Bay, and in 2012 and 2013 in Placentia Bay and Fortune Bay. The lack of recent tagging in other areas adds uncertainty to our understanding of natural mortality rates, exploitation rates, stock structure, as well as movement patterns and how these influence survey and commercial catch rates in the recent period.

The relative efficiency of the survey trawl at capturing different age groups is uncertain. Differing patterns of catchability were explored in a recent assessment and yielded a similar outcome in terms of current status relative to the LRP. If the catchabilities differ from the assumed values, stock dynamics may differ from the results presented above.

Survey indices are at times influenced by “year-effects”, an atypical survey result that can be caused by a number of factors (e.g., environmental conditions, movement, degree of aggregation, etc.) which may be unrelated to absolute stock size. There are strong indications that the 2013 survey may have been influenced by a year effect. In 2013, a large single catch of fish on Burgeo Bank resulted in > 50% of the overall biomass being located in this particular area and causing a large spike in the survey indices for that year. This is unusual and is not consistent with survey catches in this area in either 2012 or 2014. In addition, in the 2013 RV survey, the estimated abundance of multiple cohorts increased compared to observations of these same cohorts at one age younger in 2012. For at least some cohorts, this change is largely influenced by the single large survey catch described above. The number of fish in a cohort cannot increase as it ages (without immigration) and when analyses suggest that such an increase has occurred it is considered evidence for a year effect. In the 2013 survey, the 2011 year class (age 2 fish) was estimated to be by far the strongest in the times series. Subsequently, the current estimated strength for this year class has been downgraded but still appears relatively strong.

The percentage of the catch from the < 35 ft sector that is recorded within the logbook database has declined over time and now represents only about 35% of the catch as compared to approximately 70% at the start of the time series in 1997. This likely affects the quality and comparability of the standardized catch rate index derived from these data over the time series.

Age at 50% maturity has been declining in recent years. The proportion of female cod maturing at younger ages has increased for all cohorts subsequent to the 1986 cohort, resulting in an increased proportion of young fish

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REFERENCES

Bishop, C.A., Murphy, E.F., and Davis, M.B. 1994. An assessment of the cod stock in NAFO Subdivision 3Ps. DFO Atl. Fish. Res. Doc. 1994/033, 33p.

Bolon, A.D., and Schneider, D.C. 1999. Temporal trends in condition, gonado somatic index and maturity stages of Atlantic cod (*Gadus morhua*) from northern Placentia Bay (Subdivision 3Ps), Newfoundland, during 1998. DFO Can. Sci. Advis. Sec. Res. Doc. 99/45.

Bradbury, I.R., Lawson, G. L., Robichaud, D., Rose, G.A., and Snelgrove, P.V.R. 2000. Success and failure of Atlantic cod, *Gadus morhua*: a case study from coastal Newfoundland. DFO Can. Sci. Advis. Sec. Res. Doc. 2000/022.

Brattey, J., and Cadigan, N.G. 2004. Estimation of short term tagging mortality of adult Atlantic cod (*Gadus morhua*). Fish. Res. 66: 223-233.

Brattey, J. and Healey, B.P. 2003. Updated estimates of exploitation from tagging of Atlantic cod (*Gadus morhua*) in NAFO Subdiv. 3Ps during 1997 2003. DFO Can. Sci. Advis. Sec. Res. Doc. 2003/091.

Brattey, J. and Healey, B.P 2004. Exploitation of Atlantic cod (*Gadus morhua*) in NAFO Subdiv. 3Ps: further updates based on tag returns during 1997 2004. DFO Can. Sci. Advis. Sec. Res. Doc. 2004/084.

Brattey, J. and Healey, B.P 2005. Exploitation of Atlantic cod (*Gadus morhua*) in NAFO Subdiv. 3Ps: further updates based on 1997 2005 mark recapture data. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/071.

Brattey, J. and Healey, B.P 2006. Exploitation of Atlantic cod (*Gadus morhua)* in NAFO Subdiv. 3Ps: estimates from mark recapture experiments for the October 2006 assessment. DFO Can. Sci. Advis. Sec. Res. Doc. 2006/082.

Brattey, J., Cadigan, N.G., Healey, B.P., Lilly, G.R., Murphy, E.F., Shelton, P.A., Stansbury, D.E., Morgan, M.J., and Mahé, J. C. 2001. An assessment of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in October 2001. DFO Can. Sci. Advis. Sec. Res. Doc. 2001/099.

Brattey, J., Cadigan, N.G., Healey, B.P., Lilly, G.R., Murphy, E.F., Shelton, P.A., Stansbury, and and Mahé, J. C. An assessment of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in October 2002. DFO Can. Sci. Advis. Sec. Res. Doc. 2002/096.

Brattey, J., Cadigan, N.G., Healey, B.P., Lilly, G.R., Murphy, E.F., Stansbury, D.E., and Mahé, J. C. 2003. An assessment of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in October 2003. DFO Can. Sci. Advis. Sec. Res. Doc. 2003/092.

Brattey, J., Cadigan, N.G., Healey, B.P., Lilly, G.R., Murphy, E.F., Shelton, P.A., and Mahé, J.C. 2004. An assessment of the Atlantic cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in October 2004. DFO Can. Sci. Advis. Sec. Res. Doc. 2004/083.

Brattey, J., Cadigan, N.G., Healey, B.P., Lilly, G.R., Murphy, E.F., Shelton, P.A., and Mahé, J. C 2005. Assessment of the cod (*Gadus morhua*) stock in NAFO Subdiv. 3Ps in October 2005. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/070.

Brattey, J., Cadigan, N.G., Healey, B.P., Murphy, E.F., and Mahé, J. C. 2007. Assessment of the cod (*Gadus morhua*) stock in NAFO Subdiv. 3Ps in October 2006. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/053.

Brattey, J., Cadigan, N.G., Healey, B.P., Murphy, E.F., Morgan, M.J., Maddock Parsons, D., Power, D., Dwyer, K., and Mahé, J. C. 2008. Assessment of the cod (*Gadus morhua*) stock in NAFO Subdiv. 3Ps (November 2007). DFO Can. Sci. Advis. Sec. Res. Doc. 2008/029.

Cadigan, N.G. 2010. Trends in Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps Cod (*Gadus morhua*) stock size based on a separable total mortality model and the Fisheries and Oceans Canada Research Vessel survey index. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/015.

Cadigan, N.G., and Brattey, J. 2003. Semi parametric estimation of tag loss and reporting rates for tag recovery experiments using exact time at liberty data. Biometrics. 59: 869-876.

Cadigan, N.G., and Brattey, J. 2006. Reporting and shedding rate estimates from tag recovery experiments in Atlantic cod (*Gadus morhua*) in coastal Newfoundland. Can. J. Fish. Aquat. Sci. 63: 1944-1958.

Cadigan, N.G., and Brattey, J. 2008. Reporting rates from cod tagging studies in NAFO Divisions 2J3KL and Subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2008/031.

Cadigan, N.G., Walsh, S.J., and Brodie, W. 2006. Relative efficiency of the Wilfred Templeman and Alfred Needler research vessels using a Campelen 1800 shrimp trawl in NAFO Subdivision 3Ps and Divisions 3LN. DFO Can. Sci. Advis. Sec. Res. Doc. 2006/085.

Colbourne, E.B., Craig, J., Fitzpatrick, C., Senciall, D., Stead, P., and Bailey. W. 2011. An assessment of the physical oceanographic environment on the Newfoundland and Labrador Shelf in NAFO Subareas 2 and 3 during 2010. NAFO SCR Doc. 11/016, Ser. No. N5898.

Cook, R.M. 1997. Stock trends in six North Sea stocks as revealed by an analysis of research vessel surveys. ICES J. Mar. Sci. 54: 924–933.

DFO. 2004. Subdivision 3Ps Cod. DFO Can. Sci. Advis. Sec. Stock Status Report. 2004/039.

DFO. 2006. Stock Assessment of Subdivision 3Ps cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/043.

DFO. 2007. Proceedings of the Newfoundland and Labrador Regional Advisory Process for 3Ps Cod; October 16-20, 2006. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2007/016.

DFO. 2010. Stock Assessment of Subdivision 3Ps cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/067.

DFO. 2011. Stock Assessment of Subdivision 3Ps cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/079.

DFO. 2012. Proceedings of the Newfoundland and Labrador Regional Advisory Process for 3Ps cod in October 2011. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2012/029.

DFO. 2013. Stock Assessment of NAFO Subdivision 3Ps Cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/078.

DFO. 2015. Stock Assessment of NAFO subdivision 3Ps cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/001.

Gavaris, S., and Gavaris, C.A. 1983. Estimation of catch at age and its variance for groundfish stocks in the Newfoundland Region. *In:* Sampling commercial catches of marine fish and invertebrates. Edited by W. G. Doubleday and D. Rivard. Can. Spec. Publ. Fish. Aquat. Sci. 66: pp. 178-182.

Healey, B.P., Murphy, E.F., Brattey, J., Morgan, M.J., Maddock Parsons, D., and J. Vigneau. 2014. Assessing the status of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in 2012. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/087. v + 84 p.

Healey B.P., Murphy, E.F., Brattey, J., Cadigan, N.G., Morgan, M.J., Maddock Parsons, D., and Mahé, J.-C. 2013. Assessing the status of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in 2011. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/158. iv + 81 p.

Healey B.P., Murphy, E.F., Brattey, J., Cadigan, N.G., Morgan, M.J., Maddock Parsons, D., Power, D., Rideout, R., Colbourne, E., and Mahé, J.-C. 2011a. Assessing the status of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in 2010. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/076. vi + 86 p.

Healey, B.P., Murphy, E.F., Brattey, J., Cadigan, N.G., Morgan, M.J., Maddock Parsons, D., Power, D., Dwyer, K., and Mahé, J-C. 2011b. Assessing the status of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in 2009 – results from a Zonal Assessment Process (February/March 2009) and a Regional Assessment Process (September/October 2009). DFO Can. Sci. Advis. Sec. Res. Doc. 2010/102. viii + 91 p.

Lawson, G.L., and Rose, G.A. 1999. Changes in the timing and location of cod spawning in Placentia Bay (NAFO sub-division 3Ps), 1997-1998. DFO Can. Sci. Advis. Sec. Res. Doc. 99/43.

Lilly, G.R. 1998. Size-at-age and condition of cod in 3Ps as determined from research bottom-trawl surveys (1972-1997). DFO Can. Stock Assess. Sec. Res. Doc. 98/94. 29p.

Parsons, D.M. 2013. Sentinel surveys 1995-2011: Catch per Unit Effort in NAFO Subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/012. iii + 18p.

McCullagh, P., and Nelder, J.A. 1989. Generalized linear models. London, Chapman and Hall. 261 p.

Morgan, M.J., and Hoenig, J.M. 1997. Estimating age at maturity from length stratified sampling. J. Northw. Fish. Sci. 21: 51-63.

Northeast Fisheries Science Center. 2008. Assessment of 19 Northeast Groundfish Stocks through 2007: Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Northeast Fisheries Science Center, Woods Hole, Massachusetts, August 4-8, 2008. US Dep Commer, NOAA Fisheries, Northeast Fish Sci Cent Ref Doc. 08-15; 884 p + xvii.

Shelton, P.A., Stansbury, D.E., Murphy, E.F., Brattey, J., and Lilly, G. 1996. An Assessment of the cod stock in NAFO subdivision 3Ps. DFO Atl. Fish. Res. Doc. 1996/091.

Smith, S.J., and Somerton, G.D. 1981. STRAP: a user-oriented computer analysis system for groundfish research trawl survey data. Can. Tech. Rep. Fish. Aquat. Sci. 1030.

Stansbury, D.E. 1996. Conversion factors from comparative fishing trials for Engels 145 otter trawl on the FRV Gadus Atlantica and the Campelen 1800 shrimp trawl on the FRV Teleost. NAFO SCR Doc. 96/77, Ser. No. N2752. 15 p.

Stansbury, D.E. 1997. Conversion factors for cod from comparative fishing trials for Engel 145 otter trawl and the Campelen 1800 shrimp trawl used on research vessels. NAFO SCR Doc. 97/73, Ser. No. N2907. 10 p.

Warren, W.G. 1996. Report on the Comparative Fishing Trial between the Gadus Atlantica and Teleost. NAFO SCR Doc. 96/28, Ser. No. N2701.

Warren, W., Brodie, W., Stansbury, D., Walsh, S., Morgan, J. and Orr, D. 1997. Analysis of the 1996 Comparative Fishing Trial between the Alfred Needler with the Engel 145' Trawl and the Wilfred Templeman with the Campelen 1800 Trawl. NAFO SCR Doc. 97/68, Ser. No. N2902.

TABLES

Table 1. Reported landings of cod (t) from NAFO Subdiv. 3Ps by country and for fixed and mobile gear sectors. Landings are presented by calendar year but note that since 2000 the TAC has been established for April 1-March 31. Catch estimates for 2014 are incomplete since the fishing year was in progress at the time of the assessment. See Healey et al. (2014) for pre-1980 data.

Year	Canada NL (Mobile)	Canada NL (Fixed)[2]	Canada Mainland (All gears)	France SPM (Inshore)	France SPM (Offshore)	France Metro (All gears)	Others (All gears)	Total	TAC
1980	2,809	29,427	715	214	1,722	2,681	-	37,568	28,000
1981	2,696	26,068	2,321	333	3,768	3,706	-	38,892	30,000
1982	2,639	21,351	2,948	1,009	3,771	2,184	-	33,902	33,000
1983	2,100	23,915	2,580	843	4,775	4,238	-	38,451	33,000
1984	895	22,865	1,969	777	6,773	3,671	-	36,950	33,000
1985	4,529	24,854	3,476	642	9,422	8,444	-	51,367	41,000
1986	5,218	24,821	1,963	389	13,653	11,939	7	57,990	41,000
1987	4,133	26,735	2,517	551	15,303	9,965	-	59,204	41,000
1988	3,662	19,742	2,308	282	10,011	7,373	4	43,382	41,000
1989	3,098	23,208	2,361	339	9,642	892	-	39,540	35,400
1990	3,266	20,128	3,082	158	14,771	-	-	41,405	35,400
1991	3,916	21,778	2,106	204	15,585	-	-	43,589	35,400
1992	4,468	19,025	2,238	2	10,162	-	-	35,895	35,400
1993	1,987	11,878	1,351	-	-	-	-	15,216	20,000
1994	82	493	86	-	-	-	-	661	0
1995	26	676	60	59	-	-	-	821	0
1996	60	836	118	43	-	-	-	1,057	0
1997	108	7,594	79	448	1,191	-	-	9,420	10,000
1998	2,543	13,609	885	609	2,511	-	-	20,156	20,000
1999	3,059	21,156	614	621	2,548	-	-	27,997	30,000
2000	3,436	16,247	740	870	3,807	-	-	25,100	20,000
2001	2,152	11,187	856	675	1,675	-	-	16,546	15,000
2002	1,326	11,292	499	579	1,623	-	-	15,319	15,000
2003	1,869	10,600	412	734	1,645	-	-	15,260	15,000
2004	1,595	9,450	790	465	2,113	-	-	14,414	15,000
2005	1,863	9,537	818	617	1,941	-	-	14,776	15,000
2006	1,011	9,590	675	555	1,326	-	-	13,157	13,000
2007	1,339	9,303	294	520	1,503	-	-	12,959	13,000
2008	982	8,654	377	467	1,293	-	-	11,773	13,000
2009	1,733	5,870	193	282	1,684	-	-	9,762	11,500
2010	1,419	5,244	196	76	1,364	-	-	8,299	11,500
2011	1,392	4,046	300	456	682	-	-	6,876	11,500
2012	658	3,596	277	265	291	-	-	5,087	11,500
2013[1]	378	2,680	174	366	768	-	-	4,366	11,500
2014[1]	84	2,818	458	75	759	-	-	4,194	13,225

[1]Provisional catches

[2]1996-2006 includes recreational and sentinel catch. 2007-14 does not include recreational catch

Table 2. Reported fixed gear catches of cod (t) from NAFO Subdiv. 3Ps by gear type (includes non-Canadian and recreational catch). See Healey et al. (2014) for pre-1980 data.

Year	Gillnet	Longline	Handline	Trap	Total
1980	5,493	19,331	2,545	2,077	29,446
1981	4,998	20,540	1,142	948	27,628
1982	6,283	13,574	1,597	1,929	23,383
1983	6,144	12,722	2,540	3,643	25,049
1984	7,275	9,580	2,943	3,271	23,069
1985	7,086	10,596	1,832	5,674	25,188
1986	8,668	11,014	1,634	4,073	25,389
1987	9,304	11,807	1,628	4,931	27,670
1988	6,433	10,175	1,469	2,449	20,526
1989	5,997	10,758	1,657	5,996	24,408
1990	6,948	8,792	2,217	3,788	21,745
1991	6,791	10,304	1,832	4,068	22,995
1992	5,314	10,315	1,330	3,397	20,356
1993	3,975	3,783	1,204	3,557	12,519
1994	90	0	381	0	471
1995	383	182	0	5	570
1996	467	158	137	10	772
1997	3,760	1,158	1,172	1,167	7,258
1998	10,116	2,914	308	92	13,430
1999	17,976	3,714	503	45	22,237
2000	14,218	3,100	186	56	17,561
2001	7,377	2,833	2,089	57	12,357
2002	7,827	2,309	775	119	11,030
2003	8,313	2,044	546	35	10,937
2004	7,910	2,167	415	15	10,508
2005	8,112	2,016	626	6	10,760
2006	7,590	2,698	314	2	10,603
2007[2]	7,287	2,374	445	11	10,116
2008[2]	6,636	2,482	341	21	9,480
2009[2]	4,052	1,644	612	36	6,344
2010[2]	4,013	1,182	296	2	5,493
2011[2]	2,910	882	221	19	4,032
2012[1,2]	3,089	670	192	10	3,961
2013[1,2]	1,700	304	221	3	2,228
2014[1,2,3]	1,724	854	279	35	2,892

[1]provisional

[2]excluding recreational catch

[3]As of September 30, 2014

Table 3. Reported monthly landings (t) of cod per unit area in NAFO Subdiv. 3Ps.

Year	Month	Inshore 3Psa	Inshore 3Psb	Inshore 3Psc	Offshore 3Psd	Offshore 3Pse	Offshore 3Psf	Offshore 3Psg	Offshore 3Psh	Total
2012	Jan	9.0	101.0	26.5	0.0	5.0	3.4	0.0	148.8	293.7
2012	Feb	1.8	39.2	105.3	0.0	0.0	2.0	2.5	300.6	451.4
2012	Mar	0.2	0.0	0.0	2.3	0.0	0.0	0.1	38.5	41.1
2012	Apr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2012	May	12.9	22.0	73.0	0.0	0.4	0.0	0.0	0.0	108.3
2012	Jun	54.9	161.3	582.3	0.0	0.0	0.0	0.0	2.4	800.9
2012	Jul	36.5	130.4	363.3	3.8	0.0	17.1	1.9	5.6	558.6
2012	Aug	18.9	32.0	51.0	0.2	0.0	7.4	0.0	0.5	110.0
2012	Sep	24.5	58.0	108.7	2.1	11.4	140.5	0.2	0.1	345.5
2012	Oct	39.2	41.6	69.2	0.0	43.2	107.9	9.4	0.8	311.3
2012	Nov	68.9	82.2	194.6	11.1	1.9	490.8	37.9	12.5	899.9
2012	Dec	43.0	39.5	99.2	0.0	0.0	96.8	0.0	53.0	331.5
2012	Total	309.8	707.2	1673.1	19.5	61.9	865.9	52.0	562.8	4252.2
2013	Jan	13.0	46.6	38.5	0.0	0.0	0.0	0.0	77.1	175.2
2013	Feb	19.9	56.4	44.8	0.0	0.0	0.0	0.0	71.9	193.0
2013	Mar	0.2	0.0	0.0	0.0	0.0	0.0	7.1	36.4	43.7
2013	Apr	0.0	0.0	0.0	0.0	0.0	0.0	1.3	16.8	18.1
2013	May	21.1	17.3	42.4	0.0	0.1	0.6	3.6	25.9	111.0
2013	Jun	45.1	51.4	492.2	0.0	0.5	0.0	1.9	0.0	591.1
2013	Jul	45.1	68.9	447.1	3.0	0.1	1.0	11.1	7.0	583.3
2013	Aug	1.8	26.3	77.0	0.0	0.0	0.6	1.2	0.0	106.9
2013	Sep	16.5	21.0	66.5	0.0	0.6	38.1	0.0	0.0	142.7
2013	Oct	24.5	36.8	141.5	0.0	0.0	127.0	0.0	14.1	343.9
2013	Nov	68.9	35.9	255.9	11.4	0.0	239.2	5.3	13.2	629.8
2013	Dec	16.2	9.9	77.9	0.0	0.0	29.0	0.0	0.0	133.0
2013	Total	272.3	370.5	1683.8	14.4	1.3	435.5	31.5	262.4	3071.7
2014	Jan	7.4	60.3	46.9	7.7	0.0	0.1	5.8	62.3	190.5
2014	Feb	8.8	35.0	58.1	6.1	0.2	0.0	70.5	38.2	216.9
2014	Mar	5.5	2.0	15.8	0.0	0.0	0.0	108.9	67.7	199.9
2014	Apr	0.1	21.5	0.0	0.0	0.0	0.0	0.0	21.9	43.5
2014	May	35.5	32.8	77.8	0.3	0.0	21.9	5.4	78.8	252.5
2014	Jun	46.5	75.3	600.0	15.6	7.9	69.1	11.7	51.4	877.5
2014	Jul	18.5	67.8	403.7	10.1	4.4	9.3	4.7	12.0	530.5
2014	Aug	5.6	18.0	183.9	0.0	4.9	17.0	0.5	1.6	231.5
2014	Sep	1.7	37.2	158.6	6.3	37.7	89.3	14.6	0.1	345.5
2014	Oct	-	-	-	-	-	-	-	-	0.0
2014	Nov	-	-	-	-	-	-	-	-	0.0
2014	Dec	-	-	-	-	-	-	-	-	0.0
2014	Total	129.6	349.9	1544.8	46.1	55.1	206.7	222.1	334.0	2888.3

*French catch (2012 = 557 t, 2013 = 1134 t, 2014 = 834 t) excluded since unit area not available.

Table 4a. Number of cod measured for length from the Canadian commercial catch.

Year	Month	Offshore Otter trawl	Offshore Gillnet	Offshore Linetrawl	Inshore Gillnet	Inshore Linetrawl	Inshore Handline	Inshore Other	Total
2011	Jan	2,209	-	-	709	1,044	135	-	4,097
2011	Feb	2,005	-	44	100	-	-	-	2,149
2011	Mar	1,413	-	36	-	230	-	-	1,679
2011	Apr	-	-	-	-	-	-	-	0
2011	May	-	-	-	868	-	-	-	868
2011	Jun	-	-	-	1,447	566	-	379	2,392
2011	Jul	9	-	-	1,056	2,651	151	-	3,867
2011	Aug	-	-	-	594	2,766	-	-	3,360
2011	Sep	-	1,439	-	257	4,526	-	-	6,222
2011	Oct	-	2,635	-	153	667	-	-	3,455
2011	Nov	503	532	-	783	5,069	12	-	6,899
2011	Dec	467	-	-	502	958	-	-	1,927
2011	Total	6,606	4,606	80	6,469	18,477	298	379	36,915
2012	Jan	764	-	-	1,037	2,897	-	-	4,698
2012	Feb	1,355	-	-	64	671	-	-	2,090
2012	Mar	-	-	-	-	177	-	-	177
2012	Apr	-	-	-	208	-	-	-	208
2012	May	-	-	-	208	-	-	-	208
2012	Jun	-	-	-	2,524	434	95	28	3,081
2012	Jul	-	-	-	6,622	1,102	46	50	7,820
2012	Aug	-	-	-	461	1,580	49	-	2,090
2012	Sep	-	253	-	93	1,417	-	-	1,763
2012	Oct	-	636	-	241	2,313	76	-	3,266
2012	Nov	-	216	-	752	2,449	-	-	3,417
2012	Dec	-	-	-	212	2,167	109	-	2,488
2012	Total	2,119	1,105	-	12,214	15,207	375	78	31,098
2013	Jan	578	-	-	788	2,817	594	-	4,777
2013	Feb	1,446	-	-	1,049	2,626	111	-	5,232
2013	Mar	-	-	-	-	169	-	-	169
2013	Apr	-	-	-	-	-	-	-	0
2013	May	-	-	-	669	-	-	-	669
2013	Jun	-	-	-	1,923	229	246	-	2,398
2013	Jul	-	-	-	1,372	607	-	-	1,979
2013	Aug	-	-	-	349	1,276	-	-	1,625
2013	Sep	-	-	-	322	791	-	-	1,113
2013	Oct	-	-	-	186	1,758	-	-	1,944
2013	Nov	440	-	-	2,323	1,670	-	-	4,433
2013	Dec	658	-	-	454	2,059	-	-	3,171
2013	Total	3,122	-	-	9,435	14,002	951	-	27,510

Table 4b. Number of cod aged from the Canadian commercial catch.

Year	Quarter	Offshore Otter trawl	Offshore Gillnet	Offshore Linetrawl	Inshore Gillnet	Inshore Linetrawl	Inshore Handline	Inshore Other	Total
2011	1	1,346	-	-	46	36	48	-	1,476
2011	2	-	-	-	465	-	-	-	465
2011	3	-	522	-	1,246	668	86	-	2,522
2011	4	-	-	-	61	477	-	-	538
2011	total	1,346	522	-	1,818	1,181	134	-	5,001
2012	1	508	-	-	180	238	-	-	926
2012	2	-	-	-	42	-	-	-	42
2012	3	-	79	-	673	441	72	-	1,265
2012	4	-	223	-	36	771	-	-	1,030
2012	total	508	302	-	931	1,450	72	-	3,263
2013	1	282	-	-	251	362	117	-	1,012
2013	2	259	-	-	152	-	-	-	411
2013	3	-	-	-	374	201	63	-	638
2013	4	225	-	-	286	749	-	-	1,260
2013	total	766	-	-	1,063	1,312	180	-	3,321

Table 4c. Number of cod sampled for length and age from French commercial catch.

Year	Quarter	Measured Otter trawl	Measured Gillnet	Aged Otter trawl
2011	1	2,119	-	142
2011	3	-	353	-
2011	4	1,645	-	-
2011	Total	3,764	353	142
2012	1	3,502	-	496
2012	3	-	-	-
2012	4	408	-	259
2012	Total	3,910	-	755
2013	1	1,235	-	261
2013	3	-	-	-
2013	4	244	-	269
2013	Total	1,479	-	530

Table 5. Estimates of average weight, average length and the total numbers (000s) and weight of 3Ps cod caught at age from Canadian and french landings during 2011-13 (Excludes recreational catch).

Year	Age	Average Weight (kg)	Average Length (cm)	Total Catch (000's)	Total Catch std error	Total Catch CV	Total Catch Weight (t)*
2011	1	0.23	30.01	15	0.01	0.51	0
2011	2	0.58	40.43	873	0.27	0.31	1
2011	3	1.07	48.47	30916	3.24	0.10	33
2011	4	1.06	48.84	137795	10.66	0.08	146
2011	5	1.37	53.00	883823	21.23	0.02	1211
2011	6	1.63	55.97	835934	22.74	0.03	1363
2011	7	2.18	61.48	884976	22.21	0.03	1929
2011	8	2.44	63.51	363077	13.88	0.04	886
2011	9	2.77	65.46	178109	10.29	0.06	493
2011	10	2.64	64.64	68452	6.75	0.10	181
2011	11	2.71	65.80	33059	4.88	0.15	90
2011	12	2.80	65.98	23987	3.70	0.15	67
2011	13	4.12	74.22	10948	2.63	0.24	45
2011	14	7.56	93.32	5357	0.55	0.10	41
2011	15	4.12	76.77	9109	4.16	0.46	38
2011	16	6.90	91.00	382	0.11	0.29	3
2012	1	0.06	19.00	1	0.00	0.02	0
2012	2	0.18	27.59	24	0.01	0.21	0
2012	3	0.80	44.28	8016	0.90	0.11	6
2012	4	0.95	47.05	66925	5.07	0.08	64
2012	5	1.42	53.24	188640	11.45	0.06	268
2012	6	1.98	59.27	700578	26.92	0.04	1387
2012	7	2.03	60.08	634317	28.00	0.04	1288
2012	8	2.21	61.29	403926	23.76	0.06	893
2012	9	2.78	65.77	149075	13.92	0.09	414
2012	10	3.31	69.41	63968	5.79	0.09	212
2012	11	3.55	70.64	22883	3.48	0.15	81
2012	12	2.68	65.14	30931	5.36	0.17	83
2012	13	2.73	66.28	5139	1.17	0.23	14
2012	14	2.76	66.07	10016	1.83	0.18	28
2012	15	6.04	86.47	2530	0.60	0.24	15
2012	16	4.95	80.28	552	0.37	0.67	3
2012	17	8.40	97.00	9	0.01	1.31	0
2013	1	-	-	0	-	-	0
2013	2	0.21	29.17	34	0.01	0.18	0
2013	3	0.63	41.63	6394	1.35	0.21	4
2013	4	1.19	50.47	154746	11.66	0.08	184
2013	5	1.57	55.49	433327	20.74	0.05	680
2013	6	1.86	58.54	333067	19.54	0.06	620
2013	7	2.14	61.17	490171	22.34	0.05	1050
2013	8	2.05	60.19	362281	19.06	0.05	743
2013	9	2.59	64.26	140559	11.63	0.08	364
2013	10	2.86	67.20	47994	6.69	0.14	137
2013	11	3.05	67.97	21659	5.57	0.26	66
2013	12	3.03	68.45	20030	4.71	0.24	61
2013	13	2.46	64.13	4996	1.80	0.36	12
2013	14	2.42	64.47	9237	3.42	0.37	22
2013	15	2.01	61.00	2061	1.37	0.67	4
2013	16	-	-	0	-	-	0

Table 5. Continued.

Year	Age	Average Weight (kg)	Average Length (cm)	Total Catch (000's)	Total Catch std error	Total Catch CV	Total Catch Weight (t)*
2013	17	-	-	0	-	-	0
2013	18	3.96	76.00	164	0.14	0.84	1

2011 * Total catch estimate (t) 6527, Total landings (t) 6863, SOP 0.95

2012 * Total catch estimate (t) 4756, Total landings (t) 5007, SOP 0.95

2013 * Total catch estimate (t) 3948, Total landings (t) 4116, SOP 0.96

Table 6. Numbers-at-age (000s) for the commercial cod fishery in NAFO Subdiv. 3Ps from 1959 to 2013 (ages 3-14 shown). Recreational catches excluded for 2007 onward (see text).

Year	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1959	1001	13940	7525	7265	4875	942	1252	1260	631	545	44	1
1960	567	5496	23704	6714	3476	3484	1020	827	406	407	283	27
1961	450	5586	10357	15960	3616	4680	1849	1376	446	265	560	58
1962	1245	6749	9003	4533	5715	1367	791	571	187	140	135	241
1963	961	4499	7091	5275	2527	3030	898	292	143	99	107	92
1964	1906	5785	5635	5179	2945	1881	1891	652	339	329	54	27
1965	2314	9636	5799	3609	3254	2055	1218	1033	327	68	122	36
1966	949	13662	13065	4621	5119	1586	1833	1039	517	389	32	22
1967	2871	10913	12900	6392	2349	1364	604	316	380	95	149	3
1968	1143	12602	13135	5853	3572	1308	549	425	222	111	5	107
1969	774	7098	11585	7178	4554	1757	792	717	61	120	67	110
1970	756	8114	12916	9763	6374	2456	730	214	178	77	121	14
1971	2884	6444	8574	7266	8218	3131	1275	541	85	125	62	57
1972	731	4944	4591	3552	4603	2636	833	463	205	117	48	45
1973	945	4707	11386	4010	4022	2201	2019	515	172	110	14	29
1974	1887	6042	9987	6365	2540	1857	1149	538	249	80	32	17
1975	1840	7329	5397	4541	5867	723	1196	105	174	52	6	2
1976	4110	12139	7923	2875	1305	495	140	53	17	21	4	3
1977	935	9156	8326	3209	920	395	265	117	57	43	31	11
1978	502	5146	6096	4006	1753	653	235	178	72	27	17	10
1979	135	3072	10321	5066	2353	721	233	84	53	24	13	10
1980	368	1625	5054	8156	3379	1254	327	114	56	45	21	25
1981	1022	2888	3136	4652	5855	1622	539	175	67	35	18	2
1982	130	5092	4430	2348	2861	2939	640	243	83	30	11	7
1983	760	2682	9174	4080	1752	1150	1041	244	91	37	18	8
1984	203	4521	4538	7018	2221	584	542	338	134	35	8	8
1985	152	2639	8031	5144	5242	1480	626	545	353	109	21	6
1986	306	5103	10253	11228	4283	2167	650	224	171	143	79	23
1987	585	2956	11023	9763	5453	1416	1107	341	149	78	135	50
1988	935	4951	4971	6471	5046	1793	630	284	123	75	53	31
1989	1071	8995	7842	2863	2549	1112	600	223	141	57	29	26
1990	2006	8622	8195	3329	1483	1237	692	350	142	104	47	22
1991	812	7981	10028	5907	2164	807	620	428	108	76	50	22
1992	1422	4159	8424	6538	2266	658	269	192	187	83	34	41
1993	278	3712	2035	3156	1334	401	89	38	52	13	14	5
1994	9	78	173	74	62	28	12	3	2	0	0	0
1995	3	7	56	119	57	37	7	2	0	0	0	0
1996	9	43	43	101	125	35	24	8	2	1	0	0
1997	66	427	1130	497	937	826	187	93	31	4	1	0
1998	91	373	793	1550	948	1314	1217	225	120	56	15	1
1999	49	628	1202	2156	2321	1020	960	873	189	110	21	8
2000	76	335	736	1352	1692	1484	610	530	624	92	37	16
2001	80	475	718	1099	1143	796	674	257	202	192	28	13
2002	155	607	1451	1280	900	722	419	355	96	70	71	14
2003	15	301	879	1810	1139	596	337	277	167	67	55	84
2004	62	113	654	1592	1713	649	266	180	104	47	17	24
2005	49	330	515	1007	1628	1087	499	143	95	41	26	12
2006	43	253	866	928	846	1055	632	237	80	36	19	7
2007	97	311	727	1072	761	501	526	401	160	44	34	21
2008	35	422	617	1105	976	634	350	295	193	91	27	12
2009	17	129	813	1000	902	460	205	99	114	86	56	12
2010	31	377	549	1240	726	385	181	76	22	57	30	8
2011	31	138	884	836	885	363	178	68	33	24	11	5
2012	8	67	189	701	634	404	149	64	23	31	5	10
2013	6	155	433	333	490	362	141	48	22	20	5	9

Table 7a. Mean annual weights-at-age (kg) calculated from lengths-at-age based on samples from commercial fisheries (including food fisheries and sentinel surveys where available) in Subdiv. 3Ps in 1959-2010. The weights-at-age from 1976 are extrapolated back to 1959.

Year	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1959	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1960	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1961	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1962	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1963	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1964	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1965	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1966	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1967	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1968	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1969	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1970	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1971	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1972	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1973	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1974	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1975	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1976	0.280	0.690	1.080	1.680	2.400	3.210	4.100	5.080	6.030	7.000	8.050	9.160
1977	0.550	0.680	1.300	1.860	2.670	3.420	4.190	4.940	5.920	6.760	8.780	10.900
1978	0.450	0.700	1.080	1.750	2.450	2.990	4.100	5.160	5.170	7.200	7.750	8.720
1979	0.410	0.650	1.010	1.650	2.550	3.680	4.300	6.490	7.000	8.200	9.530	10.840
1980	0.520	0.720	1.130	1.660	2.480	3.600	5.400	6.950	7.290	8.640	9.330	9.580
1981	0.480	0.790	1.320	1.800	2.300	3.270	4.360	5.680	7.410	9.040	8.390	9.560
1982	0.450	0.770	1.170	1.780	2.360	2.880	3.910	5.280	6.180	8.620	8.640	11.410
1983	0.580	0.840	1.330	1.990	2.580	3.260	3.770	5.040	6.560	8.450	10.060	11.820
1984	0.660	1.040	1.400	1.970	2.640	3.770	4.750	5.560	6.010	9.040	11.200	10.400
1985	0.630	0.850	1.230	1.790	2.810	3.440	5.020	6.010	6.110	7.180	9.810	10.480
1986	0.540	0.750	1.180	1.840	2.430	3.150	4.300	5.500	6.190	8.720	8.050	11.910
1987	0.560	0.770	1.210	1.630	2.310	3.020	4.330	5.110	6.200	6.980	7.080	8.340
1988	0.630	0.820	1.090	1.670	2.170	2.920	3.580	4.980	5.610	6.600	7.460	8.920
1989	0.630	0.810	1.160	1.630	2.250	3.370	4.110	5.180	6.290	7.300	7.750	8.730
1990	0.580	0.860	1.270	1.850	2.450	3.000	4.220	5.090	6.350	7.600	8.310	10.370
1991	0.600	0.750	1.170	1.740	2.370	2.910	3.690	4.230	6.340	7.680	8.640	9.720
1992	0.459	0.694	1.038	1.560	2.226	2.891	4.142	5.542	6.420	7.822	10.397	11.880
1993	0.355	0.680	1.077	1.480	2.127	2.824	4.341	4.302	4.683	7.494	6.845	8.238
1994	0.617	0.816	1.303	1.860	2.054	2.746	3.593	4.377	6.291	7.768	6.784	8.073
1995	0.520	0.850	1.570	2.030	2.470	2.780	3.460	4.300	4.270	4.160	5.590	9.241
1996	0.674	0.985	1.485	2.048	2.525	2.941	3.232	4.031	4.823	4.680	7.257	9.921

Table 7a. Continued.

Year	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1997	0.617	0.898	1.304	1.871	2.510	3.242	3.471	3.524	4.587	6.365	8.579	10.733
1998	0.620	1.020	1.570	2.050	2.420	3.100	4.040	4.130	4.620	5.210	6.390	9.690
1999	0.700	0.920	1.570	2.310	2.530	2.820	3.920	5.320	4.990	5.270	6.140	7.270
2000	0.615	0.896	1.358	2.066	2.741	2.813	3.152	4.597	6.538	6.123	6.423	7.734
2001	0.689	1.018	1.440	1.935	2.575	3.405	3.206	3.456	5.593	8.607	7.609	8.115
2002	0.572	1.017	1.544	2.040	2.324	3.104	4.326	3.896	3.874	6.046	8.895	7.942
2003	0.681	0.974	1.574	2.111	2.342	2.634	3.867	4.750	4.297	5.330	7.819	10.346
2004	0.587	0.963	1.368	2.036	2.495	2.737	2.851	5.021	6.707	5.247	7.128	8.786
2005	0.637	0.943	1.386	1.840	2.458	2.904	3.161	3.246	4.361	6.153	5.525	7.854
2006	0.567	1.010	1.549	1.939	2.167	2.748	3.435	3.465	3.133	4.923	6.593	7.498
2007	0.556	0.938	1.444	1.962	2.235	2.533	3.732	4.957	5.512	4.861	7.079	8.806
2008	0.663	0.981	1.350	1.919	2.223	2.465	2.629	3.804	5.199	5.292	5.003	8.455
2009	0.626	1.019	1.533	1.932	2.375	2.482	2.614	3.671	5.815	7.070	7.973	8.997
2010	0.635	1.089	1.363	2.009	2.260	2.585	2.761	2.932	5.518	7.910	9.520	9.981
2011	1.072	1.064	1.370	1.633	2.176	2.438	2.769	2.638	2.706	2.798	4.116	7.560
2012	0.801	0.945	1.421	1.980	2.028	2.205	2.783	3.309	3.553	2.682	2.726	2.759
2013	0.629	1.188	1.571	1.862	2.140	2.051	2.592	2.862	3.047	3.030	2.464	2.417

Table 7b. Beginning of the year weights-at-age (kg) calculated from commercial annual mean weights-at-age. The values for 1976 are extrapolated back to 1959.

Year	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1959	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1960	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1961	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1962	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1963	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1964	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1965	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1966	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1967	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1968	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1969	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1970	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1971	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1972	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1973	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1974	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1975	0.000	0.178	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1976	0.000	0.180	0.440	0.863	1.347	2.008	2.776	3.628	4.564	5.535	6.497	7.507
1977	0.000	0.488	0.436	0.947	1.417	2.118	2.865	3.667	4.500	5.484	6.385	7.840
1978	0.000	0.374	0.620	0.857	1.508	2.135	2.825	3.745	4.650	5.054	6.529	7.238
1979	0.000	0.309	0.541	0.841	1.335	2.112	3.003	3.586	5.158	6.010	6.511	8.283
1980	0.000	0.422	0.543	0.857	1.295	2.023	3.030	4.458	5.467	6.878	7.777	8.747
1981	0.000	0.379	0.641	0.975	1.426	1.954	2.848	3.962	5.538	7.176	8.118	8.514
1982	0.000	0.329	0.608	0.961	1.533	2.061	2.574	3.576	4.798	5.925	7.992	8.838
1983	0.000	0.433	0.615	1.012	1.526	2.143	2.774	3.295	4.439	5.885	7.226	9.312
1984	0.000	0.582	0.777	1.084	1.619	2.292	3.119	3.935	4.578	5.504	7.701	9.728
1985	0.000	0.577	0.749	1.131	1.583	2.353	3.014	4.350	5.343	5.829	6.569	9.417
1986	0.000	0.452	0.687	1.001	1.504	2.086	2.975	3.846	5.255	6.099	7.299	7.603
1987	0.000	0.463	0.645	0.953	1.387	2.062	2.709	3.693	4.688	5.840	6.573	7.857
1988	0.000	0.556	0.678	0.916	1.422	1.881	2.597	3.288	4.644	5.354	6.397	7.216
1989	0.000	0.539	0.714	0.975	1.333	1.938	2.704	3.464	4.306	5.597	6.399	7.152
1990	0.000	0.510	0.736	1.014	1.465	1.998	2.598	3.771	4.574	5.735	6.914	7.789
1991	0.000	0.558	0.660	1.003	1.487	2.094	2.670	3.327	4.225	5.681	6.983	8.103
1992	0.000	0.377	0.645	0.882	1.351	1.968	2.618	3.472	4.522	5.211	7.042	8.936
1993	0.000	0.234	0.559	0.865	1.239	1.822	2.507	3.543	4.221	5.095	6.936	7.317
1994	0.000	0.525	0.538	0.941	1.415	1.744	2.417	3.185	4.359	5.202	6.032	7.130
1995	0.000	0.378	0.724	1.132	1.626	2.143	2.390	3.083	3.931	4.323	5.116	6.590
1996	0.000	0.584	0.716	1.123	1.793	2.264	2.695	2.998	3.734	4.554	4.470	5.494
1997	0.000	0.480	0.778	1.133	1.667	2.267	2.861	3.195	3.375	4.300	5.540	6.337

Table 7b. Continued.

Year	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1998	0.000	0.509	0.793	1.187	1.635	2.128	2.789	3.619	3.786	4.035	4.889	6.377
1999	0.000	0.619	0.755	1.265	1.904	2.277	2.612	3.486	4.636	4.540	4.934	5.656
2000	0.000	0.478	0.792	1.118	1.801	2.516	2.668	2.981	4.245	5.898	5.528	5.818
2001	0.000	0.567	0.792	1.136	1.621	2.307	3.055	3.003	3.300	5.071	7.502	6.826
2002	0.000	0.439	0.837	1.254	1.714	2.121	2.827	3.838	3.534	3.659	5.815	8.750
2003	0.000	0.573	0.746	1.265	1.806	2.186	2.474	3.465	4.533	4.092	4.544	6.876
2004	0.000	0.464	0.810	1.154	1.790	2.295	2.532	2.740	4.406	5.644	4.749	6.164
2005	0.000	0.506	0.744	1.155	1.586	2.237	2.692	2.941	3.042	4.679	6.424	5.384
2006	0.000	0.455	0.802	1.209	1.640	1.997	2.599	3.159	3.309	3.189	4.633	6.369
2007	0.000	0.419	0.729	1.207	1.744	2.082	2.343	3.203	4.126	4.370	3.902	5.903
2008	0.000	0.535	0.738	1.125	1.665	2.089	2.347	2.581	3.768	5.076	5.400	4.931
2009	0.000	0.474	0.822	1.226	1.615	2.135	2.349	2.538	3.107	4.703	6.063	6.495
2010	0.000	0.491	0.825	1.178	1.755	2.089	2.478	2.618	2.768	4.501	6.782	8.204
2011	0.000	1.142	0.822	1.222	1.492	2.091	2.347	2.675	2.698	2.817	3.929	5.706
2012	0.000	0.658	1.007	1.230	1.647	1.820	2.190	2.605	3.027	3.061	2.694	2.762
2013	0.000	0.717	0.976	1.218	1.627	2.059	2.039	2.390	2.822	3.175	3.281	2.571
2014	0.000	0.717	0.931	1.223	1.587	1.986	2.189	2.554	2.846	3.014	3.263	3.434

Table 8a. Standardized gillnet (5.5 in mesh) annual catch rate-at-age indices estimated using data from sentinel fishery fixed sites. Catch rates are expressed as fish per net.

Year	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Total
1995	0.02	0.07	3.83	8.32	5.05	2.36	0.35	0.14	20.15
1996	0.01	0.25	2.54	11.65	9.51	2.72	0.81	0.07	27.55
1997	0.01	0.20	4.92	4.93	8.80	7.12	1.05	0.57	27.59
1998	0.00	0.05	1.04	7.16	3.21	2.52	1.55	0.29	15.83
1999	0.05	0.06	0.40	0.77	1.20	0.56	0.24	0.23	3.52
2000	0.01	0.02	0.28	0.67	0.66	0.89	0.30	0.10	2.92
2001	0.01	0.10	0.38	0.83	0.65	0.38	0.35	0.16	2.87
2002	0.00	0.02	0.47	0.74	0.72	0.32	0.16	0.17	2.60
2003	0.01	0.05	0.21	0.92	0.44	0.16	0.09	0.04	1.91
2004	0.00	0.04	0.20	0.75	0.76	0.37	0.12	0.03	2.28
2005	0.00	0.02	0.12	0.54	0.61	0.35	0.26	0.05	1.96
2006	0.00	0.05	0.26	0.51	0.46	0.52	0.22	0.12	2.14
2007	0.00	0.05	0.38	0.97	0.68	0.35	0.25	0.17	2.83
2008	0.00	0.07	0.24	0.97	0.82	0.41	0.21	0.09	2.82
2009	0.01	0.02	0.23	0.58	1.04	0.20	0.16	0.04	2.29
2010	0.01	0.05	0.34	0.74	0.62	0.30	0.11	0.17	2.35
2011	0.01	0.01	0.10	0.31	0.55	0.22	0.16	0.02	1.37
2012	0.00	0.03	0.13	0.47	0.48	0.38	0.12	0.06	1.67
2013	0.13	0.06	0.49	1.11	0.46	0.50	0.28	0.03	3.05

Table 8b. Standardized line-trawl annual catch rate-at-age indices estimated using data from sentinel fishery fixed sites. Catch rates are expressed as fish per 1000 hooks.

Year	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Total
1995	6.91	14.05	49.69	71.66	18.96	17.27	3.62	1.37	183.53
1996	7.77	28.28	27.24	43.61	45.20	13.02	7.20	1.69	174.02
1997	5.34	22.69	24.74	16.04	16.33	20.24	2.80	1.62	109.80
1998	6.46	16.01	19.62	15.67	6.05	8.98	11.01	2.44	86.24
1999	4.98	16.69	23.19	13.33	7.54	4.75	4.41	1.85	76.74
2000	11.98	26.94	25.12	16.71	7.71	6.06	2.14	0.98	97.63
2001	17.15	30.41	22.49	13.33	7.28	4.16	2.24	0.69	97.75
2002	13.41	27.79	24.94	8.70	5.33	1.84	1.00	0.74	83.74
2003	2.47	33.77	38.90	19.95	7.97	3.44	1.16	0.87	108.53
2004	9.03	9.98	36.86	19.52	10.16	3.38	1.60	0.39	90.92
2005	6.31	19.65	13.29	13.48	11.49	4.35	1.87	0.82	71.25
2006	8.64	16.77	26.11	19.80	13.20	11.84	3.52	1.58	101.44
2007	10.59	18.83	16.48	13.82	8.34	4.99	4.41	1.81	79.27
2008	4.92	25.32	22.40	18.42	8.86	5.50	2.74	2.50	90.65
2009	5.10	13.36	27.18	15.53	6.28	3.69	1.58	1.29	74.00
2010	2.12	14.45	11.90	15.04	7.49	2.01	0.79	0.74	54.54
2011	7.59	10.58	17.22	17.03	10.93	3.94	1.76	0.66	69.71
2012	6.71	13.18	12.98	13.34	12.86	4.46	2.45	0.67	66.64
2013	2.13	11.84	12.45	8.07	5.64	5.55	1.52	0.74	47.92

Table 9. Annual number of logbook records from larger vessels (> 35') in NAFO Subdiv. 3Ps used in the analysis of catch and catch rates by gillnets, linetrawls and otter trawls during 1998 to 2013.

Year	Gillnet catch records	Linetrawl catch records	Ottertrawl catch records	Total catch records	Gillnet CPUE records	Linetrawl CPUE records	Ottertrawl CPUE records	Total CPUE records
1998	1149	209	551	1909	951	113	385	1449
1999	3346	313	524	4183	3113	144	443	3700
2000	2454	320	374	3148	2274	154	303	2731
2001	2203	501	260	2964	1986	280	163	2429
2002	1735	317	418	2470	1560	233	302	2095
2003	1672	261	360	2293	1460	114	248	1822
2004	1823	354	422	2599	1647	263	359	2269
2005	2034	296	247	2577	1812	170	181	2163
2006	1776	277	308	2361	1559	148	261	1968
2007	1994	422	325	2741	1818	274	241	2333
2008	1902	451	299	2652	1715	289	224	2228
2009	1355	339	358	2052	1199	186	320	1705
2010	993	238	384	1615	901	145	362	1408
2011	925	160	362	1447	802	78	340	1220
2012	569	120	274	963	440	45	246	731
2013	340	84	121	545	256	48	94	398

Table 10a. Annual number of cod tagged in NAFO Subdiv. 3Ps during 2007-13 by tag type (low or high reward) and by unit statistical unit area.

Release Year	Low Reward ($10)	High Reward ($100)	Total Tagged in 3Psa	Total Tagged in 3Psb	Total Tagged in 3Psc	Total Tagged in 3Ps
2007	3410	480	840	1019	2031	3890
2008	315	80	-	-	395	395
2009	2006	504	-	-	2510	2510
2010	817	205	-	-	1022	1022
2011	767	196	-	-	963	963
2012	1869	471	-	743	1597	2340
2013	3153	798	554	557	2840	3951

Table 10b. Annual number of cod tags returned from NAFO Subdiv. 3Ps during 2007-2013 by harvester type (commercial or recreational, unknowns excluded).

Recapture Year	Commercial Fishery	Recreational Fishery
2007	353 (93.9)	23 (6.1)
2008	289 (95.8)	13 (4.2)
2009	282 (925)	23 (7.5)
2010	268 (94.7)	15 (5.3)
2011	117 (88.6)	15 (11.4)
2012	180 (95.2)	9 (4.8)
2013	214 (91.1)	21 (8.9)

Table 10c. Harvest rates based on tagging for various size groups of cod tagged in three inshore areas of NAFO Subdiv. 3Ps.

Unit Area	Year	50-85 cm	>50 cm	>55 cm	>60 cm	>65 cm
3Psa (Hermitage Bay)	2009	16.8	15.9	17.4	18.9	19.5
3Psa (Hermitage Bay)	2010	-	-	-	-	-
3Psa (Hermitage Bay)	2011	-	-	-	-	-
3Psa (Hermitage Bay)	2012	-	-	-	-	-
3Psa (Hermitage Bay)	2013	-	-	-	-	-
3Psb (Fortune Bay)	2009	11.4	10.8	10.5	12.3	10.2
3Psb (Fortune Bay)	2010	-	-	-	-	-
3Psb (Fortune Bay)	2011	-	-	-	-	-
3Psb (Fortune Bay)	2012	-	-	-	-	-
3Psb (Fortune Bay)	2013	9.6	10.5	13.2	14.7	24.6
3Psc (Placentia Bay)	2009	12.0	12.3	13.5	17.1	15.9
3Psc (Placentia Bay)	2010	18.9	20.4	25.8	34.5	23.4
3Psc (Placentia Bay)	2011	10.2	10.5	14.1	19.5	9.0
3Psc (Placentia Bay)	2012	9.9	13.8	18.6	22.2	17.7
3Psc (Placentia Bay)	2013	11.4	12.9	13.2	15.0	15.9

Table 11. Details of annual DFO research vessel surveys of 3Ps.

Year	Vessel	Start Date	End Date	Days	Sets	Sets w/ Cod	% w/ cod
1983	AN 9	23-Apr-83	8-May-83	15	164	117	0.71
1984	AN 26	10-Apr-84	17-Apr-84	7	93	59	0.63
1985	WT 26	8-Mar-85	25-Mar-85	17	109	78	0.72
1986	WT 45	6-Mar-86	23-Mar-86	17	136	88	0.65
1987	WT 55-56	13-Feb-87	22-Mar-87	37	130	95	0.73
1988	WT 68	27-Jan-88	14-Feb-88	18	146	106	0.73
1989	WT 81	1-Feb-89	16-Feb-89	15	146	90	0.62
1990	WT 91	1-Feb-90	19-Feb-90	18	108	66	0.61
1991	WT 103	2-Feb-91	20-Feb-91	18	158	104	0.66
1992	WT 118	6-Feb-92	24-Feb-92	18	137	63	0.46
1993.1	WT 133	6-Feb-93	23-Feb-93	17	136	52	0.38
1993.4	WT 135	2-Apr-93	20-Apr-93	18	130	63	0.48
1994	WT 150-151	6-Apr-94	26-Apr-94	20	166	73	0.44
1995	WT 166-167	04-Apr-95	28-Apr-95	24	161	65	0.40
1996	WT 186-187	10-Apr-96	01-May-96	22	148	105	0.71
1997	WT 202-203	02-Apr-97	23-Apr-97	22	158	104	0.66
1998	WT 219-220	10-Apr-98	05-May-98	25	177	113	0.64
1999	WT 236-237	13-Apr-99	06-May-99	23	175	128	0.73
2000	WT 313-315	08-Apr-00	11-May-00	34	171	136	0.80
2001	WT 364-365, Tel 351	07-Apr-01	29-Apr-01	23	173	134	0.77
2002	WT 418-419	05-Apr-02	27-Apr-02	21	177	117	0.66
2003	WT 476-477	05-Apr-03	02-May-03	23	176	117	0.66
2004	WT 523, WT 546, Tel 522	11-Apr-04	11-May-04	30	177	107	0.60
2005	WT 617-618, AN 656	17-Apr-05	09-May-05	22	178	134	0.75
2006	WT 688	13-Apr-06	18-Apr-06	5.1	48	43	-
2007	WT 757-759	04-Apr-07	02-May-07	29	178	135	0.76
2008	WT 824-827	10-Apr-08	23-May-08	44	169	115	0.68
2009	AN 902-904	08-Apr-09	13-May-09	35	175	137	0.78
2010	AN 930-932	08-Apr-10	08-May-10	31	177	132	0.75
2011	AN 401-403	07-Apr-11	08-May-11	32	174	131	0.75
2012	AN 415-417	31-Mar-12	26-Apr-12	27	177	137	0.77
2013	AN 430-432	26-Mar-13	23-Apr-13	29	179	133	0.74
2014	AN 445-446, Tel 130	05-Apr-14	10-May-14	36	156	105	0.67

*Table 12. Cod abundance estimates (000's of fish) from DFO bottom-trawl research vessel surveys in NAFO Division 3Ps.**

Strata	Depth (fathoms)	sq. mi.	2004	2005	2007	2008	2009	2010	2011	2012	2013	2014
314	<30	974	117	256	1570	2144	573	287	328	1223	563	172
320	<30	1320	396	523	333	363	3222	1260	1603	4213	1189	893
293	31-50	159	375	2850	317	252	208	55	284	503	1312	186
308	31-50	112	2265	16719	1410	2373	486	16893	3058	1167	878	4437
312	31-50	272	56	1141	370	270	0	112	337	1310	854	4247
315	31-50	827	395	1161	1268	675	1634	767	1405	3705	2243	11141
321	31-50	1189	16	229	65	189	218	1823	2608	393	549	307
325	31-50	944	1120	383	893	812	1542	7970	8019	519	2194	2708
326	31-50	166	0	0	285	11	0	11	627	11	57	11
783	31-50	229	16	252	126	126	157	515	228	126	110	63
294	51-100	135	288	20685	1281	108	4960	713	59	2658	1476	845
297	51-100	152	244	1317	1047	273	1056	4242	2781	3922	1547	1181
307	51-100	395	9328	3172	2735	4849	18237	7758	4945	3412	1902	2010
311	51-100	317	2733	788	1715	2519	3632	9627	1979	3212	17063	2847
317	51-100	193	199	1367	2522	2881	912	3215	330	7022	12721	0
319	51-100	984	26117	6064	15245	14670	24418	20120	10120	35549	40494	15851
322	51-100	1567	649	2463	2507	1297	1049	820	2546	3162	11202	8400
323	51-100	696	0	101	32	3300	105	15274	8179	3067	1332	2489
324	51-100	494	85	432	481	153	359	417	3590	646	610	510
781	51-100	446	1052	568	445	552	548	293	506	813	5031	1166
782	51-100	183	63	221	101	227	201	22	566	327	512	1032
295	101-150	209	72	976	1469	633	396	2441	nf	971	1639	1776
298	101-150	171	976	282	7475	3384	73	585	0	6764	134	125
300	101-150	217	168	657	478	90	507	194	917	43	637	254
306	101-150	363	666	1015	2175	818	4054	714	1382	706	877	574
309	101-150	296	109	582	1122	244	49	236	529	308	49273	145
310	101-150	170	12	249	94	269	30	143	129	35	1695	86
313	101-150	165	10	66	124	23	111	259	21	11	164	571
316	101-150	189	69	117	117	13	116	10	12	17	65	0
318	101-150	129	275	683	336	16	189	18	9	9	237	21
779	101-150	422	19	142	671	310	186	0	503	5955	12283	7372
780	101-150	403	0	18	400	0	37	0	388	526	3587	1002
296	151-200	71	2627	35	881	273	999	32	3581	2269	2338	103
299	151-200	212	44	29	44	13	13	42	58	39	110	188
705	151-200	195	267	64	0	76	155	36	29	0	13	63
706	151-200	476	120	310	31	65	87	258	131	98	16	0
707	151-200	74	121	1263	122	257	737	23	16	15	173	12
715	201-300	1074	102	305	132	170	599	63	53	18	26	0
716	151-200	128	74	142	1368	51	1546	180	130	676	2330	264
708	151-200	539	85	1419	641	0	4299	26	30	28	199	nf
711	201-300	126	29	1530	505	29	125	44	29	3850	16	0
712	201-300	593	60	15	106	54	60	15	34	65	0	20
713	201-300	731	127	80	45	17	99	56	0	134	36	0
714	201-300	851	230	77	373	44	819	55	70	79	0	0
Total	Offshore	-	45832	42716	38722	38652	69462	88490	52275	74660	148972	57779
Total	In/Offshore	-	51776	70748	53457	44906	78803	97625	62146	99575	179689	73072
Upper	Offshore	-	95755	171310	48978	55629	103588	139453	69678	102076	467242	80068
T-value	Offshore	-	2.31	4.30	4.30	2.20	2.23	2.11	2.12	2.23	5.92	2.14
std	Offshore	-	21649	29906	2383	7713	15303	24153	8209	12294	53762	10415

*See Fig. 12 for location of strata. The survey was not completed in 2006. See Brattey et al. (2007) for pre-2004 data.

*Table 13. Cod biomass estimates (t) from DFO bottom-trawl research vessel surveys in NAFO Division 3Ps.**

Strata	Depth (fathoms)	sq. mi.	2004	2005	2007	2008	2009	2010	2011	2012	2013	2014
314	<30	974	10	185	53	204	68	43	100	200	69	30
320	<30	1320	395	1890	1274	442	1069	603	500	1695	1618	759
293	31-50	159	18	1810	16	18	7	15	19	46	52	10
308	31-50	112	1949	8011	253	789	170	8343	1558	426	732	1408
312	31-50	272	18	345	60	434	0	37	78	206	234	904
315	31-50	827	335	13514	6456	99	1777	235	1295	1585	544	4726
321	31-50	1189	2	40	186	17	54	2054	1639	150	114	140
325	31-50	944	568	84	172	555	447	4194	2831	269	547	923
326	31-50	166	0	0	55	1	0	19	140	4	25	3
783	31-50	229	1	303	12	18	13	31	25	7	19	27
294	51-100	135	14	21147	85	27	149	55	7	315	73	47
297	51-100	152	42	1482	382	122	156	1224	2110	1863	528	227
307	51-100	395	6055	2423	1471	3059	8114	4100	3258	1563	650	951
311	51-100	317	182	570	83	219	395	2414	394	348	1512	684
317	51-100	193	78	218	1118	231	158	2436	31	2849	970	0
319	51-100	984	67844	5845	14166	8888	33064	20494	10024	28365	20804	12559
322	51-100	1567	38	1532	79	205	104	439	1395	206	607	1439
323	51-100	696	0	28	1	2525	4	10070	4602	655	127	1220
324	51-100	494	8	148	51	39	53	39	653	86	175	97
781	51-100	446	61	203	23	49	28	33	44	55	151	70
782	51-100	183	3	34	5	13	20	1	328	30	101	42
295	101-150	209	4	727	128	83	20	519	nf	477	117	204
298	101-150	171	488	250	8445	2881	56	250	0	3903	37	79
300	101-150	217	103	391	149	25	286	111	480	94	200	74
306	101-150	363	960	812	2142	645	2021	630	932	649	501	268
309	101-150	296	56	464	1328	673	10	282	333	210	44380	25
310	101-150	170	4	410	11	427	7	82	105	17	306	74
313	101-150	165	4	101	352	79	61	213	14	21	39	315
316	101-150	189	103	95	120	5	156	7	7	29	23	0
318	101-150	129	506	1672	445	25	189	32	38	15	438	51
779	101-150	422	1	47	41	38	18	0	168	1246	4719	1875
780	101-150	403	0	2	86	0	2	0	71	21	284	178
296	151-200	71	900	54	146	76	239	5	2702	1863	589	29
299	151-200	212	35	15	327	1	2	26	63	29	9	275
705	151-200	195	288	96	0	111	122	47	36	0	49	141
706	151-200	476	147	301	56	76	51	153	180	126	17	0
707	151-200	74	329	3347	109	243	469	20	24	71	154	27
715	151-200	1074	114	451	167	296	1793	101	74	16	45	0
716	151-200	128	75	123	1933	59	961	124	111	1102	1476	307
708	201-300	539	76	1272	940	0	3688	16	30	32	269	nf
711	201-300	126	22	1864	1024	52	100	33	25	3546	4	0
712	201-300	593	39	6	94	81	52	10	22	55	0	9
713	201-300	731	172	63	27	5	59	101	0	124	16	0
714	201-300	851	183	149	514	51	808	55	59	87	0	0
Total	Offshore	-	80560	46059	34740	20535	56024	57429	30487	44706	76447	27057
Total	In/Offshore	-	82230	72524	44585	23910	57020	59698	36505	54656	83327	30195
Upper	Offshore	-	218043	146619	53944	31,842	107025	99022	41177	70874	576695	43492
T-value	Offshore	-	2.37	3.18	2.12	2.31	2.31	2.20	2.12	2.26	11.19	2.36
std	Offshore	-	58132	31623	9058	4895	22078	18906	5042	11579	44705	6964

*See Fig. 12 for location of strata. The survey was not completed in 2006. See Brattey et al. (2007) for pre-2004 data.

*Table 14a. Mean numbers per tow at age (1-15 only) in Campelen units for the Canadian research vessel bottom trawl survey of NAFO Subdiv. 3Ps (offshore index strata only).**

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Total
1983	6.42	10.01	6.52	1.14	3.72	1.62	0.48	0.89	1.61	0.75	0.36	0.14	0.06	0.05	0.04	33.81
1984	0.30	5.40	2.33	1.55	0.63	2.11	0.77	0.37	0.46	0.71	0.18	0.15	0.06	0.03	0.00	15.03
1985	0.38	7.74	14.88	12.57	9.96	3.28	2.66	0.79	0.48	0.42	0.42	0.49	0.21	0.12	0.03	54.43
1986	0.20	6.62	5.65	6.48	7.95	6.33	2.13	1.47	0.84	0.29	0.24	0.29	0.17	0.10	0.06	38.82
1987	1.09	8.48	5.67	4.97	13.82	8.31	3.35	1.29	0.69	0.28	0.23	0.16	0.17	0.16	0.06	48.73
1988	0.42	9.13	5.93	2.96	2.84	6.50	5.84	3.65	1.49	0.84	0.74	0.35	0.16	0.15	0.09	41.09
1989	0.49	6.50	4.66	3.17	1.51	1.16	2.15	1.21	0.67	0.37	0.41	0.13	0.11	0.05	0.09	22.68
1990	0.00	1.48	9.82	14.49	10.89	5.67	3.84	3.14	1.15	0.71	0.32	0.16	0.12	0.09	0.01	51.88
1991	1.30	27.69	5.03	10.00	11.24	5.75	2.84	1.58	1.19	0.74	0.56	0.22	0.11	0.07	0.04	68.36
1992	0.00	1.80	6.95	2.11	4.15	2.03	1.03	0.53	0.26	0.24	0.08	0.04	0.01	0.01	0.02	19.26
1993(Feb)	0.00	0.00	1.83	4.03	0.71	2.96	0.68	0.33	0.13	0.09	0.11	0.03	0.04	0.01	0.01	10.96
1993(Apr)	0.00	0.00	1.99	4.04	1.49	1.35	0.47	0.10	0.04	0.03	0.04	0.01	0.00	0.01	0.01	9.58
1994	0.00	1.63	1.46	4.31	6.10	1.73	1.62	0.50	0.08	0.04	0.03	0.02	0.01	0.01	0.00	17.54
1995	0.00	0.31	1.16	1.67	13.08	19.65	4.40	5.75	2.19	0.25	0.20	0.01	0.07	0.03	0.00	48.77
1996	0.90	1.08	3.67	3.62	1.32	2.69	2.91	0.54	0.46	0.09	0.09	0.02	0.00	0.00	0.00	17.39
1997	0.22	1.53	2.33	1.04	0.50	0.28	0.30	0.24	0.14	0.05	0.02	0.00	0.00	0.00	0.00	6.65
1998	0.52	0.97	6.79	8.42	5.60	3.99	1.96	2.50	2.79	0.43	0.30	0.06	0.03	0.00	0.00	34.36
1999	1.24	2.54	2.55	2.38	2.58	2.34	1.72	0.44	0.79	0.60	0.09	0.02	0.02	0.00	0.00	17.31
2000	1.25	3.33	5.36	3.10	2.17	1.82	1.20	0.89	0.35	0.31	0.53	0.12	0.00	0.01	0.00	20.44
2001	0.57	2.26	12.41	12.29	4.36	2.04	1.26	0.77	0.71	0.38	0.50	0.94	0.12	0.06	0.03	38.70
2002	0.58	1.10	3.90	8.28	5.85	3.04	2.04	0.99	0.53	0.37	0.08	0.12	0.19	0.01	0.00	27.08
2003	0.52	1.46	1.78	4.08	6.55	3.94	1.50	0.72	0.33	0.18	0.19	0.05	0.11	0.01	0.01	21.43
2004	0.20	1.90	2.07	1.71	2.08	4.05	4.24	1.26	0.81	0.67	0.79	0.15	0.10	0.02	0.07	20.12
2005	0.77	1.43	6.73	4.96	1.60	0.89	0.79	0.71	0.28	0.05	0.17	0.08	0.03	0.03	0.09	18.61
2006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007	3.18	1.73	4.84	3.11	1.48	0.76	0.44	0.22	0.47	0.42	0.12	0.09	0.08	0.05	0.01	17.00
2008	0.47	4.39	4.51	3.32	1.92	1.12	0.47	0.32	0.12	0.15	0.10	0.04	0.03	0.01	0.00	16.97
2009	0.40	1.43	9.25	6.67	5.70	3.09	1.79	0.99	0.21	0.17	0.21	0.38	0.14	0.02	0.00	30.45
2010	0.60	2.13	7.65	15.71	6.70	4.06	1.47	0.29	0.10	0.04	0.04	0.09	0.01	0.00	0.00	38.89
2011	0.15	4.70	6.55	2.46	5.08	1.92	1.41	0.48	0.10	0.08	0.00	0.02	0.01	0.01	0.00	22.97
2012	5.32	2.94	8.88	5.82	3.22	3.38	1.75	0.96	0.17	0.26	0.02	0.04	0.00	0.01	0.02	32.79
2013	1.58	18.42	11.49	16.61	6.43	4.50	3.09	2.36	0.56	0.28	0.07	0.01	0.00	0.01	0.00	65.41
2014	0.85	3.33	11.33	4.74	2.22	1.15	0.43	0.94	0.48	0.07	0.00	0.01	0.00	0.01	0.00	25.56

*Data are adjusted for missing strata. The survey in 2006 was not completed and there were two surveys in 1993 (February and April).

Table 14b. Mean numbers per tow at age (1-15 only) in Campelen units for the Canadian research vessel bottom trawl survey of NAFO Subdiv. 3Ps (inshore and offshore strata).

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Total
1997	0.32	1.68	2.44	1.01	0.46	0.25	0.26	0.21	0.12	0.04	0.01	0.00	0.00	0.00	0.00	6.80
1998	0.72	1.28	6.28	7.40	4.91	3.53	1.73	2.19	2.43	0.38	0.26	0.06	0.03	0.00	0.00	31.20
1999	1.31	3.05	2.52	2.26	2.41	2.12	1.54	0.39	0.68	0.52	0.07	0.02	0.02	0.01	0.00	16.92
2000	1.38	3.84	6.66	3.52	2.24	1.75	1.11	0.80	0.31	0.28	0.46	0.11	0.00	0.01	0.00	22.47
2001	0.99	2.88	11.44	10.58	3.71	1.74	1.08	0.66	0.60	0.32	0.43	0.80	0.10	0.05	0.03	35.41
2002	0.79	1.53	3.72	7.08	4.95	2.58	1.73	0.85	0.45	0.31	0.07	0.11	0.16	0.01	0.00	24.34
2003	0.61	2.62	2.24	3.67	5.88	3.51	1.34	0.63	0.28	0.16	0.17	0.04	0.09	0.01	0.01	21.26
2004	0.33	2.24	2.50	1.85	1.93	3.49	3.61	1.08	0.68	0.57	0.67	0.13	0.09	0.02	0.06	19.25
2005	0.80	1.63	7.32	7.27	3.49	2.08	1.52	1.20	0.41	0.09	0.15	0.06	0.03	0.03	0.08	26.16
2006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007	3.31	2.34	5.33	3.26	2.11	1.14	0.76	0.35	0.56	0.37	0.12	0.10	0.07	0.04	0.01	19.87
2008	0.55	4.09	4.30	3.27	1.99	1.22	0.50	0.34	0.12	0.14	0.08	0.04	0.02	0.01	0.00	16.67
2009	1.44	2.47	8.64	5.81	4.91	2.65	1.53	0.84	0.18	0.15	0.18	0.32	0.12	0.01	0.00	29.25
2010	0.68	2.76	7.75	13.95	5.87	3.53	1.27	0.25	0.08	0.03	0.03	0.07	0.01	0.00	0.00	36.28
2011	0.19	4.63	6.37	2.56	5.46	2.04	1.42	0.49	0.09	0.08	0.00	0.02	0.01	0.01	0.00	23.37
2012	5.50	3.99	11.21	6.37	3.34	3.39	1.76	0.94	0.16	0.25	0.01	0.04	0.00	0.01	0.02	36.99
2013	3.14	19.94	12.11	16.14	5.83	4.04	2.72	2.06	0.48	0.24	0.06	0.01	0.00	0.01	0.00	66.78
2014	1.44	5.21	11.03	4.54	2.23	1.11	0.41	0.83	0.42	0.06	0.00	0.01	0.00	0.01	0.00	27.32

*Data are adjusted for missing strata. The survey in 2006 was not completed.

Table 15. Mean length-at-age (cm) of cod sampled during research bottom-trawl surveys in Subdiv. 3Ps in winter-spring 1983-2012. Shaded entries (*) are based on fewer than 5 aged fish.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1983	10.3	20.2	31.2	43.1	52.9	57.8	65.6	71.5	73.4	79.4	89.6	93.7
1984	12.0*	19.2	30.7	42.1	52.2	60.7	66.2	70.6	75.5	79.1	84.2	98.1
1985	-	17.9	29.1	40.3	51.2	60.2	66.4	74.2	73.9	79.4	88.9	93.0
1986	11.0*	18.8	27.1	40.3	49.0	55.7	62.1	72.2	76.4	82.8	93.3	93.9
1987	10.7	19.9	29.5	39.5	48.4	54.1	61.2	67.3	77.8	85.4	83.2	89.9
1988	9.2*	19.7	29.0	40.7	47.8	56.2	62.2	66.7	74.6	79.7	79.7	87.5
1989	12.0*	19.2	30.2	41.7	48.2	56.3	64.0	71.8	75.9	84.6	88.5	96.6
1990	-	19.9	29.9	40.1	48.3	53.7	56.6	62.3	70.1	76.2	79.1	88.7
1991	9.5	19.2	29.8	39.0	47.0	53.5	57.4	62.8	68.2	73.7	73.8	77.1
1992	-	20.7	30.4	40.9	47.4	55.3	61.2	62.4	66.7	73.3	83.9	81.8
1993	-	-	30.9	41.3	48.0	52.7	62.3	70.6	77.1	80.2*	96.0	106.0*
1994	-	19.1	32.2	39.4	48.2	50.2	53.7	59.1	68.0	87.7	79.7*	90.5
1995	-	21.2*	29.9	42.0	50.4	56.5	58.2	57.9	63.0	79.6	81.3	83.6*
1996	12.6	20.8	30.0	38.7	44.2	52.9	60.9	61.2	63.3	76.8	74.7	86.1*
1997	12.7	24.1	31.8	40.9	48.2	51.6	60.7	65.4	67.3	67.3	82.5*	-
1998	10.6	22.3	32.8	42.7	49.1	53.3	57.6	67.1	77.4	77.2	64.3	78.0*
1999	12.0	22.4	31.4	43.2	51.4	58.9	61.7	66.2	77.6	86.8	76.9	109.0*
2000	13.3	22.0	31.7	40.8	48.8	54.7	60.5	65.3	67.9	81.2	92.7	89.1
2001	10.6	21.9	33.2	40.6	47.6	51.4	57.4	68.8	77.5	75.0	85.5	96.8
2002	12.0	22.0	31.8	42.0	50.8	55.1	55.2	67.2	74.6	79.8	73.4*	86.0
2003	10.7	23.7	31.9	43.0	51.8	55.4	58.6	58.7	70.5	72.0	65.5	86.6*
2004	14.0	20.2	33.7	38.9	47.6	60.8	66.3	69.2	67.3	69.6	73.2	73.5*
2005	12.1	25.5	34.2	41.9	48.6	54.5	63.5	67.6	72.3	72.6*	99.2	103.4
2006	-	-	-	-	-	-	-	-	-	-	-	-
2007	11.1	21.2	30.7	38.1	48.9	54.9	55.8	64.9	81.7	91.6	86.9	86.6
2008	11.7	18.4	26.6	38.5	45.9	53.0	60.2	59.4	66.9	68.2	90.0	94.1
2009	12.3	19.1	31.3	38.7	46.7	55.0	60.5	63.5	72.3	76.0	83.3	87.2
2010	11.8	22.7	30.5	40.4	45.6	55.0	65.8	70.9	75.2	81.1*	92.6*	103.1
2011	14.0	23.5	30.2	40.1	47.1	49.5	56.1	61.7	73.8	53.2*	-	75.5*
2012	11.1	18.6	34.2	41.7	48.1	55.8	53.9	61.0	72.2	73.8*	105.0*	107.0*
2013	12.3	20.4	27.9	41.9	47.7	47.8	53.4	54.0	63.7	55.4	97.0*	95.9*
2014	10.6	20.9	30.2	35.0	47.8	53.4	54.5	63.2	65.0	59.3*	-	80.0*

Table 16. Mean round weight-at-age (kg) of cod sampled during DFO bottom-trawl surveys in Subdiv. 3Ps in winter-spring 1983-2012. Shaded entries (*) are based on fewer than 5 aged fish.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12
1983	0.01	0.07	0.22	0.66	1.29	1.59	2.15	3.44	3.87	5.22	8.81	10.34
1984	-	0.07	0.25	0.63	1.13	1.84	2.74	3.84	4.26	5.06	8.09	10.03
1985	-	-	0.21	0.49	1.05	1.60	2.30	3.19	3.31*	3.76*	-	3.97*
1986	-	0.05	0.17	0.45	0.87	1.36	2.39	3.25	5.42	4.41	6.42*	9.16
1987	-	-	0.23	0.52	0.92	1.32	1.88	2.41	4.33	6.35	6.74	6.11
1988	-	0.06	0.19	0.56	0.88	1.42	2.17	2.51	4.08	4.77	4.21	9.43
1989	-	0.06	0.24	0.58	0.91	1.28	2.25	3.74	4.57	5.95	8.78	8.88
1990	-	0.06	0.20	0.52	0.96	1.36	1.62	2.19	3.21	4.33	5.09	7.46
1991	0.01	0.05	0.20	0.45	0.84	1.33	1.74	2.37	3.09	4.08	4.10	5.09
1992	-	0.06	0.22	0.54	0.89	1.44	2.06	2.32	2.91	4.15	5.90	5.81
1993	-	-	0.21	0.54	0.86	1.20	2.05	3.13	4.48	4.47*	8.53	13.20*
1994	-	0.05	0.23	0.44	0.87	1.08	1.33	1.87	3.03	6.35	5.21*	7.47
1995	-	0.06*	0.20	0.52	0.93	1.50	1.75	1.75	2.28	4.88	5.50	6.49*
1996	0.02	0.07	0.22	0.46	0.71	1.21	2.04	2.19	2.41	4.46	3.99	7.01*
1997	0.02	0.11	0.26	0.54	0.88	1.15	1.87	2.64	3.06	3.22	5.46*	-
1998	0.01	0.09	0.28	0.62	0.99	1.27	1.63	2.74	4.76	5.07	2.68	5.25*
1999	0.01	0.10	0.28	0.64	1.10	1.72	2.08	2.57	4.39	6.87	5.12	13.16*
2000	0.02	0.08	0.27	0.57	0.92	1.35	1.90	2.51	2.91	5.19	8.34	8.13
2001	0.01	0.08	0.28	0.55	0.87	1.16	1.67	2.96	4.39	4.35	6.09	9.05
2002	0.01	0.09	0.24	0.56	1.01	1.39	1.45	2.75	4.00	5.11	4.20*	6.24
2003	0.01	0.10	0.27	0.61	1.10	1.46	1.83	1.74	3.15	3.76	2.64	6.56*
2004	0.02	0.07	0.31	0.50	0.86	1.81	2.47	3.15	2.95	3.34	4.25	4.71*
2005	0.01	0.14	0.34	0.62	1.00	1.37	2.24	3.12	4.06	4.47*	10.31	11.30
2006	-	-	-	-	-	-	-	-	-	-	-	-
2007	0.01	0.08	0.23	0.46	0.95	1.44	1.57	2.54	5.34	8.17	7.66	7.82
2008	0.01	0.05	0.16	0.47	0.80	1.18	1.85	1.88	2.78	3.29	7.21	9.11
2009	0.01	0.05	0.24	0.47	0.79	1.39	1.96	2.42	3.68	4.27	6.26	7.07
2010	0.01	0.09	0.22	0.52	0.79	1.40	2.51	3.24	4.24	6.96*	9.05*	11.31
2011	0.02	0.11	0.24	0.50	0.87	1.09	1.67	2.35	3.80	1.30*	-	4.43*
2012	0.01	0.05	0.33	0.60	0.89	1.45	1.35	2.20	3.82	4.02	9.23*	12.61*
2013	0.02	0.07	0.19	0.60	0.89	0.98	1.42	1.43	2.44	1.76	9.88	10.32*
2014	0.01	0.08	0.21	0.35	0.86	1.28	1.36	2.24	2.65*	2.20*	-	4.68

Table 17. Parameter estimates and SE's for a probit model fitted to observed proportions mature at age (from "combined" survey area) for female cod from NAFO Subdiv. 3Ps based on surveys conducted during 1959-2014.

Cohort	Slope	Slope SE	Intercept	Intercept SE	Cohort	Slope	Slope SE	Intercept	Intercept SE
1954	1.1094	0.2940	-8.1702	2.4445	**1982**	2.0091	0.2059	-13.3056	1.3496
1955	1.5059	0.2237	-10.2633	1.6124	**1983**	1.8944	0.2608	-11.8903	1.6045
1956	1.3174	0.3208	-9.4592	2.2216	**1984**	2.2315	0.2981	-13.4166	1.8044
1957	1.4604	0.3703	-10.3248	2.3525	**1985**	2.6988	0.3728	-16.0342	2.2010
1958	2.3929	0.5853	-16.4519	3.6202	**1986**	2.5829	0.2930	-14.0673	1.5934
1959	2.1113	0.5358	-13.0196	2.9364	**1987**	2.2526	0.2231	-11.9227	1.2350
1960	1.6741	0.2990	-10.6677	1.7584	**1988**	2.7731	0.4110	-14.0212	2.1672
1961	1.8639	0.3551	-11.4722	2.0669	**1989**	1.8846	0.1577	-9.7844	0.8110
1962	1.7141	0.2898	-10.5115	1.7043	**1990**	1.7888	0.1900	-9.2101	0.9575
1963*	-	-	-	-	**1991**	2.4874	0.4971	-13.1443	2.5618
1964	1.9272	0.2411	-12.7182	1.5667	**1992**	2.6015	0.3903	-13.0008	1.9108
1965	2.4194	0.5982	-16.4244	4.2387	**1993**	1.8954	0.2394	-9.8698	1.2957
1966	1.5492	0.2401	-10.0608	1.6025	**1994**	1.6015	0.1969	-8.1481	1.0091
1967	1.6876	0.3782	-10.0845	2.2543	**1995**	1.6523	0.2188	-8.7711	1.1242
1968	2.1397	0.2885	-13.1625	1.7869	**1996**	1.7414	0.2410	-9.3461	1.2620
1969	1.6825	0.3043	-10.3672	1.8439	**1997**	3.0797	0.4567	-14.8462	2.1742
1970	1.5265	0.2305	-8.8558	1.3136	**1998**	1.9984	0.2396	-9.6586	1.1567
1971	1.3122	0.1401	-7.8405	0.8346	**1999**	1.8423	0.2647	-9.1495	1.3103
1972	1.4117	0.1445	-8.9081	0.8853	**2000**	1.7800	0.3025	-9.2716	1.4885
1973	1.4521	0.1667	-9.3550	1.0320	**2001**	1.7588	0.2292	-8.3449	1.0333
1974	2.0042	0.1969	-13.1541	1.2944	**2002**	1.6768	0.2439	-8.8522	1.2949
1975	1.7846	0.2174	-11.1641	1.3757	**2003**	1.5873	0.2283	-9.0376	1.2856
1976	1.3552	0.2056	-8.5990	1.2510	**2004**	1.4998	0.1654	-8.3629	0.9172
1977	2.5066	0.3505	-15.3640	2.1732	**2005**	1.8574	0.2314	-10.0268	1.2524
1978	1.7920	0.1680	-10.7323	1.0205	**2006**	1.7491	0.1781	-8.5921	0.9051
1979	1.0297	0.1138	-6.4477	0.7670	**2007**	1.5798	0.2523	-7.5185	1.1952
1980	1.4270	0.1415	-9.4134	0.9131	**2008**	1.6777	0.2542	-8.2825	1.1113
1981	1.7431	0.1781	-11.9865	1.1846	**2009**	2.2862	0.3272	-10.9310	1.3912

*Fit not significant

Table 18. Estimated proportions mature for female cod from NAFO Subdiv. 3Ps from DFO surveys from 1978 to 2014, projected forward to 2015. Estimates were obtained from a probit model fitted by cohort to observed proportions mature at age (from "combined" survey area). Black shaded cells(*) are averages of the three closest cohorts; grey shaded cells (†) are the average of estimates for the adjacent cohorts.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1954	0.0004*	0.0015*	0.0050*	0.0175*	0.0607*	0.1938*	0.4701*	0.7573*	0.9135*	0.9723*	0.9914*	0.9973*	0.9992*	0.9997*
1955	0.0009	0.0015*	0.0050*	0.0175*	0.0607*	0.1938*	0.4701*	0.7573*	0.9135*	0.9723*	0.9914*	0.9973*	0.9992*	0.9997*
1956	0.0002	0.0026	0.0050*	0.0175*	0.0607*	0.1938*	0.4701*	0.7573*	0.9135*	0.9723*	0.9914*	0.9973*	0.9992*	0.9997*
1957	0.0003	0.0007	0.0078	0.0175*	0.0607*	0.1938*	0.4701*	0.7573*	0.9135*	0.9723*	0.9914*	0.9973*	0.9992*	0.9997*
1958	0.0001	0.0011	0.0032	0.0234	0.0607*	0.1938*	0.4701*	0.7573*	0.9135*	0.9723*	0.9914*	0.9973*	0.9992*	0.9997*
1959	0.0000	0.0006	0.0040	0.0142	0.0677	0.1938*	0.4701*	0.7573*	0.9135*	0.9723*	0.9914*	0.9973*	0.9992*	0.9997*
1960	0.0000	0.0000	0.0026	0.0149	0.0610	0.1804	0.4701*	0.7573*	0.9135*	0.9723*	0.9914*	0.9973*	0.9992*	0.9997*
1961	0.0001	0.0002	0.0001	0.0112	0.0535	0.2265	0.4003	0.7573*	0.9135*	0.9723*	0.9914*	0.9973*	0.9992*	0.9997*
1962	0.0001	0.0007	0.0012	0.0010	0.0464	0.1744	0.5691	0.6693	0.9135*	0.9723*	0.9914*	0.9973*	0.9992*	0.9997*
1963	0.0002	0.0004	0.0035	0.0102	0.0111	0.1733	0.4409	0.8562	0.8599	0.9723*	0.9914*	0.9973*	0.9992*	0.9997*
1964	0.0001†	0.0008	0.0028	0.0185	0.0785	0.1096	0.4745	0.7465	0.9641	0.9490	0.9914*	0.9973*	0.9992*	0.9997*
1965	0.0000	0.0005†	0.0046	0.0177	0.0914	0.4129	0.5741	0.7955	0.9166	0.9918	0.9826	0.9973*	0.9992*	0.9997*
1966	0.0000	0.0001	0.0028†	0.0252	0.1041	0.3491	0.8531	0.9365	0.9437	0.9762	0.9982	0.9942	0.9992*	0.9997*
1967	0.0002	0.0000	0.0010	0.0159†	0.1255	0.4283	0.7410	0.9796	0.9938	0.9863	0.9935	0.9996	0.9981	0.9997*
1968	0.0002	0.0009	0.0001	0.0066	0.0847†	0.4435	0.8285	0.9385	0.9975	0.9994	0.9968	0.9983	0.9999	0.9994
1969	0.0000	0.0012	0.0044	0.0012	0.0438	0.3415†	0.8157	0.9689	0.9879	0.9997	0.9999	0.9993	0.9995	1.0000
1970	0.0002	0.0001	0.0066	0.0206	0.0130	0.2396	0.7498†	0.9609	0.9950	0.9977	1.0000	1.0000	0.9998	0.9999
1971	0.0007	0.0009	0.0012	0.0344	0.0899	0.1292	0.6839	0.9489†	0.9927	0.9992	0.9996	1.0000	1.0000	1.0000
1972	0.0015	0.0030	0.0049	0.0099	0.1616	0.3174	0.6250	0.9370	0.9915†	0.9987	0.9999	0.9999	1.0000	1.0000
1973	0.0006	0.0054	0.0137	0.0257	0.0784	0.5103	0.6864	0.9493	0.9903	0.9986†	0.9998	1.0000	1.0000	1.0000
1974	0.0004	0.0023	0.0198	0.0601	0.1241	0.4196	0.8493	0.9115	0.9953	0.9986	0.9998†	1.0000	1.0000	1.0000
1975	0.0000	0.0016	0.0093	0.0697	0.2273	0.4324	0.8600	0.9682	0.9798	0.9996	0.9998	1.0000†	1.0000	1.0000
1976	0.0001	0.0001	0.0067	0.0369	0.2176	0.5752	0.8038	0.9812	0.9940	0.9956	1.0000	1.0000	1.0000†	1.0000
1977	0.0007	0.0005	0.0008	0.0280	0.1359	0.5081	0.8617	0.9566	0.9978	0.9989	0.9991	1.0000	1.0000	1.0000†
1978	0.0000	0.0028	0.0030	0.0058	0.1096	0.3922	0.7933	0.9663	0.9916	0.9997	0.9998	0.9998	1.0000	1.0000
1979	0.0001	0.0000	0.0106	0.0175	0.0418	0.3447	0.7259	0.9344	0.9925	0.9984	1.0000	1.0000	1.0000	1.0000
1980	0.0044	0.0008	0.0004	0.0400	0.0961	0.2444	0.6921	0.9157	0.9815	0.9984	0.9997	1.0000	1.0000	1.0000
1981	0.0003	0.0123	0.0047	0.0048	0.1391	0.3878	0.7059	0.9057	0.9781	0.9949	0.9996	0.9999	1.0000	1.0000
1982	0.0000	0.0014	0.0336	0.0275	0.0557	0.3852	0.7905	0.9468	0.9762	0.9946	0.9986	0.9999	1.0000	1.0000
1983	0.0000	0.0002	0.0059	0.0888	0.1452	0.4197	0.7084	0.9574	0.9925	0.9943	0.9987	0.9996	1.0000	1.0000
1984	0.0000	0.0001	0.0012	0.0240	0.2143	0.5049	0.8987	0.9040	0.9926	0.9990	0.9987	0.9997	0.9999	1.0000
1985	0.0000	0.0003	0.0007	0.0066	0.0929	0.4331	0.8595	0.9909	0.9734	0.9987	0.9999	0.9997	0.9999	1.0000

Table 18. Continued.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
1986	0.0000	0.0001	0.0020	0.0051	0.0366	0.2991	0.6814	0.9735	0.9993	0.9930	0.9998	1.0000	0.9999	1.0000
1987	0.0000	0.0000	0.0012	0.0132	0.0370	0.1783	0.6400	0.8569	0.9955	0.9999	0.9982	1.0000	1.0000	1.0000
1988	0.0001	0.0001	0.0004	0.0111	0.0818	0.2225	0.5536	0.8811	0.9437	0.9992	1.0000	0.9995	1.0000	1.0000
1989	0.0000	0.0006	0.0018	0.0053	0.0946	0.3719	0.6809	0.8764	0.9686	0.9792	0.9999	1.0000	0.9999	1.0000
1990	0.0004	0.0002	0.0057	0.0233	0.0731	0.4931	0.7975	0.9409	0.9759	0.9923	0.9925	1.0000	1.0000	1.0000
1991	0.0006	0.0024	0.0033	0.0515	0.2400	0.5396	0.9006	0.9632	0.9916	0.9957	0.9981	0.9973	1.0000	1.0000
1992	0.0000	0.0036	0.0158	0.0507	0.3408	0.8069	0.9457	0.9883	0.9943	0.9989	0.9992	0.9996	0.9990	1.0000
1993	0.0000	0.0003	0.0210	0.0957	0.4612	0.8310	0.9822	0.9962	0.9987	0.9991	0.9998	0.9999	0.9999	0.9997
1994	0.0003	0.0004	0.0034	0.1136	0.4106	0.9320	0.9791	0.9986	0.9997	0.9999	0.9999	1.0000	1.0000	1.0000
1995	0.0014	0.0023	0.0055	0.0394	0.4339	0.8210	0.9955	0.9978	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
1996	0.0008	0.0071	0.0150	0.0695	0.3302	0.8209	0.9679	0.9997	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
1997	0.0005	0.0042	0.0341	0.0921	0.5017	0.8557	0.9648	0.9950	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1998	0.0000	0.0028	0.0216	0.1490	0.4030	0.9314	0.9862	0.9939	0.9992	1.0000	1.0000	1.0000	1.0000	1.0000
1999	0.0005	0.0002	0.0160	0.1032	0.4649	0.8180	0.9946	0.9988	0.9990	0.9999	1.0000	1.0000	1.0000	1.0000
2000	0.0007	0.0035	0.0037	0.0847	0.3753	0.8117	0.9676	0.9996	0.9999	0.9998	1.0000	1.0000	1.0000	1.0000
2001	0.0006	0.0042	0.0250	0.0740	0.3455	0.7582	0.9553	0.9950	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2002	0.0014	0.0033	0.0260	0.1591	0.6347	0.7507	0.9424	0.9907	0.9992	1.0000	1.0000	1.0000	1.0000	1.0000
2003	0.0008	0.0079	0.0192	0.1443	0.5826	0.9742	0.9450	0.9884	0.9981	0.9999	1.0000	1.0000	1.0000	1.0000
2004	0.0006	0.0041	0.0444	0.1042	0.5155	0.9115	0.9988	0.9899	0.9978	0.9996	1.0000	1.0000	1.0000	1.0000
2005	0.0010	0.0028	0.0214	0.2125	0.4082	0.8704	0.9870	0.9999	0.9982	0.9996	0.9999	1.0000	1.0000	1.0000
2006	0.0003	0.0047	0.0137	0.1048	0.6104	0.8035	0.9769	0.9982	1.0000	0.9997	0.9999	1.0000	1.0000	1.0000
2007	0.0011	0.0018	0.0206	0.0637	0.3850	0.9010	0.9604	0.9963	0.9998	1.0000	0.9999	1.0000	1.0000	1.0000
2008	0.0026	0.0061	0.0115	0.0860	0.2495	0.7701	0.9814	0.9931	0.9994	1.0000	1.0000	1.0000	1.0000	1.0000
2009	0.0014	0.0126	0.0341	0.0693	0.2965	0.6192	0.9471	0.9967	0.9988	0.9999	1.0000	1.0000	1.0000	1.0000
2010	0.0002	0.0072	0.0585	0.1686	0.3230	0.6538	0.8883	0.9897	0.9994	0.9998	1.0000	1.0000	1.0000	1.0000
2011	0.0014*	0.0017	0.0373	0.2316	0.5383	0.7535	0.8943	0.9749	0.9981	0.9999	1.0000	1.0000	1.0000	1.0000
2012	0.0014*	0.0072*	0.0168	0.1720	0.5940	0.8702	0.9514	0.9743	0.9948	0.9996	1.0000	1.0000	1.0000	1.0000
2013	0.0014*	0.0072*	0.0375*	0.1435	0.5265	0.8766	0.9747	0.9921	0.9941	0.9989	0.9999	1.0000	1.0000	1.0000
2014	0.0014*	0.0072*	0.0375*	0.1824*	0.6225	0.8562	0.9718	0.9955	0.9988	0.9987	0.9998	1.0000	1.0000	1.0000
2015	0.0014*	0.0072*	0.0375*	0.1824*	0.5810*	0.9419	0.9696	0.9941	0.9992	0.9998	0.9997	1.0000	1.0000	1.0000
2016	0.0014*	0.0072*	0.0375*	0.1824*	0.5810*	0.8915*	0.9938	0.9942	0.9988	0.9999	1.0000	0.9999	1.0000	1.0000

FIGURES

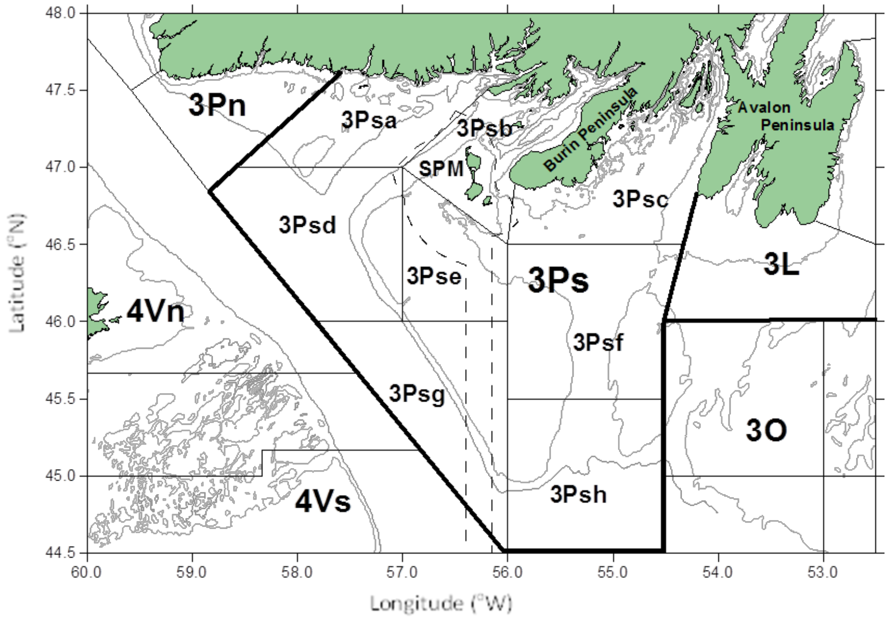


Figure 1. NAFO Subdiv. 3Ps management zone showing the economic zone around the French islands of St. Pierre and Miquelon (SPM, dashed line), the 100 m and 250 m depth contours (grey lines) and the boundaries of the statistical unit areas (solid lines).

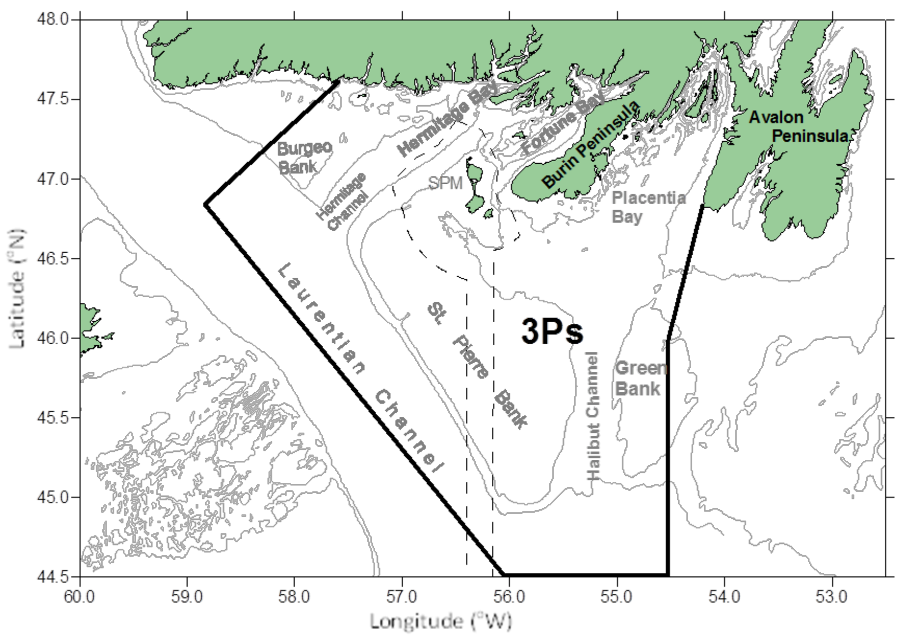


Figure 2. NAFO Subdiv. 3Ps management zone showing the economic zone around the French islands of St. Pierre and Miquelon (SPM, dashed line), the 100 m and 250 m depth contours (grey lines) and the main fishing areas.

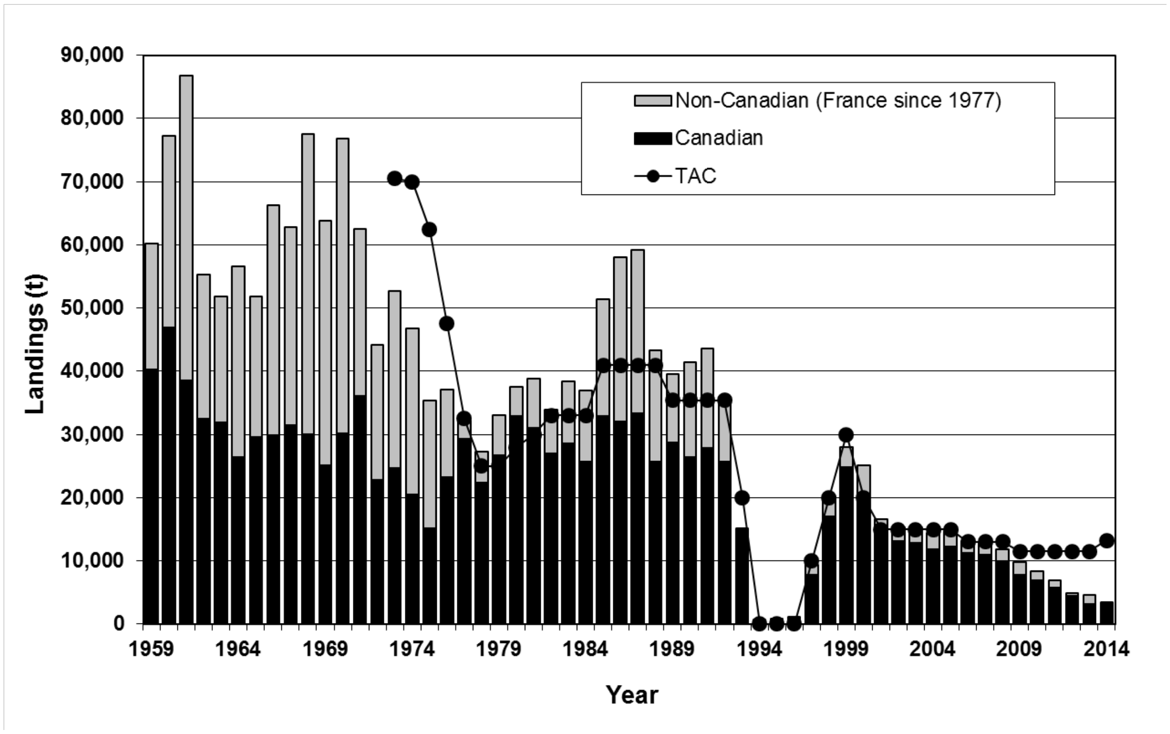


Figure 3a. Reported landings of cod by Canadian and non-Canadian vessels in NAFO Subdiv. 3Ps during 1959-September 2014. The 2014 fishery was still in progress at the time of the October 2014 assessment.

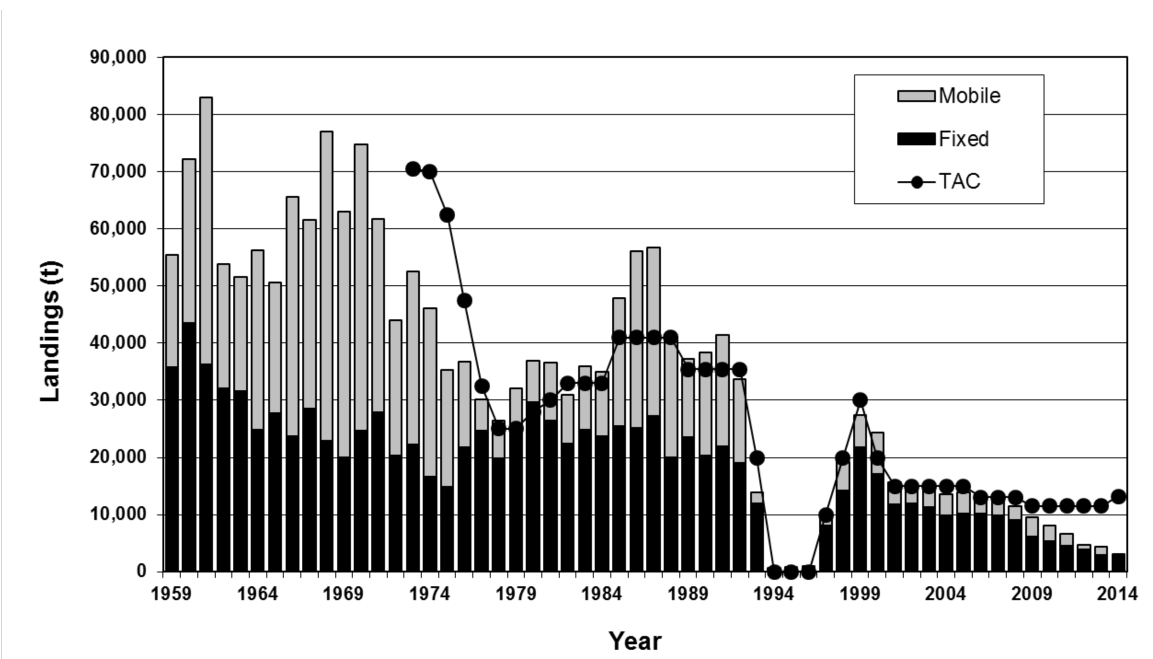


Figure 3b. Reported landings of cod by fixed and mobile gears in NAFO Subdiv. 3Ps during 1959-September 2014. The 2014 fishery was still in progress at the time of the October 2014 assessment.

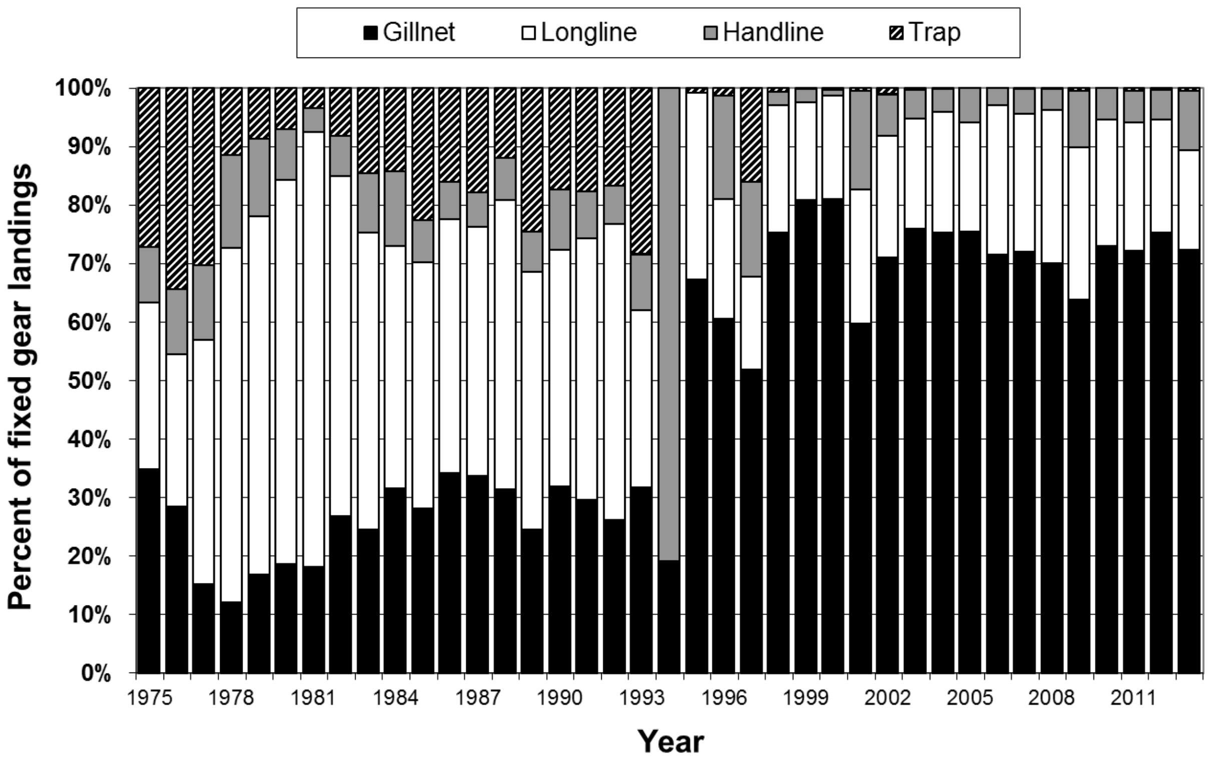
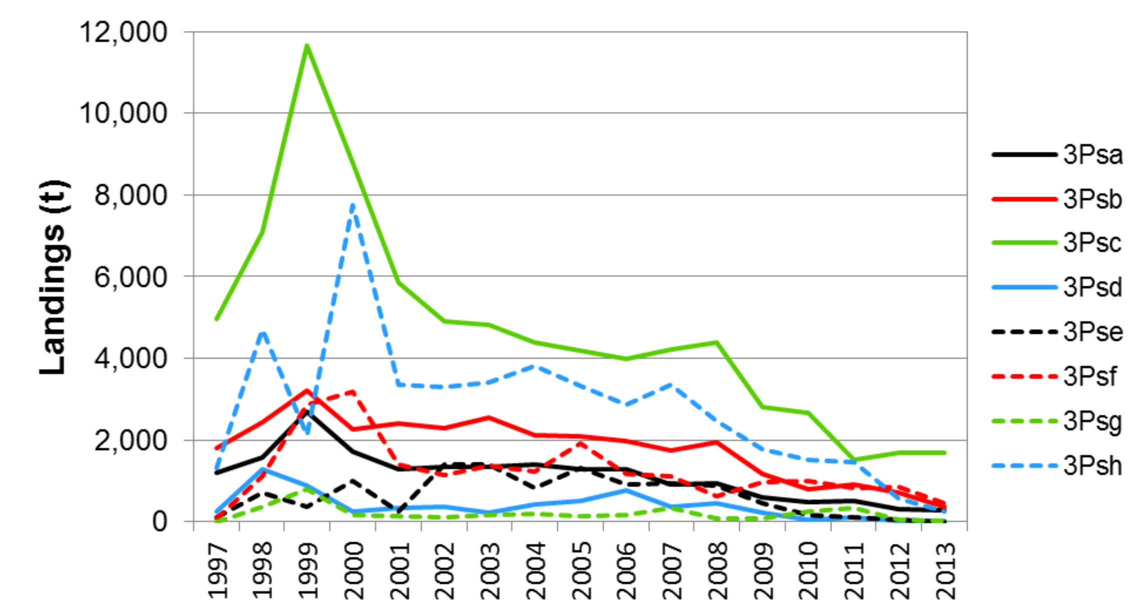


Figure 4. Percent of total fixed gear landings by the four main fixed gears used in the cod fishery in NAFO Subdiv. 3Ps during 1975-2013. The fishery was under a moratorium during 1994-96 and values for those years are based on sentinel and by-catch landings of < 800 t.



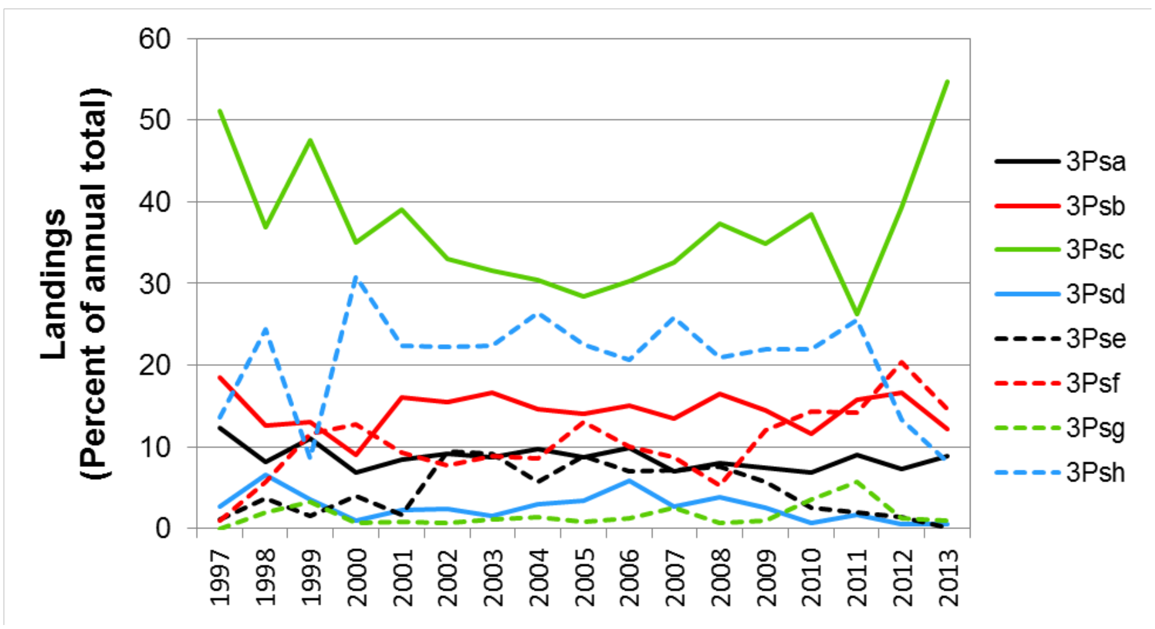


Figure 5. Annual reported landings of cod (upper panel) and percent of annual total (lower panel) by unit area from NAFO Subdiv. 3Ps during 1997-2013. Refer to Figure 1 for locations of unit areas.

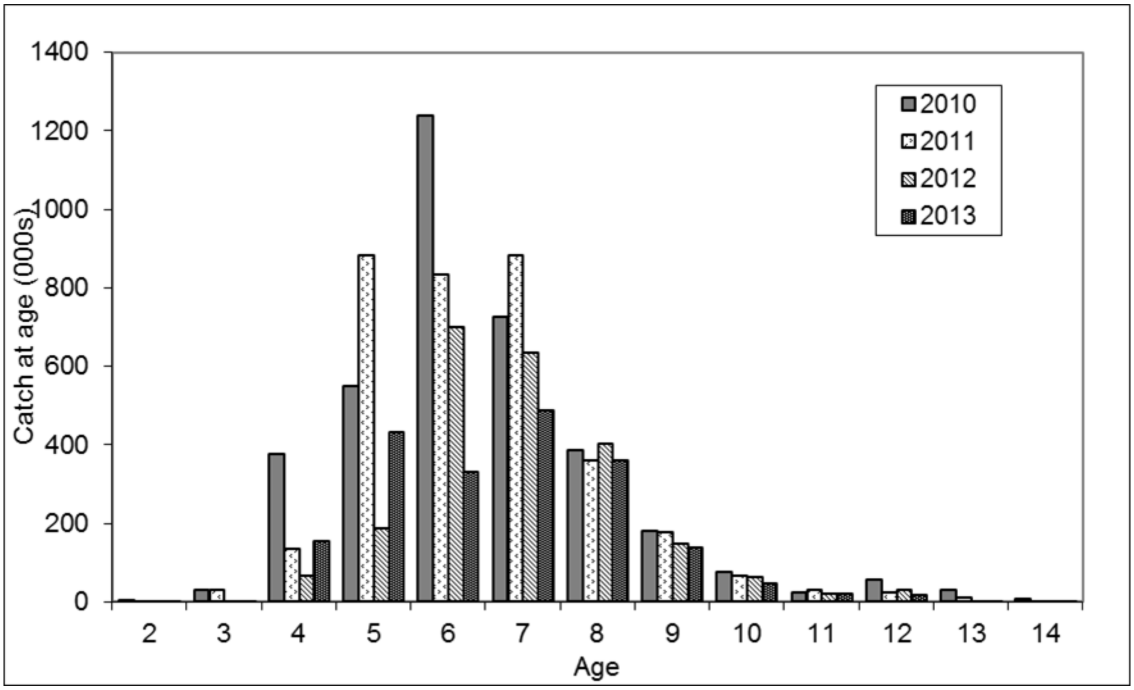


Figure 6a. Catch at age (numbers of fish; in thousands) for the cod fishery in Subdiv. 3Ps during 2010 to 2013. Recreational catches are not included (see text).

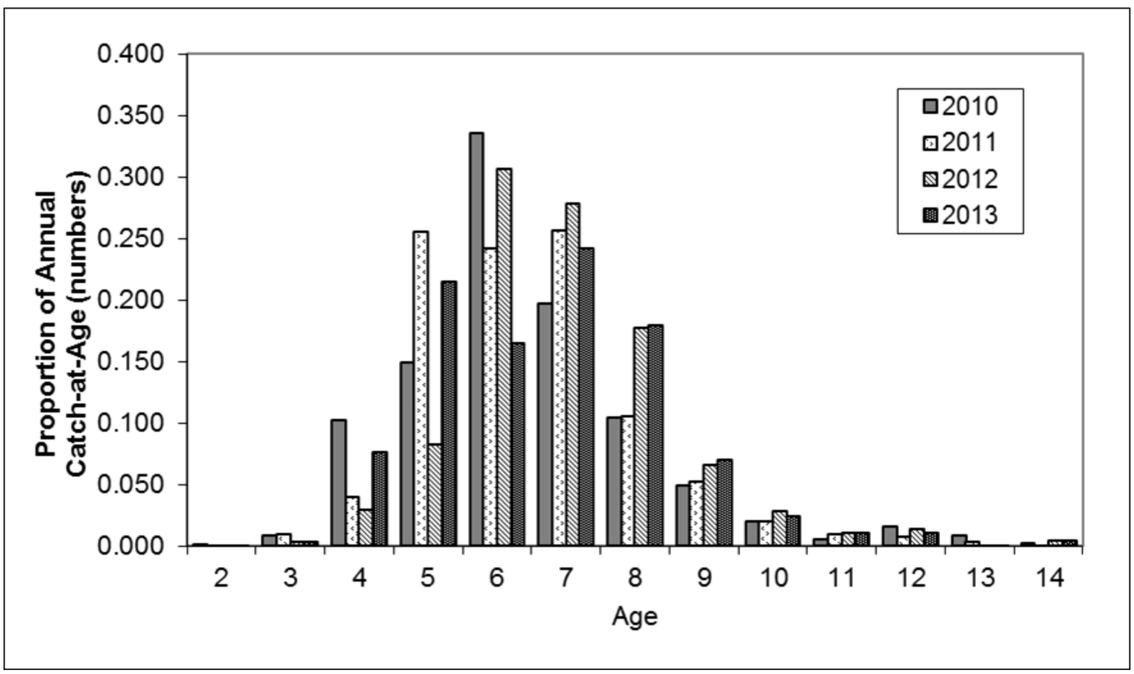


Figure 6b. Percent catch at age for Subdiv. 3Ps cod from 2010 to 2013.

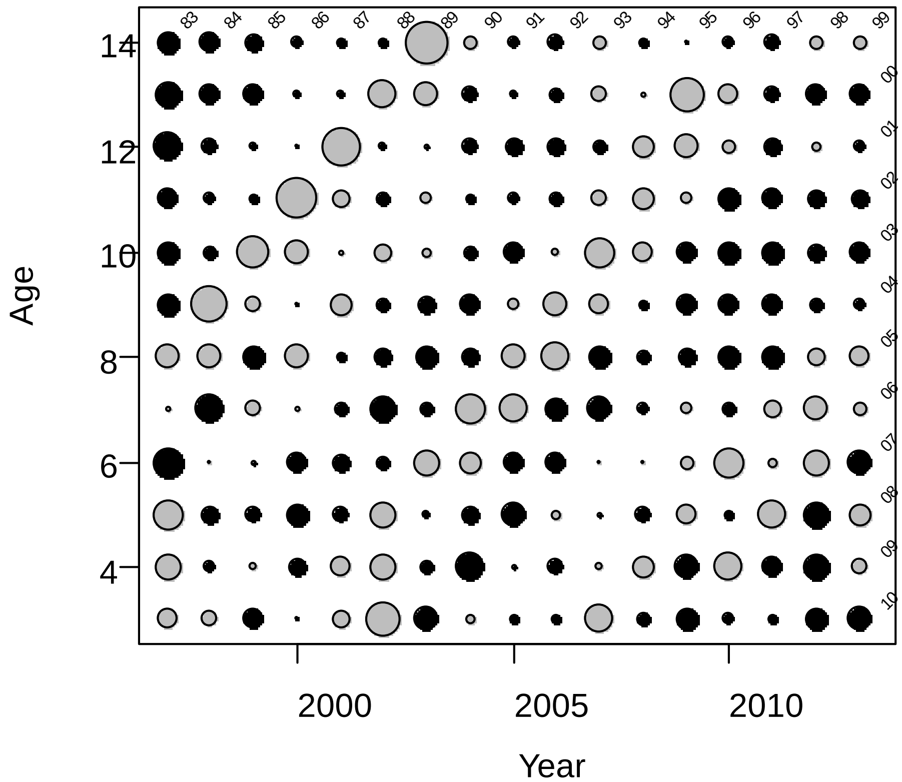


Figure 6c. Standardized proportions at age of commercial catch at age in Subdiv. 3Ps. Catch proportions within each year were computed, and then standardized by subtracting the mean proportion and dividing by the standard deviation of the proportions across years. Symbol sizes are scaled and values greater than average are shown as grey circles, average values are shown as small dots, and less than average values are shown as black circles. Labels in the upper and right margins identify cohorts. Only catches from the post-moratorium period (1997-2013) are shown.

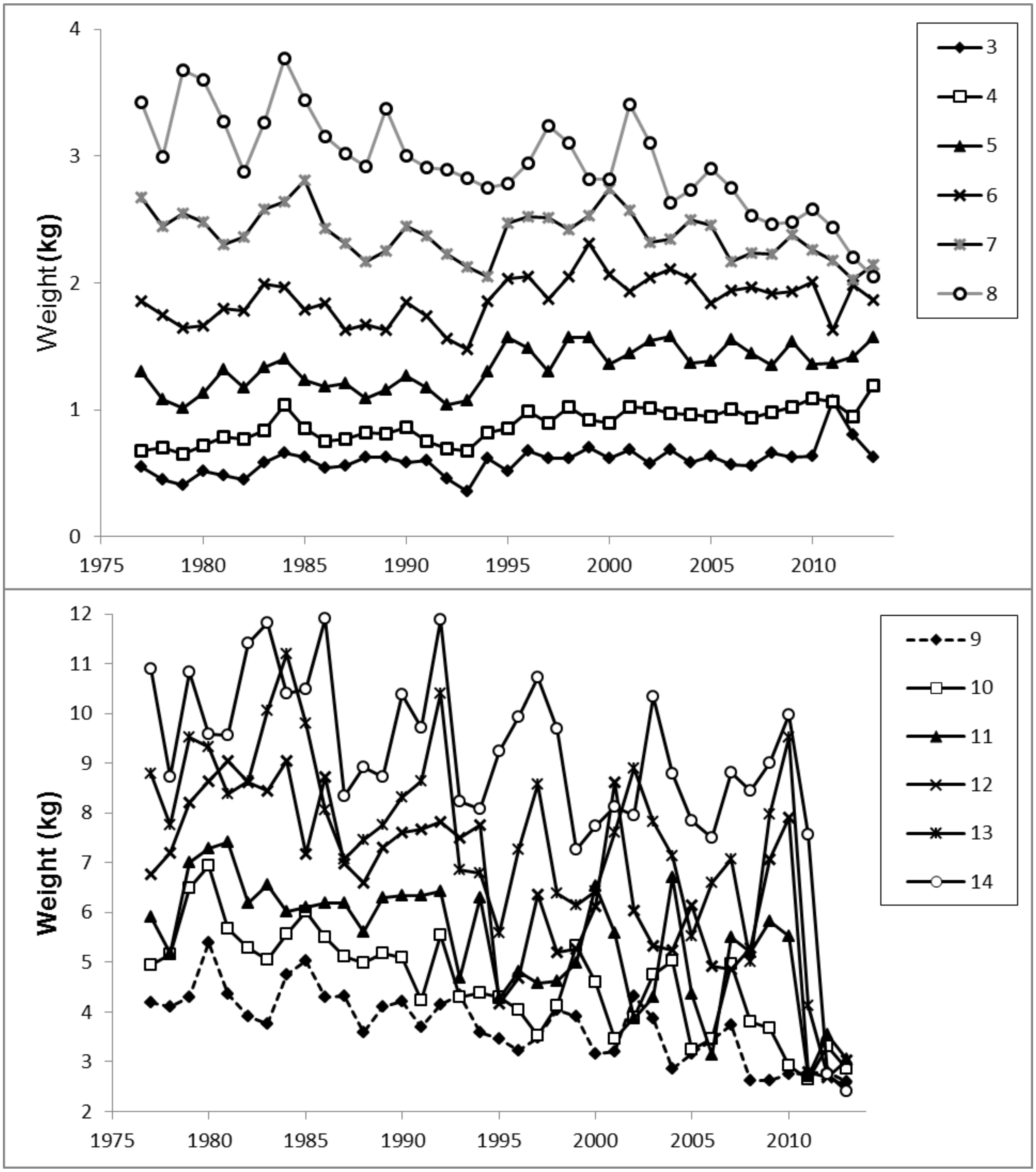


Figure 7. Mean weights-at-age calculated from mean lengths-at-age (upper panel: ages 3-8; lower panel: ages 9-14) from the commercial catch of cod in Subdiv. 3Ps during 1977 to 2013.

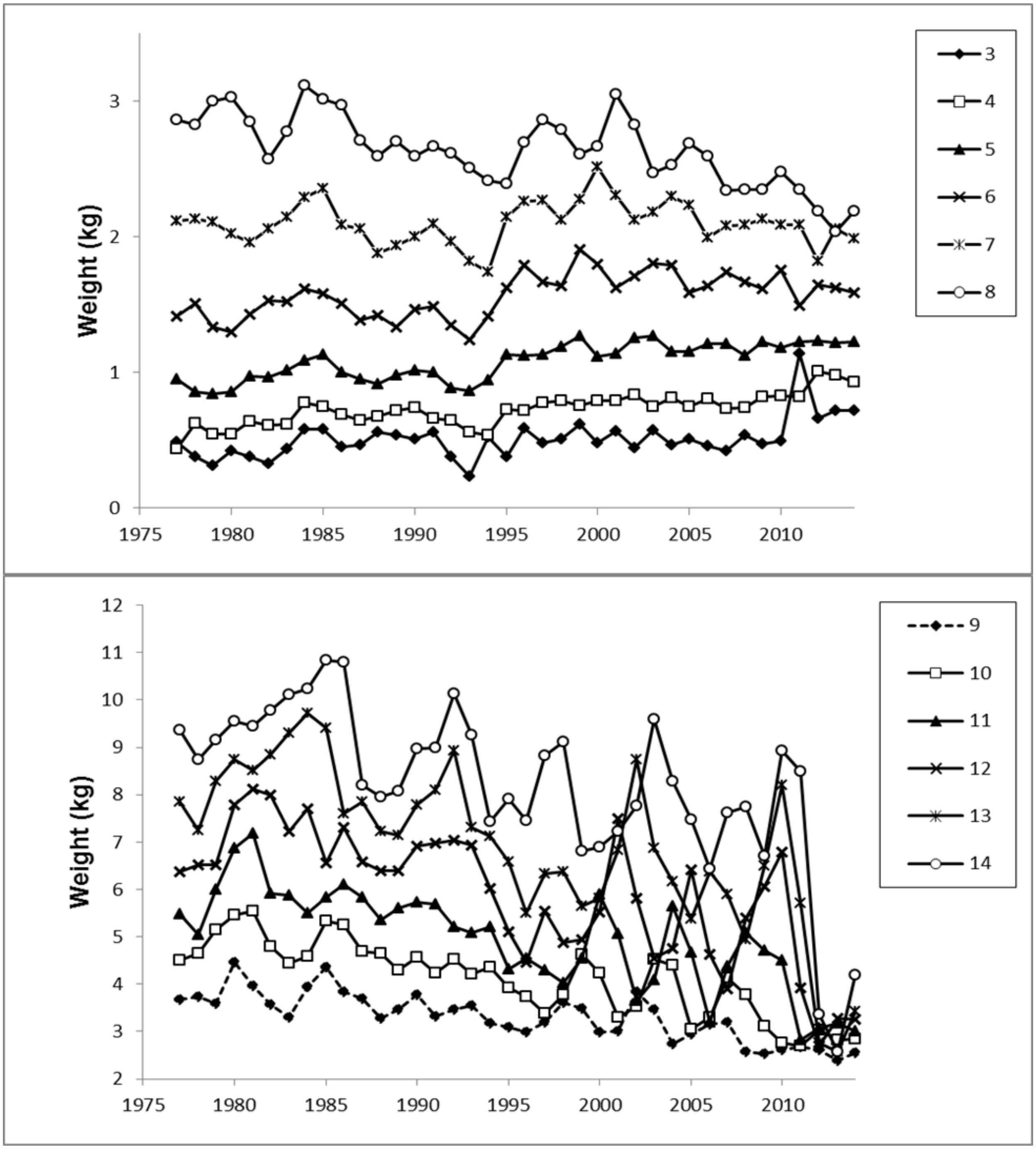
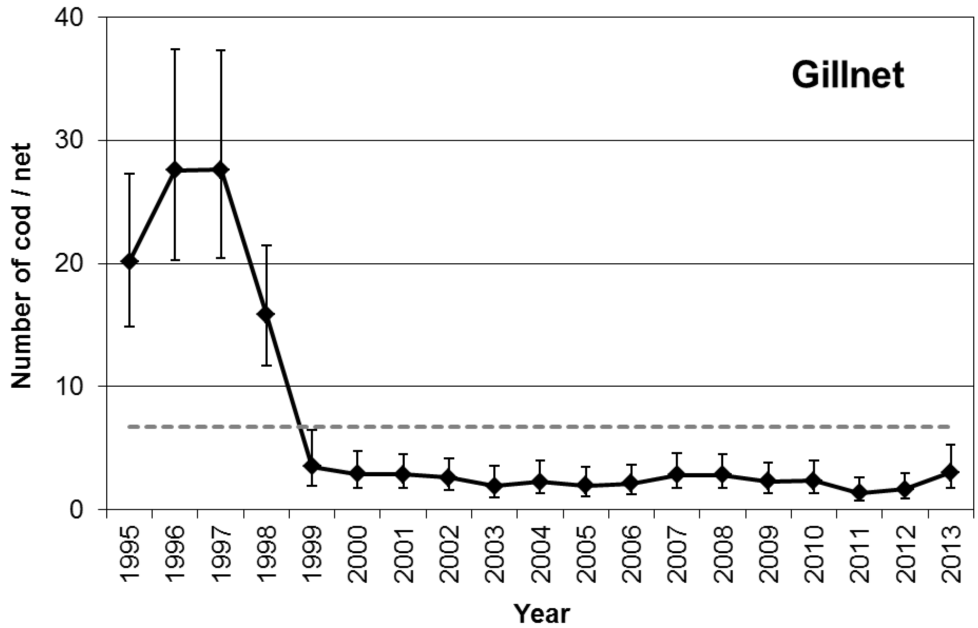


Figure 8. Beginning of year mean weights-at-age (upper panel: ages 3-8; lower panel: ages 9-14) from the commercial catch of cod in Subdiv. 3Ps during 1997 to 2013.



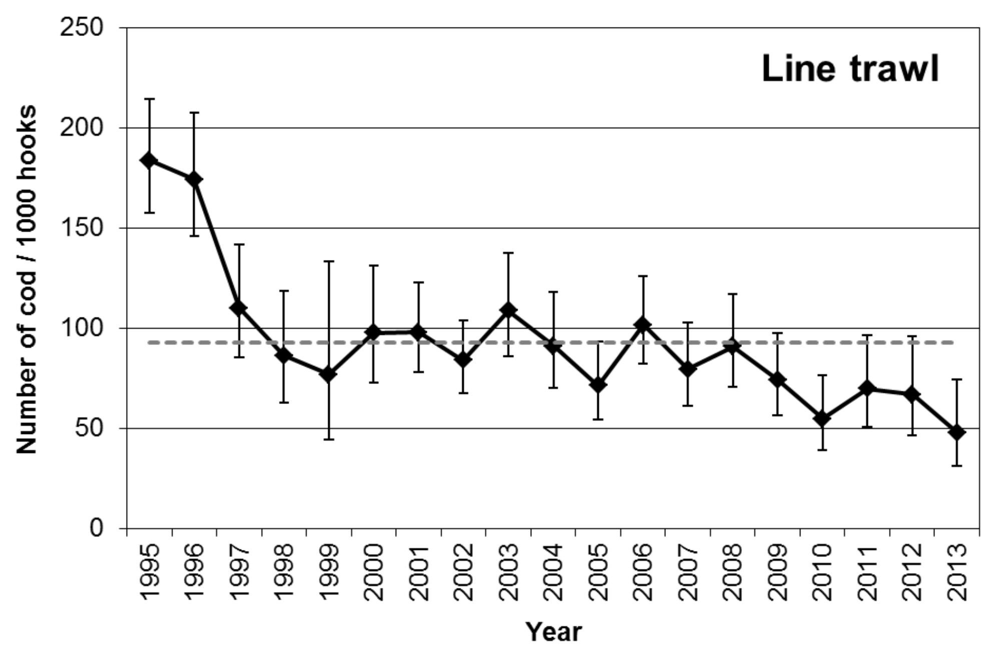
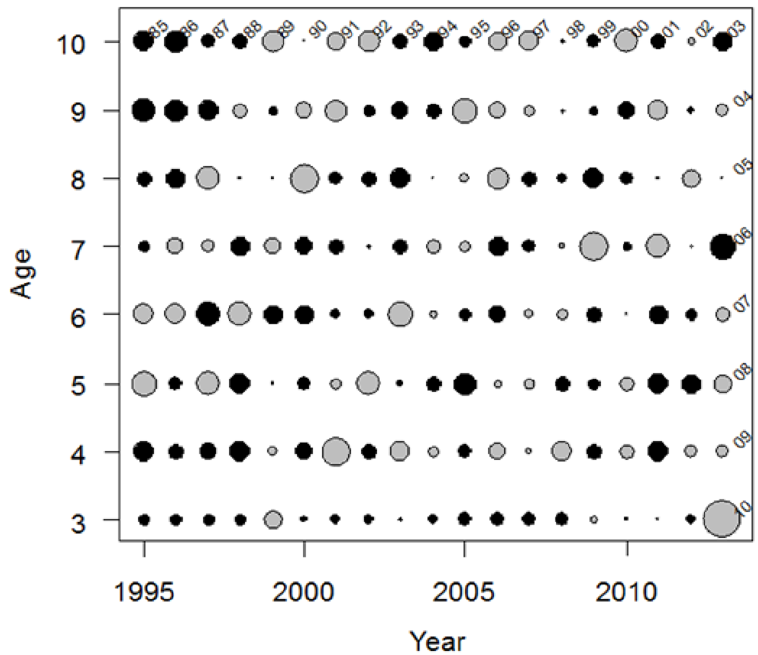


Figure 9a. Standardized age-aggregated catch rate indices for gillnets (5.5" mesh) and line-trawls (with 95% CL's) estimated using data from sentinel fishery fixed sites. Dashed horizontal lines indicate time-series average.

Gillnet



Linetrawl

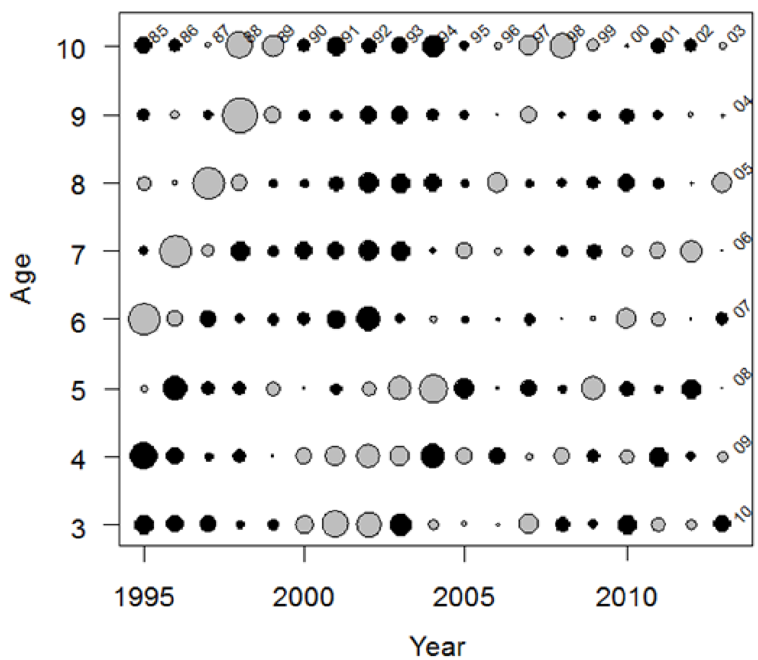


Figure 9b. Standardized proportions at age of sentinel catch rates at age in Subdiv. 3Ps. Annual proportions were computed, and then standardized by subtracting the mean proportion and dividing by the standard deviation of the proportions across years. Symbol sizes are scaled and values greater than average are shown as grey circles, average values are shown as small dots, and less than average values are shown as black circles. Labels in the upper and right margins identify cohorts.

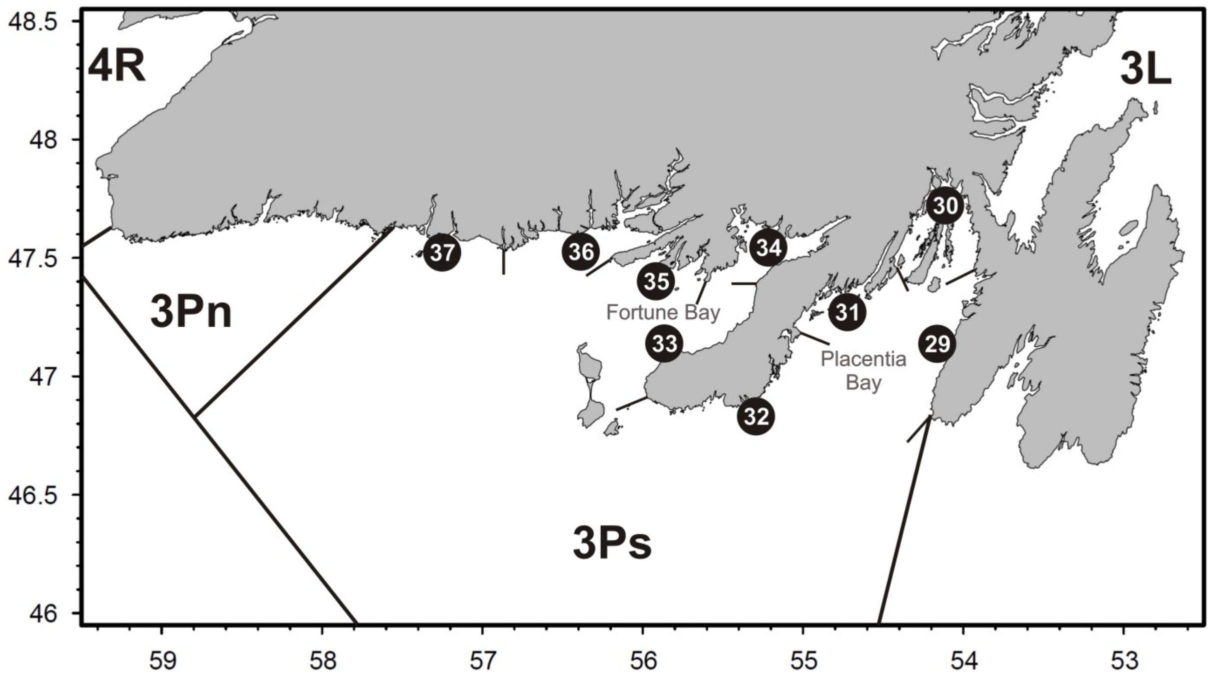


Figure 10a. Location and boundaries of numbered management areas along the inshore of the south coast of Newfoundland (NAFO Subdiv. 3Ps) (29=Placentia Bay East, 30=Head of Placentia Bay, 31=Placentia Bay West, 32=The Boot, 33=Fortune Bay, 34=Head of Fortune Bay, 35=Connaigre, 36=Hermitage Bay, 37=Francois-Burgeo).

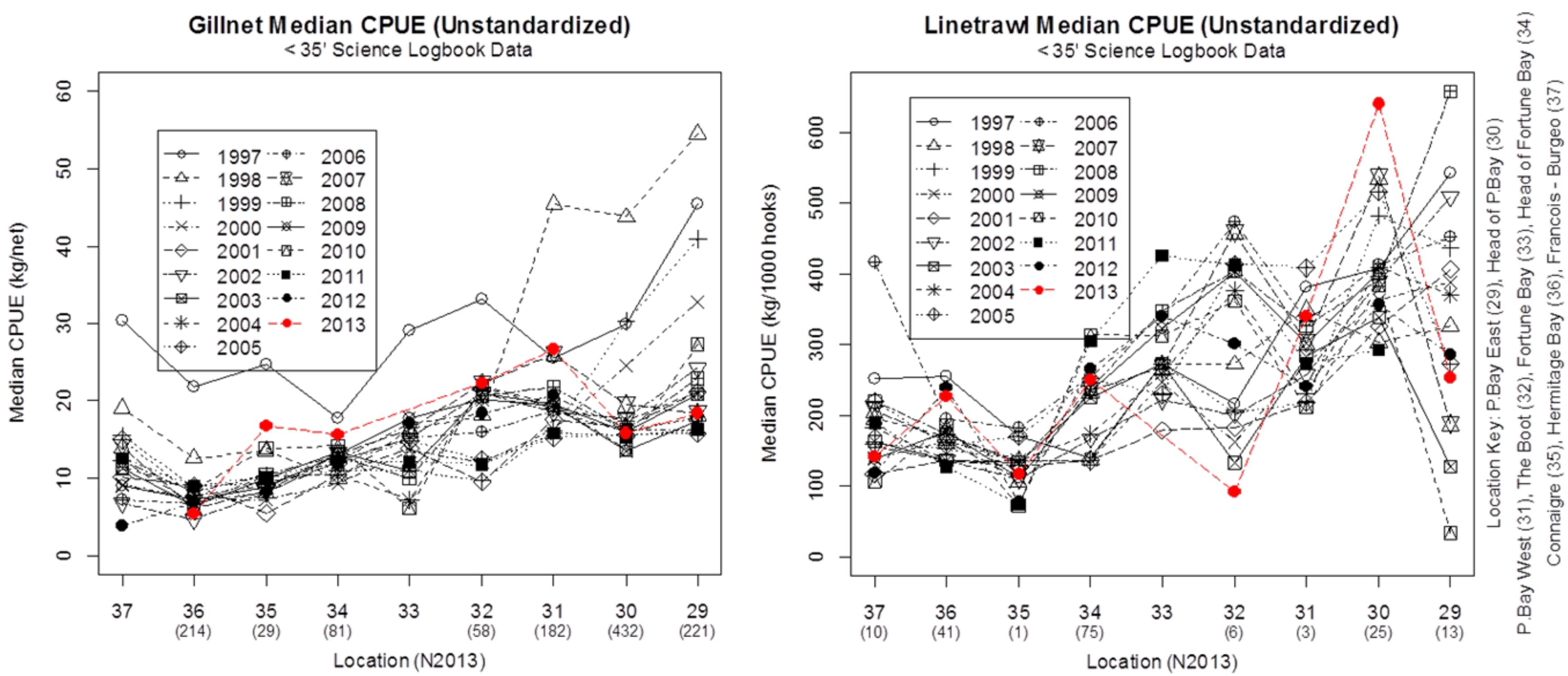
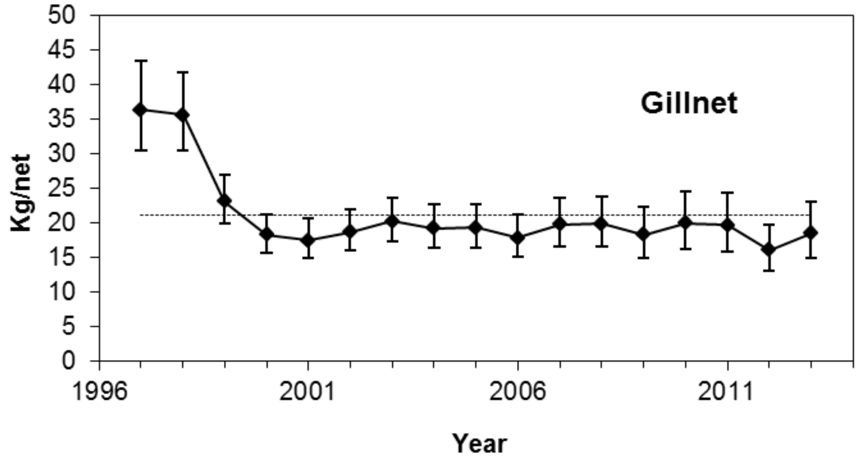


Figure 10b. Area-specific median annual catch rates of cod from gillnets (left panel, kg per net) and line-trawls (right panel, kg per 1,000 hooks) from science log-books for vessels < 35 ft. Labels on x-axis are lobster fishing areas ordered from west to east (see key on far right). Values in parenthesis on x-axis are number of valid sets per site during the 2013 fishery.



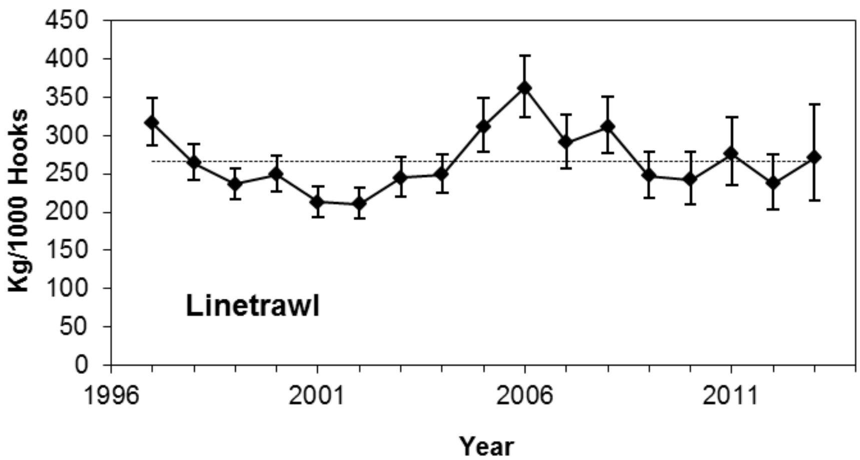


Figure 10c. Standardized catch rates for gillnets and line-trawls from science log-books for vessels < 35 ft. Horizontal dashed lines are time-series average; error bars are 95% confidence intervals of the means. Catch rates are expressed in terms of weight (kg per net or kg per 1000 hooks).

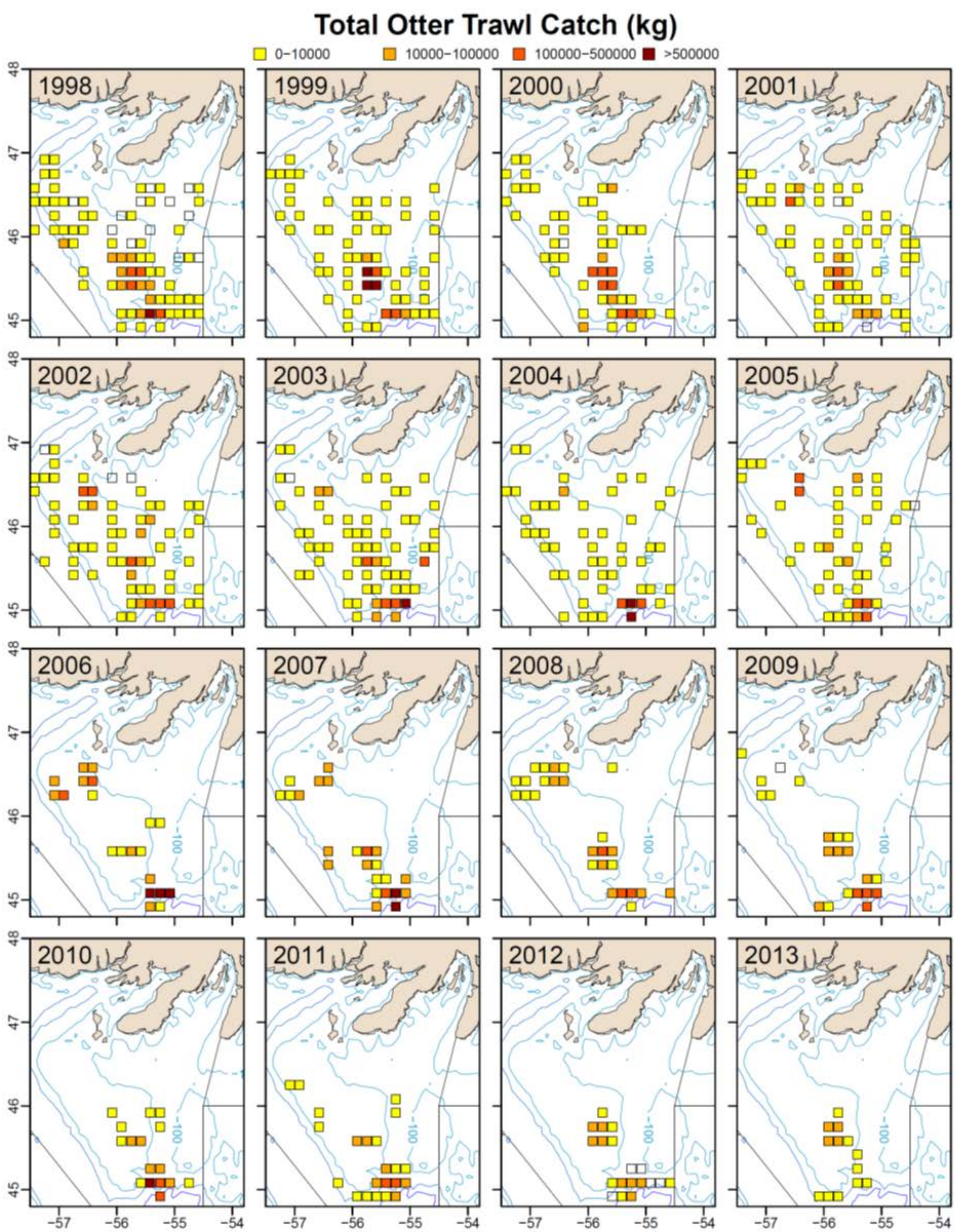


Figure 11a. Otter trawl landings of 3Ps Cod for 10 by 10 degree blocks of latitude and longitude as reported in logbooks from the > 35 ft. fleet during 1998 to 2013. Total landings are shown as four colors corresponding to four landings categories.

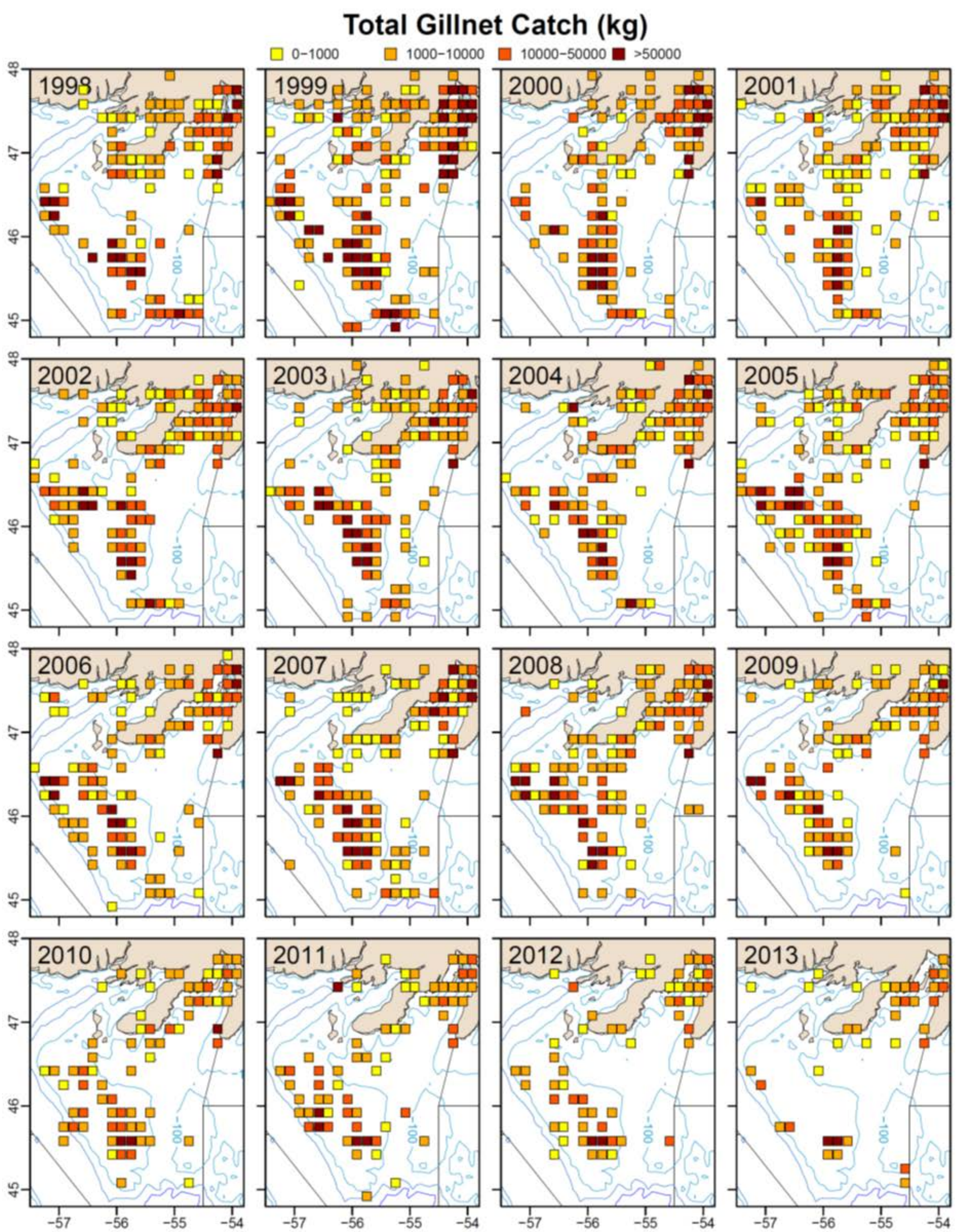


Figure 11b. Gillnet landings of 3Ps Cod for 10 by 10 degree blocks of latitude and longitude as reported in logbooks from the > 35 ft. fleet during 1998 to 2013. Total landings are shown as four colors corresponding to four landings categories.

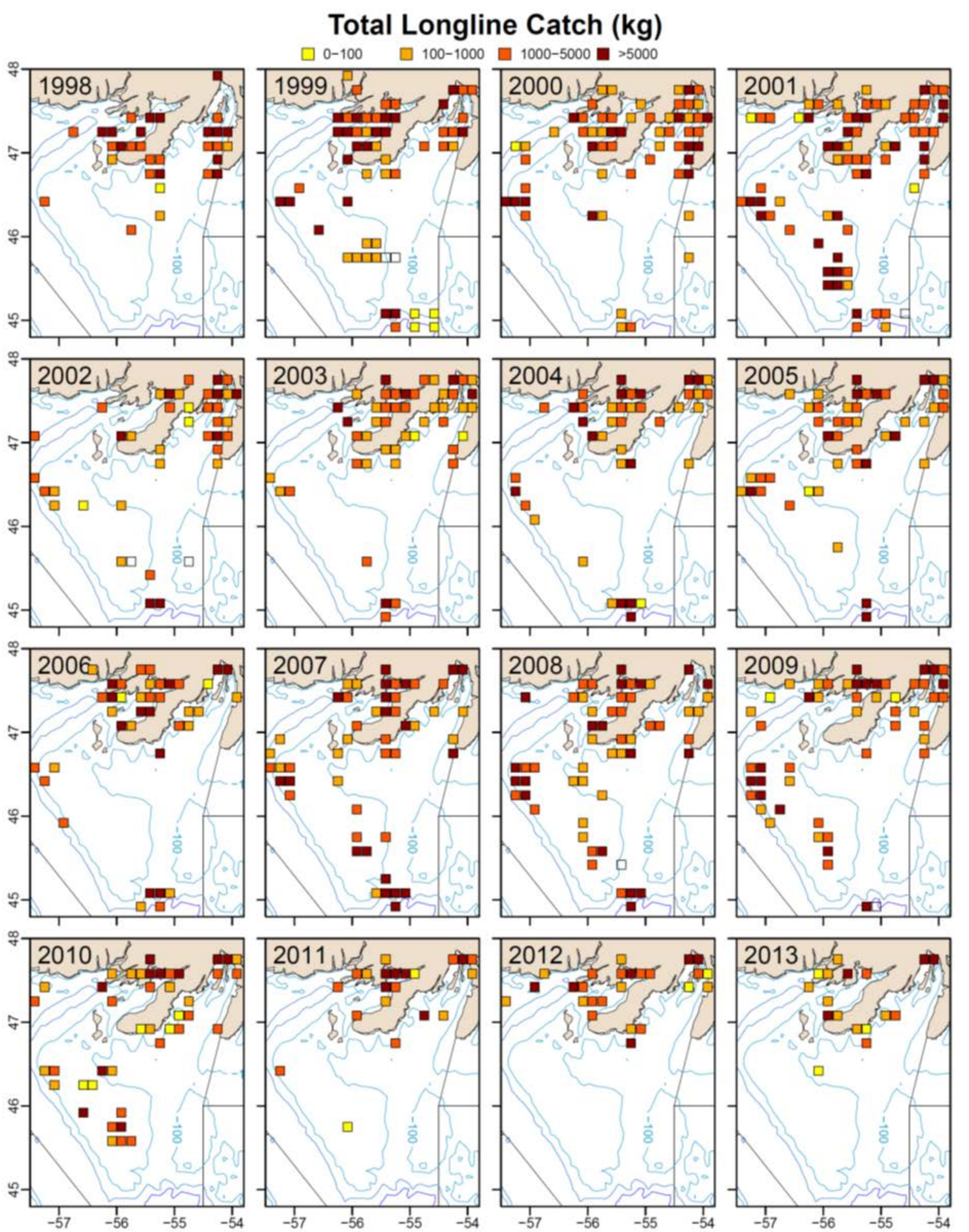


Figure 11c. Linetrawl landings of 3Ps Cod for 10 by 10 degree blocks of latitude and longitude as reported in logbooks from the > 35 ft. fleet during 1998 to 2013. Total landings are shown as four colors corresponding to four landings categories.

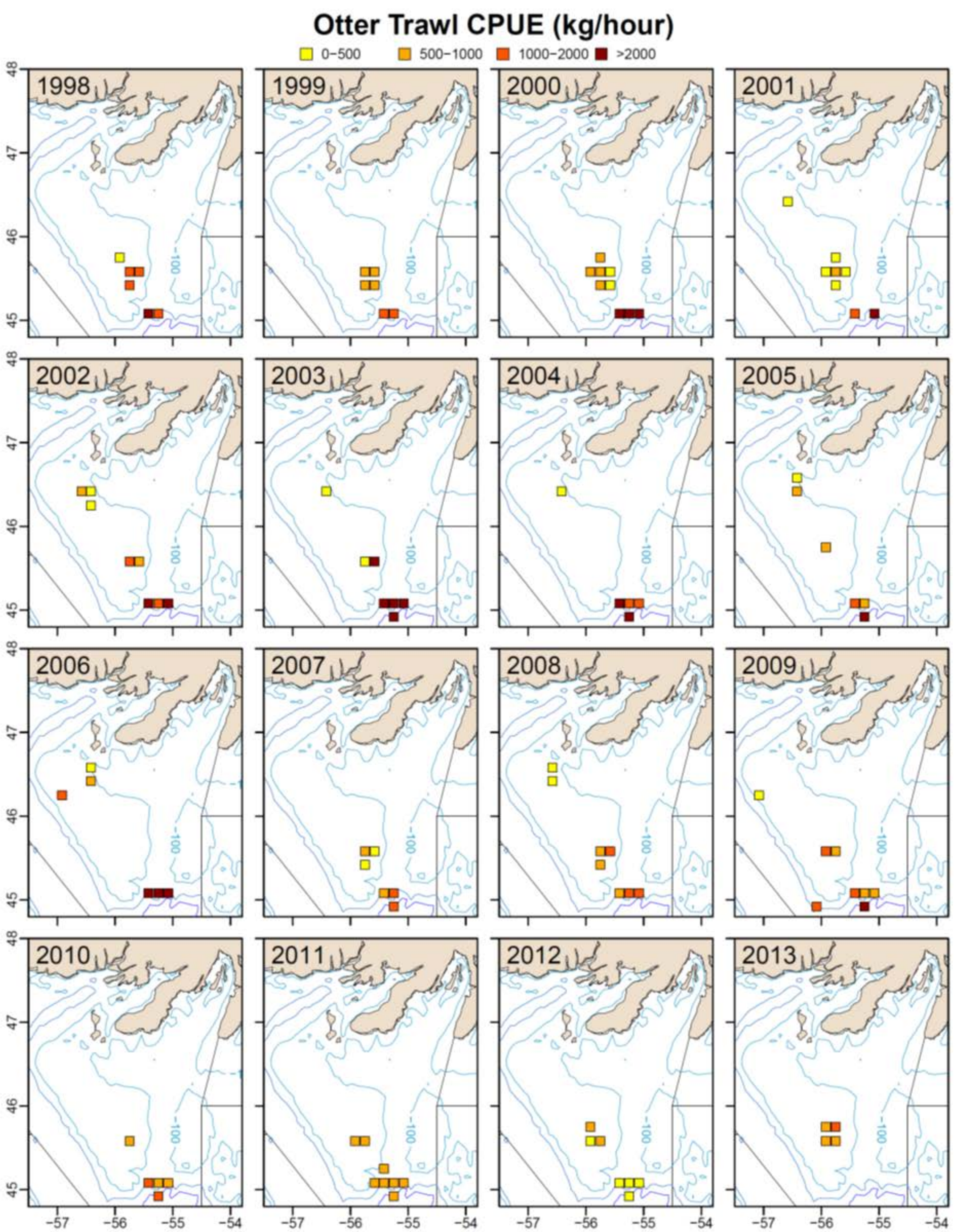


Figure 11d. Catch rates of 3Ps Cod by otter trawlers in 10 by 10 degree blocks of latitude and longitude as reported in logbooks from the > 35 ft. fleet during 1998 to 2013. Rates are calculated as kg per hour of towing and shown as four colors corresponding to four rate categories.

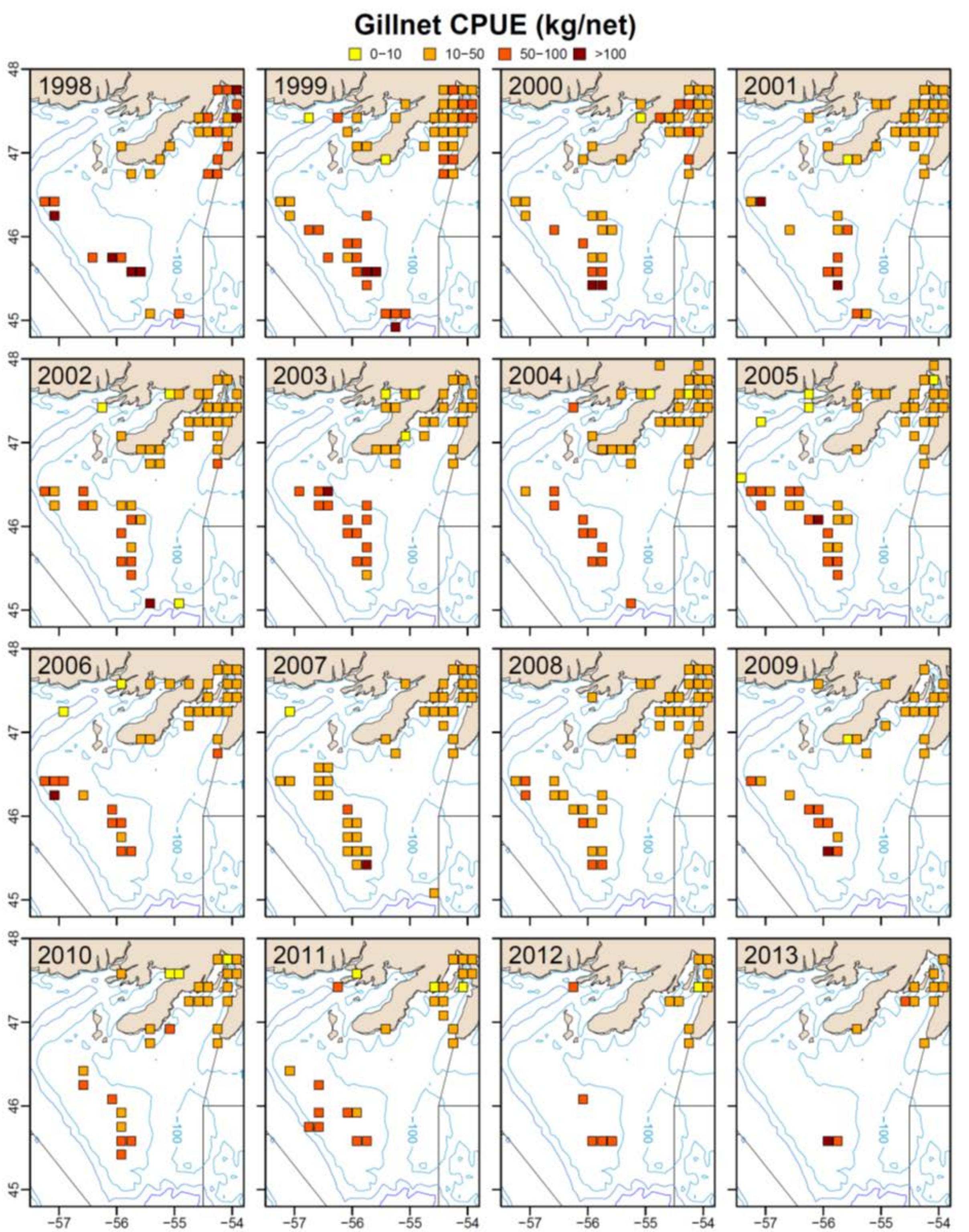


Figure 11e. Catch rates of 3Ps Cod for gillnets in 10 by 10 degree blocks of latitude and longitude as reported in logbooks from the > 35 ft. fleet during 1998 to 2013. Rates are calculated as kg per net and shown as four colors corresponding to four rate categories.

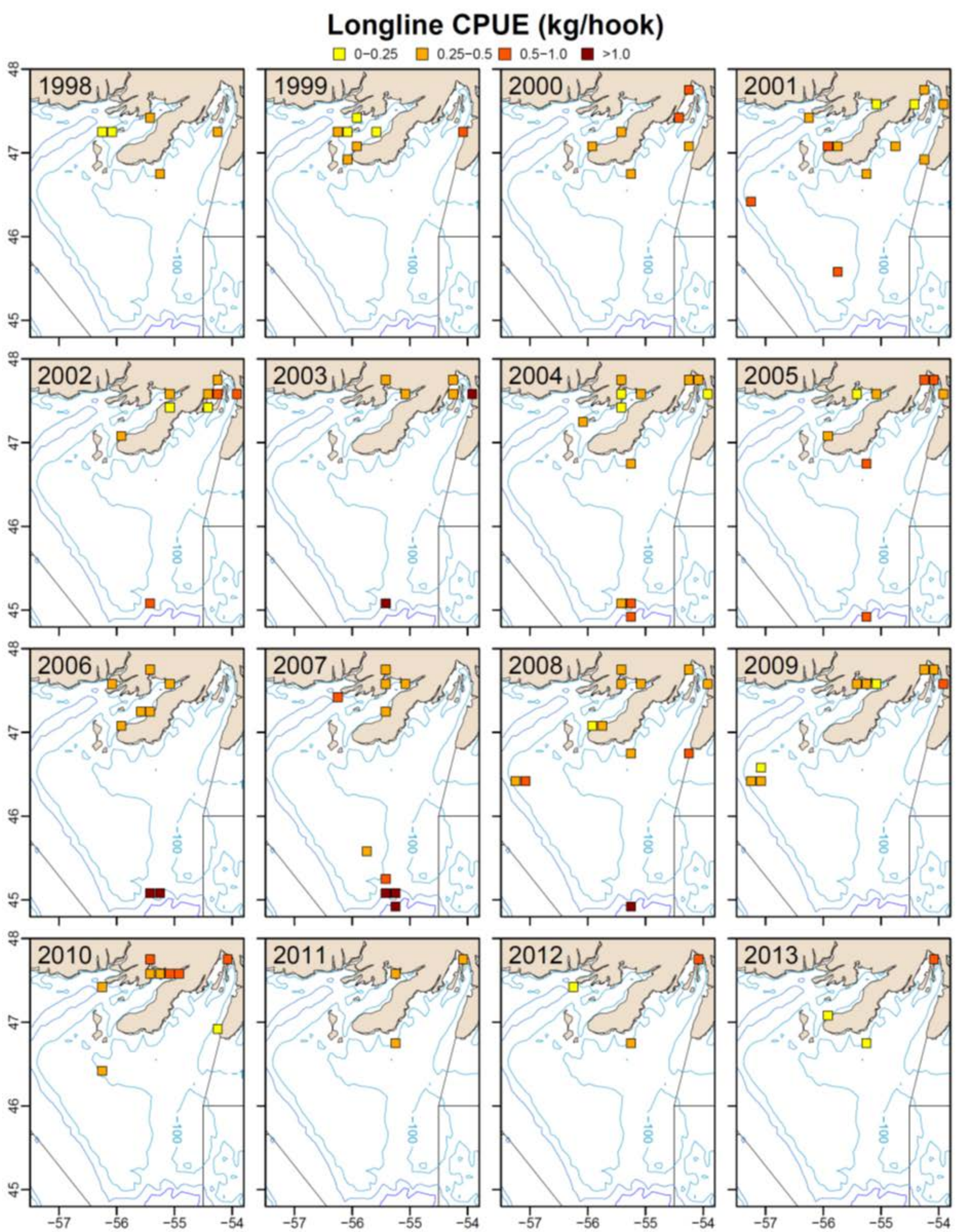


Figure 11f. Catch rates of 3Ps Cod for linetrawls in 10 by 10 degree blocks of latitude and longitude as reported in logbooks from the > 35 ft. fleet during 1998 to 2013. Rates are calculated as kg per hook and shown as four colors corresponding to four rate categories.

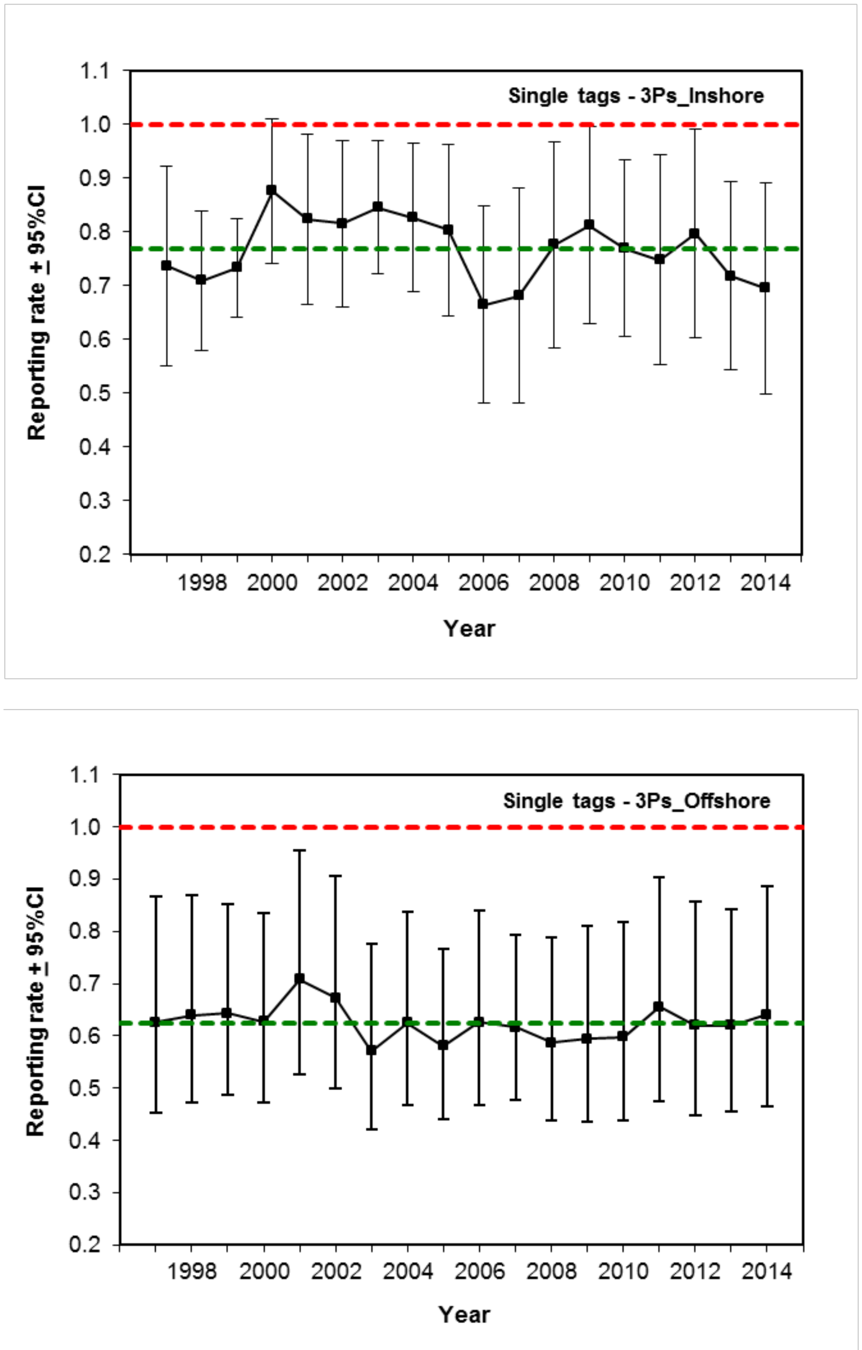


Figure 12. Trends in annual tag reporting rates (± CI's) for low reward ($10) tags based on a mixed effects logistic regression model. Horizontal dashed green line is time series average.

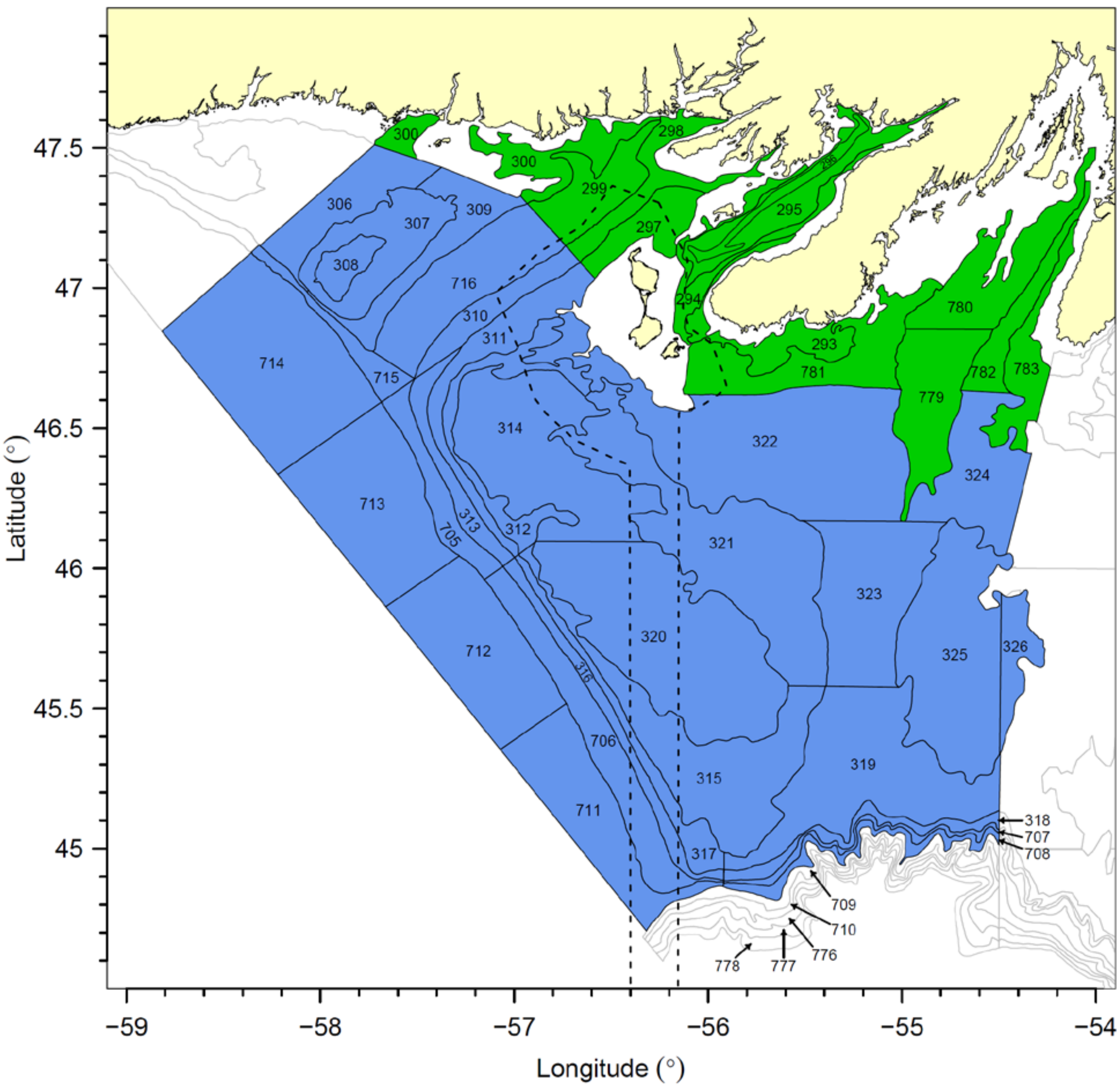


Figure 13. Stratum area boundaries and area surveyed during the DFO research vessel bottom-trawl survey of NAFO Subdiv. 3Ps. Offshore strata are shaded blue. Inshore strata were added in 1994 (strata 779-783) and 1997 (strata 293-300) and are shaded green. The dashed line represents the boundary of the French economic zone.

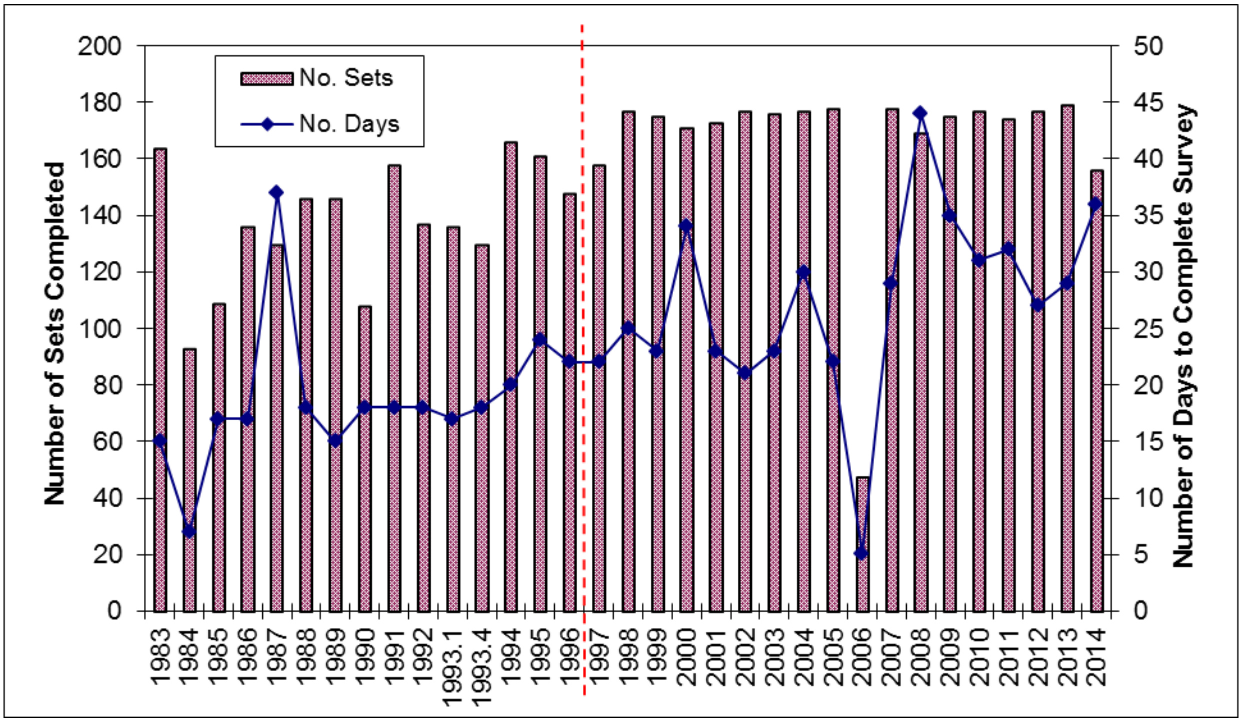


Figure 14. Number of research vessel survey sets completed during surveys of NAFO Subdiv. 3Ps, and the number of days required to complete these sets over 1983-2014. Survey coverage was expanded to present levels (i.e. covering all inshore and offshore index strata) in 1997 (dashed vertical line).

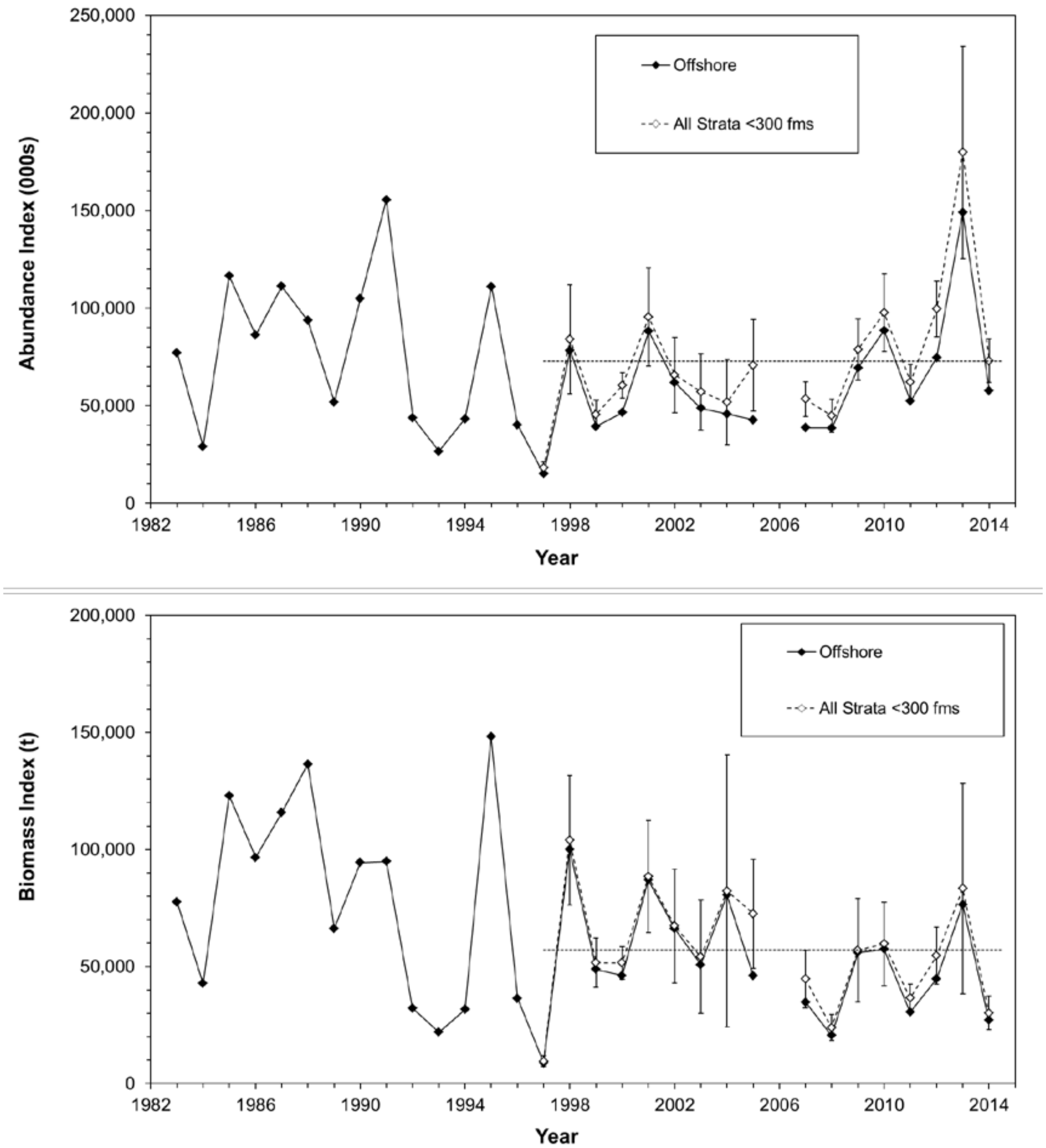


Figure 15. Abundance (upper panel) and biomass (lower panel) indices for cod in NAFO Subdiv. 3Ps from DFO research vessel bottom trawl surveys of index strata during winter/spring from 1983 to 2014. Error bars show plus/minus one standard deviation. Open symbols show values for the augmented survey area that includes additional inshore strata added to the survey in 1997. Dashed horizontal lines are means of the time-series for all index strata.

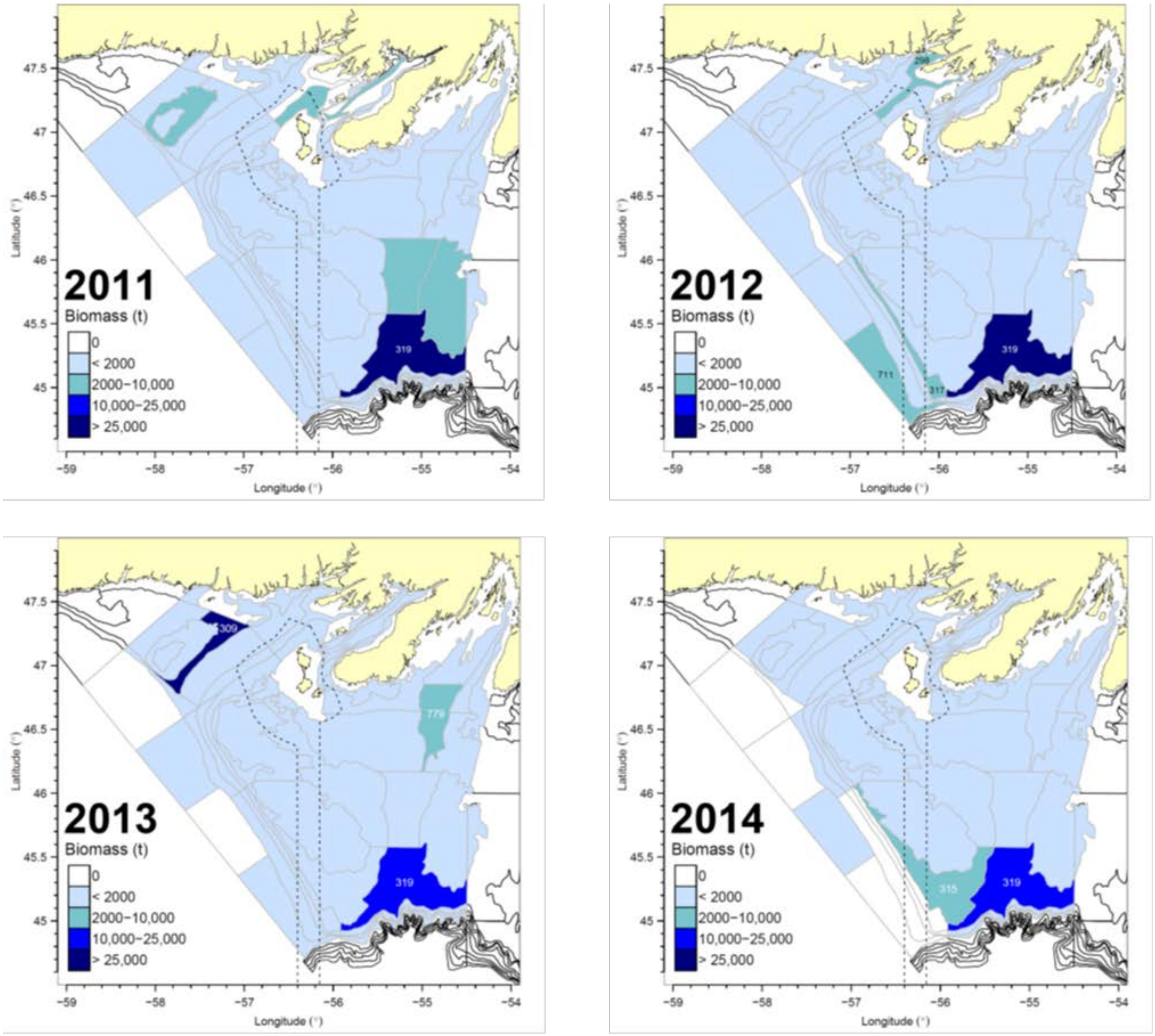


Figure 16. Stratum-specific biomass estimates of cod in Subdiiv. 3Ps based on the DFO RV survey.

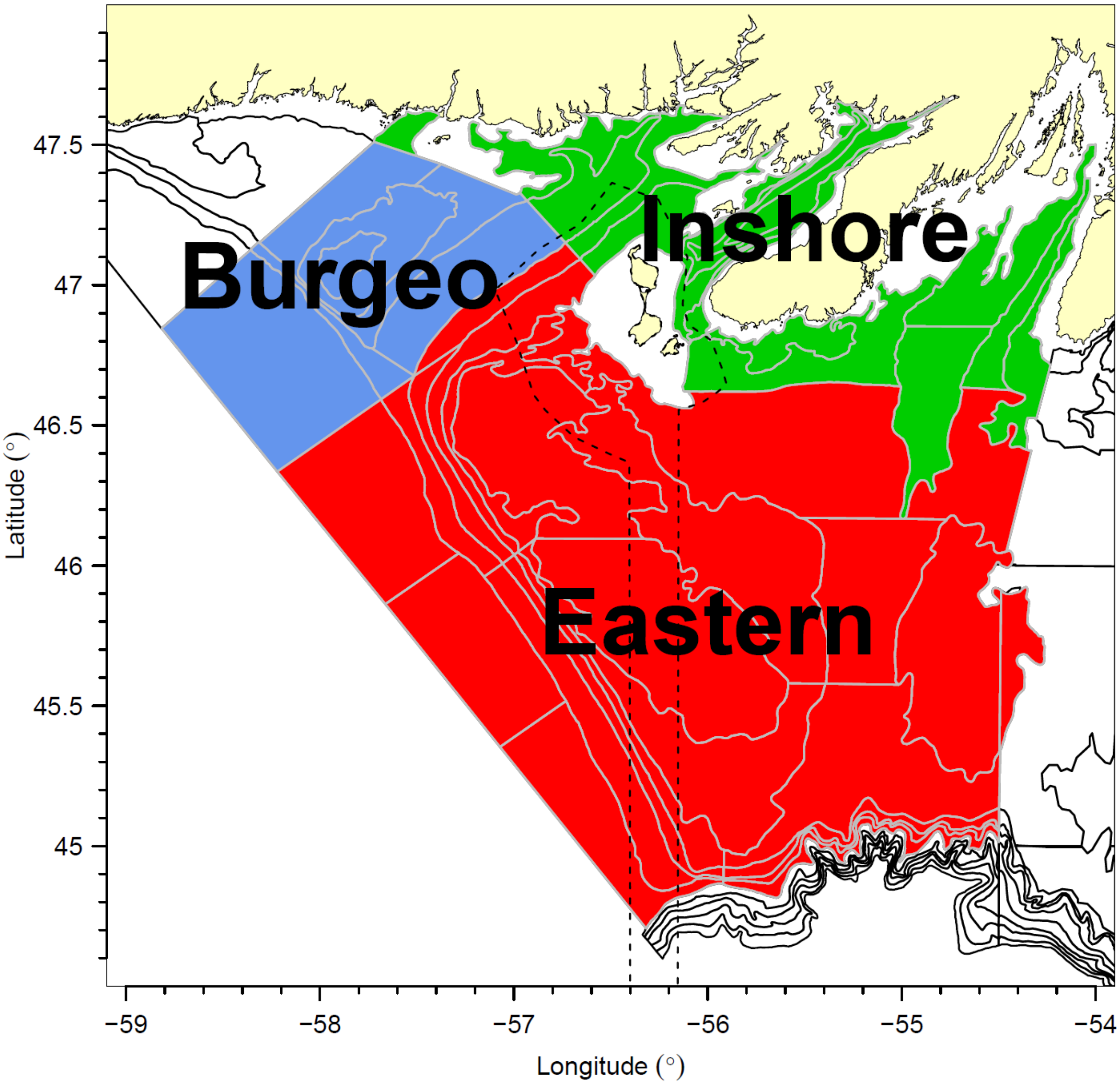


Figure 17. NAFO Subdiv. 3Ps management zone illustrating the allocation of survey strata into 'Inshore', 'Burgeo', and 'Eastern' regions. Survey trends for the three regions are depicted in Fig. 17.

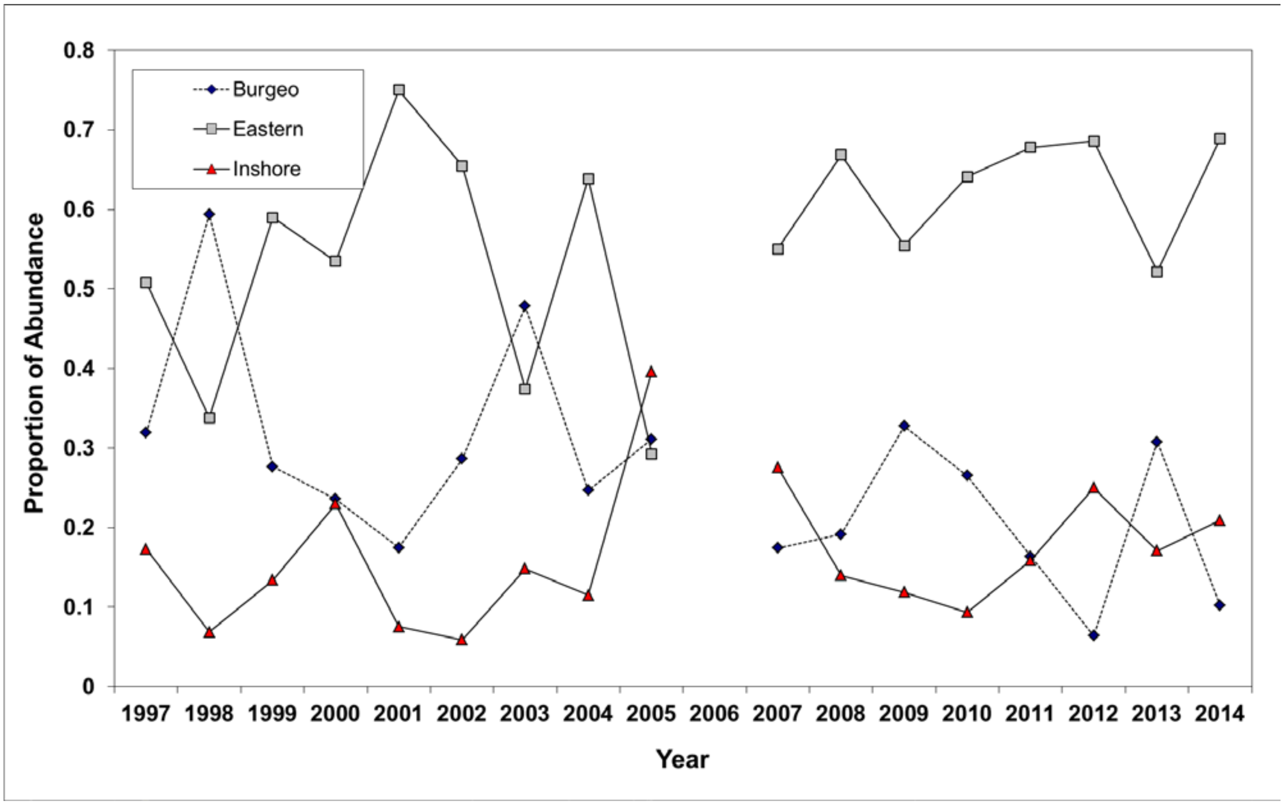


Figure 18. Total abundance index for cod in various regions of NAFO Subdiv. 3Ps from DFO research vessel bottom trawl surveys during winter/spring from 1997 to 2014. The 2006 survey was not completed. The Campelen trawl was used in all surveys.

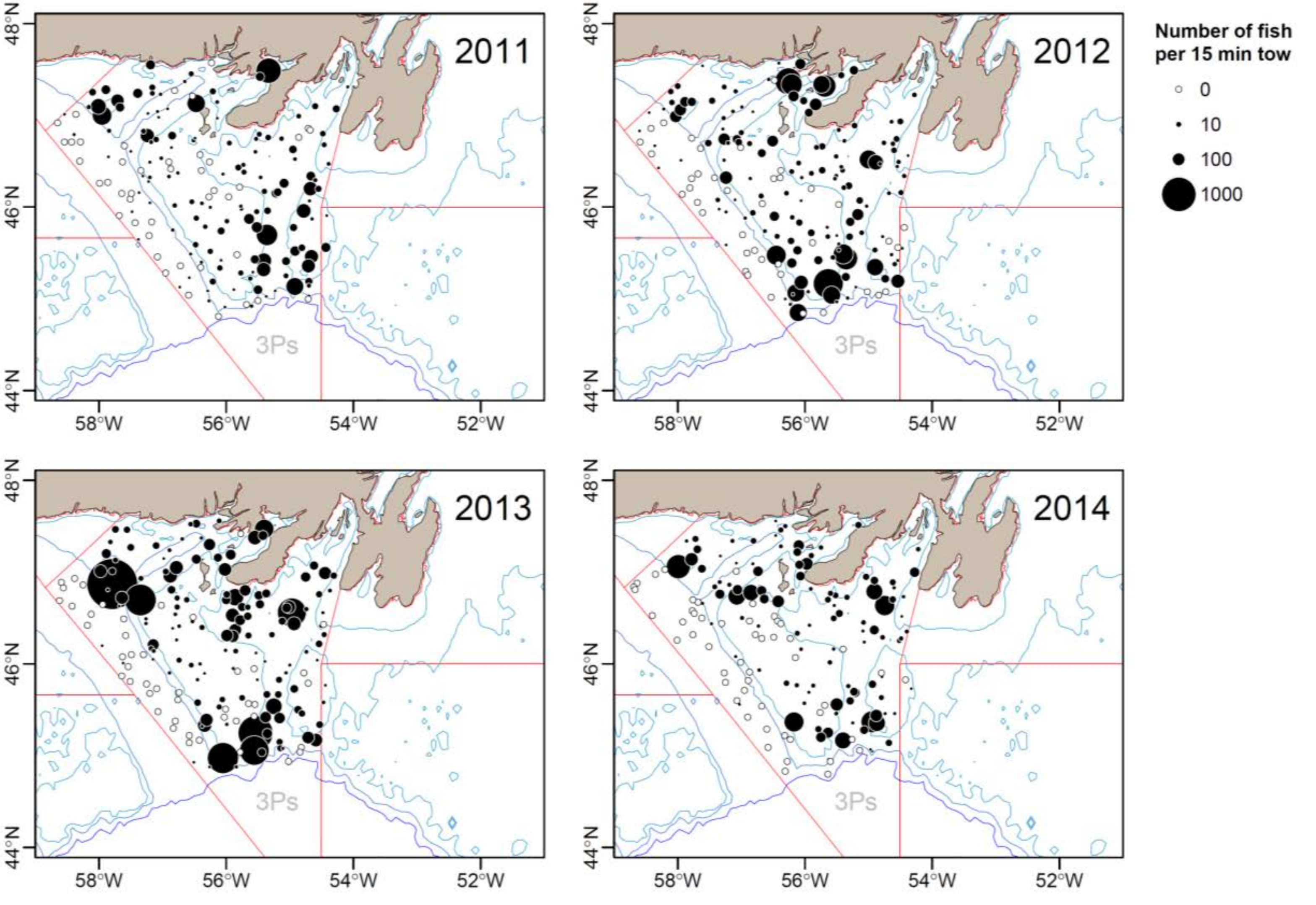


Figure 19a. Age aggregated distribution of cod catches (nos. per tow) from the April DFO research vessel surveys of NAFO Subdiv. over 2011-14. Bubble size is proportional to numbers caught.

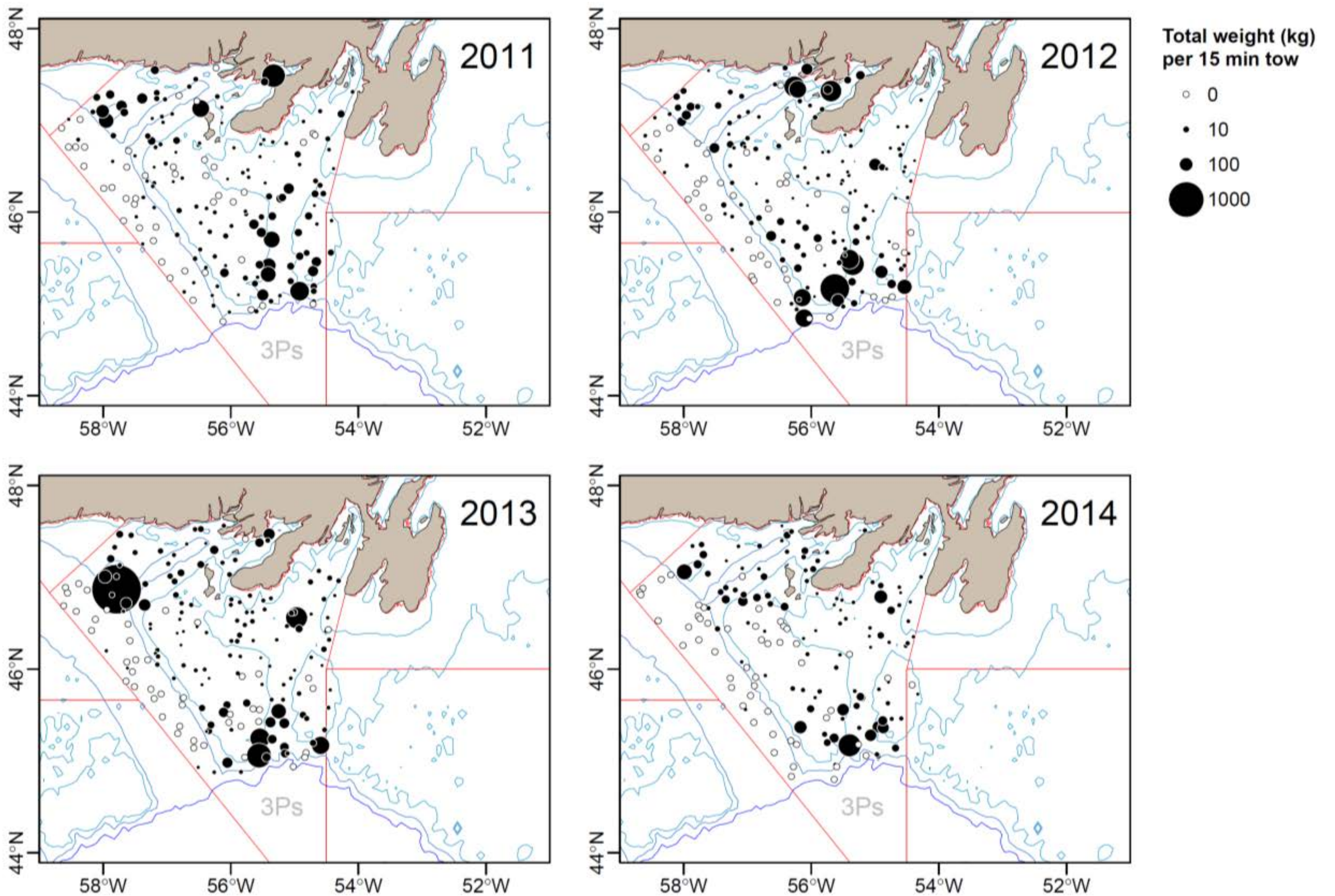


Figure 19b. Age aggregated distribution of cod catches (weight per tow) from the April DFO research vessel surveys of NAFO Subdiv. 3Ps over 2011-14. Bubble size is proportional to total weight caught.

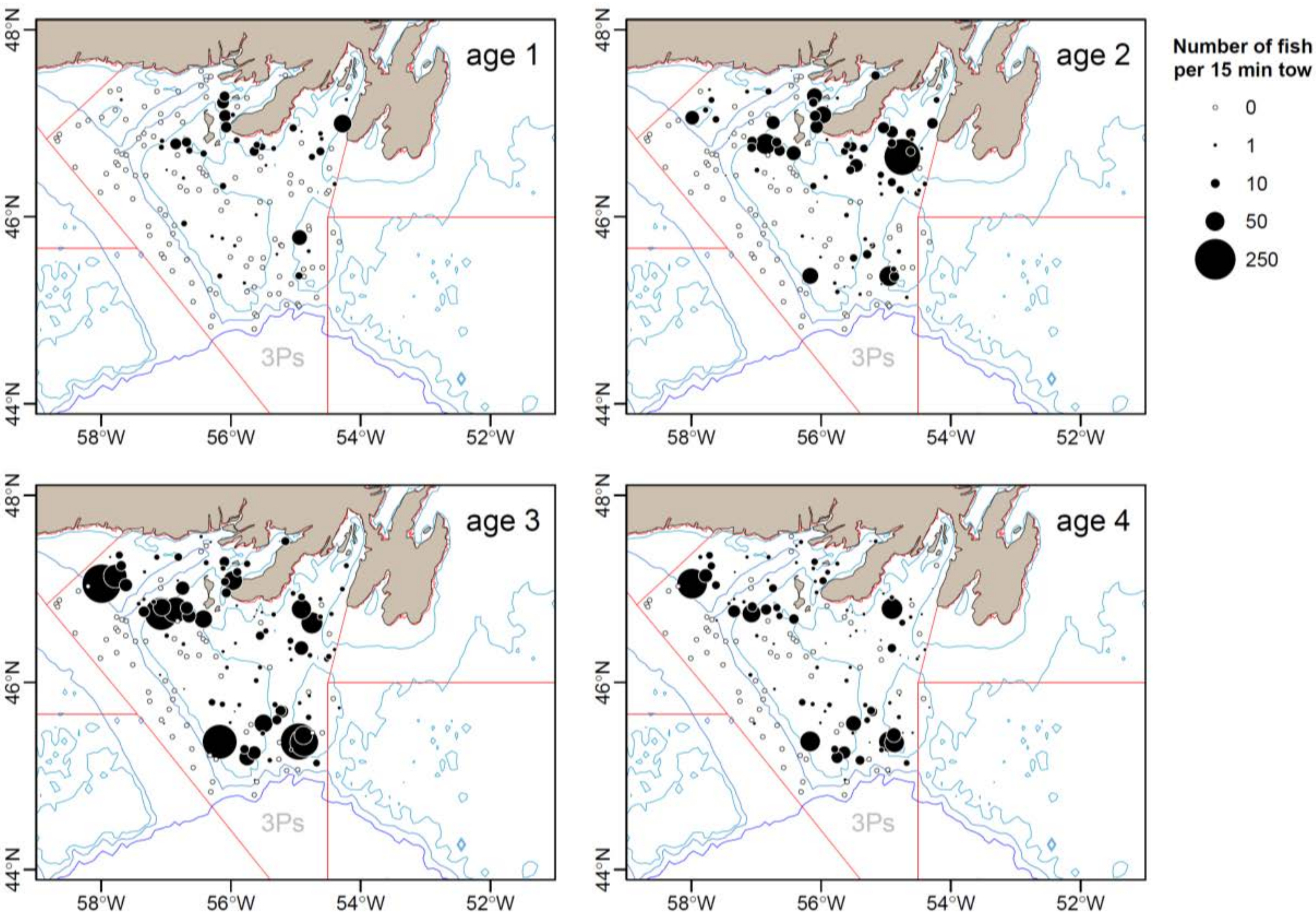


Figure 19c. Age dis-aggregated distribution of cod catches (nos. per tow, ages 1-4) from the April 2014 DFO research vessel survey of NAFO Subdiv. 3Ps. Bubble size is proportional to numbers caught.

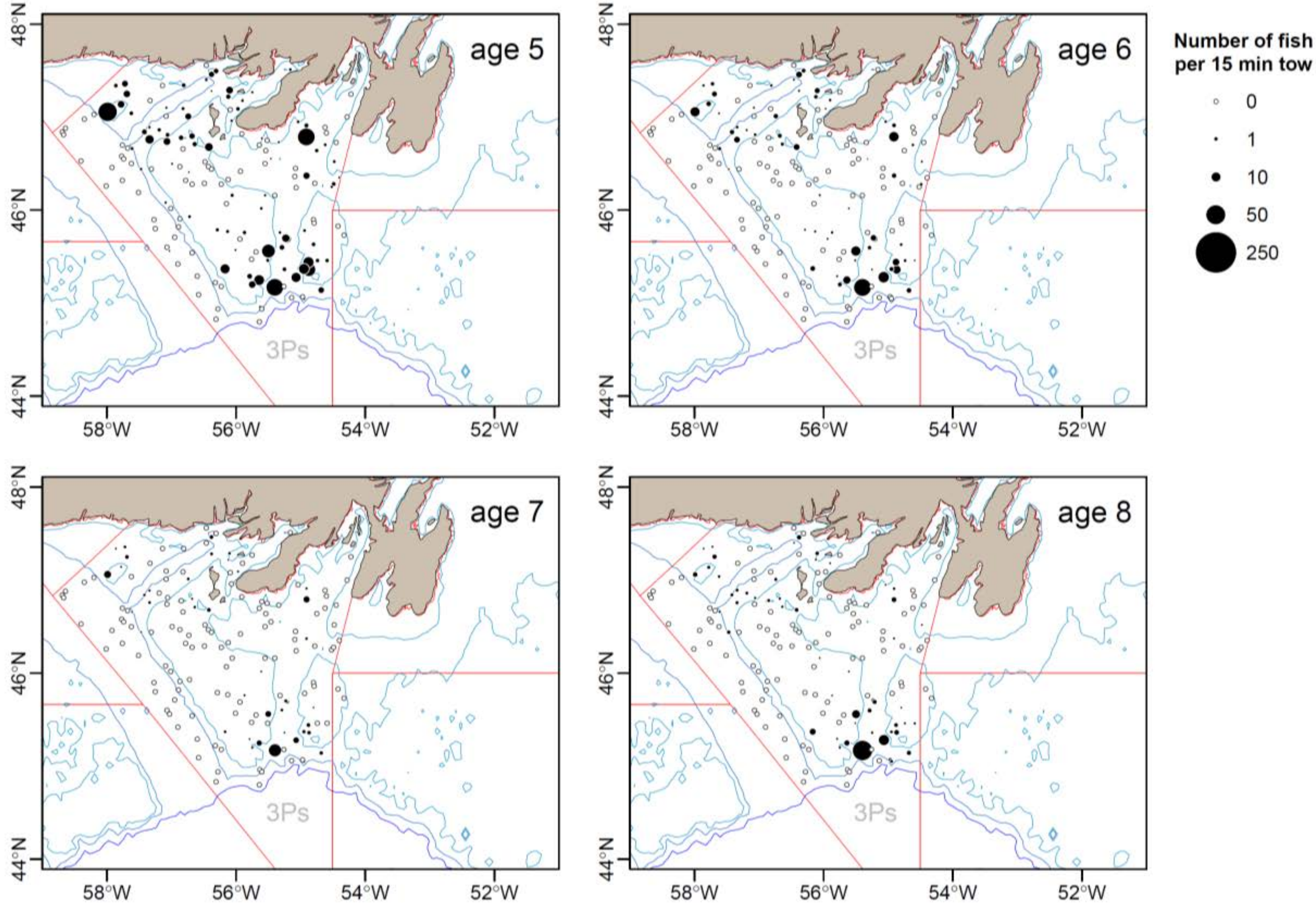


Figure 19c. Continued.

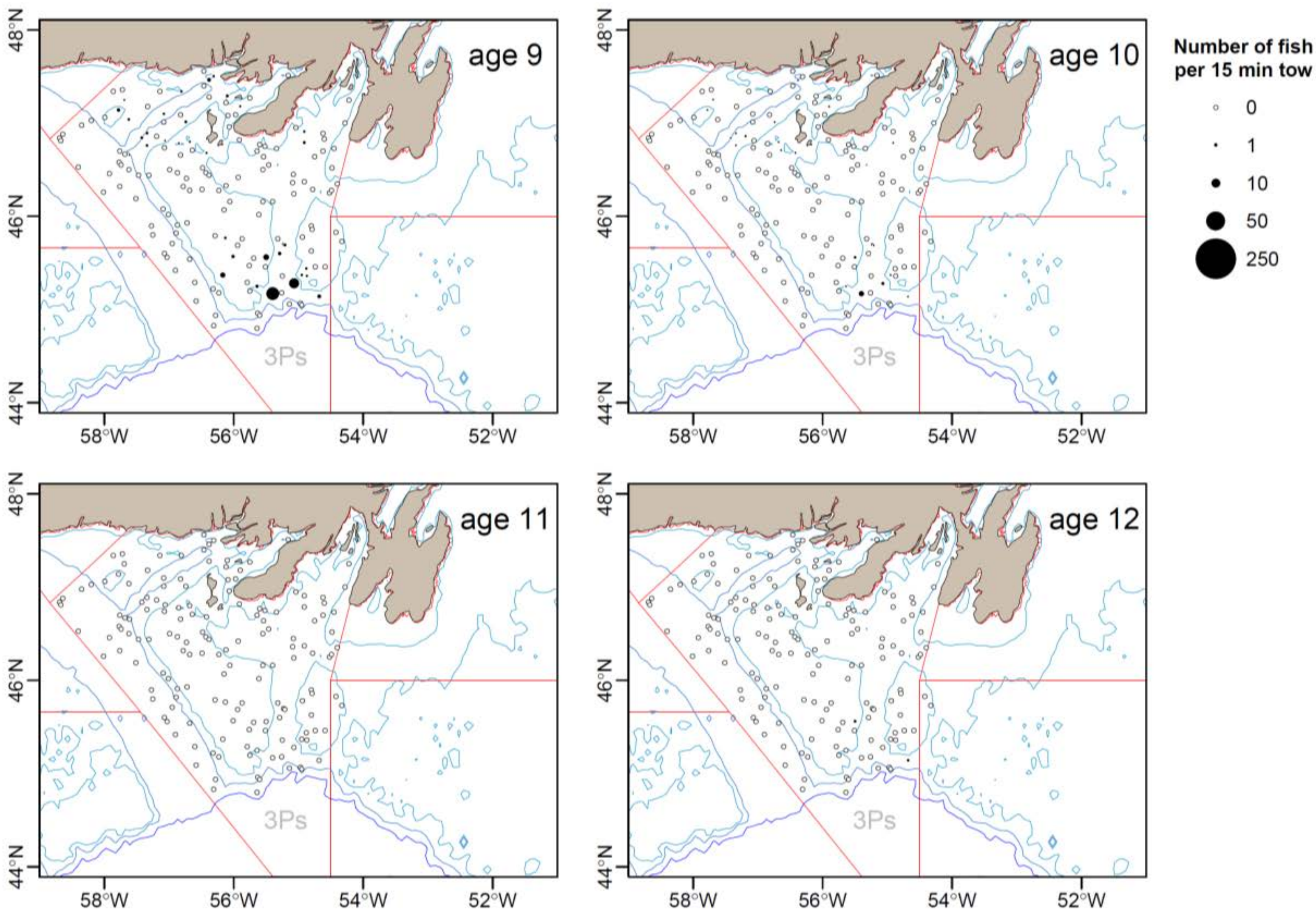


Figure 19c. Continued.

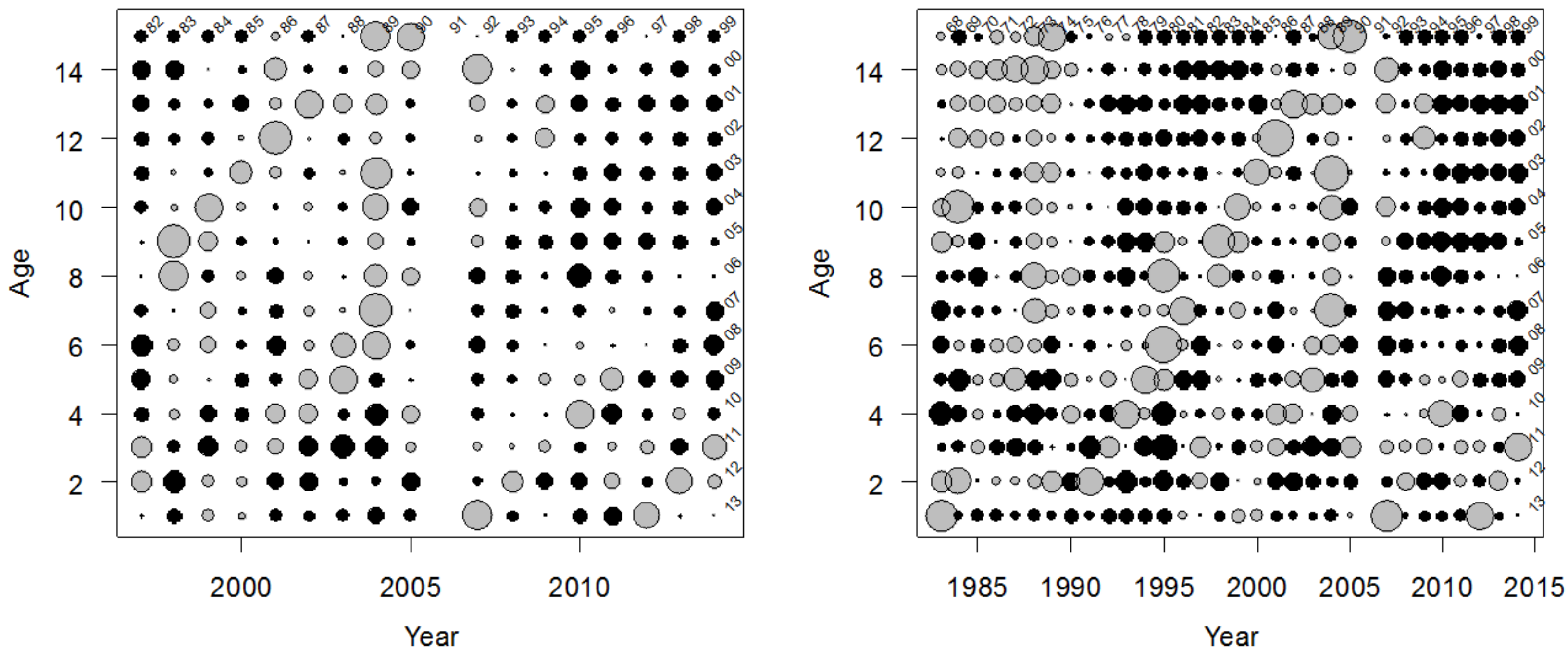


Figure 20. Standardized age-disaggregated catch rates from the spring bottom trawl survey of Subdiv. 3Ps. Catch rates (mean nos per tow) were converted to proportions within each year. Values were standardized by subtracting the mean proportion and dividing by the standard deviation of the proportions computed across years. Symbol sizes are scaled and values greater than average are shown as grey circles, average values are shown as small dots, and less than average values are shown as black circles. Labels in the upper and right margins identify cohorts. Left panel includes the 1997-2014 "All Strata < 300 fm" data, and panel at right includes data which comprise the "Offshore" index (1983-2014).

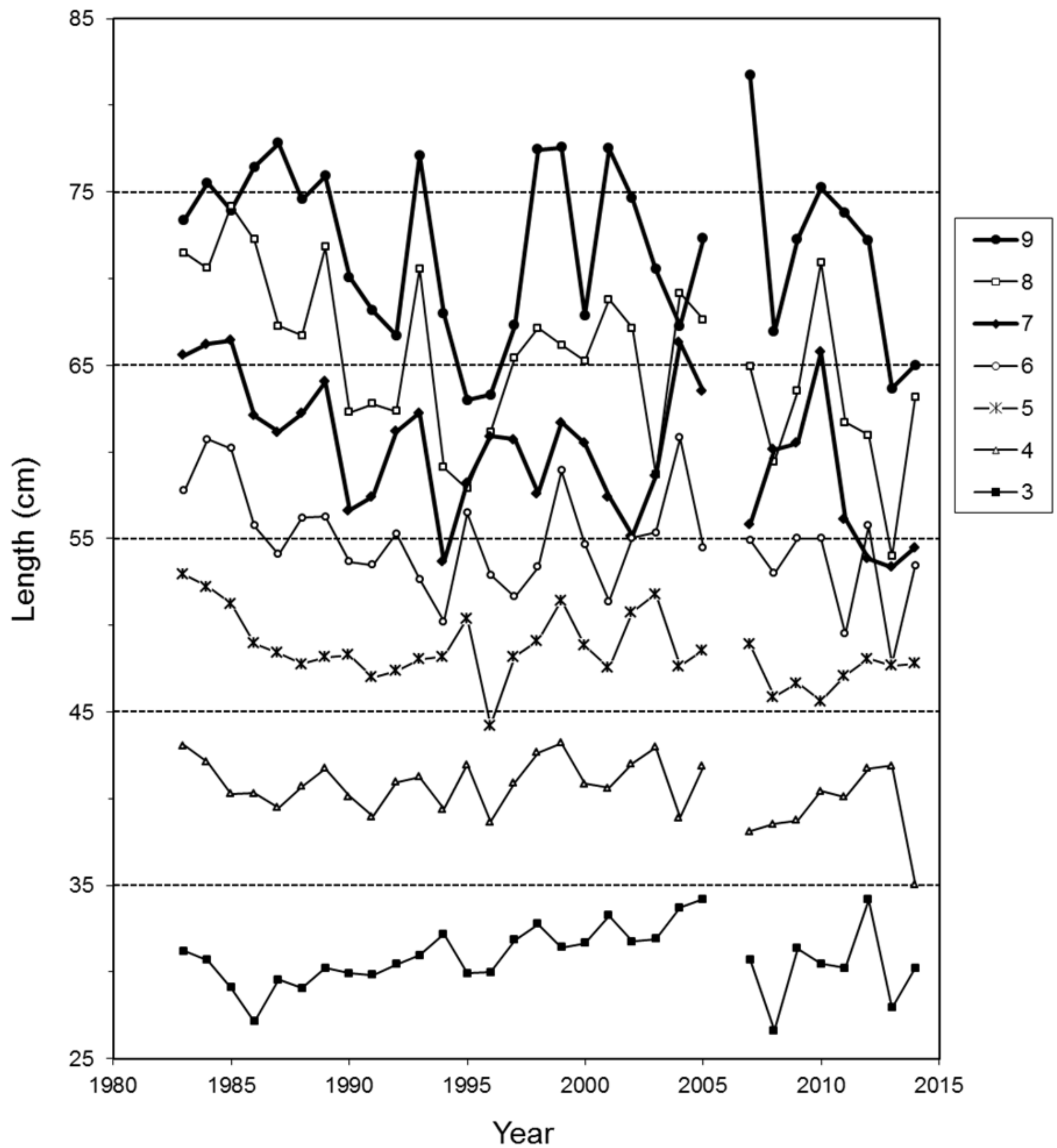


Figure 21a. Mean length at ages 3-9 of cod in Subdiv. 3Ps during 1983-2014 from sampling during DFO bottom-trawl surveys in winter-spring.

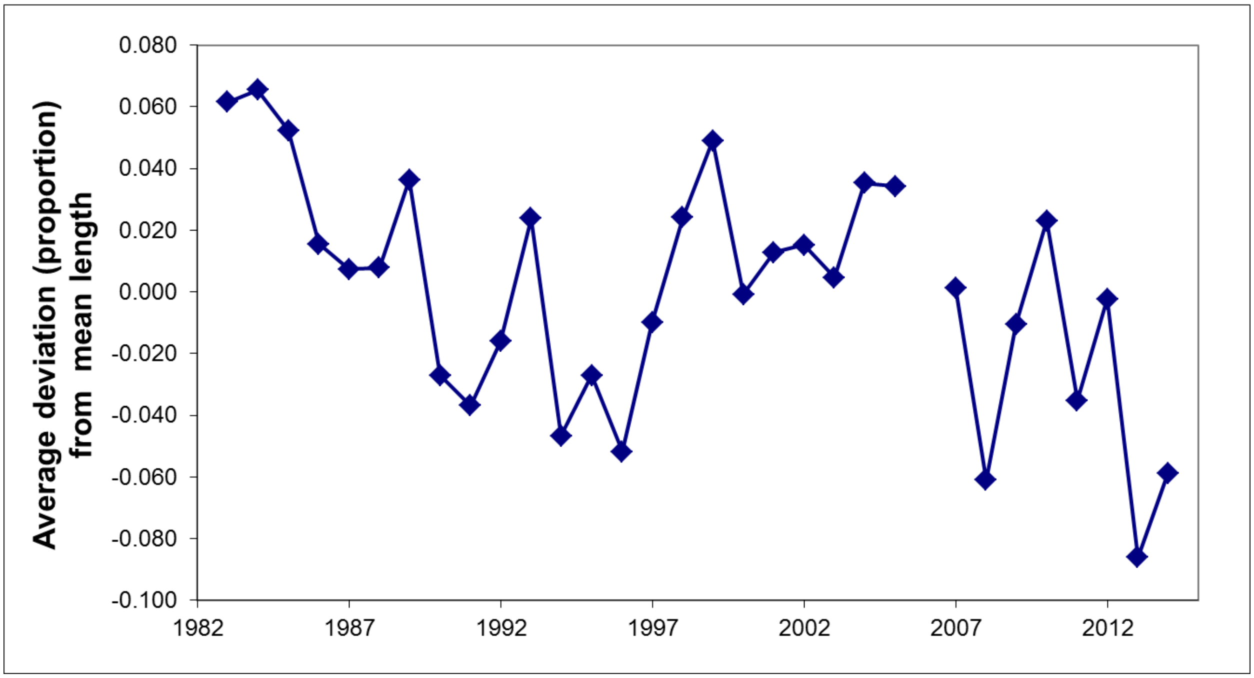


Figure 21b. Average proportion deviation from mean length at age for ages 3-9 from DFO bottom-trawl surveys from 1983-2014.

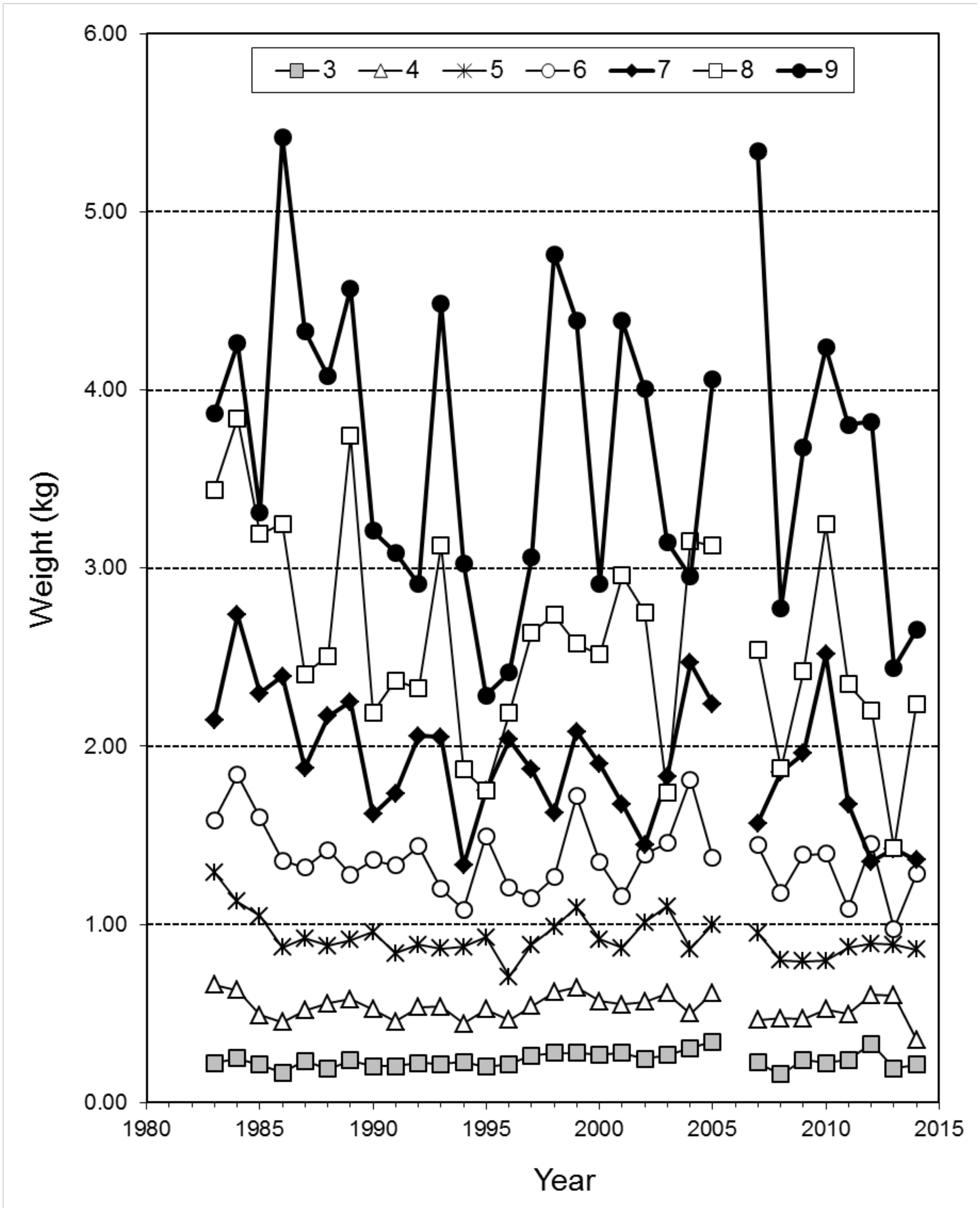


Figure 22a. Mean round weight-at-age (kg) of cod sampled during DFO bottom-trawl surveys in NAFO Subdiv. 3Ps in winter-spring 1983--2014.

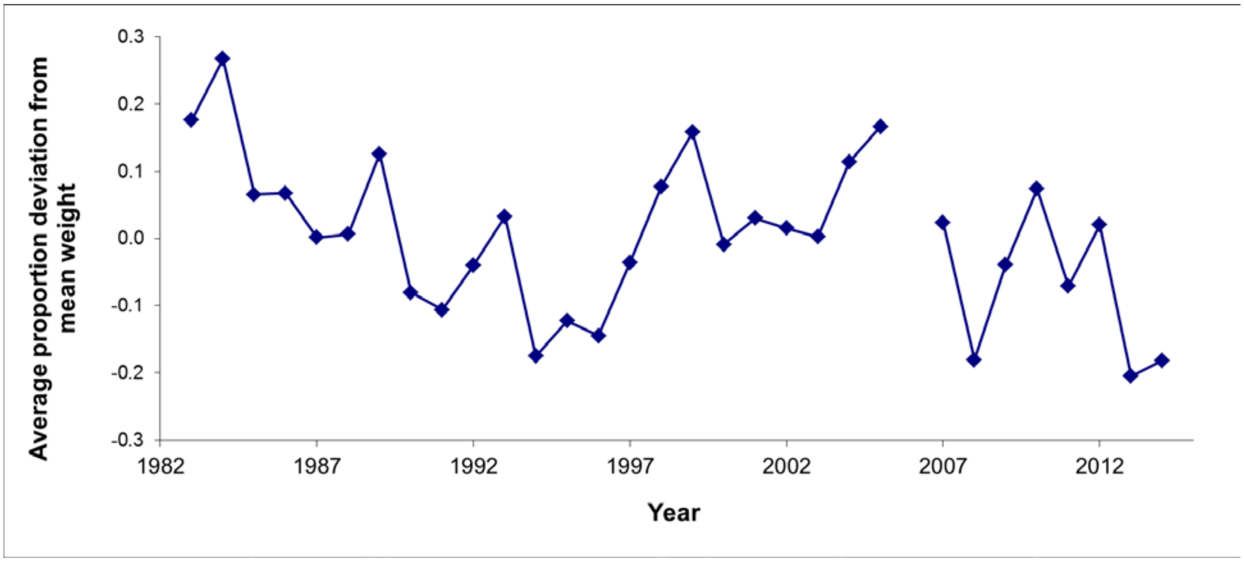


Figure 22b. Average proportion deviation from mean weight at age for ages 3-9 from DFO bottom-trawl surveys from 1983-2014.

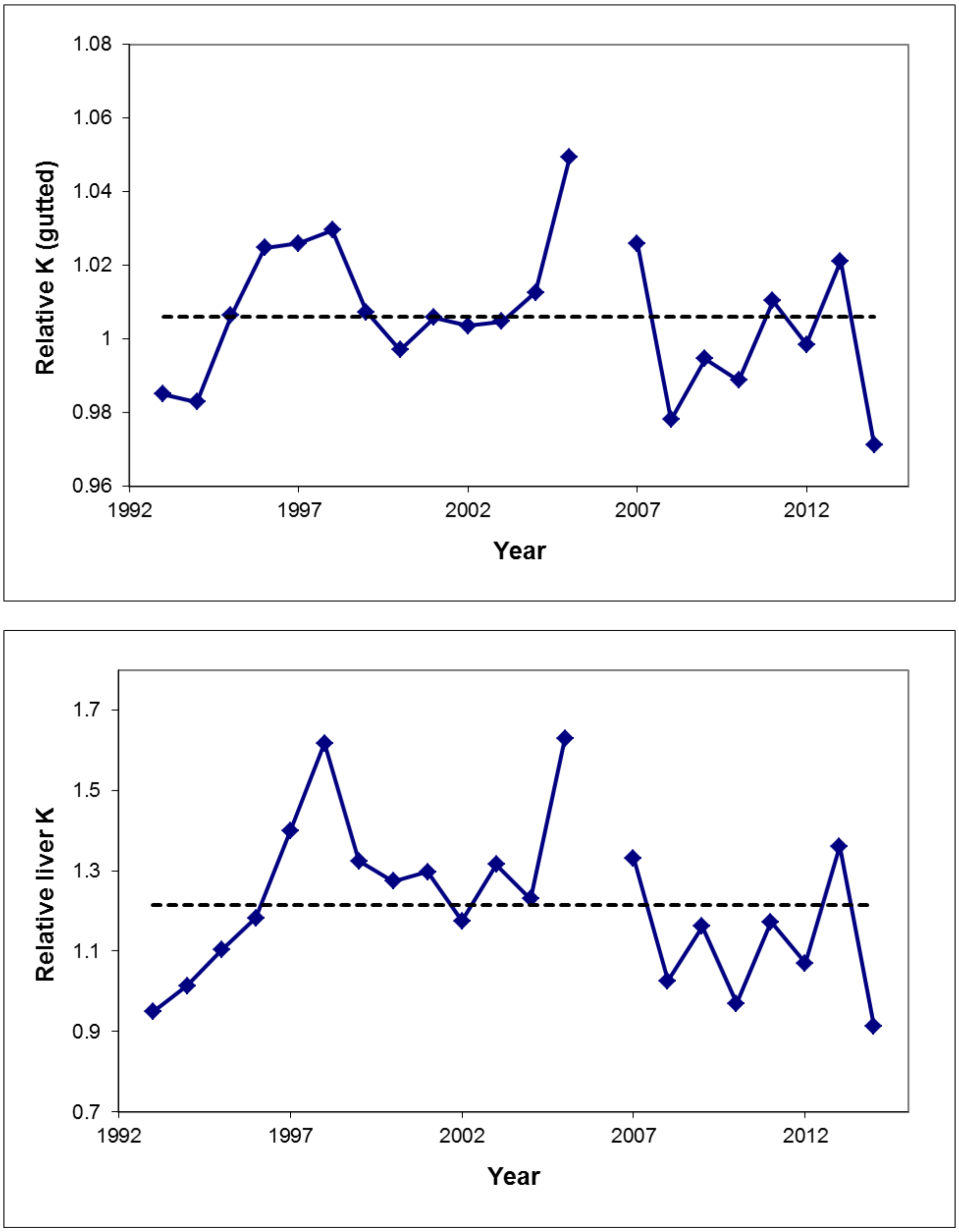


Figure 23. Relative condition indices for 3Ps cod from spring surveys over 1993-2014. Upper panel is relative gutted condition index; lower panel relative liver condition index. Dashed horizontal line represents time-series average.

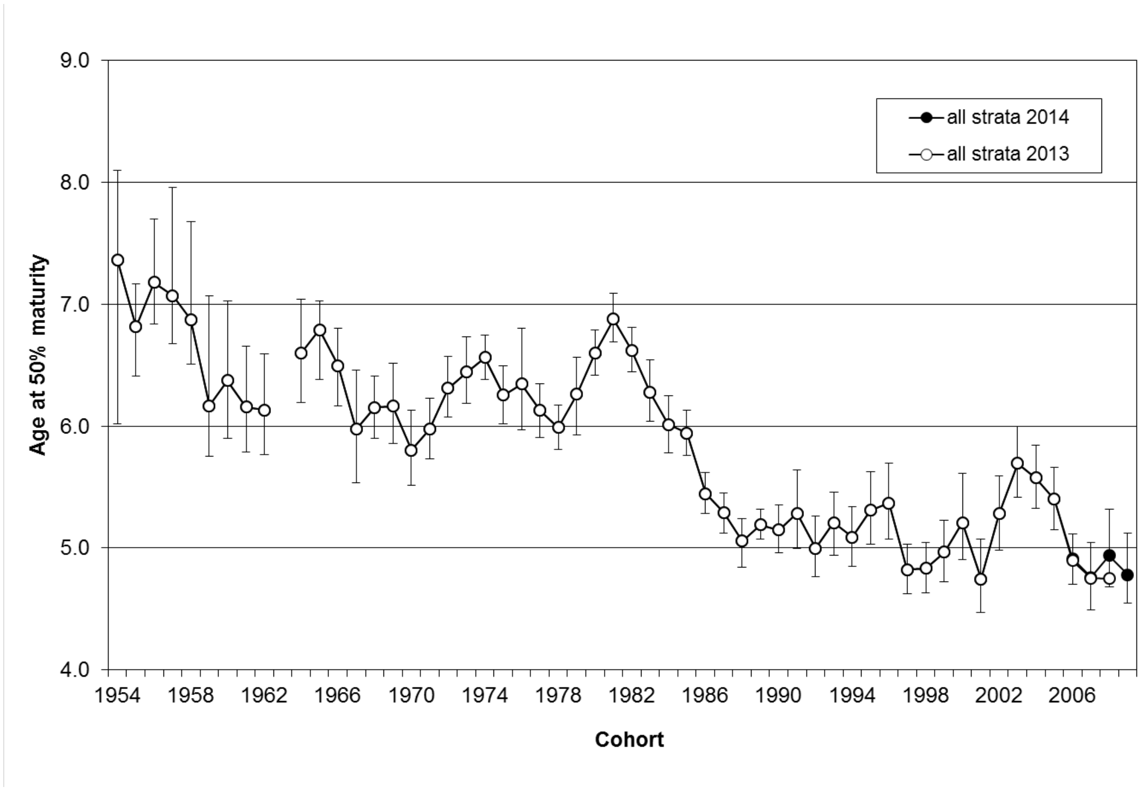


Figure 24a. Age at 50% maturity by cohort (1954-2009, excluding 1963) for female cod sampled during DFO research vessel bottom-trawl surveys of NAFO Subdiv. 3Ps. Error bars are 95% fiducial limits.

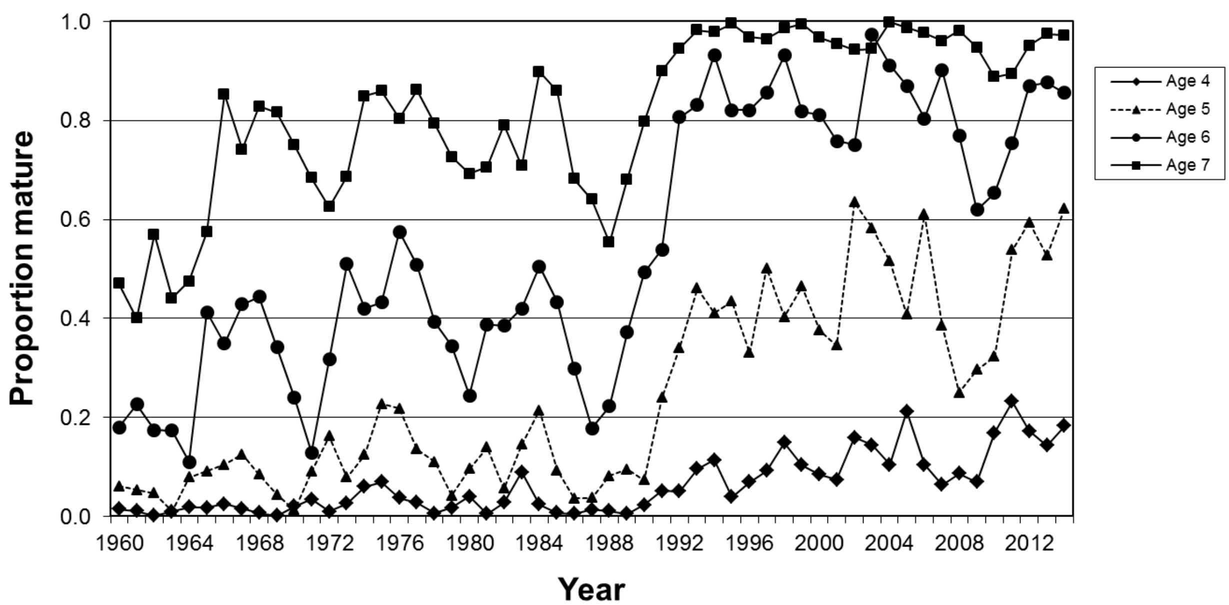


Figure 24b. Estimated proportions mature at ages 4-7 for female cod sampled during DFO research vessel bottom-trawl surveys in NAFO Subdiv. 3Ps (data from all strata surveyed).

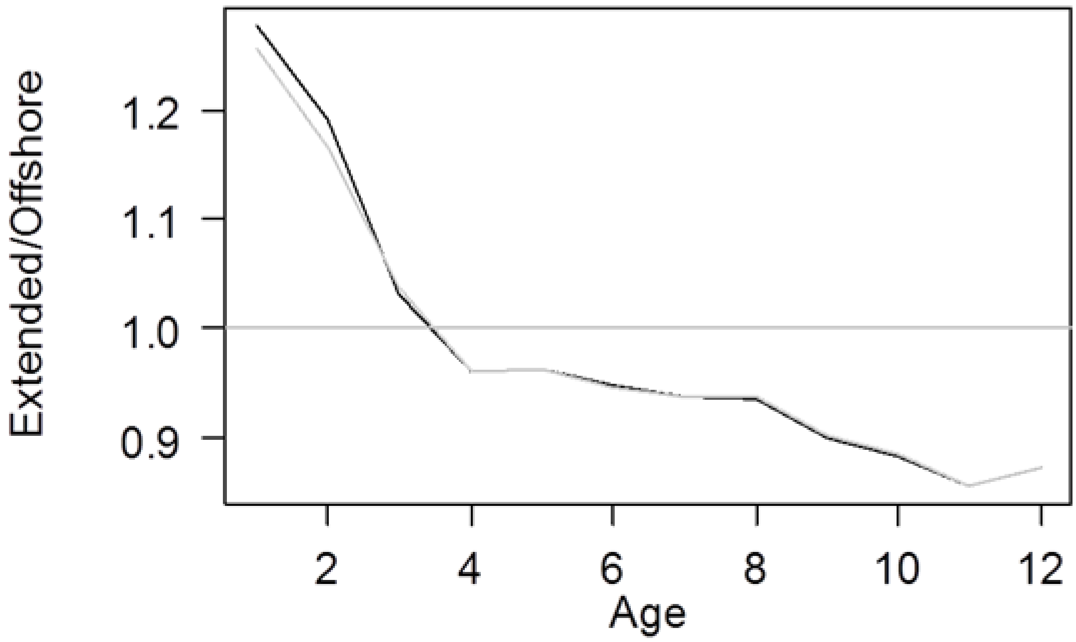


Figure 25. Age-specific ratio of the extended survey indices to the offshore survey indices (each index averaged over 1997-2014). Grey line indicates ratios from previous assessment, where averages were computed over 1997-2013.

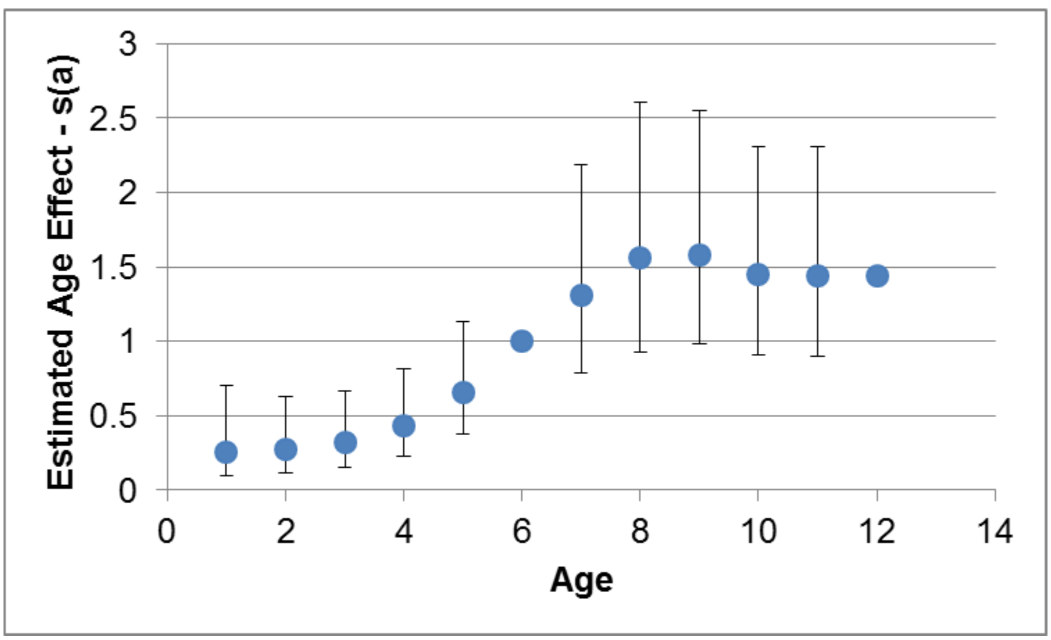


Figure 26. Estimated age-effects from SURBA cohort analysis, with 95% confidence interval. Age 6 is arbitrarily chosen as a reference age (and set to a value of 1), and the effect at age 12 is fixed at the level estimated for age 11.

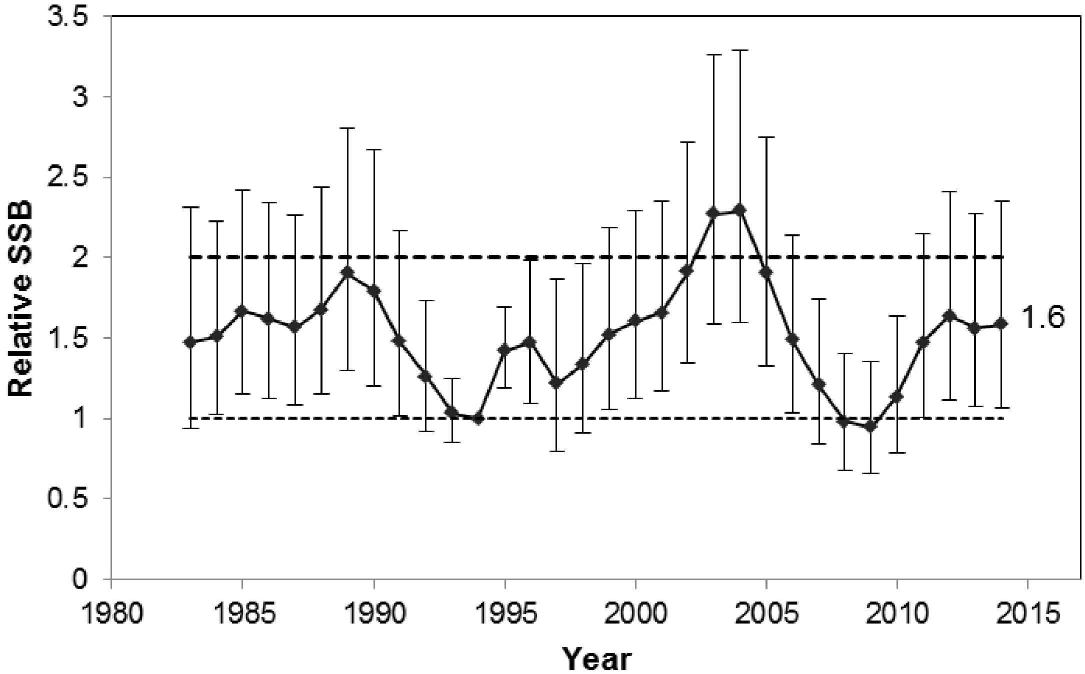


Figure 27a. Estimates of spawning stock biomass (SSB) relative to B_{lim} from SURBA cohort analysis model (i.e., estimates are divided by 1994 SSB), with 95% confidence interval.

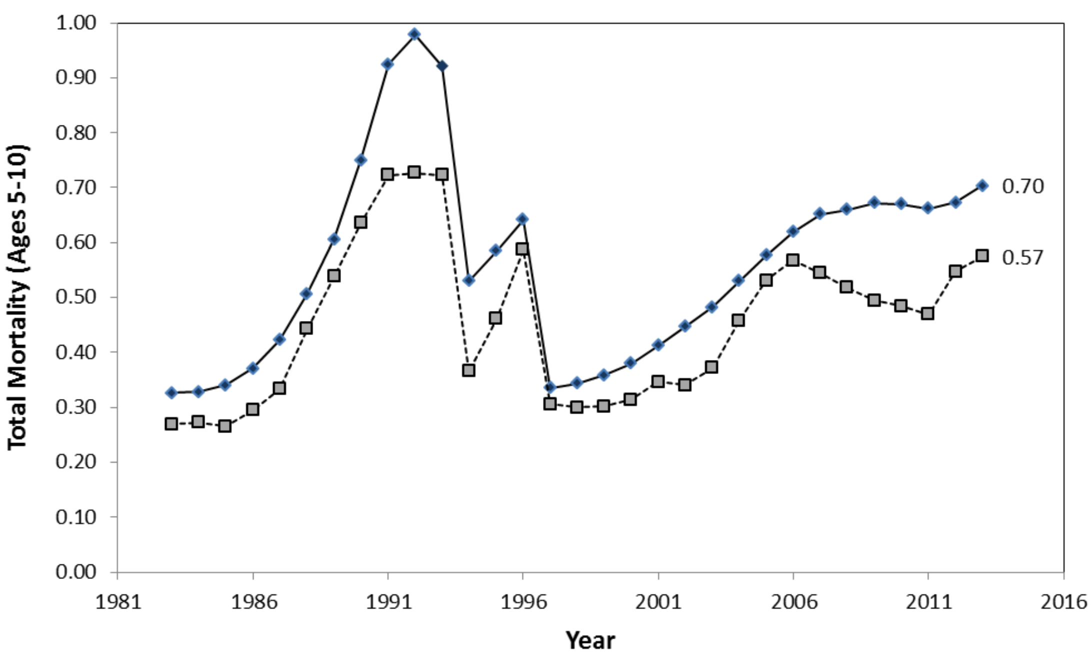


Figure 27b. Estimates of total mortality (Z) from a SURBA cohort analysis model, averaged over ages 5-10. Solid line: average annual mortality; dashed line: average annual mortality weighted by population size at ages 5-10. Text label indicates the estimated total mortality for 2014.

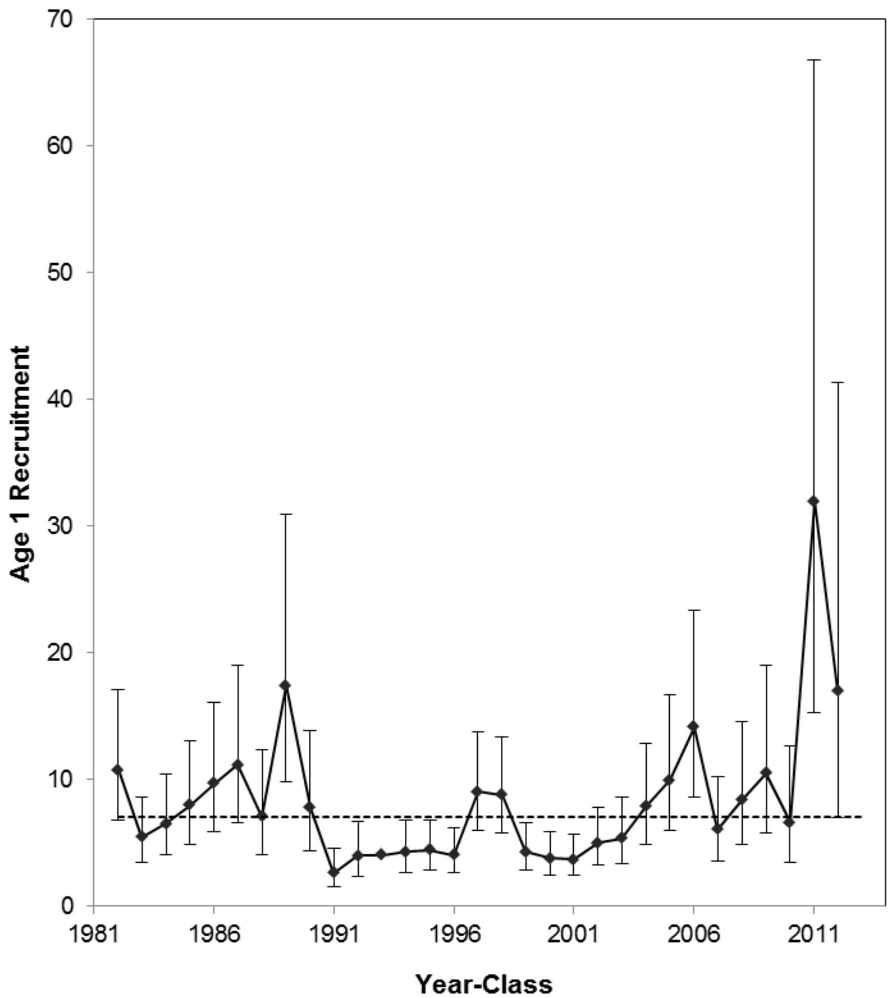


Figure 27c. Estimates of age 1 recruitment from SURBA cohort analysis model.

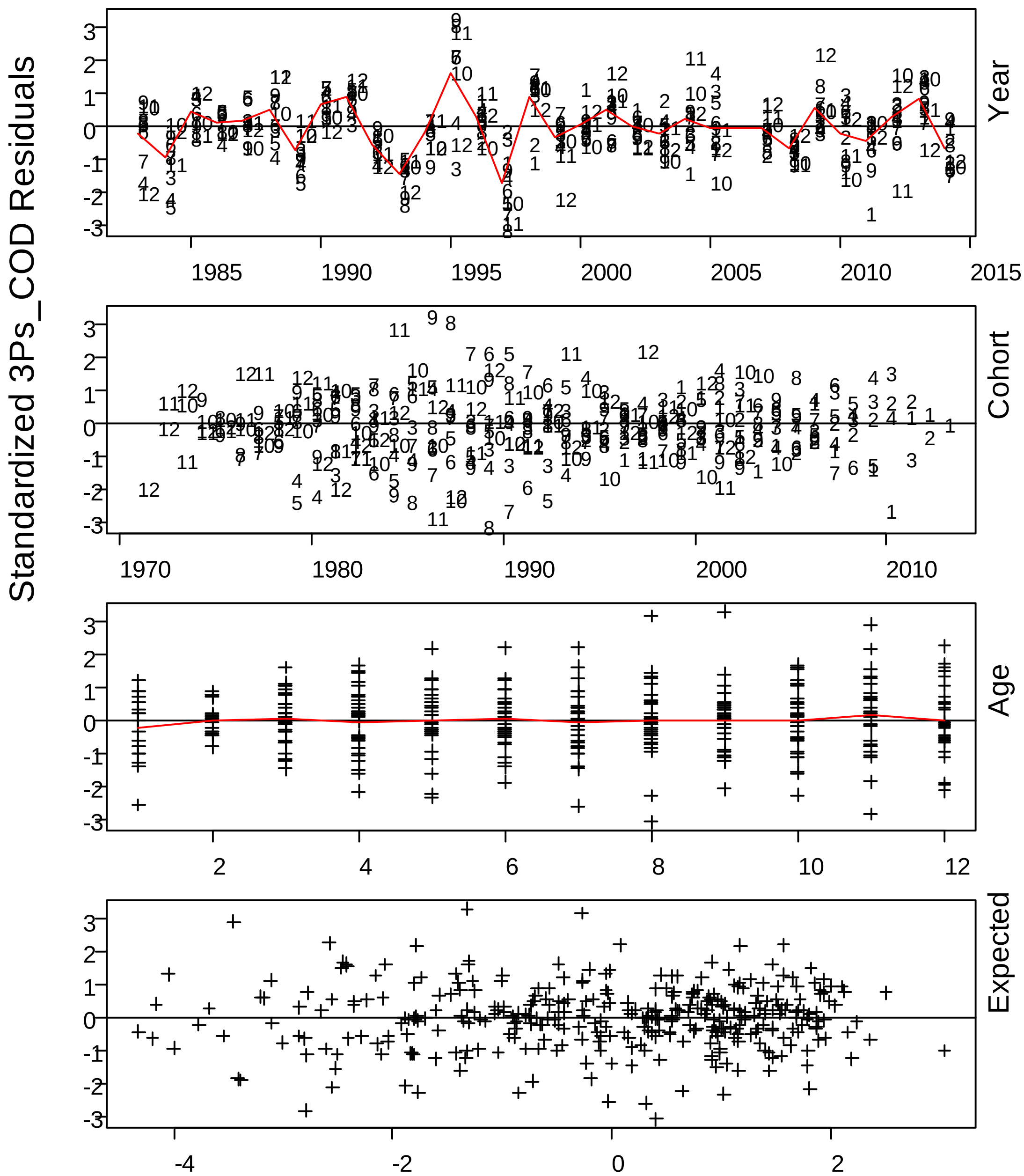


Figure 28. Standardized residuals from SURBA cohort analysis. Panels show residuals plotted year, cohort, age, and expected value, respectively.

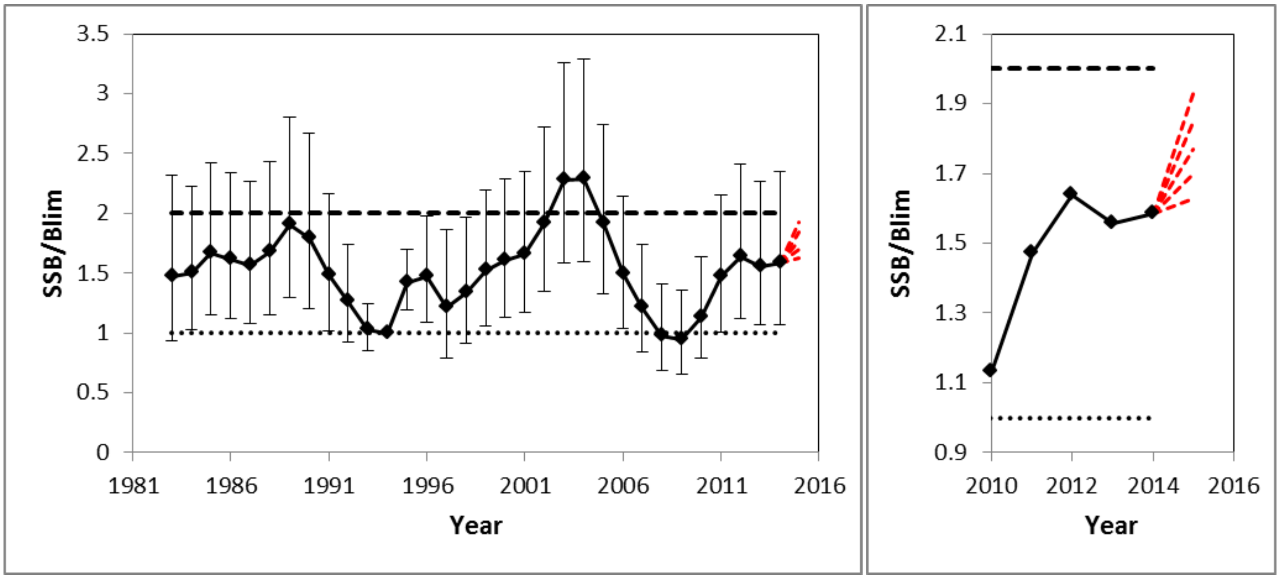


Figure 29. Projections of spawning stock biomass from SURBA cohort analysis (refer to text for details). The panel on the right provides a higher magnification look at the last five years of SSB and the projections.