Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

**Canadian Science Advisory Secretariat (CSAS)**

**Research Document 2019/024**

**Newfoundland and Labrador Region**

# Assessing the status of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in 2017

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June 2019

Canada

**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.

**Published by:**

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca


ISSN 1919-5044

**Correct citation for this publication:**

Ings, D.W., Rideout, R.M., Wheeland, L., Healey, B.P., Morgan, M.J., Regular, P., and J. Vigneau. 2019. Assessing the status of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in 2017. DFO Can. Sci. Advis. Sec. Res. Doc. 2019/024. iv + 83 p.

***Aussi disponible en français :***

*Ings, D.W., Rideout, R.M., Wheeland, L., Healey, B. P., Morgan, M.J., Regular, P. et J. Vigneau. 2019. Évaluation de l'état du stock de morue (Gadus morhua) de la sous-division 3Ps de l'OPANO en 2017. Doc. de rech. du Secr. can. de consult. sci. du MPO 2019/024. iv + 86 p.*

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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 17-18, 2017.

Total landings for the 2016-17 management year (April 1-March 31) were 6,282 t or just 48% of the Total Allowable Catch (TAC). This marks the seventh consecutive season that the TAC has not been fully taken.

Survey abundance and biomass estimates from the DFO research vessel (RV) spring survey were below average during 2016 and 2017. Sentinel gillnet catch rates have been very low and stable since 1999. Sentinel linetrawl catch rates have been below average for the past seven years and the 2016 catch rate was among the lowest in the time series.

Estimates of Spawning Stock Biomass (SSB) derived from a survey-based (SURBA) cohort model increased considerably over 2009-12 but have since declined. The stock is currently estimated to be in the Cautious Zone (54% above $B_{lim}$) as defined by the DFO Precautionary Approach (PA) Framework. The probability that the stock is in the critical zone is 0.03. SSB decreased from 2012, but showed an increase in 2017. However, SSB is concentrated (75% of SSB) in ages 5 and 6, with few older (ages 7+) fish in the population. Estimated total mortality for fish in the age range of 5-10 years is currently very high (three year average Z = 0.70), which is a large concern especially considering that reported landings have been only about half of the TACs over this time period.

Short-term projections of the stock were performed to 2020 assuming mortality rates will be within +/- 20% of current values (2014 to 2016 average). Projected SSB shows a continuous decline to 2020 in most cases, with the decrease ranging from 23 to 58% (2017-20). The risk of being below $B_{lim}$ by 2019 ranges from 0.09 and 0.73, and by 2020 from 0.25 to 0.94.

# INTRODUCTION

This document gives an account of the 2017 assessment of the Atlantic Cod (*Gadus morhua*) stock in North Atlantic Fisheries Organization (NAFO) Subdivision (Subdiv.) 3Ps, located off the south coast of Newfoundland, Canada (Figs. 1 and 2). The French overseas territory of St. Pierre et Miquelon also lies within the boundaries of NAFO Subdiv. 3Ps and only Canada and France have fished in this area since the extension of jurisdiction by each country to 200 miles in the late 1970s. The stock is jointly managed by Canada and France through formal agreements.

A Regional Peer Review Process meeting was conducted during October 2017 (DFO 2018) with participation from Fisheries and Oceans Canada (DFO) scientists, IFREMER (France), DFO Fisheries Management, academia, the Canadian fishing industry, and the province of Newfoundland and Labrador (NL).

Various sources of information on 3Ps cod were available to update the status of this stock. Commercial landings through September 2017 were presented. The results of the 2017 DFO research vessel (RV) survey were reviewed in detail and compared to previous survey results. 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. Additional sources of information presented included data from the Sentinel survey (1995-2016), science logbooks for vessels less than 35 feet (1997-2016), logbooks from vessels greater than 35 feet (1998-2016) and observer sampling. Results of a telephone survey of inshore Canadian fish harvesters and exploitation (harvest) rates estimated from tagging experiments in Placentia Bay (and more recently Fortune Bay), were also available.

# 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 to 2013-14) and was subsequently increased to 13,225 t for the 2014-15 management year. In 2015-16 Canada adopted a Conservation Plan and Rebuilding Strategy (CPRS) for 3Ps cod that included a harvest control rule (HCR) for suggesting the TAC level for the upcoming year. In 2015-16 and 2016-17 this rule suggested TACs of 13,490 t and 13,043 t respectively, and Canada and France agreed to accept these TAC values. It was not considered prudent to provide management advice for 2017-18 based on the HCR. Canada and France agreed on a TAC of 6,500 t for the 2017-18 season. 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, French landings 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 2016-17 management year (April 1–March 31) were 6,282 t, or 48% of the 13,043 t TAC. This marks the seventh consecutive year in which the landings have been less than the TAC with the landings averaging half the TAC over the past six years. Industry participants have indicated multiple reasons contributing to this change, including reduced availability of fish, poor market conditions/economics, 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 among the lowest of the available time series. Preliminary landings data for 2017-18 to September 28 totaled 2,396 t. Although the 2017-18 fishing season was incomplete at the time of the assessment, these landings to date are comparable to those from recent years when landings approximated the current TAC of 6,500 t.

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 7-26% 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 6% 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 details of reported landings are reported in Table 3 and shown in Figure 5. Of particular note is the fact that offshore catches in 3Psh were higher from December 2014 through to March 2015 than in other recent years.

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 2016 the landings from 3Psc were 2,216 t, representing 53% of the 3Ps total. Most of the offshore landings have come from 3Psh and 3Psf (Halibut Channel and the southeastern portion of St. Pierre Bank; Fig. 2). Unit areas 3Psd, 3Pse and 3Psg have accounted for a very small portion of the total catch in recent years but totals for these areas were increased in 2014. Catches in these areas thus far in 2017 have again been very low. 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 and these restrictions continue to apply to the fishery. 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

Estimates of numbers-at-age for the Canadian catch during 2014, 2015 and 2016 were available for the 2017 3Ps cod Regional Assessment Process, but restraints at the French aging facility prevented the availability of age estimates from French catches. The amount of landings sampled is highly variable among gear types and years, but generally the otter trawl fleet is sampled well compared to other fleets while line trawl landings are poorly sampled both inshore and offshore (Table 4). There was sampling for roughly half of landings from gillnets and handlines.

Detailed catch-at-age estimates for the three most recent years (i.e. 2014-16) are provided in Table 5 and shown in Figure 6 with the complete time series (1959 to 2016) of available catch numbers at age (ages 3-14 shown) for the 3Ps cod fishery is given in Table 6. During 2014 to 2016, the landings were composed mostly of age five to eight fish, which is typical of fisheries dominated by gillnet catches (Fig. 6). 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 as estimates of total removals in population analyses.

## WEIGHT AT AGE

The assessment uses approximate beginning of the year weights calculated from weight-at-age via the Rivard geometric mean method (Rivard 1980). The time series of available 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, while beginning of the year weights-at-age are given in Table 7b and Fig. 8. Estimates of mean weights-at-age are derived from sampling of the catches stratified by gear type, unit area and month. Seasonal age length keys are applied to length frequency data to age the catch and calculate proportions at age. Weights-at-age are calculated using a length-weight relationship for cod that has been applied to all cod stocks in the Newfoundland Region.

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. 8). 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 scarcity of old fish in the catch. The current 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.

## RESEARCH VESSEL (RV) SURVEYS

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 CCGS A.T. Cameron (1972-82), CCGS Alfred Needler (1983-84; 2009-present), and CCGS 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 CCGJ A.T. Cameron was a side trawler. Cadigan et al. 2006 found no significant differences in catchability for several species, including cod, between the Wilfred Templeman and Alfred Needler research vessels. 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 a*l*. 1994.

The Canadian research vessel surveys from 1983-95 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. 9. 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 8). 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 2017 survey completed 179 of the intended 178 fishing sets (Fig. 10). The alternate tow site was sampled in addition to two scheduled sites in Stratum 310.

## 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. 11). 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 2009-17. The 2013 estimate was particularly high, but was followed by a subsequent large decline during 2014-17, with the 2017 estimate being below average. The trawlable biomass estimate has been variable for much of the post-moratorium period, but shows a general declining trend over 1998-2017, with the exception of a high value of 83,000 t in 2013.The survey biomass estimate for 2017 was 15,356 t and below the time series average.

The trends and degree of variability in the combined inshore/offshore survey are almost identical to those of the offshore survey (Tables 9 and 10, Fig. 11) in spite of the 18% increase in surveyed area. However, the combined inshore/offshore survey showed higher biomass and abundance during two years; in 2005 and 2017, values were comparatively higher for the inshore/offshore index due mainly to large estimates (single large set) from inshore stratum 294 and 295 respectively.

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. There are strong indications that the 2013 survey may have been influenced by a year effect. A clear sign of a year-effect is the fact that the 2013 RV survey estimated that the abundance of multiple cohorts increased compared to observations of these same cohorts at one age younger in 2012. 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. The subsequent three assessments have downgraded the estimated strength for this year class but it still appears strong relative to other recent year classes.

Surveys in 3Ps are prone to single large fishing sets that heavily influence the survey indices and are often largely responsible for the year-effects mentioned previously. An extreme example is the 1995 survey, where a single large catch contributed 87% of the total biomass index. In 2013, a large single catch of larger fish on Burgeo Bank (Figs. 12 and 13) resulted in >50% of the overall biomass being located in this particular area (Fig. 14) and causing a large spike in the survey indices for that year. A similar phenomenon occurred in the 2015 and 2016 surveys with a single large set in the Burgeo Bank area accounting for 38% and 60%, respectively, of the biomass index in those years. The fact that single large fishing sets have heavily influenced survey indices throughout the history of this stock, including three out of the last five years, is a concern for the assessment. The recent sporadic appearance of high numbers of fish on Burgeo Bank is not fully understood. Méthot et al. 2005 used otolith microchemistry to investigate the stock affinity of fish collected on Burgeo Bank in 2001 and suggested that approximately half of the fish in this area in April (which also equates to the time of the DFO RV survey) were fish that originated from the Northern Gulf of St. Lawrence. The presence of Northern Gulf fish within the 3Ps stock area at the time of the RV survey could bias the assessment of 3Ps cod.

To further investigate survey trends for different portions of the stock area, the stratification scheme was divided up (Fig. 15) into areas referred to as ‘inshore’ (strata 293-298, and 779-783), ‘Burgeo’ (strata 306-309, and 714-716), and ‘eastern’ (remaining strata) and the trends in biomass and abundance in each of these regions were examined based on the combined inshore/offshore survey data. The proportions were variable, with typically 30-70% observed in the larger eastern area, 15-60% in the Burgeo area, and around 10-25% in the inshore area. For the inshore region in 2017, biomass and abundance increased from 2015 and 2016 levels. Over the last five years the Eastern region showed a decline in both abundance and biomass (Fig. 16), whereas the Burgeo indices have been highly variable. In three of the last five years the survey biomass has been estimated to be higher on Burgeo Bank than the Eastern area due largely to the single large sets mentioned previously.

## Age Composition

Survey numbers at age are obtained by applying an age-length key (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 $2.7 \times 10^6$ trawlable units.

The mean numbers per tow at age in the DFO RV survey are given in Table 11 and results for ages 1-15 are shown in the form of standardized proportion at age per year (SPAY) “bubble” plots in Fig. 17. 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, few cod aged 15 or older have been sampled during surveys in the past two decades and none have been sampled in the last three years.

Over 2007-11, survey results indicated the 2006 year-class was much greater than average (at ages 1 through 5). However, subsequent surveys 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 2014 survey, representing the 2013 year-class, was much greater than the time-series average. Although the relative strength of this year class has been revised downward to some degree in subsequent surveys it continues to look strong and is now of age to be partially selected to the fishery. An examination of age-disaggregated spatial plots indicate that this year class was located primarily on Burgeo Bank, in Fortune Bay and in the Halibut Channel area in the 2017 RV survey (Fig. 18).

## 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 2017 survey data (Fig. 19). For ages older than age 3 there was a general decline in length-at-age from the early 1980s to the mid-1990s (Fig. 19, Table 12). 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 2017 ages 1 to 11 were present. In 2017 length-at-age was lower compared to 2016 for 6 of the ages.

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 2017 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. 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 8 of the last 11 years and remains well below average in 2017. The last 5 years are 5 of the 6 lowest in the time series, with 2016 and 2017 being the lowest in the time series (Fig. 19).

Values for mean weight at age were updated with data from the 2017 survey (Fig. 20). There was an increase in weight-at-age from the mid-1990s through the mid-2000s, but data from 2007-17 surveys suggest that mean weight-at-age was mainly lower than the mid-2000s. Mean weight-at-age was greater than average in the mid 1980s and generally declined to very low levels in the mid-1990s (Fig. 20). As with mean length-at-age, mean weights-at-age increased after the mid 1990s to about 2000. Weight-at-age since 2005 has been generally lower with 8 of the last 18 years below average. Weight-at-age in 2016 and 2017 are the lowest observations in the time series with weight-at-age in 2017 being 30% below average. The time series for selected ages (3-9) are shown in Figure 20, along with their average deviation from mean weight. Ages three to six showed a slight increase in weight-at-age from about 1986 to 2005 while older age groups (6-9) were variable but stable. Values for most ages were lower during the 2013-17 period than earlier in the time-series (Table 13; Fig. 20).

### 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 then 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 length regression. However, evaluation of the model fit indicated that a simple linear regression did not provide an adequate fit to the data. In addition, liver weight data for fish under 30 cm and greater than 120 cm were highly variable. Therefore, the analyses were restricted to fish 30-120 cm in length and the regression was computed as:

log(liver weight) = intercept + b1*lglen + b2*(log(length)*log(length)).

Both gutted and liver condition increased to about 1998 and then were lower until 2004 with a spike in 2005 (Figure 21). Gutted condition reached a low in 2008 but increased steadily to reach above average levels in 2013, however it declined again and was below average from 2014-17, with 2016 being the lowest in the time series. Liver condition has been below average in 7 of the last 10 years, with 2017 being the lowest in the time series.

In conclusion, mean length-at-age and mean weight-at-age have both been low over the last 5 years and indices of condition have been low in the last 4 years.

## 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. 22a (only cohorts with a significant slope and intercept term are shown); parameter estimates and associated standard errors for the 1954 to 2011 cohorts are given in Table 14, 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 are once again near 5 years (Fig. 22a). 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 15; these were obtained from the cohort model parameter estimates in Table 14. The estimates of proportion mature for ages 4-7 show an 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. 22b). 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. 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). An age-specific adjustment is applied to the 1983-96 survey indices to account for the inshore area that was not sampled in these years. The ratio of the average survey index for the expanded area (1997-present) to the average offshore survey index over the same period is computed for each age. 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. 2011). 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 9, after which relative mortality decreases slightly (Fig. 23). Results indicated that SSB declined by 58% over 2004-09 (Fig. 23a). Median SSB was estimated to be at the LRP in 2008 and below the LRP in 2009. SSB decreased from 2012, but showed an increase in 2017. The stock is currently estimated to be in the Cautious Zone (54% above $B_{lim}$) as defined by the DFO Precautionary

Approach (PA) Framework; the probability that the stock is in the critical zone (i.e. below Blim) is 0.03. However, SSB is concentrated (75% of SSB) in ages 5 and 6, with few older (ages 7+) fish in the population. This is an enormous reliance on young spawners and may be a concern given that younger fish produce fewer and smaller eggs/larvae that may have reduced survival. Young fish also spawn over a narrower time frame which decreases the probability of overlap between larval emergence and peak plankton abundance and can result in reduced survival.

Total mortality rates reflect mortality due to all causes, including fishing. Estimated total mortality increased from 1997 to the time-series maximum in 2015 decreased slightly in 2016, but remains high (Fig. 23b). Over 2014-16, total mortality averaged 0.7 (50% survival per year). This is very high considering that landings have been about half of the TACs over this time period. However, the relative contributions of natural and fishing mortality to total mortality are unknown. The total mortality values are weighted by population number at each of ages 5-10.

Recruitment (Fig. 23c) has improved over the last decade with most cohorts at or above the time series (1983-2015) average. Indications are that the 2011 and 2012 cohorts are among the strongest in the time-series. Even these strong cohorts are expected to decline rapidly in coming years if total mortality rates remain at recent high levels.

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) as well as 2013 (almost all positive residuals). Otherwise, there are no indications of systematic model fit issues (Fig. 24).

Retrospective revisions are not uncommon in cohort models, which use annual information to predict the abundance of multiple cohorts. In the current assessment, retrospective revision in SSB is also impacted by changes in the predicted values for proportion mature at age from a cohort-based model and the updated stock weight estimates for 2014 and 2015. Strong retrospective patterns in the same direction over multiple years could suggest an issue with the assessment (input data and/or model formulation). In the current assessment, only minor revisions were noted in the terminal year estimates of SSB, biomass, total mortality and recruitment at age. Moreover, revisions were not always in the same direction. It was agreed that these differences were not sufficient to suggest an issue with the assessment (Fig. 25).

Projection of the stock to 2020 was conducted assuming mortality rates will be within ±20% of current values (2014-16 average). Recruitment was assumed to be the geometric mean of the age 1 estimates over 2014-16, and weights at age were assumed to equal the average of those over 2014-16. The proportions mature at age were projected forward from the cohort-specific model estimates. Five projection scenarios were conducted, using multipliers of 0.8, 0.9 1.0, 1.1, and 1.2 current Z, with a constant mortality rate assumed for each year projected. Under these scenarios, projected SSB shows a continuous decline to 2020 in most cases (Fig. 26), with the decrease ranging from 23 to 58% (2017-20). The risk of being below $B_{lim}$ by 2019 ranges from 0.09 and 0.73, and by 2020 from 0.25 to 0.94 (Table 16).

## OTHER DATA SOURCES

Other sources of information were considered in the assessment to provide perspectives on stock status in addition to the DFO survey indices. These sources of information include data from the Sentinel survey (1995-2016), science logbooks for vessels less than 35 feet (1997-2016), logbooks from vessels greater than 35 feet (1998-2016) and observer sampling. Results of a telephone survey of inshore Canadian fish harvesters and exploitation (harvest) rates estimated from tagging experiments in Placentia Bay (and more recently Fortune Bay), were also available. Any differences in trends between these additional data sources and the DFO survey are difficult to reconcile but attributed to differences in survey/project design, seasonal

changes in stock distribution, differing selectivity of various gear types, or the degree to which the various data sources track only certain subareas/ components versus the entire distribution of the stock.

## 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 2016 only, and exclude the current (in-progress) year. Also, data for 2015 were incomplete at the time of the assessment and were not included in the analyses. 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 15% 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 observed in previous assessments, preliminary examination of the logbook data indicated that 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 2016 only 12% of the < 35 ft gillnet catch and 3% of the < 35 ft linetrawl catch is included in the CPUE standardization. These values are lower than usual and reflect both the low reporting rate and an increasing portion of logbooks 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 this logbook. (These are denoted as fishing areas 29-37 and illustrated in Fig. 27). Most of these instances are generated from logbooks which report the location fished as either "10" or "11"-these references correspond 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. 27. 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 (1,000s), 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 frequency distribution of catches per set is skewed to the right for both gears (not shown). For gillnets, catches per net are typically around 15 kg with a long tail on the distribution extending to about 75-100 kg per net. The distribution of catches for line trawls was similarly skewed, with median catches of about 180kg/1000 hooks; but extending out to 500-600kg/1000 hooks.

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 (1997-2014, 2016). 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. Catch rates for gillnets tend to be higher in areas 29-32 (Placentia Bay and south of Burin Peninsula) than elsewhere. Gillnet catch rates in 2011 for Fortune Bay and east are amongst the lowest in the time-series (Fig. 27). For line trawl, most data come from areas west of the Burin Peninsula and the results in areas 29 33 are based on low sample sizes and show more annual variability (Fig. 28). Line trawl catch rates from areas 34-37 in 2011 were quite variable compared to recent years in those areas. Around the Burin peninsula, catch rates were above average, but further westward were at or below average.

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. A Generalized Linear Model with a log link and Gamma distribution was used to estimate year and month within location and there was no intercept. Effort was used as an offset. 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 20kg/net (Fig. 29). For linetrawls, temporal patterns differ from those in of gillnets, with much inter-annual variation since 2000. After peaking in 2006, linetrawl catch rates generally declined to 2010, and remained near the time-series average in 2014 (Fig. 30). The catch rate estimated for 2016 was the lowest in the time-series (57% below the average), but it was based on a low number of logbook returns, and only from four areas where catch rates are typically lowest.

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 long 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 by catch 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 recent 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 not been as strong (the 2013 year class was not fully recruited to the fishery in 2016), and catches would be more comprised of younger and hence lighter fish.

## LOGBOOKS (> 35 FT SECTOR)

New standardized catch rate indices for gillnets and otter trawls were developed for vessels greater than 35 ft based on logbook data. This logbook series is administered with follow up by DFO staff when logbooks are not returned promptly and return rates, calculated as the proportion of landings represented by logbooks to sector landings, have been considerably higher than those for the < 35 ft sector.

For gillnets, data were screened to select deployments between 12 and 24 hours and a minimum of five data entries was arbitrarily set for including cells (year, area, quarter) in models. The number of vessels in the logbook database, which were subsequently used in the catch rate model, decreased by half over the time-series with only 62 vessels reporting in 2016. This decline was due to a reduction in the number of vessels participating in the fishery over time. The amount of landings covered by the logbooks was 65 % or higher over the last decade (Table 17). The model developed for the assessment, standardized catch rates to account for spatial and seasonal effects. All parameters in the model were significant. Results indicated that catch rates were higher in magnitude (Fig. 31) than those from vessels less than 35 ft (Fig. 27), but the pattern over time was similar. Catch rates in the > 35 ft fleet initially (1998 to 2000) declined by about half and remained stable at those levels to 2016.

To develop a standardized index for the otter trawl fleet, data were screened to exclude tows less than 15 minutes and longer than 10 hours. As most of the fishery occurs during fall and winter, only tows conducted between October and March were retained for analyses and a minimum of five entries per cell (year, area, quarter) was included in modeling. Catch per unit effort was calculated as catch weight per hour of towing. The percentage of the otter trawl catch that is accounted for in the standardized index is variable over time (27-94%) but has been 80% or higher since 2010 (Table 18). During this period, the otter trawl fleet was small and generally, logbook data was available from less than ten vessels annually.

Catch rates were standardized to remove spatial, seasonal, and vessel size (categorized as greater or less than 100 feet) effects. The frequency distribution of vessel length was bimodal with a clear gap around 100 feet and preliminary testing indicated that vessel length was an important factor in determining catch rates for otter trawlers. Results indicated that standardized annual catch rates generally declined from 1999 to 2016 with high values during 2006 (Fig. 32) attributed to atypically high fishing effort in 3Psh where catch rates are much higher than other areas. The long term decline in catch rates by otter trawlers is broadly consistent with the declining trend in biomass indices from the RV survey. However, otter trawl effort is variable with respect to timing (little or no autumn tows during some years) and is highly concentrated relative to RV survey coverage.

Attempts to standardize catch rates from line trawls revealed diagnostic issues with the models tested and further exploration would be required to develop a catch rate series for the > 35' sector. Data screening for line trawls removed deployments longer than 24 hours. Also, only line trawls with a minimum of 150 hooks were retained in the analyses to reduce the potential number of mistakes in effort recordings. Standardization was attempted across years, areas and seasons. However, significant interactions between areas and quarters complicated analyses.

## OBSERVER SAMPLING

Information collected at sea by observers on Canadian vessels fishing for cod (1997-2016) were reviewed for the potential to create standardized catch rate indices for gillnets, line trawls and

otter trawls. Preliminary analyses of the line trawl effort data revealed issues associated with changes in recording protocols over time that could not be resolved before the assessment. Therefore, no standardized estimates of catch rates by line trawls were developed based on observer data. Also, there was insufficient data to develop a standardized catch rate index for the otter trawl fleet.

To develop a standardized catch rate index for gillnets based on observer sampling, data were screened to remove deployments longer than five days. Data exploration indicated substantial variations in observer coverage over time and among unit areas, and the proportion of the landings observed was low (< 2 %) during most years (Table 19). Standardization accounted for area and seasonal effects. Generally, the results of standardizing the gillnet data were broadly consistent with those from both logbook series. Catch rates were observed to decline by about half over 1998 to 2000 and remain relatively stable up to 2016 (Fig. 33).

## TAGGING EXPERIMENTS/EXPLOITATION RATE

Tagging of adult (> 45 cm fork length) cod in Subdiv. 3Ps was initiated in 1997 and has continued through 2016. 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 20a). 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 World Wildlife Fund. The number of tags released (Table 20a) was increased to 2,340 in 2012 and 3,951 in 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. In 2014 and 2015, the number of tags released declined to 989 and 1250, respectively, and coverage was again restricted to 3Psb and 3Psc. In 2016, only 501 tags were released in 3Psb. A brief synopsis of results from recent tagging is provided below.

Over 2008-10, approximately 300 tags were returned annually (Table 20b). Fewer tags were returned in 2011 and 2012 (130 & 188, respectively), resulting from both reductions in landings and the restricted spatial extent of releases. Returns increased in 2013 (246) and remained at similar levels to 2015 (239). For 2017, there were 194 tag recaptures reported (Table 20b). 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. 34). Reporting rate for the offshore portion of 3Ps in 2016 was 0.59 and for the inshore was 0.67.

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, 2004, 2005, 2006; Cadigan and Brattey 2003, 2006, 2008). 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 predominantly gill-net fishery. Exploitation rates for 2016 were obtained. These incorporated annual estimates of tag reporting rates (~67% during 2016) based on high-reward tagging and a range of assumed values for the annual rate of natural mortality (M = 0.2 or 0.4). At M = 0.2, in 2016, the harvest rates ranged from 12% to 19% (F = 0.13 to 0.21) among cod 50-85 cm at release tagged in Placentia Bay and Fortune Bay (Table 20c). These values would be approximately double if the entire quota had been taken as most of the unharvested TAC was available to the inshore sector.

With respect to migratory patterns and stock distribution, recent tagging suggests exploitation of 3Ps cod in neighbouring stock areas (3KL) is minimal and not a major issue for management. No new data are available to investigate mixing in the western portion of the stock area (3Psa/d). Post-moratorium tagging studies have generally revealed extensive movement of cod tagged inshore between Placentia Bay (3Psc) and Fortune Bay (3Psb), but limited movement from inshore to offshore. In contrast, many cod tagged offshore in Halibut Channel (3Psh) have shown extensive movement shoreward, particularly into Placentia Bay.

## CONCLUSIONS AND ADVICE

- Consistent with recent assessments, a cohort model (SURBA) based on the spring DFO survey was used to infer overall stock trends.
- The 2017 SSB is estimated to be in the Cautious Zone (54% above $B_{lim}$) as defined by the DFO Precautionary Approach (PA) Framework. The probability that the stock is in the critical zone is 0.03.
- SSB decreased from 2012, but showed an increase in 2017. However, SSB is concentrated (75% of SSB) in ages 5 and 6, with few older (ages 7+) fish in the population.
- Recruitment has generally been at or above the time-series average since 2005, with particularly strong cohorts produced in 2006 and 2011.
- Estimated total mortality decreased slightly in 2016, but remains high. Over 2014-16, total mortality averaged 0.7 (50% survival per year), however the relative contributions of natural and fishing mortality to total mortality are unknown.
- Projection of the stock to 2020 was conducted assuming mortality rates will be within +/- 20% of current values (2014 to 2016 average). Projected SSB shows a continuous decline to 2020 in most cases, with the decrease ranging from 23 to 58% (2017 to 2020). The risk of being below $B_{lim}$ by 2019 ranges from 0.09 and 0.73, and by 2020 from 0.25 to 0.94.
- Ecosystem signals observed in 3Ps in recent years indicate that structural changes are occurring, and overall ecosystem productivity may be low. Although the full impacts of these changes on cod itself are not fully known, they imply that at least some aspects of cod productivity may be impaired.

## SOURCES OF UNCERTAINTY

Although the RV survey of Subdivision 3Ps includes coverage of 45 index strata, the majority of the survey indices for cod are typically attributed primarily to only a small number of those strata. In some years the high estimates in some of these strata are a result of a single large survey tow. For example, in three of the last four years, a large survey tow on Burgeo Bank has had a major influence on survey indices (e.g. 60% of the biomass index in 2016 resulted from a single survey tow in stratum 309). The RV survey uses a stratified-random design which assumes fish density to be uniform within a stratum and hence single large survey tows have the potential to bias survey (and hence assessment) results.

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 that resulted in a large spike in the survey indices for that year. The 2013 RV survey estimated that the abundance of multiple

cohorts increased compared to observations of these same cohorts at one age younger in 2012. Since the number of fish in a cohort cannot increase as it ages (without immigration), such results are usually considered clear evidence for a year effect. Year effects in the survey data have the potential to bias results, mask trends in the data and contribute to retrospective patterns.

Recent assessments of 3Ps cod have been subject to retrospective revisions of estimates from previous years with the addition of a new year's survey data. For example, in the 2015 assessment the SSB for 2015 was estimated to be at 1.4 times the level of the LRP. In the current assessment, however, the 2015 SSB has been retrospectively revised downward to less than 1.2 times the level of the LRP. This is the third year in a row where the assessment has performed a downward revision of the terminal year estimate of SSB from the previous assessment. Likewise upward retrospective revisions of mortality have occurred over the same period. Retrospective revisions are not uncommon in cohort models, which use annual information to predict the abundance of multiple cohorts. However, strong retrospective patterns in the same direction over multiple years could suggest an issue with the assessment (input data and/or model formulation). Some concern was expressed over the magnitude and direction of the retrospective in recent years. However, it was agreed that these differences were not sufficient to reject model results considering the degree to which confidence intervals of the 2015 and 2016 assessments overlap.

Fish sampled on Burgeo Bank have represented a large portion of the survey estimates of cod in Subdivision 3Ps in recent years. However, the origin of fish in this area is not certain, with previous reports suggesting that a large portion of the fish in this area in April (the time of the RV survey) may in fact be fish from the Northern Gulf of St. Lawrence that migrate seasonally into the Burgeo Bank area. If this is true it would suggest an overestimation of recent indices for the 3Ps stock.

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), though the relative magnitudes of these biases are unknown. 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.

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.

## ACKNOWLEDGMENTS

This assessment is supported by the extensive efforts by DFO personnel who participate in collection of data during annual research surveys or sampling of the 3Ps commercial cod fishery. Additionally, data processing by D. Pittman and P. Upward and the age reading efforts of G. Cossitt, Marty Snooks and Jamie Thomson are gratefully acknowledged.

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# 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 2017 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** | 378 | 2,680 | 174 | 366 | 768 | - | - | 4,366 | 11,500 |
| **2014** | 614 | 4,199 | 637 | 279 | 1,158 | - | - | 6,887 | 13,225 |
| **2015** | 1415 | 3,706 | 175 | 440 | 724 | - | - | 6,460 | 13,490 |
| **2016** | 1,930 | 3,343 | 239 | 324 | 1,360 | - | - | 7,196 | 13,043 |
| **2017[1]** | 1,079 | 3,010 | 289 | 15 | 551 | - | - | 4,944 | 6,500 |

[1]Provisional catches

[2]1996-2006 includes recreational and sentinel catch. 2007-17 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[2] | 3,089 | 670 | 192 | 10 | 3,961 |
| 2013[2] | 1,939 | 457 | 270 | 14 | 2,680 |
| 2014[2] | 2,760 | 1,066 | 331 | 38 | 4,195 |
| 2015[2] | 3,065 | 326 | 299 | 9 | 3,699 |
| 2016[2,3] | 2,779 | 283 | 268 | 10 | 3,340 |
| 2017[1,2,3] | 2,590 | 208 | 194 | 17 | 3,009 |

[1]provisional
[2]excluding recreational catch
[3]As of September 28, 2017

*Table 3. Reported Canadian (NL+Mar) monthly landings (t) of cod per unit area in NAFO Subdiv. 3Ps.*

| - | - | Inshore | Inshore | Inshore | Offshore | Offshore | Offshore | Offshore | Offshore | - |
|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Month** | **3Psa** | **3Psb** | **3Psc** | **3Psd** | **3Pse** | **3Psf** | **3Psg** | **3Psh** | **Total** |
| 2014 | Jan | 7.4 | 60.3 | 46.9 | 9.9 | 0.0 | 0.1 | 5.8 | 311.1 | 441.4 |
| 2014 | Feb | 8.8 | 35.0 | 58.1 | 12.5 | 0.2 | 0.0 | 79.1 | 244.2 | 437.9 |
| 2014 | Mar | 5.5 | 2.0 | 15.0 | 1.5 | 0.0 | 0.0 | 109.6 | 193.2 | 326.8 |
| 2014 | Apr | 0.1 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 21.5 | 22.5 | 44.7 |
| 2014 | May | 35.5 | 32.8 | 77.9 | 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 | 404.7 | 10.1 | 5.4 | 9.3 | 4.7 | 12.0 | 532.5 |
| 2014 | Aug | 5.6 | 18.0 | 183.2 | 0.0 | 4.9 | 17.0 | 0.5 | 1.6 | 230.7 |
| 2014 | Sep | 1.6 | 28.8 | 118.9 | 8.5 | 39.6 | 153.9 | 14.6 | 0.1 | 365.9 |
| 2014 | Oct | 7.8 | 52.6 | 119.9 | 50.2 | 18.0 | 216.3 | 51.9 | 8.5 | 525.2 |
| 2014 | Nov | 27.0 | 36.1 | 135.2 | 29.4 | 1.5 | 253.2 | 0.1 | 7.2 | 489.6 |
| 2014 | Dec | 21.5 | 126.2 | 258.0 | 0.0 | 0.0 | 11.3 | 11.8 | 498.0 | 926.8 |
| **2014** | **Total** | **185.8** | **534.9** | **2,017.6** | **138.6** | **77.5** | **752.0** | **316.5** | **1,428.5** | **5,451.4** |
| 2015 | Jan | 59.3 | 99.6 | 90.6 | 0.0 | 0.0 | 7.2 | 1.2 | 429.4 | 687.3 |
| 2015 | Feb | 58.6 | 18.3 | 34.4 | 4.6 | 0.0 | 0.0 | 15.6 | 210.2 | 341.8 |
| 2015 | Mar | 3.2 | 0.8 | 14.3 | 0.4 | 0.0 | 1.1 | 6.5 | 470.4 | 496.7 |
| 2015 | Apr | 3.3 | 0.5 | 4.3 | 0.0 | 0.0 | 0.0 | 0.2 | 4.6 | 12.8 |
| 2015 | May | 38.4 | 37.0 | 59.9 | 0.0 | 0.0 | 0.0 | 0.1 | 0.5 | 135.9 |
| 2015 | Jun | 35.3 | 51.7 | 280.2 | 0.5 | 0.2 | 8.2 | 0.0 | 0.2 | 376.4 |
| 2015 | Jul | 20.5 | 53.2 | 469.7 | 27.6 | 0.3 | 10.7 | 0.0 | 0.1 | 582.1 |
| 2015 | Aug | 7.4 | 20.1 | 222.6 | 18.9 | 0.0 | 77.6 | 8.1 | 0.1 | 354.8 |
| 2015 | Sep | 1.4 | 23.3 | 129.2 | 33.2 | 15.6 | 230.4 | 39.8 | 0.0 | 472.9 |
| 2015 | Oct | 4.3 | 37.9 | 189.0 | 2.0 | 31.3 | 226.9 | 46.5 | 24.3 | 562.2 |
| 2015 | Nov | 23.7 | 23.6 | 294.8 | 5.1 | 0.0 | 223.6 | 34.1 | 106.3 | 711.3 |
| 2015 | Dec | 63.6 | 150.4 | 127.0 | 0.5 | 32.9 | 0.0 | 0.0 | 187.2 | 561.6 |
| **2015** | **Total** | **319.1** | **516.4** | **1,916.0** | **93.0** | **80.4** | **785.7** | **152.2** | **1,433.2** | **5,295.9** |
| 2016 | Jan | 18.5 | 89.9 | 93.5 | 0.1 | 4.2 | 0.0 | 1.4 | 567.5 | 775.2 |
| 2016 | Feb | 29.0 | 56.2 | 37.0 | 0.7 | 0.0 | 4.7 | 14.3 | 941.9 | 1,083.9 |
| 2016 | Mar | 0.6 | 1.1 | 5.4 | 8.3 | 0.0 | 0.0 | 37.7 | 255.2 | 308.4 |
| 2016 | Apr | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.3 | 5.3 |
| 2016 | May | 34.1 | 41.8 | 51.2 | 0.0 | 0.0 | 0.0 | 0.0 | 19.0 | 146.2 |
| 2016 | Jun | 54.4 | 91.5 | 286.5 | 2.4 | 0.3 | 9.8 | 3.5 | 27.9 | 476.4 |
| 2016 | Jul | 30.8 | 56.0 | 456.0 | 14.4 | 0.7 | 10.8 | 5.8 | 9.3 | 583.9 |
| 2016 | Aug | 4.7 | 22.9 | 130.5 | 3.9 | 7.6 | 89.1 | 48.4 | 2.2 | 309.5 |
| 2016 | Sep | 7.5 | 9.1 | 83.4 | 40.2 | 5.2 | 121.1 | 41.1 | 1.5 | 309.0 |
| 2016 | Oct | 4.3 | 13.4 | 135.0 | 34.9 | 3.9 | 100.9 | 45.0 | 2.1 | 339.5 |
| 2016 | Nov | 59.5 | 115.1 | 423.2 | 63.3 | 28.9 | 56.5 | 21.6 | 74.0 | 842.2 |
| 2016 | Dec | 19.2 | 96.3 | 101.2 | 0.0 | 0.0 | 1.9 | 0.0 | 163.5 | 382.2 |
| **2016** | **Total** | **262.5** | **593.4** | **1,803.1** | **168.3** | **51.0** | **394.9** | **218.9** | **2,069.4** | **5,561.6** |
| 2017 | Jan | 128.9 | 129.6 | 159.4 | 0.9 | 15.2 | 15.3 | 20.5 | 530.1 | 1,000.0 |
| 2017 | Feb | 41.9 | 106.0 | 67.1 | 4.3 | 0.0 | 0.0 | 110.3 | 344.8 | 674.3 |
| 2017 | Mar | 23.7 | 0.0 | 1.8 | 19.5 | 0.0 | 0.5 | 0.4 | 100.8 | 146.6 |
| 2017 | Apr | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 5.1 | 5.2 |
| 2017 | May | 19.4 | 58.6 | 47.2 | 0.5 | 0.2 | 0.0 | 0.3 | 0.5 | 126.8 |
| 2017 | Jun | 47.1 | 123.0 | 444.5 | 0.2 | 1.1 | 0.0 | 0.0 | 0.0 | 615.9 |
| 2017 | Jul | 8.7 | 57.5 | 989.2 | 0.9 | 0.0 | 3.1 | 0.4 | 3.9 | 1,063.6 |
| 2017 | Aug | 9.7 | 30.2 | 208.9 | 0.7 | 0.3 | 1.0 | 0.7 | 0.0 | 251.4 |
| 2017 | Sep | 5.6 | 14.1 | 298.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 318.1 |
| 2017 | Oct | - | - | - | - | - | - | - | - | - |
| 2017 | Nov | - | - | - | - | - | - | - | - | - |
| 2017 | Dec | - | - | - | - | - | - | - | - | - |
| **2017** | **Total** | **285.1** | **518.9** | **2,216.2** | **27.0** | **16.9** | **19.9** | **132.5** | **985.4** | **4,201.9** |

*French catch (2014 = 1,437 t, 2015 = 1,164 t, 2016 = 1,132 t, 2017 = 566 t) excluded since unit area not available.

*Table 4. Summary of sampling conducted on 3Ps cod landings during 2016.*

| Gear | Year | - | Landings | - | - | Number of |
|---|---|---|---|---|---|---|
| - | - | Reported (t) | Sampled (t) | Unsampled (%) | Length frequencies | Otoliths |
| Inshore | - | - | - | - | - | - |
| Hand line | 2014 | 331.3 | 203.8 | 38.5 | 3 | 288 |
| - | 2015 | 299 | 188.3 | 37 | 4 | 251 |
| - | 2016 | 267.7 | 147.5 | 44.9 | 4 | 147 |
| Gillnet | 2014 | 2192 | 962.3 | 56.1 | 17 | 666 |
| - | 2015 | 2553.4 | 1305.6 | 48.9 | 18 | 471 |
| - | 2016 | 2431.9 | 1395 | 42.6 | 22 | 55 |
| Line trawl | 2014 | 453 | 102 | 77.5 | 20 | 279 |
| - | 2015 | 322.5 | 25.4 | 92.1 | 17 | 48 |
| - | 2016 | 270.9 | 81.4 | 69.9 | 16 | 194 |
| Offshore | - | - | - | - | - | - |
| Gillnet | 2014 | 847.3 | 471.7 | 44.3 | 7 | 350 |
| - | 2015 | 1008.7 | 444 | 56 | 4 | 156 |
| - | 2016 | 747.2 | 222.1 | 70.3 | 3 | 8 |
| Line trawl | 2014 | 613.9 | 583.1 | 5 | 16 | 457 |
| - | 2015 | 101.6 | 0 | 100 | 0 | 48 |
| - | 2016 | 109 | 0 | 100 | 0 | 52 |
| Otter trawl | 2014 | 2409 | 1696 | 29.6 | 13 | 938 |
| - | 2015 | 2160.8 | 1875.1 | 13.2 | 8 | 1175 |
| - | 2016 | 2854.7 | 2187 | 23.4 | 6 | 587 |

*Table 5. Estimates of average weight, average length and the total numbers and weight of 3Ps cod caught at age from Canadian and french landings during 2014-16 (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)* |
|---|---|---|---|---|---|---|---|
| 2014 | 1 | - | - | - | - | - | - |
| 2014 | 2 | 0.29 | 32.22 | 28 | 0.00 | 0.09 | 0 |
| 2014 | 3 | 0.93 | 47.15 | 5,756 | 0.96 | 0.17 | 5 |
| 2014 | 4 | 1.07 | 49.27 | 52,453 | 6.04 | 0.12 | 56 |
| 2014 | 5 | 1.84 | 58.58 | 769,384 | 27.65 | 0.04 | 1,419 |
| 2014 | 6 | 2.06 | 60.60 | 806,173 | 37.04 | 0.05 | 1,662 |
| 2014 | 7 | 2.08 | 60.74 | 364,217 | 28.71 | 0.08 | 757 |
| 2014 | 8 | 2.70 | 65.75 | 580,070 | 32.25 | 0.06 | 1,569 |
| 2014 | 9 | 2.52 | 64.16 | 214,912 | 18.85 | 0.09 | 542 |
| 2014 | 10 | 3.27 | 69.14 | 138,988 | 18.04 | 0.13 | 454 |
| 2014 | 11 | 3.91 | 73.52 | 29,231 | 5.03 | 0.17 | 114 |
| 2014 | 12 | 2.74 | 63.91 | 35,551 | 12.95 | 0.36 | 97 |
| 2014 | 13 | 4.27 | 76.15 | 5,511 | 2.50 | 0.45 | 24 |
| 2014 | 14 | 5.02 | 77.17 | 2,055 | 0.70 | 0.34 | 10 |
| 2014 | 15 | 12.43 | 110.11 | 107 | 0.05 | 0.43 | 1 |
| 2014 | 16 | 11.61 | 103.76 | 424 | 0.14 | 0.33 | 5 |
| 2014 | 17 | 11.05 | 106.00 | 115 | 0.00 | 0.03 | 1 |
| 2014 | 18 | - | - | - | - | - | - |
| 2014 | 19 | 15.55 | 118.25 | 130 | 0.05 | 0.35 | 2 |
| 2014 | 20 | - | - | - | - | - | - |
| - | - | - | - | - | - | - | |
| 2015 | 1 | - | - | - | - | - | - |
| 2015 | 2 | 0.09 | 22.00 | 6 | 0.00 | 0.40 | 0 |
| 2015 | 3 | 0.80 | 44.98 | 1,908 | 0.66 | 0.34 | 2 |
| 2015 | 4 | 1.10 | 49.76 | 211,048 | 9.65 | 0.05 | 232 |
| 2015 | 5 | 1.56 | 55.45 | 261,693 | 14.38 | 0.05 | 408 |
| 2015 | 6 | 2.06 | 60.50 | 899,648 | 26.34 | 0.03 | 1,851 |
| 2015 | 7 | 2.38 | 63.43 | 652,674 | 25.78 | 0.04 | 1,551 |
| 2015 | 8 | 2.68 | 65.72 | 270,269 | 17.93 | 0.07 | 723 |
| 2015 | 9 | 2.93 | 67.37 | 325,525 | 18.63 | 0.06 | 954 |
| 2015 | 10 | 3.13 | 68.72 | 74,559 | 8.34 | 0.11 | 233 |
| 2015 | 11 | 4.30 | 76.11 | 29,487 | 4.05 | 0.14 | 127 |
| 2015 | 12 | 5.99 | 85.43 | 7,647 | 1.35 | 0.18 | 46 |
| 2015 | 13 | 5.24 | 82.17 | 4,580 | 1.70 | 0.37 | 24 |
| 2015 | 14 | - | - | - | - | - | - |
| 2015 | 15 | 7.19 | 92.10 | 3,301 | 0.10 | 0.03 | 24 |
| 2015 | 16 | 6.22 | 88.00 | 454 | 0.38 | 0.83 | 3 |
| 2015 | 17 | - | - | - | - | - | - |
| 2015 | 18 | - | - | - | - | - | - |
| 2015 | 19 | 14.21 | 115.00 | 79 | 0.00 | 0.01 | 1 |
| 2015 | 20 | - | - | - | - | - | - |
| - | - | - | - | - | - | - | - |
| 2016 | 1 | - | - | - | - | - | - |
| 2016 | 2 | 0.13 | 25.00 | 7 | 0.00 | 0.01 | 0 |
| 2016 | 3 | 0.71 | 43.00 | 874 | 0.42 | 0.48 | 1 |
| 2016 | 4 | 1.18 | 50.74 | 64,233 | 7.71 | 0.12 | 76 |
| 2016 | 5 | 1.57 | 55.61 | 974,502 | 26.79 | 0.03 | 1,529 |
| 2016 | 6 | 1.80 | 58.09 | 558,177 | 23.25 | 0.04 | 1,007 |
| 2016 | 7 | 2.35 | 62.97 | 753,167 | 24.82 | 0.03 | 1,768 |

| Year | Age | Average Weight (kg) | Average Length (cm) | Total Catch (000's) | Total Catch std error | Total Catch CV | Total Catch Weight (t)* |
|---|---|---|---|---|---|---|---|
| 2016 | 8 | 2.47 | 63.75 | 355,691 | 17.74 | 0.05 | 878 |
| 2016 | 9 | 2.94 | 67.48 | 109,685 | 8.57 | 0.08 | 322 |
| 2016 | 10 | 3.69 | 72.14 | 138,978 | 9.57 | 0.07 | 513 |
| 2016 | 11 | 4.04 | 74.65 | 36,712 | 4.39 | 0.12 | 148 |
| 2016 | 12 | 4.80 | 77.72 | 23,636 | 3.64 | 0.15 | 114 |
| 2016 | 13 | 4.52 | 75.86 | 9,361 | 2.77 | 0.30 | 42 |
| 2016 | 14 | 7.82 | 92.31 | 2,331 | 0.63 | 0.27 | 18 |
| 2016 | 15 | 11.42 | 106.62 | 438 | 0.28 | 0.64 | 5 |
| 2016 | 16 | 19.31 | 127.00 | 176 | 0.19 | 1.10 | 3 |
| 2016 | 17 | 16.63 | 121.00 | 272 | 0.25 | 0.92 | 5 |
| 2016 | 18 | - | - | - | - | - | - |
| 2016 | 19 | - | - | - | - | - | - |
| 2016 | 20 | - | - | - | - | - | - |
| 2016 | 21 | - | - | - | - | - | - |
| 2016 | 22 | 15.39 | 118.00 | 11 | 0.00 | 0.01 | 0 |

2014 * Total catch estimate (t) 6705, Total landings (t) 6901, SOP 0.97

2015 * Total catch estimate (t) 6178, Total landings (t) 6475, SOP 0.95

2016 * Total catch estimate (t) 6429, Total landings (t) 6703, SOP 0.96

*Table 6. Numbers-at-age (000s) for the commercial cod fishery in NAFO Subdiv. 3Ps from 1959 to 2016 (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 | 13,940 | 7,525 | 7,265 | 4,875 | 942 | 1,252 | 1,260 | 631 | 545 | 44 | 1 |
| **1960** | 567 | 5,496 | 23,704 | 6,714 | 3,476 | 3,484 | 1,020 | 827 | 406 | 407 | 283 | 27 |
| **1961** | 450 | 5,586 | 10,357 | 15,960 | 3,616 | 4,680 | 1,849 | 1,376 | 446 | 265 | 560 | 58 |
| **1962** | 1245 | 6,749 | 9,003 | 4,533 | 5,715 | 1,367 | 791 | 571 | 187 | 140 | 135 | 241 |
| **1963** | 961 | 4,499 | 7,091 | 5,275 | 2,527 | 3,030 | 898 | 292 | 143 | 99 | 107 | 92 |
| **1964** | 1906 | 5,785 | 5,635 | 5,179 | 2,945 | 1,881 | 1,891 | 652 | 339 | 329 | 54 | 27 |
| **1965** | 2314 | 9,636 | 5,799 | 3,609 | 3,254 | 2,055 | 1,218 | 1,033 | 327 | 68 | 122 | 36 |
| **1966** | 949 | 13,662 | 13,065 | 4,621 | 5,119 | 1,586 | 1,833 | 1,039 | 517 | 389 | 32 | 22 |
| **1967** | 2871 | 10,913 | 12,900 | 6,392 | 2,349 | 1,364 | 604 | 316 | 380 | 95 | 149 | 3 |
| **1968** | 1143 | 12,602 | 13,135 | 5,853 | 3,572 | 1,308 | 549 | 425 | 222 | 111 | 5 | 107 |
| **1969** | 774 | 7,098 | 11,585 | 7,178 | 4,554 | 1,757 | 792 | 717 | 61 | 120 | 67 | 110 |
| **1970** | 756 | 8,114 | 12,916 | 9,763 | 6,374 | 2,456 | 730 | 214 | 178 | 77 | 121 | 14 |
| **1971** | 2884 | 6,444 | 8,574 | 7,266 | 8,218 | 3,131 | 1275 | 541 | 85 | 125 | 62 | 57 |
| **1972** | 731 | 4,944 | 4,591 | 3,552 | 4,603 | 2,636 | 833 | 463 | 205 | 117 | 48 | 45 |
| **1973** | 945 | 4,707 | 11,386 | 4,010 | 4,022 | 2,201 | 2,019 | 515 | 172 | 110 | 14 | 29 |
| **1974** | 1887 | 6,042 | 9,987 | 6,365 | 2,540 | 1,857 | 1,149 | 538 | 249 | 80 | 32 | 17 |
| **1975** | 1840 | 7,329 | 5,397 | 4,541 | 5,867 | 723 | 1,196 | 105 | 174 | 52 | 6 | 2 |
| **1976** | 4110 | 12,139 | 7,923 | 2,875 | 1,305 | 495 | 140 | 53 | 17 | 21 | 4 | 3 |
| **1977** | 935 | 9,156 | 8,326 | 3,209 | 920 | 395 | 265 | 117 | 57 | 43 | 31 | 11 |
| **1978** | 502 | 5,146 | 6,096 | 4,006 | 1,753 | 653 | 235 | 178 | 72 | 27 | 17 | 10 |
| **1979** | 135 | 3,072 | 10,321 | 5,066 | 2,353 | 721 | 233 | 84 | 53 | 24 | 13 | 10 |
| **1980** | 368 | 1,625 | 5,054 | 8,156 | 3,379 | 1,254 | 327 | 114 | 56 | 45 | 21 | 25 |
| **1981** | 1022 | 2,888 | 3,136 | 4,652 | 5,855 | 1,622 | 539 | 175 | 67 | 35 | 18 | 2 |
| **1982** | 130 | 5,092 | 4,430 | 2,348 | 2,861 | 2,939 | 640 | 243 | 83 | 30 | 11 | 7 |
| **1983** | 760 | 2,682 | 9,174 | 4,080 | 1,752 | 1,150 | 1,041 | 244 | 91 | 37 | 18 | 8 |
| **1984** | 203 | 4,521 | 4,538 | 7,018 | 2,221 | 584 | 542 | 338 | 134 | 35 | 8 | 8 |
| **1985** | 152 | 2,639 | 8,031 | 5,144 | 5,242 | 1,480 | 626 | 545 | 353 | 109 | 21 | 6 |
| **1986** | 306 | 5,103 | 10,253 | 11,228 | 4,283 | 2,167 | 650 | 224 | 171 | 143 | 79 | 23 |
| **1987** | 585 | 2,956 | 11,023 | 9,763 | 5,453 | 1,416 | 1,107 | 341 | 149 | 78 | 135 | 50 |
| **1988** | 935 | 4,951 | 4,971 | 6,471 | 5,046 | 1,793 | 630 | 284 | 123 | 75 | 53 | 31 |
| **1989** | 1071 | 8,995 | 7,842 | 2,863 | 2,549 | 1,112 | 600 | 223 | 141 | 57 | 29 | 26 |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1990** | 2006 | 8,622 | 8,195 | 3,329 | 1,483 | 1,237 | 692 | 350 | 142 | 104 | 47 | 22 |
| **1991** | 812 | 7,981 | 10,028 | 5,907 | 2,164 | 807 | 620 | 428 | 108 | 76 | 50 | 22 |
| **1992** | 1422 | 4,159 | 8,424 | 6,538 | 2,266 | 658 | 269 | 192 | 187 | 83 | 34 | 41 |
| **1993** | 278 | 3,712 | 2,035 | 3,156 | 1,334 | 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 | 1,130 | 497 | 937 | 826 | 187 | 93 | 31 | 4 | 1 | 0 |
| **1998** | 91 | 373 | 793 | 1,550 | 948 | 1,314 | 1,217 | 225 | 120 | 56 | 15 | 1 |
| **1999** | 49 | 628 | 1,202 | 2,156 | 2,321 | 1,020 | 960 | 873 | 189 | 110 | 21 | 8 |
| **2000** | 76 | 335 | 736 | 1,352 | 1,692 | 1,484 | 610 | 530 | 624 | 92 | 37 | 16 |
| **2001** | 80 | 475 | 718 | 1,099 | 1,143 | 796 | 674 | 257 | 202 | 192 | 28 | 13 |
| **2002** | 155 | 607 | 1,451 | 1,280 | 900 | 722 | 419 | 355 | 96 | 70 | 71 | 14 |
| **2003** | 15 | 301 | 879 | 1,810 | 1,139 | 596 | 337 | 277 | 167 | 67 | 55 | 84 |
| **2004** | 62 | 113 | 654 | 1,592 | 1,713 | 649 | 266 | 180 | 104 | 47 | 17 | 24 |
| **2005** | 49 | 330 | 515 | 1,007 | 1,628 | 1,087 | 499 | 143 | 95 | 41 | 26 | 12 |
| **2006** | 43 | 253 | 866 | 928 | 846 | 1,055 | 632 | 237 | 80 | 36 | 19 | 7 |
| **2007** | 97 | 311 | 727 | 1,072 | 761 | 501 | 526 | 401 | 160 | 44 | 34 | 21 |
| **2008** | 35 | 422 | 617 | 1,105 | 976 | 634 | 350 | 295 | 193 | 91 | 27 | 12 |
| **2009** | 17 | 129 | 813 | 1,000 | 902 | 460 | 205 | 99 | 114 | 86 | 56 | 12 |
| **2010** | 31 | 377 | 549 | 1,240 | 726 | 385 | 181 | 76 | 22 | 57 | 30 | 8 |
| **2011** | 31 | 136 | 839 | 809 | 854 | 351 | 172 | 68 | 33 | 23 | 17 | 8 |
| **2012** | 8 | 66 | 183 | 675 | 621 | 396 | 146 | 63 | 23 | 31 | 6 | 11 |
| **2013** | 6 | 154 | 431 | 332 | 488 | 361 | 140 | 49 | 22 | 21 | 5 | 9 |
| **2014** | 0 | 6 | 52 | 769 | 806 | 364 | 580 | 215 | 139 | 29 | 36 | 6 |
| **2015** | 2 | 211 | 262 | 900 | 653 | 270 | 326 | 75 | 29 | 8 | 5 | 0 |
| **2016** | 1 | 63 | 938 | 542 | 728 | 345 | 106 | 133 | 36 | 23 | 9 | 2 |

*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 1959-2016. 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 |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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 |
| **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** | 1.060 | 1.063 | 1.374 | 1.633 | 2.170 | 2.422 | 2.717 | 2.665 | 2.788 | 2.806 | 7.008 | 10.424 |
| **2012** | 0.772 | 0.930 | 1.392 | 1.948 | 2.012 | 2.174 | 2.749 | 3.307 | 3.590 | 2.654 | 4.333 | 3.507 |
| **2013** | 0.628 | 1.184 | 1.568 | 1.860 | 2.138 | 2.050 | 2.569 | 2.976 | 3.050 | 3.252 | 2.464 | 2.416 |
| **2014** | 0.929 | 1.066 | 1.844 | 2.061 | 2.078 | 2.704 | 2.522 | 3.265 | 3.913 | 2.742 | 4.27 | 5.022 |
| **2015** | 0.799 | 1.101 | 1.559 | 2.057 | 2.377 | 2.676 | 2.93 | 3.127 | 4.299 | 5.988 | 5.236 | - |
| **2016** | 0.705 | 1.179 | 1.569 | 1.804 | 2.348 | 2.468 | 2.936 | 3.691 | 4.035 | 4.804 | 4.522 | 7.818 |

*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. Weights at age 3 in 2016, and age 14 in 2015 are the geometric means of the prior three years.*

| 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** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1960** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1961** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1962** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1963** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1964** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1965** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1966** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1967** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1968** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1969** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1970** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1971** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1972** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1973** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1974** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1975** | 0.178 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1976** | 0.180 | 0.440 | 0.863 | 1.347 | 2.008 | 2.776 | 3.628 | 4.564 | 5.535 | 6.497 | 7.507 | 8.587 |
| **1977** | 0.488 | 0.436 | 0.947 | 1.417 | 2.118 | 2.865 | 3.667 | 4.500 | 5.484 | 6.385 | 7.840 | 9.367 |
| **1978** | 0.374 | 0.620 | 0.857 | 1.508 | 2.135 | 2.825 | 3.745 | 4.650 | 5.054 | 6.529 | 7.238 | 8.750 |
| **1979** | 0.309 | 0.541 | 0.841 | 1.335 | 2.112 | 3.003 | 3.586 | 5.158 | 6.010 | 6.511 | 8.283 | 9.166 |
| **1980** | 0.422 | 0.543 | 0.857 | 1.295 | 2.023 | 3.030 | 4.458 | 5.467 | 6.878 | 7.777 | 8.747 | 9.555 |
| **1981** | 0.379 | 0.641 | 0.975 | 1.426 | 1.954 | 2.848 | 3.962 | 5.538 | 7.176 | 8.118 | 8.514 | 9.444 |
| **1982** | 0.329 | 0.608 | 0.961 | 1.533 | 2.061 | 2.574 | 3.576 | 4.798 | 5.925 | 7.992 | 8.838 | 9.784 |
| **1983** | 0.433 | 0.615 | 1.012 | 1.526 | 2.143 | 2.774 | 3.295 | 4.439 | 5.885 | 7.226 | 9.312 | 10.106 |
| **1984** | 0.582 | 0.777 | 1.084 | 1.619 | 2.292 | 3.119 | 3.935 | 4.578 | 5.504 | 7.701 | 9.728 | 10.229 |
| **1985** | 0.577 | 0.749 | 1.131 | 1.583 | 2.353 | 3.014 | 4.350 | 5.343 | 5.829 | 6.569 | 9.417 | 10.834 |
| **1986** | 0.452 | 0.687 | 1.001 | 1.504 | 2.086 | 2.975 | 3.846 | 5.255 | 6.099 | 7.299 | 7.603 | 10.809 |
| **1987** | 0.463 | 0.645 | 0.953 | 1.387 | 2.062 | 2.709 | 3.693 | 4.688 | 5.840 | 6.573 | 7.857 | 8.194 |
| **1988** | 0.556 | 0.678 | 0.916 | 1.422 | 1.881 | 2.597 | 3.288 | 4.644 | 5.354 | 6.397 | 7.216 | 7.947 |
| **1989** | 0.539 | 0.714 | 0.975 | 1.333 | 1.938 | 2.704 | 3.464 | 4.306 | 5.597 | 6.399 | 7.152 | 8.070 |
| **1990** | 0.510 | 0.736 | 1.014 | 1.465 | 1.998 | 2.598 | 3.771 | 4.574 | 5.735 | 6.914 | 7.789 | 8.965 |
| **1991** | 0.558 | 0.660 | 1.003 | 1.487 | 2.094 | 2.670 | 3.327 | 4.225 | 5.681 | 6.983 | 8.103 | 8.987 |
| **1992** | 0.377 | 0.645 | 0.882 | 1.351 | 1.968 | 2.618 | 3.472 | 4.522 | 5.211 | 7.042 | 8.936 | 10.131 |
| **1993** | 0.234 | 0.559 | 0.865 | 1.239 | 1.822 | 2.507 | 3.543 | 4.221 | 5.095 | 6.936 | 7.317 | 9.255 |
| **1994** | 0.525 | 0.538 | 0.941 | 1.415 | 1.744 | 2.417 | 3.185 | 4.359 | 5.202 | 6.032 | 7.130 | 7.434 |
| **1995** | 0.378 | 0.724 | 1.132 | 1.626 | 2.143 | 2.390 | 3.083 | 3.931 | 4.323 | 5.116 | 6.590 | 7.918 |
| **1996** | 0.584 | 0.716 | 1.123 | 1.793 | 2.264 | 2.695 | 2.998 | 3.734 | 4.554 | 4.470 | 5.494 | 7.447 |
| **1997** | 0.480 | 0.778 | 1.133 | 1.667 | 2.267 | 2.861 | 3.195 | 3.375 | 4.300 | 5.540 | 6.337 | 8.825 |
| **1998** | 0.509 | 0.793 | 1.187 | 1.635 | 2.128 | 2.789 | 3.619 | 3.786 | 4.035 | 4.889 | 6.377 | 9.118 |
| **1999** | 0.619 | 0.755 | 1.265 | 1.904 | 2.277 | 2.612 | 3.486 | 4.636 | 4.540 | 4.934 | 5.656 | 6.816 |
| **2000** | 0.478 | 0.792 | 1.118 | 1.801 | 2.516 | 2.668 | 2.981 | 4.245 | 5.898 | 5.528 | 5.818 | 6.891 |
| **2001** | 0.567 | 0.792 | 1.136 | 1.621 | 2.307 | 3.055 | 3.003 | 3.300 | 5.071 | 7.502 | 6.826 | 7.220 |
| **2002** | 0.439 | 0.837 | 1.254 | 1.714 | 2.121 | 2.827 | 3.838 | 3.534 | 3.659 | 5.815 | 8.750 | 7.774 |
| **2003** | 0.573 | 0.746 | 1.265 | 1.806 | 2.186 | 2.474 | 3.465 | 4.533 | 4.092 | 4.544 | 6.876 | 9.593 |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2004** | 0.464 | 0.810 | 1.154 | 1.790 | 2.295 | 2.532 | 2.740 | 4.406 | 5.644 | 4.749 | 6.164 | 8.288 |
| **2005** | 0.506 | 0.744 | 1.155 | 1.586 | 2.237 | 2.692 | 2.941 | 3.042 | 4.679 | 6.424 | 5.384 | 7.482 |
| **2006** | 0.455 | 0.802 | 1.209 | 1.640 | 1.997 | 2.599 | 3.159 | 3.309 | 3.189 | 4.633 | 6.369 | 6.436 |
| **2007** | 0.419 | 0.729 | 1.207 | 1.744 | 2.082 | 2.343 | 3.203 | 4.126 | 4.370 | 3.902 | 5.903 | 7.620 |
| **2008** | 0.535 | 0.738 | 1.125 | 1.665 | 2.089 | 2.347 | 2.581 | 3.768 | 5.076 | 5.400 | 4.931 | 7.736 |
| **2009** | 0.474 | 0.822 | 1.226 | 1.615 | 2.135 | 2.349 | 2.538 | 3.107 | 4.703 | 6.063 | 6.495 | 6.709 |
| **2010** | 0.491 | 0.825 | 1.178 | 1.755 | 2.089 | 2.478 | 2.618 | 2.768 | 4.501 | 6.782 | 8.204 | 8.921 |
| **2011** | 1.132 | 0.822 | 1.223 | 1.492 | 2.088 | 2.340 | 2.650 | 2.712 | 2.859 | 3.935 | 7.445 | 9.962 |
| **2012** | 0.623 | 0.993 | 1.216 | 1.636 | 1.813 | 2.172 | 2.580 | 2.998 | 3.093 | 2.720 | 3.487 | 4.958 |
| **2013** | 0.482 | 0.956 | 1.208 | 1.609 | 2.041 | 2.031 | 2.363 | 2.860 | 3.176 | 3.417 | 2.557 | 3.236 |
| **2014** | 0.853 | 0.818 | 1.478 | 1.798 | 1.966 | 2.404 | 2.274 | 2.896 | 3.412 | 2.892 | 3.726 | 3.518 |
| **2015** | 0.658 | 1.011 | 1.289 | 1.948 | 2.213 | 2.358 | 2.815 | 2.808 | 3.746 | 4.841 | 3.789 | 3.836 |
| **2016** | 0.647 | 0.971 | 1.314 | 1.677 | 2.198 | 2.422 | 2.803 | 3.289 | 3.552 | 4.544 | 5.204 | 6.398 |
| **2017** | 1.132 | 0.822 | 1.223 | 1.492 | 2.088 | 2.340 | 2.650 | 2.712 | 2.859 | 3.935 | 7.445 | 9.962 |

*Table 8. 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 |
| **2015** | AN 450-452 | 11-Apr-15 | 10-May-15 | 30 | 173 | 116 | 0.67 |
| **2016** | Tel 157,158,169 | 02-Apr-16 | 01-May-16 | 30 | 157 | 110 | 0.70 |
| **2017** | AN 476-478 | 06-Apr-17 | 08-May-17 | 33 | 179 | 121 | 0.68 |

*Table 9. Cod abundance estimates (000's of fish) from DFO bottom-trawl research vessel surveys in NAFO Subdiv. 3Ps.**

| Strata | Depth (fathoms) | sq. mi. | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 314 | <30 | 974 | 2,144 | 573 | 287 | 328 | 1,223 | 563 | 172 | 89 | 395 | 1,280 |
| 320 | <30 | 1320 | 363 | 3,222 | 1,260 | 1,603 | 4,213 | 1,189 | 893 | 363 | 715 | 1,483 |
| 293 | 31-50 | 159 | 252 | 208 | 55 | 284 | 503 | 1,312 | 186 | 56 | 66 | 93 |
| 308 | 31-50 | 112 | 2,373 | 486 | 16,893 | 3,058 | 1,167 | 878 | 4,437 | 28,379 | 131 | 3,821 |
| 312 | 31-50 | 272 | 270 | 0 | 112 | 337 | 1310 | 854 | 4,247 | 75 | 792 | 599 |
| 315 | 31-50 | 827 | 675 | 1,634 | 767 | 1,405 | 3,705 | 2,243 | 11,141 | 211 | 2,476 | 228 |
| 321 | 31-50 | 1189 | 189 | 218 | 1,823 | 2,608 | 393 | 549 | 307 | 157 | 613 | 474 |
| 325 | 31-50 | 944 | 812 | 1,542 | 7,970 | 8,019 | 519 | 2,194 | 2,708 | 1,217 | 200 | 114 |
| 326 | 31-50 | 166 | 11 | 0 | 11 | 627 | 11 | 57 | 11 | 23 | 38 | 23 |
| 783 | 31-50 | 229 | 126 | 157 | 515 | 228 | 126 | 110 | 63 | 72 | 142 | 16 |
| 294 | 51-100 | 135 | 108 | 4,960 | 713 | 59 | 2,658 | 1,476 | 845 | 1,401 | 716 | 1,576 |
| 297 | 51-100 | 152 | 273 | 1,056 | 4,242 | 2,781 | 3,922 | 1,547 | 1,181 | 1,241 | 554 | 1,302 |
| 307 | 51-100 | 395 | 4,849 | 18,237 | 7,758 | 4,945 | 3,412 | 1,902 | 2,010 | 7,480 | 1,793 | 5,868 |
| 311 | 51-100 | 317 | 2,519 | 3,632 | 9,627 | 1,979 | 3,212 | 17,063 | 2,847 | 1,352 | 2,209 | 2,965 |
| 317 | 51-100 | 193 | 2,881 | 912 | 3,215 | 330 | 7,022 | 12,721 | 0 | 199 | 1,739 | 942 |
| 319 | 51-100 | 984 | 146,70 | 24,418 | 20,120 | 10,120 | 35,549 | 40,494 | 15,851 | 20,338 | 13,826 | 11,624 |
| 322 | 51-100 | 1567 | 1,297 | 1,049 | 820 | 2,546 | 3,162 | 11,202 | 8,400 | 1,376 | 1,616 | 1,026 |
| 323 | 51-100 | 696 | 3,300 | 105 | 15,274 | 8,179 | 3,067 | 1,332 | 2,489 | 7,854 | 3,452 | 112 |
| 324 | 51-100 | 494 | 153 | 359 | 417 | 3,590 | 646 | 610 | 510 | 680 | 234 | 158 |
| 781 | 51-100 | 446 | 552 | 548 | 293 | 506 | 813 | 5,031 | 1,166 | 756 | 205 | 622 |
| 782 | 51-100 | 183 | 227 | 201 | 22 | 566 | 327 | 512 | 1,032 | 277 | 138 | 566 |
| 295 | 101-150 | 209 | 633 | 396 | 2,441 | nf | 971 | 1,639 | 1,776 | 2,444 | 1,495 | 13,451 |
| 298 | 101-150 | 171 | 3,384 | 73 | 585 | 0 | 6,764 | 134 | 125 | 141 | 118 | 3,093 |
| 300 | 101-150 | 217 | 90 | 507 | 194 | 917 | 43 | 637 | 254 | 68 | 388 | 968 |
| 306 | 101-150 | 363 | 818 | 4,054 | 714 | 1,382 | 706 | 877 | 574 | 433 | 136 | 233 |
| 309 | 101-150 | 296 | 244 | 49 | 236 | 529 | 308 | 49,273 | 145 | 41 | 22,517 | 38 |
| 310 | 101-150 | 170 | 269 | 30 | 143 | 129 | 35 | 1,695 | 86 | 386 | 82 | 53 |
| 313 | 101-150 | 165 | 23 | 111 | 259 | 21 | 11 | 164 | 571 | 23 | 227 | 261 |
| 316 | 101-150 | 189 | 13 | 116 | 10 | 12 | 17 | 65 | 0 | 45 | 30 | 23 |
| 318 | 101-150 | 129 | 16 | 189 | 18 | 9 | 9 | 237 | 21 | 35 | 68 | 9 |
| 779 | 101-150 | 422 | 310 | 186 | 0 | 503 | 5,955 | 12,283 | 7,372 | 192 | 348 | 318 |
| 780 | 101-150 | 403 | 0 | 37 | 0 | 388 | 526 | 3,587 | 1,002 | 127 | 698 | 147 |
| 296 | 151-200 | 71 | 273 | 999 | 32 | 3,581 | 2,269 | 2,338 | 103 | 161 | 347 | 893 |
| 299 | 151-200 | 212 | 13 | 13 | 42 | 58 | 39 | 110 | 188 | 0 | 29 | 33 |
| 705 | 151-200 | 195 | 76 | 155 | 36 | 29 | 0 | 13 | 63 | 13 | 27 | 13 |
| 706 | 151-200 | 476 | 65 | 87 | 258 | 131 | 98 | 16 | 0 | 35 | 147 | 646 |
| 707 | 151-200 | 74 | 257 | 737 | 23 | 16 | 15 | 173 | 12 | 22 | 5 | 9 |
| 715 | 201-300 | 1074 | 170 | 599 | 63 | 53 | 18 | 26 | 0 | 3,600 | 117 | 149 |
| 716 | 151-200 | 128 | 51 | 1,546 | 180 | 130 | 676 | 2,330 | 264 | 551 | 148 | 0 |
| 708 | 151-200 | 539 | 0 | 4,299 | 26 | 30 | 28 | 199 | Nf | 59 | nf | 327 |
| 711 | 201-300 | 126 | 29 | 125 | 44 | 29 | 3,850 | 16 | 0 | 16 | 41 | 63 |
| 712 | 201-300 | 593 | 54 | 60 | 15 | 34 | 65 | 0 | 20 | 17 | 40 | 0 |
| 713 | 201-300 | 731 | 17 | 99 | 56 | 0 | 134 | 36 | 0 | 0 | 20 | 17 |
| 714 | 201-300 | 851 | 44 | 819 | 55 | 70 | 79 | 0 | 0 | 169 | 92 | 29 |
| **Total** | Offshore | - | 38,652 | 69,462 | 88,490 | 52,275 | 74,660 | 148,972 | 57,779 | 75,237 | 53,926 | 32,588 |
| **Total** | In/Offshore | - | 44,906 | 78,803 | 97,625 | 62,146 | 99,575 | 179,689 | 73,072 | 82,172 | 59,170 | 55,667 |
| **std** | Offshore | - | 7,713 | 15,303 | 24,153 | 8,209 | 12,294 | 53,762 | 10,415 | 29,521 | 24,399 | 5,429 |

*See Fig. 14 for location of strata. The survey was not completed in 2006. See Brattey et al. (2007) for pre-2005 data.

*Table 10. Cod biomass estimates (t) from DFO bottom-trawl research vessel surveys in NAFO Subdiv. 3Ps.**

| Strata | Depth (fathoms) | sq. mi. | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 314 | <30 | 974 | 204 | 68 | 43 | 100 | 200 | 69 | 30 | 52 | 98 | 269 |
| 320 | <30 | 1,320 | 442 | 1,069 | 603 | 500 | 1,695 | 1,618 | 759 | 69 | 363 | 1,113 |
| 293 | 31-50 | 159 | 18 | 7 | 15 | 19 | 46 | 52 | 10 | 13 | 5 | 6 |
| 308 | 31-50 | 112 | 789 | 170 | 8,343 | 1,558 | 426 | 732 | 1,408 | 13,903 | 49 | 2,184 |
| 312 | 31-50 | 272 | 434 | 0 | 37 | 78 | 206 | 234 | 904 | 30 | 125 | 104 |
| 315 | 31-50 | 827 | 99 | 1,777 | 235 | 1,295 | 1,585 | 544 | 4,726 | 180 | 796 | 83 |
| 321 | 31-50 | 1,189 | 17 | 54 | 2,054 | 1,639 | 150 | 114 | 140 | 56 | 130 | 78 |
| 325 | 31-50 | 944 | 555 | 447 | 4,194 | 2,831 | 269 | 547 | 923 | 385 | 18 | 12 |
| 326 | 31-50 | 166 | 1 | 0 | 19 | 140 | 4 | 25 | 3 | 5 | 7 | 3 |
| 783 | 31-50 | 229 | 18 | 13 | 31 | 25 | 7 | 19 | 27 | 1 | 25 | 2 |
| 294 | 51-100 | 135 | 27 | 149 | 55 | 7 | 315 | 73 | 47 | 111 | 45 | 67 |
| 297 | 51-100 | 152 | 122 | 156 | 1,224 | 2,110 | 1,863 | 528 | 227 | 285 | 138 | 175 |
| 307 | 51-100 | 395 | 3,059 | 8,114 | 4,100 | 3,258 | 1,563 | 650 | 951 | 2,185 | 565 | 3,137 |
| 311 | 51-100 | 317 | 219 | 395 | 2,414 | 394 | 348 | 1,512 | 684 | 108 | 310 | 178 |
| 317 | 51-100 | 193 | 231 | 158 | 2,436 | 31 | 2,849 | 970 | 0 | 67 | 325 | 29 |
| 319 | 51-100 | 984 | 8,888 | 33,064 | 20,494 | 10,024 | 28,365 | 20,804 | 12,559 | 11,071 | 4,507 | 6,151 |
| 322 | 51-100 | 1,567 | 205 | 104 | 439 | 1,395 | 206 | 607 | 1,439 | 201 | 182 | 77 |
| 323 | 51-100 | 696 | 2,525 | 4 | 10,070 | 4,602 | 655 | 127 | 1,220 | 4,048 | 1,676 | 11 |
| 324 | 51-100 | 494 | 39 | 53 | 39 | 653 | 86 | 175 | 97 | 112 | 21 | 20 |
| 781 | 51-100 | 446 | 49 | 28 | 33 | 44 | 55 | 151 | 70 | 114 | 15 | 44 |
| 782 | 51-100 | 183 | 13 | 20 | 1 | 328 | 30 | 101 | 42 | 51 | 9 | 22 |
| 295 | 101-150 | 209 | 83 | 20 | 519 | Nf | 477 | 117 | 204 | 453 | 260 | 6,718 |
| 298 | 101-150 | 171 | 2881 | 56 | 250 | 0 | 3,903 | 37 | 79 | 43 | 59 | 1,732 |
| 300 | 101-150 | 217 | 25 | 286 | 111 | 480 | 94 | 200 | 74 | 14 | 138 | 510 |
| 306 | 101-150 | 363 | 645 | 2,021 | 630 | 932 | 649 | 501 | 268 | 244 | 74 | 120 |
| 309 | 101-150 | 296 | 673 | 10 | 282 | 333 | 210 | 44,380 | 25 | 14 | 17,005 | 18 |
| 310 | 101-150 | 170 | 427 | 7 | 82 | 105 | 17 | 306 | 74 | 152 | 28 | 39 |
| 313 | 101-150 | 165 | 79 | 61 | 213 | 14 | 21 | 39 | 315 | 12 | 87 | 341 |
| 316 | 101-150 | 189 | 5 | 156 | 7 | 7 | 29 | 23 | 0 | 75 | 30 | 12 |
| 318 | 101-150 | 129 | 25 | 189 | 32 | 38 | 15 | 438 | 51 | 50 | 76 | 7 |
| 779 | 101-150 | 422 | 38 | 18 | 0 | 168 | 1,246 | 4,719 | 1,875 | 34 | 15 | 19 |
| 780 | 101-150 | 403 | 0 | 2 | 0 | 71 | 21 | 284 | 178 | 13 | 80 | 3 |
| 296 | 151-200 | 71 | 76 | 239 | 5 | 2,702 | 1,863 | 589 | 29 | 33 | 131 | 236 |
| 299 | 151-200 | 212 | 1 | 2 | 26 | 63 | 29 | 9 | 275 | 0 | 21 | 29 |
| 705 | 151-200 | 195 | 111 | 122 | 47 | 36 | 0 | 49 | 141 | 18 | 88 | 8 |
| 706 | 151-200 | 476 | 76 | 51 | 153 | 180 | 126 | 17 | 0 | 53 | 110 | 597 |
| 707 | 151-200 | 74 | 243 | 469 | 20 | 24 | 71 | 154 | 27 | 21 | 6 | 17 |
| 715 | 151-200 | 1,074 | 296 | 1,793 | 101 | 74 | 16 | 45 | 0 | 2,033 | 181 | 288 |
| 716 | 151-200 | 128 | 59 | 961 | 124 | 111 | 1,102 | 1,476 | 307 | 311 | 178 | 0 |
| 708 | 201-300 | 539 | 0 | 3,688 | 16 | 30 | 32 | 269 | nf | 109 | nf | 334 |
| 711 | 201-300 | 126 | 52 | 100 | 33 | 25 | 3,546 | 4 | 0 | 7 | 21 | 61 |
| 712 | 201-300 | 593 | 81 | 52 | 10 | 22 | 55 | 0 | 9 | 9 | 31 | 0 |
| 713 | 201-300 | 731 | 5 | 59 | 101 | 0 | 124 | 16 | 0 | 0 | 7 | 17 |
| 714 | 201-300 | 851 | 51 | 808 | 55 | 59 | 87 | 0 | 0 | 160 | 119 | 48 |
| **Total** | Offshore | - | 20,535 | 56,024 | 57,429 | 30,487 | 44,706 | 76,447 | 27,057 | 35,740 | 27,211 | 15,356 |
| **Total** | In/Offshore | - | 23,910 | 57,020 | 59,698 | 36,505 | 54,656 | 83,327 | 30,195 | 36,905 | 28,154 | 24,920 |
| **std** | Offshore | - | 4,895 | 22,078 | 18,906 | 5,042 | 11,579 | 44,705 | 6,964 | 14,899 | 17,255 | 3,512 |

*See Fig. 14 for location of strata. The survey was not completed in 2006. See Brattey et al. (2007) for pre-2005 data.

*Table 11a. 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 |
| **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 |
| **2015** | 0.11 | 4.55 | 9.11 | 12.60 | 3.32 | 1.36 | 1.07 | 0.36 | 0.50 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 33.05 |
| **2016** | 0.98 | 2.40 | 6.10 | 5.27 | 5.45 | 2.31 | 0.81 | 0.25 | 0.14 | 0.16 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 23.87 |
| **2017** | 1.30 | 2.42 | 2.77 | 2.25 | 2.42 | 2.12 | 0.55 | 0.32 | 0.09 | 0.03 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 14.30 |

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

*Table 11b. 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 |
| **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 |
| **2015** | 0.41 | 4.90 | 8.47 | 10.97 | 2.87 | 1.17 | 0.92 | 0.31 | 0.43 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 30.51 |
| **2016** | 1.07 | 2.58 | 5.98 | 4.62 | 4.71 | 2.00 | 0.69 | 0.22 | 0.12 | 0.14 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 22.13 |
| **2017** | 1.74 | 3.22 | 4.34 | 3.99 | 3.57 | 2.62 | 0.62 | 0.38 | 0.09 | 0.04 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 20.66 |

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

*Table 12. Mean length-at-age (cm) of cod sampled during research bottom-trawl surveys in Subdiv. 3Ps in winter-spring 1983-2017. 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* |
| **2015** | 11.9 | 20.9 | 30.5 | 39.8 | 45.0 | 53.8 | 56.5 | 56.0 | 64.5 | 72.4* | 87.0* | - |
| **2016** | 12.2 | 19.4 | 29.7 | 38.6 | 45.3 | 48.8 | 55.7 | 61.4 | 57.0* | 72.4 | 96.0* | - |
| **2017** | 11.7 | 19.6 | 28.2 | 38.8 | 44.9 | 49.1 | 52.8 | 53.8 | 61.7* | 85.5* | 72.4* | - |

*Table 13. Mean round weight-at-age (kg) of cod sampled during DFO bottom-trawl surveys in Subdiv. 3Ps in winter-spring 1983-2016. 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 | 0.23 | 0.72 | 1.30 | 1.65 | 1.86 | 3.55 | 4.04 | 4.90 | 8.85 | 10.27 |
| **1984** | - | 0.07 | 0.27 | 0.63 | 1.21 | 1.85 | 2.79 | 3.83 | 4.23 | 5.03 | 7.87 | 9.82 |
| **1985** | - | - | 0.21 | 0.51 | 1.04 | 1.57 | 2.28 | 3.21 | 3.14 | 3.76 | - | 3.97 |
| **1986** | - | 0.05 | 0.17 | 0.46 | 0.90 | 1.33 | 2.38 | 3.34 | 5.02 | 4.65 | 6.63* | 8.87 |
| **1987** | - | - | 0.25 | 0.54 | 0.95 | 1.27 | 1.89 | 2.30 | 4.48 | 6.34 | 6.62 | 5.94 |
| **1988** | - | 0.06 | 0.19 | 0.58 | 0.92 | 1.49 | 2.21 | 2.42 | 3.94 | 4.84 | 4.26 | 9.10 |
| **1989** | - | 0.06 | 0.24 | 0.61 | 0.90 | 1.33 | 2.36 | 3.78 | 4.51 | 5.82 | 8.28 | 9.06 |
| **1990** | - | 0.06 | 0.21 | 0.54 | 0.95 | 1.35 | 1.62 | 2.18 | 3.05 | 4.24 | 4.86 | 7.35 |
| **1991** | 0.01 | 0.05 | 0.22 | 0.46 | 0.87 | 1.32 | 1.70 | 2.35 | 3.09 | 3.96 | 4.05 | 4.91 |
| **1992** | - | 0.06 | 0.23 | 0.57 | 0.87 | 1.46 | 2.03 | 2.26 | 2.86 | 3.98 | 5.80 | 5.24 |
| **1993** | - | - | 0.22 | 0.55 | 0.89 | 1.15 | 1.99 | 3.00 | 4.28 | 4.47* | 8.67* | 13.20* |
| **1994** | - | 0.05 | 0.25 | 0.46 | 0.90 | 1.04 | 1.24 | 1.81 | 2.89 | 6.45 | 4.47 | 6.75 |
| **1995** | - | 0.06* | 0.21 | 0.54 | 1.02 | 1.51 | 1.69 | 1.58 | 2.21 | 4.78 | 5.45 | 5.54* |
| **1996** | 0.02 | 0.07 | 0.22 | 0.46 | 0.67 | 1.28 | 2.01 | 2.08 | 2.14 | 4.46 | 3.90 | 6.79* |
| **1997** | 0.02 | 0.11 | 0.26 | 0.55 | 0.88 | 1.08 | 1.90 | 2.61 | 2.87 | 3.08 | 5.46* | - |
| **1998** | 0.01 | 0.09 | 0.28 | 0.66 | 0.94 | 1.27 | 1.64 | 2.79 | 4.66 | 4.44 | 2.53 | 4.19* |
| **1999** | 0.01 | 0.10 | 0.28 | 0.65 | 1.13 | 1.71 | 2.00 | 2.55 | 4.56 | 6.57 | 4.26 | 12.39* |
| **2000** | 0.02 | 0.09 | 0.27 | 0.56 | 0.95 | 1.33 | 1.90 | 2.38 | 2.90 | 5.44 | 8.35 | 6.78 |
| **2001** | 0.01 | 0.09 | 0.29 | 0.53 | 0.82 | 1.17 | 1.66 | 3.15 | 4.32 | 4.20 | 6.30 | 8.96 |
| **2002** | 0.01 | 0.09 | 0.26 | 0.60 | 1.03 | 1.37 | 1.36 | 2.84 | 4.03 | 4.84 | 3.58* | 6.03 |
| **2003** | 0.01 | 0.11 | 0.27 | 0.64 | 1.13 | 1.43 | 1.78 | 1.72 | 2.95 | 3.93 | 2.47 | 5.99* |
| **2004** | 0.02 | 0.07 | 0.32 | 0.48 | 0.87 | 1.95 | 2.48 | 2.99 | 2.77 | 3.32 | 3.91 | 4.20* |
| **2005** | 0.01 | 0.14 | 0.34 | 0.61 | 0.94 | 1.42 | 2.29 | 3.02 | 4.00 | 4.62* | 10.75 | 11.45 |
| **2006** | - | - | - | - | - | - | - | - | - | - | - | - |
| **2007** | 0.01 | 0.08 | 0.23 | 0.44 | 0.97 | 1.43 | 1.45 | 2.67 | 5.91 | 7.84 | 7.15 | 7.63 |
| **2008** | 0.01 | 0.05 | 0.16 | 0.48 | 0.77 | 1.22 | 1.87 | 1.78 | 2.63 | 3.03 | 7.38 | 8.58 |
| **2009** | 0.01 | 0.05 | 0.25 | 0.47 | 0.81 | 1.39 | 1.92 | 2.27 | 3.53 | 4.33 | 6.72 | 7.09 |
| **2010** | 0.01 | 0.09 | 0.23 | 0.52 | 0.77 | 1.35 | 2.55 | 3.06 | 4.14 | 6.37* | 9.02* | 11.15 |
| **2011** | 0.02 | 0.11 | 0.25 | 0.51 | 0.91 | 1.01 | 1.59 | 2.21 | 3.59 | 1.23* | - | 4.43* |
| **2012** | 0.01 | 0.06 | 0.34 | 0.58 | 0.90 | 1.45 | 1.32 | 2.04 | 3.82 | 3.62 | 9.23* | 13.34* |
| **2013** | 0.02 | 0.07 | 0.19 | 0.64 | 0.94 | 0.91 | 1.29 | 1.31 | 2.31 | 1.68 | 9.88* | 10.32* |
| **2014** | 0.01 | 0.08 | 0.21 | 0.35 | 0.88 | 1.24 | 1.41 | 2.22 | 2.48 | 1.92* | - | 4.68 |
| **2015** | 0.01 | 0.07 | 0.22 | 0.49 | 0.74 | 1.35 | 1.50 | 1.52 | 2.51 | 3.82* | 5.67* | - |
| **2016** | 0.01 | 0.05 | 0.20 | 0.45 | 0.73 | 0.92 | 1.40 | 2.14 | 1.30* | 3.24 | 9.68* | - |
| **2017** | 0.01 | 0.06 | 0.18 | 0.46 | 0.72 | 0.93 | 1.13 | 1.26 | 2.23* | 5.95 | 3.10* | - |

*Table 14. 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 1954-2016.*

| Cohort | Slope | Slope SE | Intercept | Intercept SE | Cohort | Slope | Slope SE | Intercept | Intercept SE |
|---|---|---|---|---|---|---|---|---|---|
| **1954** | 1.1094 | 0.2940 | -8.1702 | 2.4445 | **1983** | 1.8944 | 0.2608 | -11.8903 | 1.6045 |
| **1955** | 1.5059 | 0.2237 | -10.2633 | 1.6124 | **1984** | 2.2315 | 0.2981 | -13.4166 | 1.8044 |
| **1956** | 1.3174 | 0.3208 | -9.4592 | 2.2216 | **1985** | 2.6988 | 0.3728 | -16.0342 | 2.2010 |
| **1957** | 1.4604 | 0.3703 | -10.3248 | 2.3525 | **1986** | 2.5829 | 0.2930 | -14.0673 | 1.5934 |
| **1958** | 2.3929 | 0.5853 | -16.4519 | 3.6202 | **1987** | 2.2526 | 0.2231 | -11.9227 | 1.2350 |
| **1959** | 2.1113 | 0.5358 | -13.0196 | 2.9364 | **1988** | 2.7731 | 0.4110 | -14.0212 | 2.1672 |
| **1960** | 1.6741 | 0.2990 | -10.6677 | 1.7584 | **1989** | 1.8846 | 0.1577 | -9.7844 | 0.8110 |
| **1961** | 1.8639 | 0.3551 | -11.4722 | 2.0669 | **1990** | 1.7888 | 0.1900 | -9.2101 | 0.9575 |
| **1962** | 1.7141 | 0.2898 | -10.5115 | 1.7043 | **1991** | 2.4874 | 0.4971 | -13.1443 | 2.5618 |
| **1963*** | - | - | - | - | **1992** | 2.6015 | 0.3903 | -13.0008 | 1.9108 |
| **1964** | 1.9272 | 0.2411 | -12.7182 | 1.5667 | **1993** | 1.8954 | 0.2394 | -9.8698 | 1.2957 |
| **1965** | 2.4194 | 0.5982 | -16.4244 | 4.2387 | **1994** | 1.6015 | 0.1969 | -8.1481 | 1.0091 |
| **1966** | 1.5492 | 0.2401 | -10.0608 | 1.6025 | **1995** | 1.6523 | 0.2188 | -8.7711 | 1.1242 |
| **1967** | 1.6876 | 0.3782 | -10.0845 | 2.2543 | **1996** | 1.7414 | 0.2410 | -9.3461 | 1.2620 |
| **1968** | 2.1397 | 0.2885 | -13.1625 | 1.7869 | **1997** | 3.0797 | 0.4567 | -14.8462 | 2.1742 |
| **1969** | 1.6825 | 0.3043 | -10.3672 | 1.8439 | **1998** | 1.9984 | 0.2396 | -9.6586 | 1.1567 |
| **1970** | 1.5265 | 0.2305 | -8.8558 | 1.3136 | **1999** | 1.8423 | 0.2647 | -9.1495 | 1.3103 |
| **1971** | 1.3122 | 0.1401 | -7.8405 | 0.8346 | **2000** | 1.7800 | 0.3025 | -9.2716 | 1.4885 |
| **1972** | 1.4117 | 0.1445 | -8.9081 | 0.8853 | **2001** | 1.7588 | 0.2292 | -8.3449 | 1.0333 |
| **1973** | 1.4521 | 0.1667 | -9.3550 | 1.0320 | **2002** | 1.6768 | 0.2439 | -8.8522 | 1.2949 |
| **1974** | 2.0042 | 0.1969 | -13.1541 | 1.2944 | **2003** | 1.5873 | 0.2283 | -9.0376 | 1.2856 |
| **1975** | 1.7846 | 0.2174 | -11.1641 | 1.3757 | **2004** | 1.4999 | 0.1654 | -8.3631 | 0.9171 |
| **1976** | 1.3552 | 0.2056 | -8.5990 | 1.2510 | **2005** | 1.8575 | 0.2314 | -10.0273 | 1.2522 |
| **1977** | 2.5066 | 0.3505 | -15.3640 | 2.1732 | **2006** | 1.7505 | 0.1777 | -8.5990 | 0.9036 |
| **1978** | 1.7920 | 0.1680 | -10.7323 | 1.0205 | **2007** | 1.5891 | 0.2499 | -7.5602 | 1.1863 |
| **1979** | 1.0297 | 0.1138 | -6.4477 | 0.7670 | **2008** | 1.7558 | 0.2390 | -8.6015 | 1.0573 |
| **1980** | 1.4270 | 0.1415 | -9.4134 | 0.9131 | **2009** | 2.1773 | 0.2502 | -10.4870 | 1.1094 |
| **1981** | 1.7431 | 0.1781 | -11.9865 | 1.1846 | **2010** | 1.8513 | 0.2875 | -9.2381 | 1.4001 |
| **1982** | 2.0091 | 0.2059 | -13.3056 | 1.3496 | **2011** | 2.3973 | 0.3534 | -12.3860 | 1.8100 |

*Fit not significant

*Table 15. Estimated proportions mature for female cod from NAFO Subdiv. 3Ps from DFO surveys from 1978 to 2016, projected forward to 2019. 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 | 0.6840 | 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 | 0.6251 | 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 | 0.6865 | 0.9493 | 0.9903 | 0.9986† | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| **1974** | 0.0004 | 0.0023 | 0.0198 | 0.0601 | 0.1240 | 0.4196 | 0.8492 | 0.9116 | 0.9953 | 0.9986 | 0.9998† | 1.0000 | 1.0000 | 1.0000 |
| **1975** | 0.0000 | 0.0016 | 0.0093 | 0.0697 | 0.2274 | 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 | 0.5082 | 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 | 0.6920 | 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 | 0.7058 | 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 | 0.3851 | 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 | 0.1453 | 0.4196 | 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 | 0.8986 | 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 | 0.4330 | 0.8596 | 0.9909 | 0.9733 | 0.9987 | 0.9999 | 0.9997 | 0.9999 | 1.0000 |
| **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 | 0.6401 | 0.8569 | 0.9955 | 0.9999 | 0.9982 | 1.0000 | 1.0000 | 1.0000 |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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 | 0.8763 | 0.9686 | 0.9791 | 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** | 0.0025 | 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** | 0.0011 | 0.0123 | 0.0340 | 0.0693 | 0.2966 | 0.6192 | 0.9471 | 0.9967 | 0.9988 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2010** | 0.0002 | 0.0062 | 0.0577 | 0.1684 | 0.3230 | 0.6539 | 0.8883 | 0.9897 | 0.9994 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2011** | 0.0006 | 0.0022 | 0.0344 | 0.2308 | 0.5383 | 0.7536 | 0.8944 | 0.9749 | 0.9981 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2012** | 0.0000 | 0.0039 | 0.0188 | 0.1710 | 0.5952 | 0.8703 | 0.9514 | 0.9743 | 0.9948 | 0.9996 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2013** | 0.0003 | 0.0005 | 0.0245 | 0.1446 | 0.5443 | 0.8781 | 0.9748 | 0.9921 | 0.9942 | 0.9989 | 0.9999 | 1.0000 | 1.0000 | 1.0000 |
| **2014** | 0.0003 | 0.0022 | 0.0055 | 0.1379 | 0.5986 | 0.8736 | 0.9724 | 0.9955 | 0.9988 | 0.9987 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| **2015** | 0.0003 | 0.0022 | 0.0163 | 0.0575 | 0.5046 | 0.9294 | 0.9756 | 0.9942 | 0.9992 | 0.9998 | 0.9997 | 1.0000 | 1.0000 | 1.0000 |
| **2016** | 0.0003 | 0.0022 | 0.0163 | 0.1133 | 0.4014 | 0.8664 | 0.9915 | 0.9957 | 0.9988 | 0.9999 | 1.0000 | 0.9999 | 1.0000 | 1.0000 |
| **2017** | 0.0003 | 0.0022 | 0.0163 | 0.1133 | 0.5015 | 0.8806 | 0.9764 | 0.9990 | 0.9993 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2018** | 0.0003 | 0.0022 | 0.0163 | 0.1133 | 0.5015 | 0.8921 | 0.9878 | 0.9962 | 0.9999 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2019** | 0.0003 | 0.0022 | 0.0163 | 0.1133 | 0.5015 | 0.8921 | 0.9852 | 0.9989 | 0.9994 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| **2020** | 0.0003 | 0.0022 | 0.0163 | 0.1133 | 0.5015 | 0.8921 | 0.9852 | 0.9980 | 0.9999 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |

*Table 16: Risk of projected SSB being below $B_{lim}$ under five scenarios of total mortality (Z at status quo, ±10% status quo and ±20% status quo) over 2018- 2020. Status quo Z was estimated as the geometric mean of the last three year.*

| Year | Mortality (Z) scenario | Relative SSB (median with 95% CI) | P(SSB<$B_{lim}$) |
|---|---|---|---|
| 2017 | Status quo | 1.54 (0.99-2.40) | 0.03 |
| 2018 | -20% | 1.57 (1.00-2.45) | 0.02 |
| - | -10% | 1.47 (0.94-2.31) | 0.04 |
| - | Status quo | 1.39 (0.88-2.18) | 0.08 |
| - | +10% | 1.30 (0.83-2.06) | 0.13 |
| - | +20% | 1.23 (0.78-1.94) | 0.19 |
| 2019 | -20% | 1.36 (0.86-2.15) | 0.09 |
| - | -10% | 1.21 (0.76-1.93) | 0.21 |
| - | Status quo | 1.08 (0.67-1.73) | 0.38 |
| - | +10% | 0.96 (0.60-1.56) | 0.56 |
| - | +20% | 0.86 (0.53-1.41) | 0.73 |
| 2020 | -20% | 1.18 (0.73-1.91) | 0.25 |
| - | -10% | 1.01 (0.62-1.66) | 0.48 |
| - | Status quo | 0.87 (0.52-1.45) | 0.71 |
| - | +10% | 0.75 (0.44-1.27) | 0.86 |
| - | +20% | 0.65 (0.38-1.12) | 0.94 |

*Table 17. Estimated catch rates for gillnets and summaries of data provided in logbooks for vessels greater than 35 feet.*

| - | - | - | - | - | - | Landings (t) | - |
|---|---|---|---|---|---|---|---|
| Quota Year | Estimated CPUE (t/net) | Standard Error | Number of sets | Number of vessels | Logbooks | Reported | % of reported |
| 1998 | 113 | 3.58 | 1048 | 128 | 2495 | 4237 | 59 |
| 1999 | 86 | 1.86 | 2893 | 168 | 4966 | 8213 | 60 |
| 2000 | 71 | 1.83 | 1734 | 148 | 2088 | 4456 | 47 |
| 2001 | 43 | 1.13 | 1701 | 131 | 1044 | 2309 | 45 |
| 2002 | 53 | 1.62 | 1154 | 115 | 1085 | 2600 | 42 |
| 2003 | 55 | 1.64 | 1212 | 134 | 1277 | 2772 | 46 |
| 2004 | 54 | 1.51 | 1367 | 127 | 1112 | 2437 | 46 |
| 2005 | 40 | 1.08 | 1526 | 133 | 1230 | 2446 | 50 |
| 2006 | 50 | 1.37 | 1393 | 134 | 1439 | 2564 | 56 |
| 2007 | 49 | 1.26 | 1642 | 151 | 1722 | 2456 | 70 |
| 2008 | 48 | 1.25 | 1599 | 137 | 1598 | 2278 | 70 |
| 2009 | 46 | 1.40 | 1126 | 119 | 1068 | 1642 | 65 |
| 2010 | 50 | 1.73 | 805 | 89 | 902 | 1469 | 61 |
| 2011 | 48 | 1.68 | 788 | 92 | 1114 | 1412 | 79 |
| 2012 | 49 | 2.18 | 466 | 69 | 792 | 1235 | 64 |
| 2013 | 56 | 2.78 | 364 | 49 | 443 | 681 | 65 |
| 2014 | 61 | 2.33 | 632 | 63 | 969 | 1397 | 69 |
| 2015 | 51 | 1.85 | 718 | 58 | 1217 | 1813 | 67 |
| 2016 | 43 | 1.40 | 926 | 62 | 1076 | 1662 | 65 |

*Table 18. Estimated catch rates for otter trawlers and summaries of data provided in logbooks for vessels greater than 35 feet.*

| - | - | - | - | - | - | Landings (t) | - |
|---|---|---|---|---|---|---|---|
| Quota Year | Estimated CPUE (t/net) | Standard Error | Number of sets | Number of vessels | Logbooks | Reported | % of reported |
| 1998 | 1000 | 107 | 396 | 7 | 1692 | 2506 | 68 |
| 1999 | 1638 | 180 | 254 | 9 | 1055 | 2766 | 38 |
| 2000 | 1469 | 177 | 184 | 12 | 739 | 1875 | 39 |
| 2001 | 1356 | 165 | 174 | 9 | 582 | 1122 | 52 |
| 2002 | 1210 | 121 | 317 | 12 | 1278 | 1897 | 67 |
| 2003 | 1833 | 203 | 233 | 11 | 1076 | 1942 | 55 |
| 2004 | 1043 | 103 | 327 | 9 | 1159 | 1857 | 62 |
| 2005 | 1429 | 200 | 136 | 8 | 632 | 978 | 65 |
| 2006 | 2362 | 318 | 152 | 4 | - | - | 71 |
| 2007 | 712 | 118 | 95 | 6 | 280 | 1030 | 27 |
| 2008 | 681 | 78 | 215 | 4 | - | - | 32 |
| 2009 | 695 | 69 | 340 | 8 | 1048 | 1514 | 69 |
| 2010 | 479 | 51 | 317 | 6 | 1043 | 1234 | 85 |
| 2011 | 378 | 39 | 348 | 3 | - | - | 94 |
| 2012 | 332 | 37 | 260 | 6 | 307 | 350 | 88 |
| 2013 | 556 | 75 | 158 | 4 | - | - | 81 |
| 2014 | 388 | 37 | 412 | 5 | 1295 | 1465 | 88 |
| 2015 | 411 | 38 | 448 | 7 | 1780 | 2061 | 86 |
| 2016 | 277 | 27 | 379 | 5 | 1063 | 1326 | 80 |

NOTE: Landings not presented for less than 5 vessels

*Table 19. Standardized catch rates for gillnets based on at sea sampling by observers. Number for sets and proportion of landings observed are also provided.*

| Quota Year | CPUE | Standard Error | Number of Trips | Number of Sets | Observed catch (t) | Landings (t) | % observed |
|---|---|---|---|---|---|---|---|
| 1997 | 72.20 | 6.82 | 19 | 111 | 59.3 | 3760 | 1.58 |
| 1998 | 79.91 | 4.78 | 22 | 350 | 281.7 | 10102 | 2.79 |
| 1999 | 39.24 | 1.99 | 32 | 425 | 158.5 | 20469 | 0.77 |
| 2000 | 31.46 | 1.77 | 20 | 395 | 131.1 | 10891 | 1.20 |
| 2001 | - | - | 0 | 0 | 0.0 | 6159 | 0.00 |
| 2002 | 62.78 | 20.80 | 3 | 8 | - | - | 0.03 |
| 2003 | 32.40 | 1.68 | 40 | 432 | 131.2 | 8055 | 1.63 |
| 2004 | 34.71 | 1.79 | 34 | 457 | 146.7 | 7353 | 2.00 |
| 2005 | 23.05 | 1.33 | 23 | 363 | 50.9 | 6898 | 0.74 |
| 2006 | 23.58 | 1.68 | 23 | 217 | 44.9 | 6877 | 0.65 |
| 2007 | 28.63 | 1.79 | 19 | 285 | 77.9 | 6678 | 1.17 |
| 2008 | 31.34 | 1.85 | 30 | 304 | 58.9 | 6264 | 0.94 |
| 2009 | 32.09 | 2.40 | 13 | 179 | 48.6 | 3602 | 1.35 |
| 2010 | 21.74 | 1.56 | 10 | 212 | 13.9 | 3709 | 0.37 |
| 2011 | 23.19 | 2.30 | 9 | 94 | 23.7 | 2994 | 0.79 |
| 2012 | 15.09 | 2.04 | 5 | 49 | 9.2 | 2741 | 0.34 |
| 2013 | 28.35 | 9.98 | 1 | 7 | - | - | 0.01 |
| 2014 | 49.71 | 10.16 | 3 | 21 | - | - | 0.67 |
| 2015 | 38.70 | 5.04 | 8 | 53 | 31.4 | 3066 | 1.02 |
| 2016 | 20.91 | 2.00 | 7 | 109 | 13.0 | 3047 | 0.43 |

NOTE: Landing not presented for less than 5 vessels

*Table 20a. Annual number of cod tagged in NAFO Subdiv. 3Ps during 2007-16 by tag type (low or high reward) and by 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 |
| 2014 | 789 | 200 | - | 416 | 573 | 989 |
| 2015 | 994 | 256 | - | 514 | 736 | 1250 |
| 2016 | - | - | - | 401 | 101 | 502 |

*Table 20b. Annual number of cod tags returned from NAFO Subdiv. 3Ps during 2007-16 by tag type (low or high reward).*

| Recapture Year | Low Reward ($10) | High Reward ($100) | Total Returned |
|---|---|---|---|
| 2007 | 333 | 67 | 400 |
| 2008 | 262 | 58 | 320 |
| 2009 | 245 | 70 | 315 |
| 2010 | 210 | 74 | 284 |
| 2011 | 95 | 35 | 130 |
| 2012 | 146 | 42 | 188 |
| 2013 | 179 | 67 | 246 |
| 2014 | 195 | 73 | 268 |
| 2015 | 176 | 63 | 239 |
| 2016 | 130 | 64 | 194 |

*Table 20c. Fishing mortality rates based on tagging for two size groups of cod tagged in three inshore areas of NAFO Subdiv. 3Ps.*

| Unit Area | Year | 50-85 cm | >60 cm |
|---|---|---|---|
| - | - | m=0.2 | m=0.2 |
| 3Psa (Hermitage Bay) | 2009 | 0.17 | 0.20 |
| 3Psa (Hermitage Bay) | 2010 | - | - |
| 3Psa (Hermitage Bay) | 2011 | - | - |
| 3Psa (Hermitage Bay) | 2012 | - | - |
| 3Psa (Hermitage Bay) | 2013 | - | - |
| 3Psa (Hermitage Bay) | 2014 | 0.14 | 0.17 |
| 3Psa (Hermitage Bay) | 2015 | 0.05 | 0.10 |
| 3Psa (Hermitage Bay) | 2016 | - | - |
| 3Psb (Fortune Bay) | 2009 | 0.12 | 0.11 |
| 3Psb (Fortune Bay) | 2010 | - | - |
| 3Psb (Fortune Bay) | 2011 | - | - |
| 3Psb (Fortune Bay) | 2012 | - | - |
| 3Psb (Fortune Bay) | 2013 | 0.10 | 0.16 |
| 3Psb (Fortune Bay) | 2014 | 0.13 | 0.24 |
| 3Psb (Fortune Bay) | 2015 | 0.15 | 0.14 |
| 3Psb (Fortune Bay) | 2016 | 0.19 | 0.21 |
| 3Psc (Placentia Bay) | 2009 | 0.13 | 0.18 |
| 3Psc (Placentia Bay) | 2010 | 0.20 | 0.36 |
| 3Psc (Placentia Bay) | 2011 | 0.11 | 0.16 |
| 3Psc (Placentia Bay) | 2012 | 0.14 | 0.25 |
| 3Psc (Placentia Bay) | 2013 | 0.12 | 0.18 |
| 3Psc (Placentia Bay) | 2014 | 0.11 | 0.18 |
| 3Psc (Placentia Bay) | 2015 | 0.15 | 0.20 |
| 3Psc (Placentia Bay) | 2016 | 0.12 | 0.27 |

## FIGURES

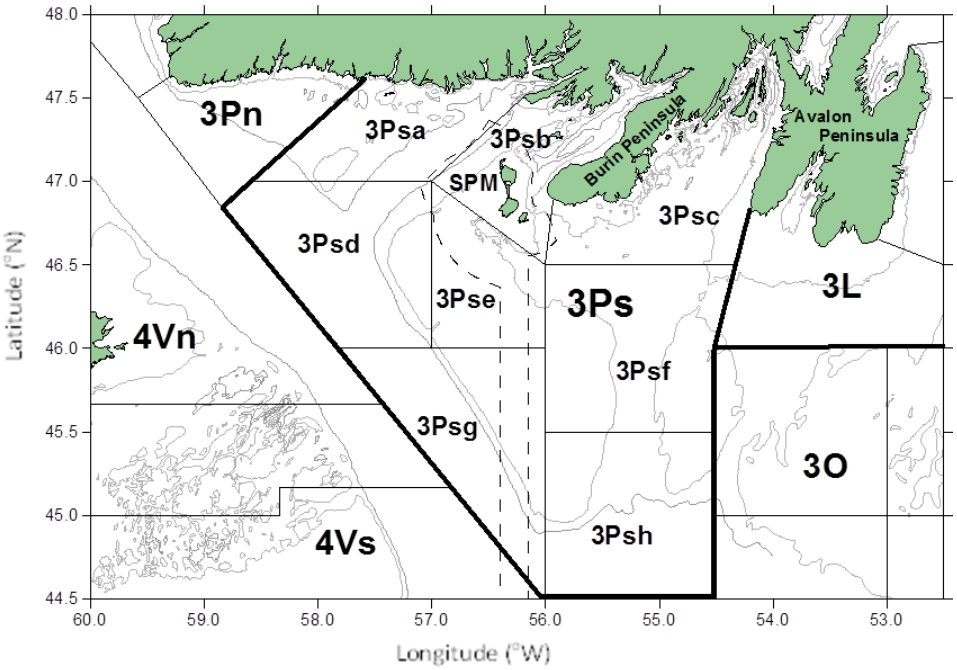



*Figure 1. NAFO Subdiv. 3Ps management zone showing the economic zone around the French islands of St. Pierre et Miquelon (SPM, dashed line), the 100 m and 250 m depth contours (grey lines) and the boundaries of the statistical unit areas (solid lines).*

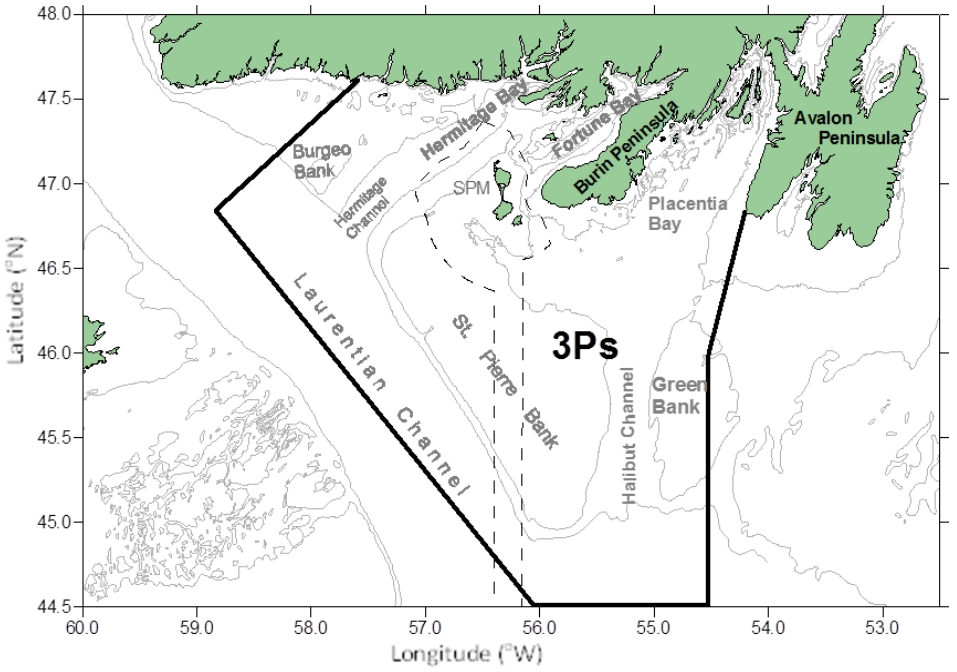



*Figure 2. NAFO Subdiv. 3Ps management zone showing the economic zone around the French islands of St. Pierre and Miquelon (SPM, dashed line), the 100 m and 250 m depth contours (grey lines) and the main fishing areas.*

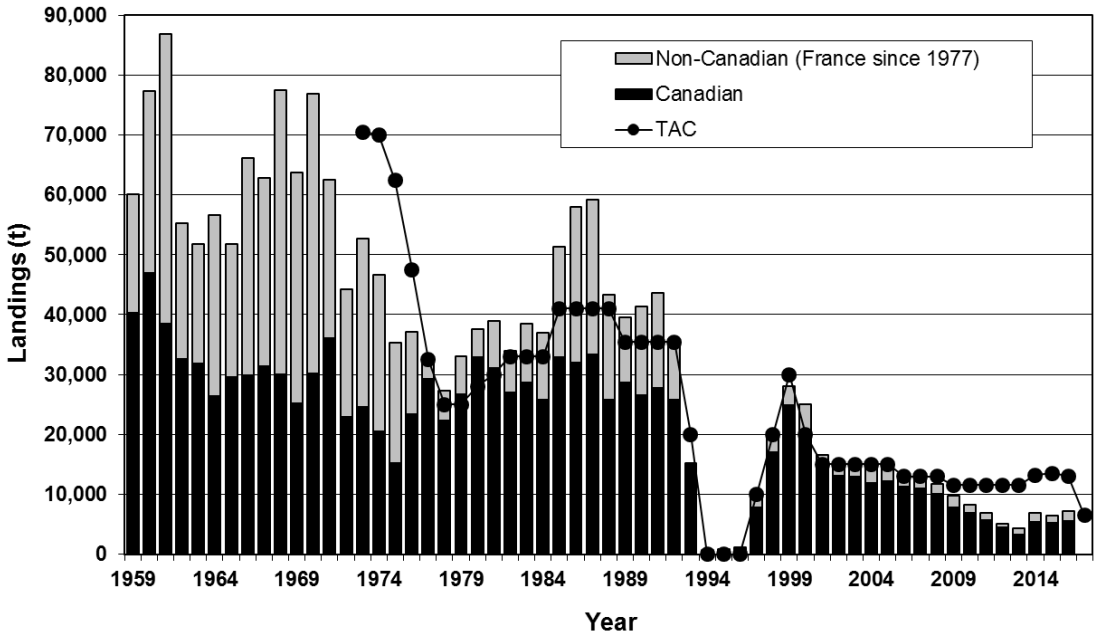



*Figure 3a. Reported landings of cod by Canadian and non-Canadian vessels in NAFO Subdiv. 3Ps. Note that the 2017 fishery was still in progress at the time of the current assessment.*

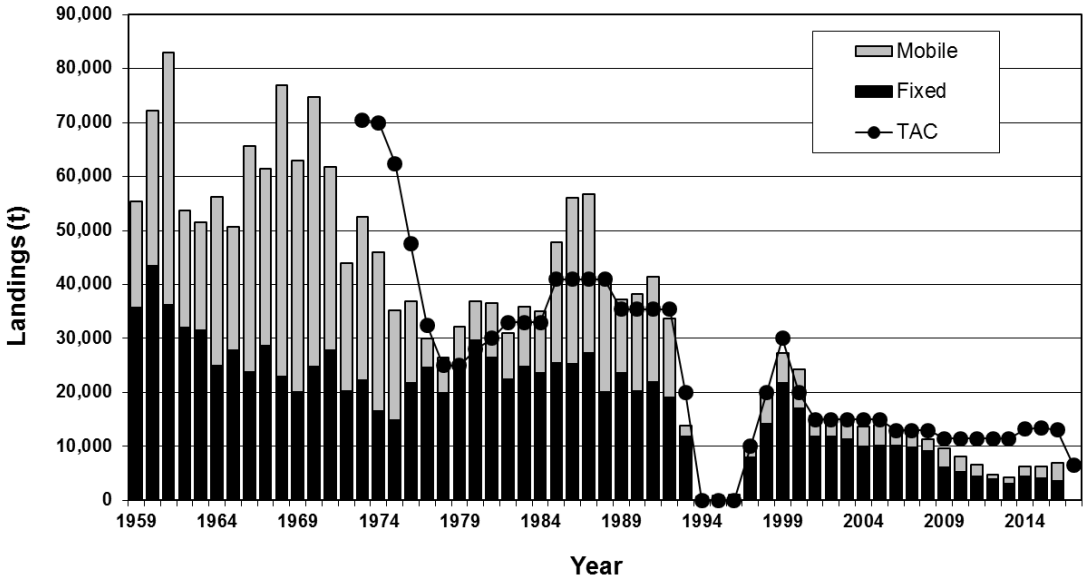



*Figure 3b. Reported landings of cod by fixed and mobile gears in NAFO Subdiv. 3Ps. Note that the 2017 fishery was still in progress at the time of the current assessment.*

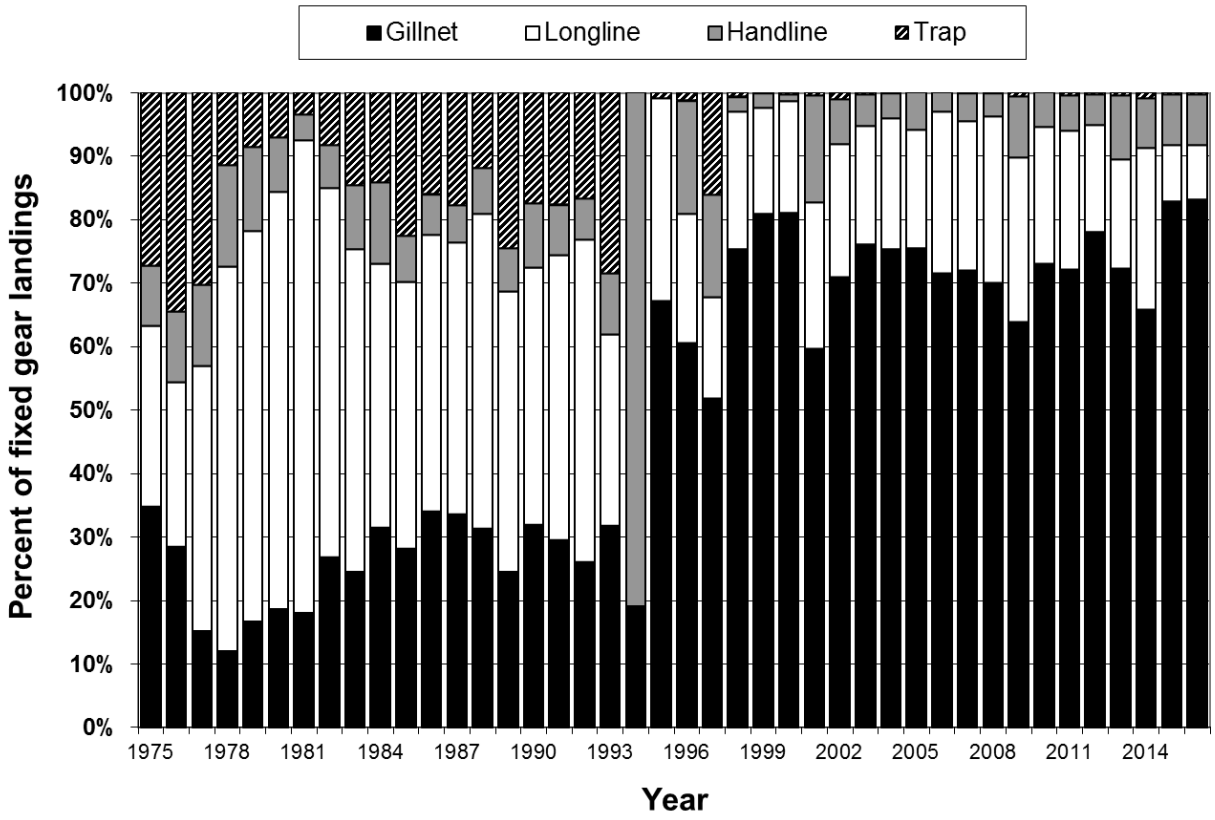



*Figure 4. Percent of total fixed gear landings by the four main fixed gears used in the cod fishery in NAFO Subdiv. 3Ps. The fishery was under a moratorium during 1994-96 and values for those years are based on sentinel and by-catch landings of < 800 t.*

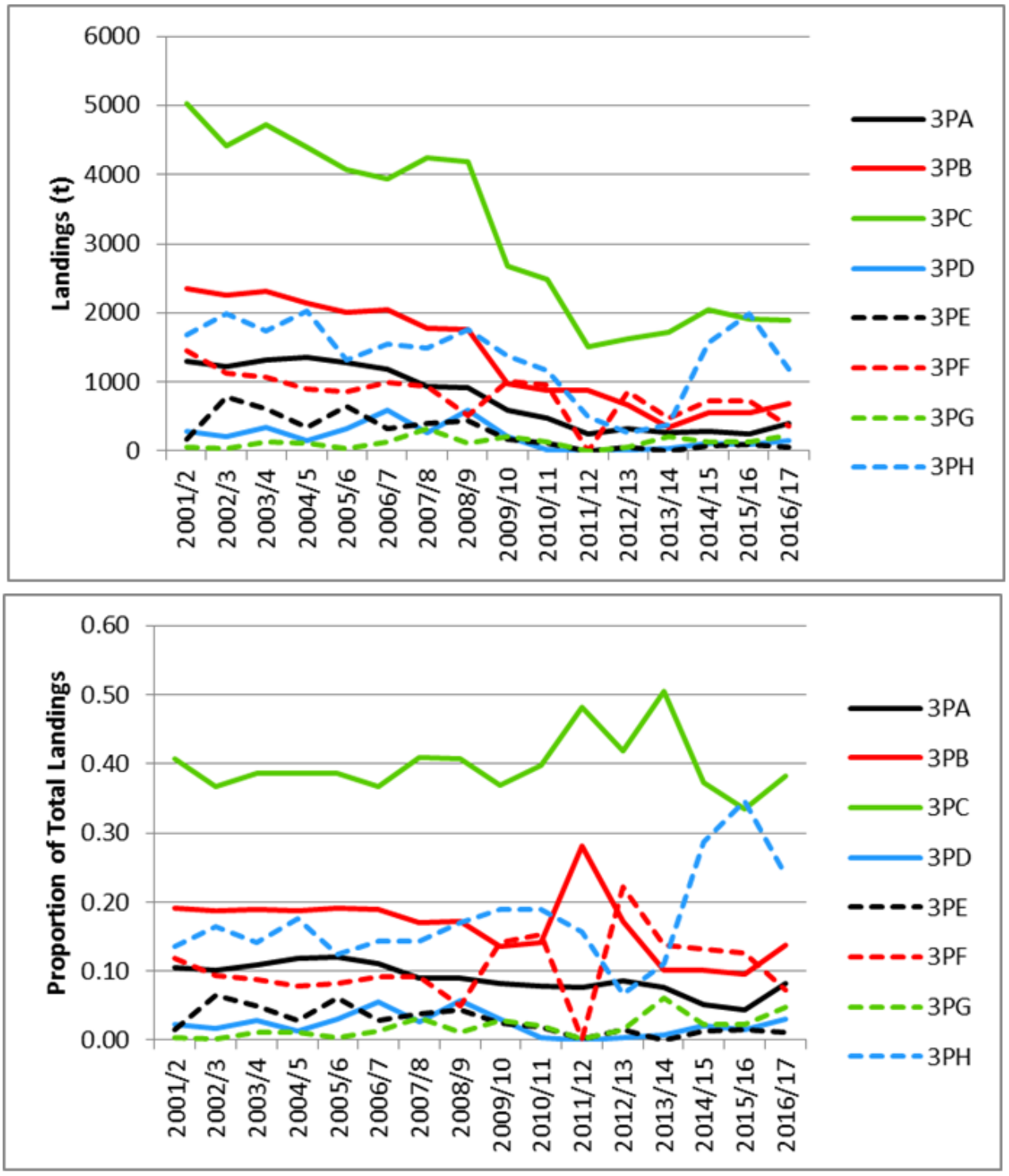



*Figure 5. Breakdown of recent Canadian annual landings of 3Ps cod by statistical unit areas. Both landings (upper panel) and percent of total landings (lower panel) are presented. Unit area is not available for SPM landings. Refer to Figure 1 for locations of unit areas.*

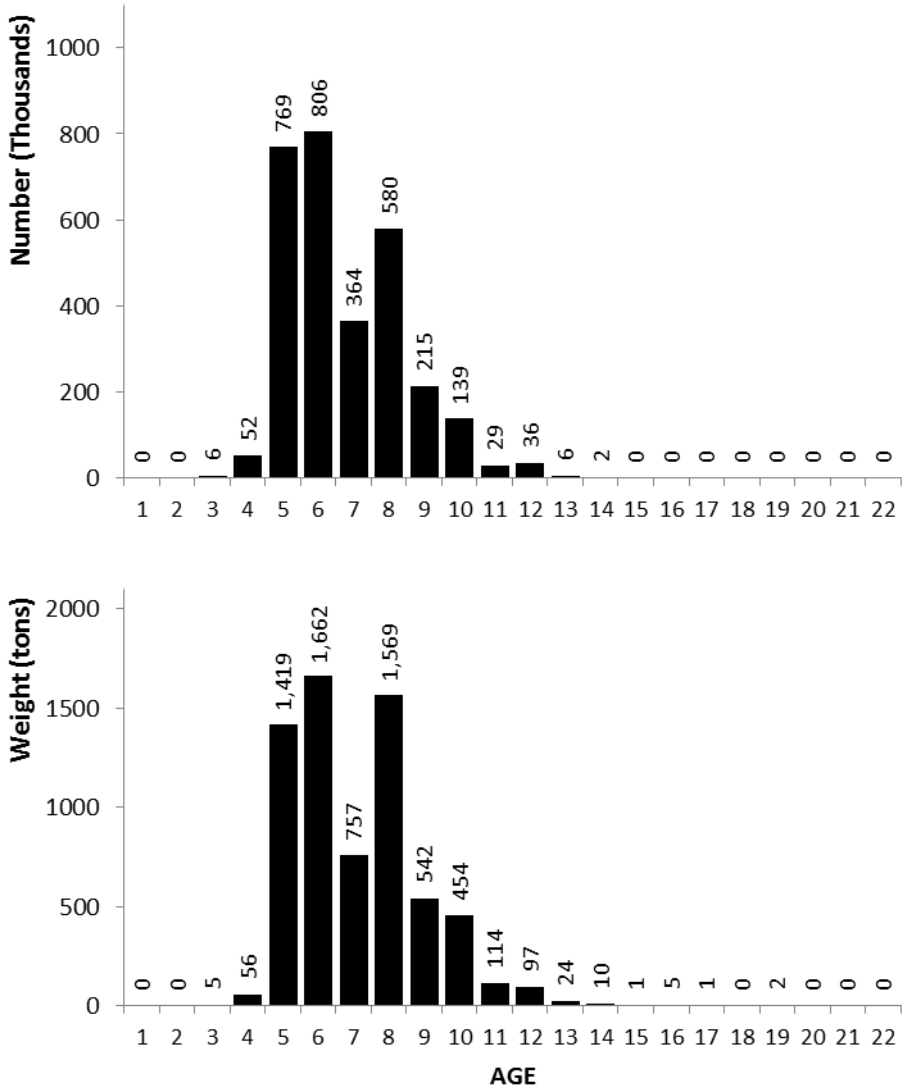



*Figure 6a. Catch numbers and weight at age from commercial fisheries and sentinel sampling in 2014.*

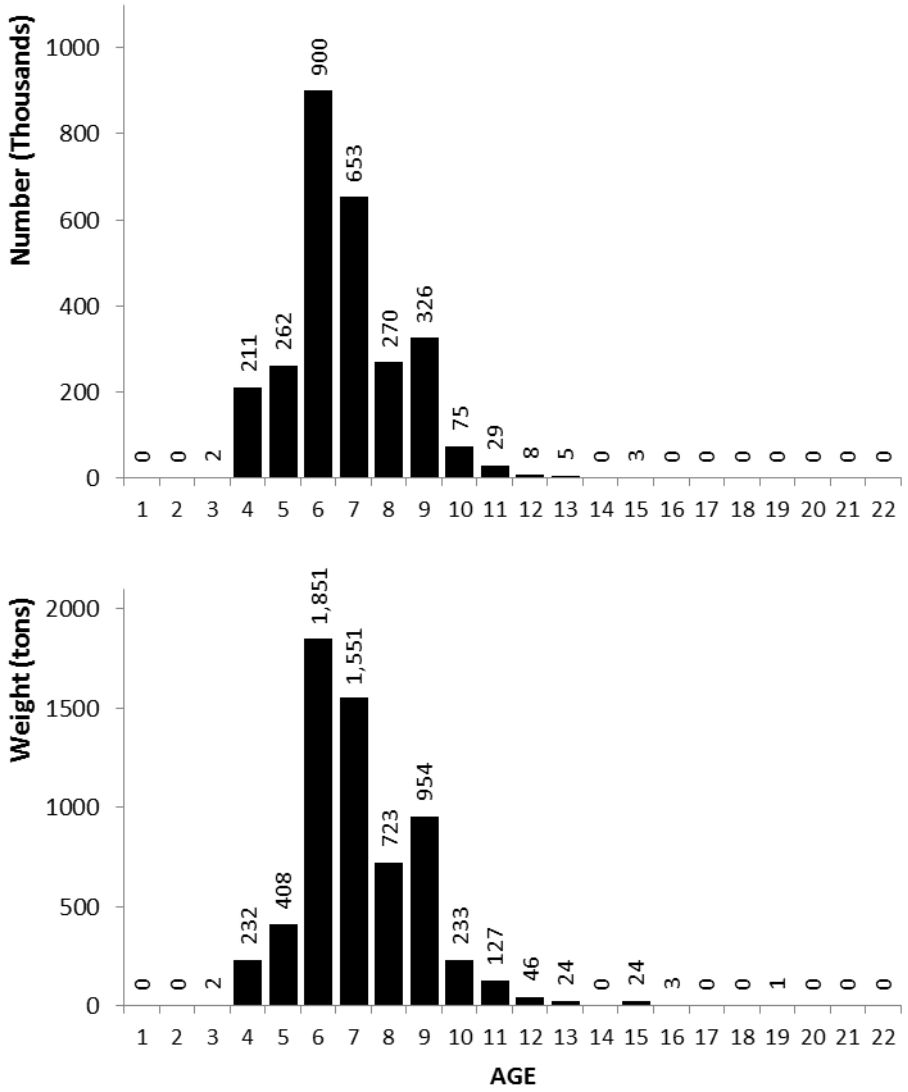



*Figure 6b. Catch numbers and weights at age from commercial fisheries and sentinel sampling in 2015.*

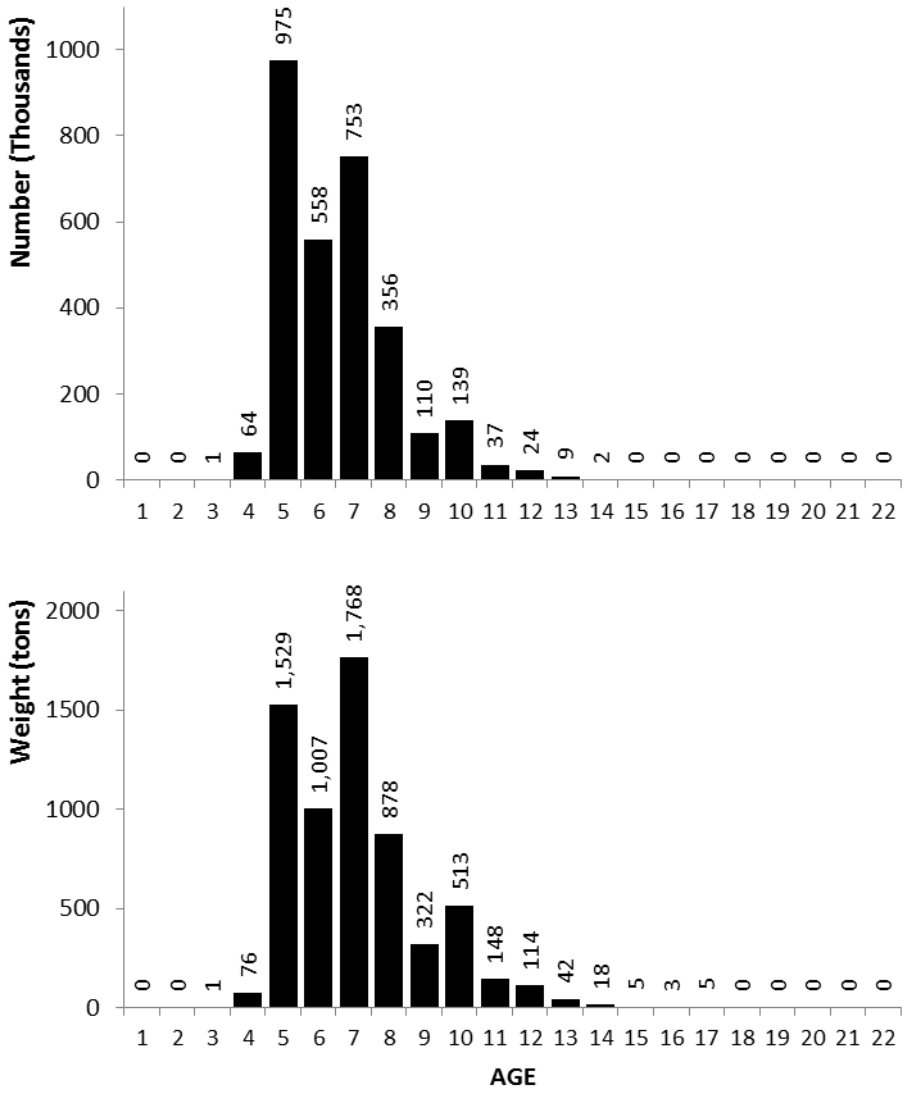



*Figure 6c. Catch numbers and weights at age from commercial fisheries and sentinel sampling in 2016.*

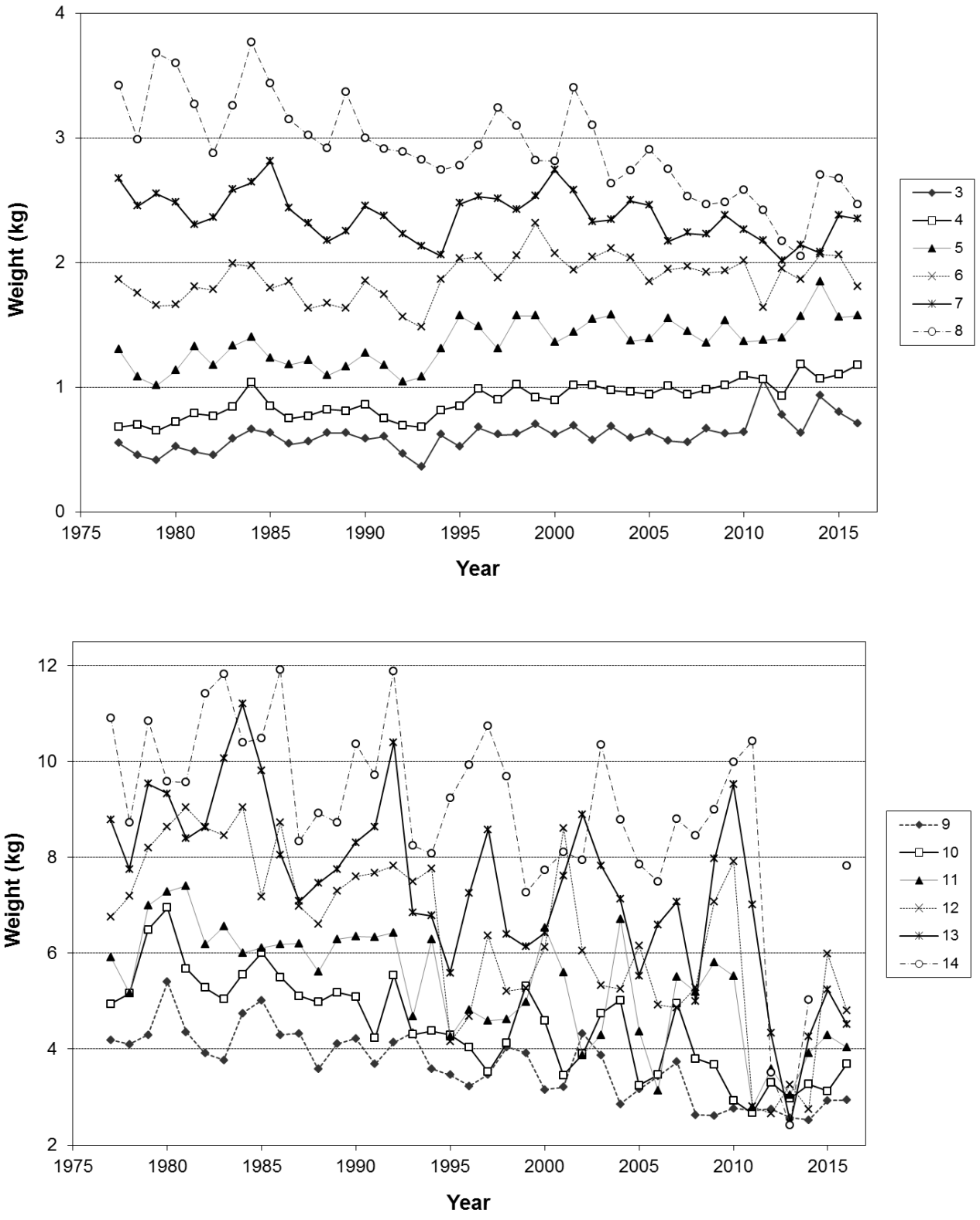



*Figure 7. Mean weights-at-age calculated from mean lengths-at-age (upper panel: ages 3-8; lower panel: ages 9-14) from the commercial catch of cod in Subdiv. 3Ps during 1977 to 2017.*

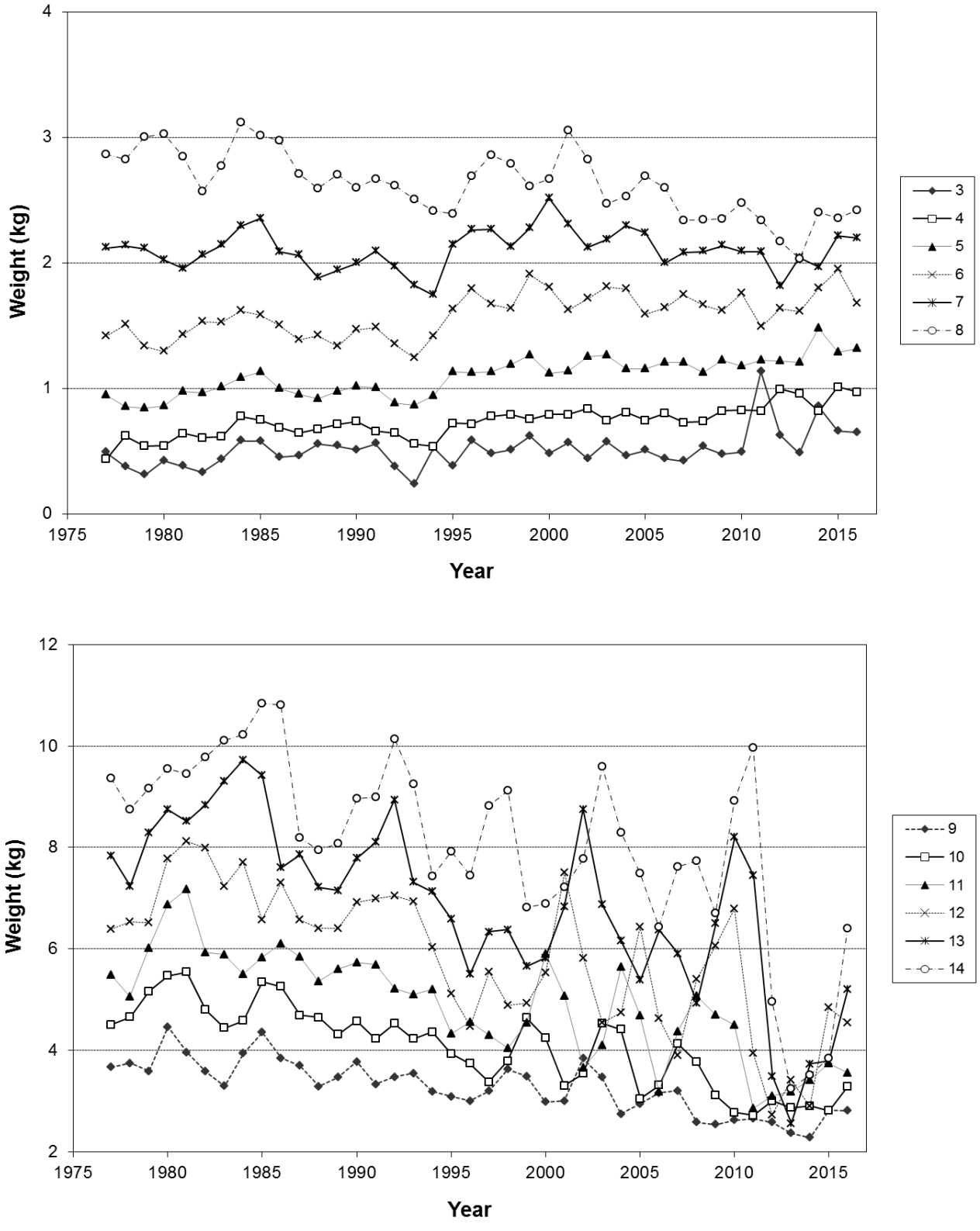



*Figure 8. Beginning of year mean weights-at-age (upper panel: ages 3-8; lower panel: ages 9-14) from the commercial catch of cod in Subdiv. 3Ps during 1977 to 2017. Weights at age 3 in 2016, and age 14 in 2015 are the geometric means of the prior three years.*

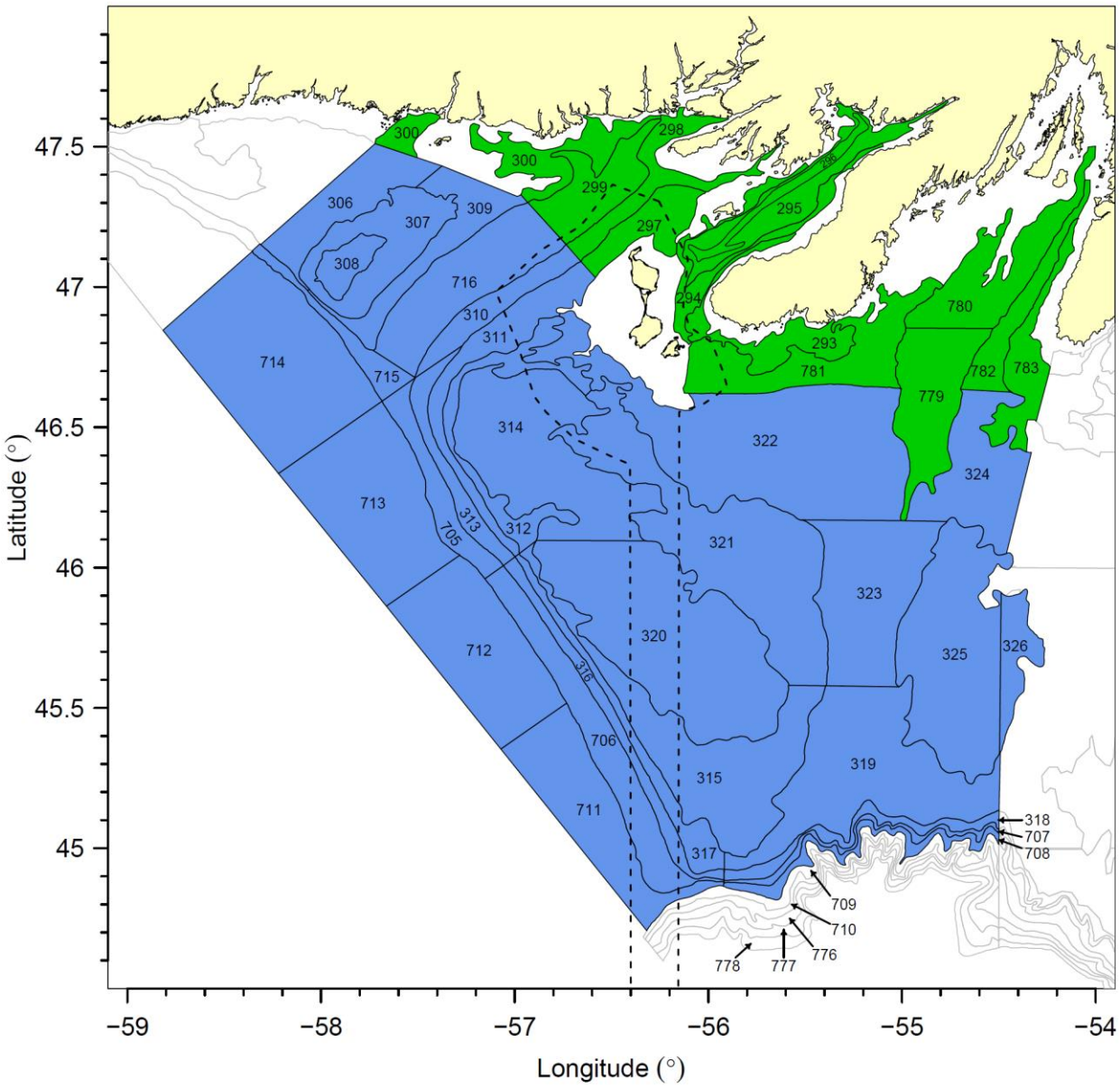



*Figure 9. Stratum area boundaries and area surveyed during the DFO research vessel bottom-trawl survey of NAFO Subdiv. 3Ps. Offshore strata are shaded blue. Inshore strata were added in 1994 (strata 779-783) and 1997 (strata 293-300) and are shaded green. The dashed line represents the boundary of the French economic zone.*

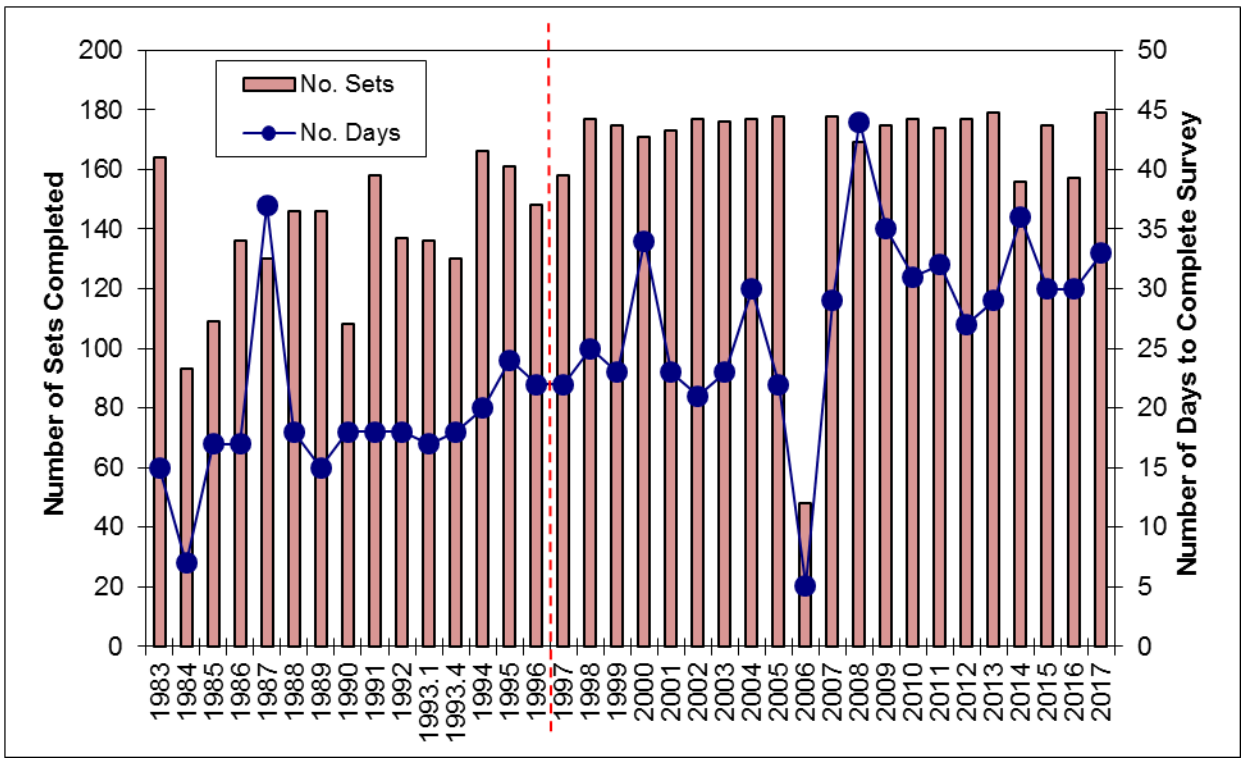



*Figure 10. Number of research vessel survey sets completed during surveys of NAFO Subdiv. 3Ps, and the number of days required to complete these set. Survey coverage was expanded to present levels (i.e. covering all inshore and offshore index strata) in 1997 (dashed vertical line).*

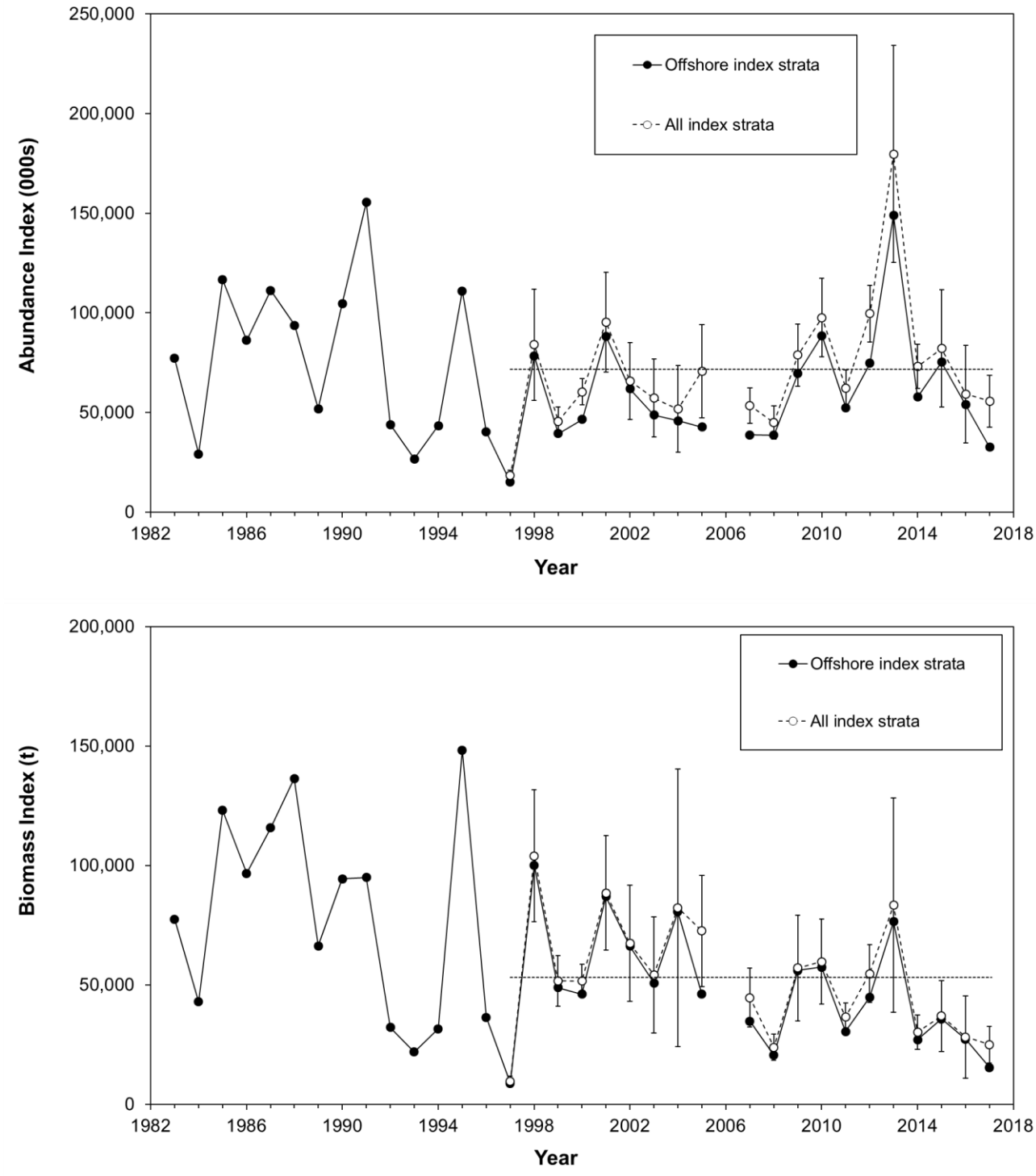



*Figure 11. Abundance (upper panel) and biomass (lower panel) indices for cod in NAFO Subdiv. 3Ps from DFO research vessel bottom trawl surveys of index strata during winter/spring from 1983 to 2016. Error bars show plus/minus one standard deviation. Open symbols show values for the augmented survey 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.*

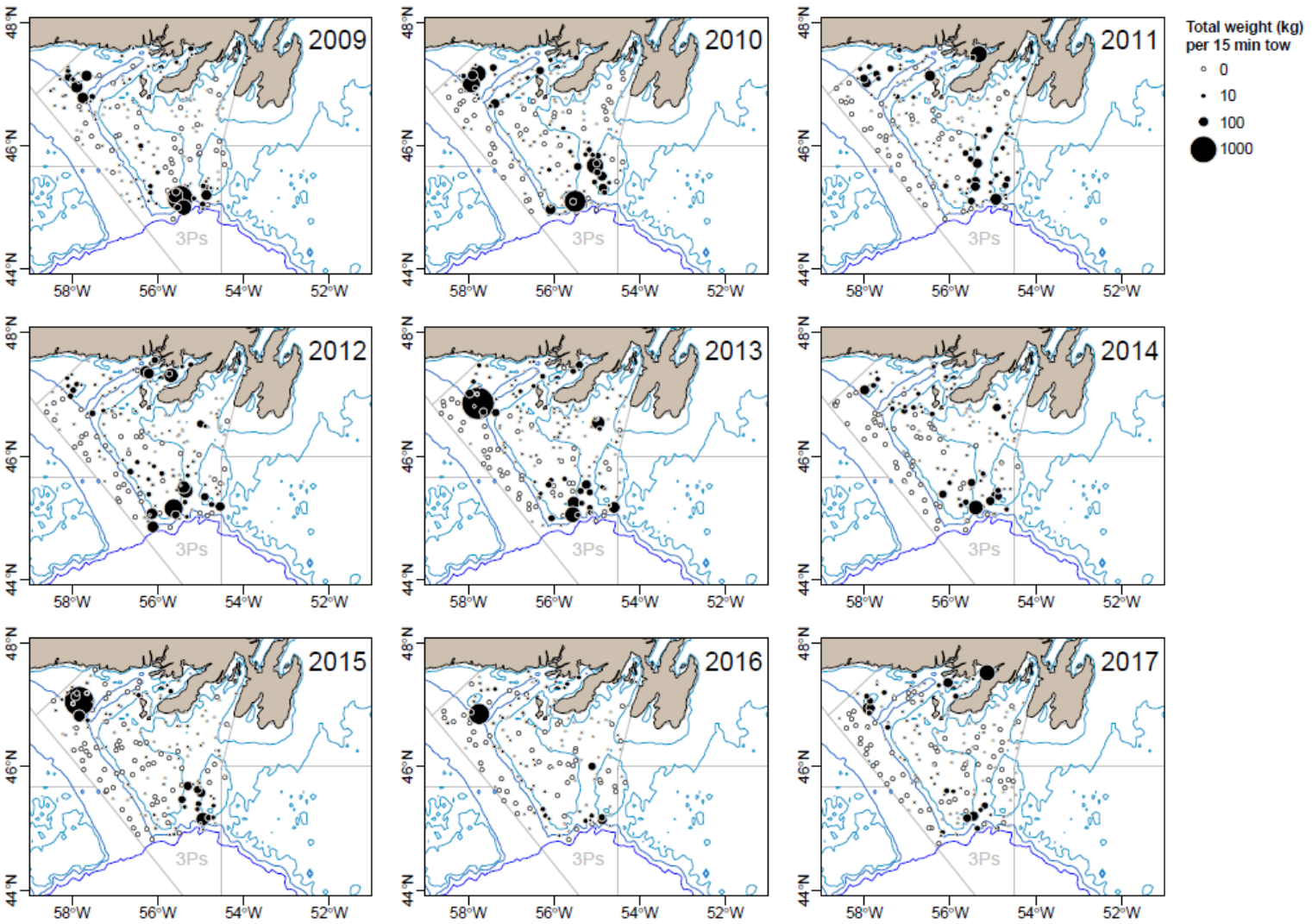



*Figure 12. Age aggregated distribution of cod catches (weight per tow) from the April DFO research vessel surveys of NAFO Subdiv. 3Ps over 2009-17 Bubble size is proportional to total weight caught.*

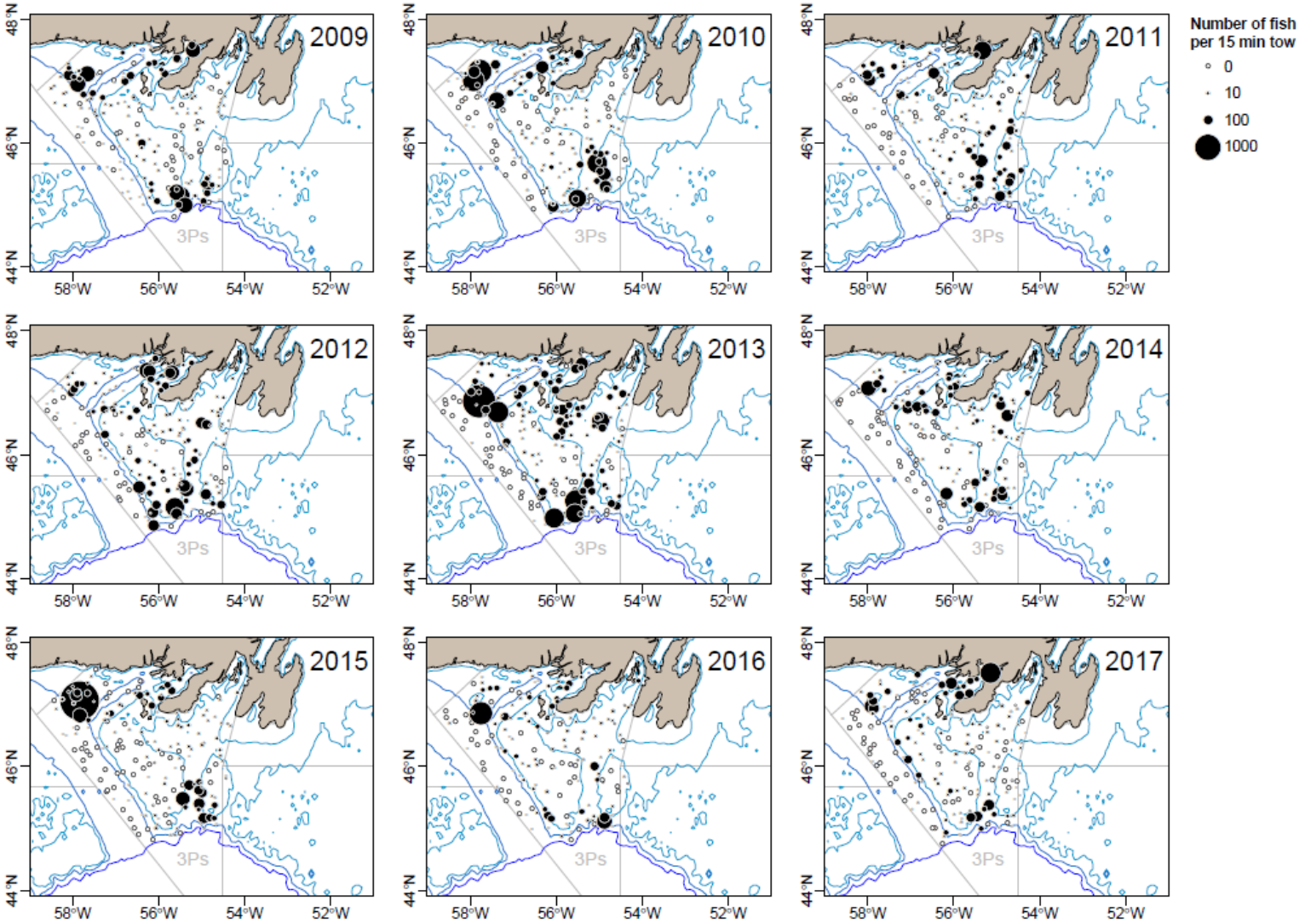



*Figure 13. Age aggregated distribution of cod catches (nos. per tow) from the April DFO research vessel surveys of NAFO Subdiv. over 2009-17. Bubble size is proportional to numbers caught.*

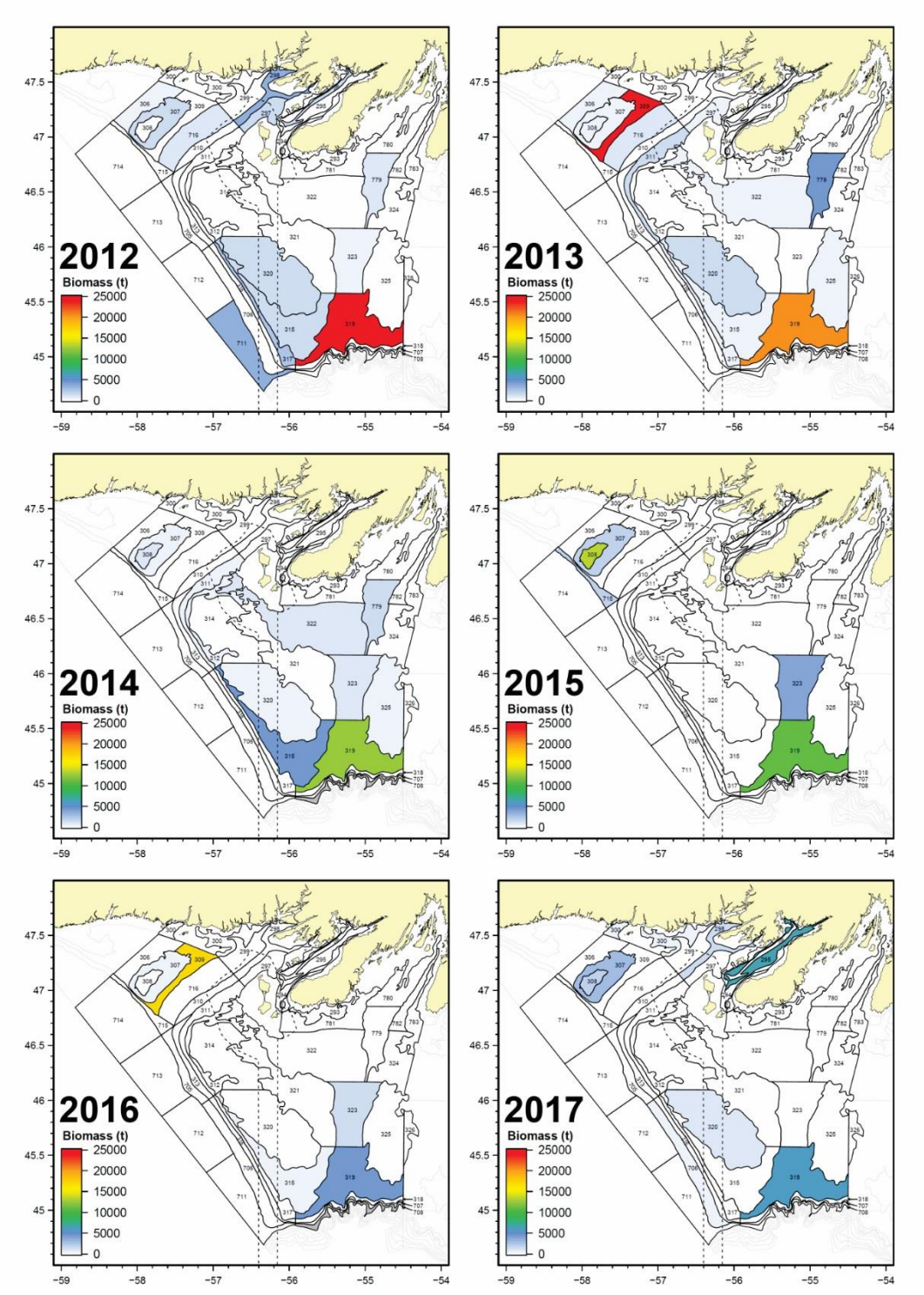



*Figure 14. Stratum-specific biomass estimates of cod in Subdiv. 3Ps based on the DFO RV survey.*

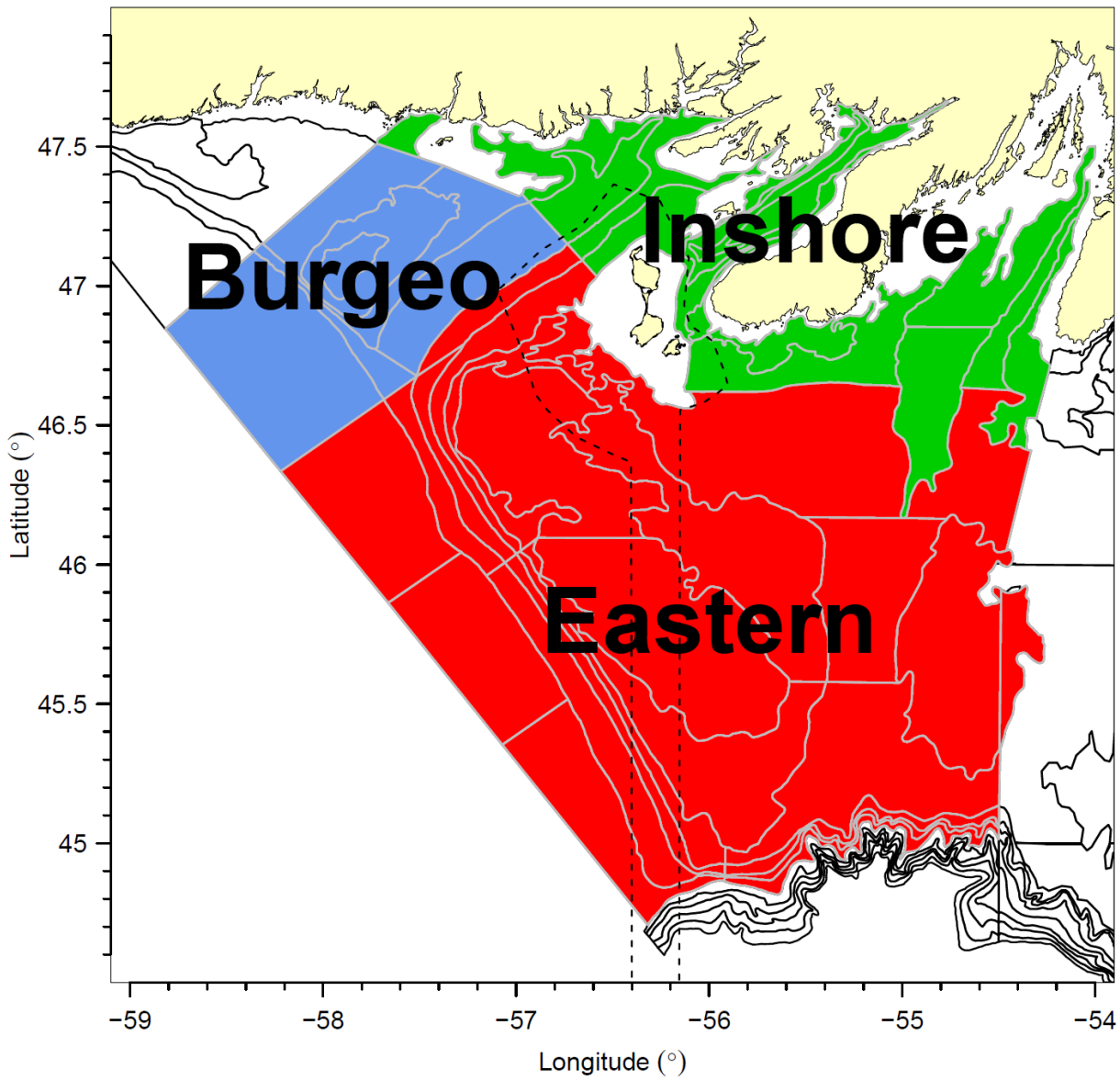



*Figure 15. NAFO Subdiv. 3Ps management zone illustrating the allocation of survey strata into 'Inshore', 'Burgeo', and 'Eastern' regions. Survey trends for the three regions are depicted in Figure 16.*

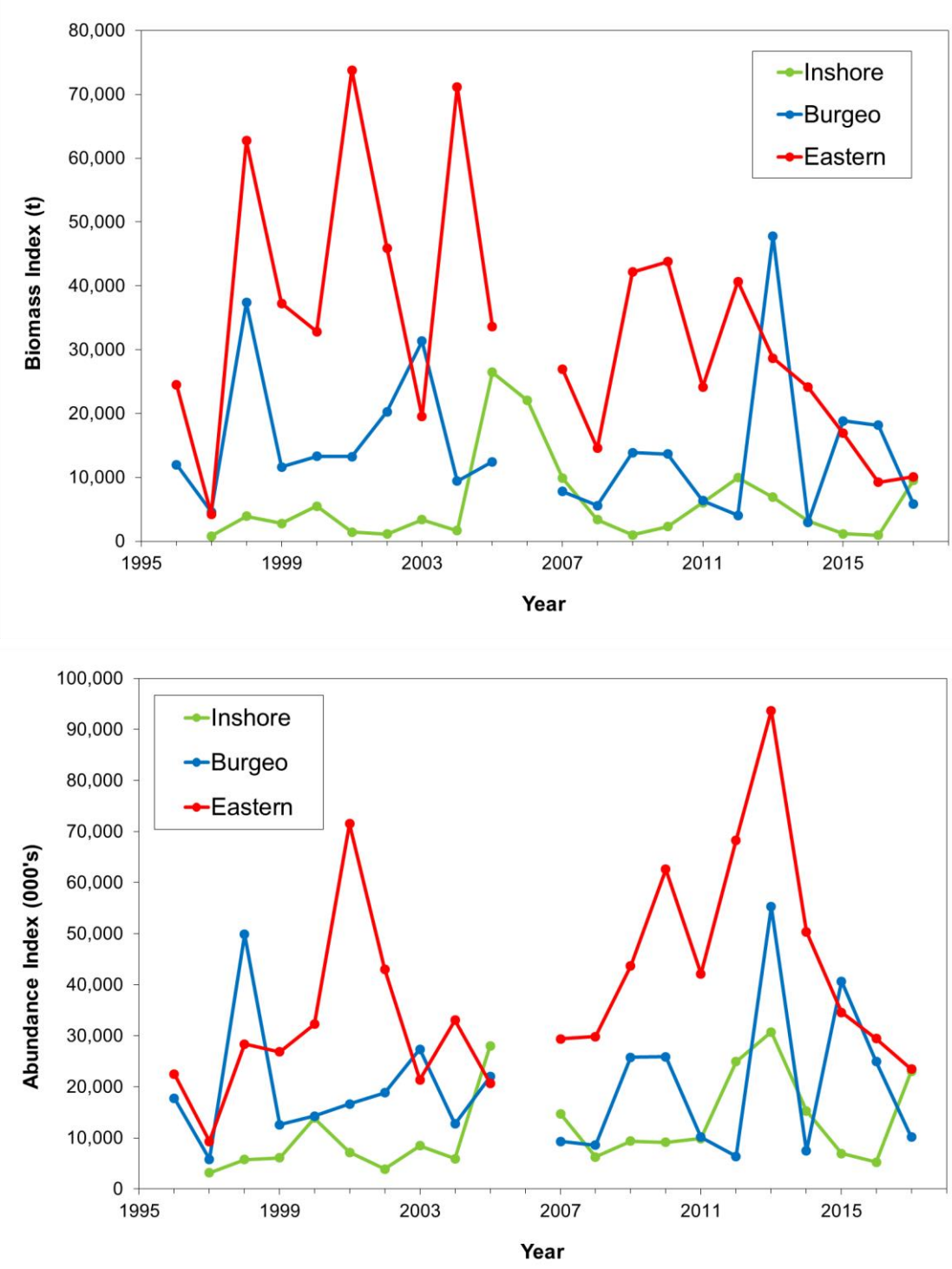



*Figure 16. Total biomass (above) and abundance (below) index for cod in various regions of NAFO Subdiv. 3Ps from DFO research vessel bottom trawl surveys during winter/spring from 1997 to 2017. The 2006 survey was not completed. The Campelen trawl was used in all surveys.*

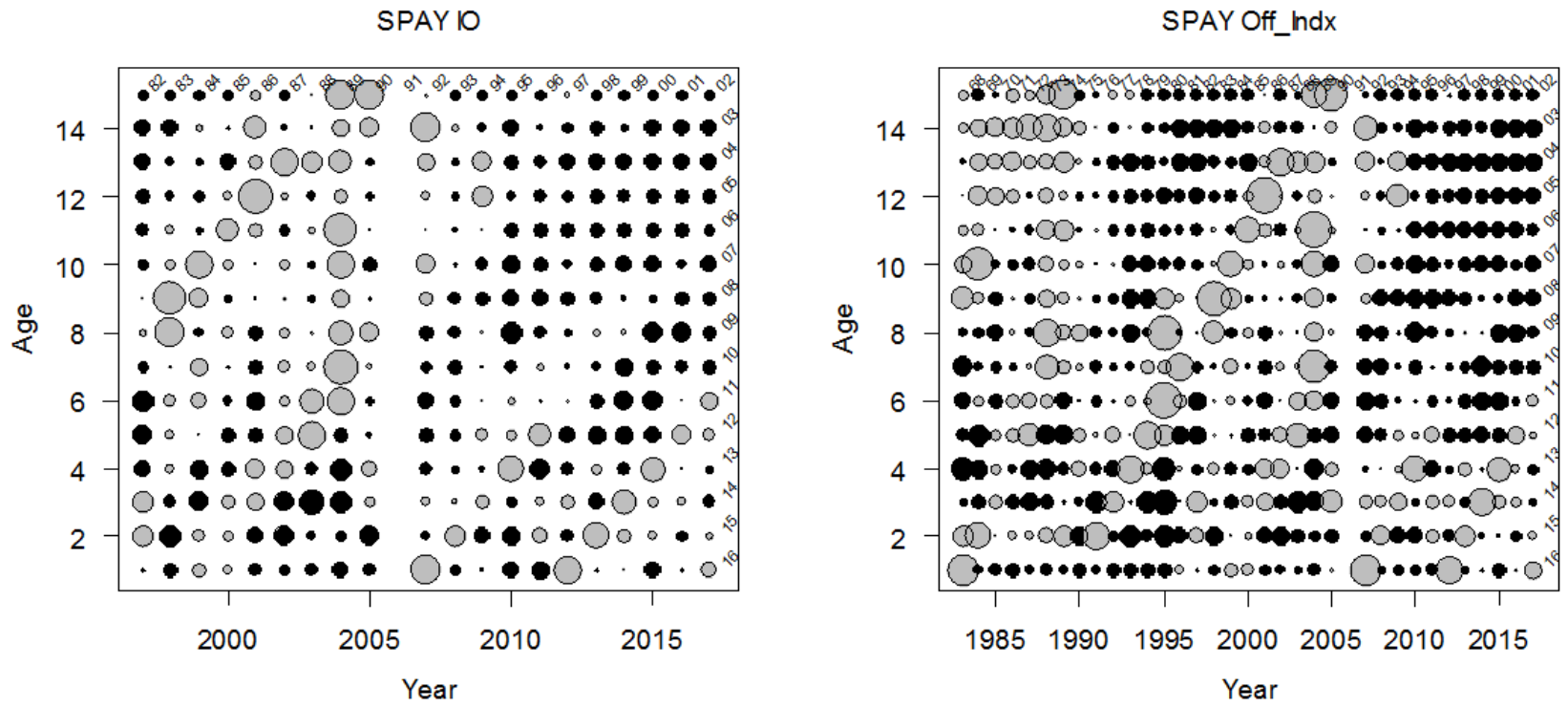



*Figure 17. Standardized age-disaggregated catch rates from the spring bottom trawl survey of Subdiv. 3Ps. Catch rates (mean nos per tow) were converted to proportions within each year. Values were standardized by subtracting the mean proportion and dividing by the standard deviation of the proportions 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 1997-2017 "All Strata < 300 fm" data, and panel at right includes data which comprise the "Offshore" index (1983-2017).*

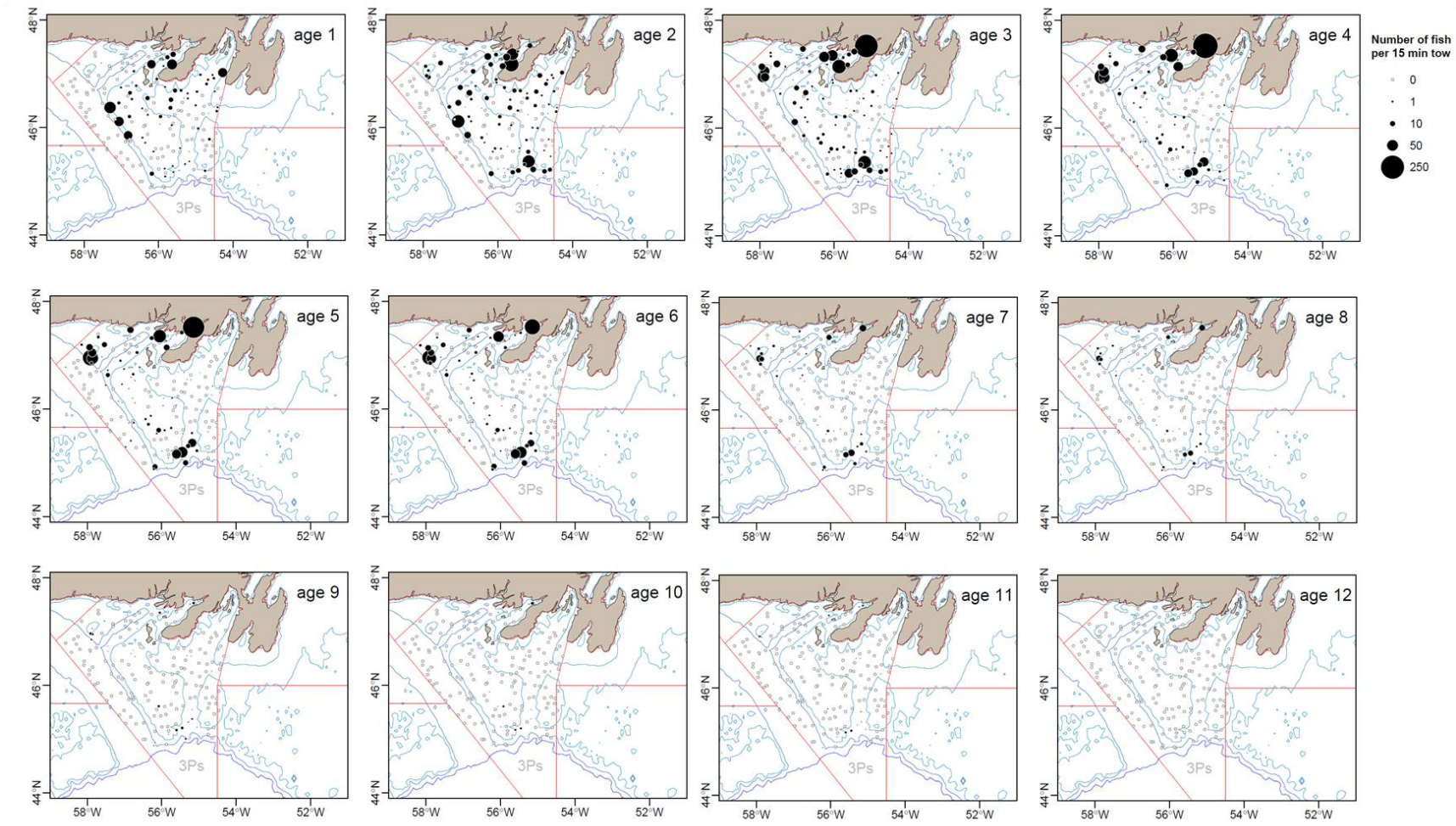



*Figure 18. Age dis-aggregated distribution of cod catches (nos. per tow at age) from the Spring 2017 DFO research vessel survey of NAFO Subdiv. 3Ps. Bubble size is proportional to numbers caught.*

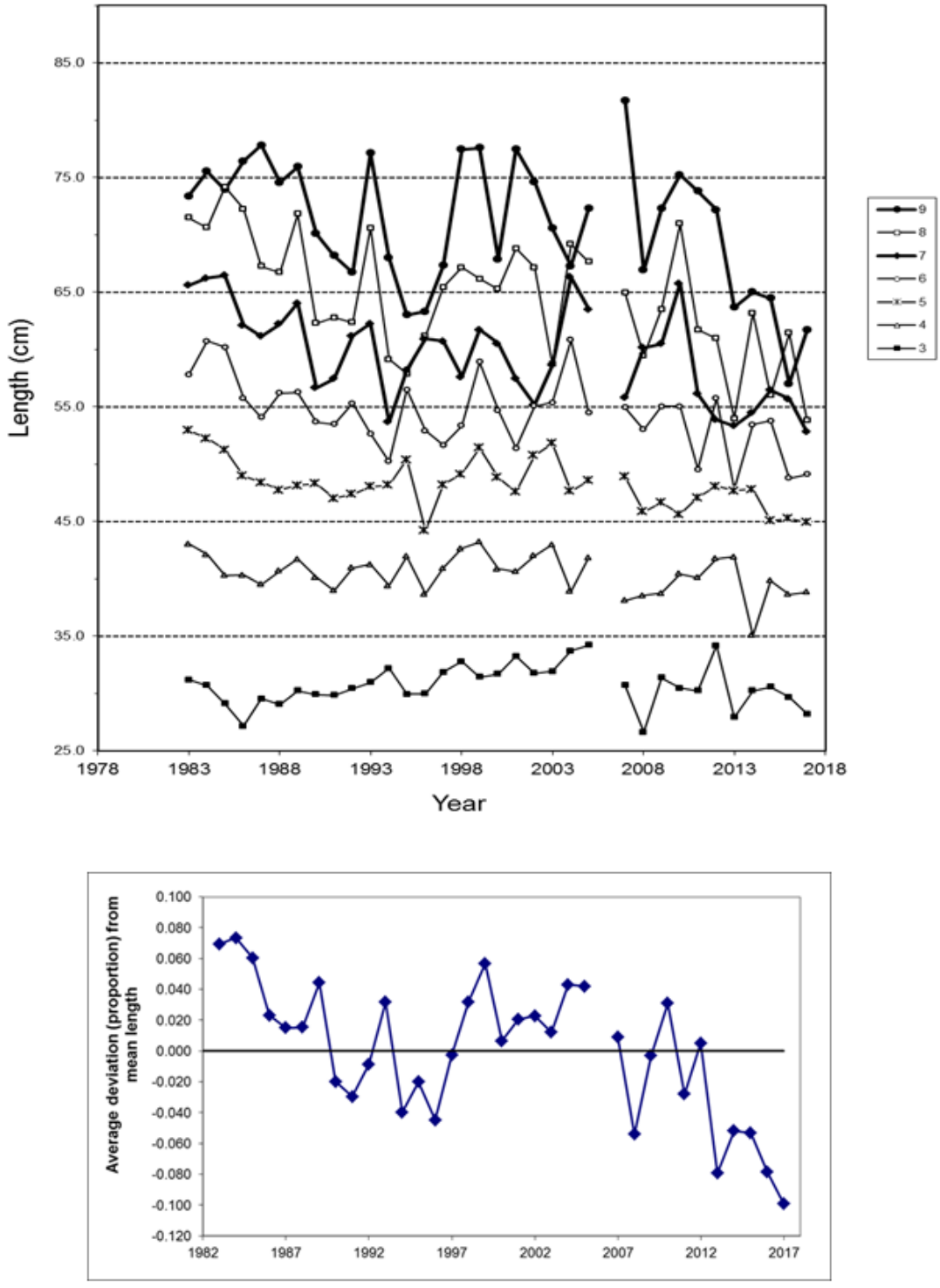



*Figure 19. Mean length at ages 3-9 (above) and average proportion deviation from mean length at age for ages 3-9 combined (below) of cod in Subdiv. 3Ps during 1983-2017 from sampling during DFO bottom-trawl surveys in winter-spring.*

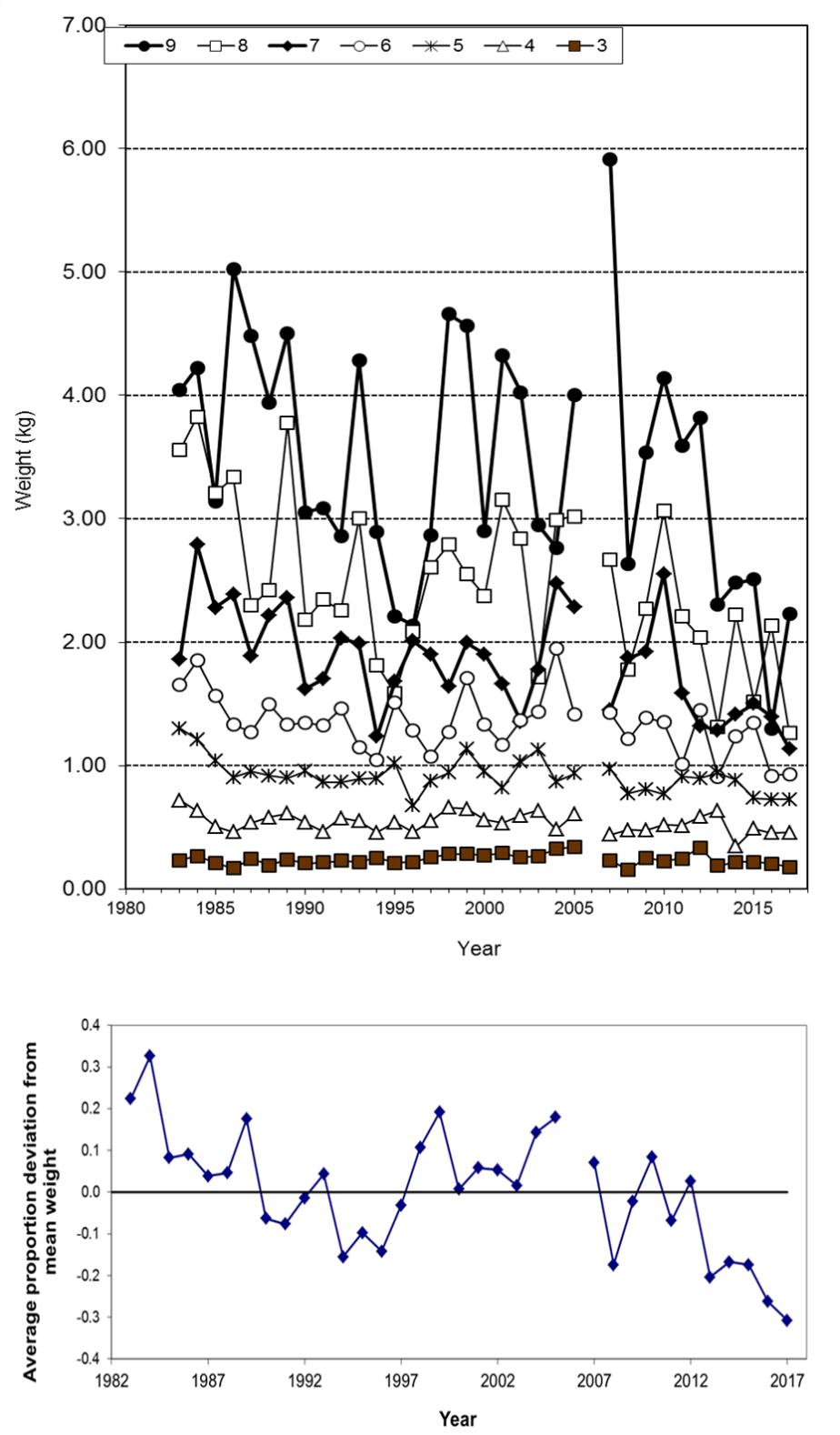



*Figure 20. Mean round weight-at-age (kg) (above) and average proportion deviation from mean weight at age for ages 3-9 (below) of cod sampled during DFO bottom-trawl surveys in NAFO Subdiv. 3Ps in winter-spring 1983--2017.*

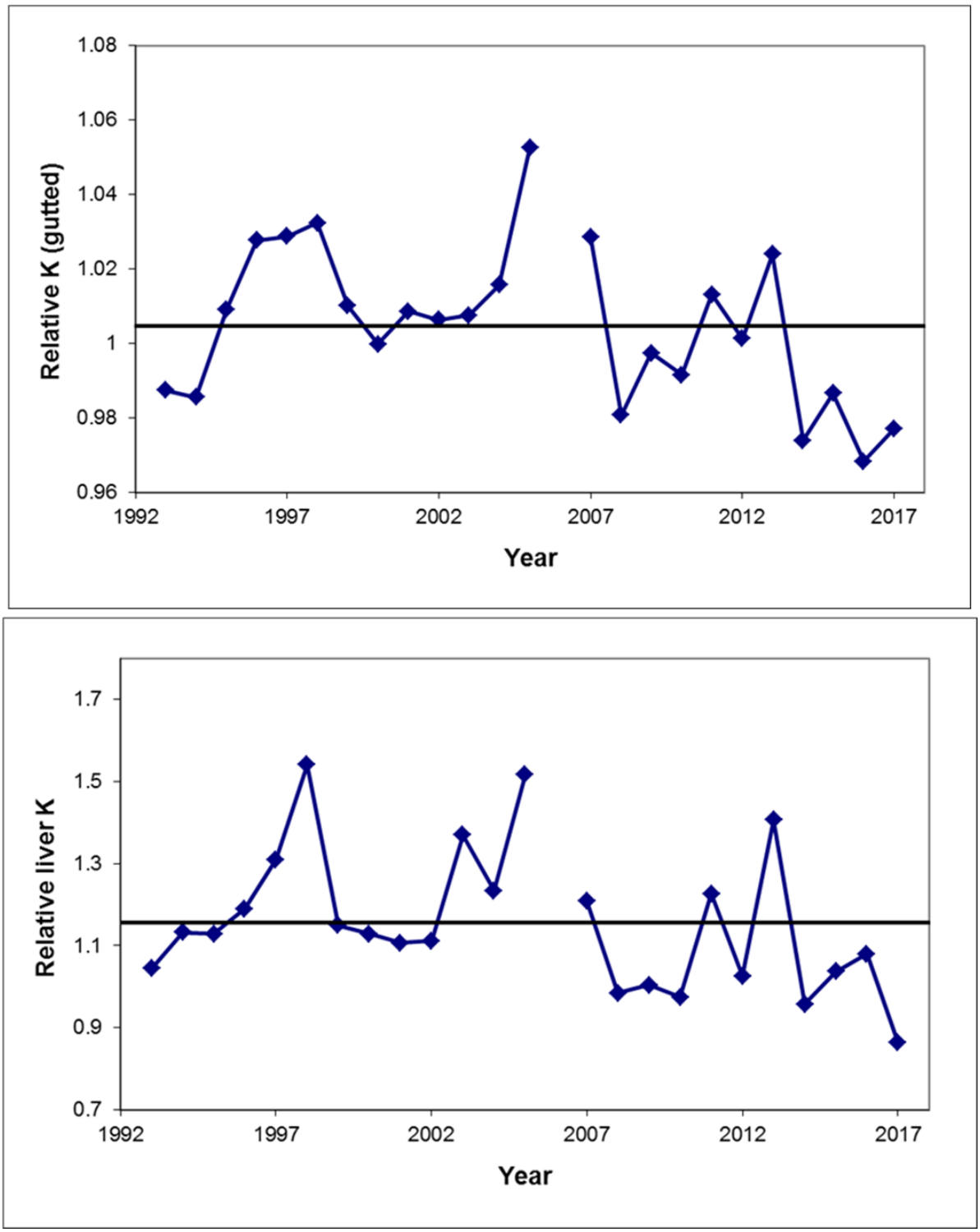



*Figure 21. Relative condition indices for 3Ps cod from spring surveys over 1993-2017. Upper panel is relative gutted condition index; lower panel relative liver condition index. Horizontal line represents time-series average.*

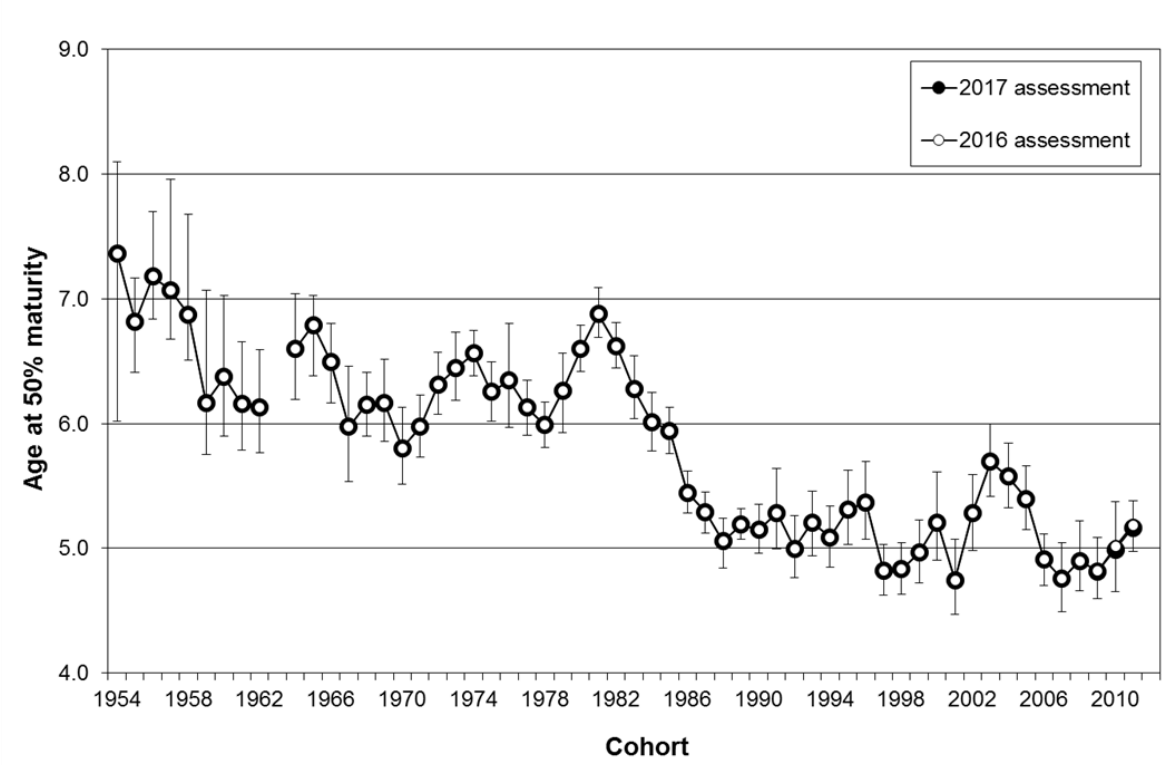



*Figure 22a. Age at 50% maturity by cohort for female cod sampled during DFO research vessel bottom-trawl surveys of NAFO Subdiv. 3Ps. Error bars are 95% fiducial limits.*

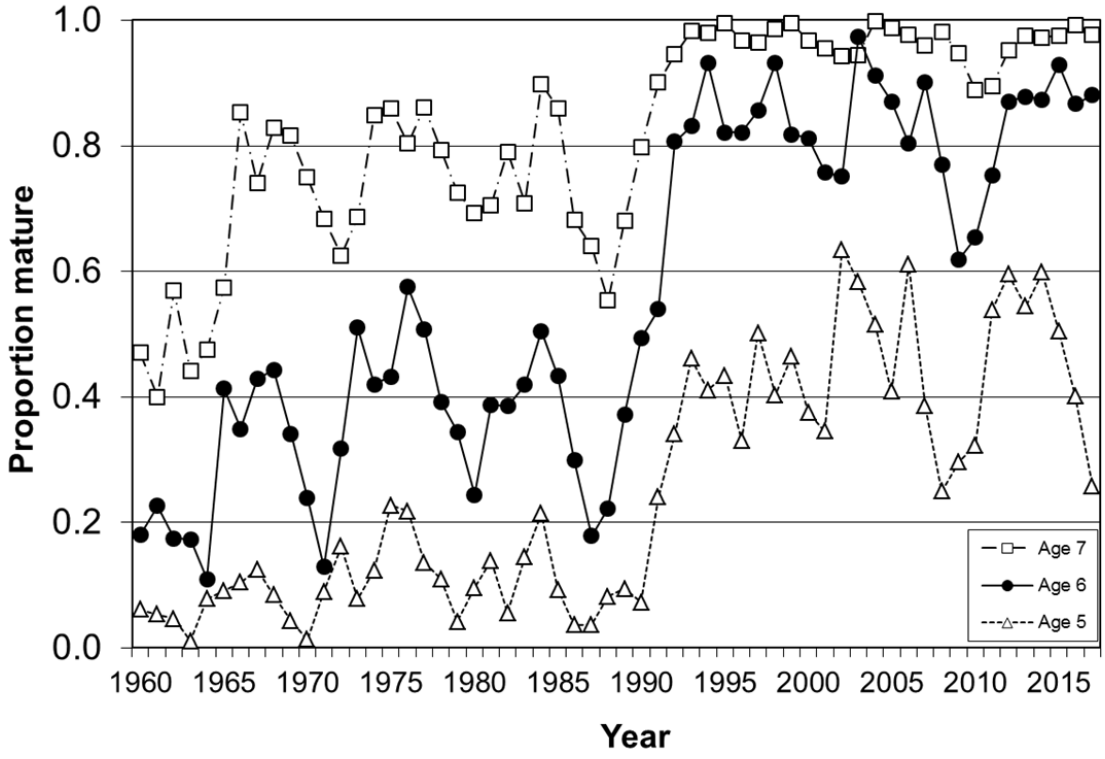



*Figure 22b. Estimated proportions mature at ages 5-7 for female cod sampled during DFO research vessel bottom-trawl surveys in NAFO Subdiv. 3Ps (data from all strata surveyed).*

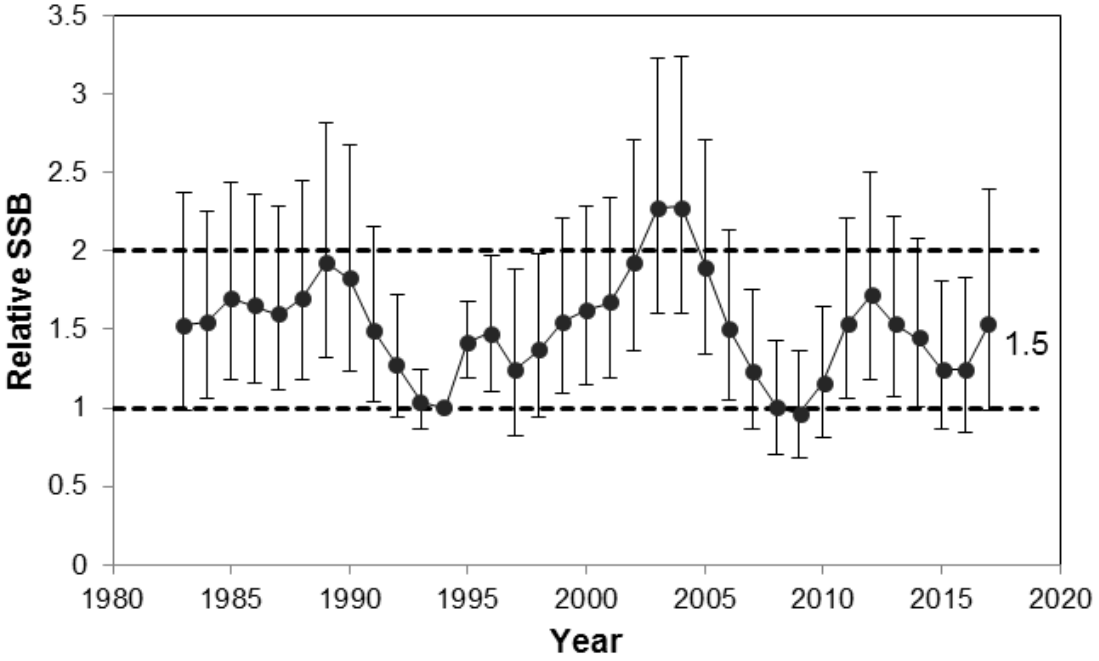



*Figure 23a. Cohort analysis estimates of SSB, relative to the 1994 value (median estimate with 95% confidence interval). The lower dashed line at one (reference level) represents the SSB Limit Reference Point and the upper horizontal dashed line at two represents the Upper Stock Reference (i.e., 2 x LRP). These reference points represent the boundaries between the zones of DFO's precautionary approach framework, as indicated on the right axis. Text label indicates the current SSB relative to the LRP.*

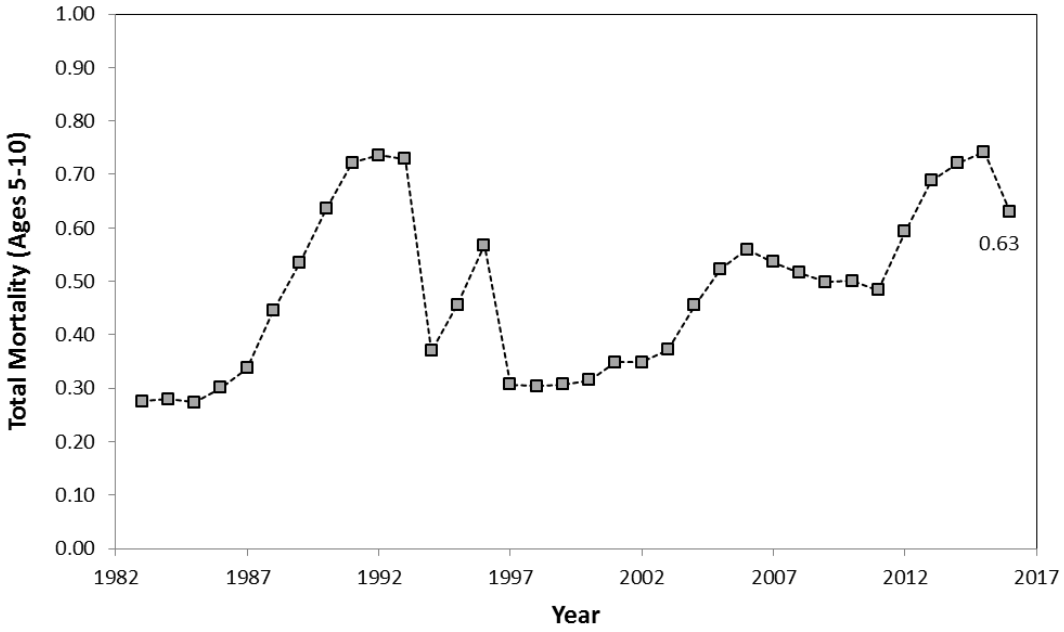



*Figure 23b. Cohort analysis estimates of population weighted average annual mortality (ages 5-10). Text label indicates the estimated total mortality for 2016.*

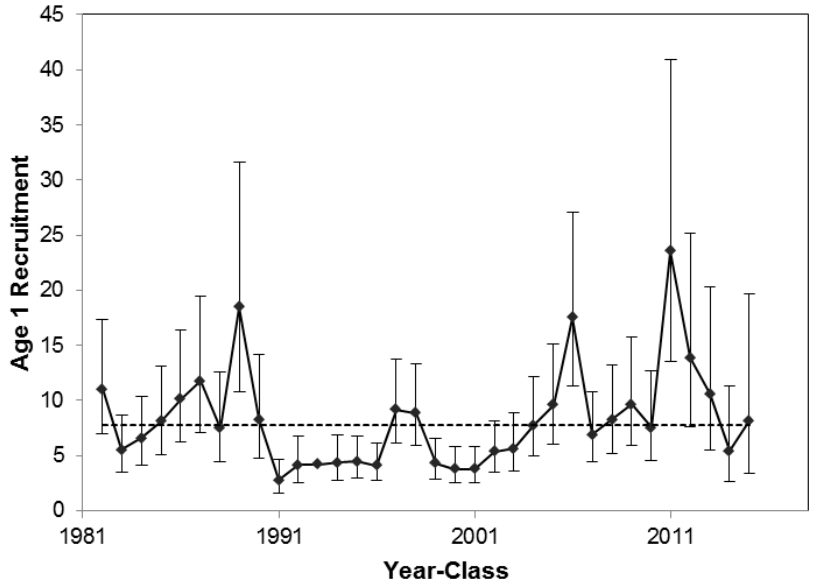



*Figure 23c. Estimates of age 1 recruitment from SURBA cohort analysis model.*

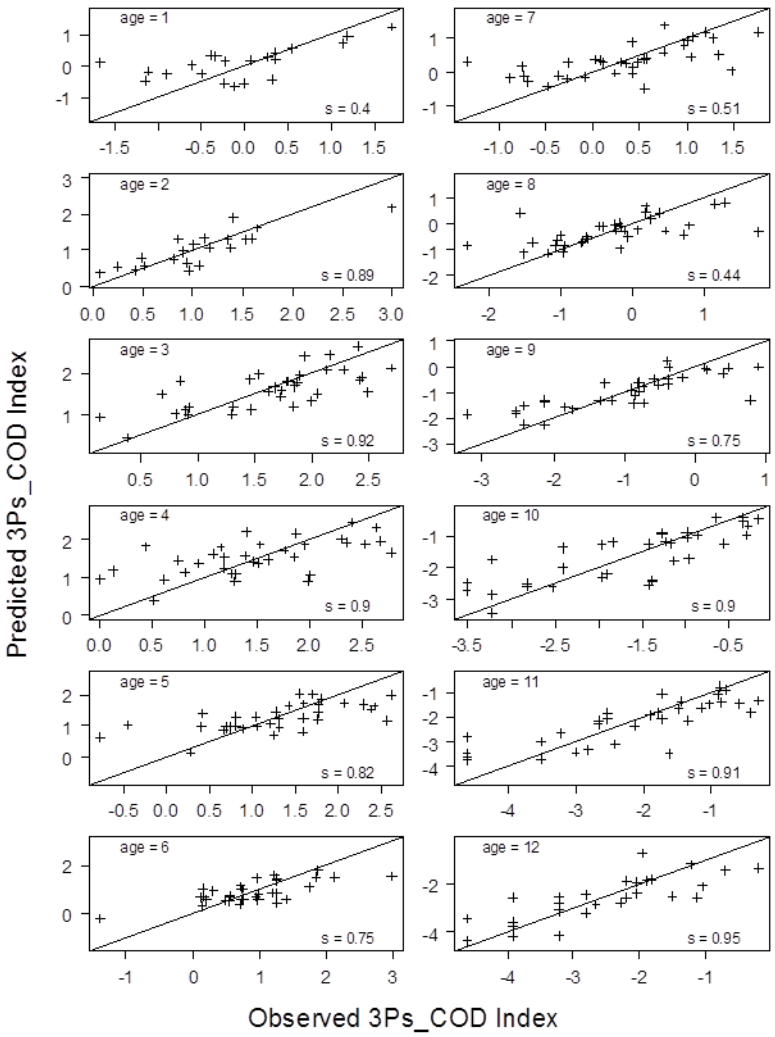



*Figure 24. Standardized residuals from SURBA cohort analysis. Panels show residuals plotted year, cohort, age, and expected value, respectively.*

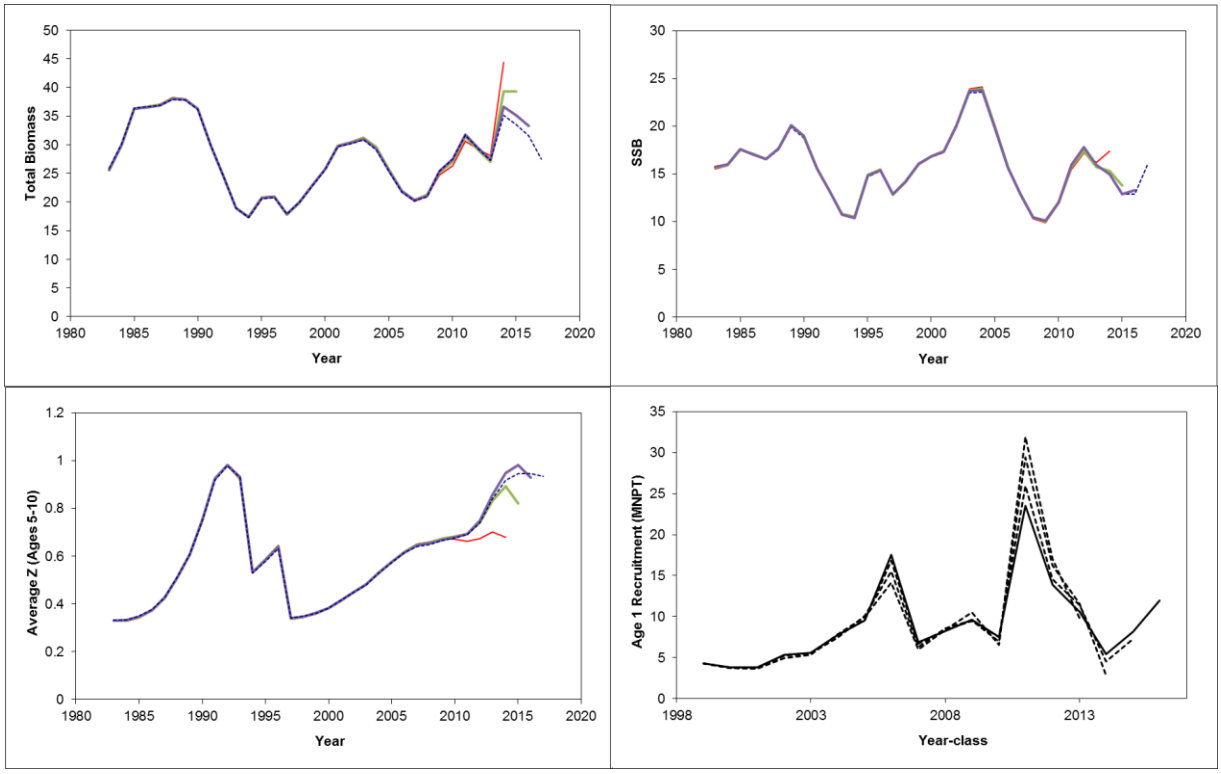



*Figure 25. Retrospective patterns comparing the four most recent assessments for 3Ps cod based on a SURBA cohort analysis model.*

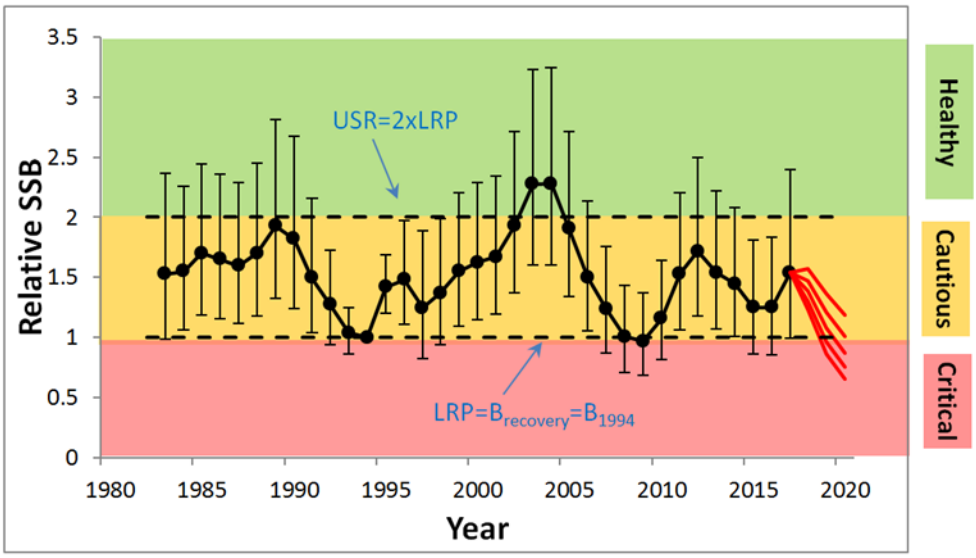
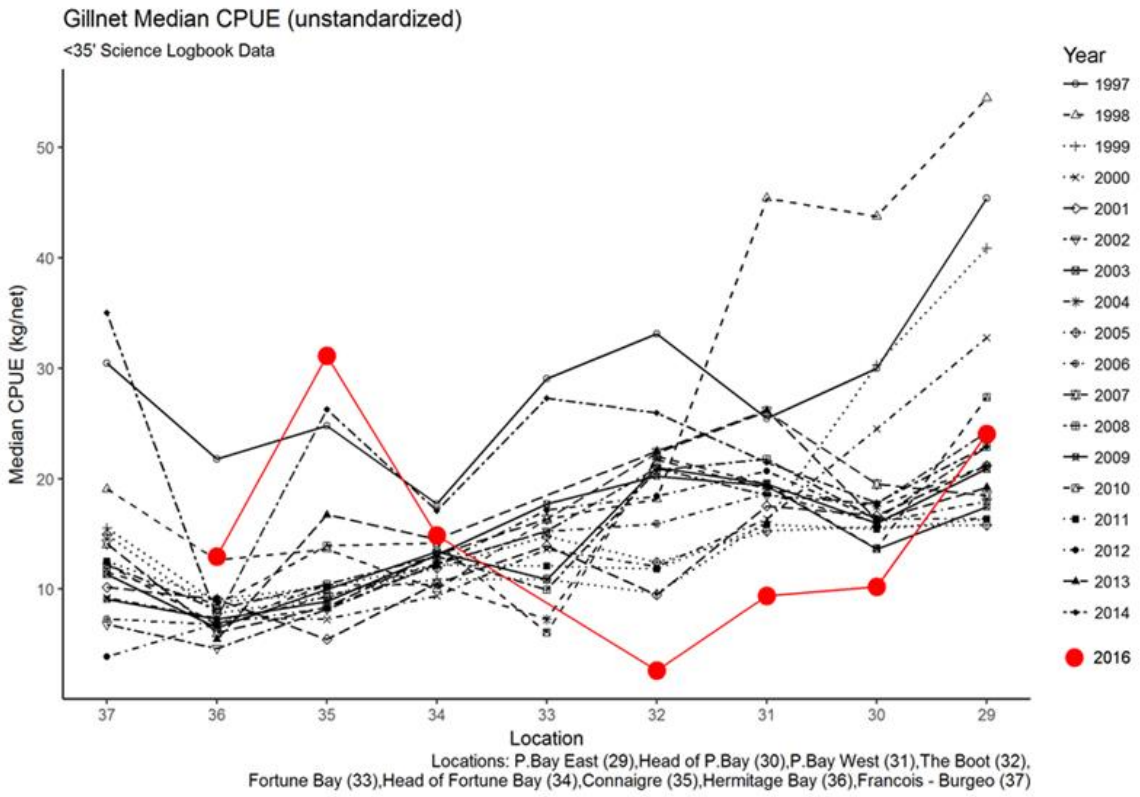



*Figure 26. Estimates of SSB, relative to the 1994 value (median estimate with 95% confidence interval) and projected SSB to 2020 (shown in red) under five mortality multipliers (0.8, 0.9, 1.0, 1.1 and 1.2). The lower dashed line at one (reference level) represents the SSB Limit Reference Point and the upper horizontal dashed line at two represents the Upper Stock Reference (i.e., 2 x LRP). These reference points represent the boundaries between the zones of DFO's precautionary approach framework, as indicated on the right axis.*




| Location | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 |
|---|---|---|---|---|---|---|---|---|---|
| # $CFV_{2014}$ | 2 | 14 | 3 | 14 | 2 | 10 | 14 | 22 | 15 |
| # $CFV_{2016}$ | 0 | 7 | 3 | 6 | 0 | 2 | 6 | 4 | 3 |

*Figure 27. Unstandardized catch rates in gillnets based on data reported in logbooks for vessels < 35 feet.*

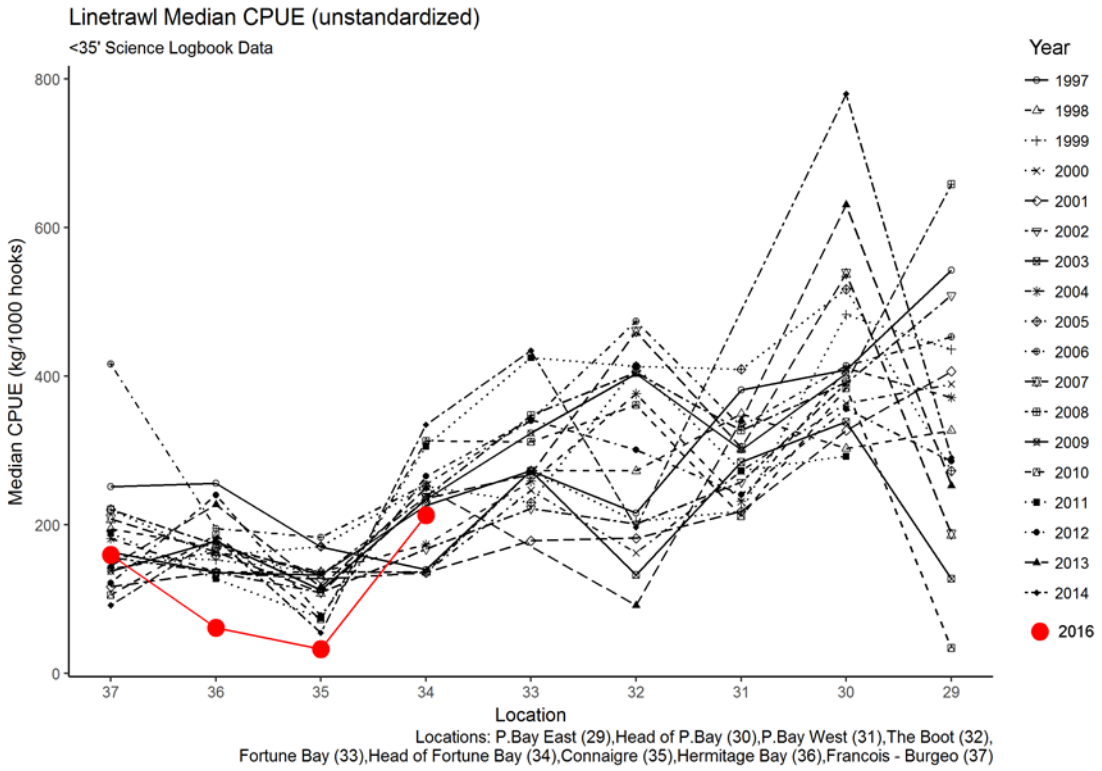



*Figure 28. Unstandardized catch rates in linetrawls based on data reported in logbooks for vessels < 35 feet.*

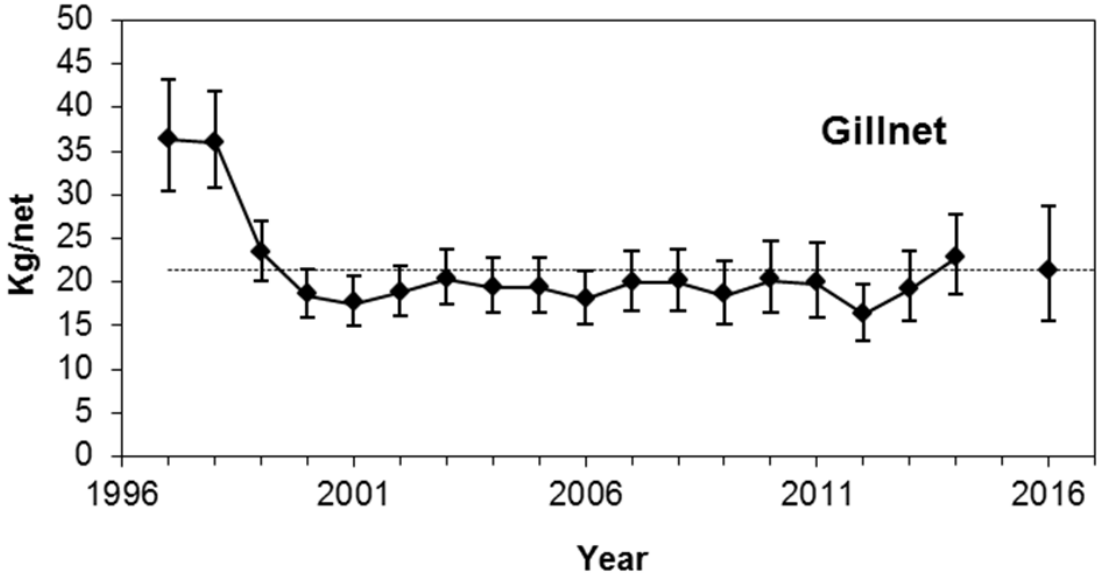



*Figure 29. Standardized catch rates plus 95 % confidence intervals for gillnets based on data reported in logbooks for vessels less than 35 feet. Horizontal line represents the time-series average.*

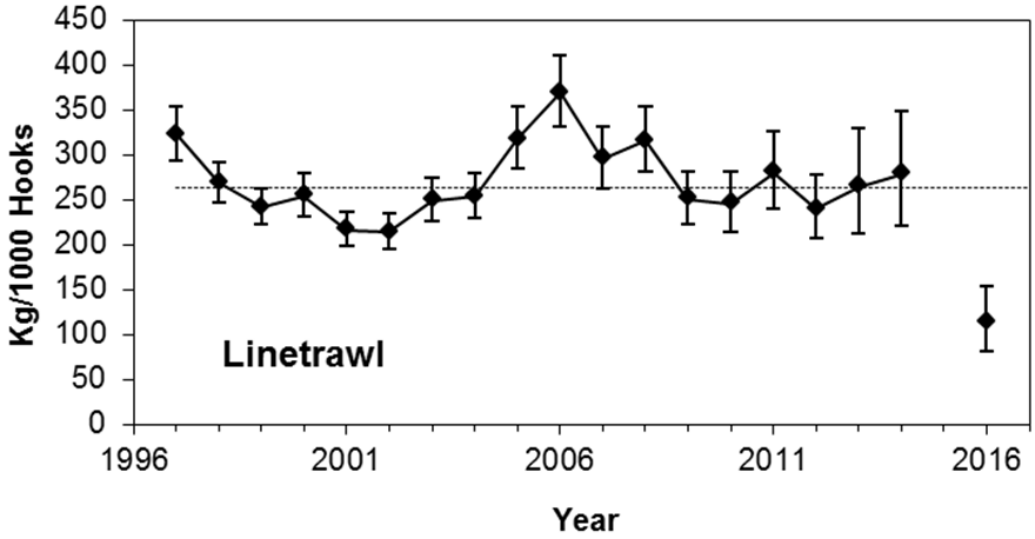



*Figure 30. Standardized catch rates plus 95 % confidence intervals for linetrawls as reported in logbooks for vessels less than 35 feet. Horizontal line represents the time-series average. Data were unavailable for 2015 during the assessment.*

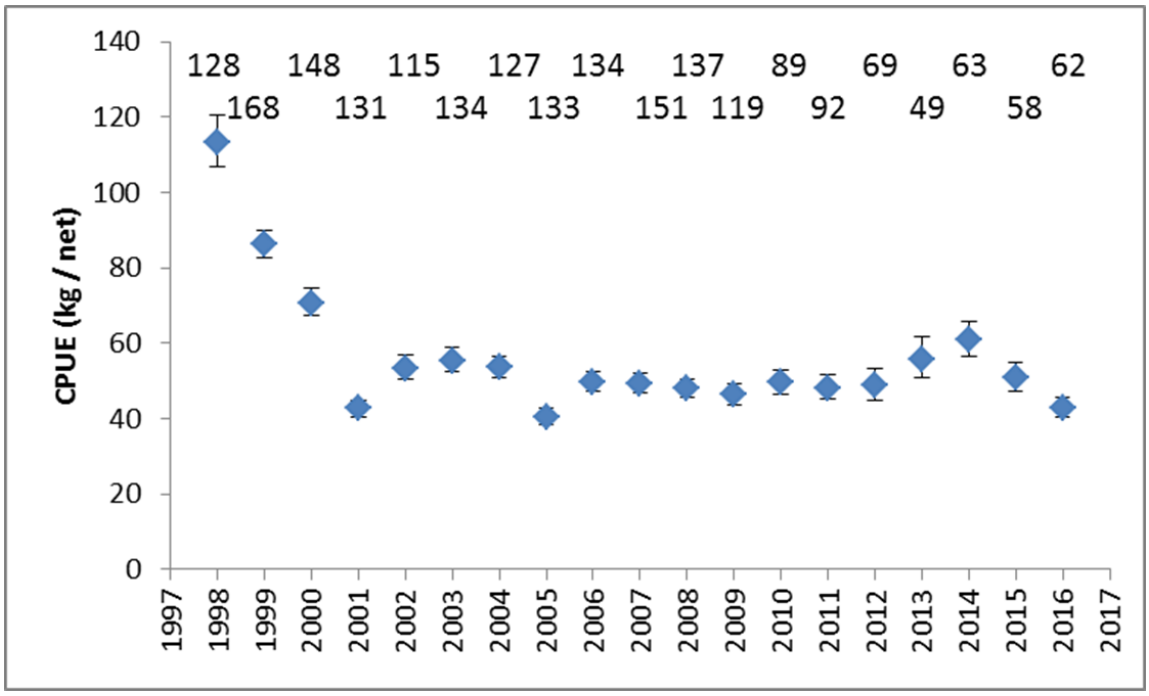



*Figure 31. Standardized catch rates with 95% confidence intervals for gillnets based on data from logbooks from vessels greater than 35 feet. Number of sets annually shown at top of graph.*

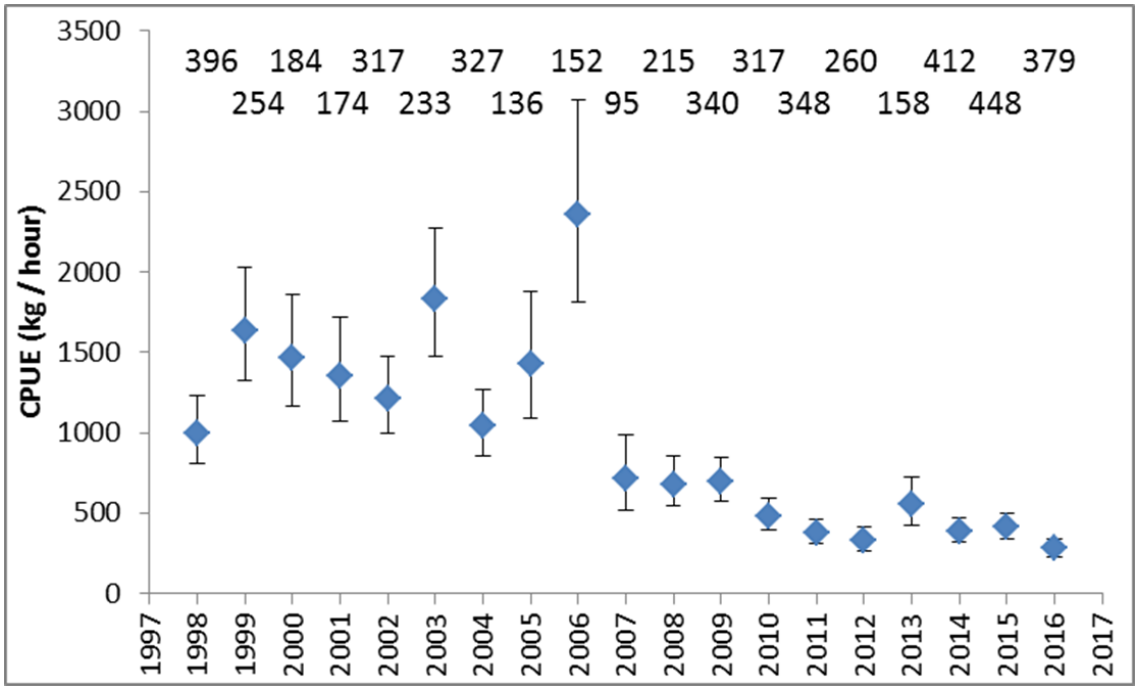



*Figure 32. Standardized catch rates with 95% confidence intervals for otter trawlers based on data from logbooks from vessels greater than 35 feet. Number of sets annually shown at top of graph.*

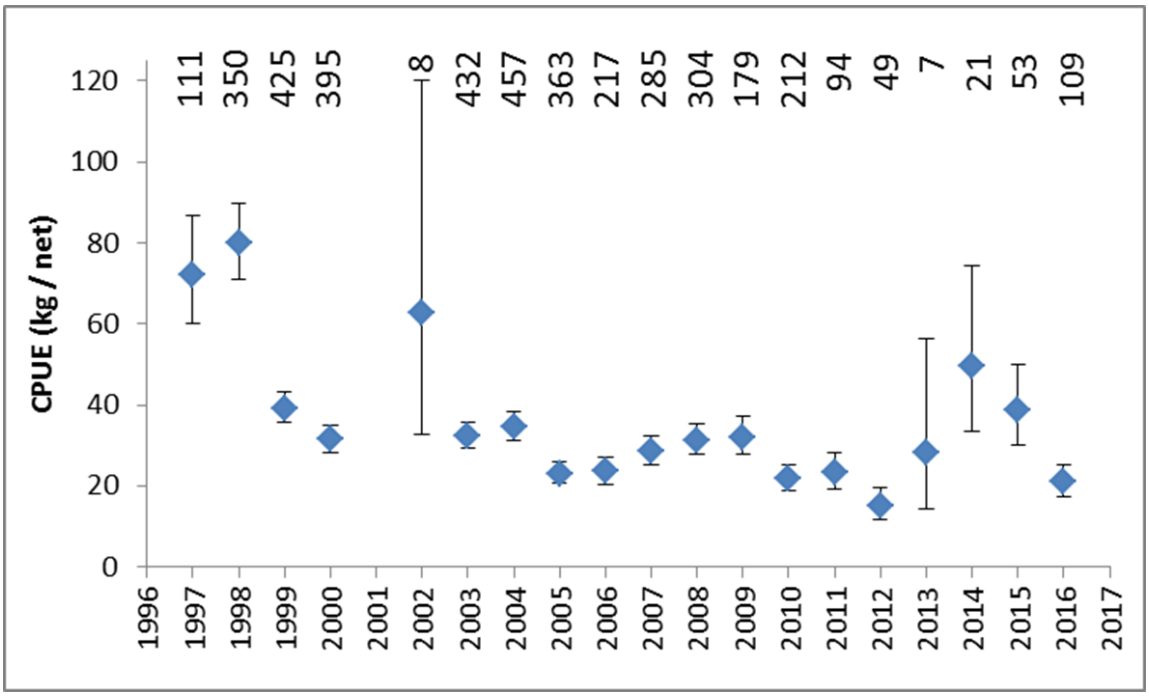



*Figure 33. Standardized catch rates for gillnets plus 95 % confidence intervals based on at sea sampling by observers during 1996 to 2016. Number of sets annually shown at top of graph.*

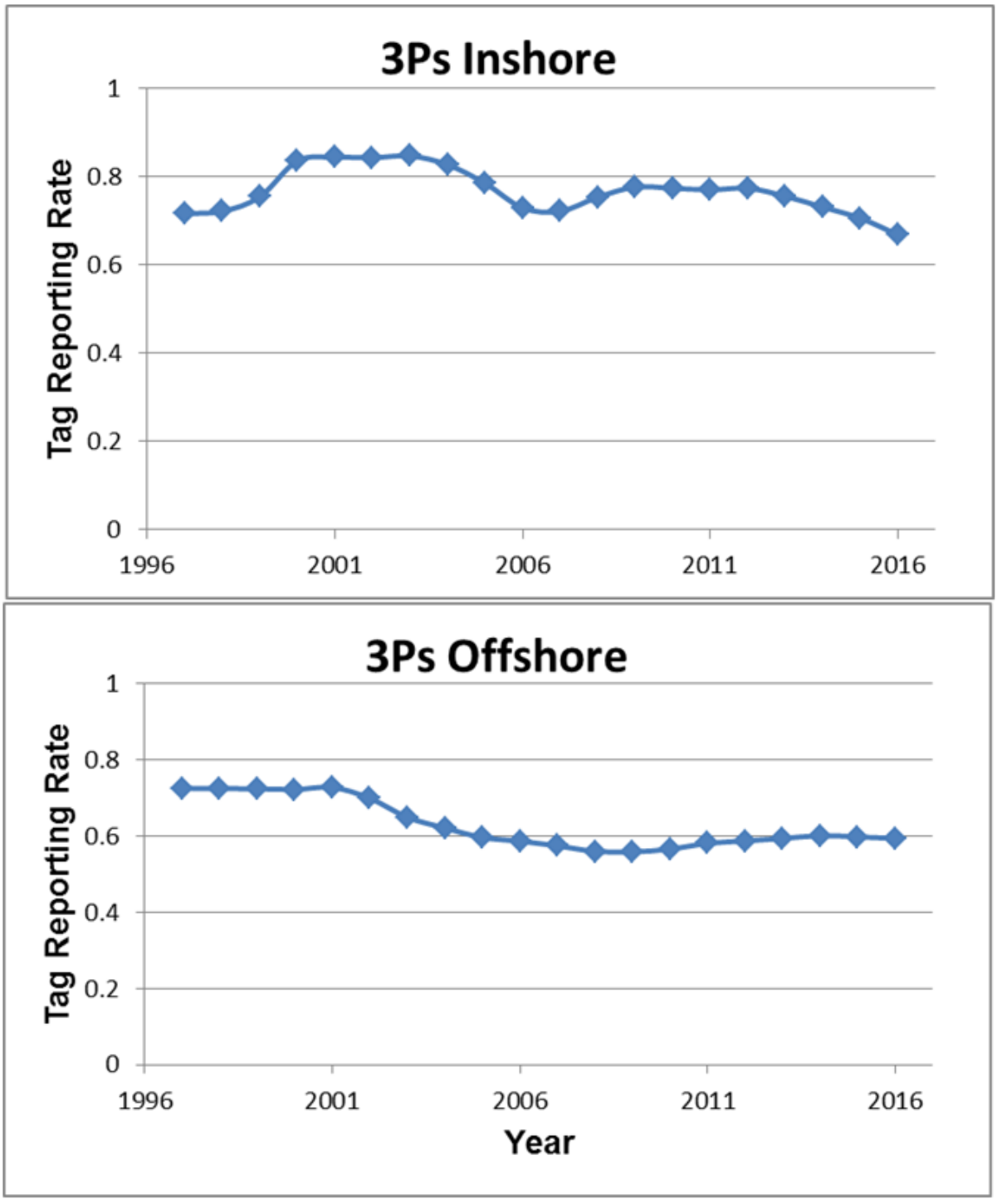



*Figure 34. Trends in annual tag reporting rates for low reward ($10) tags based on a mixed effects logistic regression model.*