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Assessment of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in October 2006

Évaluation du stock de morue (*Gadus morhua*) de la sous-division 3Ps de l'OPANO en octobre 2006

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ABSTRACT

This document summarizes scientific information used to determine the status of the cod stock in NAFO Subdiv. 3Ps off the south coast of Newfoundland. Principal sources of information available for this assessment were: reported landings from commercial fisheries (1959-March 2006), oceanographic data, a time series (1973-2005) of abundance and biomass indices from Canadian winter/spring research vessel (RV) bottom-trawl surveys, an industry offshore bottom-trawl survey (1997-2005), inshore sentinel surveys (1995-2005), science logbooks from vessels < 35ft (1997-2005), industry logbooks for larger (> 35 ft) vessels (1998-2005), and tagging studies (1997 onwards). The fishery was still in progress at the time of the assessment and complete information on catch rates and age compositions from the 13,000 t TAC from 1 April 2006 to 31 March 2007 was not available. In addition, the spring 2006 RV survey was not completed due to operational difficulties with the vessel; consequently, there has been no update of the abundance, biomass, or catch rate indices, or of biological information (growth, maturation rate, and condition) from this survey. In this assessment, a model of the dynamics of the stock using sequential population analysis was not accepted and the assessment is based primarily on analyses of survey indices and trends in catch. All four indices of population size are presently below average; the two offshore (trawl) indices have been declining, whereas the two inshore (fixed gear) indices have been fairly stable. Catches of cod in the 2005 GEAC survey, particularly for the 1997 and 1998 year classes, were much lower than those in preceding years. Sentinel line-trawl catches of the 1997 and 1998 year classes were not markedly different from those of other recent cohorts at the same age. New information on recruitment from the GEAC survey and sentinel linetrawl is consistent with the previous (2005) assessment and indicates that year classes produced during 2000-03 are mostly (3 of 4) below average. Two strong year-classes (1997-98) have been well represented in the catch during 2003-05; however, these are followed by weaker recruitment (2000-03 year classes) and at current catch levels it is anticipated that the stock abundance will decline over the next few years.

RÉSUMÉ

Dans ce document, nous résumons les données scientifiques utilisées pour déterminer l'état du stock de morue dans la sous-division 3Ps de l'OPANO, située au sud de Terre-Neuve***.*** Voici les données utilisées pour l'évaluation : débarquements déclarés des pêches commerciales (1959 – mars 2006)***,*** données océanographiques, une série chronologique (1973 – 2005) d'indices d'abondance et de biomasse obtenus par des relevés de navire de recherche (NR) canadien au chalut de fond, effectués à l'hiver et au printemps, ainsi que des données de relevés au chalut de fond effectués en haute mer par l'industrie (1997-2005***),*** relevés par pêche sentinelle dans les eaux côtières (1995 – 2005***),*** journaux de bord des bateaux < 35 pi de longueur (1997 – 2005), journaux de bord des bateaux de l'industrie > 35 pi de longueur (1998 – 2005), et études d'étiquetage (1997 et suivantes). Au moment de l'évaluation, la pêche battait encore son plein, de sorte que les données complètes sur les taux de capture et la composition par âge pour le TAC de 13 000 t couvrant la période allant du 1er avril 2006 au 31 mars 2007 n'étaient pas disponibles. De plus, en 2006, le relevé par navire de recherche n'a pas été réalisé en raison de difficultés opérationnelles imprévues éprouvées avec le navire; par conséquent, il n'y a eu aucune mise à jour de l'indice des navires de recherche et des données biologiques (croissance, taux de maturation et condition) associées à ce relevé. La présente évaluation, pour laquelle on a refusé un modèle de la dynamique des stocks utilisant une analyse séquentielle de la population (ASP), est fondée principalement sur des analyses des indices des relevés et des tendances concernant les prises. Les quatre indices de la taille de la population sont actuellement en-dessous de leur valeur moyenne; les deux indices hauturiers (chalut) ont diminué, tandis que les deux indices pour les engins fixes en eaux côtières sont stables. Dans les relevés du GEAC de 2005, les prises de morue et notamment les classes d'âge de 1997 et 1998, étaient sensiblement inférieures. Les prises des classes d'âge de 1997 et 1998 dans le cadre des pêches sentinelles (aux lignes et au chalut) n'étaient pas particulièrement différentes de celles des autres cohortes récentes au même âge. Les nouvelles données sur le recrutement tirées des relevés du GEAC et des pêches sentinelles aux lignes et au chalut concordent avec l'évaluation précédente (2005) et montrent que les classes d'âge produites entre 2000 et 2003 sont principalement (3 sur 4) inférieures à la moyenne. Deux classes d'âge fortes (1997-1998) ont été bien représentées dans les prises de 2003 à 2005. Cependant, celles-ci ont été suivies d'un recrutement plus faible (classes d'âge 2000 – 2003) et, aux niveaux de captures actuels, on prévoit que la mortalité par la pêche augmentera au cours des années à venir.

INTRODUCTION

This document gives an account of the regional assessment of the Atlantic cod (*Gadus morhua*) stock in NAFO Subdiv. 3Ps located off the south coast of Newfoundland (Fig. 1, 2). The assessment was conducted in St. John's, Newfoundland during 16-20 October 2006.

The history of the cod fishery in NAFO Subdiv. 3Ps and results from other recent assessments of this stock are described in previous documents (Pinhorn 1969; Bishop et al. 1991, 1992, 1993, 1994, 1995; Shelton et al. 1996; Stansbury et al. 1998; Brattey et al. 1999a, 1999b, 2000, 2001a, 2002a, 2003, 2004, 2005).

The directed cod fishery on this stock was reopened in May 1997 with a total allowable catch (TAC) set at 10,000 t (see Table 1). following a moratorium initiated in August 1993. The TAC was subsequently increased to 20,000 t in 1998 and further to 30,000 t in 1999. The TAC was subsequently reduced to 20,000 t in 2000, and for the five management years (ending 31 March 2006) was been set at 15,000 t. The TAC for management year 1 April 2006-31 March 2007 was reduced to 13,000 t.

The present assessment incorporates various sources of information on 3Ps cod, but the 2006 DFO research vessel bottom-trawl survey data was not completed; hence there was no update of the survey index, biological information or of oceanographic data. The 2005-06 commercial fishery was still in progress at the time of the assessment meeting (October 2006). Detailed information on catch-at-age up to the end of March 2006 was available and preliminary catch information for the period 1 April -1 October 2006 was also used. Additional sources of information included science logbooks for vessels <35 ft (1997-2005), industry logbooks for vessels >35 ft (1998-2005), an industry trawl survey on St. Pierre Bank from 1997 to 2005 (McClintock [in prep.]), inshore sentinel surveys from 1995 to 2005 (Maddock-Parsons and Stead 2005), and recaptures of tagged cod (received up to the end of 2005) from tagging conducted during 1997-2005 (Brattey and Healey 2006).

In the current analyses it was assumed that the entire 13,000 t TAC would be taken in the fishing season from 1 April 2006 to 31 March 2007, as outlined in the management plan released by DFO prior to the start of the season.

ENVIRONMENTAL OVERVIEW

The time-series of oceanographic conditions in 3Ps could not be updated because the spring 2006 DFO research vessel survey was not completed. The text here is repeated from the 2005 assessment document (Brattey et al. 2005). Oceanographic data from NAFO Div. 3P during the spring of 2005 were examined and compared to the previous year and the long-term (1971-2000) average (Colbourne and Murphy 2005). Temperature measurements on St. Pierre Bank show anomalous cold periods in the mid-1970s and from the mid-1980s to mid-1990s. Beginning in 1996 however, temperatures moderated, decreased again during the spring of 1997 and returned to more normal values during 1998. During 1999 and 2000 temperatures continued to increase, reaching the highest values observed since the late 1970s in some regions. During 2001-03 however, temperatures cooled significantly to values observed during the mid-1990s with the average temperature during the spring of 2003 the coldest in about 13 years. Temperatures during both 2004 and 2005 warmed considerably over 2003 values to 1°C above normal in some areas. The areal extent of <0°C bottom water during 2003 increased to the highest in about 13 years but decreased during

2004 and 2005 to <10%, the lowest since 1988. The areal extent of bottom water with temperatures >3°C has remained relatively constant at about 50% of the 3P area during the past decade. On St. Pierre Bank bottom water with temperatures <0°C essentially disappeared during the warm years of 1999 and 2000, reappeared again during 2001-03 and disappeared again during 2004 and 2005. In general, temperatures during 2004 and 2005 increased significantly over values observed during 2001-03.

COMMERCIAL CATCH

Catches (reported landings) from 3Ps for the period 1959 to 1 October 2006 are summarized by country and separately for fixed and mobile gear in Table 1 and Fig. 3a and 3b. Prior to the moratorium, Canadian landings for vessels <35 ft were estimated mainly from purchase slip records collected and interpreted by Statistics Division, Department of Fisheries and Oceans. Shelton et al. (1996) emphasized that these data may be unreliable. Post-moratorium landings for vessels <35 ft have come mainly from a dock-side monitoring program initiated in 1997. Landings for vessels >35 ft come from logbooks. Non-Canadian landings (mainly France) are compiled from national catch statistics reported by individual countries to NAFO and there is generally a lag in the submission of final statistics; consequently, the most recent entries in Table 1 are designated as provisional.

The stock in the 3Ps management unit was heavily exploited in the 1960's and early 1970's by non-Canadian fleets, mainly from Spain and Portugal, with reported landings peaking at about 87,000 t in 1961 (Table 1, Fig. 3a). After extension of jurisdiction (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, reaching a high for the post-extension of jurisdiction period of about 59,000 t in 1987. Subsequently, reported catches declined gradually to 36,000 t in 1992. Catches exceeded the TAC throughout the 1980's and into the 1990's. The Canada-France boundary dispute led to fluctuations in the French catch during the late 1980's. A moratorium was imposed on all directed cod fishing in August 1993 after only 15,216 t had been landed, the majority being taken by the Canadian inshore fixed gear fishery (where inshore is typically defined as unit areas 3Psa, b, and c; Fig. 2). In this year access by French vessels to Canadian waters was restricted. Under the terms of the 1994 Canada-France agreement, France is now allocated 15.6% of the TAC, of which Canadian trawlers must fish 70%, with the remainder fished by small inshore fixed gear vessels based in St. Pierre and Miquelon.

Since 1997, most of the TAC has been landed by Canadian inshore fixed gear fishermen, with most of the remaining catch taken by the mobile gear sector fishing the offshore, i.e. unit areas 3Psd, e, f, g, h (Table 1, Fig. 3a and 3b). This general pattern has continued since the fishery reopened in 1997, but there has been a slight (12%) increase in landings from offshore unit areas due to some smaller fixed gear vessels redirecting their effort to offshore fishing areas. During the 2005 calendar year, total reported landings were 14,778 t with the inshore fixed gear sector accounting for 9,537 t (64.5%) of the total (Table 1). In the 2006 calendar year to 1 October, the inshore fixed gear sector accounted for 6,261 t (77.1%) of the reported landings of 8,122 t; the offshore mobile gear sector typically fishes in the late fall and early winter and this allocation had yet to be taken; inshore landings are also typically high in late fall (see below).

Line-trawl (=longline) catches dominated the fixed gear landings over the period 1977-93, reaching a peak of over 20,000 t in 1981 and typically accounting for 40-50% of the annual total for fixed gear (Table 2, Fig. 4). In the post-moratorium period, line-trawls have accounted for 16 to 23% 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, but declined thereafter until the moratorium. Gillnets have been responsible for the dominant portion of the inshore catch since the fishery reopened in 1997, with gillnet landings exceeding 10,000 t (i.e. 50% of the TAC) for the first time in 1998, and approaching 18,000 t in 1999. 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 management restriction in their use that was removed part way through the fishery following extensive complaints from industry. Gillnets are also being used extensively in the offshore areas in the post-moratorium period (see below). Trap catches have varied over the time period, but have not exceeded 8,000 t and have declined from 1,167 t to negligible amounts (< 120 t) from 1998 onwards. Hand-line catches were a small component of the inshore fixed gear fishery prior to the moratorium (about 10-20%) and accounted for < 5% of landings during most of the post-moratorium period. However, hand-line catch for 2001 shows a substantial increase (to 17% of total fixed gear) compared with the 1998-2000 period and this may reflect the temporary restriction in use of gillnets described above.

Monthly landings during 2005 and up to 1 October 2006 are summarized for inshore (3Psa/b/c) and offshore (3Psd-h) and for each of the major gear types, in Table 3a. Inshore catches in 2005 have come mostly from gillnets with substantial gillnet landings (>200 t) in most months except January-April. Line-trawls were fished inshore mostly during late summer and fall with highest monthly landings (>380 t) in November. Hand-line catches were taken mainly during summer and fall with a peak in August. In the offshore, otter trawl fishing by Canadian trawlers and vessels chartered by St. Pierre and Miquelon to fish the French allocation was concentrated mainly during the first and last quarters of the year. There was also a substantial offshore gillnet catch in 2005 with landings totaling over 2,909 t taken mostly during July-November. Line-trawls were fished in the offshore throughout the year but accounted for a small proportion (5%) of offshore landings, totaling <50 t most months except February (170 t). Overall, landings in 2005 were dominated by the directed gillnet fishery with the remaining catch taken by otter trawl, followed by line-trawl and hand-line, with negligible amounts taken by trap. Landings by gear type and season show no major changes in recent years, except for a slight increase in offshore gillnet.

The landings for the 2005 calendar year and the first nine months of 2006 are summarized by month and unit area in Table 3b. Inshore landings were low (<5 t) in March and April 2005 and came mostly from by-catch fisheries. Monthly landing trends in 3Psb and 3Psc show similar patterns, with peaks in June-July and November, whereas those in 3Psa were more variable through June-November. Placentia Bay accounts for most of the inshore catch although the proportion of the total taken in this area has been gradually diminishing.

In the offshore, monthly landings tended to be more variable among unit areas. Unit area 3Psh accounted for most of the offshore catch from winter otter trawl fisheries, but landings from 3Pse and 3Psf were also high (>1,300 t) in late summer and fall from vessels fishing gillnets. Preliminary landings for the 2006 calendar year for the offshore show similar spatial and temporal trends to those seen in 2005.

The distribution of post-moratorium catches among unit areas is illustrated in Fig. 5. 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 4,900 t to almost 11,650 t with typically 28-51% of the entire TAC coming from this unit area alone; however, this percentage has shown a slight decline recently, from 39% in 2001 to 28% in 2005. Landings from 3Psa and 3Psb have been fairly consistent at about 1,100-3,200 t and generally between 7-12% and 9-18% of the TAC, respectively. Most of the offshore landings have come from 3Psh and 3Pse/f (Halibut Channel and the southeastern portion of St. Pierre

Bank) and there has been a slight increase in landings from St. Pierre Bank (3Pse/f). Unit area 3Psg continues to have the lowest landings (<4% of the annual total each year since 1997). Overall the landings show a slight switch towards reduced landings in 3Psc but slightly increased landings in offshore areas, suggesting a redirection of effort towards the offshore unit areas by some vessels.

The 1 April 2005 to 31 March 2006 conservation harvesting plan placed various seasonal and gear restrictions on how the 3Ps cod fishery could be pursued. Full details of these measures, which differ among gear sectors, are available from DFO Fisheries and Aquaculture Management (FAM) in St. John's.

CATCH-AT-AGE

Samples of length and age composition of catches were obtained from the inshore trap, gillnet, line-trawl and hand-line fisheries and the offshore otter trawl, gillnet, and line-trawl fisheries by port samplers and fishery observers. Sampling of the Canadian and French (St. Pierre and Miquelon, SPM) catches in 2005/2006 was undertaken, with 60,500 fish measured for length (Table 4a) and close to 8,000 otoliths collected for age determination (Table 4b). The sampling was well distributed spatially and temporally across the gear sectors. Substantial landings in summer from inshore fixed gears (see Table 3a) were sampled intensively, particularly line-trawl and gillnet. The winter offshore otter trawl fishery was also sampled heavily, particularly in the first quarter. Sampling of lengths and ages of the Canadian and French catches during January-March 2006 was also undertaken (Table 4c), with about 794 otoliths collected for age determination and 9,796 fish measured for length.

The age composition and mean length-at-age of commercial catches were calculated as described in Gavaris and Gavaris (1983). The average weights were derived from a standard length-weight (wt) relationship where:

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

Catch-at-age for all gears combined based on sampling of Canadian and French vessels in 2005 and January to March 2006 is summarized in Tables 5a, 5b, 6 and Fig. 6a and 6b. Catch-at-age data for the French catch was provided by colleagues in SPM.

In the 2005 landings from all gears combined, a wide range of ages are represented (mostly 4-17 year olds) with ages 7 and 8 (1997 and 1998 year classes) accounting for 48% of the total catch by numbers (Fig. 6a). The age composition of the 2005 catch is consistent with that of the previous two years, with the 1997 and 1998 year classes strongly represented in all three years. The proportion of younger cod (ages 3-5) in the catch in 2005 was 16%, similar to that of 2004 (15%). The percentage of older ages (>10 yr old) in 2005 (6.4%) was also similar to that of 2004 (7%). The most notable change in age composition between 2004 and 2005 is a decline in the numbers of 5 and 6 years and an increase in the numbers of 7 and 8 year olds.

The catch from the first three months of 2006 is taken mainly by mobile gear in the offshore and is mostly comprised of 7, 8 and 9 year olds (1999, 1998 and 1997 year classes), although all ages from 4 years up to 17 years were present.

Catch at age for the three main gear types for 2004 and 2005 is illustrated in Fig. 7. The dominance of gillnet selectivity on ages 6-7 in 2004 is evident, and 8 and 9 year olds are also well represented in 2005 but in lower numbers. In comparison, line-trawls caught mostly younger fish of ages 5-7 in 2004 and ages 4-7 in 2005. In 2005, five and six year olds are less well represented in offshore mobile gear, whereas 4 year olds were more strongly represented in line-trawls compared to the previous year.

A time series of catch numbers-at-age (ages 3-14) for the 3Ps cod fishery from 1959 to March 2005 is given in Table 6. As noted in recent assessments there are discrepancies in the sum of the product check for the 1959-76 catch-at-age 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. Further investigation is ongoing to check the fixed weights used for the 1959-76 period and to check the sampling protocols to see if either contributed to the discrepancies. Until these discrepancies are resolved, catch at age prior to 1977 will not be used in SPA analyses.

The catch-at-age data that are available indicate that in the pre-moratorium period the landings were dominated by young fish, typically aged 4-6, whereas in the post moratorium period slightly older ages (i.e. ages 5-8) have been more common; this probably reflects the switch in dominant gears from line-trawl to gillnet. For the 2005 fishery, 7 and 8 year-old cod (1997-98 year classes) dominated the final catch in terms of numbers. Note that the TAC, total landings, and gears employed in the fishery have been similar throughout the past five management years, yet the composition of the catch has shown some notable changes. The modal age in the catch has increased progressively over the past three years as the 1997 year class gets progressively older and moves through the peak ages selected by gillnets (typically ages 5-7). The 1998 year class follows the same pattern, but appears less strongly in the catch compared to the 1997 year class.

WEIGHT-AT-AGE

Mean weights-at-age in the 3Ps fishery (including landings from the commercial and food fisheries and the sentinel surveys) are given in Table 7a and Fig. 8a. Beginning of the year weights-at-age are given in Table 7b and Fig. 8b. The mean weights-at-age are derived from the sampling of catches taken by several gears in various locations at various times of the year; the weights at age may therefore vary with season and gear, and possibly by geographic area. The annual means by gear vary considerably; for example, mean weights-at-age in the 2002 3Ps fishery tended to be least in hand-line and greatest in offshore mobile gear (predominantly otter trawl) (Brattey et al. 2003), with the weight of the 1994 year-class at age 8 in the former being less than half the weight in the latter.

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. 8a). The converse is true for older fish. Sample sizes for the oldest age groups (>10) have been low in recent years due to the relative scarcity of old fish in the catch. 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.

The overall mean weights-at-age computed for recent years have some notable features. First, it was stated in Brattey et al. (2003) that apparent growth from 2001 to 2002 was unusually low for the 1989-91 year-classes, and nil for the 1988 year-class. The weights-at-age for 2002 have been recomputed, and growth from 2001 to 2002 now appears greater for all year-classes. Second, as noted by Brattey et al. (2003), weight-at-age appears to depend to some extent on year-class. For example, the 1989 and 1993 year-classes appear to be relatively heavy at age 9, whereas the 1991 and 1992 year-classes appear relatively light. For this reason, it is difficult to state in a few words how growth in recent years compares to growth in the past.

SENTINEL SURVEY

The sentinel survey has been conducted in 3Ps since 1995 and there are now eleven complete years of catch and effort data (Maddock-Parsons and Stead 2006). During 2005, the sentinel survey continued to produce a time series of catch/effort data and biological information collected by trained fish harvesters at various inshore sites along the south coast of Newfoundland. In 2005, there were 13 active sites in 3Ps, using predominantly gillnets (5½" mesh) in unit area 3Psc (Placentia Bay) and line-trawls in 3Psb and 3Psa (Fortune Bay and west). One 3¼" gillnet was also fished at each of 6 sites in Placentia Bay one day per week. Fishing effort was reduced in 2003 to an average of 6 weeks, but increased to 9 weeks during 2004 and 2005. Fishing times averaged 10 weeks in 2001 and 2002, 8 weeks in 2000 as opposed to 6 weeks in 1999 and 12 weeks from 1995 to 1998. Most fishing takes place in fall/early winter. Maddock-Parsons and Stead (2001, 2003a, 2003b, 2004, 2005, 2006) have produced a time series of weekly average catch rates and annual relative length frequencies (number of fish at length divided by amount of gear). Catch rates for 5½" gillnets in 2005 remained low and similar to those reported for 2004 and line-trawl catch rates showed a slight decline.

As in previous assessments, an attempt was made to produce an age dis-aggregated index of abundance for the eleven completed years in gillnet (5½" mesh) and line-trawl sectors of the program; there is insufficient data from the 3¼" gillnets to develop an index for this gear. Sentinel fishers typically fish a control and an experimental site; the location of the control site is fixed, whereas the location of the experimental site can change only within the local area.

STANDARDIZED SENTINEL CATCH RATES

The catch from 3Ps was divided into cells defined by gear type (5½" mesh gillnet and line-trawl), area (unit areas 3Psa, 3Psb, and 3Psc), year (1995-2005) and quarter. Age-length keys were generated for each cell using fish sampled from both the fixed and experimental sites; however, only fish caught at the fixed sites were used to derive the catch rate indices. Length frequencies and age-length keys were combined within cells. The numbers of fish at length are assigned an age proportional to the number at age for that particular cell length combination. Fish that were not assigned an age because of lack of information within the initial cell were assigned an age by aggregating cells until the data allowed an age to be assigned. For example, if there are no sample data in a quarter then quarters are combined to half-year, half-years are combined to year; if an age still cannot be assigned, and then areas are combined for the year. Sampling of the sentinel catch for otoliths for ageing has been somewhat reduced since 2002 with <455 otoliths per year from gillnet catches and <700 otoliths per year from line-trawl catches, except for line-trawl in 2005 (1132 otoliths)

Catch-at-age and catch per unit effort (CPUE) data were standardized using a generalised linear model to remove site and seasonal effects. For gillnets, only sets at fixed sites during July to November with a soak time between 12 and 32 hours were used in the analysis. For line-trawl, sets at fixed sites during August to November with a soak time less than or equal to 12 hours were used in the analysis. Zero catches were generated for ages not observed in a set. Prior to modeling, data are aggregated within a gear-division-site-month-year-age cell. Sets with effort and no catch are valid entries in the model. Note that catch rates from the sentinel fishery are expressed in terms of numbers of fish, rather than catch weight as was used in the analyses of logbook data. This has important implications when comparing trends in these indices.

A generalised linear model (McCullagh and Nelder 1989) was applied to the sentinel catch and effort data for each gear type. The response distribution was specified as Poisson and the link function was chosen to be log. That is, the Poisson mean parameter μ_i is related to the linear predictor by

$$\log(\mu_i) = X_i^T \beta$$

where X_i^T is a vector of explanatory factors for catch observation *i* (i.e. month, site, age and year) and β is a vector of coefficients to be estimated from the data.

Thus, catch is assumed to have a Poisson probability distribution with the mean related to the factors month nested within site and age nested within year by

$$\log(\mu_i) = \log(E_i) + month_{i(j)}\beta_j\left(site_{i(k)}\beta_k\right) + age_{i(l)}\beta_l\left(year_{i(m)}\beta_m\right),$$

where log (E_i) is an offset parameter for fishing effort and j,k,l,m indicate the level for each of the four factors.

In the present assessment, the model adequately fitted data from gillnets and line-trawls.

Trends in standardized total (ages 3-10 combined) annual catch rates, expressed in terms of numbers of fish, are shown in Fig. 9a. For gillnets there is no trend over the period 1995-97, but catch rates declined rapidly from 1997 to 1999 then remained stable but low from 1999 to 2005. For line-trawls, catch rates show a decline from 1995, but have been relatively stable from 1997 to 2003 with a marginal decline thereafter to 2005.

Two standardized annual catch rate-at-age indices were also produced in the present assessment, one for each gear type. All effects included in the model were significant. The standardized gillnet and line-trawl catch rate-at-age indices for 1995-2005 are given in Table 8 and Fig. 9b. For gillnets, the catches during 1995-97 were dominated by the 1989 and 1990 year-classes and for the subsequent period the 1992 year-class is well represented, although catch rates for the latter do not appear to be as strong. During 2002-05, the 1997 and 1998 year classes are not strongly represented in the sentinel gillnet catch. Gill-net catch rates are among the lowest for all ages in 2005.

For line-trawls, catch rates were higher for the 1989 and 1990 year-classes during 1995-96 followed by the weaker 1992 year-class. In the 2000-02 sentinel line-trawl, catch rates improved for younger fish (3 and 4 year olds) compared to 1995-99, but those for older fish continued to decline. The estimates for age 3 in 2003, age 4 in 2004, and age 5 in 2005 (i.e. the 2000 cohort) are the lowest in the series for those ages. The estimates for ages 5-7 in sentinel line-trawl in recent years have improved somewhat and reflect the appearance of the 1997 and 1998 year classes. The 1999 year class also appears reasonably strong at ages 4-5 then below average for age 6 in sentinel line-trawl. The 1999 year class is weak in sentinel gillnet and in other (mobile gear) indices.

As described in recent 3Ps cod assessments, interpretation of the sentinel catch rate indices is difficult. Sentinel fisheries were free from competitive influences during 1995-96 as the commercial fishery was closed. However, commercial fisheries may have had some disruptive influence on the execution of the sentinel fishery during 1997-2004, particularly in Placentia Bay. The concentration of fishing effort in Placentia Bay, primarily with gillnets, may have had a negative influence on the sentinel gill-net catch rates. Competition with commercial fishers for fishing sites, local depletion, inter-annual changes in the availability of fish to inshore, and shifts in the timing of sentinel fishing to accommodate periods of commercial fishing could all influence mean catch rates between years. The extents to which such effects influence catch rates are not fully understood. Nonetheless, the declines in sentinel gillnet catch rates when the fishery re-opened and continued low gillnet catch rate are interpreted as signs of concern. Furthermore, gillnets do not clearly track the 1997 and 1998 cohorts which are evident in other indices of the 3Ps cod stock. The decline in sentinel gill net catch rates after the fishery reopened in 1997 are consistent with the inshore catch rate data from science log-books and the high estimates of exploitation from tagging in Placentia Bay. In contrast, the line-trawl catch rates, which mainly incorporate data from areas west of the Burin Peninsula, show less of a decline and rates have increased for younger fish in recent years due to the appearance of the 1997 and 1998 year classes. The trends in the sentinel line-trawl catch rate data were also reasonably consistent with those seen in the line-trawl catch rate data from science log-books up to 2004, but do not reflect the increase seen in logbooks for 2005 (see below). The cohort signals in the sentinel line-trawl are also reasonably consistent with the DFO RV survey index, the GEAC survey index, and the commercial catch-at-age.

SCIENCE LOGBOOKS (<35 ft sector)

A new science logbook was introduced to record catch and effort data for vessels less than 35 ft in the re-opened fishery in 1997. 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. There are currently data for about 92,000 records in the database, although only 5,700 for 2005 and 5,900 for 2004, the two lowest values since 1997. A notable finding in this assessment was that the percentage of cod catch in the logbooks for the <35' sector has decreased over time, from about 70% in 1997 and 1998 to currently less than 30%. These figures exclude catches recorded without location and adding these catches would bring the recent figures up to about 50%. Part of the decline may be due to an increasing portion of small boat owners taking their allocation in offshore unit areas. Nonetheless, a substantial fraction of the catch and effort data from smaller vessels is not available for examination.

These data pertain 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, more than 30 gillnets were used or <100 or >4,000 hooks were used on a line-trawl. 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. About 13% of the records were excluded using these criteria.

As in previous assessments, effort was treated as simply the number of gillnets, or hooks for line-trawls (1000's), 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 kg by multiplying by 2.2026.

The frequency distribution of catches per set is skewed to the right for most gears (not shown). For gillnets, catches per set are typically 100-200 kg with a long tail on the distribution extending to about 2 t. The distribution of catches for line-trawls was similarly skewed.

The catch from 3Ps was divided into cells defined by gear type (gillnet and line-trawl), location (defined as fishing areas 29-37 and illustrated in Fig. 10a), and year (1997-2005).

Initially, un-standardized 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. The 2005 gillnet catch rates generally decreased over 2004 values in Placentia Bay and around the Burin Peninsula, but improved in Fortune Bay and were similar to 2004 results for areas further west (Fig. 10b). For line-trawl, most data comes from areas west of the Burin Peninsula and the results for Placentia Bay are based on fewer data and show more annual variability (Fig. 10c). Line-trawl catch rates in 2005 were generally good across 3Ps and values for several areas (30-32, 34) were the highest in the time series.

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 (CPUE) data were standardized to remove site (fishing area) and seasonal (month, year) effects. Note that sets with effort and no catch are valid entries in the model.

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

From model results for gillnets, catch rates have shown a downward trend during 1998-2000 and have subsequently been low but stable (Fig. 11). The gill-net catch rates have declined from about 37 kg per net in 1997 to 17 kg per net in 2001, but subsequently remained fairly constant at 19-21 kg/net during 2002-05. For line-trawls, catch rates declined from 303 kg/1000 hooks in 1997 to a minimum of 203 kg/1000 hooks during 2002. Values for 2003 and 2004 have been slightly higher and the 2005 value is the highest observed at 304 kg/1000 hooks.

The observed trends in commercial catch rate indices for the inshore fishery are influenced by many factors. There have been substantial annual changes in the management plans in the post-moratorium period (Brattey et al. 2003). In addition, catch rates from mobile commercial fleets can be related more to changes in the degree of local aggregation of cod and can be a poor reflection of overall trends in stock abundance, particularly for stocks in decline. While this is likely to be a bigger problem with respect to otter-trawl derived catch rates, gillnets and line-trawls can also 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 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. Where these data can be dis-aggregated into ages independently of the commercial catch at age data (as is the case with the sentinel survey) the information may be more easily interpreted in terms of stock size. 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 slight increase in modeled catch rates for line-trawl observed in 2003 and 2004 appear to be reflecting the appearance of the 1997 and 1998 year classes in the inshore catch; the further increase observed in 2005 may be reflecting the increased growth and larger size of these same year classes. However, the modeled gillnet catch rates have shown no significant changes in recent years.

INDUSTRY LOGBOOKS (>35 ft sector)

Median annual catch rates by gear sector and unit area from log books of larger vessels (>35' sector) were also examined. The data for gillnets was too sparse for firm conclusions to be drawn. The large vessel (>100 ft) otter trawl catch rates showed strong seasonality with generally lower catch rates during late fall (October-December) and highest catch rates in February (Fig. 12) ; superimposed on this seasonality there was an overall declining trend in catch rates from 1999 to 2004, but the 2005 values were higher than 2004. The trends remain difficult to interpret in terms of stock size given that the large vessels typically fish a localized area in the vicinity of southern Halibut Channel (see Fig. 1) during the winter months when cod in this area are highly aggregated.

TAGGING EXPERIMENTS

A project involving tagging of adult (>45 cm) cod initiated in 1997 has continued since the previous (2004) assessment, but only offshore cod have been tagged since the fall of 2003. The purpose of the study is to provide information on movement patterns of 3Ps cod as well as obtain ongoing estimates of exploitation rates on different components of the stock. Further details are provided below and in Brattey and Healey (2006).

ESTIMATES OF EXPLOITATION (HARVEST) RATE

The methods used to estimate exploitation rates are described in detail previously (Brattey and Cadigan 2004; Brattey and Healey 2003, 2004; Cadigan and Brattey 2003, 2006). Among cod tagged in Placentia Bay (3Psc) mean annual estimates of exploitation declined from 35% in 1999 to 21% in 2005. For cod tagged in Fortune Bay (3Psb) mean annual estimates have been similar (8-12%) during 2000-05, with tag returns indicating considerable movement of cod between Fortune Bay and Placentia Bay. For cod tagged in 3Psd (Burgeo Bank) the estimate for 2005 was 1.3%, the lowest estimate since 1998, but similar to the 2004 value. Mean annual estimates of exploitation for cod tagged in offshore areas (3Psh) are marginally higher for 2005 (5.5%, compared with 1.5-3.2% during 1998-2004), but remain lower than those for inshore areas in spite of offshore landings of > 6,000 t.

Brattey and Healey (2006) emphasized that the 2005 results pertain mostly to the 6+ portion of the 3Ps cod stock because no inshore tagging has been conducted since the fall of

2003 and at that time tagged could would typically be at least 4 years old. Also, the exploitation rate on 4 and 5 year old cod that are newly recruited to the fishery during 2005 cannot be determined from the tagging returns from the 2005 fishery. The fishery in the past three years (2003-05) has mostly exploited the relatively strong 1997 and 1998 year classes which in 2005 were 7 and 8 years old, respectively (Brattey et al. 2005, 2006). Subsequent year classes (2000-03) appear to be mostly weak (Brattey et al. 2005 and results herein); consequently, Brattey and Healey (2006) cautioned that as the 1997 and 1998 year classes age and grow beyond the main selection size of gillnets, the fishery will switch to these weaker incoming year classes which could result in an increase in fishing mortality if current catch levels are maintained.

The tagging results for 2005 agree with previous findings (Brattey et al. 2001b, 2002b; Brattey and Healey 2004, 2005), and indicate restricted mixing of cod from different portions of the 3Ps stock area as well as higher exploitation of adult cod tagged inshore, particularly in Placentia Bay. The complex migration patterns and stock structure may have some influence on the various abundance indices that are available for the stock (see Brattey et al. 2005) and add uncertainty to any sequential population analyses of the stock as a whole. The limited mixing of inshore cod in particular make it difficult to determine whether inshore indices are reflecting trends in the stock as a whole or mainly of inshore components of the stock. Trends in the indices differ between inshore and offshore and are difficult to reconcile with the tagging results. Tagging suggests low exploitation in the offshore yet the two offshore abundance indices have been declining trends in recent years. In contrast, inshore indices (sentinel) have been stable for several years (albeit at a lower level than when the fishery opened in 1997), but tagging suggests that in some inshore area such as Placentia Bay exploitation has consistently been relatively high. At present, the discrepancy between trends in offshore abundance indices and tagging estimates of exploitation remain enigmatic and difficult to explain.

The estimates of overall exploitation for cod tagged in the Burgeo region (3Psd) continue to be low and suggest that cod present in this area at that time, irrespective of their stock affinity, have not been heavily exploited. Any removals of migrant 3Pn4RS cod from 3Psd in the past few management years will therefore be small and have little influence on the dynamics of that stock. Re-opening of the northern Gulf cod fishery in 2004-05 and the ongoing fishery in 2005-06 to date appears to have had little influence on estimates of exploitation rate for cod tagged in 3Psd. Some cod in 3Ps are also known to migrate into southern 3L in some years rendering them vulnerable to fisheries in that area; however, landings have been restricted in 3L in the past few years (see Lilly et al. 2006) and only a few cod tagged in 3Ps were recaptured in 3L during 2005.

Compared with many other regions in 3Ps, the estimates of exploitation for the offshore areas continue to be low, in spite of substantial offshore landings of over 6,000 t per annum in the past several years (see Brattey and Healey 2006). In previous analyses (Brattey and Healey 2004, 2005) concerns were expressed that the estimates for the offshore may be more uncertain because of the sparseness of the tagging coverage, depth of capture and survival of cod for tagging, and limited spatial extent of activity in the offshore fishery. Some of this uncertainty has been addressed by conducting more tagging offshore during December rather than April for a third consecutive year (2003-05) as part of an industry trawl survey (see McClintock, in prep). Results to date show a marginally higher exploitation rate of these cod in 2005 (5.5%) compared to those tagged offshore during 1998-2004, but otherwise agree with findings from spring tagging. Most recaptures were taken offshore near the tagging site, on southeastern St. Pierre Bank, or inshore in Placentia Bay.

MIXING OF NORTHERN GULF COD (4Rs3Pn) INTO 3Ps

The issue of mixing of northern Gulf (3Pn4RS) cod into 3Ps during winter has often been discussed at assessments of both of these stocks and during the 2006 assessment of 3Ps cod the results of a “counting fence” cod telemetry project were presented. This project involved mooring several arrays of ultrasonic receivers at various locations within 4R3Pn and western 3Ps, particularly along the border between the two stock areas, and release of approximately 250 cod equipped with surgically implanted ultrasonic (50 kHz) transmitters at various locations (mostly within 3Pn4R). The ultrasonic transmitters release a series of unique “pings” for a period of about 15 months, and receivers record the time and serial number of any fish equipped with a transmitter that pass within range of each receiver (range ~1 km radius under optimal conditions). The receivers have to be retrieved from the ocean floor and data downloaded prior to analysis. The receivers and transmitters were deployed during the period May 2004-September 2005.

The main result was that 61% of cod implanted with transmitters in the northern Gulf (3Pn4RS) crossed into 3Ps during winter of 2004/05. The peak of movement into 3Ps was in December and the peak of return into 3Pn was in the first two weeks of April. This result indicates that a portion of the northern Gulf stock was in 3Ps when the DFO RV survey of 3Ps is usually conducted (April). The extent to which this proportion varies annually is not known. Oceanographic conditions may affect timing and possibly extent of mixing, with more mixing in cold years. Conditions were warm in 3P in winter 2004-05.

RESEARCH VESSEL SURVEY

During 2006, the DFO research bottom trawl survey was not completed due to technical problems with the vessel. The time series of abundance and biomass indices, age compositions and biological information (growth, condition, maturity) could not be updated with 2006 values (see Brattey et al. 2005 for information up to 2005). A total of only 50 sets were completed in 2006, mostly in the central inshore portion of the stock area (Fig. 13).

GEAC STRATIFIED RANDOM TRAWL SURVEY

In 2005, the Groundfish Enterprise Allocation Council (GEAC) carried out a ninth consecutive fall bottom-trawl survey directed at cod to complement current DFO RV surveys conducted in spring. DFO provided advice on the stratified random design and catch sampling. Results of the previous surveys are reported in McClintock (1999a, 1999b, 2000, 2001, 2002) and for the survey conducted during 1-14 December 2005 full details are given in McClintock (in prep.). These surveys are carried out in late fall and cover a large portion of offshore 3Ps, but not the Burgeo Bank area. The commercial trawler *M.V. Pennysmart* was used in all surveys. Tows are of 30 min. duration using an Engels 96 high lift trawl with a 135 mm diamond mesh cod end (not lined). The trawl was fitted with rock-hopper foot-gear and Bergen #7 trawl doors. Performance of the trawl was checked onboard using Scanmar net sensors: bridge display of door-spread, opening, and clearance were recorded as well as depth and temperature. A total of 71 successful stratified random tow sets were completed in the 2005 survey.

The mean cod catch in 2005 was 5.2 fish per tow with a mean catch weight of 4.5 kg; these values are substantially lower than previous surveys (see McClintock, in prep.).

The trawlable biomass index for 2005 was 11,000 t, the lowest value in the time series and substantially less than the 2004 value of 23,000 t (Fig. 14). The biomass index has shown considerable annual variability, increasing by a factor of four between 1999 and 2000 and decreasing by a factor of 2.3 between 2000 and 2001; however, the biomass index has declined consistently since 2002. Survey coverage during 1997 was somewhat less than in subsequent years; hence the values for 1997 are for a slightly smaller area.

The abundance index for 2005 was 4.5 million fish, somewhat less than the 2004 value (6.6 million fish). The abundance index is also variable, but has declined consistently since 2001 with the lowest value in 2005 (Fig. 14).

In terms of age composition, the 2005 catch (expressed as mean nos. at age per tow) was comprised of a range of ages from 2 to12 (Table 9). Three and four year old cod (2001 and 2002 year classes) were most abundant, but their numbers were not high relative to catches of those ages in preceding years, notably 1997, 2000, and 2001. Older ages were weakly represented and there were no fish older than age 12. The 1997 and 1998 year classes, though present, were not strongly represented and have declined rapidly in GEAC survey catches over past 3-4 years. Overall, the GEAC survey is showing considerable annual variability, but with a recent declining trend. This is similar to the DFO RV survey that covers a wider area and is conducted in spring. The age composition of the catches from the industry and DFO surveys are in reasonably close agreement, particularly in the most recent years, and both surveys show poorer incoming recruitment and a decline in the numbers of older fish.

RECRUITMENT INDEX

A multiplicative model was used to estimate the relative year class strength produced by the 3Ps spawning stock as indicated from trawl survey indices (mean numbers per tow at age). Following discussion on the appropriate indices to include in attempting to develop a recruitment index, it was decided that it would be inappropriate to include all of the available indices because of the different trends and uncertainty as to whether the available indices were indicative of trends in the stock as a whole or only portions of it. The input data set was restricted to:

i) GEAC mean numbers per tow data,1998-2005, at ages 3 and 4, and

ii) DFO RV mean numbers per tow over 1983-2005, including ages 1-4 from 1996 to 2005 (true Campelen units) but only ages 3 and 4 from 1983 to 1995 (Engels units converted to Campelen equivalents).

On a log-scale the model can be written as follows:

$\log(I_{s,a,y}) = \mu + Y_y + (SA)_{s,a} + \varepsilon_{s,a,y}$,

where:

μ = overall mean
s = survey subscript
a = age subscript
y = year class subscript
I = Index (mean nos. per tow)
Y = year class effect

SA = Survey * Age effect, and
ε = error term.

Estimation of model parameters was conducted using PROC MIXED in SAS/OR software. The input data were weighted (inverse variance) by each survey. Each of the model terms (year-class and survey-age) were significant. Standardized residuals from the model show a trend in the GEAC residuals (not shown); however, this is of limited concern as the GEAC data receive just over 20% of the overall weighting as a result of self-weighting by survey. The estimated least-squares means are plotted in Fig. 15. The results indicate that recruitment has been highly variable and particularly poor during the early to mid-1990's when several consecutive year classes were below the long-term average. The 1997 and 1998 year classes have been much stronger. The 1989 year class does not appear particularly strong in this analysis; however, this cohort has a unique history and experienced little fishing mortality for four consecutive years (at ages 4-7) due to the moratorium from August 1993 until May 1997. This analysis also indicates that many (3 of 4) of the most recent year classes (2000-03) are weak relative to the long-term average.

Some information on the relative strength of recent year-classes is also available from the sentinel line-trawl index. This index covers an inshore portion of the stock area. The age-disaggregated sentinel line trawl index (Table 8) provides evidence that most year classes produced during 2000-02 are weak.

SEQUENTIAL POPULATION ANALYSIS (SPA)

In recent assessments of 3Ps cod, concerns have been raised regarding whether the various indices and commercial catch were detecting cohort signals in the stock. In all of the SPA analyses conducted in recent years, strong year effects were evident in several of the indices, trends differed among indices from different portions of the stock area, and parameter estimates typically had poor precision and large biases. In addition, in previous assessments we were unable to identify a single most appropriate model formulation, and two formulations incorporating different assumptions about fishery selectivity (flat topped and domed) were used to illustrate potential stock dynamics. Both formulations fitted the data poorly and gave widely differing estimates of stock size. These findings could partly be due to lack of consistent cohort signals on the input data; consequently, in the 2006 assessment an approach adopted in ICES (ICES 2003) was used, where some simple correlation analyses were conducted to help determine the extent to which cohort signals were being tracked by each of the indices. Initially, within survey correlation was examined for cohort effects by comparing two successive age groups, repeated for all years. For each index log(I[s,a+1,y+1]) was compared with log(I[s,a,y]), where I=mean numbers per tow, s=survey, a=age, y=year). Correlation plots and r^2 values were examined along with bi-variate plots to check for spurious correlation using the 2005 assessment data. The within-survey analysis (Fig. 16 and 17) showed that the correlations were poor for the Cameron index (r-values often negative or <0.4) and the DFO RV eastern portion (r-values ranging from 0.3 to 0.5), and western (Burgeo) portion (r-values negative for most ages <8 years old, and <0.5 for older ages). The correlations were higher for the GEAC Survey (r-values mostly >0.4) and the sentinel line-trawl and gillnet indices (r-values mostly >0.7). The commercial catch was internally consistent in tracking cohorts with most r-values around 0.8.

Between-survey correlation was also examined (not shown) to determine whether the different surveys were consistent at common age groups. The values of log(I[s1,a,y]) were compared with log(I[s2,a,y]) for each combination of catch or surveys s1 and s2. These correlations also showed highly variable patterns, with low correlations at some and often many ages, in each of the comparisons.

Correlations between the input data and SPA outputs from the last assessment were also examined, by plotting observed and predicted index values from ADAPT-2005 – run E in Brattey et al. (2005). There were odd and inconsistent patterns in the ADAPT SPA observed/predicted index correlations (Fig. 18). Some (Canadian RV and GEAC) were better for the younger ages, poor for middle ages and better for older ages; most showed the highest correlations (r^2-values of 0.6-0.7) among the youngest ages (2-3).

The majority of meeting participants agreed that none of the SPA formulations should be accepted. In previous assessments the model fits have consistently been poor with strong year effects evident in several of the indices, and parameter estimates showing poor precision (large standard errors) and large biases. New information available for this assessment also showed further inconsistency among the indices, with the sentinel line-trawl and gillnet indices showing no trend and the GEAC indicating further decline. Consequently, no SPA was accepted during the 2006 assessment due to continued poor model fit to the available indices. The issue was also complicated by the loss of the 2006 research vessel survey which would normally be an integral component of such an analysis. It was concluded that further progress on a SPA would be unlikely without a comprehensive evaluation of indices and model formulations.

REFERENCES

Bishop, C.A., Baird, J.W., and Murphy, E.F. 1991. An assessment of the cod stock in NAFO Subdivision 3Ps. CAFSAC Res. Doc. 1991/036, 56p.

Bishop, C.A., and Murphy, E.F. 1992. An assessment of the cod stock in NAFO Subdivision 3Ps. CAFSAC Res. Doc. 1992/111, 43p.

Bishop, C.A., Murphy, E.F., and Davis, M.B. 1993. An assessment in 1993 of the cod stock in NAFO Subdivision 3Ps. DFO Atlantic Fisheries Res. Doc. 1993/070, 39p.

1994. An assessment of the cod stock in NAFO Subdivision 3Ps. DFO Atlantic Fisheries Res. Doc. 1994/033, 33p.

Bishop, C.A., Murphy, E.F., and Stansbury, D.E. 1995. Status of the cod stock in NAFO Subdivision 3Ps. DFO Atlantic Fisheries Res. Doc. 1995/031, 21p.

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

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

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

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

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

Brattey, J., Cadigan, N.G., Lilly, G.R., Murphy, E.F., Shelton, P.A., and Stansbury, D.E. 1999a. An assessment of the cod stock in NAFO Subdivision 3Ps. DFO Can. Stock Assess. Sec. Res. Doc. 1999/036.

1999b. An assessment of the cod stock in NAFO Subdivision 3Ps in October 1999. DFO Can Stock Assess. Sec. Res. Doc. 1999/161.

2000. An assessment of the cod stock in NAFO Subdivision 3Ps in October 2000. DFO Can. Stock Assess. Sec. Res. Doc. 2000/134.

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

2002a. An assessment of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in October 2002. DFO Can. Sci. Advis. Sec. Res. Doc. 2002/096.

Brattey, J., Porter, D.R., and George, C.W. 2001b. Stock structure, movements, and exploitation of Atlantic cod (*Gadus morhua*) in NAFO Subdiv. 3Ps based on tagging experiments conducted during 1997-2001. DFO Can. Sci. Advis. Sec. Res. Doc. 2001/072.

Brattey, J., Porter, D.R., and George, C.W.. 2002b. Movements of Atlantic cod (*Gadus morhua*) in NAFO Subdiv. 3Ps and updated estimates of exploitation from tagging experiments in 1997-2002. DFO Can. Sci. Advis. Sec. Res. Doc. 2002/097.

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

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

2005. Assessment of the cod (*Gadus morhua*) stock in NAFO Subdiv. 3Ps in October 2005. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/070.

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

Cadigan, N.G., and Brattey, J. 2006. Reporting and shedding rate estimates from tag-recovery experiments in Atlantic cod (*Gadus morhua*) in coastal Newfoundland. Can. J. Fish. Aquat. Sci. 63: 1944-58.

Colbourne, E. B. and Murphy, E.F.. 2005. Physical oceanographic conditions in NAFO Division 3P during 2005 - possible influences on the distribution and abundance of Atlantic cod (*Gadus morhua*). DFO Can. Sci. Advis. Sec. Res. Doc 2005/065.

DFO. 2005. Stock Assessment on Subdivision 3Ps cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/047.

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

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

ICES, 2003. Evaluation of Research Surveys in relation to Management Advice (EVARES-FISH/2001/02-Lot 1). Final Report to the European Commission Director General Fisheries. 305 p.

Lilly, G. R., Murphy, E.F., Healey, B. P., and Brattey, J. 2006. An assessment of the cod (Gadus morhua) stock in NAFO Divisions 2J3KL in April 2006. DFO Can. Sci. Advis. Sec. Res. Doc. 2006/043.

Maddock-Parsons, D. M., and Stead, P. 2001. Sentinel surveys 1995-2001: catch per unit effort in NAFO Subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2001/133.

2003a. Sentinel surveys 1995-2002: catch per unit effort in NAFO Subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2003/021.

2003b. Sentinel surveys 1995-2003: catch per unit effort in NAFO Subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2003/094.

2004. Sentinel surveys 1995-2004: catch per unit effort in NAFO Subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2004/088.

2005. Sentinel surveys 1995-2005: catch per unit effort in NAFO Subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/073.

2006. Sentinel surveys 1995-2006: catch per unit effort in NAFO Subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2006/094.

McClintock, J. 1999a. Results of surveys directed at Cod in NAFO Division 3Ps. DFO Can. Stock Assess. Sec. Res. Doc. 1999/020.

1999b. Second year results of surveys Directed at Cod in NAFO Division 3Ps. DFO Can. Stock Assess. Sec. Res. Doc. 1999/034.

McClintock, J. 2000. Cod catch results from fall 1999 survey in NAFO Division 3Ps. DFO Can. Stock Assess. Sec. Res. Doc. 2000/024.

Cod catch results 2000: year four of the NAFO Division 3Ps fall GEAC surveys . DFO Can. Sci. Advis. Sec. Res. Doc. 2001/012.

Cod catch results 2001: year five of the NAFO Subdivision 3Ps fall GEAC surveys . DFO Can. Sci. Advis. Sec. Res. Doc. 2002/037.

Cod catch results 2002: year six of the NAFO Subdivision 3Ps fall GEAC surveys . DFO Can. Sci. Advis. Sec. Res. Doc. 2003/097.

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

Pinhorn, A. T. 1969. Fishery and biology of Atlantic Cod (*Gadus morhua*) off the southwest coast of Newfoundland. J. Fish. Res. Bd. Can. 26: 3133-3164.

Shelton, P. A., Stansbury, D.E., Murphy, E.F., Lilly, G.R., and Brattey, J. 1996. An assessment of the cod stock in NAFO Subdivision 3Ps. DFO Atlantic Fisheries Res. Doc. 1996/091.

Stansbury, D. E., Shelton, P.A., J. Brattey, Lilly, G.R., Winters G. R., Murphy, E.F., Davis, M. B., and Kulka, D. W. 1998. An assessment of the cod stock in NAFO Subdivision 3Ps. DFO Can. Stock Assess. Sec. Res. Doc. 1998/019.

Table 1. Reported landings of cod (t) from NAFO Subdivision 3Ps, 1959 - October 2006 by country and for fixed and mobile gear sectors.

	Can. (Newfoundland)		Can. (Mainland)	France			Spain	Portugal	Others	Total	TAC
	Offshore	Inshore		St. Pierre & Michelon		Metro					
Year	(Mobile)	(Fixed)	(All gears)	Inshore	Offshore	(All gears)	(All gears)	(All gears)	(All gears)		
1959	2,726	32,718	4,784	3,078		4,952	7,794	3,647	471	60,170	
1960	1,780	40,059	5,095	3,424	210	2,460	17,223	2,658	4,376	77,285	
1961	2,167	32,506	3,883	3,793	347	11,490	21,015	6,070	5,553	86,824	
1962	1,176	29,888	1,474	2,171	70	4,138	10,289	3,542	2,491	55,239	
1963	1,099	30,447	331	1,112	645	324	10,826	209	6,828	51,821	
1964	2,161	23,897	370	1,002	1,095	2,777	15,216	169	9,880	56,567	
1965	2,459	25,902	1,203	1,863	707	1,781	13,404		4,534	51,853	
1966	5,473	23,785	583	-	3,207	4,607	23,678	519	4,355	66,207	
1967	3,861	26,331	1,259	2,244		3,204	20,851	980	4,044	62,774	
1968	6,538	22,938	585	-	880	1,126	26,868	8	18,613	77,556	
1969	4,269	20,009	849	-	2,477	15	28,141	57	7,982	63,799	
1970	4,650	23,410	2,166	1,307	663	35	35,750	143	8,734	76,858	
1971	8,657	26,651	731	1,196	455	2,730	19,169	81	2,778	62,448	
1972	3,323	19,276	252	990	446	-	18,550	109	1,267	44,213	
1973	3,107	21,349	181	976	189	-	19,952	1,180	5,707	52,641	70,500
1974	3,770	15,999	657	600	348	5,366	14,937	1,246	3,789	46,712	70,000
1975	741	14,332	122	586	189	3,549	12,234	1,350	2,270	35,373	62,400
1976	2,013	20,978	317	722	182	1,501	9,236	177	2,007	37,133	47,500
1977	3,333	23,755	2,171	845	407	1,734	-	-		32,245	32,500
1978	2,082	19,560	700	360	1,614	2,860	-	-	45	27,221	25,000
1979	2,381	23,413	863	495	3,794	2,060	-	-	-	33,006	25,000
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	555	60	-	-	-	-	-	-	641	0
1996	60	707 [2]	118			-	-	-	-	885	0
1997 [1]	122	7,205 [2]	79	448	1,191	-	-	-	-	9,045	10,000
1998 [1]	4,320	11,370 [2]	885	609	2,511	-	-	-	-	19,694	20,000
1999 [1]	3,097	21,231 [2]	614	621	2,548	-	-	-	-	28,111	30,000
2000 [1]	3,436	16,247 [2]	740	870	3,807	-	-	-	-	25,100 [4]	20,000
2001 [1]	2,152	11,187 [2]	856	675	1,675	-	-	-	-	16,546 [4]	15,000
2002 [1]	1,326	11,292 [2]	499	579	1,623	-	-	-	-	14,892 [4]	15,000
2003 [1]	1,869	10,600 [2]	412	734	1,645	-	-	-	-	15,260 [4]	15,000
2004 [1]	1,595	9,450 [2]	790	465	2,113	-	-	-	-	14,414 [4]	15,000
2005 [1]	1,863	9,537 [2]	818	617	1,941	-	-	-	-	14,778 [4]	15,000
2006 [3]	722	6,261	499	0	640	-	-	-	-	8,122 [4]	13,000

[1]Provisional catches

[2] Includes recreational fishery and sentinel fishery.

[3] Catch for Canada and France to 1 October 2006.

[4] TAC's are now set for the period 1 April to 31 March rather than by calender year and the TAC was 20,000 t for 2000-2001, and 15,000 t for subsequent management years, until 2006-2007 when it was reduced to 13,000 t.

Table 2. Reported fixed gear catches of cod (t) from NAFO Subdivision 3Ps by gear type. (Includes non-Canadian and recreational catch)

Year	Gillnet	Longline	Handline	Trap	Total
1975	4,995	4,083	1,364	3,902	14,344
1976	5,983	5,439	2,346	7,224	20,992
1977	3,612	9,940	3,008	7,205	23,765
1978	2,374	11,893	3,130	2,245	19,642
1979	3,955	14,462	3,123	2,030	23,570
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 [1]	3,760	1,158	1,172	1,167	7,258
1998 [1]	10,116	2,914	308	92	13,430
1999 [1]	17,976	3,714	503	45	22,237
2000 [1]	14,218	3,100	186	56	17,561
2001 [1]	7,377	2,833	2,089	57	12,357
2002 [1]	7,827	2,309	775	119	11,030
2003 [1]	8,313	2,044	546	35	10,937
2004 [1]	7,910	2,167	415	15	10,508
2005 [1]	8,112	2,016	626	6	10,760
2006 [2]	4,798	1,243	199	1	6,241

[1] provisional catch

[2] catch to 1 October 2006

Table 3a. Reported monthly landings (t) of cod from the inshore and offshore of NAFO Subdivision 3Ps by gear type during 2005 and 2006 (to 20 September).

2005	Offshore			Inshore					
MONTH	Otter trawl	Gillnet	Line trawl	Gillnet	Line trawl	Handline	Trap	Otter trawl	*Total
Jan	846.9	0.0	20.2	169.9	87.4	0.9	0.0	0.9	1,126.2
Feb	1,582.7	92.3	170.7	88.3	25.4	0.0	0.0	3.1	1,962.5
Mar	332.3	0.0	8.9	0.5	0.1	0.0	0.0	2.0	343.8
Apr	8.4	0.0	13.9	0.2	2.0	0.0	0.0	0.0	24.5
May	0.0	0.0	10.6	201.8	14.1	0.9	0.5	0.0	227.9
Jun	0.0	45.4	11.0	1,354.9	51.2	31.9	0.2	0.0	1,494.6
Jul	0.0	403.0	14.2	1,204.4	106.6	167.8	0.7	0.0	1,896.7
Aug	79.5	824.7	17.5	569.2	325.6	271.1	4.3	8.8	2,100.7
Sep	5.9	575.7	0.2	267.6	209.9	49.9	0.0	0.0	1,109.2
Oct	224.5	310.3	1.6	270.4	322.7	31.0	0.0	0.2	1,160.7
Nov	447.5	617.1	21.8	829.4	388.0	58.2	0.0	0.0	2,362.0
Dec	461.2	40.7	45.5	246.4	146.9	14.2	0.0	8.1	963.0
TOTAL	3,988.9	2,909.2	336.1	5,203.0	1,679.9	625.9	5.7	23.1	14,771.8

*total excludes 3.9 t of landings from other gear types

2006	Offshore			Inshore					
MONTH	Otter trawl	Gillnet	Line trawl	Gillnet	Line trawl	Handline	Trap	Otter trawl	Total
Jan	601.7	0.0	124.9	110.0	117.9	11.3	0.0	7.6	973.4
Feb	733.1	9.7	405.4	36.5	64.2	24.9	0.0	0.8	1,274.6
Mar	51.2	19.0	54.6	4.3	0.3	0.0	0.0	0.0	129.4
Apr	4.9	0.0	11.1	0.6	4.5	0.0	0.0	5.5	26.6
May	4.7	19.8	0.0	374.5	83.5	2.2	0.0	0.0	484.7
Jun	0.0	43.4	3.0	1,321.1	102.2	26.6	1.4	0.2	1,497.9
Jul	4.3	109.1	7.2	1,673.4	95.1	72.7	0.0	0.1	1,961.9
Aug	1.2	192.2	12.9	513.3	261.8	51.6	0.0	64.6	1,097.6
Sep	0.0	102.6	0.4	419.8	127.0	10.0	0.0	12.2	672.0
Oct	.	.	.	.	.	.	.	.	.
Nov	.	.	.	.	.	.	.	.	.
Dec	.	.	.	.	.	.	.	.	.
TOTAL	1,401.1	495.8	619.5	4,453.5	856.5	199.3	1.4	91.0	8,118.1

*total excludes 3.9 t of landings from other gear types

Table 3b. Reported monthly landings (t) of cod from unit areas in NAFO Subdivision 3Ps during 2005 and 2006 (to 20 September).

2005	Inshore			Offshore					
Month	**3Psa**	**3Psb**	**3Psc**	**3Psd**	**3Pse**	**3Psf**	**3Psg**	**3Psh**	***Totals**
Jan	27.7	77.9	153.5	29.4	0.0	0.0	2.7	834.8	1,126.0
Feb	10.9	85.7	20.2	13.2	0.0	4.7	4.4	1,823.4	1,962.5
Mar	2.1	0.0	0.5	56.1	0.0	0.0	13.3	271.8	343.8
Apr	1.0	0.9	0.2	0.0	0.0	0.0	4.1	18.2	24.5
May	50.1	117.7	49.5	2.2	0.0	0.0	0.3	8.1	227.9
Jun	158.9	337.5	941.8	25.6	13.7	9.0	0.6	0.3	1,487.4
Jul	177.0	439.0	863.6	134.3	144.7	114.8	0.0	13.2	1,886.6
Aug	345.2	317.8	516.1	153.5	467.7	169.0	78.8	29.1	2,077.2
Sep	184.1	140.2	203.2	10.7	428.7	94.9	21.5	26.0	1,109.1
Oct	219.5	90.1	314.8	15.4	130.4	338.7	4.0	47.9	1,160.8
Nov	65.4	319.3	894.0	69.8	109.9	736.2	0.0	170.1	2,364.8
Dec	46.9	149.2	219.9	1.6	7.7	454.8	0.1	83.1	963.3
Totals	1,288.9	2,075.3	4,177.2	511.7	1,302.8	1,922.2	129.8	3,326.0	14,733.9

* Excludes 42 t of catch from unknown unit area

2006	Inshore			Offshore					
Month	**3Psa**	**3Psb**	**3Psc**	**3Psd**	**3Pse**	**3Psf**	**3Psg**	**3Psh**	**Totals**
Jan	43.0	109.0	94.7	8.4	0.4	76.7	0.0	641.2	973.4
Feb	25.2	45.3	55.9	33.8	0.0	370.5	0.0	743.9	1,274.5
Mar	0.3	0.0	4.3	0.2	0.0	19.0	1.6	104.0	129.4
Apr	3.2	7.2	0.6	0.7	0.0	0.0	2.8	12.6	27.0
May	100.5	173.6	186.2	15.3	0.6	1.2	0.0	7.4	484.8
Jun	129.8	298.2	1,023.5	2.4	0.0	5.7	2.7	32.6	1,494.9
Jul	149.8	500.9	1,191.0	24.0	31.6	21.4	17.2	23.4	1,959.3
Aug	286.9	168.6	436.0	25.4	23.3	85.9	23.5	37.0	1,086.7
Sep	90.2	241.3	239.9	26.8	13.0	38.0	17.6	7.7	674.4
Oct	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nov	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	829.0	1,544.2	3,232.0	136.9	68.8	618.4	65.3	1,609.9	8,104.4

Table 3c. Reported monthly landings (t) of cod from unit areas in NAFO Subdivision 3Ps during the management year 1 April 2005 to 31 March 2006.

	Inshore			Offshore					
2005	**3Psa**	**3Psb**	**3Psc**	**3Psd**	**3Pse**	**3Psf**	**3Psg**	**3Psh**	**Totals**
Apr	1.0	0.9	0.2	0.0	0.0	0.0	4.1	18.2	24.5
May	50.1	117.7	49.5	2.2	0.0	0.0	0.3	8.1	227.9
Jun	158.9	337.5	941.8	25.6	13.7	9.0	0.6	0.3	1,487.4
Jul	177.0	439.0	863.6	134.3	144.7	114.8	0.0	13.2	1,886.6
Aug	345.2	317.8	516.1	153.5	467.7	169.0	78.8	29.1	2,077.2
Sep	184.1	140.2	203.2	10.7	428.7	94.9	21.5	26.0	1,109.1
Oct	219.5	90.1	314.8	15.4	130.4	338.7	4.0	47.9	1,160.8
Nov	65.4	319.3	894.0	69.8	109.9	736.2	0.0	170.1	2,364.8
Dec	46.9	149.2	219.9	1.6	7.7	454.8	0.1	83.1	963.3
2006									
Jan	43.0	109.0	94.7	8.4	0.4	76.7	0.0	641.2	973.4
Feb	25.2	45.3	55.9	33.8	0.0	370.5	0.0	743.9	1,274.5
Mar	0.3	0.0	4.3	0.2	0.0	19.0	1.6	104.0	129.4
Totals	1316.7	2066.0	4157.9	455.3	1303.2	2383.7	110.9	1885.1	13678.8

Table 4a. Number of cod sampled for length from Canadian and French catches and available to estimate the commercial catch at age for 2005.

Canada and France (SPM)	Number measured									
	Inshore			Offshore						
All Gears	3PA	3PB	3PC	3PD	3PE	3PF	3PG	3PH	3PS	Total
JAN		2,229	1,666	262				1,906		6,063
FEB		747	3					4,899		5,649
MAR	24		59					1,701		1,784
MAY	317	800	1,372							2,489
JUN	1,066	1,120	3,826							6,012
JUL	2,076	1,910	2,540	136	231					6,893
AUG	3,881	743	1,160	482	28	1,465	305	19	205	8,288
SEP	93	626	3,690		775			308		5,492
OCT	542	1,851	136			344		152		3,025
NOV	1,328	8,122	4,127	285	711	231				14,804
DEC			4							4
Total	9,327	18,148	18,583	1,165	1,745	2,040	305	8,985	205	60,503

	Inshore			Offshore						
Gillnets	3PA	3PB	3PC	3PD	3PE	3PF	3PG	3PH	3PS	Total
JAN		1,012	1,620							2,632
FEB		42	1							43
MAR			40							40
MAY	208	757	1,243							2,208
JUN	521	1,120	3,567							5,208
JUL	38	1,390	1,764	136	231					3,559
AUG	355	146	535	482	28	1,465		19	205	3,235
AUG-France							305			305
SEP		6	1,132		775			308		2,221
OCT	67	303	93							463
NOV		3,689	2,232	285	711	231				7,148
Total	1,189	8,465	12,227	903	1,745	1,696	305	327	205	27,062

	Inshore			Offshore						
Linetrawl	3PA	3PB	3PC	3PD	3PE	3PF	3PG	3PH	3PS	Total
JAN		1,217								1,217
FEB		705								705
MAR	24									24
MAY	109	43								152
JUN	545									545
JUL	2,038									2,038
AUG	3,461	283	203							3,947
SEP	93	620	1,884							2,597
OCT	475	1,548	43							2,066
NOV	1,328	4,304	1,617							7,249
Total	8,073	8,720	3,747							20,540

	Inshore			Offshore						
Ottertrawl	3PA	3PB	3PC	3PD	3PE	3PF	3PG	3PH	3PS	Total
JAN				262				250		512
JAN (France)								1,656		1,656
FEB								3,854		3,854
FEB(France)								1,045		1,045
MAR								1,701		1,701
OCT								152		152
OCT(France)						344				344
Total				262		344		8,658		9,264

	Inshore			Offshore						
Handline	3PA	3PB	3PC	3PD	3PE	3PF	3PG	3PH	3PS	Total
MAY			129							129
JUN			179							179
JUL		520	581							1,101
AUG	65	314	203							582
SEP			674							674
NOV		129	123							252
Total	65	963	1,889							2,917

Table 4b. Number of cod sampled for age from Canadian and French catches and available to estimate the commercial catch at age for 2005.

Can.+Fr.	Numbers aged							
All gears	Inshore			Offshore				
Quarter	3PA	3PB	3PC	3PD	3PE	3PF	3PH	Total
1		336	273				1423	2032
2	195	363	361					919
3	1125	469	738	66	126	320	20	2864
4	256	912	816		128	59		2171
Total	1576	2080	2188	66	254	379	1443	7986
Gillnets	Inshore			Offshore				
Quarter	3PA	3PB	3PC	3PD	3PE	3PF	3PH	Total
1		175	273					448
2	195	320	304					819
3	314	404	595	66	126	320	20	1845
4	27	341	337		128	59		892
Total	536	1240	1509	66	254	379	20	4004
Linetrawl	Inshore			Offshore				
Quarter	3PA	3PB	3PC	3PD	3PE	3PF	3PH	Total
1		161						161
2		43						43
3	762	17						779
4	229	571	328					1128
Total	991	792	328					2111
Otter trawl	Inshore			Offshore				
Quarter	3PA	3PB	3PC	3PD	3PE	3PF	3PH	Total
1							967	967
1(France)							456	456
Total								1423
Handline	Inshore			Offshore				
Quarter	3PA	3PB	3PC	3PD	3PE	3PF	3PH	Total
1								
2			57					57
3	49	48	143					240
4			151					151
Total	49	48	351					448

Table 4c. Number of cod sampled for age and length from Canadian and French catches and available to estimate the commercial catch at age for the first quarter of 2006.

Canada and	Number measured									
France (SPM)	Inshore			Offshore						
All gears	3PA	3PB	3PC	3PD	3PE	3PF	3PG	3PH	3PS	Total
JAN		2,281	599					1,106		3,986
FEB	14		24					735		773
MAR	129									129
MAR (France)								4,908		4,908
Total	143	2,281	623					6,749		9,796

	Number measured									
	Inshore			Offshore						
Gillnet	3PA	3PB	3PC	3PD	3PE	3PF	3PG	3PH	3PS	Total
JAN		526	146							672
FEB			20							20
Total		526	166							692

	Number measured									
	Inshore			Offshore						
Linetrawl	3PA	3PB	3PC	3PD	3PE	3PF	3PG	3PH	3PS	Total
JAN		1,755	422							2,177
FEB	14							475		489
MAR	129									129
Total	6,745	2,614	786					475		10,620

	Number measured									
	Inshore			Offshore						
Ottertrawl	3PA	3PB	3PC	3PD	3PE	3PF	3PG	3PH	3PS	Total
JAN								1,106		1,106
JAN(France)								4908		4908
FEB								260		260
MAR								117		117
Total								6,391		6,391

	Number measured									
Sentinel 31/4"	Inshore			Offshore						
gillnet	3PA	3PB	3PC	3PD	3PE	3PF	3PG	3PH	3PS	Total
JAN			31							31
FEB			4							4
MAR			189							189
Total			786							786

1st quarter	Number aged									
2006	Inshore			Offshore						
Gear	3PA	3PB	3PC	3PD	3PE	3PF	3PG	3PH	3PS	Total
Gillnet			51							51
Linetrawl		87	67					216		370
Ottertrawl									256	256
Ottertrawl(France)									525	117
Total		87	118					216	373	794

Table 5a. Estimates of average weight (kg), length (cm), and numbers-at-age (000's) for Canadian landings together with French catch and the resulting total catch numbers-at-age for cod in 3Ps during 2005.

	Total Canadian						Canada+ France
	AVERAGE			CATCH			Total
AGE	WEIGHT (kg.)	LENGTH (cm.)	SOP	NUMBER (000'S)	STD ERR.	CV	NUMBER (000'S)
1	0.00	0.00	0.00	0	0.00		0
2	0.34	34.13	0.20	1	0.29		1
3	0.64	41.52	31.06	49	4.20	0.09	49
4	0.94	47.28	309.40	328	11.16	0.03	330
5	1.39	53.41	685.03	494	15.47	0.03	515
6	1.84	58.69	1634.46	888	21.14	0.02	1007
7	2.46	64.12	3242.59	1319	25.50	0.02	1628
8	2.90	67.53	2856.45	983	22.13	0.02	1087
9	3.16	69.30	1508.84	477	16.87	0.04	499
10	3.25	69.59	412.99	127	6.77	0.05	143
11	4.36	75.33	339.77	78	5.68	0.07	95
12	6.15	84.97	217.20	35	3.64	0.10	41
13	5.53	81.78	114.34	21	2.19	0.11	26
14	7.85	91.95	45.96	6	0.78	0.13	12
15	12.14	107.85	152.95	13	1.32	0.10	16
16	13.67	112.86	167.44	12	1.28	0.10	13
17	12.49	109.90	19.84	2	0.52		2
18	17.93	124.00	1.49	0	0.05	0.56	0
19	14.91	116.09	3.07	0	0.10		0
20	0.00	0.00	0.00	0	0.00		0
21	0.00	0.00	0.00	0	0.00		0
22	19.31	127.00	0.49	0	0.00		0
23	0.00	0.00	0.00	0	0.00		0
24	0.00	0.00	0.00	0	0.00		0
25	0.00	0.00	0.00	0	0.00		0

Table 5b. Estimates of average weight (kg), length (cm), and numbers-at-age (000's) for Canadian landings together with French catch and the resulting total catch numbers-at-age for cod in 3Ps during January-March 2006.

	Total Canadian						Canada and France
	AVERAGE			CATCH			Total
AGE	WEIGHT (kg.)	LENGTH (cm.)	SOP	NUMBER (000'S)	STD ERR.	CV	NUMBER (000'S)
1	0.00	0.00	0.00	0	0.00		0
2	0.00	0.00	0.00	0	0.00		0
3	0.00	0.00	0.00	0	0.00		0
4	0.74	44.06	1.68	2	0.76	0.33	4
5	1.22	51.09	57.59	47	4.41	0.09	61
6	1.44	53.72	96.86	67	5.39	0.08	96
7	1.93	59.26	162.16	84	6.59	0.08	135
8	3.36	70.96	421.77	125	6.63	0.05	158
9	3.67	72.84	468.01	128	6.74	0.05	141
10	3.57	72.10	118.92	33	3.76	0.11	35
11	3.66	71.18	42.29	12	2.06	0.18	15
12	6.00	82.20	36.72	6	1.35	0.22	8
13	9.82	99.68	33.52	3	0.81	0.24	5
14	11.93	108.47	6.04	1	0.26	0.51	2
15	12.69	109.97	23.00	2	0.50	0.28	2
16	11.04	104.11	62.38	6	1.19	0.21	6
17	15.93	119.03	118.52	7	0.84		7
18	0.00	0.00	0.00	0	0.00		0
19	20.75	130.00	3.65	0	0.15		0
20	17.93	124.00	4.76	0	0.19		0
21	0.00	0.00	0.00	0	0.00		0
22	0.00	0.00	0.00	0	0.00		0
23	0.00	0.00	0.00	0	0.00		0
24	0.00	0.00	0.00	0	0.00		0
25	0.00	0.00	0.00	0	0.00		0

Table 6. Catch numbers-at-age (000s) for the commercial cod fishery in NAFO Subdivision 3Ps from 1959 to 31 March 2006. (the 1989, 1997 and 1998 cohorts are shaded).

Year/Age	3	4	5	6	7	8	9	10	11	12	13	14
1959	1,001	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	1,245	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	1,906	5,785	5,635	5,179	2,945	1,881	1,891	652	339	329	54	27
1965	2,314	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	2,871	10,913	12,900	6,392	2,349	1,364	604	316	380	95	149	3
1968	1,143	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	2,884	6,444	8,574	7,266	8,218	3,131	1,275	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	1,887	6,042	9,987	6,365	2,540	1,857	1,149	538	249	80	32	17
1975	1,840	7,329	5,397	4,541	5,867	723	1,196	105	174	52	6	2
1976	4,110	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	1,022	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	1,071	8,995	7,842	2,863	2,549	1,112	600	223	141	57	29	26
1990	2,006	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	1,422	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	1007	1628	1087	499	143	95	41	26	12
2006*	0	4	61	96	135	158	141	35	15	8	5	2

* January-March 2006 only

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) in Subdivision 3Ps in 1959-2005. The weights-at-age from 1976 are extrapolated back to 1959. The 2006 values are geometric means of the 2003-05 values.

	3	4	5	6	7	8	9	10	11	12	13	14
1959	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1960	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1961	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1962	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1963	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1964	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1965	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1966	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1967	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1968	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1969	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1970	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1971	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1972	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1973	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1974	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1975	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1976	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1977	0.55	0.68	1.30	1.86	2.67	3.42	4.19	4.94	5.92	6.76	8.78	10.90
1978	0.45	0.70	1.08	1.75	2.45	2.99	4.10	5.16	5.17	7.20	7.75	8.72
1979	0.41	0.65	1.01	1.65	2.55	3.68	4.30	6.49	7.00	8.20	9.53	10.84
1980	0.52	0.72	1.13	1.66	2.48	3.60	5.40	6.95	7.29	8.64	9.33	9.58
1981	0.48	0.79	1.32	1.80	2.30	3.27	4.36	5.68	7.41	9.04	8.39	9.56
1982	0.45	0.77	1.17	1.78	2.36	2.88	3.91	5.28	6.18	8.62	8.64	11.41
1983	0.58	0.84	1.33	1.99	2.58	3.26	3.77	5.04	6.56	8.45	10.06	11.82
1984	0.66	1.04	1.40	1.97	2.64	3.77	4.75	5.56	6.01	9.04	11.20	10.40
1985	0.63	0.85	1.23	1.79	2.81	3.44	5.02	6.01	6.11	7.18	9.81	10.48
1986	0.54	0.75	1.18	1.84	2.43	3.15	4.30	5.50	6.19	8.72	8.05	11.91
1987	0.56	0.77	1.21	1.63	2.31	3.02	4.33	5.11	6.20	6.98	7.08	8.34
1988	0.63	0.82	1.09	1.67	2.17	2.92	3.58	4.98	5.61	6.60	7.46	8.92
1989	0.63	0.81	1.16	1.63	2.25	3.37	4.11	5.18	6.29	7.30	7.75	8.73
1990	0.58	0.86	1.27	1.85	2.45	3.00	4.22	5.09	6.35	7.60	8.31	10.37
1991	0.60	0.75	1.17	1.74	2.37	2.91	3.69	4.23	6.34	7.68	8.64	9.72
1992	0.46	0.69	1.04	1.56	2.23	2.89	4.14	5.54	6.42	7.82	10.40	11.88
1993	0.36	0.68	1.08	1.48	2.13	2.82	4.34	4.30	4.68	7.49	6.85	8.24
1994	0.62	0.82	1.30	1.86	2.05	2.75	3.59	4.38	6.29	7.77	6.78	8.07
1995	0.52	0.85	1.57	2.03	2.47	2.78	3.46	4.30	4.27	4.16	5.59	9.24
1996	0.67	0.98	1.48	2.05	2.53	2.94	3.23	4.03	4.82	4.68	7.26	9.92
1997	0.62	0.90	1.30	1.87	2.51	3.24	3.47	3.52	4.59	6.37	8.58	10.73
1998	0.62	1.02	1.57	2.05	2.42	3.10	4.04	4.13	4.62	5.21	6.39	9.69
1999	0.70	0.92	1.57	2.31	2.53	2.82	3.92	5.32	4.99	5.27	6.14	7.27
2000	0.62	0.90	1.36	2.07	2.74	2.81	3.15	4.60	6.54	6.12	6.42	7.73
2001	0.69	1.02	1.44	1.94	2.57	3.41	3.21	3.46	5.59	8.61	7.61	8.11
2002	0.57	1.02	1.54	2.04	2.32	3.10	4.33	3.90	3.87	6.05	8.89	7.94
2003	0.68	0.97	1.57	2.11	2.34	2.63	3.87	4.75	4.30	5.33	7.82	10.35
2004	0.59	0.96	1.37	2.04	2.49	2.74	2.85	5.02	6.71	5.25	7.13	8.79
2005	0.64	0.94	1.39	1.84	2.46	2.90	3.16	3.25	4.36	6.15	5.53	7.85
2006	0.63	0.96	1.44	1.99	2.43	2.76	3.27	4.26	5.01	5.56	6.75	8.94

Table 7b. Beginning of the year weights-at-age calculated from commercial annual mean weights-at-age, as described in Lilly (MS 1998). The values for 1976 are extrapolated back to 1959. The values for 2006 are geometric means of the 2003-05 values.

Year/age	3	4	5	6	7	8	9	10	11	12	13	14
1959	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1960	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1961	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1962	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1963	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1964	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1965	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1966	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1967	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1968	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1969	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1970	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1971	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1972	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1973	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1974	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1975	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1976	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1977	0.49	0.44	0.95	1.42	2.12	2.86	3.67	4.50	5.48	6.38	7.84	9.37
1978	0.37	0.62	0.86	1.51	2.13	2.83	3.74	4.65	5.05	6.53	7.24	8.75
1979	0.31	0.54	0.84	1.33	2.11	3.00	3.59	5.16	6.01	6.51	8.28	9.17
1980	0.42	0.54	0.86	1.29	2.02	3.03	4.46	5.47	6.88	7.78	8.75	9.55
1981	0.38	0.64	0.97	1.43	1.95	2.85	3.96	5.54	7.18	8.12	8.51	9.44
1982	0.33	0.61	0.96	1.53	2.06	2.57	3.58	4.80	5.92	7.99	8.84	9.78
1983	0.43	0.61	1.01	1.53	2.14	2.77	3.30	4.44	5.89	7.23	9.31	10.11
1984	0.58	0.78	1.08	1.62	2.29	3.12	3.94	4.58	5.50	7.70	9.73	10.23
1985	0.58	0.75	1.13	1.58	2.35	3.01	4.35	5.34	5.83	6.57	9.42	10.83
1986	0.45	0.69	1.00	1.50	2.09	2.98	3.85	5.25	6.10	7.30	7.60	10.81
1987	0.46	0.64	0.95	1.39	2.06	2.71	3.69	4.69	5.84	6.57	7.86	8.19
1988	0.56	0.68	0.92	1.42	1.88	2.60	3.29	4.64	5.35	6.40	7.22	7.95
1989	0.54	0.71	0.98	1.33	1.94	2.70	3.46	4.31	5.60	6.40	7.15	8.07
1990	0.51	0.74	1.01	1.46	2.00	2.60	3.77	4.57	5.74	6.91	7.79	8.96
1991	0.56	0.66	1.00	1.49	2.09	2.67	3.33	4.22	5.68	6.98	8.10	8.99
1992	0.38	0.65	0.88	1.35	1.97	2.62	3.47	4.52	5.21	7.04	8.94	10.13
1993	0.23	0.56	0.86	1.24	1.82	2.51	3.54	4.22	5.09	6.94	7.32	9.25
1994	0.53	0.54	0.94	1.42	1.74	2.42	3.19	4.36	5.20	6.03	7.13	7.43
1995	0.38	0.72	1.13	1.63	2.14	2.39	3.08	3.93	4.32	5.12	6.59	7.88
1996	0.58	0.72	1.12	1.79	2.26	2.70	3.00	3.73	4.55	4.47	5.49	7.45
1997	0.48	0.78	1.13	1.67	2.27	2.86	3.20	3.37	4.30	5.54	6.34	8.83
1998	0.51	0.79	1.19	1.64	2.13	2.79	3.62	3.79	4.03	4.89	6.38	9.12
1999	0.62	0.76	1.26	1.91	2.28	2.61	3.49	4.64	4.54	4.93	5.65	6.81
2000	0.48	0.79	1.12	1.80	2.52	2.67	2.98	4.25	5.90	5.53	5.82	6.89
2001	0.58	0.79	1.14	1.62	2.31	3.06	3.00	3.30	5.07	7.50	6.83	7.22
2002	0.44	0.84	1.25	1.71	2.12	2.83	3.84	3.53	3.66	5.82	8.75	7.77
2003	0.49	0.75	1.27	1.81	2.19	2.47	3.46	4.53	4.09	4.54	6.88	9.59
2004	0.52	0.81	1.15	1.79	2.29	2.53	2.74	4.41	5.64	4.75	6.16	8.29
2005	0.49	0.74	1.16	1.59	2.24	2.69	2.94	3.04	4.68	6.42	5.38	7.48
2006	0.50	0.77	1.19	1.72	2.24	2.56	3.03	3.93	4.76	5.18	6.11	8.41

Table 8. Standardized gillnet (5.5 in mesh) and line-trawl annual catch rate-at-age indices estimated using data from sentinel fishery fixed sites. Catch rates are fish per net for gill nets and fish per 1000 hooks for line-trawl. The 1997 and 1998 cohorts are shaded.

Gill net	Age								
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Totals**
1995	0.03	0.11	4.91	10.35	6.03	2.90	0.39	0.14	23.85
1996	0.02	0.26	2.57	11.90	9.84	2.84	0.84	0.07	28.22
1997	0.01	0.25	5.66	5.26	8.84	7.91	0.97	0.70	28.66
1998	0.00	0.05	0.91	6.26	3.03	2.22	1.40	0.32	13.68
1999	0.06	0.08	0.56	0.92	1.46	0.65	0.31	0.30	5.41
2000	0.01	0.03	0.29	0.68	0.66	0.88	0.29	0.10	2.91
2001	0.03	0.17	0.40	0.82	0.63	0.34	0.31	0.13	2.81
2002	0.01	0.04	0.56	0.93	0.89	0.38	0.18	0.20	3.15
2003	0.02	0.06	0.22	0.92	0.43	0.15	0.07	0.03	1.90
2004	0.00	0.06	0.20	0.79	0.81	0.34	0.10	0.02	2.32
2005	0.00	0.03	0.14	0.58	0.67	0.36	0.25	0.02	2.03
Linetrawl	**Age**								
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Totals**
1995	10.43	19.54	62.75	87.25	22.77	17.28	3.70	1.80	225.52
1996	9.31	33.52	31.70	50.44	51.84	14.46	8.03	1.88	201.19
1997	6.45	27.13	27.00	18.06	16.97	23.99	2.35	1.79	123.74
1998	8.81	19.59	22.72	17.80	6.61	9.93	11.71	2.11	99.29
1999	5.88	16.21	20.87	14.99	7.09	5.47	4.05	1.62	76.17
2000	16.17	34.84	32.60	21.45	9.41	8.16	2.69	1.14	126.45
2001	19.84	30.27	21.45	12.06	7.05	4.33	2.43	0.77	98.21
2002	14.24	29.71	26.92	9.41	5.80	2.00	1.11	0.87	90.07
2003	2.74	33.54	35.32	17.94	7.78	3.24	1.15	0.65	102.35
2004	9.89	10.32	36.34	19.78	10.07	3.31	1.58	0.45	91.73
2005	7.82	20.20	13.48	13.07	12.25	4.80	2.20	0.82	74.65

Table 9. Mean numbers per tow at age for the fall industry (GEAC) trawl survey of the offshore portion of NAFO Subdivision 3Ps. The 1997 and 1998 cohorts are highlighted (shaded cells).

Age/Year	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	0.00	0.01	0.00	0.00	0.03	0.00	0.00	0.00	0.00
2	0.29	0.06	0.34	1.64	0.21	0.00	0.22	0.08	0.05
3	3.28	0.40	1.14	7.24	12.47	1.26	0.41	0.68	1.74
4	9.42	1.76	1.71	2.86	26.74	16.88	2.46	0.80	1.15
5	13.62	2.32	2.83	3.35	3.75	18.47	8.34	1.07	0.43
6	3.02	1.81	3.58	5.18	2.14	2.90	9.28	2.98	0.31
7	10.03	0.35	3.27	5.89	1.62	1.39	1.32	1.18	0.74
8	11.97	1.64	0.51	3.99	1.34	1.18	0.73	0.15	0.50
9	1.34	3.40	1.43	1.14	0.96	0.91	1.32	0.12	0.08
10	0.54	0.40	1.36	5.83	0.10	0.46	0.48	0.18	0.04
11	0.24	0.04	0.17	7.14	0.44	0.09	0.24	0.13	0.09
12	0.04	0.13	0.10	0.79	0.58	0.27	0.00	0.05	0.04
13	0.00	0.22	0.02	0.11	0.08	0.30	0.16	0.00	0.00
14	0.00	0.00	0.00	0.17	0.05	0.00	0.15	0.13	0.00
15	0.00	0.04	0.00	0.00	0.03	0.00	0.03	0.06	0.00
Totals	53.79	12.58	16.46	45.33	50.54	44.11	25.14	7.61	5.17

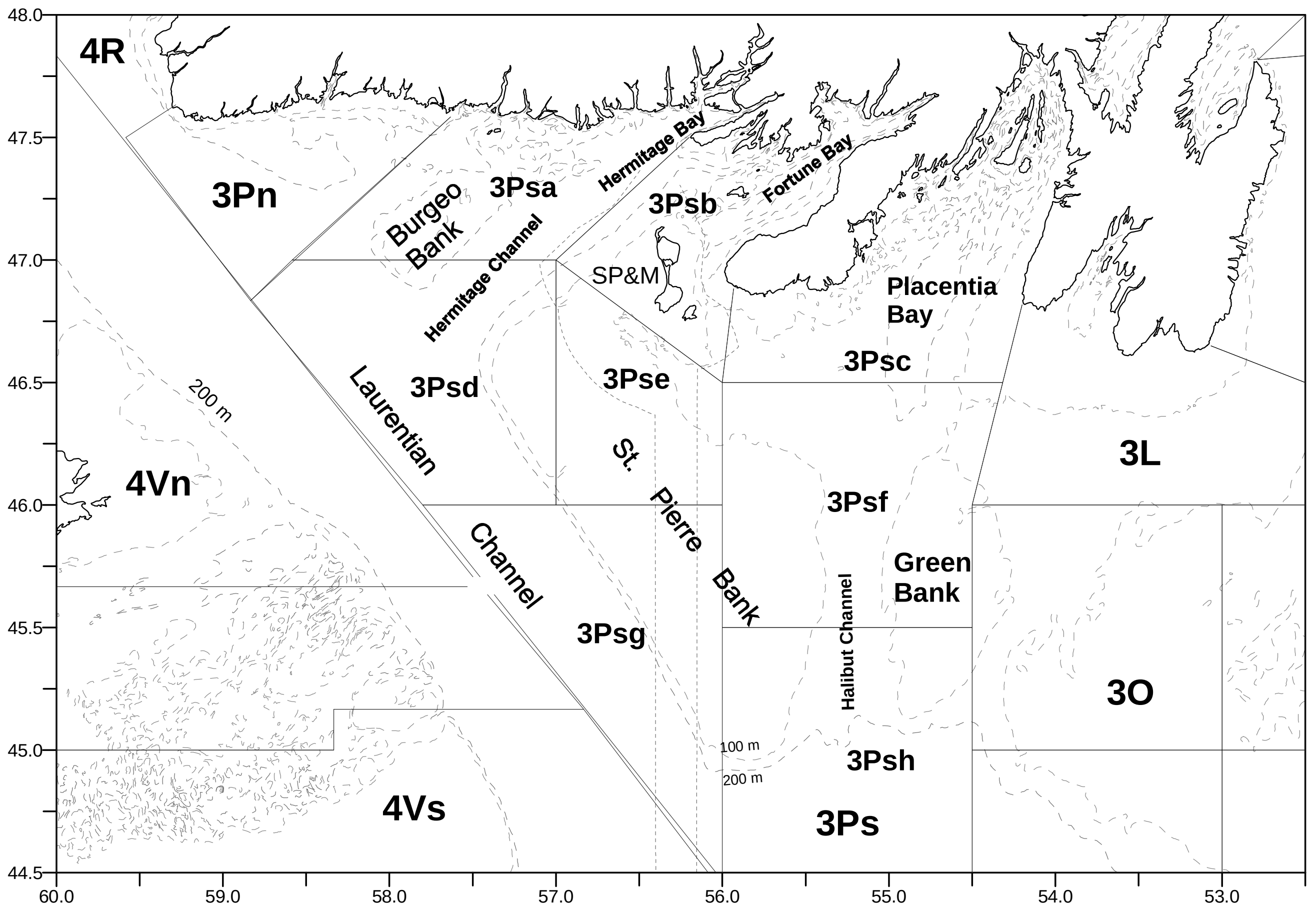


Figure 1. NAFO Subdivision 3Ps management unit showing French economic zone (fine dashed line), boundaries of statistical unit areas, 100 m and 200 m depth contours, and main fishing areas and banks.

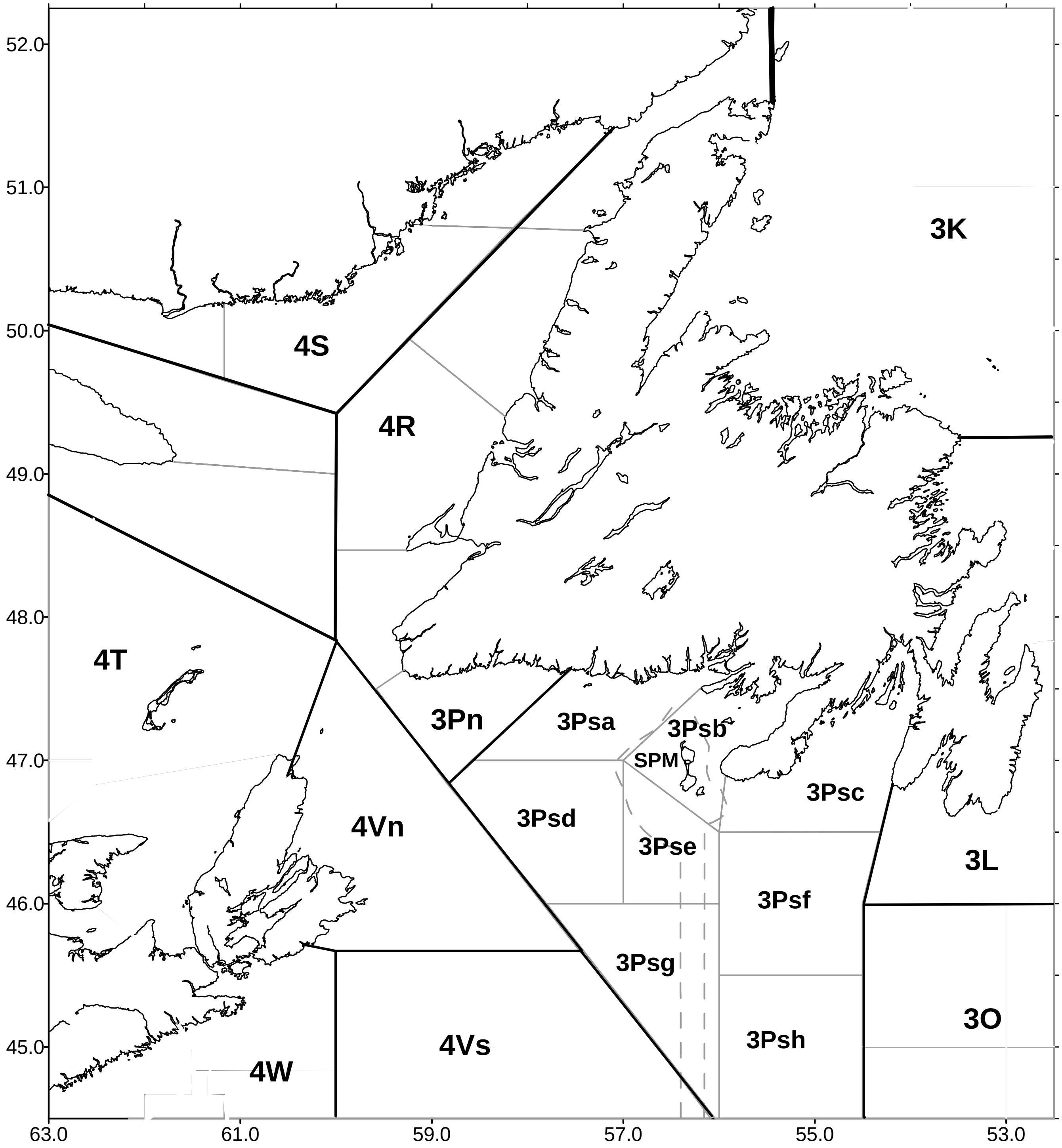


Figure 2. Boundaries of NAFO divisions and statistical units in NAFO Subdivision 3Ps off the south coast of insular Newfoundland. The dashed line is the boundary of the economic zone surrounding the French Islands of St. Pierre and Miquelon (SPM).

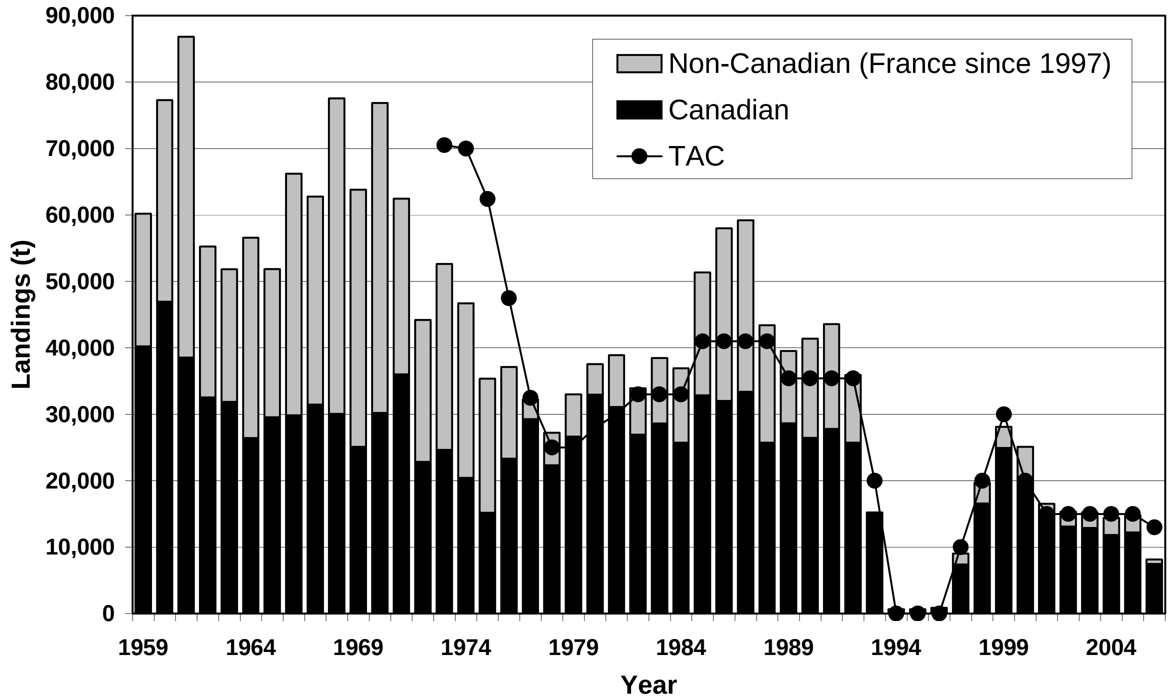


Figure 3a. Reported landings of cod by Canadian and non-Canadian vessels in NAFO Subdivision 3Ps during 1959 - 1 October 2006.

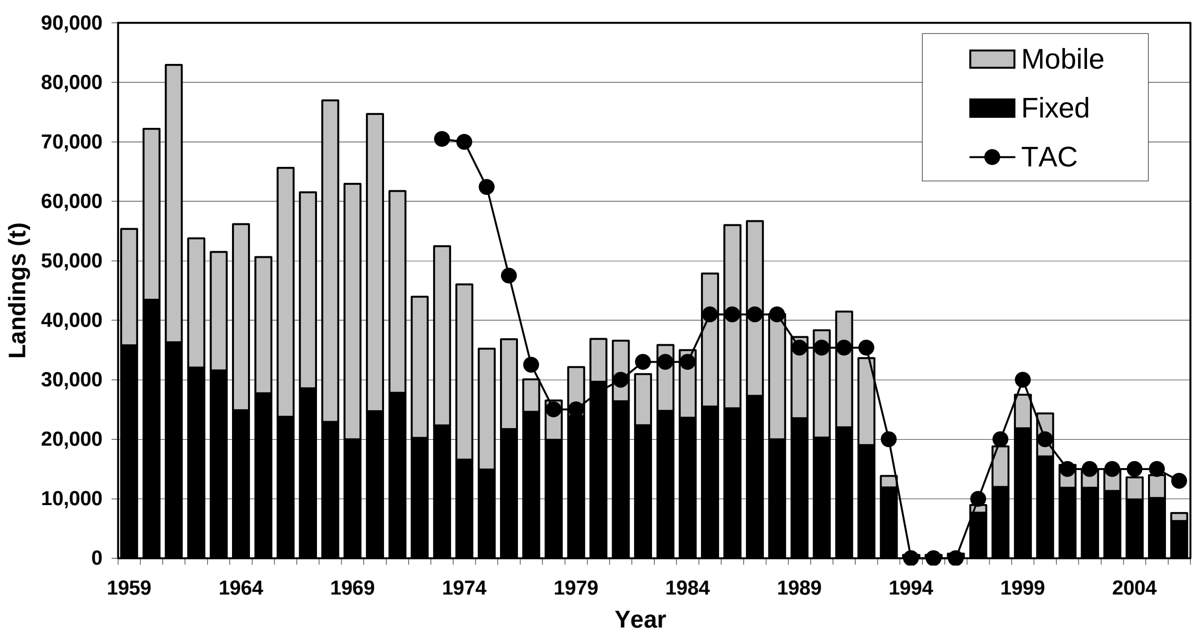


Figure 3b. Reported landings of cod by fixed and mobile gear vessels in NAFO Subdivision 3Ps during 1959 until 1 October 2006.

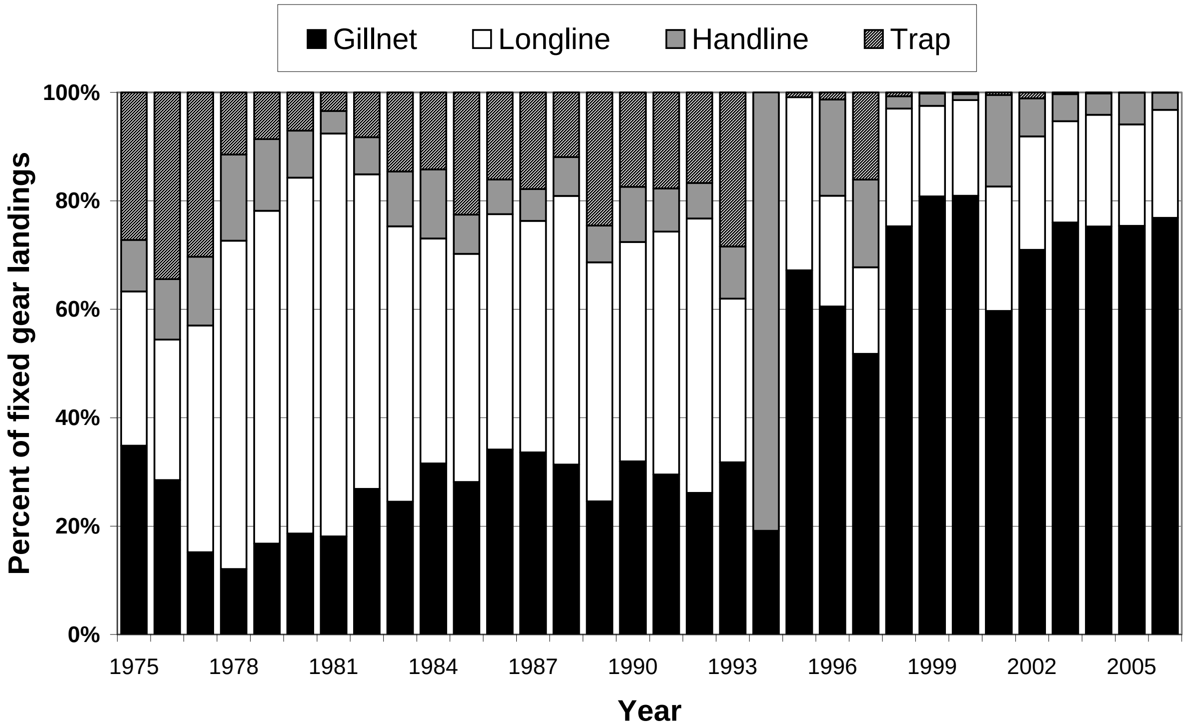


Figure 4. Percent of total fixed gear landings by the four main fixed gears used in the cod fishery in NAFO Subdivision 3Ps during 1975 - 1 October 2006. The fishery was under a moratorium during 1994-1996 and values for those years are based on sentinel and by-catch landings of <900 t. The values for 2006 are based on fixed gear landings to 1 October (about 6,241 t) as the fishery was still in progress.

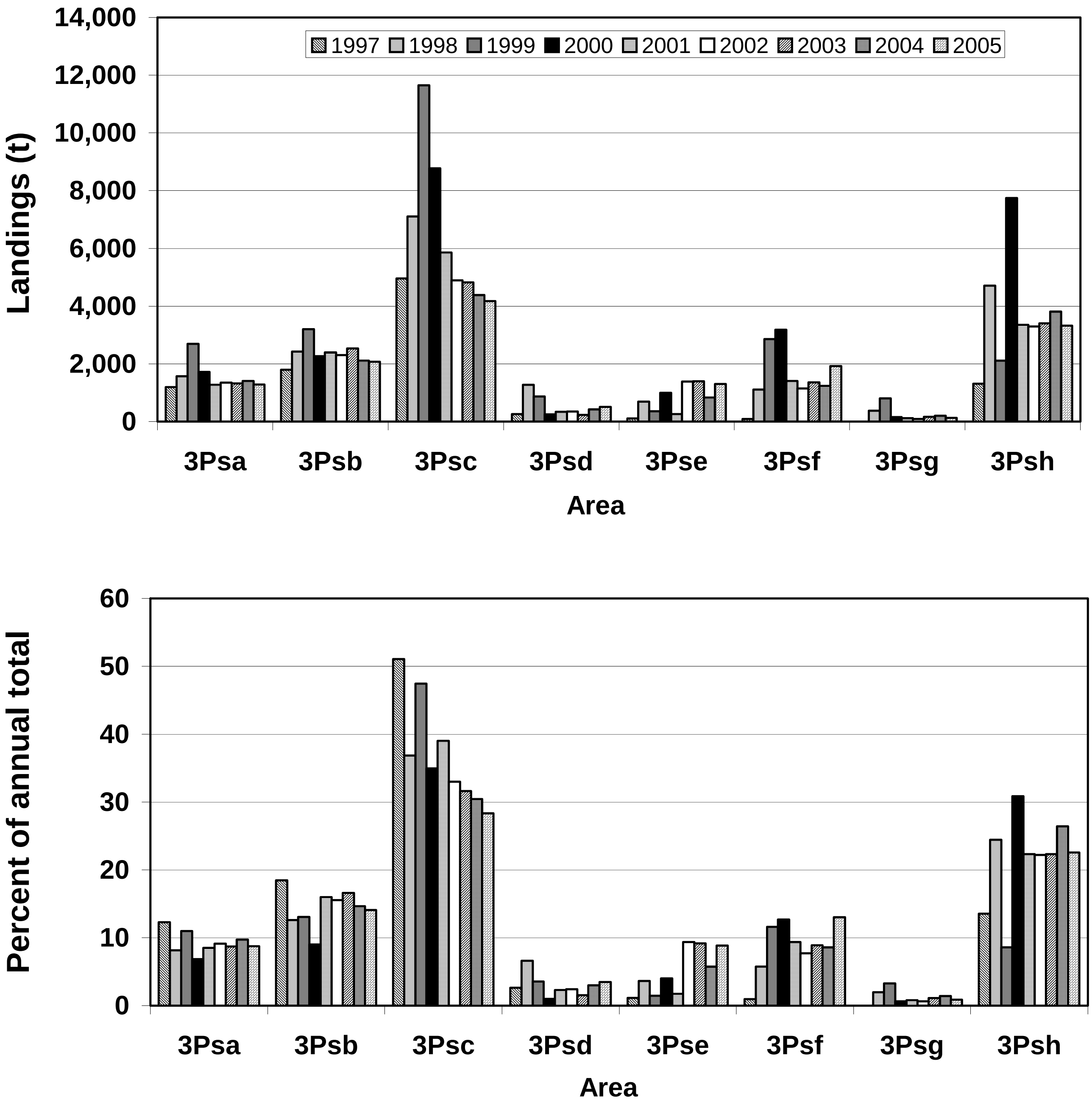


Figure 5. Annual reported landings of cod by unit area from NAFO Subdivision 3Ps during 1997-2005.

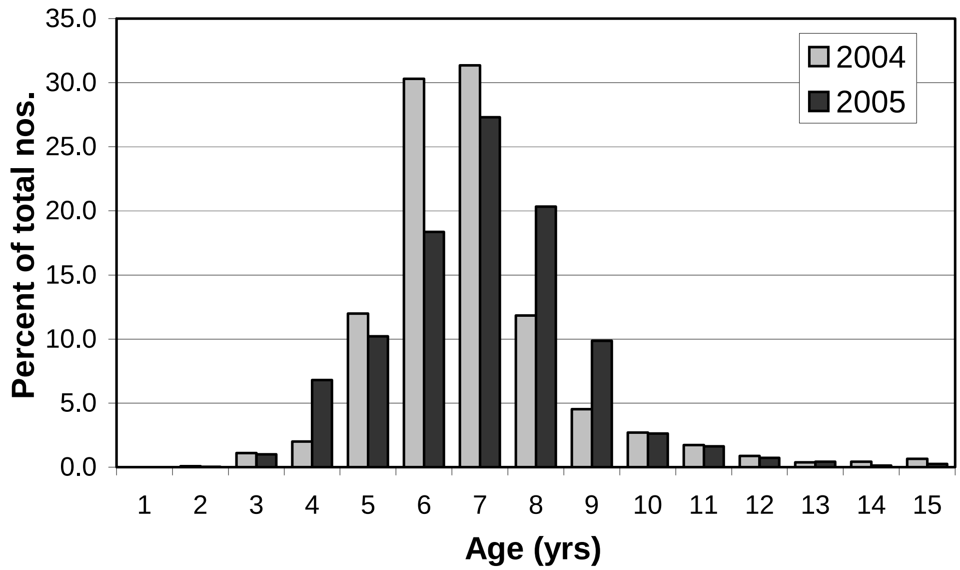


Fig. 6a. Catch-at-age (percents) for the commercial cod fishery in NAFO Subdiv. 3Ps. Comparison of 2004 with 2005.

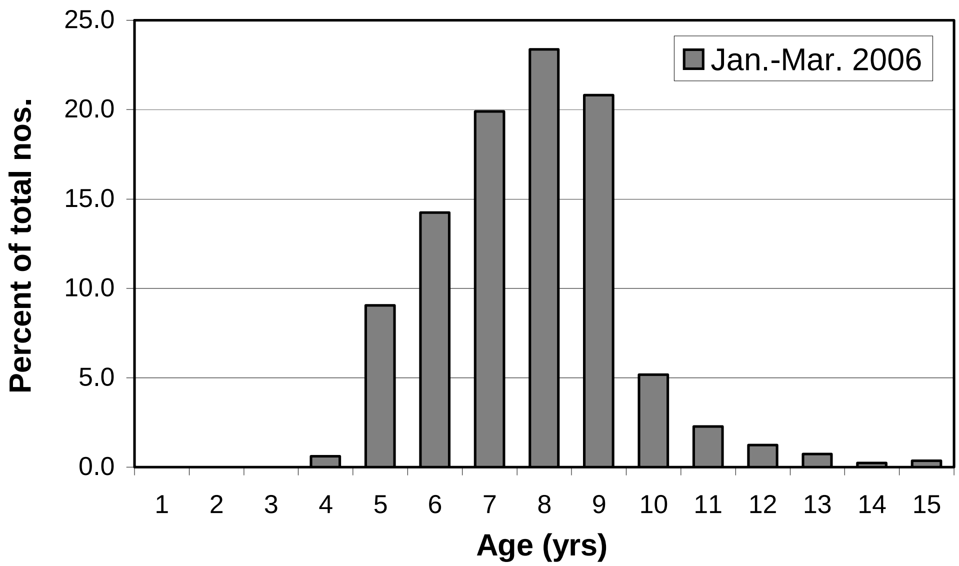


Fig. 6b. Catch-at-age (percents) for the commercial cod fishery in NAFO Subdiv. 3Ps during January-March 2006.

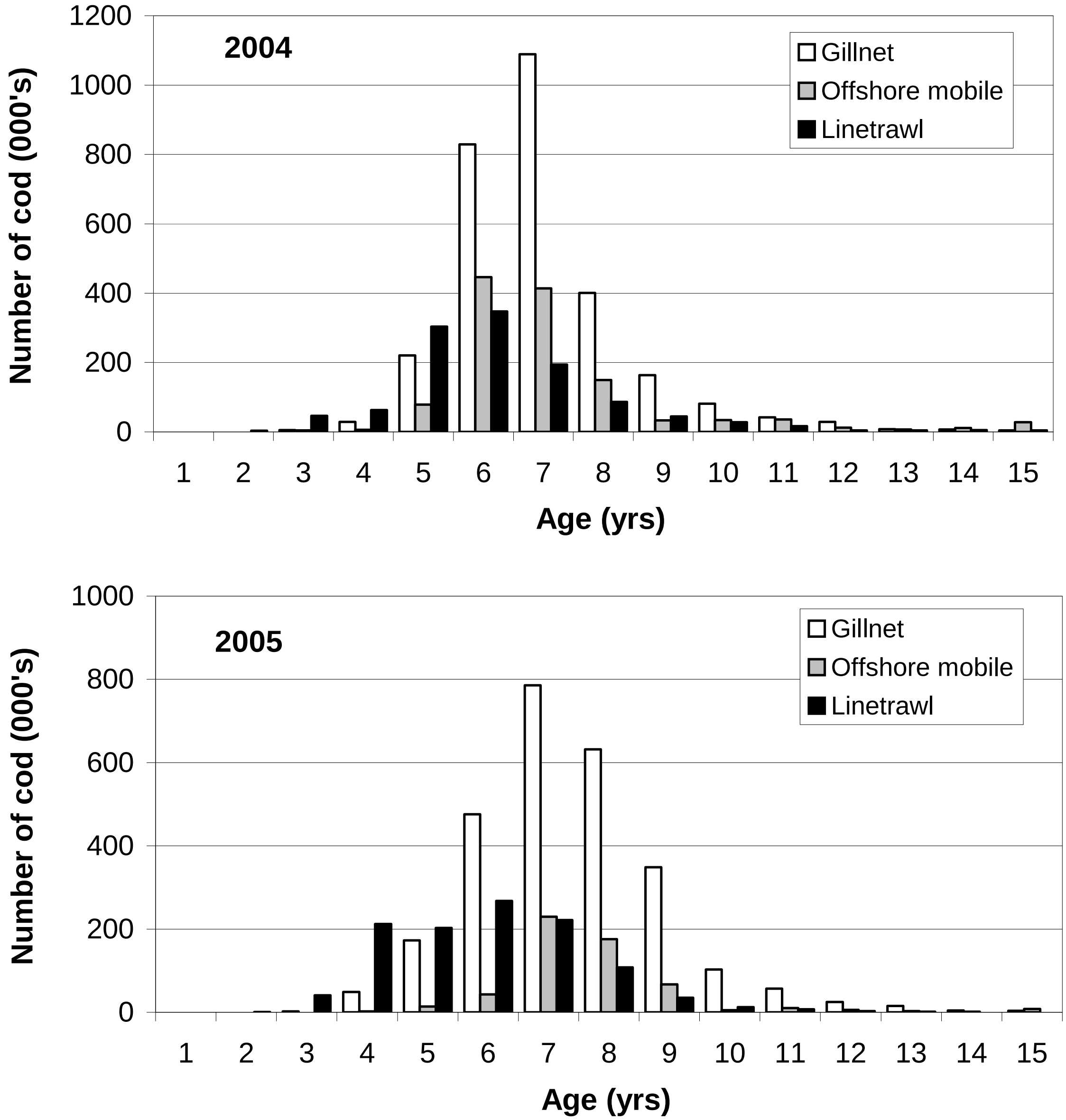


Figure 7. Catch numbers-at-age for the main gear types used in the cod fishery in NAFO Subdivision 3Ps during 2004 with 2005.

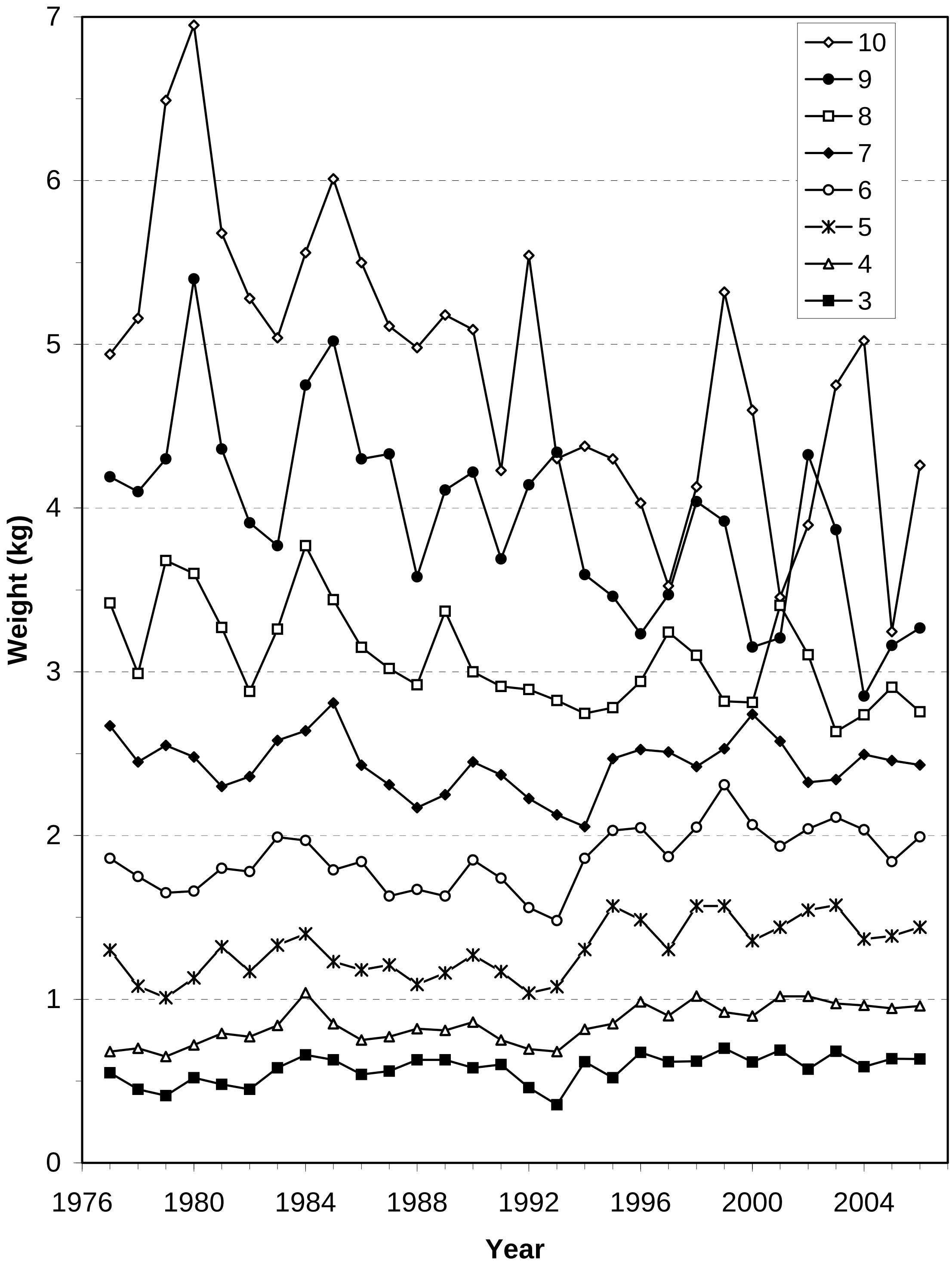


Figure 8a. Mean weights-at-age calculated from mean lengths-at-age for the commercial catch of cod in NAFO Subdivision 3Ps during 1977-2006.

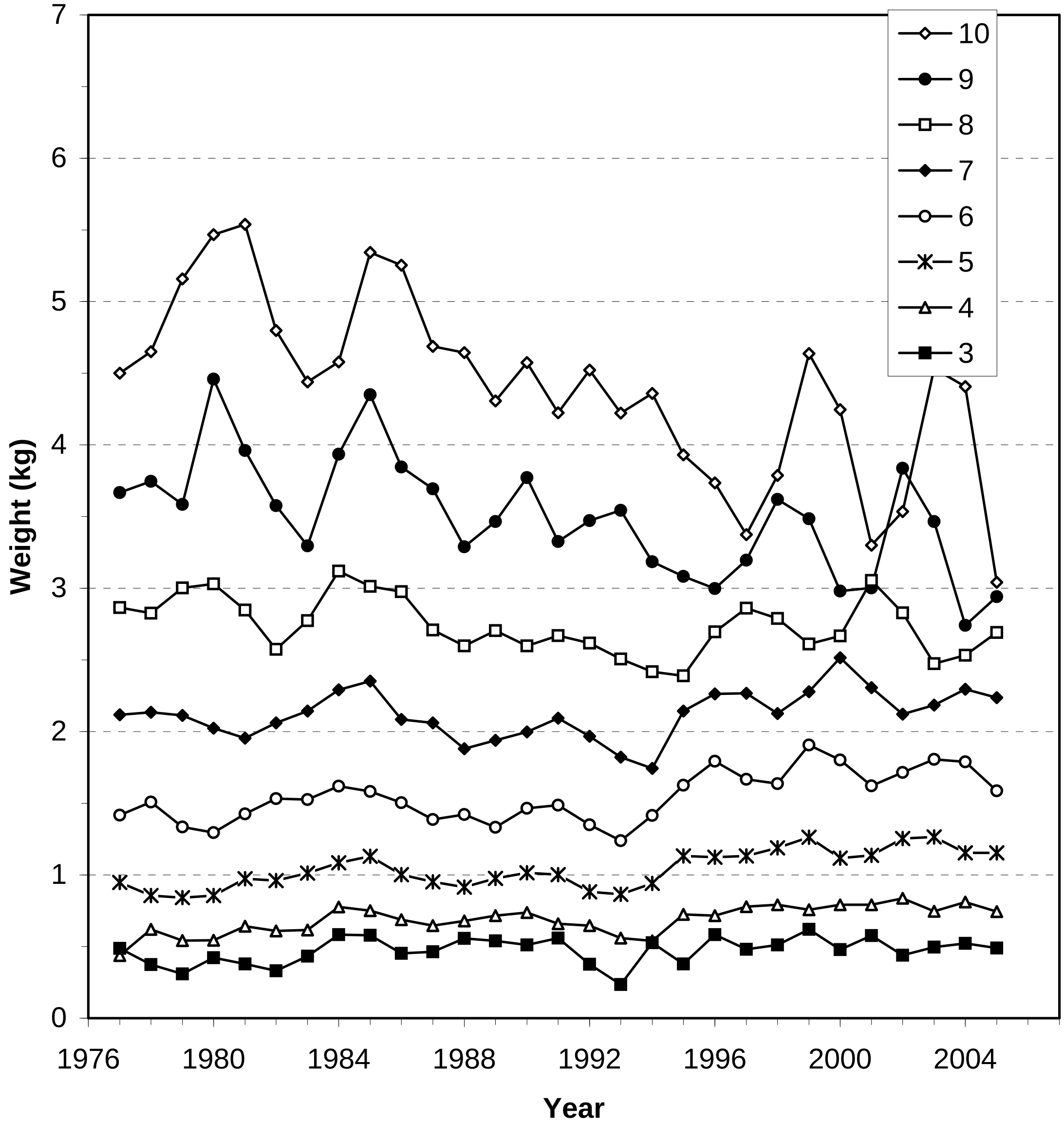


Figure 8b. Beginning of year mean weights-at-age (3-10) from the commercial catch of cod in NAFO Subdivision 3Ps during 1977-2005.

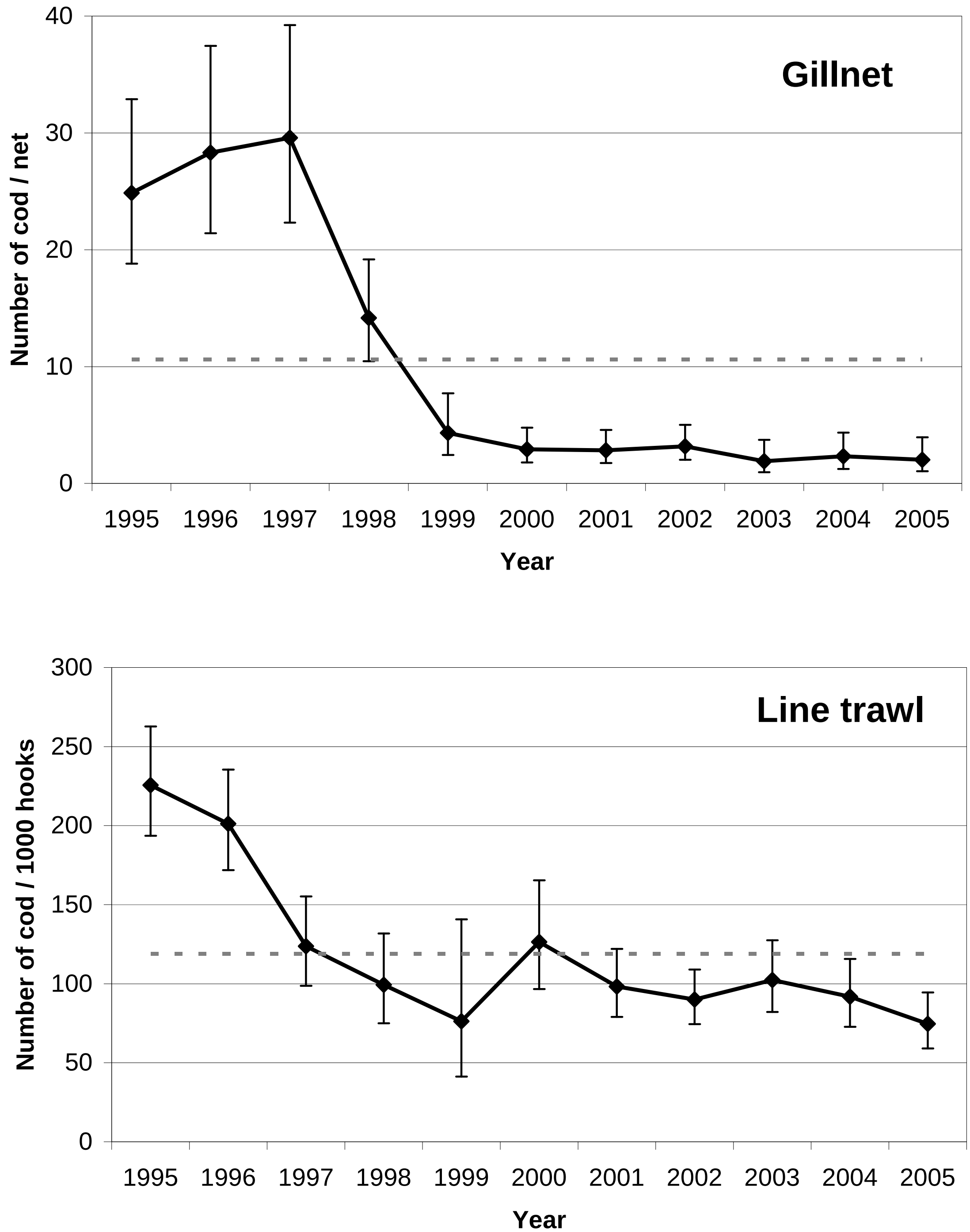
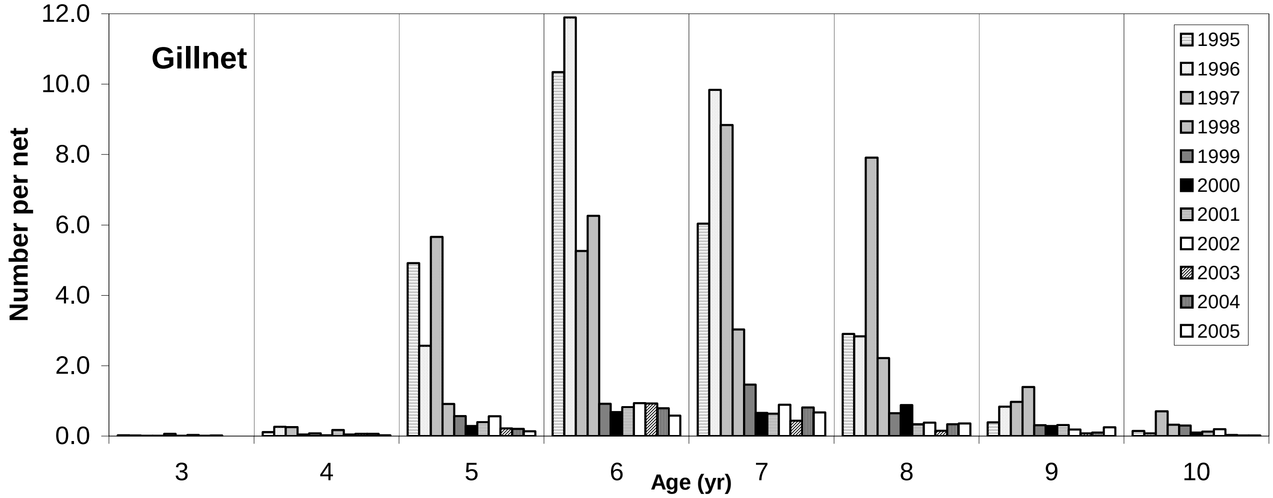


Figure 9a. Standardized age-aggregated catch rate indices for gillnets (5.5" mesh) and line-trawls (with 95% CL's) estimated using data from sentinel fishery fixed sites. The dashed line is the long-term average.



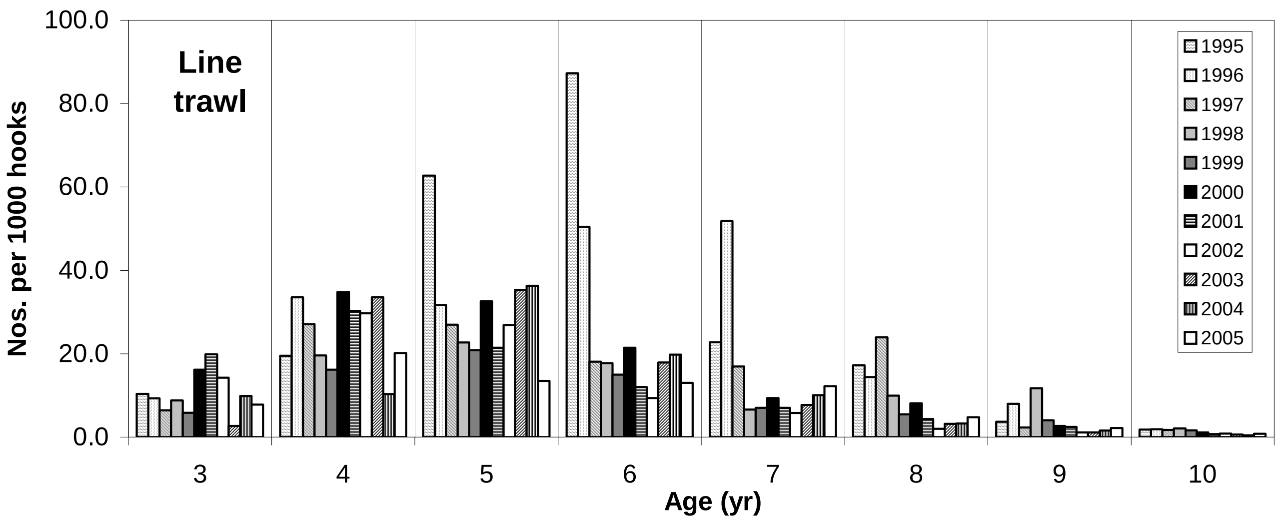


Figure 9b. Standardized age-disaggregated catch rate indices for gill nets (5.5" mesh) and line-trawls estimated using data from sentinel fishery fixed sites. Catch rates are fish per 50 fathom net for gill nets and fish per 1,000 hooks for line-trawl.

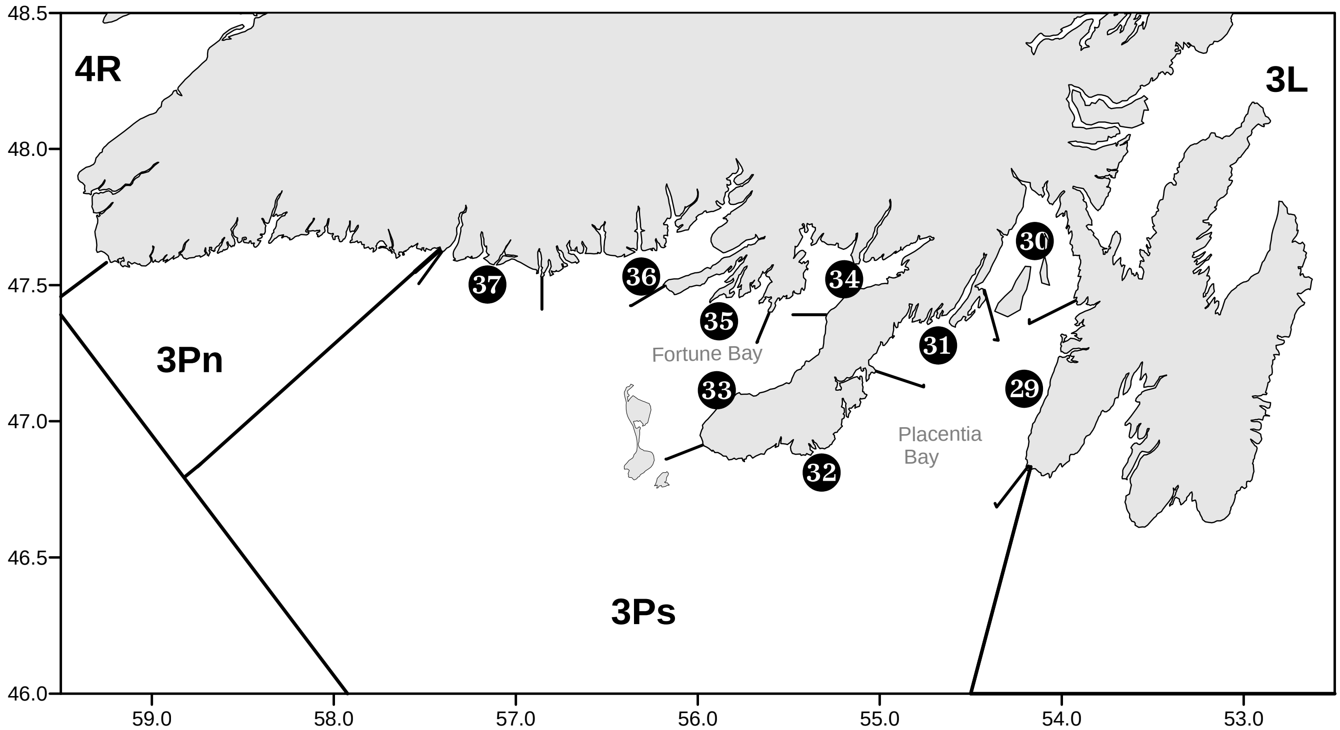


Figure 10a. Location and boundaries of numbered management areas along the inshore of the south coast of Newfoundland (29=Placentia Bay East, 30=Head of Placentia Bay, 31=Placentia Bay West, 32=The Boot, 33=Fortune Bay, 34=Head of Fortune Bay, 35=Connaigre, 36=Hermitage Bay, 37=Francois-Burgeo).

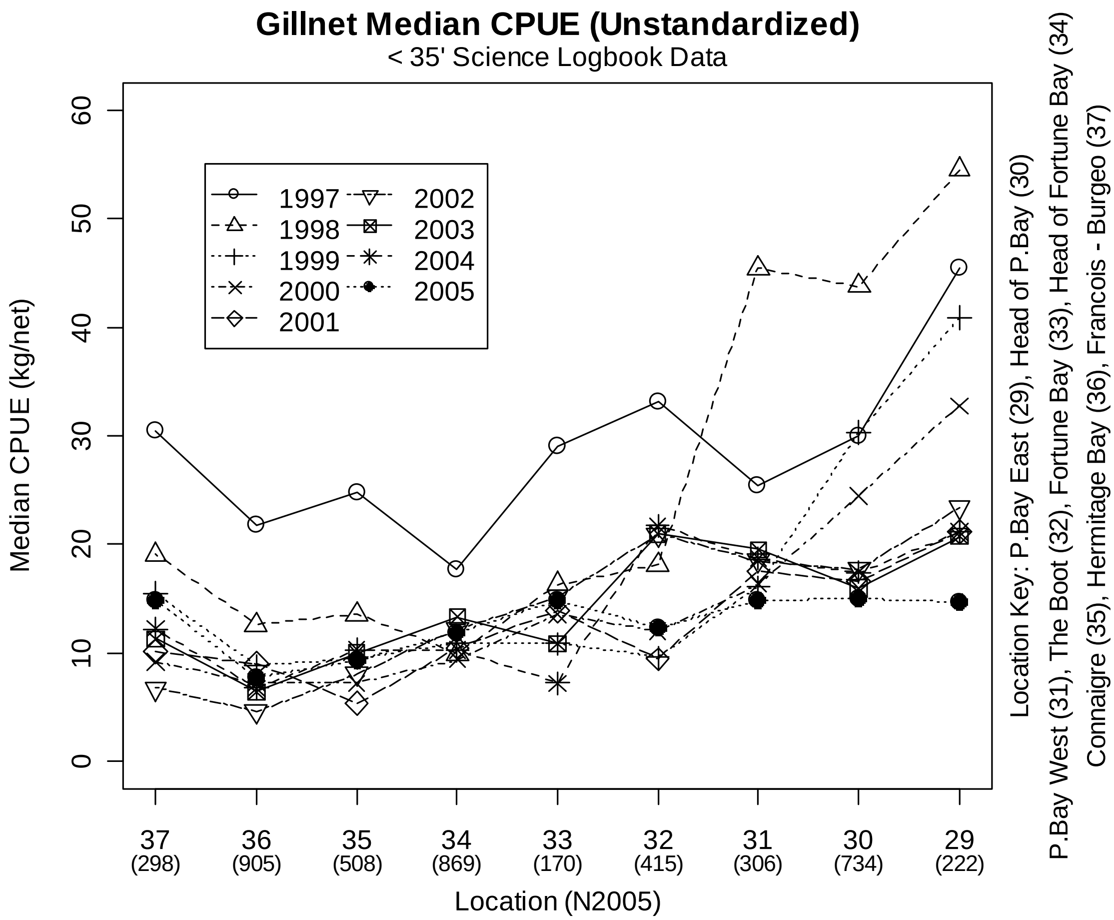


Figure 10b. Median annual catch rates for gillnets in management areas 29-37 (Placentia Bay westward to Burgeo) from <35 ft science logbook data. Values in parenthesis below each location are the number of records for 2005.

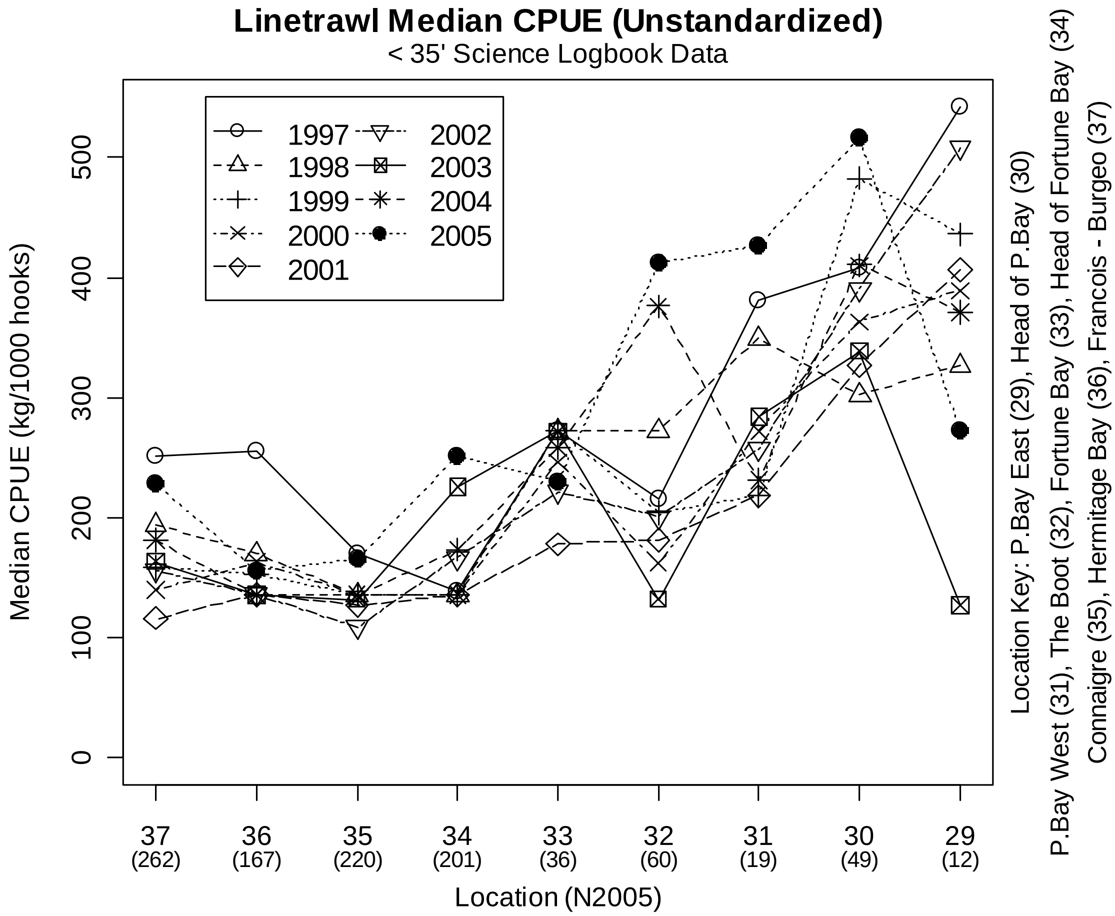


Figure 10c. Median annual catch rates for line-trawl in management areas 29-37 (Placentia Bay westward to Burgeo) from <35 ft science logbook data. Values in parenthesis below each location are the number of records for 2005.

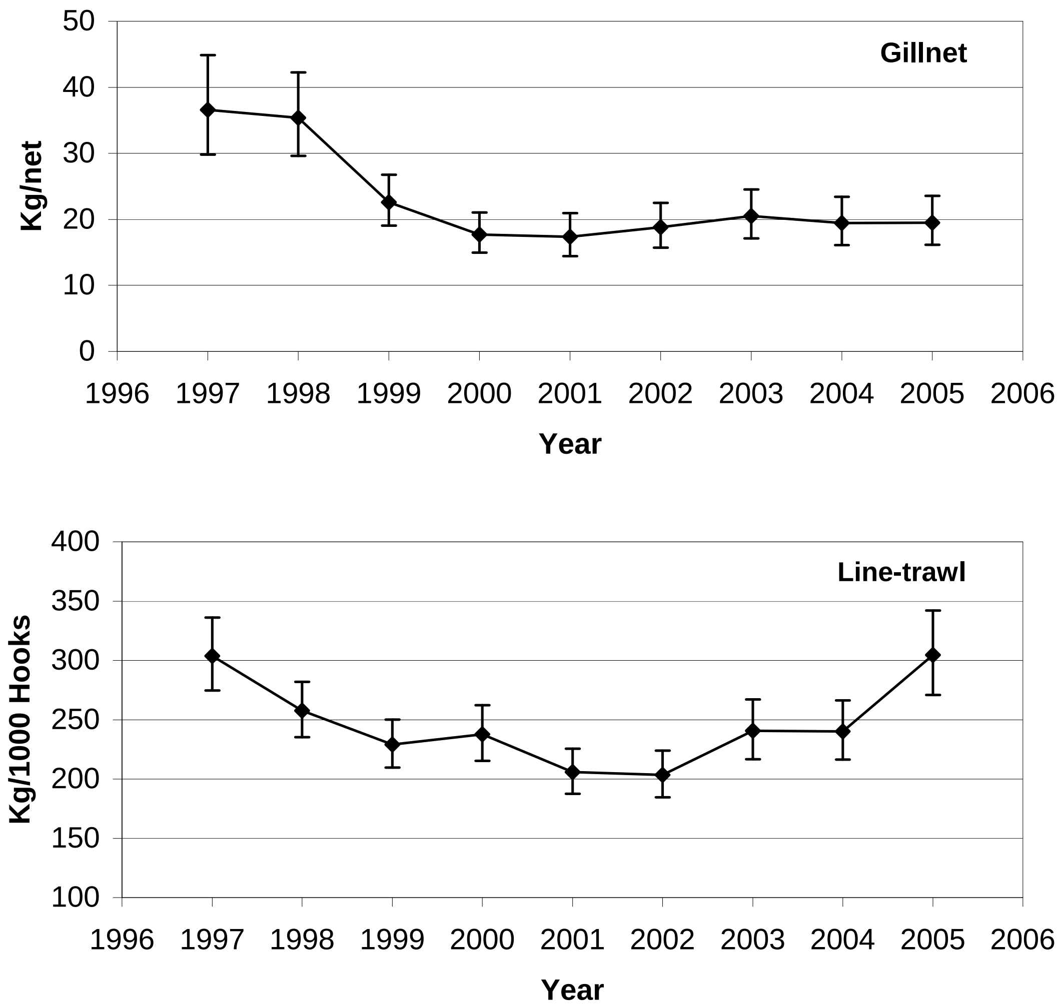


Figure 11. Standardized catch rates for gillnets and line-trawls from science log-books for vessels <35 ft. Error bars are 95% confidence intervals of the means. Catch rates are expressed in terms of weight (kg per net or kg per 1000 hooks).

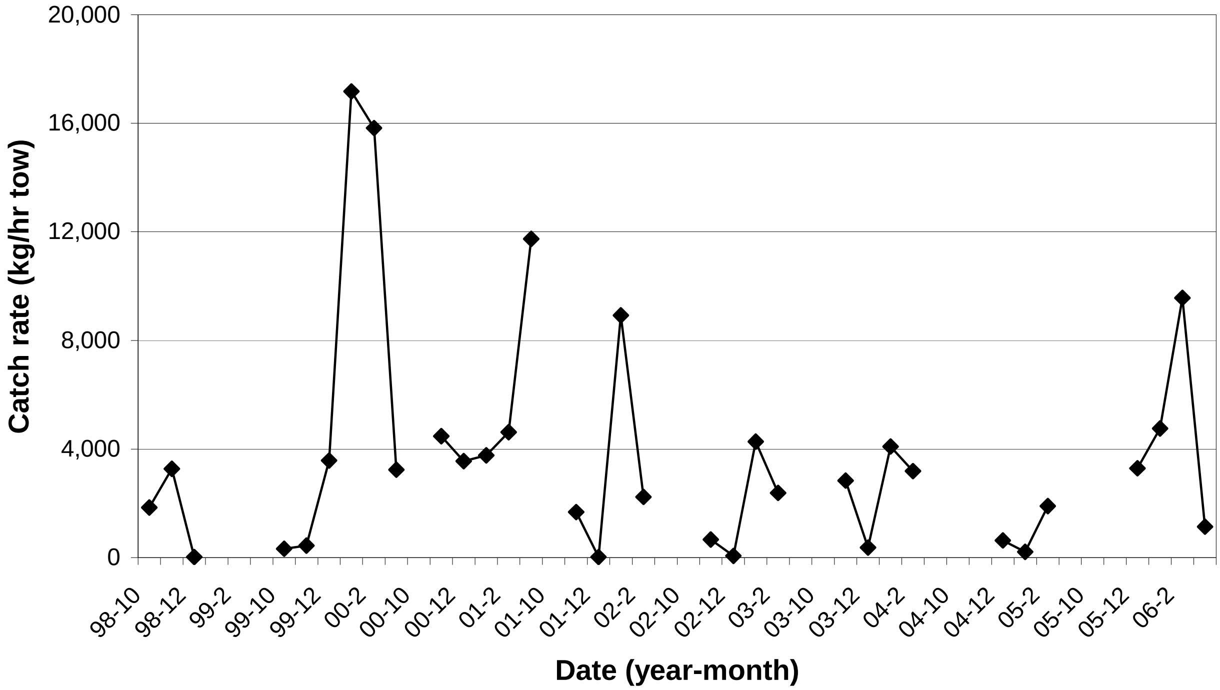


Figure 12. Median catch rates of cod for large (>100 ft) otter trawlers fishing in 3Ps during late fall and winter 1998-2006.

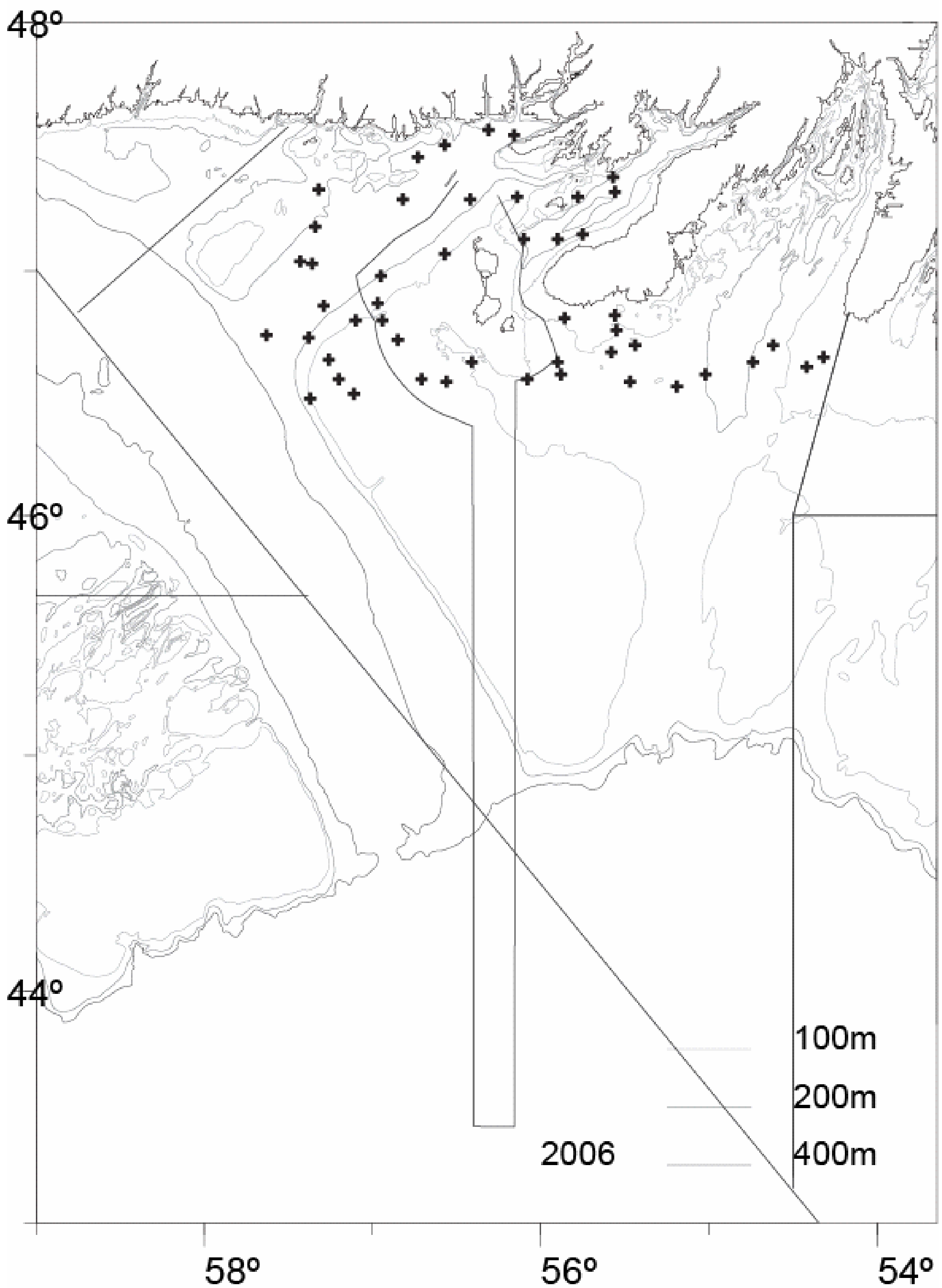


Figure 13. Locations of sets fished during the 2006 DFO research vessel bottom trawl survey of NAFO Subdivision 3Ps (the survey was not completed).

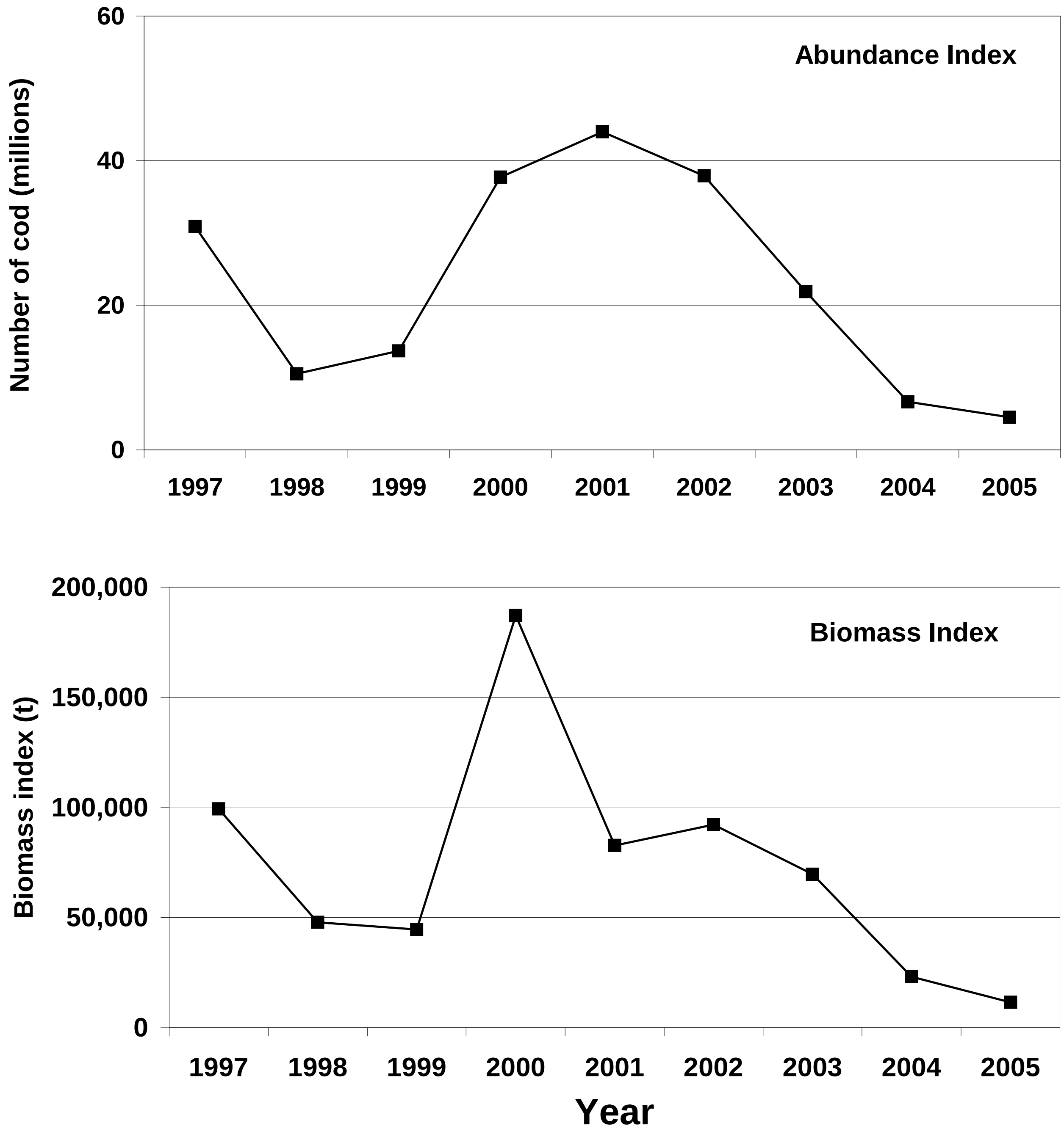


Figure 14. Trends in cod abundance and biomass indices from the fall industry (GEAC) bottom trawl survey of the offshore portion of NAFO Subdivision 3Ps.

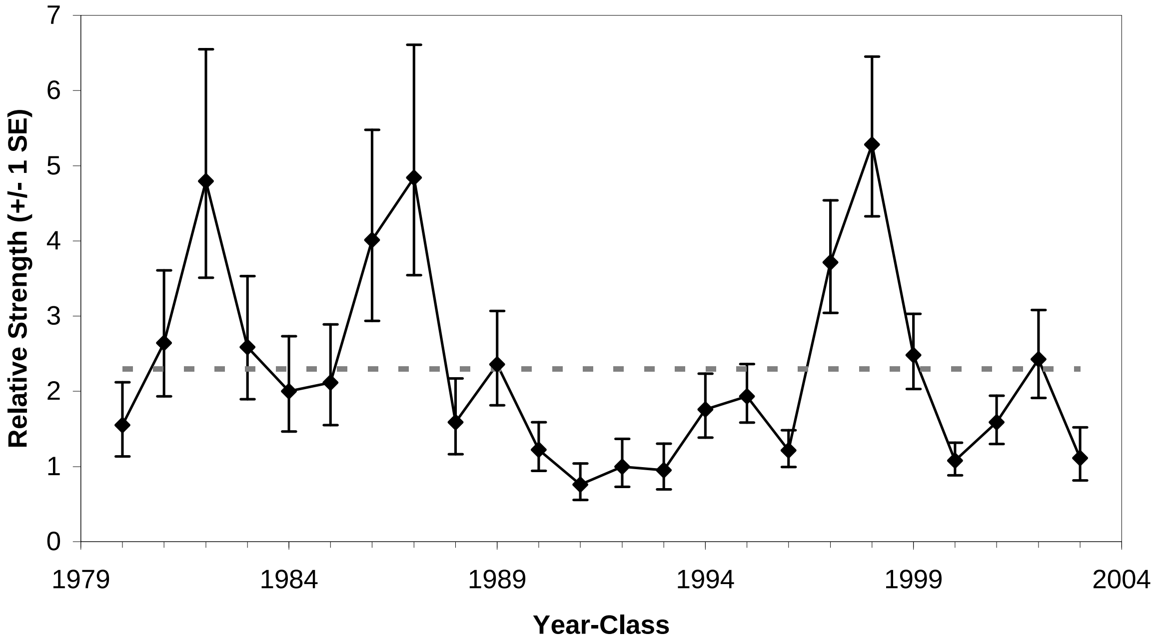


Figure 15. Standardized year-class strength estimated from catches of juvenile cod during the DFO research vessel survey and the industry (GEAC) survey. The error bars are 95% confidence intervals of the means. The grey dashed line is the long-term average. See text for details.

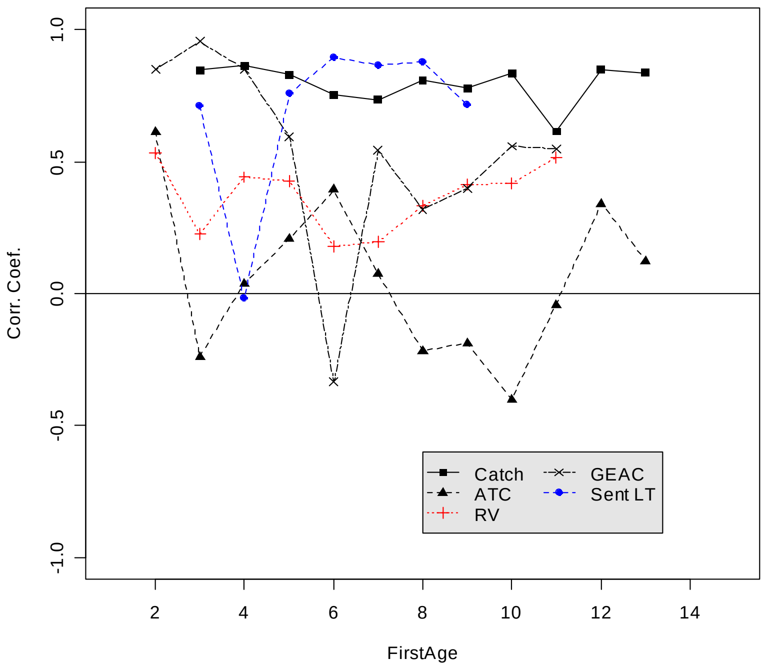


Figure 16. Correlation coefficients between successive age groups from catch rate indices used to tune SPA runs described in the previous (2005) assessment of 3Ps cod.

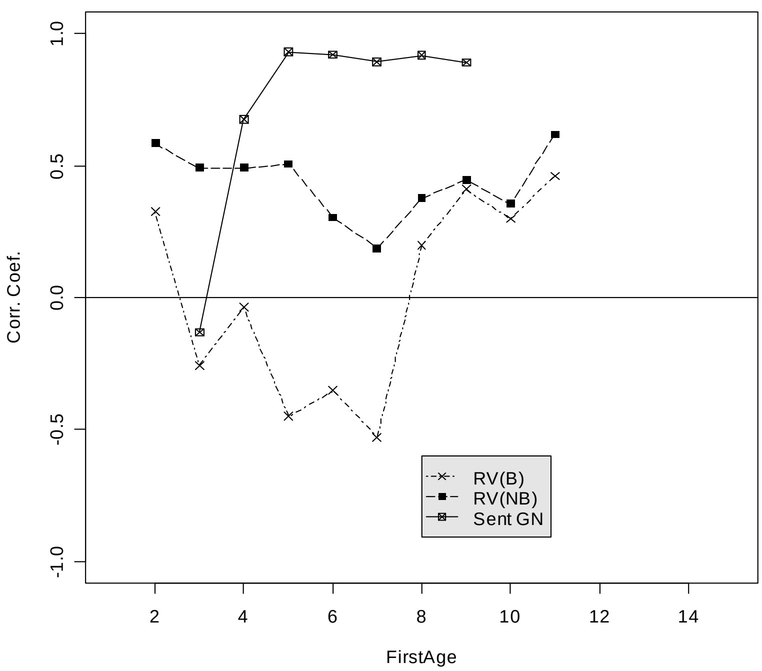


Figure 17. Correlation coefficients between successive age groups from catch rate indices that were not used in SPA runs in the previous (2005) assessment of 3Ps cod.

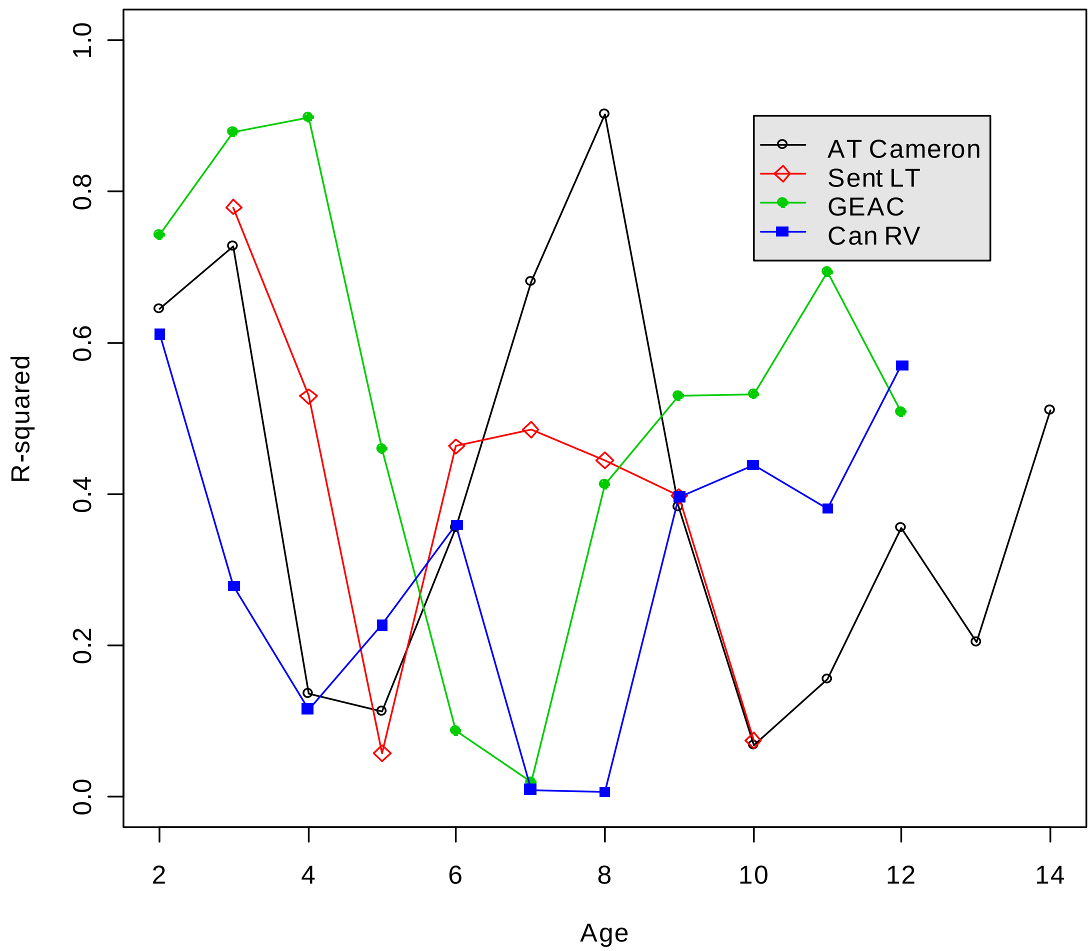


Figure 18. Coefficient of determination (r^2) between catch rate at age from various tuning indices and VPA estimates of numbers at age. The VPA was ADAPT-2005 - Run E from the 2005 assessment of 3Ps cod described in Brattey et al. (2005).