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An assessment of the cod (*Gadus morhua*) stock in NAFO Subdiv. 3Ps in October 2003.

Évaluation de l'état du stock de morue Atlantique (*Gadus morhua*) de la sous-division 3Ps de l'OPANO en octobre 2003.

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Abstract

This document summarizes scientific information used to determine the status of the cod stock in NAFO Subdivision 3Ps off the south coast of Newfoundland. The current assessment provides revised estimates of the abundance of fish on 1 April 2003. Numbers-at-age are projected to 1 April 2004 by accounting for recorded catch up to the end of September 2003 and assumed catch for the remainder of the season to 31 March 2004. Sources of information available for this assessment were: reported landings from commercial fisheries (1959-March 2003), oceanographic data, a time series (1973-2003) of abundance and biomass indices from Canadian winter/spring research vessel (RV) bottom-trawl surveys, an industry offshore bottom-trawl survey (1997-2002), inshore sentinel surveys (1995-2002), science logbooks from vessels <35ft (1997-2002), logbooks from vessels >35ft (1998-2002), and tagging studies (1997-2003). The fishery was still in progress at the time of the assessment and complete information on catch rates and age compositions from the 15,000 t TAC from 1 April 2003 – 31 March 2004 was not available. Several sequential population analyses (SPA) were carried out using reported commercial catches, calibrated with various indices. Spawner biomass estimates for 1 April 2004 from the various SPA formulations considered covered a wide range (82,000 to 185,000 t), and as in the 2002 assessment, no single SPA run was considered to best represent absolute population size. However, estimated trends in 3+ population numbers and spawner biomass were generally consistent; the SPA's indicated 3+ population numbers increased during 1998-2000 but have tended to decline slightly during 2001-2003. Spawner biomass increased during 1993-1998, declined during 1999 to 2001, and increased slightly between 2002 and 2003. The 1997 year-class was well represented in fishery catches as 5 year olds and the 1998 year class also appears strongly in many stock indices, whereas catches and catch rates of many older age classes declined. The sizes of the 1997-1999 year classes were estimated to be lower than determined during the 2002 assessment; consequently, the outlook about the short-term productivity of the stock is less optimistic. Medium term (3 yr) deterministic projections were also conducted to provide managers with general insights into possible stock trends over the next three years. At a TAC of 20,000 t four of five formulations indicate that spawner biomass would decline by 1 April 2006. At a TAC of 15,000 t or 10,000 t three of five formulations indicated that spawner biomass would decline. The medium term projections do not take into account any uncertainties, such as those associated with the stock composition of the commercial catch, misreported catches and assumptions about natural mortality. The trends in the projections are particularly sensitive to recent changes in estimates of the proportion of females that mature at young ages and become part of the spawning population, as well as estimates of the 1997-1999 year classes and their subsequent survival and recruitment to the fishery.

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. L'évaluation fournit des estimations révisées de l'abondance de la morue au 1er avril 2003. Nous faisons une projection des effectifs par âge au 1er avril 2004 en tenant compte des prises signalées jusqu'à la fin de septembre 2003 et des prises supposées pour le reste de la saison, soit jusqu'au 31 mars 2004. Voici les données utilisées pour l'évaluation : débarquements déclarés des pêches commerciales de 1959 à mars 2003, données océanographiques, une série chronologique (1973 - 2003) 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 – 2002), de relevés par pêche indicatrice dans les eaux côtières (1995-2002), des journaux de bord des bateaux < 35 pi de longueur (1997-2002) et des bateaux > 35 pi de longueur (1998-2002) et d'études d'étiquetage (1997-2003). Au moment de l'évaluation, la pêche battait encore son plein, et les données complètes sur les taux de capture et la composition par âge pour le TAC de 15 000 t couvrant la période allant du 1er avril 2003 au 31 mars 2004 n'étaient pas disponibles. Nous avons effectué plusieurs analyses séquentielles de population (ASP) reposant sur les prises commerciales déclarées, étalonnées par rapport à divers indices. Les estimations de la biomasse de géniteurs au 1er avril 2004 obtenues par les diverses variantes de l'ASP variaient considérablement (82 000 à 185 000 t) et, comme cela était le cas lors de l'évaluation de 2002, aucune ASP n'a été considérée comme représentant le mieux la taille absolue de la population. Par contre, les tendances estimées des effectifs de 3 ans et plus et de la biomasse des géniteurs étaient généralement semblables. Toutes les ASP ont montré, d'une part, que le nombre de morue de 3 ans et plus a augmenté de 1998 à 2000 mais a eu légèrement tendance à diminuer de 2001 à 2003 et, d'autre part, que la biomasse de géniteurs a augmenté de 1993 à1998, diminué de 1999 à 2001, puis augmenté légèrement entre 2002 et 2003. La classe d'âge 1997 était bien représentée dans les prises en termes de morues de 5 ans et la classe d'âge 1998 semble forte aussi, comme l'indiquent de nombreux indices du stock; par contre, les prises et les taux de capture de nombreuses classes d'âge plus âgées ont diminué. Les classes d'âge 1997 à 1999 semblent moins fortes qu'en 2002; par conséquent, nous sommes donc moins optimistes pour ce qui est de la productivité du stock à court terme. Nous avons aussi effectué des projections déterministes à moyen terme, soit sur trois ans, à l'intention des gestionnaires des pêches, afin de leur donner une idée des tendances possibles du stock durant cette période. À un TAC de 20 000 t , quatre des cinq options indiquent que la biomasse de géniteurs serait moins élevée le 1er avril 2006, tandis qu'à un TAC de 15 000 t ou de 10 000 t, trois des cinq options indiquent qu'elle aurait diminué. Ces projections ne tiennent pas compte d'aucune incertitude, comme celles liées à la composition des prises commerciales, aux déclarations erronées des prises et aux hypothèses relatives à la mortalité naturelle. Les tendances que se dégagent dans les projections sont particulièrement sensibles aux changements récents dans les estimations de la proportion de femelles qui atteignent la maturité à un jeune âge et qui sont intégrées à la population de géniteurs, ainsi qu'à l'exactitude des estimations des effectifs des classes d'âge 1997-1999, de leur taux de survie et de leur recrutement à la pêche.

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1. Introduction

This document gives the results of the regional assessment of the Atlantic cod (*Gadus morhua*) stock in NAFO Subdiv. 3Ps located off the south coast of Newfoundland (Figs 1, 2). The assessment was conducted in St. John's, Newfoundland during 15-25 October 2003. Following a moratorium that began in August 1993, the directed cod fishery on this stock was reopened in May 1997 with a total allowable catch (TAC) set at 10,000 t. The TAC was subsequently increased to 20,000 t for 1998 and to 30,000 t for 1999. In addition, an interim TAC of 6,000 t was set for the first 3 months of year 2000 to initiate a new management year beginning 1 April 2000 and ending 31 March 2001. The TAC for 1 April 2000 – 31 March 2001 was set at 20,000 t and the TAC for the next three management years (1 April 2001 – 31 March 2002 until 1 April 2003 – 31 March 2004) has remained at 15,000 t.

The history of the cod fishery in NAFO Subdivision 3Ps and results from other recent assessments of this stock, are described in detail 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, b, 2000, 2001a, 2002a).

The present assessment incorporates all available information on 3Ps cod, including the April 2003 research vessel bottom-trawl survey data. The 2002-2003 commercial fishery was still in progress at the time of the assessment meeting. Detailed information on catch-at-age up to the end of March 2003 was available and preliminary catch information up to 1 October 2003 was also used in the assessment. Additional sources of information included: oceanographic data (Colbourne and Murphy 2003), science logbooks for vessels <35ft (1997-2002), industry logbooks for vessels >35ft (1998-2002), an industry trawl survey on St. Pierre Bank from 1997-2002 (McClintock 2002), inshore sentinel surveys from 1995-2002 (Maddock-Parsons and Stead 2003), and recaptures of tagged cod (received up to 30 September 2003) from tagging experiments conducted during 1997-2003 (Brattey and Healey 2003).

In the current analyses it was assumed that the entire 15,000 t TAC would be taken in the fishing season from 1 April 2003 to 31 March 2004, as outlined in the management plan released by DFO prior to the start of the season. The current assessment provides a revised estimate of the abundance of fish on 1 April 2003. Numbers at age are first projected to 1 April 2004 by accounting for recorded catch up to the end of September 2003 and assumed catch for the remainder of the fishery to 31 March 2004. In a second step, a deterministic medium term (3 yr) projection was conducted, where numbers were projected from 1 April 2003 to 31 March 2006 under fixed annual TAC option of 10,000, 15,000 or 20,000 t.

2. Environmental overview

Water mass characteristics in the 3Ps region are largely determined by the general circulation, which consists of Labrador Current Water, the inshore branch of which flows through the Avalon Channel, and around Cape Race (Colbourne 2003). This branch then divides into two parts, one flowing to the west around the north of St. Pierre Bank, and the other flowing to the south between Green Bank and Whale Bank. Additionally, part of the offshore branch of the Labrador Current flows around the tail of the Grand Bank, westward along the continental slope (where it may interact with the Gulf Stream and slope waters), to the Laurentian Channel and into the Gulf of St. Lawrence. As a result the near-bottom habitat in the 3P region can be divided into two distinct oceanographic regimes. One is influenced by cold-fresh water from the eastern Newfoundland Shelf, which includes much of St. Pierre Bank and regions to the east. In this region temperatures generally range from 0-2°C but are <0°C in many years. The other oceanographic regime includes the deeper regions of the Laurentian and Hermitage Channels and areas to the west of St. Pierre Bank. This region appears to be influenced mostly by warmer slope water from the south. As a result this region experiences high variability with temperatures ranging from 3-6°C.

Oceanographic data from NAFO Division 3P during the spring of 2003 were examined and compared to the previous year and the long-term (1971-2000) average (Colbourne 2003). Temperature measurements on St. Pierre Bank show anomalous cold periods in the mid-1970s and from the mid-1980s to the mid-1990s. Temperatures moderated in 1996, 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 the past 3 years, temperatures have cooled significantly to values observed during the mid-1990s. In fact, the average temperature for NAFO Division 3P during the spring of 2003 was the coldest observed in about 13 years. The areal extent of <0°C bottom water increased significantly from the mid-1980s to mid-1990s, but decreased to very low values during 1998-2000. During 2001 to 2003, however, this area increased to values observed during the cold years of the early 1990s. Since 1995, the areal extent of bottom waters with temperatures >1°C has been increasing, reaching pre-1985 values during 1999-2000, but during 2001-2003 this area decreased by 25%. On St. Pierre Bank <0°C water completely disappeared during the warm years of 1999 and 2000. It has since increased to between 20-30% areal coverage during 2001 and 2002 and to over 90% during 2003. In general, temperatures during the spring of 2003 decreased significantly over values observed during the past several years.

3. Commercial catch

Catches (reported landings) from 3Ps for the period 1959 to 1 October 2003 are summarized by country and separately for fixed and mobile gear in Table 1 and Figs. 3a and 3b. Canadian landings for vessels <35 ft were estimated mainly from purchase slip records collected and interpreted by Statistics Division, Department of Fisheries and Oceans, prior to the moratorium. Shelton et al. (1996) emphasized that these data may be unreliable. Post-moratorium landings for vessels <35 ft have come mainly from a new dock-side monitoring program. 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-1980’s 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. In this year access by French vessels to Canadian waters was restricted. Under the terms of the 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.

In 1997, 72% of the 10,000 t TAC was landed by Canadian inshore fixed gear fishermen, with most of the remaining catch taken by the French mobile gear sector fishing the offshore (Table 1, Figs. 3a and 3b). This general pattern has been repeated in subsequent years although TAC's have ranged from 15,000 t to 30,000 t. During 2001, total reported landings were 16,510 t with the inshore fixed gear sector accounting for 74.6% of the total and in 2002 the corresponding figure was similar at 71.1%. In the 2003 calendar year to 1 October, the inshore fixed gear sector accounted for 72% of the reported landings of 10,040t; the offshore mobile gear sector typically fishes in the late fall and early winter and this allocation had yet to be taken.

Line-trawl catches dominated the fixed gear landings over the period 1977 to 1993, 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.

Landings during 2002 and up to 1 October 2003 are summarized by month, for inshore and offshore, and for each gear type separately, in Table 3a. Inshore catches in 2002 have come mostly from gillnets with substantial landings (> 500 t) in all months except February-May and December. Line-trawls were fished inshore mostly during summer and fall with highest monthly landings (>250 t) in September-November. Hand-line catches were taken mainly during late summer and fall. In the offshore, otter trawl (and Norwegian seine) 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. As in 2000 and 2001, there was also a substantial offshore gillnet catch in 2002 with landings totaling over 2,000 t taken mostly during July-November. Line-trawl accounted for a small proportion of offshore landings. Overall, landings in 2002 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. Preliminary landings for 2003 show similar trends to those seen for the corresponding period in 2002.

The landings for the 2002 calendar year and the first nine months of 2003 are summarized by month and unit area in Table 3b. Compared to 2001 (see Brattey et al. 2002a), there were less inshore landings in the first three months of the year although in both years most of the inshore landings came from 3Psc. Inshore landings in April 2002 and April 2003 were low and came mostly from by-catch fisheries. Landings began to increase in the inshore unit areas in May and by July reached a peak in 3Psb and 3Psc. In Placentia Bay (3Psc) landings of over 1,200 t were reported in July alone in 2002 and 2003. Landings from inshore areas tended to be lower in August 2002 and August 2003, but in September 2003 inshore landings increased dramatically with over 1,000 t reported from 3Psb and 3Psc. In 3Psa highest landings occurred in September and October. There were substantial landings (987 t) during November in Placentia Bay in 2002; however, total landings in 2002 for 3Psc (4,891 t) were substantially less than those for 2001 (5,855 t). In the offshore, landings tended to be higher in fall and winter and lower during the summer months (June-August). Unit area 3Psh typically accounts for most of the offshore catch, but landings from 3Pse in 2002 (803 t) were substantially higher than those reported in 2001 (262 t). Overall, preliminary landings for the 2003 calendar year show similar spatial and temporal trends to those seen in 2002, except for the dramatic increase in inshore landings in September.

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 12,000 t with typically 35-51% of the entire TAC coming from this unit area alone. Landings from 3Psa and 3Psb have been fairly consistent at about 1,100-3,200 t and generally 7-12% and 9-18% of the TAC, respectively. Most of the offshore landings have come from 3Psh and 3Psf (Halibut Channel and the southeastern portion of St. Pierre Bank), although the percentage coming from 3Pse (north central St. Pierre Bank) increased somewhat in 2002 (6.4%) compared with preceding years (1.1-4.0%).

The 1 April 2003 to 31 March 2004 conservation harvesting plan placed various restrictions on how the 3Ps cod fishery could be pursued. Unit area 3Psd has remained closed to directed cod fishing from 15 November to 15 April since 1998, due to possible mixing of northern Gulf cod into the western portion of the 3Ps stock area at this time of year. Spring closures were also imposed in some areas to protect spawning fish. From 1997 to 31 March 2001, fishers with homeports west of the Burin Peninsula fished competitively with quarterly quotas, but an IQ system was introduced in this area starting in the 2001/2002 management year and this was continued in 2002/2003 and 2003/04. In contrast, fishers in Placentia Bay have operated under an individual quota (IQ) system since 1998. A dockside monitoring system was introduced following the reopening of the fishery in 1997, and other restrictions, many of which varied according to vessel class, have included the amount of gear that could be fished, where fish could be landed, trip and weekly limits, and a small fish limit. Mesh size of gillnets was also restricted to a maximum of 6.5 inches. As in previous years, the 6.5” mesh limit in the directed cod fishery could be circumvented by gill-netters fishing the offshore portion of 3Ps because they could use much larger mesh size (8” and 10”), and more gillnets, when fishing for other species such as skate and white hake or monkfish and still keep some cod as by-catch.

3.1 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 catch in 2002/2003 was intensive, with 8,000 otoliths collected for age determination and over 81,400 fish measured for length (Table 4A). The sampling was well distributed spatially and temporally across the gear sectors. Substantial landings in summer from inshore fixed gears (see Table 3) were sampled intensively, particularly line-trawl and gillnet. The smaller number of samples from the offshore line-trawl catch reflects the smaller catches from these gears in 2002. Sampling during January-March 2003 has also been intensive with 1,564 otoliths collected for age and 11,816 fish measured for length (Table 4b) from the offshore otter trawl and inshore gillnet and inshore line-trawl catches.

Sampling of the French gillnet and otter trawl landings was also conducted with over 1,000 otoliths collected and over 9,000 length measurements taken (Table 4c).

One significant portion of the catch from which no sample ages or lengths were provided concerns the catch from vessels based in Nova Scotia that operate in 3Ps and land their catch in Nova Scotia. These are typically larger vessels (>65 ft) fishing mostly line-trawls. The reported catch from this sector is significant, and has ranged from 885 t in 1998 to 394 t in 2003 (see Table 1). Most of it is taken in the offshore of 3Ps. In addition, observer coverage on these vessels has been extremely poor leading to concerns that the actual catch may be significantly higher than reported.

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 relationship where log(weight)=3.0879*log(length)-5.2106. Catch-at-age for all gears combined based on sampling of Canadian and French vessels in 2002 and January to March in 2003 is summarized in Tables 5a, 5b, 6 and Figs. 6a and 6b. In the 2002 landings from all gears combined, ages 5 to 8 were well represented (1994 to 1997 year classes) with age 5 (1997 year class) the most abundant overall. There was a notable shift toward younger ages in the 2002 catch compared to 2001, with 5 year olds increasing from 13% to over 24% of the total catch by numbers and this was accompanied by a corresponding drop in the numbers of many older age classes (i.e. 7, 8, 9, 11 and 12 year olds; Fig 6a). The age composition of the catch from the first three months of 2003 was consistent with that of 2002, with ages 5-7 predominating (Fig. 6b).

Catch at age by gear type for 2001 and 2002 is illustrated in Fig. 7a. The dominance of gillnet selectivity on ages 6 to 9 in 2001 and 6 to 8 in 2002 is apparent. In comparison, line-trawls selected younger fish, mostly ages 4 to 6. Hand-line tended to catch slightly older fish compared to line-trawl. A notable finding is that the number of five year olds increased in the 2002 catch in all gear types, suggesting that this age class was widely distributed across the stock area.

Offshore mobile gear accounted for most of the landings in January-March 2003 with ages 6-7 (1997 and 1996 year classes) predominating and age 14 (i.e. 1989 year classes) still well represented (Fig. 7b). The catch for the first 3 months of 2003 for line-trawl and gillnet is quite small (see Table 3a).

A time series of catch numbers-at-age (3-14) for the 3Ps cod fishery from 1959 to 2002 is given in Table 6. At the assessment it was pointed out that there is a problem with the sum-of-products for the catch in some years during 1959 to 1976. Weights were not sampled prior to 1977 and fixed values for weights at age are used. In addition, plus groups were often used for age >14 and the data prior to 1996 are not in electronic format making reconstructions of historical catch-at-age extremely difficult. These problems could not be rectified at the assessment meeting; consequently, there are known errors in the historical portion of the catch-at-age data in Table 6. Only the catch-at-age from 1977 was used in most analyses.

The catch-at-age data that are available indicate that in the pre-moratorium period the landings were typically dominated by young fish, typically aged 4-6, whereas in the post moratorium period slightly older ages (i.e. 5-8) have been more common; this probably reflects the switch in dominant gears from line-trawl to gillnet. For the 2002 fishery, 5 and 6 year-old cod (1996 and 1997 year classes) dominated the final catch although in terms of numbers 7 and 8 year olds are also well represented. Note that although the TAC and total landings were similar in 2001 and 2002, the composition of the catch changed considerably between these two years, with greater numbers of 5 and 6 year olds in 2002 and a corresponding reduction in the numbers of many older age classes.

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. It is helpful to recall that the mean weights-at-age are derived from catches taken by several gears in various locations at various times of the year. If one looks at the mean weights-at-age for each of the 4 major gears, weights tend to be greatest in offshore mobile gear (predominantly otter trawl) and least in hand-line (Fig. 8c). For example, the 1994 year-class at age 8 was computed to weigh 1.89 kg in hand-line catches, 2.44 kg in line-trawl, 3.03 kg in gillnet, and 4.04 kg in mobile gear. The percentage differences among gears tend to increase with age. The overall mean weight-at-age tended to be close to the value computed for gillnets (which accounted for 50% of the catch by number), but hook and line gears had more influence at the younger ages and mobile gears had an increasing influence at older ages (Fig. 8d).

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, apparent growth from 2001 to 2002 was unusually low for the 1989-1991 year-classes, and nil for the 1988 year-class (Table 7a). The reason is not immediately apparent, but as noted above, the computed value for weight-at-age varies not only with annual variability in the true mean weight-at-age of fish in the sea, but also with variability in the manner in which the fish are caught and sampled. Second, weight-at-age appears to depend to some extent on year-class (Fig. 8e). 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.

The apparent variability in growth of year-classes lead to the decision, during the 2002 assessment, to obtain a projected weight-at-age in 2002 by projecting along each year-class, rather than by using an average of the weights-at-age in the previous *n* years. The projection was accomplished by starting with the weight at age *a* in 2001, and assuming that the cohort would grow at an instantaneous rate equal to the average of the instantaneous growth rates attained by the previous 4 cohorts over the age interval from age *a*-1 to age *a*. The weights-at-age projected in this manner are provided in Fig. 8f, along with the weights-at-age that would have been projected if the weights at age *a* were set equal to the average of the weights at age *a* during the previous 3 years. (Note that use of the 3-year average would have resulted in some projected weight increases that would have been extraordinarily high, and others that would have been negative.) When one compares the 2 series of projections to the weights-at-age computed from sampling during 2002, one finds that the method of projecting along each year-class was more successful in projecting the pattern in weight-at-age in 2002, but it tended to overestimate the weights, particularly at ages 10 and older. (As noted above, the weights-at-age derived from sampling of the catch indicated very little growth in these older fish from 2001 to 2002.)

There continues to be considerable among-cohort variability in weight-at-age. For this reason, projection of weight-at-age to mid-2003 was conducted using the weight already attained by age *a* in 2002 and assuming that the year-class would grow at a rate equal to the average of the instantaneous growth rates experienced by the previous 5 year-classes over the age interval from age *a* to age *a*+1. The values so computed are provided in Table 7a.

4. Sentinel survey

The sentinel survey has been conducted in 3Ps since 1995 and there are now eight complete years of catch and effort data (Maddock-Parsons and Stead 2003) and collection of data for the ninth year is in progress. During 2003 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. There were 16 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 is also fished at each of 4 sites in Placentia Bay one day per week. Fishing times averaged 10 weeks in 2001 and 2002, 9 weeks in 2000 as opposed to 6 weeks in 1999 and 12 weeks from 1995-1998. Most fishing takes place in fall/early winter. Maddock-Parsons and Stead (2001, 2003) 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 5.5" gillnets in 2002 were marginally lower than those reported for comparable times in 2001, whereas catch rates for some line-trawl sites showed a slight increase.

As in previous assessments, an attempt was made to produce an age dis-aggregated index of abundance for the eight completed years in the 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.

4.1 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, 3Psc), year (1995-2002) 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, then areas are combined for the year.

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 where used in the analysis. Zero catches were generated for ages not observed in a set. 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 generalized 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

$$\log(\mu_i) = X_i'\beta$$

where X_i' 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 μ_i related to the factors month nested within site and age nested within year by

$$\log(\mu_i) = \log(E_i) + month_i(j)\beta_j(site_i(k)\beta_k) + age_i(l)\beta_l(year_i(m)\beta_m),$$

where E_i is and 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 and two standardized annual catch rate-at-age indices were produced, one for each gear type. All effects included in the model were significant. The standardised gillnet and line-trawl catch rate-at-age indices for 1995 to 2002 are given in Table 8. For gillnets, the catches during 1995-1997 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. In 2001, the 1997 and 1998 year classes appear strong although these fish are still rather small to be caught effectively by 5½" mesh. However, in the 2002 sentinel gillnet, the 1997 year class is only marginally better than the two preceding year classes at age 5 and the 1998 year class looks weak. Gill-net catch rates for older fish in 2002 continue to be low. For line-trawls, catch rates were higher for the 1989 and 1990 year-classes during 1995 to 1996 followed by the weaker 1992 year-class. In the 2000-2002 sentinel line-trawl, catch rates have improved for younger fish (3 and 4 year olds) compared to 1995-1999, but those for older fish have continued to decline. In general, both indices are reasonably consistent and differences tend to reflect the different size (age) selectivity of the two gears.

Annual trends in standardized total (ages 3-10 combined) annual catch rates, expressed in terms of numbers of fish, are shown in Fig. 9. For gillnets there is no trend over the period 1995-1997, but catch rates are progressively lower in 1998-1999 and remained low from 2000 to 2002. For line-trawls, catch rates show a decline from 1996 to 1997, but have been relatively stable from 1997 to 2002. As described in recent 3Ps cod assessments, commercial fisheries during 1997-2002 may have had some disruptive influence on the execution of the sentinel fishery. 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. The declines in sentinel gillnet catch rates since the fishery re-opened continues to be interpreted as cause for concern. These declines are consistent with the inshore catch rate data from science log-books and the high estimates of exploitation from tagging in Placentia Bay.

5. Science logbooks

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. The purpose of this logbook is for scientific stock assessments and not for quota monitoring or other controls on the fishery. Previously only purchase slip records were available for these size vessels, containing limited information on catch and no information on effort. 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 more than 55,000 gillnet sets and 19,000 line-trawl sets directing for cod in the database. These data pertain to the inshore fishery, i.e. unit areas 3Psa, 3Psb, and 3Psc.

As in the previous assessment, 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 were expressed in terms of weight; catches are generally landed as head-on gutted and recorded in pounds; these were converted to kg by multiplying by 2.2026.

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. In addition, the 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 2 tons. The distribution of catches for line-trawls was similarly skewed.

In the 1999 and 2000 assessments, an exploratory analysis of science logbook data was conducted to investigate spatial and temporal trends in catch rates at the level of unit areas and lobster management areas (Brattey et al. 1999a, b, 2000). At that time the science logbook data covered a period of only three years. However, in the current assessment 5 years of data were available and an attempt was made to develop a catch rate index from these data. The same generalised linear model approach to that described above for the sentinel fishery was adopted, except that age composition data were not directly available for the logbook data so that the age effect is dropped. In addition, catch rates from logbooks were expressed in terms of weight, whereas sentinel catch rates were expressed in terms of numbers of fish. In a similar approach to that adopted for the sentinel survey data, the response distribution was specified as Poisson and the logarithmic link function was used.

The catch from 3Ps was divided into cells defined by gear type (gillnet and line-trawl), statistical area (numbered 29-37 and illustrated in Fig. 10b in [Brattey et al. 2002a]), and year (1997-2002). Catch per unit effort (CPUE) data were standardised to remove site and seasonal effects. Gillnet sets where the number of nets used was >30 were excluded to remove offshore gillnet activity from the analysis. Similarly, line-trawl sets where the number of hooks was <100 or >4,000 were excluded. 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. Preliminary analyses indicated that catch rates were generally higher for both line-trawl and gillnet in Placentia Bay compared to inshore areas further west. For gillnets, catch rates have shown a downward trend during 1998-2000 but have subsequently been low but stable (Fig. 10). The gill-net catch rates have declined from 34 kg per net in 1997 to 14.0 kg per net in 2001. For line-trawls, catch rates declined during 1997-1999 but have remained about the same during 2000-2002. Line-trawl catch rates were highest in 1997 at 301 kg per 1,000 hooks and have declined to around 200 kg per 1000 hooks in 2001 and 2002.

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, with respect to timing of the 3Ps cod fishery, amount of gear fished, trip and weekly limits, as well as a trend toward individual quotas (IQ's) rather than a competitive fishery. In addition, experience has shown that 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 IQ’s can have a strong influence on catch rates that is unrelated to stock size. 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 declines in gillnet and line-trawl catch rates since the fishery re-opened in 1997 are cause for concern. The more stable catch rates for line-trawl in the past two years may, however, be reflecting the improved recruitment that is evident in other indices for the 3Ps stock (DFO RV survey, GEAC survey, sentinel line-trawl index).

6. Tagging experiments

A Strategic Project involving tagging of adult (> 45 cm) cod was continued during 2003 with an additional 7,933 tagged fish released in 3Ps up to 30 September 2003 (Brattey and Healey 2003). Recoveries of tagged cod from the fishery are used to provide information on movement patterns and to estimate exploitation rates on cod tagged in different regions of the stock area. As in previous years single, double, and high-reward tags were applied, and tagging was conducted on spawning and pre- and post-spawning aggregations in the following areas: Halibut Channel (3Psh), Burgeo Bank-Hermitage Channel (3Psd), Fortune Bay (3Psb), and Placentia Bay (3Psc).

Total numbers of cod released in 3Ps and reported as recaptured annually (up to 30 September 2003) from all areas combined are shown below.

Year released	Number tagged	Numbers reported recaptured/year						
		1997	1998	1999	2000	2001	2002	2003*
1997	6,029	343	366	470	224	60	19	3
1998	9,941	.	542	1,066	539	182	64	8
1999	8,450	.	.	656	789	300	113	18
2000	9,900	.	.	.	678	801	338	56
2001	8,368	.	.	.	.	731	518	79
2002	9,940	.	.	.	.	.	611	207
2003	7,933	.	.	.	.	.	.	212

* to 30 September 2003.

Over 60,000 cod have been tagged and released in 3Ps since 1997, with typically 6,000 to 10,000 cod released annually. Over 10,000 tagged cod have been reported as recaptured and a substantial database of recapture information now exists. In most years, typically about 5% to 8.5% of the initial releases are reported as recaptured in the year of release. As landings have declined in years subsequent to 1999 (see Table 1), fewer tagged cod have been reported as recaptured. In the 2001 calendar year, when landings were 16,510 t, 8.5% of the tagged cod released were reported as recaptured; in 2002 the percentage drops to 6.1%. Although the 2003 fishery is still in progress with approximately 10,000 t landed to 1 Oct 2003, the number of recaptures reported to date during 2003 appears to be relatively low.

6.1 Estimates of exploitation (harvest) rate

Brattey et al. (2001b, 2002a, 2002b) and Brattey and Healey (2003) used data from post-moratorium tagging experiments to estimate annual exploitation rates for cod tagged in various regions of 3Ps. The number of reported recaptures from individual cod tagging experiments gives minimum estimates of the exploitation rates on the aggregations of cod that were tagged. However, in practice, not all fish survive tagging, some tags are lost from fish particularly in the first year, and not all recaptures of tagged fish are reported. Tagged (and untagged) cod also suffer natural mortality due to factors such as predation and disease. Accounting for these losses leads to a reduction in the number of tagged (and untagged) animals available to the fishery. The design of the tagging study enabled estimates of tagging mortality, tag loss and reporting rates to be made and these were incorporated when estimating exploitation (Brattey and Healey 2003). Double tagging was used to estimate tag loss rates and a high-reward tagging study was used to estimate reporting rates (Cadigan and Brattey 2003); tagging mortality was estimated by various methods including retaining batches of tagged cod in submersible enclosures (Brattey and Cadigan 2004). Exploitation rates were estimated for cod tagged in a specific area at a specific time (i.e. individual tagging experiments), irrespective of where recaptures came from. In this analysis no attempt was made to estimate population sizes using tag returns and commercial catches, because typically some harvesting occurs in an area different from where fish were tagged. This makes it difficult to convert local catches to local population biomass.

During 2000 and 2001, mean exploitation was high (30% and 26%, respectively) for cod tagged in Placentia Bay (3Psc), intermediate (10% and 11%) for cod tagged in Fortune Bay (3Psb), and low (5% and 7%) for cod tagged in the Burgeo Bank – Hermitage Channel area (3Psd). During 2002, mean exploitation estimates declined slightly to 20% for Placentia Bay, whereas the estimates for Fortune Bay (10%) and Burgeo Bank - Hermitage Channel (3Psd) were largely unchanged (5%). Note that the values reported here for previous years may have changed slightly from those reported in previous documents; this is due to a slight change in the estimated reporting rate and tag loss rates, recovery of additional tags from previous years, and inclusion of a seasonal estimate of the tagging mortality rate. Values for 2003 for all experiments are preliminary as the fishery was still in progress

All estimates of mean exploitation have been much lower (1% to 3%) among cod tagged offshore (Halibut Channel, 3Psh) compared to the inshore throughout 1998-2002 in spite of substantial offshore landings. These low offshore exploitation rates are consistent with a large offshore biomass given the magnitude of recent offshore catches. However, the offshore estimates of exploitation are considered less reliable. There have been substantially fewer tag returns from offshore areas resulting in greater uncertainty in the estimate of reporting rate for this region. In addition, there has been restricted offshore tagging coverage and a restricted distribution of fishing activity in the offshore, and possibly lower survival of fish caught for tagging offshore in deep (>200 m) water; combination of these factors also adds to the uncertainty in the estimates of exploitation rate for the offshore.

Movement patterns of cod inferred from the post moratorium tag returns have been quite consistent and suggest that the 3Ps stock comprises a complex group of sub-components that, at least as adults, do not mix thoroughly. The tagging suggests that there are coastal stock components that migrate extensively between Fortune Bay, Placentia Bay and in some years southern 3L, and that these do not mix extensively with cod in offshore regions of 3Ps. In addition, a portion of the offshore cod that over-winter in the southern edge of the Halibut Channel move onto the southeast corner of St. Pierre Bank during summer, whereas others migrate seasonally inshore to Placentia Bay and the southern Avalon during summer. There is also mixing in western 3Ps with cod that migrate out of the neighbouring 3Pn4Rs stock area. The main consequences of the lack of thorough mixing within 3Ps is that local areas are prone to overexploitation and that it adds to the uncertainty of the Sequential Population Analysis of the stock as a whole.

7. Research vessel survey

Stratified-random surveys have been conducted in the offshore areas of Subdiv. 3Ps during the winter-spring period by Canada since 1972, and by France for the period 1978-92. The two surveys were similar with regard to the stratification scheme used, sampling methods and analysis, but differed in the type of fishing gear and the daily timing of trawls (daylight hours only for French surveys). Canadian surveys were conducted using the research vessels *A.T. Cameron* (1972-82), *Alfred Needler* (1983-84), and *Wilfred Templeman* (1985-2003). From the limited amount of comparable fishing data available, it has been concluded that the three vessels had similar fishing power and no adjustments were necessary to achieve comparable catchability factors, even though the *A.T. Cameron* was a side trawler. The French surveys were conducted using the research vessels *Cyros* (1978-91) and *Thalassa* (1992) and the results are summarized in Bishop et al. (1994).

The stratification scheme used in the DFO RV bottom-trawl survey in 3Ps is shown in Fig 11. Canadian surveys have covered strata in depth ranges to 300 ftm since 1980. Five new inshore strata were added to the survey from 1994 (779-783) and a further eight inshore strata were added from 1997 (293-300). For surveys from 1983 to 1995, the Engel 145 high-rise bottom trawl was used. The trawl catches for these years were converted to Campelen 1800 shrimp trawl-equivalent catches using a length-based conversion formulation derived from comparative fishing experiments (Warren 1997; Warren et al. 1997; Stansbury 1996, 1997).

The Canadian survey results (in Campelen-equivalent units, see below) are summarized by stratum (Fig. 11) in terms of numbers (abundance) and biomass in Tables 9 and 10, respectively, for the period 1983 to 2003. Strata for which no samples are available were filled in using a multiplicative model. Timing of the survey has varied considerably over the period. In 1983 and 1984 the mean date of sampling was in April, in 1985 to 1987 it was in March, from 1988 to 1992 it was in February. Both a February and an April survey were carried out in 1993; subsequently, the survey has been carried out in April. The change to April was aimed at reducing the possibility that cod from the adjacent northern Gulf (3Pn4RS) stock would erroneously be counted as part of the 3Ps stock. A portion of the Northern Gulf cod stock may cross the stock boundary into the Burgeo Bank area (see Fig. 1) and mix with 3Ps cod in winter in some years, mixing with the 3Ps stock and migrating back into the Gulf some time during the following spring. Campana et al. (1998, 1999, 2000) has suggested that mixing may be substantial and recent tagging studies suggest that it may extend into April in some years (Brattey et al. 2001b, 2002b; Brattey and Healey 2003). However, the extent, timing, and duration of mixing are variable and at present there is no reliable method to assign survey catches to the appropriate stock on an annual basis.

7.1 Abundance, biomass, and distribution

A time series of trawlable abundance and trawlable biomass estimates from random stratified RV surveys is given in Tables 9 and 10. Details of the catch estimates by stratum, timing of the surveys, number of sets fished, and vessel(s) used are also given. The abundance and biomass estimates for the 2003 survey were 48.7 million fish and 50,800 t, respectively, both values being lower than the estimates for the preceding year. In the 2003 survey there were four strata with high abundance and biomass estimates, including one stratum on Burgeo Bank (307), one in the outer reaches of Fortune Bay (298), and two strata in Halibut Channel (318, 319) although the estimate for stratum 319 was the lowest observed in the past six years . The stratum with the largest catch was 307 located on Burgeo Bank; this stratum accounted for 52.8% of the biomass index and 47% of the abundance index for the stock area.

Trends in abundance and biomass from the RV survey of the index strata in 3Ps (depths less than or equal to 300 ftm, excluding the new inshore strata) are shown Fig. 12. The abundance and biomass time series from 1983 to 1999 shows considerable variability, with strong year effects in the data. Both abundance and biomass are low after 1991 with the exception of 1995, 1998, and 2001. The 1995 estimate is influenced by a single enormous catch contributing 87% of the biomass index and therefore has a very large standard deviation. The 1997 Canadian index was the lowest observed in the time series, which goes back to 1983, being less than half of the 1996 index. The size composition of fish in the 1997 RV survey suggested that this survey did not encounter aggregations of older fish, yet these fish were present in the 1996 survey and in commercial and sentinel catches in subsequent years. The minimum trawlable biomass estimate has declined slightly over the past three years, from 86,991 t in 2001 to 50,811 in 2003. The minimum trawlable abundance index has declined from 88.2 million in 2001 to 48.7 million in 2003.

The survey data are also expressed in terms of catch rates (i.e. mean numbers per tow) for the survey as a whole (Fig. 13a) and for the eastern and western portions of the stock area separately (Fig. 13b). The trend for the eastern portion of the stock area is similar to that for the abundance and biomass indices for the stock area as a whole. Catch rates for the eastern portion show considerable variability, with strong year effects, but are generally higher in the 1980's, and low after 1991, except in 2001. The 1995 estimate is influenced by a single large catch taken at the southern end of Halibut Channel. The catch rates for the western (Burgeo) portion, which has been surveyed in April since 1993, are extremely variable, but are generally higher than those for the eastern region. The value for 1998 is extremely high due to several large catches on Burgeo Bank and vicinity that may have included fish from the neighbouring northern Gulf (3Pn4RS) cod stock. The trends in recent years have diverged between indices for the eastern and western portions, with the eastern region showing a decline and the western region showing an increase. The overall trend in the combined index is a slight downward trend in recent years.

The spatial distribution of catches of cod during the recent surveys was examined (Figs. 14-17). During 1999-2002 cod were caught over a considerable portion of NAFO Div. 3P with the largest catches typically in the southern Halibut Channel area, on Burgeo Bank and vicinity, in the outer portion of Fortune Bay, and in 3Pn (Fig 14). During these four years cod were consistently scarce in the deep water below the mouth of Placentia Bay and in the inner reaches of Hermitage Channel. Since 2000, catches of cod on the central portion of St. Pierre Bank have become progressively scarcer. In the 2003 survey (Fig. 15), the distribution of cod is similar to that of the 2002 survey, with no large catches on St. Pierre Bank. In the age-disaggregated plots of the 2003 survey (Fig. 16, Fig. 17), there are notable catches of most ages from 3-8 year olds in four areas, namely outer Fortune Bay, Halibut Channel, the entrance to Hermitage Channel adjacent to the southern edge of Burgeo Bank, and in 3Pn. Notably, there are two large catches of 5 and 6 year olds (1997 and 1998 year classes) on the southern edge of Burgeo Bank and a single large catch of these same year classes at the extreme southern edge of Halibut Channel.

Colbourne and Murphy (2003) analysed changes in the distribution of survey catches in relation to temperature. The most evident trend in the numbers of cod caught per set during the multi-species surveys was the high number of zero catches in the <0°C water on St. Pierre Bank and regions to the east of the Bank, mainly from 1985 to 1998 but also from 2001 to 2003. During 1999 and 2000 larger catches became more widespread over St. Pierre Bank as cold (<0°C) water disappeared from the area. In general, during all surveys most of the larger catches occurred in the warmer waters (2°-6°C) along the slopes and areas to the west of St. Pierre Bank. In addition, variations in the estimated abundance and biomass of cod from the RV surveys in strata with water depths <92 m are significantly correlated with bottom temperatures for that depth range.

7.2 Age composition

Survey numbers at age are obtained by applying an age-length key to the numbers of fish at length in the samples. The current sampling instructions for Subdiv. 3Ps require that an attempt be made to obtain 2 otoliths per one cm length class from each of the following locations:

Northwest St. Pierre Bank (strata 310-314, 705, 713), Burgeo Bank (strata 306-309, 714-716), Green Bank-Halibut Channel (strata 318-319, 325-326, 707-710), Placentia Bay (strata 779-783) and remaining area (strata 315-317, 320-324, 706, 711-712). This is done to spread the sampling over the survey area. The otoliths are then combined into a single age-length key and applied to the survey data. The resulting estimates of age-disaggregated mean numbers per tow are given in Table 11. It is in this form that the data are used in the calibration of sequential population analysis models. These data can be transformed into trawlable population at age by multiplying the mean numbers per tow at age by the number of trawlable units in the survey area. This is obtained by dividing the area of the survey by the number of trawlable units. For 3Ps, the survey area is 16,732 square nautical miles including only strata out to 300 ftms and excluding the relatively recent strata created in Placentia Bay. The swept area for a standard 15 min tow of the Campelen net is 0.00727 square nautical miles. Thus, the number of trawlable units in the 3Ps survey is $16{,}732 \div 0.00727 = 2.3 \times 10^6$.

The mean numbers per tow at age in the RV survey for the entire index is given in Table 11A. Cod up to 20 years old were not uncommon in survey catches during the 1980's, but the age composition became more contracted through the late 1980's and early 1990s. Survey catches over the post-moratorium period have consistently shown few survivors from year-classes prior to 1989. Recent surveys (2000-2003) indicate that the 1997 and 1998 year classes are stronger than those seen through the mid-1990s, given that their catch rates are much higher and they track through the time series quite consistently. The strength of these recent year classes has tended to diminish in the overall index and this has considerable influence in the sequential population analysis results (see Section 10). These 1997 and 1998 age classes were well distributed across the stock area in the 2003 survey and also appear strong in recent GEAC surveys, and to a lesser extent in the sentinel line-trawl catches in recent years. The 1999, 2000, and 2001 year classes all appear less strong than those of 1997 and 1998 at young ages (i.e ≤ 4). Data for the most recent year classes are somewhat limited for firm conclusions to be drawn, but this may be cause for concern. In the survey results, the exceptionally low 1997 survey catches appear anomalous given that three year classes (1989, 1990 and 1992) that have been well represented in the post-moratorium fishery, the 1998-2002 DFO surveys, and the fall industry (GEAC) surveys, did not appear to be encountered in the 1997 survey. The 1990 and 1989 year classes have reached ages 13 and 14 in the most recent survey, but the 1989 year class is no longer well represented. The age composition of survey catches has improved but remains somewhat contracted relative to the mid-1980's with few fish older than age 15 in recent surveys of 3Ps.

The age composition of the survey catches from the eastern and western portions of the stock area can be compared from 1993 onwards (Table 11B). Catches-at-age per tow have tended to be higher in the western portion of the stock area, with a notable spike in 1998 and a recent upward trend in the index for the western portion largely due to the strong 1997 and 1998 year classes. The trend for the recent portion of the index for the eastern region, and for the overall index has been downward in the past three years, although the 1997 and 1998 year classes are still well represented.

7.3 Size-at-age (mean length and mean weight)

The sampling protocol for obtaining lengths-at-age (1972-2003) and weights-at-age (1978-2003) has varied over time (Lilly 1998), but has consistently involved stratified sampling by length. For this reason, calculation of mean lengths and weights included weighting observations by population abundance at length (Morgan and Hoenig 1997), where the abundance at length (3-cm size groups) was calculated by areal expansion of the stratified arithmetic mean catch at length per tow (Smith and Somerton 1981).

Mean lengths-at-age (Table 12; Fig. 18a) varied over time. A peak occurred in the mid-1970s for young ages (3-4) and progressively later to 1980 for older ages. This peak does not track individual year-classes particularly well, but in general year-classes born in the 1970s experienced faster growth than those born in the 1980s (Lilly 1996; Chen and Mello 1999a). From the mid-1980s to the present, length-at-age tended to increase at young ages (2-3) and to vary with no clear trend at older ages. Year-to-year variability at older ages was considerable (as much as 20 cm at age 10) during the past decade or so.

There has not yet been a thorough analysis to determine if these differences were caused mainly by environmental factors (e.g. temperature or prey availability), cohort factors (e.g. cohort or population abundance, distribution) or any of the numerous additional possibilities, such as changes in maturation schedules (Chen and Mello 1999b) or size-selective fishing mortality. Variability associated with sampling or processing could also be important.

An exploration of the effects of environmental factors such as temperature has not been conducted because there appears to be negative growth for at least 2 cohorts during each of the intervals 1977-1978, 1980-1981, 1989-1990 and 1993-1994 (Lilly 1998). Such extreme year effects could result from the existence within 3Ps of groups of fish with different growth rates, coupled with annual variability in the proportion of the age sample taken from each of those groups. This possibility is discussed further by Lilly (1996), but has not yet been explored.

Much of the high variability in length-at-age at older ages (say 7-10) in recent years appears to be caused by cohort effects. For example, the 1989, 1990 and 1992 year-classes were relatively long at age, whereas the 1988, 1991 and particularly the 1987 year-classes were relatively short (Fig. 18b). The small length-at-age of the 1991 year-class, compared to the adjacent 1990 and 1992 year-classes, is striking. There has not yet been an investigation of the reasons for such cohort effects.

Selectivity characteristics of the research trawl are also of concern for accurate estimation of size-at-age at younger ages, particularly ages 1 and 2. It may be assumed that estimation at younger ages has improved since the change to the Campelen trawl in 1996. An important contributor to variability in the estimates of size-at-age at older ages is the increase in range of sizes within a cohort as it ages, combined with a decrease in sample size at length, the latter being a simple consequence of declining abundance.

As expected, the patterns in mean weight-at-age (Table 13; Fig. 19) appear to be very similar to those in length-at-age. The high year-to-year variability at older ages in recent years, noted above for length-at-age, is much more pronounced in weight-at-age, with weights-at-age in some years being more than twice that in others. The weight-at-age estimates may include more sampling variability than the length-at-age estimates in years prior to 1990 because they are based on much smaller sample sizes (Lilly 1998). The weight-at-age data also include variability associated with among-year and within-year variability in weight at length (condition).

7.4 Condition

The somatic condition and liver index of each fish were expressed using Fulton's condition factor ($(W/L^3)*100$), where W is gutted weight (kg) or liver weight (kg) and L is length (cm). Condition and liver index at age were calculated as described above for size-at-age.

Mean somatic (gutted) condition at age (Table 14; Fig. 20A) was variable from 1978 to 1986 and relatively constant from 1986 to 1992. It dropped suddenly in 1993, rose to an intermediate level in 1996-1998 and subsequently declined although the most recent values have returned to an intermediate level. Condition at age could be influenced by changes in length-at-age (see above) combined with the tendency for condition calculated with Fulton's formula to increase with body length. For this reason, condition at length (Fig. 20B) might be more appropriate than condition at age as an indicator of changes in condition over time. In addition, much of the apparent annual variability in the survey data is related to the timing of the surveys (Lilly 1996). When mean condition in each of three length groups was plotted against the median date of sampling during the survey (Fig. 20C), there was a gradual decline in condition from the earliest median date (Feb. 7) to approximately late April, after which there was an increase. The time course of changes from late April onward is poorly defined because of the paucity of observations. Sampling of cod caught during sentinel surveys in the inshore in 1995 revealed a similar decline in condition during the winter and early spring, with a minimum in roughly late April to early June (Lilly 1996).

Mean liver index at age (Table 15; Fig. 21A) had a pattern similar to that seen in somatic condition, except that the values in 1983 were more clearly at higher levels than during other years in the early 1980s and there was a more pronounced peak in the late 1980s and early 1990s. When the values for specific size groups (Fig. 21B) were plotted against the median date of sampling (Fig. 21C), there was a very pronounced decline in liver index during winter and early spring. A similar decline was evident in samples from the 1995 sentinel survey (Lilly 1996).

From the above, it is clear that the low somatic condition and liver index in recent years (1993-2003) are interpreted to be mainly a consequence of sampling near the low point of the annual cycle and not to be indicative of a large and persistent decline in well-being. Nevertheless, it is also apparent that there was some annual variability within this recent time period. To explore this a little further, percentiles of gutted condition and liver index were calculated for all cod of a relatively wide size range (40-59 cm) sampled during the 1993-2003 period. There was considerable variability in gutted condition (median = 0.693; 90^{th} percentile range = 0.597 – 0.792; n = 1814). The distributions did not vary much among years, but the medians in 1996, 1998, and 2003 were somewhat higher than in other years (Fig. 22). Percentiles for liver index were also highly variable (median = 0.0174; 90^{th} percentile range = 0.0064 – 0.0376; n = 1825). Median liver index was highest in 1998 and 2003 and lowest in 1999 and 2001. Reasons for these small annual differences have not been investigated, but they will undoubtedly be complex.

7.5 Maturity and spawning

The gonads of samples of cod collected during annual DFO winter/spring bottom-trawl surveys were visually inspected and assigned to the category "immature" or "mature" according to the criteria of Templeman et al. (1978). Mature fish were further classified as maturing, spawning, or spent (see Morgan and Brattey 1996). Visual inspection is not always totally accurate and there can be difficulties in classifying some stages; for example, mature fish that are skipping a spawning year may be erroneously classified as immature or vice-versa and mature fish that have recently shed a batch of hydrated eggs may be classified as maturing when they are in fact spawning. The extent to which these errors influence the estimation of proportion mature and proportion at each stage of maturation has not been fully evaluated. However, Bolon and Schneider (1999) showed using histological methods that the visual method of classification was reasonably accurate, but tended to slightly underestimate the proportion of spawning fish and overestimate the proportion of maturing fish when spawning was occurring in Placentia Bay.

Annual estimates of age at 50% maturity (A_{50}) for females from the 3Ps cod stock, collected during annual winter/spring DFO RV surveys, were calculated as described by Morgan and Hoenig (1997). Only cohorts with a significant slope and intercept term are shown. As in the 2000-2002 assessments, maturation is estimated by cohort rather than by year; prior to 2000 maturation was estimated by year. In addition, data extending back to 1954 has been included in the current analyses. The estimated age at 50% maturity (A_{50}) was generally between 6.0 and 7.0 for cohorts from the mid-1950s to the early 1980s, but declined dramatically thereafter to a low of 5.1 in the 1988 cohort (Table 16, Fig. 23A). Age at maturity by cohort remained low but fairly constant for the 1988 to 1994 cohorts; estimates for the 1995 and 1996 cohorts appeared to be increasing, but are followed by a further decline for the 1997 and 1998 cohorts with the latter having the lowest A_{50} in the time series at 4.6 yr. Estimates for the more recent cohorts are more uncertain because only younger ages from these cohorts are available to estimate A_{50}; nonetheless, these recent further declines may be of concern (Trippel 1995; Heino et al 2002). Males show a similar trend over time (data not shown), but tend to mature about one year earlier than females. The annual estimates of proportion mature for ages 3-8 show a similar increasing trend (i.e. increasing proportions of mature fish at young ages) through the late 1970s and 1980s, particularly for ages 5, 6, and 7 (Fig. 23B). In particular, the model estimate for the proportion mature at age 5 in the 1998 cohort (0.84) is much higher than that of recent cohorts at the same age. The overall age at maturity remains low among 3Ps cod and this has a substantial effect on the estimates of spawner biomass for this stock (see Section 10). In addition, the age composition of the spawning biomass may have important consequences in terms of producing recruits. A spawning stock biomass that consists mainly of older fish, or a broad age range, may result in a longer time span of spawning (Hutchings and Myers 1993; Trippel and Morgan 1994). Older, larger fish also produce more viable eggs and larvae (Solemdal et al. 1995; Kjesbu et al. 1996; Trippel 1998). Several characteristics of the spawning stock biomass (SSB) of 3Ps cod (and other NF fish stocks) were explored for variability and for relationships with the residuals from Beverton-Holt stock-recruit models (Morgan et al. 2000). Weighted mean age of the SSB, proportion of first time spawners, and proportion female all showed substantial variability over time, but the results were not consistent among the stocks examined and were difficult to interpret.

The time series of maturities for 3Ps cod shows a long-term trend as well as considerable annual variability, but is reasonably stable in the last several years. To project the maturities for 3Ps cod forward to 2010, for each age group the average of the last three estimates for the same age group was used (Table 17). To fill in missing age groups in the early part of the time series the average of the first three estimates for the same age was used. These values were available for projections of mature spawner biomass in the evaluation of TAC options (see Section 9.3).

Maturities of adult female cod sampled in three sub-areas of NAFO subdivision 3Ps during winter/spring RV bottom-trawl surveys from 1983-2003 are shown in Fig. 24. Note that immature fish are excluded from this analysis. The areas are defined as Burgeo Bank / Hermitage Channel (Strata 306-310 and 714-716), Southern 3Ps / Halibut Channel (all areas south of 45°34.5' N), and mid-3Ps which includes the remainder of the subdivision (excluding inshore strata 293-300 and 779-783). The timing of the survey varied through the time series, with surveys predominantly in April during 1983-84, March during 1985-1987, February from 1988-1992, and April from 1993 to 2002. There were two surveys (February and April) in 1993; only the April one is shown here. The three sub-areas show a consistent pattern of maturity stages across most of the time series, with maturing fish dominating in most years. The switch in timing from February to April clearly results in an increase in the proportions of spawning fish and a reduction or disappearance of fish that are spent from the previous year. When surveys were conducted in April, spawning and spent fish were found in each area; within any one year the proportion of spawning and spent fish tended to vary among sub-areas, but generally about 15-40% of the mature fish sampled were spawning or recently spent. The results from the 2003 survey show no dramatic changes from recent years, except in Halibut Channel where there is a higher proportion of spent fish. The results from the March 1987 sample from the Halibut Channel also appear somewhat anomalous, with a high proportion of spawning fish compared to other areas in 1987 and compared to adjacent years within the same area. The results also show that a substantial proportion (typically 20-30%) of the mature female cod sampled in the Burgeo area in the April surveys are spawning or spent and therefore, by definition, belong to the 3Ps stock. Most of the remaining adult females in Burgeo are maturing to spawn later in the same year and their stock affinities remain unclear.

Overall, cod in 3Ps appear to spawn over a significant portion of the year and at many locations within the stock area, and there appears to be no consistent peak in the spawning time. Spawning is spatially widespread and is known to occur on Burgeo Bank, St. Pierre Bank, and the Halibut Channel area, as well as inshore in Hermitage Bay (3Psa) Fortune Bay (3Psb) and Placentia Bay (3Psc). Spawning in Placentia Bay in recent years has been studied more intensively (Bolon and Schneider 1999; Lawson and Rose 1999; Bradbury et al. 2000; Mello and Rose 2001).

8. GEAC Stratified Random Trawl Survey

In 2002, the Groundfish Enterprise Allocation Council (GEAC) carried out a sixth consecutive fall bottom-trawl survey directed at cod with the intention of creating a series of annual fall surveys in 3Ps to complement current DFO RV surveys conducted in spring. DFO provides advice on the stratified random design and catch sampling. Results of the previous surveys are reported in McClintock (1999a, b, 2000, 2001, 2002) and for the most recent survey conducted during 23 November to 3 December 2002 in McClintock (2003). These surveys are carried out in late fall and cover a large portion of offshore 3Ps, but not the Burgeo Bank area (see McClintock 2000). The commercial trawler *M.V. Pennysmart* was used in all six 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 (Netmind in previous years): bridge display of door-spread, opening, and clearance were recorded. No wingspread sensor was used in the 2001 survey and an assumed wingspread of 60 ft was used; in the 2002 survey the doors sensor was moved in several sets to obtain measurement of trawl wingspread The gear and configuration were identical in all five surveys. A total of 75 successful stratified random tow sets were completed in the 2002 survey. One set (#7) was unsuccessful.

The Scanmar net monitoring instruments were deployed during the 2002 survey and details of trawl performance are given in McClintock (2003).

The mean cod catch per tow in 2002 was 47 fish with a mean catch weight of 114 kg. These are similar to the 2001 survey values (50.5 fish per tow and 95 kg per tow, respectively). The largest catch of 2,877 cod weighing 7,020 kg was from stratum 320 on St. Pierre Bank at a depth of 146 m. A total of 5 sets had catches over 100 kg (compared to 10 in 2001), and two sets had catches over 1,000 kg (the same as in 2001). The mean cod weight for all sets was 2.19 kg, slightly higher than the 1.87 kg per cod in 2001, but substantially less than the mean for 2000 (>5.0 kg). Most of the larger catches were obtained from the Halibut Channel (stratum 319, see Fig. 11).

The 1997 trawlable biomass index was 99,330 t whereas the 1998 and 1999 estimates for a larger survey area were 47,875 t and 44,521 t, respectively (Fig. 25). The trawlable biomass index for 2000 was 187,229 t, compared to 82,686 t in 2001. The 2002 trawlable biomass index was 92,200 t. Thus 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.
The abundance index is also variable, with lowest value in 1998 and the highest in 2001 (Fig. 25).

In terms of age composition, the 1997 survey catch was dominated by 5 year olds (1992 year class) and 7-8 year olds (1990 and 1989 year class)(Table 18). In the 1998 survey, 9 year olds dominated (1989 year class) and next most abundant were 5 year olds (1994 year). In the 1999 survey, the 1989 and 1990 year classes are well represented along with the 1992, 1993, and 1994 year classes. In the 2000 survey, the 1989, 1990, and 1997 year classes are strongly represented. In the 2001 and the 2002 survey the 1997 and 1998 year classes are strongly represented. The 1991 year class is poorly represented relative to adjacent year classes in all six surveys.

Further information on catches from the 2002 GEAC survey is given in McClintock (2003). The catch-rate-at-age information from the GEAC surveys (1997-2002) is included as an index in the sequential population analysis (see Section 9). Overall, the GEAC survey is showing considerable annual variability, similar to the DFO RV survey that covers a wider area but is conducted in spring. However, the age compositions of the catches from these surveys are in reasonably close agreement, particularly in the most recent years.

9. Mixing with adjacent stocks

Fishers and scientists have recognized that some mixing occurs between cod from the south coast of Newfoundland (3Ps) and the northern Gulf of St. Lawrence (3Pn4RS). The mixing is generally perceived to take place in the western portion of 3Ps during the winter months (approximately November to April). There is a long history of scientific investigations on mixing between these stocks (see Brattey 1996) and various techniques have been used to provide information on this issue, including genetics (Ruzzante et al. 1998; Ruzzante et al. 2000; Beacham et al. 2002), tagging (Lear 1984, 1988; Taggart et al. 1995; Bérubé and Fréchet 2001; Brattey et al. 2002a, b; Brattey and Healey 2003, Brattey and Healey 2003), meristics (Templeman 1981), analysis of fleet activities, fishery statistics and general biology (Pinhorn 1969), otolith elemental analysis (Campana et al. 1999), and parasite infection levels (Templeman et al. 1976).

These studies have shown that the duration, timing and extent of mixing appear to vary annually and may be strongly influenced by oceanographic conditions. However, these investigations have not provided reliable methods to assign fishery or survey catches from the mixing area to the appropriate stock, and the issue has been addressed in recent years partly by management measures, most notably seasonal closures of the directed cod fishery (November 15th to April 15th) in unit area 3Psd (southern Burgeo Bank and entrance to Hermitage Channel) since 1998. The total reported landings from western 3Ps (unit areas 3Psa and 3Psd combined) for 1 November to 30 April during the post-moratorium period are summarized below:

	Reported landings (t)		
November-April	**3Psa**	**3Psd**	**Total**
1998-1999	764.4	209.4	973.8
1999-2000	1285.3	223.3	1508.6
2000-2001	587.2	133.8	721.0
2001-2002	440.5	152.3	592.8
2002-2003	174.9	85.6	260.5

The reported landings have declined dramatically to only 261 t. The decline is likely due to a combination of measures, including a reduction in the overall TAC as well as a switch to individual quota's (IQ's) rather than a competitive fishery in regions west of the Burin Peninsula. Landings of the magnitude reported for 2002-2003 are unlikely to have a significant impact on the population dynamics of the northern Gulf stock.

In addition, the timing of DFO research vessel surveys has been delayed until April since 1993 in an attempt to allow any migrant northern Gulf cod present in western 3Ps to return to the Gulf and therefore not be included in 3Ps survey catches; prior to 1993 the 3Ps survey was often conducted in February-March. In some analyses conducted in recent years the DFO RV survey has also been split into two indices, one for the eastern and one for the western (Burgeo portion) of 3Ps. Various other analyses of the catch and survey data have also been conducted in an attempt to account for mixing. In some sequential population analyses (SPA's), 75% of the reported November-April catch from western 3Ps (unit areas 3Psa and 3Psd) since 1986 was assigned to the 3Pn4RS stock, but this had little influence on the outcome of the assessment of northern Gulf cod (Fréchet et al. 2003). Other attempts to account for mixing are summarized in Chouinard (2000).

The failure of northern Gulf cod to recover significantly during the moratorium period contrasts with the situation in 3Ps, with the latter supporting a directed cod fishery with TAC's ranging from 10,000 to 30,000 t since 1997. Given the history of stock mixing in western 3Ps, some fishers (particularly those in 3Pn) contend that the fishery in 3Ps is adversely affecting the recovery of the northern Gulf stock; they feel that the mixing issue has not been adequately addressed by recent management measures. They claim that mixing extends much further inshore (3Psa) and eastward to St. Pierre Bank (3Pse/f/g) and Halibut Channel (3Psf/h) than previously thought and contend that the large vessel (>100ft) winter otter trawl fishery in 3Ps is catching migrant cod from the northern Gulf and seriously impacting the recovery of that stock. The evidence for their conclusion comes from two sources: (1) a single cod tagged with a data storage tag in La Poile (3Pn) was subsequently reported as recaptured by a large otter trawler fishing in

Halibut Channel (3Psh) in winter. A second tagged cod was also recovered with identical temperature profile although the location of capture was unknown. (2) Fishers in 3Pn claim that they can track the movements of cod out of the Gulf during winter and that the cod aggregations often cross the stock management boundary into 3Ps around November, but subsequently disappear. Around the same time, a winter fishery by large trawlers begins on the south east corner of St. Pierre Bank and in Halibut Channel and, largely because of the coincidence in timing, some 3Pn fishers believe that catches taken by this fishery must include migrant cod from the northern Gulf.

Extensive tagging of cod has been conducted in 3Pn4RS since 1996, but there have been few recoveries of these cod from the offshore winter fishery in 3Ps. Fishers claim that 3Ps fishers recognize that the tags are from northern Gulf cod because of the tag return address and simply do not send them in (also there was no reward, only a lottery prize). Similarly, extensive tagging of cod in Halibut Channel has been conducted during April since 1998, with only one recovery (>6,000 releases) from 3Pn4RS. Fishers contend that tagging has been conducted at the wrong time of year and that tags should be applied at the time of the winter offshore trawler fishery (November-February) to demonstrate the presence of Gulf cod; they contend that the Gulf cod have left the area by April when tags are being applied. More extensive tagging coverage could provide more definitive information on the eastward extent of mixing. Cooperative tagging studies with industry were initiated in late fall 2003 to address this issue.

Results from recent tagging studies conducted in the Burgeo Bank / Hermitage Channel area have suggested that delaying the DFO RV survey of 3Ps until April (since 1993) may not always be entirely successful in eliminating northern Gulf cod from 3Ps survey catches. Spring tagging experiments conducted in the Burgeo area, notably those conducted in April 1998, have subsequently resulted in many recaptures from the northern Gulf stock area. Many recaptures were also obtained from within 3Ps, although overall exploitation of cod tagged in the Burgeo area was estimated to be low (Brattey and Healey 2003). The spawning locations and therefore precise stock affinities of cod found in the Burgeo area in April are not well known (see Section 8). These aggregations may comprise various combinations of locally spawning fish that migrate to eastern 3Ps or to 3Pn4RS during summer, over-wintering fish that spawn in eastern 3Ps, and over-wintering northern Gulf cod that migrate back to 3Pn4RS to spawn. Survey catch rates in the Burgeo area are generally higher than those in eastern 3Ps (see Fig. 13b) and often a considerable portion of the overall biomass index for 3Ps comes from the western portion of 3Ps. Consequently, the catches from this area have a considerable influence on the overall trends in the survey biomass index.

The relative strength of various year-classes in commercial catches and catch rate indices from 3Ps and 3Pn4RS were examined to determine if there was any synchrony or asynchrony in year-class strength that might shed light on the extent of mixing between northern Gulf (3Pn4RS) and 3Ps cod. The age-structured data sets that were examined from 3Pn4RS were: the commercial catch, with numbers at each age expressed as a percentage of the annual total (Table 19), the Needler survey (Table 20), the sentinel gillnet and the sentinel line-trawl for 3Pn4RS (Table 21). For 3Ps the data sets are the commercial catch, again with the numbers at each age expressed as a percentage of the annual total (Table 22), the RV survey index (split into eastern and western portions, Table 11B), the sentinel line-trawl index (Table 8, most line-trawl data come from the western portion of the inshore), and the GEAC fall offshore trawl survey (Table 18). In each of these tables, four year classes of interest are highlighted. Examination of the catch rates of these over time indicates the following: In the 3Pn4RS commercial catch the 1993 year class is strong for several consecutive years (ages 4-9); it is also consistently strong in the Needler survey from

1997-2001 at ages 4-8. The 1993 year class is also strong at ages 6-9 in the northern Gulf sentinel line-trawl, and from 1999-2002 at most ages from 5 to 9 in northern Gulf sentinel gillnet. In contrast, the 1993 year class is consistently weak in the commercial catch and survey indices for 3Ps, except in the 1998 and to a lesser extent 1996 survey index for the western portion of 3Ps (i.e. age 5 and age 3, Table 11B). In 3Ps, the 1989 year class is consistently strong at all ages from age 3 to age 13 in the commercial catch (Table 22), and in the DFO RV survey for the eastern portion of 3Ps at several ages from 6-13 (Table 11B). The 1989 year class is also consistently strong at ages 8-13 in the industry trawl survey that covers offshore 3Ps (Table 18), and in the 3Ps sentinel line-trawl catch (Table 8).

The 1989 year class does not appear strongly in the northern Gulf commercial catch (Table 19), the Needler survey (Table 20), or either of the northern Gulf sentinel indices (Table 21). The 1989 year class does not appear strongly in the DFO RV survey for the western portion of 3Ps, except at age 5 in 1994 and at age 9 in 1998. The age compositions of the DFO RV survey catches from western 3Ps are unusual; neither the 1993 nor 1989 year classes appear to track through the survey catches for this region with any degree of consistency. The relatively high catch rates of the 1993 year class in western 3Ps during 1998 may indicate the presence of northern Gulf cod in that year; however, close inspection of the data reveals that all ages from age 4 to age 9 (i.e. 1989 to 1995 year classes inclusive) are strongly represented in 1998, yet in subsequent years most of these year classes are not seen strongly again in either 3Ps or 3Pn4RS. Similarly, the 2003 survey index for western 3Ps has several older year classes appearing strongly that have not been well represented in previous years. This indicates that there are strong year effects in the DFO RV survey index for western 3Ps that cannot be explained by annually variable mixing alone.

In recent years the 1997 and 1998 year classes have appeared strongly in several survey indices of 3Ps. Of particular interest is the consistently high catch rates of these age classes in the DFO RV survey of western 3Ps (Table 11B) and in recent GEAC survey catches (Table 18) which cover the offshore portion of eastern 3Ps and exclude the Burgeo area. These two year classes are also well represented in the DFO RV survey index for eastern 3Ps (Table 11B). These year classes are still rather young to be fully selected by commercial gear, but the 1997 year class has appeared strongly in the 3Ps commercial catch in 2002 (Table 22). Thus, there is good evidence form several sources that these two year classes are the strongest to appear in 3Ps in several years. However, when the data for the northern Gulf are examined there are no indications that these year classes are well represented, either in the Needler survey (Table 20), the northern Gulf sentinel line-trawl or gillnet (Table 21), or the northern Gulf commercial catch (Table 19). These comparisons of year class strength indicate asynchrony in the production of strong year classes between cod from the northern Gulf and cod from 3Ps.

The strong representation of the 1997 and 1998 year classes in the DFO RV survey of western 3Ps but not in the northern Gulf stock area suggest that, at least in recent years, this area may be an over-wintering region for small fish from the 3Ps stock. While splitting the survey index for 3Ps into two tuning indices may be useful to account for potential stock mixing, these observations suggest that it may create new problems in the indices with respect to recruitment. If smaller cod aggregate in western 3Ps at the time of the survey, the influence of the high catch rates of these strong year classes is down-weighted in SPA's for the full stock that use the split index, because of the much shorter time series that is available for the index for the western region. In light of these findings the issue of splitting the 3Ps survey data into two tuning indices, one for the eastern and one for the western regions, needs to be carefully reconsidered.

Recent tagging studies have also indicated some migration of cod tagged in 3Ps into southern 3L, particularly those tagged in April in Halibut Channel (3Psh), and April-May at the head of Placentia Bay (3Psc)(Brattey and Healey 2003). Consequently, the inshore fishery in southern 3L likely results in some fishing mortality on 3Ps cod. Although the reported cod landings from southern 3L in recent years have typically been less than 1,000 t (Brattey and Healey 2003), the closure of the directed cod fishery in the inshore of 3KL during 2003 is likely to result in some reduction in the exploitation of 3Ps cod.

10. Sequential Population Analysis

10.1 Description of SPA runs for the current (2003) assessment

In the 2003 assessment, the decision was made to limit analysis to the identical 5 models / formulations considered in the 2001 and 2002 assessments. The catch-at-age data available for use in the sequential population analyses is presented in Table 6. These models were applied to the catch data from 1977 onwards (except for run A, for which the catch data back to 1959 was used)(see Table 6). The age dis-aggregated tuning indices available for calibrating the SPA's were: the RV index (split or non-split with respect to the Burgeo Bank strata depending on the model/formulation), Cameron index, Sentinel line-trawl index (and, in the case of the comparison run, the sentinel gillnet index as well) and the GEAC index (with the exception of run A). The ages and years available for each index are as follows:

Index	Ages	Years
Cameron	2-14	1977-1982
RV Index (non-split)	2-14	1983-2003
RV Index split (eastern)	2-14	1983-2003
RV Index split (western)	2-14	1993-2003
Sentinel gillnet	3-10	1995-2002
Sentinel line-trawl	3-10	1995-2002
Industry trawl (GEAC)	2-14	1997-2002

The rate of natural mortality was assumed to be 0.2 per year. As was the case in the 2002 assessment (Brattey et al. 2002a), the 5 five model/formulations comprised:

A) QLSPA run with the identical formulation to Run A in the previous assessment (Brattey et al. 2002a), updated with an additional year of data for the catch and tuning indices (includes catch from 1959 onwards and the sentinel gillnet index). In this formulation the RV is split into eastern and western portions, self-weighting is applied and the ratio of *F* at age 14 to the average *F* on ages 11-13 was estimated, but constrained to be equal in all years between 1959 and 1993. The *F* ratio was estimated independently for each year between 1998 and 2001, and for ages10-13 in 1993 (each ratio being based on the average of the preceding three ages) on account of the moratorium. This run has been termed the "comparison run" in previous assessments and did not incorporate the GEAC index because when it was first proposed the time series for this index was too short. Given that the GEAC time series now extends to 6 years it may not be informative to continue this formulation and run A is likely to be dropped in subsequent assessments.

B) QLSPA run with the catch at age from 1977 onwards, same tuning indices as in A (split RV) except with the sentinel gillnet index dropped from the calibration and the GEAC index added (not the Cameron index as was erroneously reported in Brattey et al. [2002a]), self-weighting of the indices, and the *F* ratio at age 14 estimated independently for each year from 1977-1993 and 1998-2001, but with estimates shrunk towards 0.5 (the fit function is equal to the deviance plus a shrinkage penalty), *F* ratio in 1993 estimated (with no shrinkage) for ages 10-13 (in each case based on the ratio to the average F in the previous three ages).

C) XSA was run on the same catch at age and tuning indices as B, with survey catchability *q* on age 14 constrained to be equal to age 13, with *F* on age 14 constrained to be equal to 0.4*average *F* on ages 11-13 for 1977-1992, and inverse variance weighting of each fleet's estimates of survivors limited to a minimum standard error threshold of 0.5. This limitation is implemented in order to reduce possible influence of fleets with low catchability standard errors at certain ages due to use of too few data points.

D) ADAPT using the same catch and tuning indices as B except the RV index was not split, survivors at age 14 for years 1993-2002 and ages 2-14 in 2003 estimated, *F* on age 14 constrained to be equal to half average *F* on ages 11-13 in each year for 1977-1992. Note that in the 2002 assessment Run D was calibrated with ages 2-14 from the DFO RV (Wilfred Templeman) survey index, whereas in the 2003 assessment it was found that inadvertently only ages 2-12 had been used.

E) ADAPT using the same catch and tuning indices as B, estimated survivors at age 14 for years 1993-2002 and ages 2-14 in 2003, *F* on age 14 constrained to be equal to half the average *F* on ages 11-13 in each year for 1977-1992.

In the current assessment, run D was used as an illustrative run to show trends in stock size in the Stock Status Report (SSR)(Anon, 2003), whereas details of run A ("comparison" run) were reported in detail in previous assessments and in previous SSRs. It is emphasized that run D is not considered to be "preferred" relative to the other runs. Comparisons of results from all 5 SPA formulations are given in a series of figures which illustrate trends in 3+ population numbers (Fig. 26a), 3+ population biomass (Fig. 26b), spawner biomass (Fig. 26c), recruitment expressed as the number of 3 year olds (Fig. 26d), and fishing mortality expressed as the average F on ages 5-10 (Fig. 26e). These figures indicate considerable uncertainty about the absolute size of the 3Ps cod population. However, as in the 2002 assessment the trends in the estimates from the 5 models are similar.

The estimates of 3+ population numbers from all five runs show a persistent decline from a peak of 240-290 million in the early 1980s to a minimum of 60 to 120 million through the mid 1990s (Fig. 26a). During 1998-2000 population numbers increased by about 50 to 75 million, but subsequently declined by about 30 to 50 million, with most estimates ranging between 100 and 150 million by 1 January 2003. The recent peak appears to be driven largely by the stronger incoming 1997 and 1998 year classes with the slight decline reflecting subsequent recruitment that is weaker. Run B tends to give the highest estimates of population numbers, particularly for the most recent period, whereas run C gives the lowest estimates. Note that for all SPA formulations considered the recent peak in population numbers in the early 2000's is substantially lower than the peak estimated for the mid-1980's.

The estimates of the biomass of cod 3 years and older show a peak of between 220,000 and 310,000 t in the mid-1980s followed by a steady decline down to a trough of between 35,000 – 100,000 t in the 1993/1994 period (Fig. 26b). Following the onset of the moratorium, estimates of population biomass increased during 1994 to 1998 to about 100,000 to 180,000 t. Population biomass subsequently leveled off or decreased slightly during 1998-2000 coincident with the resumption of fishing and an increase in the TAC from 10,000 t in 1997 to 30,000 t in 1999. During 2000 to 2003 most runs indicate that stock size has increased again albeit slightly. The resumption of the increase is coincident with reductions in TAC to 15,000 t in the most recent years. Note that the slight increase in biomass in the most recent years contrasts with the trajectory for population numbers for the period 2000 to 2003. The estimates of 3+ biomass from the five runs cover a broad range, particularly in the most recent period, with estimates for 1 January 2003 ranging from 100,000 t for run C to 216,000 t for run B. Both QLSPA formulations (Runs A and B) tend to give higher estimates of 3+ biomass, whereas run E tends to give the lowest. However, for all SPA formulations considered the estimates of 3+ biomass for the early 2000's are still substantially lower than the peak estimated for the mid-1980's.

The estimates of spawning stock biomass (SSB) from the five runs all show similar temporal trends, and the estimates cover a wide range throughout the time series (Fig. 26c). Two peaks in spawner biomass are evident, one in the mid-1980s and another in the late 1990's with estimates for both periods covering a range of about 75,000 t depending on the SPA. The most noticeable features of the trajectories for spawning stock biomass are (1) SSB declined persistently from the mid-1980s to the early 1990's, (2) SSB grew rapidly during the moratorium resulting in a recent peak in SSB that is almost as high as the peak of the mid 1980s, and (3) the estimates for SSB for 1 January 2003 show a marked increase from 1 January 2002, whereas 3+ population numbers have shown little change. There have been marked changes in the age at maturity of cod within 3Ps (see Figs. 23A and 23B), and a declining age at maturity appears to be an important factor in the high estimates of SSB for the post moratorium period. However, the size of the SSB may not be a sensitive measure of the reproductive and recruitment potential of the 3Ps stock (Marshall et al 1998). The spawning biomass in the post-moratorium period appears to be comprised of a much higher proportion of younger females compared to the period prior to the late 1980s. Furthermore, maturation of the 1998 cohort is of particular significance in the estimation of spawning biomass for 1 January 2003; this is a strong year class with extremely high proportion estimated to be mature by age 5 (0.85, see Table 17). The estimates of SSB for 2002 and 2003 are therefore particularly sensitive to this recent change in both cohort strength and the proportion of females that mature at young ages and become part of the spawning population.

The trends in the estimates of recruitment (numbers of 3 year olds) from the five SPA runs are generally consistent; the only exceptions are for the estimates of 3 year olds in 1992 (1989 year class) and in 2000-2001 (1997 and 1998 year classes) which vary considerably among runs (Fig. 26d). Overall, recruitment shows considerable annual variability, but as pointed out in previous assessments, there is a worrying overall downward trend in recruitment up to the late 1990s. The downward trend is even more apparent in the comparison run from previous assessments which incorporated data back to the 1956 year class (see Fig. 36 in Brattey et al. [2002a]). However, all five model estimates in the current assessment suggest that the downward trend may have recently been ameliorated by the 1997 and 1998 year classes which appear at this stage to be much stronger than those observed throughout the early to mid-1990s. Although data for subsequent year classes are limited, the 1999 and 2000 year classes appear to be much weaker, and in the longer term this may be cause for concern.

The trends in the estimates of fishing mortality (average of ages 5-10) from the five SPA runs suggest that there was a general increasing trend from about 0.3 in 1984 to a peak of 0.7 to 0.9 in 1992 (Fig. 26e). The rapid decline from 1992 to 1994 coincided with the moratorium, with the increasing trend following the reopening of the fishery in 1997 and subsequent increases in the

TAC to 30,000 t in 1999. Estimates of fishing mortality for the post-moratorium period are more variable among SPA runs, but have generally ranged between 0.19 and 0.42 and are slightly lower in the most recent years when the TAC was cut back to 15,000 t, The recent estimates are not as high as those observed for this stock in the late 1980's. Note that these estimates are for the stock as a whole and estimates of exploitation from recent tagging studies suggest that fishing mortality during 1998-2002 in some local regions such as Placentia Bay may be much higher.

10.2 Projections

In the current assessment, 3-year deterministic projections to 1 April 2006 were carried out for fixed annual TAC options of 10,000 t, 15,000 t or 20,000 t for the next three management years, i.e. the 2003/04, 2004/05 and 2005/06 fishing seasons. These projections were conducted to illustrate potential trends in the status of the stock over the next three years and they incorporate reasonable assumptions about growth, recruitment, maturation and natural and fishing mortality.

The inputs for the projections are given in Table 23. Given that the nine months of a management cycle are in one calendar year and three months are in the next year, the TAC had to be split across the calendar years because the analyses are age based and fish increment an age on January 1 each year. In recent years the catches in 3Ps have been split in proportion 0.83 to 0.17 and this split was assumed for each projection period. The partial recruitment (PR) vector was computed from the average F's for the period 2000-2002 from the relevant SPA. For projections, the PR was calculated in each year, averaged for each age, and then re-scaled to have a maximum of 1. The fishery has been dominated by gillnets in the recent period and most PR's consequently have a domed pattern. For recruitment during the projection period, the geometric mean numbers at age 3 in years 2000-2002 from the relevant SPA was used; this includes data from two year classes that are estimated to be relatively strong (1997 and 1998), and one that is estimated to be weaker (1999). Natural mortality was assumed to be 0.2 per year as used in previous assessments of 3Ps cod. The methods for estimating population weights-at-age (January 1), catch weights-at-age (mid-year), and maturity ogives are described in relevant previous sections. Note that the projections were carried out using different computer code for the different fit functions. In some cases the spawner biomass is computed for 1 January and 1 April in each projection year, while in other cases it is not in order to simplify the computer code. Given that the fishing season runs from 1 April to 31 March it is most appropriate to compare results from 1 April in one year (e.g. 2006.3) with 1 April in previous years to determine whether the population has grown or not. Furthermore, because the age composition is incremented only once each year (1 January) and beginning of year weights are applied, spawner biomass will always decrease during the 1 January to 1 April period under the combined effects of natural and fishing mortality. An additional complication arises from the age-based input matrices only extending out to age 14; consequently, the relatively strong 1989 year class drops out of the projections on 1 January 2004 and this has some influence on the estimates of stock size and spawner biomass.

A summary of projection results with respect to SSB is given in Table 24; this table summarizes percentage change relative to the values on 1 April 2003. At a TAC of 20,000 t four of the five formulations indicate that spawner biomass would decline by 1 April 2006. At a TAC of 15,000 t or 10,000 t three of five formulations indicate that spawner biomass would decline. The starting values (1 April 2003) for SSB differ widely among the five formulations, ranging from 76,000 t for run C to 174,000 t for run B. Only run C indicated that SSB would not decline relative to the 1 April 2003 values over the range of TAC options explored. The current projections are consistent with those in the previous assessment in that most formulations showed an increase in spawner biomass between 2002 and 2005, although the magnitude of the increase was generally less in this assessment.

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Table 1. Reported landings of cod (t) from NAFO Subdiv. 3Ps, 1959 - 1 Oct 2003 by country and for fixed and mobile gear sectors.

	Can. (Newfoundland)		Can. (Mainland)	France				Spain	Portugal	Others	Total
	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
1974	3,770	15,999	657	600		348	5,366	14,937	1,246	3,789	46,712
1975	741	14,332	122	586		189	3,549	12,234	1,350	2,270	35,373
1976	2,013	20,978	317	722		182	1,501	9,236	177	2,007	37,133
1977	3,333	23,755	2,171	845		407	1,734	-	-		32,245
1978	2,082	19,560	700	360		1,614	2,860	-	-	45	27,221
1979	2,381	23,413	863	495		3,794	2,060	-	-	-	33,006
1980	2,809	29,427	715	214		1,722	2,681	-	-	-	37,568
1981	2,696	26,068	2,321	333		3,768	3,706	-	-	-	38,892
1982	2,639	21,351	2,948	1,009		3,771	2,184	-	-	-	33,902
1983	2,100	23,915	2,580	843		4,775	4,238	-	-	-	38,451
1984	895	22,865	1,969	777		6,773	3,671	-	-	-	36,950
1985	4,529	24,854	3,476	642		9,422	8,444	-	-	-	51,367
1986	5,218	24,821	1,963	389		13,653	11,939	-	-	7	57,990
1987	4,133	26,735	2,517	551		15,303	9,965	-	-	-	59,204
1988	3,662	19,742	2,308	282		10,011	7,373	-	-	4	43,382
1989	3,098	23,208	2,361	339		9,642	892	-	-	-	39,540
1990	3,266	20,128	3,082	158	14,929	14,771	-	-	-	-	41,405
1991	3,916	21,778	2,106	204	15,789	15,585	-	-	-	-	43,589
1992	4,468	19,025	2,238	2	10,164	10,162	-	-	-	-	35,895
1993	1,987	11,878	1,351	-		-	-	-	-	-	15,216
1994	82	493	86	-		-	-	-	-	-	661
1995	26	555	60	-		-	-	-	-	-	641
1996	60	707 [2]	118								885
1997 [1]	122	7,205 [2]	79	448		1,191					9,045
1998 [1]	4,320	11,370 [2]	885	609		2,511					19,694
1999 [1]	3,097	21,231 [2]	614	621		2,548					28,111
2000 [1]	3,436	16,247 [2]	740	870		3,807					25,100 [4]
2001 [1]	2,152	11,187 [2]	856	675		1,675					16,546 [4]
2002 [1]	1,452	10,666 [2]	499	579		1,623					14,819 [4]
2003 [3]	1,474	7,230	394	16		927					10,040 [4]

[1] Provisional catches

[2] Includes food fishery and sentinel fishery.

[3] Catch for Canada and France to 1 October 2002.

[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 2001-2002, 2002-2003, and 2003-2004.

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		4995	4083	1364	3902	14344
1976		5983	5439	2346	7224	20992
1977		3612	9940	3008	7205	23765
1978		2374	11893	3130	2245	19642
1979		3955	14462	3123	2030	23570
1980		5493	19331	2545	2077	29446
1981		4998	20540	1142	948	27628
1982		6283	13574	1597	1929	23383
1983		6144	12722	2540	3643	25049
1984		7275	9580	2943	3271	23069
1985		7086	10596	1832	5674	25188
1986		8668	11014	1634	4073	25389
1987		9304	11807	1628	4931	27670
1988		6433	10175	1469	2449	20526
1989		5997	10758	1657	5996	24408
1990		6948	8792	2217	3788	21745
1991		6791	10304	1832	4068	22995
1992		5314	10315	1330	3397	20356
1993		3975	3783	1204	3557	12519
1994		90	0	381	0	471
1995		383	182	0	5	570
1996		467	158	137	10	772
1997		3760	1158	1172	1167	7258
1998	[1]	10116	2914	308	92	13430
1999	[1]	17976	3714	503	45	22237
2000	[1]	14218	3100	186	56	17561
2001	[1]	7377	2833	2089	57	12357
2002	[1]	8407	2655	429	119	11609
2003	[2]	6311	956	267	35	7568

[1] provisional catch

[2] provisional catch to October 1st 2003

Table 3a. Reported Canadian monthly landings (t) of cod from NAFO Subdiv. 3Ps by gear type for 2002 and 2003 (to 1 Oct 2003).

2002	**Offshore**			**Inshore**				
MONTH	**Otter trawl**	**Gillnet**	**Line trawl**	**Gillnet**	**Line trawl**	**Handline**	**Trap**	***Total**
Jan	458.3	0.0	6.4	248.1	106.8	4.4	0.0	824.0
Feb	387.4	12.5	169.1	104.0	6.6	0.0	0.0	679.7
Mar	130.1	0.0	43.3	66.7	13.5	2.9	0.0	256.5
Apr	23.4	0.0	10.2	0.1	3.9	0.0	0.0	37.6
May	4.1	0.0	0.8	321.4	30.4	0.4	1.7	358.8
Jun	0.0	19.7	5.4	697.2	126.9	48.8	42.7	940.6
Jul	0.1	104.5	30.4	1831.9	130.0	124.1	22.2	2243.3
Aug	51.5	481.2	40.9	567.6	151.6	280.5	52.5	1625.8
Sep	91.6	801.0	11.6	429.3	332.7	162.6	0.0	1828.8
Oct	100.0	405.2	31.9	297.5	371.7	29.1	0.0	1235.4
Nov	195.1	130.3	92.4	946.3	294.0	106.7	0.0	1764.8
Dec	145.6	47.4	99.6	315.6	198.5	12.7	0.0	819.4
TOTAL	1587.1	2002.0	542.0	5825.6	1766.6	772.1	119.1	12614.6

*total excludes some catch with other gears

2003	**Offshore**			**Inshore**				
MONTH	**Otter trawl**	**Gillnet**	**Line trawl**	**Gillnet**	**Line trawl**	**Handline**	**Trap**	***Total**
Jan	696.6	0.0	21.1	166.1	121.2	2.2	0.0	1007.1
Feb	743.0	14.4	33.7	25.5	30.1	0.0	0.0	846.6
Mar	44.9	0.0	54.0	1.2	0.1	0.0	0.0	100.3
Apr	17.8	0.0	10.1	0.3	1.5	0.0	0.0	29.7
May	0.5	0.0	9.4	272.4	56.8	15.1	10.1	364.3
Jun	0.0	14.8	37.0	1043.0	20.6	28.6	14.9	1158.9
Jul	7.3	113.0	9.5	1606.8	46.6	75.7	9.5	1868.4
Aug	17.9	176.9	4.0	600.2	192.1	116.1	0.0	1107.2
Sep	0.0	29.4	4.1	2230.7	303.3	29.2	0.0	2596.7
Oct	.	.	.	. .		.	.	.
Nov	.	.	.	. .		.	.	.
Dec	.	.	.	. .		.	.	.
TOTAL	1527.9	348.5	182.9	5946.2	772.3	266.9	34.5	9079.3

*total excludes some catch with other gears

Table 3b. Reported Canadian monthly landings (t) of cod from unit areas in NAFO Subdiv. 3Ps during 2002 and 2003 (to 1 Oct 2003).

2002	Inshore			Offshore						
Month	**3Psa**	**3Psb**	**3Psc**	**3Psd**	**3Pse**	**3Psf**	**3Psg**	**3Psh**	**3Ps_unk**	**Totals**
Jan	1.4	115.5	242.5	63.0	0.0	0.0	0.4	401.2	0.0	824.0
Feb	16.7	25.5	102.2	28.1	0.0	0.0	20.0	486.0	1.2	679.7
Mar	46.4	39.0	24.1	27.3	0.0	0.0	16.2	103.4	0.2	256.5
Apr	3.9	0.7	0.1	12.8	0.0	0.0	1.7	18.3	0.0	37.6
May	40.3	199.4	114.6	0.4	0.0	0.0	3.2	0.9	0.0	358.8
Jun	91.5	317.7	506.4	10.9	0.0	0.3	2.3	11.6	0.0	940.6
Jul	170.8	461.8	1475.8	29.8	7.9	78.4	0.8	10.1	8.6	2244.1
Aug	198.6	342.2	511.9	33.2	190.0	287.0	14.9	46.2	3.6	1627.7
Sep	286.2	286.7	352.0	29.4	350.9	436.3	10.0	72.3	5.2	1828.8
Oct	327.1	98.0	273.3	46.4	198.2	201.2	11.9	79.3	0.0	1235.4
Nov	154.1	206.4	987.2	1.6	55.7	127.2	1.9	207.9	22.9	1764.8
Dec	16.0	209.0	301.8	58.3	0.0	4.2	0.1	230.1	0.0	819.4
Totals	1352.8	2301.9	4891.9	341.2	802.8	1134.6	83.3	1667.2	41.6	12617.4

2003	Inshore			Offshore						
Month	**3Psa**	**3Psb**	**3Psc**	**3Psd**	**3Pse**	**3Psf**	**3Psg**	**3Psh**	**3Ps_unk**	**Totals**
Jan	1.9	197.3	90.3	6.3	0.0	0.0	0.7	710.6	0.0	1007.1
Feb	1.2	53.4	1.0	32.7	0.2	0.0	23.4	734.7	0.0	846.6
Mar	0.2	1.2	0.0	6.5	0.0	0.0	12.1	80.4	0.0	100.4
Apr	1.5	0.0	0.3		0.0	0.0	3.3	24.6	0.0	29.7
May	58.5	201.2	94.7	0.2	0.0	0.0	4.3	5.5	0.0	364.3
Jun	97.2	235.3	774.5	5.6	0.1	17.9	7.2	19.5	1.5	1158.9
Jul	147.6	316.0	1275.8	38.1	2.5	41.7	0.1	24.0	23.5	1869.1
Aug	125.1	256.4	535.3	23.9	39.2	65.6	0.9	38.9	30.3	1115.6
Sep	285.3	1113.2	1172.9	8.9	0.0	14.3	0.0	3.3	7.1	2605.0
Oct										
Nov										
Dec										
Totals	718.6	2374.0	3944.8	122.1	42.0	139.5	52.1	1641.4	62.4	9096.8

Table 4a. Numbers of cod sampled (Canadian commercial fishery and sentinel survey) for length and age and used to estimate the 3Ps commercial catch-at-age for 2002.

Number Measured							
	Offshore			Inshore			
Month	Ottertrawl	Gillnet	Linetrawl	Gillnet	Linetrawl	Handline	Total
Jan	4095	0	0	1211	1113	0	6419
Feb	3668	0	0	609	561	0	4838
Mar	403	0	0	683	138	0	1224
Apr	209	0	0	0	1275	0	1484
May	0	0	0	2749	721	0	3470
Jun	0	289	0	4377	2067	103	6836
Jul	0	844	0	6058	1195	993	9090
Aug	0	3019	94	2587	6154	1280	13134
Sep	0	958	0	1193	6798	0	8949
Oct	896	377	336	1897	6732	109	10347
Nov	2822	808	0	3335	7514	0	14479
Dec	1148	0	0	68	0	0	1216
Total	13241	6295	430	24767	34268	2485	81486

Number Aged							
	Offshore			Inshore			
QTR	Ottertrawl	Gillnet	Linetrawl	Gillnet	Linetrawl	Handline	Total
1	806		0	103	119		1028
2	48	15	0	625	70		758
3	0	677	1	1707	783	275	3443
4	430	128	0	805	1408		2771
Total	1284	820	1	3240	2380	275	8000

Table 4b. Numbers of cod sampled (commercial fishery and sentinel survey) for length and age and used to estimate the 3Ps commercial catch-at-age for Jan - Mar 2003.

Number Measured							
	Offshore			Inshore			
Month	Ottertrawl	Gillnet	Linetrawl	Gillnet	Linetrawl	Handline	Total
Jan	6100			693	227		7020
Feb	3255		133	436	383		4207
Mar	521				68		589
Total	9876	0	133	1129	678	0	11816

Number Aged							
	Offshore			Inshore			
QTR	Ottertrawl	Gillnet	Linetrawl	Gillnet	Linetrawl	Handline	Total
1	1394			112	58		1564
2							
3							
4							
Total	1394	0	0	112	58	0	1564

Table 4c. Age and length composition of samples from the French cod catch that were used to estimate the Subdiv. 3Ps commercial catch-at-age for 2002 and the first quarter of 2003.*

Gillnet

Age	Quarter III-2002	Quarter IV-2002	TOTAL
4	88	340	428
5	3,408	18,529	21,937
6	10,288	18,972	29,260
7	8,656	5,657	14,313
8	19,599	2,855	22,454
9	20,812	1,636	22,448
10	9,745	678	10,423
11	2,542	179	2,721
12	2,564	302	2,866
13	2,772	168	2,940
14	0	0	0
15	0	0	0
16	0	0	
Total Number	80,474	49,316	129,790
Total weight	442,642	129,882	572,524
Number aged	145	150	295

Otter trawl

Age	Quarter 1-2002	Quarter IV-2002	Quarter I-2003	TOTAL
4	1,409	4,206	4,652	10,267
5	13,936	115,453	47,000	176,389
6	20,044	104,302	47,879	172,225
7	28,818	27,810	12,753	69,381
8	30,639	17,727	12,045	60,411
9	21,606	11,917	18,875	52,398
10	8,303	5,937	11,702	25,942
11	12,873	1,395	11,860	26,128
12	14,878	1,510	16,716	33,104
13	3,508	1,936	6,713	12,157
14	958	0	1,102	2,060
15	417	0	1,025	1,442
16	0	82	861	943
Total Number	157,389	292,275	192,322	641,986
Total weight	843,055	780,021	931,055	2,554,131
Number aged	331	200	290	821

Gillnet

Length (cm)	Quarter III-2002	Quarter IV-2002	Total
36	0	0	
39	0	0	0
42	0	73	73
45	0	364	364
48	394	1,166	1,560
51	197	4,152	4,349
54	197	5,463	5,660
57	1,775	7,284	9,059
60	2,761	6,775	9,536
63	4,142	7,430	11,572
66	3,748	5,318	9,066
69	4,142	3,351	7,493
72	2,959	2,113	5,072
75	3,353	947	4,300
78	4,734	801	5,535
81	7,890	656	8,546
84	10,059	801	10,860
87	7,298	801	8,099
90	9,468	801	10,269
93	6,509	219	6,728
96	4,734	219	4,953
99	1,972	146	2,118
102	2,367	219	2,586
105	1,578	146	1,724
108	197	146	343
111	0	0	0
114	394	0	394
117	0	0	0
120	0	0	0
123	0	0	0
126	0	0	0
129	0	0	0
Total Number	80,868	49,391	130,259
Total weight	442,642	129,882	572,524
No. measured	410	678	1,088
Sample weight	2,244	1,783	4,027

Otter trawl

Length (cm)	Quarter I-2002	Quarter IV-2002	Quarter I-2003	Total
36	113	0	0	113
39	0	0	186	186
42	225	410	1,426	2,061
45	564	6,719	3,907	11,190
48	1,466	12,209	9,179	22,854
51	2,706	22,697	13,644	39,047
54	5,863	30,563	15,690	52,116
57	8,343	44,329	16,187	68,859
60	8,343	46,541	17,489	72,373
63	6,426	36,872	12,093	55,391
66	7,441	24,254	10,791	42,486
69	8,907	16,060	5,458	30,425
72	6,990	9,505	3,287	19,782
75	8,681	6,719	3,163	18,563
78	8,005	4,834	2,915	15,754
81	10,598	5,818	2,977	19,393
84	11,613	5,490	2,977	20,080
87	9,245	3,933	5,706	18,884
90	9,809	4,507	7,814	22,130
93	8,230	4,343	8,744	21,317
96	8,456	2,294	6,016	16,766
99	6,765	1,803	12,217	20,785
102	6,426	1,229	9,861	17,516
105	5,524	1,065	6,078	12,667
108	2,480	328	7,256	10,064
111	2,368	82	3,163	5,613
114	902	82	2,729	3,713
117	338	0	1,116	1,454
120	676	82	558	1,316
123	0	0	558	558
126	0	0	124	124
129	113	0	0	113
Total Number	157,616	292,768	193,309	643,693
Total weight	843,055	780,021	931,055	2,554,131
No. measured	1,398	3,573	3,117	8,088
Sample weight	7,478	9,520	15,013	32,011

* note that gillnet landings were restricted to the third and fourth quarters of the year, whereas otter trawl landings were taken in the first and last quarters.

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 2002.

	AVERAGE		CATCH			France	Total
AGE	WEIGHT (kg.)	LENGTH (cm.)	NUMBER (000'S)	STD ERR.	CV Canadian catch	NUMBER (000'S)	NUMBER (000'S)
1	0.00	0.00	0.00	0.00			0.00
2	0.32	33.77	1.15	0.58			1.15
3	0.57	40.19	154.30	4.87	0.03		154.30
4	0.98	47.86	564.02	12.67	0.02	6.04	570.06
5	1.49	54.72	1311.20	20.24	0.02	151.33	1462.53
6	1.98	59.97	1152.55	20.96	0.02	153.61	1306.16
7	2.27	62.68	851.71	18.91	0.02	70.94	922.65
8	2.97	67.86	662.02	16.19	0.02	70.82	732.84
9	4.04	74.59	350.90	11.11	0.03	55.97	406.87
10	3.59	71.87	309.72	11.09	0.04	24.66	334.39
11	3.67	72.28	87.64	6.26	0.07	16.99	104.63
12	5.62	82.60	58.36	4.05	0.07	19.25	77.62
13	8.74	96.62	53.76	2.82	0.05	8.38	62.15
14	7.61	91.78	7.88	1.02	0.13	0.96	8.84
15	8.61	95.95	2.36	0.56	0.24	0.42	2.78
16	12.14	108.92	0.35	0.17	0.48	0.08	0.44
17	9.13	97.88	0.01	0.01	0.85	0.00	0.01
18	10.11	103.00	0.14	0.13		0.00	0.14
19	0.00	0.00	0.00	0.00		0.00	0.00
20	0.00	0.00	0.00	0.00			0.00

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 Jan.-Mar. 2003.

	AVERAGE		CATCH			France	Total
AGE	WEIGHT (kg.)	LENGTH (cm.)	NUMBER (000'S)	STD ERR.	CV	NUMBER (000'S)	NUMBER (000'S)
1	0.00	0.00	0.00	0.00			0.00
2	0.00	0.00	0.00	0.00			0.00
3	0.55	40.00	0.01	0.01	1.20		0.01
4	0.60	40.99	41.43	4.09	0.10	4.652	46.09
5	1.23	51.23	73.89	5.71	0.08	47.000	120.89
6	1.81	58.15	123.35	5.89	0.05	47.879	171.23
7	2.02	60.14	88.47	5.09	0.06	12.753	101.22
8	2.44	64.24	38.55	3.04	0.08	12.045	50.60
9	4.99	78.99	36.04	2.60	0.07	18.875	54.92
10	5.75	82.98	35.33	2.40	0.07	11.702	47.04
11	4.41	76.13	20.23	2.15	0.11	11.860	32.09
12	8.00	93.72	7.33	0.92	0.13	16.716	24.05
13	8.68	95.32	19.06	1.63	0.09	6.713	25.78
14	10.88	104.89	39.67	1.71	0.04	1.102	40.77
15	12.90	111.18	1.59	0.37	0.23	1.025	2.62
16	11.44	106.71	0.77	0.29	0.37	0.861	1.64
17	10.86	103.76	0.63	0.21		0.000	0.63
18	13.53	113.16	0.30	0.16		0.00	0.30
19	0.00	0.00	0.00	0.00		0.00	0.00
20	22.78	133.72	0.03	0.02			0.03

Table 6. Catch numbers-at-age (000s) for the commercial cod fishery in NAFO Subdiv. 3Ps from 1959 to 31 March 2003.

Year/Age	3	4	5	6	7	8	9	10	11	12	13	14
1959	1001	13940	7525	7265	4875	942	1252	1260	631	545	44	1
1960	567	5496	23704	6714	3476	3484	1020	827	406	407	283	27
1961	450	5586	10357	15960	3616	4680	1849	1376	446	265	560	58
1962	1245	6749	9003	4533	5715	1367	791	571	187	140	135	241
1963	961	4499	7091	5275	2527	3030	898	292	143	99	107	92
1964	1906	5785	5635	5179	2945	1881	1891	652	339	329	54	27
1965	2314	9636	5799	3609	3254	2055	1218	1033	327	68	122	36
1966	949	13662	13065	4621	5119	1586	1833	1039	517	389	32	22
1967	2871	10913	12900	6392	2349	1364	604	316	380	95	149	3
1968	1143	12602	13135	5853	3572	1308	549	425	222	111	5	107
1969	774	7098	11585	7178	4554	1757	792	717	61	120	67	110
1970	756	8114	12916	9763	6374	2456	730	214	178	77	121	14
1971	2884	6444	8574	7266	8218	3131	1275	541	85	125	62	57
1972	731	4944	4591	3552	4603	2636	833	463	205	117	48	45
1973	945	4707	11386	4010	4022	2201	2019	515	172	110	14	29
1974	1887	6042	9987	6365	2540	1857	1149	538	249	80	32	17
1975	1840	7329	5397	4541	5867	723	1196	105	174	52	6	2
1976	4110	12139	7923	2875	1305	495	140	53	17	21	4	3
1977	935	9156	8326	3209	920	395	265	117	57	43	31	11
1978	502	5146	6096	4006	1753	653	235	178	72	27	17	10
1979	135	3072	10321	5066	2353	721	233	84	53	24	13	10
1980	368	1625	5054	8156	3379	1254	327	114	56	45	21	25
1981	1022	2888	3136	4652	5855	1622	539	175	67	35	18	2
1982	130	5092	4430	2348	2861	2939	640	243	83	30	11	7
1983	760	2682	9174	4080	1752	1150	1041	244	91	37	18	8
1984	203	4521	4538	7018	2221	584	542	338	134	35	8	8
1985	152	2639	8031	5144	5242	1480	626	545	353	109	21	6
1986	306	5103	10253	11228	4283	2167	650	224	171	143	79	23
1987	585	2956	11023	9763	5453	1416	1107	341	149	78	135	50
1988	935	4951	4971	6471	5046	1793	630	284	123	75	53	31
1989	1071	8995	7842	2863	2549	1112	600	223	141	57	29	26
1990	2006	8622	8195	3329	1483	1237	692	350	142	104	47	22
1991	812	7981	10028	5907	2164	807	620	428	108	76	50	22
1992	1422	4159	8424	6538	2266	658	269	192	187	83	34	41
1993	278	3712	2035	3156	1334	401	89	38	52	13	14	5
1994	9	78	173	74	62	28	12	3	2	0	0	0
1995	3	7	56	119	57	37	7	2	0	0	0	0
1996	9	43	43	101	125	35	24	8	2	1	0	0
1997	66	427	1130	497	937	826	187	93	31	4	1	0
1998	91	373	793	1550	948	1314	1217	225	120	56	15	1
1999	49	628	1202	2156	2321	1020	960	873	189	110	21	8
2000	76	335	736	1352	1692	1484	610	530	624	92	37	16
2001	80	475	718	1099	1143	796	674	257	202	192	28	13
2002	154	570	1463	1306	923	733	407	334	105	78	62	9
2003*	0	46	121	171	101	51	55	47	32	24	26	41

* January-March 2003 only

Table 7a. Annual mean weights-at-age (kg) calculated from lengths-at-age based on samples of the catch by commercial fisheries (including food fisheries and sentinel surveys) in Subdividion 3Ps in 1959-2003. The weights-at-age from 1976 are extrapolated back to 1959. The values for 2003 are extrapolations from the 2002 values as described in the text.

Year/age	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	0.98	1.49	1.98	2.27	2.97	4.04	3.59	3.67	5.62	8.74	7.61
2003	0.62	0.85	1.54	2.13	2.42	2.68	3.54	4.75	4.31	4.26	6.34	10.08

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 2004 are extrapolated as described in the text.

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	0.47	0.82	1.23	1.69	2.09	2.77	3.71	3.39	3.56	5.61	8.67	7.61
2003	0.51	0.70	1.23	1.79	2.19	2.46	3.24	4.38	3.93	3.95	5.97	9.38
2004	0.51	0.76	1.06	1.82	2.34	2.64	2.95	3.83	5.20	4.68	4.64	7.22

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 1989, 1993, 1997, and 1998 cohorts are shaded.

Gill net Year/Age	3	4	5	6	7	8	9	10	Totals
1995	0.02	0.10	4.72	9.93	5.79	2.79	0.36	0.13	23.85
1996	0.02	0.27	2.58	11.86	9.79	2.81	0.81	0.07	28.22
1997	0.01	0.25	5.48	5.09	8.55	7.66	0.94	0.69	28.66
1998	0.00	0.04	0.89	6.03	2.92	2.14	1.35	0.31	13.68
1999	0.00	0.01	0.89	1.37	2.01	0.70	0.23	0.22	5.41
2000	0.01	0.03	0.28	0.68	0.65	0.87	0.28	0.10	2.91
2001	0.03	0.17	0.39	0.82	0.63	0.33	0.31	0.13	2.81
2002	0.00	0.04	0.55	0.92	0.88	0.38	0.18	0.19	3.15
		1998	1997				1993	1989	

Linetrawl Year/Age	3	4	5	6	7	8	9	10	Totals
1995	10.50	19.82	64.02	88.89	23.08	17.38	3.27	1.33	228.29
1996	9.40	34.18	32.50	51.96	53.64	14.87	8.35	1.87	206.78
1997	6.83	27.91	27.81	18.47	17.32	24.83	2.30	1.79	127.26
1998	10.14	22.05	25.39	20.01	7.31	11.08	13.17	2.19	111.34
1999	10.61	21.23	25.71	19.10	8.25	6.37	4.48	1.42	97.17
2000	18.00	38.88	36.38	23.64	10.30	9.11	2.82	1.08	140.21
2001	20.18	30.85	21.90	12.30	7.09	4.28	2.47	0.62	99.69
2002	15.59	32.46	29.47	10.25	6.21	2.01	0.99	0.76	97.75
		1998	1997				1993	1989	

Table 9. Cod abundance estimates (000's of fish) from DFO bottom-trawl research vessel surveys in NAFO Division 3Ps (1983-2003 shown) . Shaded cells are model estimates. See Fig. 11 for locations of strata.

																					Tel 351		
		Vessel	AN	AN	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT
		Trips	9	26	26	45	55+56	68	81	91	103	118	133	135	150-151	166-167	186-187	202-203	219-220	236-237	313-315	364-365	418-419	476-477
Depth		Sets	164	93	109	136	130	146	146	108	158	137	136	130	166	161	148	158	176	175	171	173	177	176
range		Mean Date	30-Apr	13-Apr	13-Mar	15-Mar	7-Mar	5-Feb	9-Feb	9-Feb	10-Feb	14-Feb	13-Feb	11-Apr	15-Apr	16-Apr	22-Apr	12-Apr-97	21-Apr	24-Apr	21-Apr	18-Apr	15-Apr	22-Apr
(fathoms)	Strata	sq. mi.	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
<30	314	974	2527	134	96	0	0	211	30	45	0	0	0	0	74	0	0	77	57	1729	1531	153	67	19
	320	1320	3424	3473	1089	262	248	363	853	0	620	20	0	0	0	0	545	303	1292	3546	5183	1543	478	1601
31-50	293 [5]	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	107	292	601	394	219	131	120
	308	112	627	801	1741	0	169	247	15	77	31	62	39	308	701	223	177	262	4175	2704	1829	1094	285	77
	312	272	6086	374	8026	56	318	580	62	0	56	0	37	0	0	87	37	19	100	461	1235	636	112	150
	315	827	1536	1183	1983	2920	483	190	228	57	439	33	0	0	0	0	1387	38	5721	2428	1895	1040	228	49
	321	1189	2355	954	210	82	867	238	36	102	535	0	0	20	0	0	345	18	49	894	1161	55	98	82
	325	944	666	312	0	81	152	43	146	130	1068	455	14	0	0	0	103	108	16	752	2824	1526	65	16
	326	166	99	0	50	0	69	80	0	34	69	0	46	0	0	194	11	0	11	52	109	57	0	0
	783 [1]	229	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	nf	nf	47	16	110	86	142	13	95
51-100	294 [5]	135	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	176	901	362	170	195	613	455
	297 [5]	152	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	408	209	1892	7000	450	450	42
	307	395	1943	380	4347	15450	3586	8803	5524	2717	797	869	353	2826	12769	1087	1645	1123	23490	5879	6991	5665	833	22912
	311	317	7907	1090	14968	3183	16905	17236	1599	2369	1134	218	145	392	2562	116	654	371	1652	2169	2864	610	780	349
	317	193	8266	27	8190	4898	3487	2695	2363	226	1978	531	0	159	0	465	1195	451	173	305	1487	637	1049	372
	319	984	16321	4828	338	9526	25403	17258	5888	8144	25764	2883	647	3023	150	575	11477	1889	15600	11839	9327	58696	34398	2149
	322	1567	8936	2694	10297	11946	9140	5030	7760	3745	5758	81	0	0	431	0	554	234	260	713	1529	413	633	263
	323	696	3606	3878	6830	8866	10627	4040	2134	120	2011	16	0	0	0	0	82	24	32	158	1001	941	64	19
	324	494	8885	7203	38157	720	1087	2395	0	353	2633	163	0	0	544	85	91	272	160	361	442	85	306	391
	781 [1]	446	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	307	280	195	276	1058	716	1564	261	215
	782 [1]	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	302	0	nf	63	38	38	315	76	227	50
101-150	295 [5]	209	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	168	465	976	615	978	144	187
	298 [5]	171	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	110	1861	46	3450	670	371	5399
	300 [5]	217	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	584	1579	641	896	791	746	1370
	306	363	2110	75	574	1971	3845	2422	1265	8273	982	1116	389	2659	1273	350	1106	816	771	708	4191	949	246	277
	309	296	937	122	2484	4622	2443	3461	1771	3766	3122	244	95	1853	244	421	8190	260	11980	215	142	2056	13172	484
	310	170	133	94	203	351	304	896	6443	3414	13423	175	82	748	405	386	421	1380	105	131	187	505	485	1391
	313	165	68	23	238	0	409	136	2054	908	6866	2962	11	238	68	1124	182	0	454	91	113	3564	125	567
	316	189	240	117	78	26	78	87	1586	20669	3081	104		147	182	182	26	65	104	23	13	26	117	273
	318	129	6	0	974	27	710	18	4924	648	8855	5900	5051	2103	0	95656	630	1881	53	0	231	44	71	11943
	779 [1]	422	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	248	0	0	0	39	0	73	26	29	15
	780 [1]	403	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	0	nf	35	18	0	40	0	0	0
151-200	296 [5]	71	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	632	4	375	107	1924	735	303
	299 [5]	212	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	643	49	0	13	131	160	214
	705	195	9	0	563	791	255	644	94	107	134	161	80	939	528	1113	418	241	376	24	54	83	241	232
	706	476	13	0	1097	557	9835	851	49	98	49	445	109	327	327	442	393	172	327	87	49	49	82	246
	707	74	3	0	836	560	753	1919	122	557	2682	1323	1817	494	219	448	2912	353	102	9	0	293	3079	143
	715	128	158	44	3216	1638	643	3724	167	2509	20768	2386	309	1748	2249	414	4117	516	5874	484	751	3013	1615	960
	716	539	167	25	371	7656	2768	3470	704	593	1216	3979	463	204	519	578	1764	91	3089	2428	196	99	1333	952
201-300	708	126	0	0	2119	451	14317	14490	113	1410	537	1300	813	1621	15842	2808	208	388	1464	947	0	35	151	329
	711	593	20	0	33	8227	392	387	218	544	9395	503	176	0	41	20	77	44	16	0	783	80	49	96
	712	731	0	117	620	419	67	536	141	1931	1730	716	1098	302	369	322	101	60	201	50	98	117	67	345
	713	851	33	285	117	117	1463	368	843	20233	6951	1806	2819	234	1405	893	652	901	61	78	176	364	320	372
	714	1074	43	980	6701	835	396	905	4753	20966	32838	15431	12120	1440	2428	2996	750	2765	485	173	151	3781	1346	1678
301-400	709 [2]	147	0	0	0	0	nf	30	10	nf	40	nf	4556	1087	nf	101	0	nf	0	0	10	30	0	611
401-500	710 [1]	156	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	32	nf	nf	nf	nf	0	nf	nf	nf	nf
501-600	776 [1]	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
601-700	777 [1]	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
701-800	778 [1]	166	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
	Total [3]		77,124	29,213	116,546	86,238	111,219	93,723	51,885	104,745	155,522	43,882	26,713	21,785	43,330	110,985	40,250	15,122	78,250	39,438	46,543	88,209	61,895	48,737
	Total [4]		77,124	29,213	116,546	86,238	111,219	93,753	51,895	104,745	155,562	43,882	31,269	22,872	43,912	111,393	40,530	18,290	83,997	45,537	60,428	95,405	65,775	57,813
	upper		107,185	53,111	618,003	126,503	169,378	153,606	79,714	177,819	240,690	64,676	49,856	29,586	72,419	1,325,521	64,189	21,365	166,891	55,196	60749	147318	119231	109897
	t-value		2.12	3.18	12.71	2.26	2.45	3.18	3.18	2.78	2.57	2.45	3.18	2.31	2.78	12.71	2.45	2.31	3.182	2.23	2.20	2.36	2.78	3.18
	std [6]		14,180	7,515	39,466	17,801	23,767	18,831	8,746	26,286	33,139	8,487	7,273	3,377	10,464	95,558	9,771	2,703	27,857	7,066	6,457	25,046	20,624	19,233

[1] These strata were added to the stratification scheme in 1994.

[2] Strata 709 was redrawn in 1994 and includes the area covered by strata 710 in previous surveys. All sets done in 710 prior to 1994 have been recoded to 709.

[3] For index strata 0-300 fathoms in the offshore and includes esitmates (shaded cells) for non-sampled strata .

[4] totals are for all strata fished .

[5] These strata were added to the stratification scheme in 1997.

[6] std's are for index strata and do not include estimates from non-sampled strata.

Table 10. Cod biomass estimates (t) from DFO research vessel bottom-trawl surveys in NAFO Subdiv. 3Ps during 1983-2003. Shaded cells are model estimates. See Fig. 11 for location of strata.

																					Tel 351		
		Vessel	AN	AN	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT
		Trips	9	26	26	45	55+56	68	81	91	103	118	133	135	150-151	166-167	186-187	202-203	219-220	236-237	313-315	364-365	418-419	476-477
Depth		Sets	164	93	109	136	130	146	146	108	158	137	136	130	166	161	148	158	176	175	171	173	177	176
range		Mean Dat	30-Apr	13-Apr	13-Mar	15-Mar	7-Mar	5-Feb	9-Feb	9-Feb	10-Feb	14-Feb	13-Feb	11-Apr	15-Apr	16-Apr	22-Apr	12-Apr	21-Apr	24-Apr	21-Apr	18-Apr	15-Apr	22-Apr
(fathoms)	Strata	sq. mi.	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
<30	314	974	15936	733	59	0	0	104	20	240	0	0	0	0	212	0	0	32	8	595	829	46	5	0
	320	1320	8914	8700	6971	464	700	2299	1883	0	267	52	0	0	0	0	155	114	7766	6287	6761	601	932	2707
31-50	293 [5]	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	17	19	27	45	26	9	29
	308	112	1371	1157	1809	0	27	17	8	18	10	18	8	96	235	41	35	93	1461	1572	1088	184	48	12
	312	272	1179	1080	3691	110	102	25	14	0	23	0	28	0	0	13	4	13	8	226	640	93	10	9
	315	827	4143	2686	661	4606	1211	1992	2453	129	614	38	0	0	0	0	869	14	20072	3771	3092	491	822	17
	321	1189	4121	1941	173	516	410	2201	506	24	146	0	0	37	0	0	8	2	0	1855	4582	2	5	2
	325	944	671	915	0	68	255	53	36	84	246	42	194	0	0	0	173	10	0	418	1307	340	10	3
	326	166	497	0	83	0	36	59	0	14	45	0	13	0	0	14	0	0	0	8	478	25	0	0
	783 [1]	229	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	nf	nf	0	0	14	16	6	0	2
51-100	294 [5]	135	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	24	40	19	7	26	47	22
	297 [5]	152	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	39	22	1697	2339	108	38	5
	307	395	2017	1441	8454	19930	4938	21706	6118	1033	171	126	70	1677	8984	250	633	332	16164	3784	5162	1578	197	26828
	311	317	5706	1711	10086	703	8576	2484	755	265	112	25	15	100	593	35	64	51	169	3342	1661	26	145	13
	317	193	7095	62	15799	3571	1867	352	496	18	756	73	0	244	0	40	73	62	196	36	259	331	88	59
	319	984	6983	6989	1861	16211	18530	23773	14172	2702	2436	382	82	507	32	208	12785	287	28144	18019	8121	51570	38958	755
	322	1567	9141	3904	2597	4571	3226	875	492	347	426	32	0	0	38	0	177	118	13	117	1893	193	32	26
	323	696	1730	3935	2862	5790	21015	514	562	28	160	41	0	0	0	0	89	15	112	227	643	305	7	1
	324	494	1790	787	24660	521	384	455	0	38	217	33	0	0	7	18	3	11	8	252	25	7	14	13
	781 [1]	446	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	113	40	22	16	64	49	36	13	17
	782 [1]	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	8	0	nf	2	7	1	7	0	27	1
101-150	295 [5]	209	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	24	139	45	61	124	8	26
	298 [5]	171	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	42	2608	148	2632	202	75	2735
	300 [5]	217	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	147	802	650	307	153	124	175
	306	363	2167	448	974	2479	3315	4713	605	2786	149	464	114	1820	950	191	194	312	618	553	5123	543	67	51
	309	296	1690	292	3305	5739	4513	5255	3154	3062	1166	50	15	2021	359	272	4922	87	9788	320	303	1118	15666	193
	310	170	283	209	503	604	383	862	812	938	880	40	13	378	374	228	124	206	72	145	330	488	209	263
	313	165	158	242	481	0	563	155	1390	305	472	280	12	152	43	1279	259	0	481	162	97	18231	122	807
	316	189	492	262	151	113	144	59	3838	13956	294	43		144	270	42	38	40	138	43	21	63	78	146
	318	129	25	0	2436	146	1359	196	17756	668	2339	1600	1709	1616	0	129689	1075	404	88	0	592	28	43	12705
	779 [1]	422	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	16	0	0	0	10	0	4	1	1	2
	780 [1]	403	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	0	nf	3	1	0	6	0	0	0
151-200	296 [5]	71	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	175	1	102	20	341	118	36
	299 [5]	212	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	282	231	0	1	411	655	315
	705	195	55	0	904	1063	273	1053	52	235	16	67	47	1143	652	1927	663	476	345	25	20	71	244	434
	706	476	72	0	3010	907	15334	1927	189	153	182	435	76	251	277	385	575	379	266	68	63	26	40	431
	707	74	11	0	1672	2779	1821	6883	411	459	1365	767	914	648	24	591	5408	72	121	21	0	360	3726	187
	715	128	589	99	6482	2738	1315	7420	345	1061	17037	1928	347	1743	2802	575	3807	233	6849	1127	1240	5599	2525	1188
	716	539	311	24	710	7731	3291	4722	779	1112	386	952	64	226	676	777	1457	44	1772	4106	229	92	554	735
201-300	708	126	0	0	4446	690	18385	42342	123	1220	1072	2419	368	1081	10036	5511	247	629	4389	1455	0	54	139	354
	711	593	26	0	62	10625	569	841	745	496	23174	360	290	0	30	27	82	43	11	0	1242	75	35	41
	712	731	0	410	1267	644	262	1042	207	1419	1523	1020	1305	243	819	372	118	151	267	25	64	65	25	264
	713	851	61	1023	154	544	2469	567	1096	30722	6295	2025	3263	374	1700	1545	1481	1101	48	143	123	273	235	261
	714	1074	265	3788	16731	2748	473	1476	7310	30866	32946	18902	12987	1739	2528	4161	924	3471	725	155	123	4113	1212	2306
301-400	709 [2]	147	0	0	0	0	nf	118	52	nf	27	nf	2457	736	nf	121	0	nf	0	0	5	59	0	383
401-500	710 [1]	156	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	19	nf	nf	nf	nf	0	nf	nf	nf	nf
501-600	776 [1]	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
601-700	777 [1]	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
701-800	778 [1]	166	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
	Total [3]		77,499	42,838	123,054	96,611	115,746	136,422	66,327	94,398	94,925	32,214	21,934	16,240	31,641	148,191	36,442	8,802	100,100	48,857	46,111	86,991	66,193	50,811
	Total [4]		77,499	42,838	123,054	96,611	115,746	136,540	66,379	94,398	94,952	32,214	24,391	16,976	31,684	148,425	36,482	9,579	103,996	51,624	51,610	88,484	67,308	54,559
	upper		112,007	50,251	434,252	140,924	185,889	679,921	101,515	170,365	170,491	45,569	22,297	22,297	54,348	1,791,842	54,585	14,193	160,874	71,356	60,876	148,519	134,681	127,771
	t-value		2.20	2.06	12.71	2.26	2.45	12.71	2.31	2.31	2.57	2.26	2.13	2.31	2.78	12.71	2.23	2.36	2.201	2.13	2.15	2.57	2.78	3.18
	std [6]		15,678	3,599	24,492	19,608	28,630	42,762	15,259	32,943	29,403	5,909	170	2,622	8,168	129,320	8,143	2,284	27,612	10,563	6,867	23,941	24,636	24,201

[1] These strata were added to the stratification scheme in 1994.

[2] Strata 709 was redrawn in 1994 and includes the area covered by strata 710 in previous surveys. All sets done in 710 prior to 1994 have been recoded to 709.

[3] For index strata 0-300 fathoms in the offshore and includes esitmates (shaded cells) for non-sampled strata .

[4] totals are for all strata fished .

[5] These strata were added to the stratification scheme in 1997.

[6] std's are for index strata and do not include estimates from non-sampled strata.

Table 11A. Mean numbers per tow at age in Campelen units for the Canadian RV index for the period 1983 to 2003. Data are adjusted for missing strata. There were two surveys in 1993 (February and April). The 1989, 1993, 1997, and 1998 cohorts are shaded.
Boxed cells indicate the years with the two highest catch rates for a given age for the period 1993-2003.

Age/Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993F	1993A	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Age	cohort
											(Feb)	(Apr)												
1	6.42	0.30	0.38	0.20	1.09	0.42	0.49	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.90	0.22	0.52	1.24	1.25	0.57	0.58	0.52	1	
2	10.01	5.40	7.74	6.62	8.48	9.13	6.50	1.48	27.69	1.80	0.00	0.00	1.63	0.31	1.08	1.53	0.97	2.54	3.33	2.26	1.10	1.46	2	
3	6.52	2.33	14.88	5.65	5.67	5.93	4.66	9.82	5.03	6.95	1.83	1.99	1.46	1.16	3.67	2.33	6.79	2.55	5.36	12.41	3.90	1.78	3	
4	1.14	1.55	12.57	6.48	4.97	2.96	3.17	14.49	10.00	2.11	4.03	4.04	4.31	1.67	3.62	1.04	8.42	2.38	3.10	12.29	8.28	4.08	4	
5	3.72	0.63	9.96	7.95	13.82	2.84	1.51	10.89	11.24	4.15	0.71	1.49	6.10	13.08	1.32	0.50	5.60	2.58	2.17	4.36	5.85	6.55	5	1998
6	1.62	2.11	3.28	6.33	8.31	6.50	1.16	5.67	5.75	2.03	2.96	1.35	1.73	19.65	2.69	0.28	3.99	2.34	1.82	2.04	3.04	3.94	6	1997
7	0.48	0.77	2.66	2.13	3.35	5.84	2.15	3.84	2.84	1.03	0.68	0.47	1.62	4.40	2.91	0.30	1.96	1.72	1.20	1.26	2.04	1.50	7	
8	0.89	0.37	0.79	1.47	1.29	3.65	1.21	3.14	1.58	0.53	0.33	0.10	0.50	5.75	0.54	0.24	2.50	0.44	0.89	0.77	0.99	0.72	8	
9	1.61	0.46	0.48	0.84	0.69	1.49	0.67	1.15	1.19	0.26	0.13	0.04	0.08	2.19	0.46	0.14	2.79	0.79	0.35	0.71	0.53	0.33	9	
10	0.75	0.71	0.42	0.29	0.28	0.84	0.37	0.71	0.74	0.24	0.09	0.03	0.04	0.25	0.09	0.05	0.43	0.60	0.31	0.38	0.37	0.18	10	1993
11	0.36	0.18	0.42	0.24	0.23	0.74	0.41	0.32	0.56	0.08	0.11	0.04	0.03	0.20	0.09	0.02	0.30	0.09	0.53	0.50	0.08	0.19	11	
12	0.14	0.15	0.49	0.29	0.16	0.35	0.13	0.16	0.22	0.04	0.03	0.01	0.02	0.01	0.02	0.00	0.06	0.02	0.12	0.94	0.12	0.05	12	
13	0.06	0.06	0.21	0.17	0.17	0.16	0.11	0.12	0.11	0.01	0.04	0.00	0.01	0.07	0.00	0.00	0.03	0.02	0.00	0.12	0.19	0.11	13	
14	0.05	0.03	0.12	0.10	0.16	0.15	0.05	0.09	0.07	0.01	0.01	0.01	0.01	0.03	0.00	0.00	0.00	0.00	0.01	0.06	0.01	0.01	14	1989
15	0.04	0.00	0.03	0.06	0.06	0.09	0.09	0.01	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.01	15	
16	0.04	0.04	0.03	0.04	0.04	0.10	0.06	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	16	
17	0.01	0.00	0.05	0.02	0.05	0.01	0.04	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17	
18	0.02	0.03	0.02	0.00	0.04	0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18	
19	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19	
20	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20	
21	0.01	0.01	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21	
22	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22	
23	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23	
24	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24	
25	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25	

Table 11B. Mean numbers per tow at age (1-15 only) in Campelen units for the Canadian research vessel bottom trawl survey of the western (Burgeo area) and eastern portions of NAFO Subdiv. 3Ps. Data are adjusted for missing strata. There were two surveys in 1993 (February and April) The 1989, 1993, 1997 and 1998 cohorts are shaded. Boxed cells indicate the years with the two highest catch rates for a given age for the period 1993-2003.

Western 3Ps (Burgeo area)

Age/yr	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Age	cohort
1	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.41	0.04	0.16	0.08	1	
2	0.00	0.00	0.49	1.37	0.60	0.42	1.14	0.71	6.05	0.83	1.94	2	
3	3.37	4.84	2.60	10.48	2.94	26.74	4.50	4.31	12.35	6.61	4.25	3	
4	8.04	9.73	2.75	12.50	4.73	25.99	6.24	6.56	6.32	9.91	16.66	4	
5	6.44	15.76	2.26	4.87	1.83	28.22	10.27	6.52	4.07	7.77	15.90	5	1998
6	6.94	8.60	3.03	5.84	1.66	18.46	3.61	7.81	4.35	8.86	14.88	6	1997
7	1.73	6.26	1.32	6.11	1.02	13.65	3.90	6.20	4.20	6.97	5.65	7	
8	0.53	2.89	2.07	1.17	0.92	6.28	0.50	1.95	1.73	3.09	3.06	8	
9	0.21	0.51	0.58	1.50	0.72	2.43	0.78	0.95	1.22	1.37	1.95	9	
10	0.09	0.16	0.08	0.03	0.11	0.40	0.20	0.08	0.96	0.92	1.23	10	1993
11	0.15	0.08	0.06	0.17	0.05	2.10	0.23	0.00	0.21	0.32	1.89	11	
12	0.00	0.06	0.05	0.00	0.00	0.00	0.38	0.15	0.10	0.15	0.26	12	
13	0.01	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.03	0.11	0.58	13	
14	0.01	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	14	1989
15	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15	

Eastern 3Ps

Age/yr	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993F	1993A	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Age	cohort
1	7.28	0.32	0.37	0.22	1.26	0.39	0.56	0.00	1.36	0.00	0.00	0.00	0.00	0.00	0.98	0.35	0.60	1.67	1.50	0.68	0.69	0.55	1	
2	11.41	5.77	7.50	5.76	9.46	10.13	6.76	1.51	30.70	1.92	0.00	0.00	1.81	0.24	0.98	2.32	0.82	2.68	4.25	1.78	1.25	1.12	2	
3	6.63	2.53	13.83	5.79	5.94	6.44	4.24	5.14	4.40	5.32	2.19	1.73	0.73	0.92	1.96	1.70	1.84	1.94	5.26	14.31	3.04	0.72	3	
4	1.08	1.59	12.11	4.25	5.14	2.20	1.98	10.97	3.01	0.79	4.75	2.60	2.92	1.19	1.89	0.48	2.04	1.00	2.07	12.75	7.93	1.86	4	
5	3.24	0.50	7.93	6.18	13.45	1.75	0.74	6.71	4.50	1.14	0.48	0.60	3.72	15.65	0.62	0.17	1.68	1.81	0.82	3.71	5.30	4.47	5	1998
6	1.36	2.00	2.89	3.93	8.32	4.31	0.51	3.02	2.82	0.62	1.16	0.49	0.65	22.81	1.79	0.09	1.08	2.00	0.88	1.23	2.00	1.66	6	1997
7	0.42	0.52	1.76	1.48	2.74	4.41	1.45	1.75	1.24	0.33	0.12	0.28	0.73	2.93	2.38	0.14	0.64	1.34	0.52	0.63	1.13	0.20	7	
8	0.93	0.38	0.45	0.95	1.08	3.02	1.07	2.26	1.11	0.12	0.08	0.05	0.17	3.60	0.35	0.11	2.50	0.35	0.62	0.52	0.61	0.05	8	
9	1.78	0.43	0.37	0.40	0.53	1.24	0.54	0.55	0.80	0.04	0.05	0.01	0.01	2.27	0.16	0.04	2.91	0.83	0.26	0.59	0.35	0.09	9	
10	0.82	0.78	0.22	0.15	0.16	0.57	0.30	0.29	0.96	0.06	0.01	0.00	0.03	0.29	0.10	0.02	0.27	0.69	0.39	0.13	0.26	0.01	10	1993
11	0.42	0.17	0.38	0.20	0.14	0.45	0.32	0.18	0.42	0.01	0.01	0.01	0.01	0.23	0.07	0.01	0.07	0.04	0.64	0.54	0.01	0.00	11	
12	0.15	0.15	0.39	0.29	0.15	0.16	0.11	0.04	0.26	0.01	0.03	0.00	0.01	0.00	0.02	0.00	0.04	0.02	0.10	1.21	0.10	0.01	12	
13	0.06	0.06	0.20	0.14	0.23	0.08	0.10	0.03	0.12	0.00	0.01	0.00	0.01	0.07	0.00	0.00	0.00	0.03	0.00	0.09	0.16	0.02	13	
14	0.07	0.02	0.08	0.07	0.21	0.18	0.05	0.05	0.10	0.00	0.02	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.06	0.02	0.01	14	1989
15	0.05	0.00	0.03	0.02	0.09	0.09	0.10	0.00	0.03	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.01	15	

Table 12. Mean length-at-age (cm) of cod sampled during research bottom-trawl surveys in Subdivision 3Ps in winter-spring 1972-2003. Entries in boxes are based on fewer than 5 aged fish. Some entries are different from those in Table 6 of Lilly (MS 1996) because only data from successful sets in the index strata are included in the present analyses.

Age	1972	1973	1974	1975	1976	1977
1	14.0	11.6	12.2	12.7	13.2	11.0
2	23.2	22.6	21.7	23.1	22.8	20.3
3	31.5	31.7	33.4	35.3	35.4	31.7
4	41.0	39.3	43.1	44.4	48.2	43.2
5	51.9	50.1	50.8	55.4	57.4	55.6
6	58.5	56.6	55.6	61.0	64.6	63.5
7	63.0	62.1	63.6	66.5	68.1	73.9
8	74.1	66.1	71.2	74.3	71.6	75.2
9	81.8	68.4	69.3	74.2	78.5	88.0
10	90.4	81.1	79.0	75.2	81.6	83.8
11	95.0	88.2	93.3	76.2	94.8	77.6
12	88.3	87.1	95.6	107.2	110.5	87.9

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1		10.8	14.6	14.6	13.2	10.3	12.0		11.0	10.7	9.2	12.0		9.5				
2	19.6	22.1	21.0	22.4	22.0	20.2	19.2	17.9	18.7	19.9	19.7	19.2	20.0	19.2	20.7		19.1	21.2
3	28.0	32.2	28.1	32.4	33.3	31.2	30.6	29.0	26.8	29.5	29.0	30.1	29.9	29.5	30.5	30.9	32.3	30.1
4	35.9	42.6	42.9	44.4	44.9	43.0	42.1	40.3	40.3	39.4	40.8	41.6	40.0	38.5	40.9	41.1	39.2	41.4
5	48.0	47.4	50.6	50.6	53.4	52.6	51.8	50.9	48.6	48.1	47.5	47.9	48.0	46.9	47.1	48.0	48.0	50.3
6	59.0	56.3	58.2	58.6	59.3	57.8	60.6	60.0	55.5	53.9	56.2	56.0	53.7	53.3	55.1	52.6	50.2	56.4
7	65.6	70.5	71.3	63.2	66.4	65.4	66.2	66.3	62.1	61.1	61.9	63.9	56.6	57.4	61.1	62.2	53.6	58.2
8	70.1	76.8	84.8	69.9	70.1	71.4	70.6	74.0	72.1	67.3	66.7	71.8	62.2	62.7	62.4	70.3	59.1	57.9
9	84.1	85.8	94.9	72.6	75.6	73.3	75.6	74.3	76.4	77.8	74.6	75.9	70.1	68.1	66.6	77.1	68.0	63.0
10	86.3	95.3	98.0	83.2	90.6	79.4	78.9	79.3	82.6	85.4	79.7	84.4	76.1	73.7	73.4	80.5	88.0	79.8
11	88.3	94.3	97.2	97.6	98.7	89.6	84.1	89.1	93.3	83.1	79.7	88.5	79.4	73.8	83.6	96.0	79.3	81.2
12	79.3	116.0	106.6	90.1	104.6	94.1	98.2	93.0	93.8	89.9	87.5	96.5	88.7	77.2	81.8	106.0	90.3	83.6

Age	1996	1997	1998	1999	2000	2001	2002	2003
1	12.6	12.7	10.6	12.0	13.3	10.6	12.0	10.7
2	20.6	24.1	22.3	22.2	22.0	21.9	22.0	23.7
3	30.0	31.7	32.5	31.4	31.7	33.3	31.7	31.8
4	38.6	40.8	42.5	42.9	40.7	40.7	42.1	42.8
5	44.0	47.9	48.7	51.2	48.6	47.3	50.5	51.6
6	52.9	51.5	53.2	58.9	54.6	51.8	54.9	55.3
7	60.9	60.6	57.5	61.7	60.3	57.3	55.2	58.6
8	61.1	65.2	67.0	66.2	65.3	68.4	67.2	58.5
9	63.3	66.9	77.2	77.6	67.8	78.2	74.5	70.5
10	76.7	67.3	77.2	86.5	81.1	75.8	79.7	72.2
11	74.7	82.5	64.3	76.9	92.5	89.0	73.4	65.5
12	86.1		78.0	109.0	89.1	96.2	86.0	86.4

Table 13. Mean round weight-at-age (kg) of cod sampled during DFO bottom-trawl surveys in Subdiv. 3Ps in winter-spring 1978-2003. Entries in boxes are based on fewer than 5 aged fish.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1		0.011	0.027		0.040	0.010								0.012				
2	0.057	0.070	0.068	0.060	0.103	0.068	0.073		0.045		0.057	0.060	0.062	0.054	0.064		0.053	0.062
3	0.177	0.258	0.147	0.265	0.420	0.232	0.268	0.214	0.168	0.248	0.193	0.239	0.208	0.217	0.230	0.220	0.254	0.212
4	0.396	0.633	0.618	0.704	0.829	0.718	0.632	0.505	0.462	0.538	0.582	0.613	0.538	0.465	0.574	0.550	0.460	0.540
5	0.979	0.879	1.005	1.079	1.299	1.301	1.212	1.039	0.905	0.950	0.915	0.901	0.954	0.865	0.865	0.894	0.898	1.017
6	1.735	1.565	1.634	1.673	1.539	1.652	1.853	1.566	1.332	1.273	1.494	1.331	1.348	1.324	1.461	1.150	1.044	1.514
7	2.368	3.029	3.457	2.081	2.555	1.861	2.790	2.279	2.384	1.885	2.214	2.361	1.621	1.702	2.032	1.987	1.236	1.687
8	3.192	5.666	5.791	3.496	2.612	3.555	3.828	3.206	3.337	2.297	2.423	3.778	2.185	2.346	2.258	3.003	1.814	1.585
9	4.676	5.798	8.459	4.890	4.007	4.042	4.225	3.143	5.023	4.483	3.943	4.505	3.060	3.087	2.859	4.281	2.891	2.209
10	5.711	7.108	8.333	7.591	6.441	4.896	5.029	3.760	4.654	6.344	4.839	5.820	4.225	3.956	3.983	4.470	6.450	4.767
11	4.901	9.030	9.085	8.374	8.885	8.848	7.866		6.633	6.616	4.262	8.285	4.934	4.050	5.796	8.673	4.470	5.446
12	5.760		10.158	11.463	13.068	10.270	9.818	3.970	8.867	5.945	9.103	9.061	7.365	4.906	5.240	13.200	6.748	5.544

Age	1996	1997	1998	1999	2000	2001	2002	2003
1	0.018	0.016	0.011	0.014	0.018	0.012	0.015	0.014
2	0.072	0.108	0.091	0.095	0.087	0.086	0.087	0.108
3	0.218	0.257	0.282	0.286	0.272	0.293	0.258	0.266
4	0.461	0.552	0.659	0.646	0.562	0.545	0.595	0.638
5	0.673	0.878	0.941	1.130	0.953	0.819	1.031	1.130
6	1.283	1.076	1.274	1.709	1.333	1.204	1.367	1.434
7	2.009	1.904	1.640	1.992	1.902	1.668	1.357	1.780
8	2.084	2.608	2.791	2.549	2.376	2.999	2.839	1.715
9	2.136	2.867	4.660	4.565	2.904	4.453	4.027	2.952
10	4.464	3.083	4.441	6.567	5.437	4.402	4.844	3.926
11	3.897	5.456	2.528	4.265	8.351	6.949	3.576	2.470
12	6.793		4.190	12.388	6.780	8.805	6.031	5.988

Table 14. Mean gutted condition-at-age of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in winter-spring 1978-2003. Boxed entries are based on fewer than 5 aged fish. Values for 2001 have been corrected from Brattey et al. (2001).

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1																		
2	0.702	0.629	0.595	0.599	0.660	0.632	0.651		0.699		0.644	0.681	0.623	0.641	0.598		0.627	0.630
3	0.745	0.678	0.620	0.718	0.731	0.742	0.734	0.706	0.698	0.736	0.713	0.725	0.680	0.706	0.711	0.657	0.675	0.687
4	0.733	0.715	0.680	0.748	0.740	0.777	0.735	0.704	0.704	0.725	0.739	0.739	0.726	0.710	0.732	0.711	0.677	0.690
5	0.753	0.702	0.703	0.724	0.722	0.766	0.703	0.680	0.733	0.735	0.731	0.734	0.744	0.720	0.716	0.700	0.705	0.702
6	0.730	0.712	0.709	0.745	0.676	0.794	0.711	0.714	0.709	0.717	0.731	0.741	0.743	0.746	0.733	0.663	0.680	0.708
7	0.744	0.699	0.724	0.729	0.699	0.737	0.728	0.739	0.721	0.735	0.736	0.748	0.735	0.741	0.735	0.677	0.660	0.703
8	0.716	0.775	0.734	0.763	0.690	0.725	0.726	0.714	0.717	0.720	0.736	0.780	0.726	0.738	0.727	0.698	0.676	0.665
9	0.737	0.749	0.765	0.748	0.731	0.744	0.730	0.733	0.676	0.768	0.777	0.793	0.735	0.753	0.738	0.758	0.687	0.701
10	0.793	0.803	0.715	0.810	0.751	0.793	0.741	0.740	0.719	0.770	0.789	0.834	0.764	0.777	0.732	0.684	0.732	0.725
11	0.681	0.648	0.784	0.790	0.758	0.819	0.808		0.798	0.779	0.783	0.827	0.794	0.765	0.766	0.786	0.691	0.750
12	0.725		0.759	0.843	0.833	0.865	0.834	0.681	0.789	0.774	0.813	0.852	0.793	0.794	0.744	0.852	0.717	0.753

Age	1996	1997	1998	1999	2000	2001	2002	2003
1	0.754	0.727	0.898	0.673	0.594	0.963	0.638	0.876
2	0.697	0.674	0.660	0.675	0.666	0.665	0.680	0.671
3	0.706	0.717	0.699	0.704	0.696	0.684	0.694	0.700
4	0.709	0.725	0.720	0.697	0.707	0.686	0.688	0.702
5	0.695	0.702	0.704	0.694	0.688	0.680	0.676	0.703
6	0.713	0.683	0.680	0.688	0.677	0.722	0.690	0.697
7	0.715	0.693	0.689	0.690	0.674	0.659	0.666	0.701
8	0.722	0.714	0.725	0.686	0.674	0.699	0.712	0.674
9	0.671	0.713	0.757	0.722	0.698	0.702	0.728	0.674
10	0.758	0.751	0.742	0.762	0.754	0.695	0.740	0.649
11	0.725	0.785	0.748	0.722	0.784	0.732	0.669	0.669
12	0.760		0.784	0.737	0.712	0.773	0.734	0.712

Table 15. Mean liver index at age of cod caught during bottom-trawl surveys in subdivision 3Ps.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1															
2	0.0175	0.0142	0.0150	0.0118	0.0229	0.0247	0.0120	0.0236	0.0230	0.0304	0.0250	0.0279	0.0292	0.0250	0.0301
3	0.0223	0.0160	0.0114	0.0146	0.0244	0.0280	0.0167	0.0168	0.0233	0.0233	0.0227	0.0216	0.0213	0.0213	0.0200
4	0.0203	0.0181	0.0143	0.0188	0.0228	0.0323	0.0179	0.0175	0.0196	0.0225	0.0275	0.0266	0.0293	0.0280	0.0242
5	0.0227	0.0194	0.0189	0.0169	0.0230	0.0275	0.0142	0.0176	0.0214	0.0240	0.0281	0.0269	0.0335	0.0287	0.0315
6	0.0253	0.0218	0.0204	0.0194	0.0163	0.0348	0.0144	0.0217	0.0230	0.0241	0.0280	0.0300	0.0357	0.0309	0.0309
7	0.0256	0.0293	0.0262	0.0213	0.0207	0.0277	0.0195	0.0217	0.0237	0.0273	0.0279	0.0303	0.0376	0.0362	0.0263
8	0.0323	0.0359	0.0370	0.0322	0.0203	0.0303	0.0191	0.0233	0.0268	0.0291	0.0312	0.0341	0.0334	0.0337	0.0368
9	0.0284	0.0319	0.0381	0.0418	0.0225	0.0326	0.0188	0.0268	0.0303	0.0362	0.0357	0.0412	0.0349	0.0386	0.0400
10	0.0326	0.0362	0.0328	0.0470	0.0258	0.0327	0.0328	0.0301	0.0383	0.0462	0.0439	0.0432	0.0411	0.0410	0.0379
11	0.0256	0.0276	0.0381	0.0277	0.0356	0.0445	0.0330	0.0405	0.0435	0.0404	0.0495	0.0519	0.0471	0.0419	0.0473
12	0.0379		0.0385	0.0415	0.0539	0.0462	0.0451	0.0435	0.0463	0.0482	0.0545	0.0689	0.0477	0.0373	0.0376

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1											
2		0.0304	0.0139	0.0252	0.0244	0.0247	0.0239	0.0241	0.0231	0.0235	0.0242
3	0.0106	0.0144	0.0111	0.0160	0.0208	0.0165	0.0205	0.0181	0.0150	0.0193	0.0214
4	0.0154	0.0138	0.0131	0.0161	0.0199	0.0206	0.0170	0.0152	0.0163	0.0155	0.0199
5	0.0180	0.0197	0.0209	0.0168	0.0201	0.0216	0.0167	0.0193	0.0158	0.0176	0.0210
6	0.0187	0.0221	0.0201	0.0201	0.0183	0.0249	0.0168	0.0191	0.0209	0.0203	0.0231
7	0.0184	0.0170	0.0211	0.0219	0.0230	0.0227	0.0210	0.0210	0.0181	0.0172	0.0265
8	0.0206	0.0211	0.0179	0.0231	0.0240	0.0346	0.0197	0.0222	0.0245	0.0198	0.0197
9	0.0280	0.0208	0.0189	0.0194	0.0273	0.0407	0.0294	0.0235	0.0270	0.0242	0.0310
10	0.0182	0.0423	0.0265	0.0303	0.0379	0.0424	0.0388	0.0342	0.0258	0.0271	0.0228
11	0.0346	0.0232	0.0343	0.0314	0.0396	0.0271	0.0234	0.0385	0.0294	0.0110	0.0225
12	0.0379	0.0326	0.0247	0.0202		0.0284	0.0260	0.0298	0.0363	0.0259	0.0334

Table 16. Parameter estimates and standard errors (SE) for a probit model fitted by cohort to observed proportions mature at age for female cod from NAFO Subdiv. 3Ps based on sampling of cod caught during DFO RV surveys conducted during 1959-2003 (nf=no significant model fit). Estimates are given only for cohorts with a significant (P<0.05) slope and intercept term.

Cohort	slope	slope_SE	intercept	intercept_SE
1954	1.109	0.294	-8.170	2.444
1955	1.506	0.224	-10.263	1.612
1956	1.317	0.321	-9.459	2.222
1957	1.460	0.370	-10.325	2.353
1958	2.393	0.585	-16.452	3.620
1959	2.111	0.536	-13.020	2.936
1960	1.674	0.299	-10.668	1.758
1961	1.864	0.355	-11.472	2.067
1962	1.714	0.290	-10.512	1.704
1963	nf	nf	nf	nf
1964	1.927	0.241	-12.718	1.567
1965	2.419	0.598	-16.424	4.239
1966	1.549	0.240	-10.061	1.602
1967	1.688	0.378	-10.084	2.254
1968	2.140	0.289	-13.163	1.787
1969	1.683	0.304	-10.367	1.844
1970	1.526	0.231	-8.856	1.314
1971	1.312	0.140	-7.841	0.835
1972	1.412	0.145	-8.908	0.885
1973	1.452	0.167	-9.355	1.032
1974	2.004	0.197	-13.154	1.294
1975	1.785	0.217	-11.164	1.376
1976	1.355	0.206	-8.599	1.251
1977	2.507	0.350	-15.364	2.173
1978	1.792	0.168	-10.732	1.020
1979	1.030	0.114	-6.448	0.767
1980	1.427	0.141	-9.413	0.913
1981	1.743	0.178	-11.987	1.185
1982	2.009	0.206	-13.306	1.350
1983	1.894	0.261	-11.890	1.604
1984	2.232	0.298	-13.417	1.804
1985	2.699	0.373	-16.034	2.201
1986	2.583	0.293	-14.067	1.593
1987	2.253	0.223	-11.923	1.235
1988	2.773	0.411	-14.021	2.167
1989	1.884	0.158	-9.783	0.811
1990	1.787	0.190	-9.202	0.959
1991	3.548	1.040	-18.346	5.226
1992	2.333	0.359	-11.875	1.770
1993	1.817	0.244	-9.551	1.353
1994	1.468	0.207	-7.624	1.086
1995	1.531	0.244	-8.596	1.356
1996	1.944	0.343	-10.536	1.846
1997	2.747	0.474	-13.210	2.265
1998	4.070	0.668	-18.617	3.086

Table 17. Estimated proportions mature for female cod from NAFO Subdiv. 3Ps from 1955 to 2003 projected forward to 2010. Estimates were obtained from a probit model fitted by cohort to observed proportions mature at age based on sampling of catches from spring DFO research bottom trawl surveys. Shaded cells are averages of the three closest cohorts; boxed cells are the average of estimates for the adjacent cohorts.

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1955	0.0009	0.0015	0.0050	0.0175	0.0607	0.1936	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000
1956	0.0002	0.0026	0.0050	0.0175	0.0607	0.1936	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000
1957	0.0003	0.0007	0.0078	0.0175	0.0607	0.1936	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000
1958	0.0001	0.0011	0.0032	0.0233	0.0607	0.1936	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000
1959	0.0000	0.0006	0.0040	0.0142	0.0675	0.1936	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000
1960	0.0000	0.0000	0.0026	0.0149	0.0611	0.1801	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000
1961	0.0001	0.0002	0.0001	0.0112	0.0535	0.2267	0.3996	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000
1962	0.0001	0.0007	0.0012	0.0010	0.0463	0.1741	0.5693	0.6686	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000
1963	0.0002	0.0004	0.0035	0.0102	0.0111	0.1729	0.4403	0.8563	0.8595	0.9723	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000
1964	0.0001	0.0008	0.0028	0.0185	0.0783	0.1097	0.4738	0.7459	0.9641	0.9488	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000
1965	0.0000	0.0005	0.0046	0.0177	0.0913	0.4124	0.5742	0.7949	0.9164	0.9918	0.9825	0.9973	0.9992	0.9997	1.0000	1.0000
1966	0.0000	0.0001	0.0028	0.0252	0.1041	0.3489	0.8528	0.9366	0.9435	0.9761	0.9982	0.9942	0.9992	0.9997	1.0000	1.0000
1967	0.0002	0.0000	0.0010	0.0159	0.1254	0.4285	0.7408	0.9795	0.9938	0.9863	0.9935	0.9996	0.9981	0.9997	1.0000	1.0000
1968	0.0002	0.0009	0.0001	0.0066	0.0846	0.4432	0.8286	0.9384	0.9975	0.9994	0.9968	0.9982	0.9999	0.9994	1.0000	1.0000
1969	0.0000	0.0012	0.0044	0.0012	0.0438	0.3413	0.8155	0.9689	0.9878	0.9997	0.9999	0.9993	0.9995	1.0000	1.0000	1.0000
1970	0.0002	0.0001	0.0066	0.0205	0.0130	0.2394	0.7496	0.9608	0.9951	0.9977	1.0000	1.0000	0.9998	0.9999	1.0000	1.0000
1971	0.0007	0.0009	0.0012	0.0345	0.0898	0.1290	0.6837	0.9489	0.9927	0.9992	0.9996	1.0000	1.0000	1.0000	1.0000	1.0000
1972	0.0015	0.0030	0.0049	0.0099	0.1619	0.3171	0.6246	0.9369	0.9915	0.9987	0.9999	0.9999	1.0000	1.0000	1.0000	1.0000
1973	0.0006	0.0054	0.0137	0.0257	0.0785	0.5110	0.6861	0.9492	0.9903	0.9986	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
1974	0.0004	0.0023	0.0197	0.0600	0.1243	0.4199	0.8497	0.9114	0.9953	0.9986	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
1975	0.0000	0.0016	0.0093	0.0696	0.2269	0.4332	0.8602	0.9683	0.9798	0.9996	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
1976	0.0001	0.0001	0.0067	0.0370	0.2174	0.5744	0.8044	0.9812	0.9940	0.9956	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1977	0.0007	0.0005	0.0008	0.0280	0.1361	0.5077	0.8613	0.9568	0.9978	0.9989	0.9991	1.0000	1.0000	1.0000	1.0000	1.0000
1978	0.0000	0.0028	0.0030	0.0058	0.1096	0.3927	0.7930	0.9662	0.9917	0.9997	0.9998	0.9998	1.0000	1.0000	1.0000	1.0000
1979	0.0001	0.0000	0.0106	0.0176	0.0417	0.3446	0.7263	0.9343	0.9924	0.9984	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1980	0.0044	0.0008	0.0004	0.0400	0.0963	0.2442	0.6919	0.9159	0.9814	0.9983	0.9997	1.0000	1.0000	1.0000	1.0000	1.0000
1981	0.0003	0.0123	0.0047	0.0048	0.1390	0.3884	0.7056	0.9056	0.9781	0.9949	0.9996	0.9999	1.0000	1.0000	1.0000	1.0000
1982	0.0000	0.0014	0.0336	0.0275	0.0558	0.3849	0.7910	0.9467	0.9762	0.9946	0.9986	0.9999	1.0000	1.0000	1.0000	1.0000
1983	0.0000	0.0002	0.0059	0.0888	0.1453	0.4202	0.7081	0.9575	0.9925	0.9943	0.9987	0.9996	1.0000	1.0000	1.0000	1.0000
1984	0.0000	0.0001	0.0012	0.0240	0.2145	0.5050	0.8989	0.9039	0.9926	0.9990	0.9987	0.9997	0.9999	1.0000	1.0000	1.0000
1985	0.0000	0.0003	0.0007	0.0066	0.0930	0.4334	0.8596	0.9909	0.9733	0.9988	0.9999	0.9997	0.9999	1.0000	1.0000	1.0000
1986	0.0000	0.0001	0.0020	0.0051	0.0365	0.2992	0.6818	0.9735	0.9993	0.9930	0.9998	1.0000	0.9999	1.0000	1.0000	1.0000
1987	0.0000	0.0000	0.0012	0.0132	0.0369	0.1781	0.6401	0.8572	0.9955	0.9999	0.9982	1.0000	1.0000	1.0000	1.0000	1.0000
1988	0.0001	0.0001	0.0004	0.0111	0.0817	0.2224	0.5533	0.8811	0.9439	0.9992	1.0000	0.9995	1.0000	1.0000	1.0000	1.0000
1989	0.0000	0.0006	0.0018	0.0053	0.0947	0.3715	0.6807	0.8762	0.9686	0.9792	0.9999	1.0000	0.9999	1.0000	1.0000	1.0000
1990	0.0004	0.0002	0.0057	0.0233	0.0732	0.4938	0.7971	0.9408	0.9759	0.9923	0.9925	1.0000	1.0000	1.0000	1.0000	1.0000
1991	0.0006	0.0024	0.0033	0.0516	0.2401	0.5399	0.9009	0.9631	0.9916	0.9957	0.9981	0.9973	1.0000	1.0000	1.0000	1.0000
1992	0.0000	0.0036	0.0158	0.0507	0.3412	0.8071	0.9458	0.9883	0.9943	0.9989	0.9992	0.9996	0.9990	1.0000	1.0000	1.0000
1993	0.0001	0.0000	0.0210	0.0956	0.4611	0.8313	0.9823	0.9962	0.9987	0.9991	0.9998	0.9999	0.9999	0.9997	1.0000	1.0000
1994	0.0004	0.0007	0.0005	0.1136	0.4102	0.9319	0.9791	0.9986	0.9997	0.9999	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
1995	0.0021	0.0027	0.0076	0.0155	0.4336	0.8207	0.9955	0.9978	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1996	0.0009	0.0091	0.0163	0.0729	0.3530	0.8205	0.9679	0.9997	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1997	0.0002	0.0039	0.0384	0.0925	0.4477	0.9499	0.9647	0.9950	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1998	0.0000	0.0013	0.0179	0.1478	0.3856	0.8931	0.9985	0.9939	0.9992	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1999	0.0000	0.0004	0.0090	0.0778	0.4295	0.7943	0.9885	1.0000	0.9990	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2000	0.0001	0.0000	0.0069	0.0595	0.2807	0.7657	0.9596	0.9989	1.0000	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2001	0.0001	0.0006	0.0016	0.0978	0.3066	0.6434	0.9341	0.9932	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2002	0.0001	0.0006	0.0058	0.0881	0.6283	0.7555	0.8929	0.9840	0.9989	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2003	0.0001	0.0006	0.0058	0.0818	0.8498	0.9635	0.9557	0.9747	0.9963	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2004	0.0001	0.0006	0.0058	0.0818	0.5949	0.9970	0.9976	0.9934	0.9944	0.9991	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2005	0.0001	0.0006	0.0058	0.0818	0.5949	0.9053	0.9999	0.9998	0.9991	0.9988	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
2006	0.0001	0.0006	0.0058	0.0818	0.5949	0.9053	0.9844	1.0000	1.0000	0.9999	0.9997	1.0000	1.0000	1.0000	1.0000	1.0000
2007	0.0001	0.0006	0.0058	0.0818	0.5949	0.9053	0.9844	0.9978	1.0000	1.0000	1.0000	0.9999	1.0000	1.0000	1.0000	1.0000
2008	0.0001	0.0006	0.0058	0.0818	0.5949	0.9053	0.9844	0.9978	0.9997	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2009	0.0001	0.0006	0.0058	0.0818	0.5949	0.9053	0.9844	0.9978	0.9997	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2010	0.0001	0.0006	0.0058	0.0818	0.5949	0.9053	0.9844	0.9978	0.9997	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 18. Mean numbers per tow at age for the fall industry (GEAC) trawl survey of the offshore portion of NAFO Subdiv. 3Ps. Boxed cells indicate the years with the two highest catch rates for a given age.

Age/Year	1997	1998	1999	2000	2001	2002	cohort
1	0.00	0.01	0.00	0.00	0.03	0.00	
2	0.29	0.06	0.34	1.64	0.21	0.00	
3	3.28	0.40	1.14	7.24	12.47	1.26	
4	9.42	1.76	1.71	2.86	26.74	16.77	1998
5	13.62	2.32	2.83	3.35	3.75	18.27	1997
6	3.02	1.81	3.58	5.18	2.14	2.88	
7	10.03	0.35	3.27	5.89	1.62	1.39	
8	11.97	1.64	0.51	3.99	1.34	1.18	
9	1.34	3.40	1.43	1.14	0.96	0.91	1993
10	0.54	0.40	1.36	5.83	0.10	0.46	
11	0.24	0.04	0.17	7.14	0.44	0.09	
12	0.04	0.13	0.10	0.79	0.58	0.27	
13	0.00	0.22	0.02	0.11	0.08	0.30	1989
14	0.00	0.00	0.00	0.17	0.05	0.00	
15	0.00	0.04	0.00	0.00	0.03	0.00	
Totals	53.79	12.58	16.46	45.33	50.54	43.78	

Table 19. Catch-at-age for the commercial cod fishery in 3Pn4RS during 1990-2002 with each age expressed as a percentage of the annual total. Boxed cells indicate the years with the two highest catch rates for a given age for the period 1993-2002.

Age/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	cohort
3	1.2	0.4	1.1	1.0	0.2	1.0	0.5	0.6	0.1	0.0	0.0	0.0	0.0	
4	10.5	11.6	15.8	11.9	0.7	5.6	5.7	10.0	1.8	1.4	1.4	4.8	2.0	1998
5	26.0	26.7	33.8	23.2	15.7	12.6	15.1	13.0	20.2	6.3	11.7	8.8	7.8	1997
6	20.1	26.6	22.5	36.5	24.9	28.0	27.0	25.8	20.1	30.0	19.7	18.9	23.5	
7	18.4	12.9	12.6	17.5	33.8	21.4	22.8	16.0	26.6	14.3	37.0	19.0	20.3	
8	13.5	10.0	6.1	5.4	17.8	18.0	14.4	17.4	12.8	24.4	10.9	30.1	22.0	
9	5.6	7.7	4.2	2.1	2.7	9.0	10.4	7.4	7.8	11.8	12.5	9.9	17.7	1993
10	3.1	1.9	2.5	1.3	2.5	2.8	3.4	8.3	7.1	5.6	4.6	5.6	4.5	
11	0.9	1.7	0.8	0.8	0.7	0.9	0.4	1.0	2.3	4.3	1.4	1.5	1.3	
12	0.4	0.4	0.4	0.1	0.7	0.4	0.1	0.3	1.0	1.7	0.4	0.9	0.2	
13	0.2	0.2	0.2	0.1	0.3	0.3	0.1	0.1	0.2	0.2	0.3	0.7	0.7	1989

Table 20. Swept area estimates of numbers-at-age (000's) for catches of cod from the Alfred Needler trawl survey of 3Pn4RS. Boxed cells indicate the years with the two highest catch rates for a given age for the period 1993-2002.

Age/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	cohort
3	23,621	21,310	4,116	1,497	7,817	1,047	6,248	3,242	5,972	8,134	9,912	5,563	1,938	
4	18,926	45,809	9,031	1,535	4,156	4,416	3,392	8,979	7,040	8,502	8,112	4,647	4,240	1998
5	9,820	24,156	9,149	1,810	2,481	3,170	3,986	3,395	7,779	3,868	4,933	3,202	1,657	1997
6	3,730	10,702	3,509	1,734	2,456	2,105	2,195	4,046	3,485	4,569	2,177	2,910	1,141	
7	3,666	3,004	1,092	388	2,010	989	1,256	2,203	2,811	1,109	2,662	1,449	675	
8	3,533	1,772	515	168	729	899	387	1,166	811	990	709	1,966	638	
9	736	1,874	370	31	173	182	300	405	591	336	513	277	200	1993
10	239	435	162	30	57	113	63	402	167	89	157	545	151	
11	76	252	85	0	25	34	0	20	0	172	75	79	14	
12	30	47	45	16	29	0	10	0	0	32	83	85	0	
13	53	74	22	0	0	0	0	0	0	20	18	29	0	1989

Table 21. Catch-at-age for the sentinel line-trawl and sentinel gillnet surveys of 3Pn4RS during 1995-2002. Boxed cells indicate the years with the two highest catch rates for a given age.

Sentinel line-trawl

Age/Year	1995	1996	1997	1998	1999	2000	2001	2002	cohort
3	26.3	49.3	34.1	123.4	114.1	96.1	57.1	45.7	
4	178.1	173.4	151.0	344.4	636.0	588.8	635.7	350.1	1998
5	204.3	291.2	176.4	633.6	488.9	868.7	1,014.7	569.4	1997
6	299.2	337.5	334.2	601.9	881.7	840.8	995.0	744.3	
7	395.4	402.0	221.4	456.4	396.3	889.6	859.7	594.0	
8	382.1	240.3	156.8	221.2	479.1	279.9	881.8	382.3	
9	113.6	209.0	115.1	163.7	131.8	155.6	280.6	378.3	1993
10	26.2	50.8	77.9	74.8	85.9	27.6	113.9	78.6	
11	7.6	7.0	12.3	32.3	48.2	9.1	41.4	41.9	
12	5.8	1.9	3.9	9.4	22.3	10.5	15.8	6.4	
13	4.0	1.7	1.2	3.5	4.7	3.5	5.7	4.0	1989

Sentinel gillnet

Age/Year	1995	1996	1997	1998	1999	2000	2001	2002	cohort
3	3.0	5.6	5.0	54.4	4.5	3.8	0.5	1.0	
4	21.2	47.0	68.8	233.4	38.1	55.8	27.7	17.0	1998
5	63.9	709.0	228.0	1,184.0	236.0	550.9	165.8	177.6	1997
6	195.7	1,411.2	834.0	777.7	809.8	1,279.2	388.1	690.7	
7	315.9	1,277.7	620.7	935.3	536.2	1,803.2	501.7	636.6	
8	384.1	817.7	450.3	459.9	689.2	671.2	756.6	564.5	
9	96.0	588.3	321.3	281.3	209.0	471.5	279.2	517.6	1993
10	25.9	177.7	186.2	249.9	107.5	134.7	113.2	105.0	
11	3.8	7.1	26.7	65.9	59.1	48.8	24.1	61.3	
12	4.4	1.5	7.8	25.3	24.2	29.7	22.3	6.2	
13	3.5	1.7	1.0	2.0	3.7	26.6	2.0	9.4	1989

Table 22. Catch-at-age for the commercial cod fishery in NAFO Subdiv. 3Ps during 1990-2002 with each age expressed as a percentage of the annual total (see Table 6 for numbers-at-age). Boxed cells indicate the years with the two highest catch rates for a given age for the period 1993-2002.

Year/Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	cohort
3	7.6	2.8	5.9	2.5	2.0	1.0	2.3	1.6	1.4	0.5	1.0	1.4	2.5	
4	32.9	27.5	17.1	33.4	17.7	2.4	11.0	10.2	5.6	6.6	4.4	8.4	9.3	1998
5	31.2	34.6	34.7	18.3	39.2	19.4	11.0	26.9	11.8	12.6	9.7	12.7	23.8	1997
6	12.7	20.4	26.9	28.4	16.8	41.3	25.8	11.8	23.1	22.6	17.8	19.4	21.3	
7	5.7	7.5	9.3	12.0	14.1	19.8	32.0	22.3	14.1	24.3	22.3	20.1	15.0	
8	4.7	2.8	2.7	3.6	6.3	12.8	9.0	19.7	19.6	10.7	19.6	14.0	11.9	
9	2.6	2.1	1.1	0.8	2.7	2.4	6.1	4.5	18.2	10.1	8.0	11.9	6.6	1993
10	1.3	1.5	0.8	0.3	0.7	0.7	2.0	2.2	3.4	9.2	7.0	4.5	5.4	
11	0.5	0.4	0.8	0.5	0.5	0.0	0.5	0.7	1.8	2.0	8.2	3.6	1.7	
12	0.4	0.3	0.3	0.1	0.0	0.0	0.3	0.1	0.8	1.2	1.2	3.4	1.3	
13	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.2	0.5	0.5	1.0	1989
14	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.1	

Table 23. Inputs and structure for the projection of 3Ps cod spawner biomass from 1 April 2003 to 1 April 2006.

Proportion of TAC or F

Year	Period From	To	Prop
2003	1-Apr	31-Dec	0.83
2004	1-Jan	31-Mar	0.17
2004	1-Apr	31-Dec	0.83
2005	1-Jan	31-Mar	0.17
2005	1-Apr	31-Dec	0.83
2006	1-Jan	31-Mar	0.17

Partial Recruitment

To be computed from the average of the PR for the period 2000-2002 from the relevant SPA
Method is to calculated the PR in each year, take the average, and then rescale the vector to have a maximum of 1

Run/Age	2	3	4	5	6	7	8	9	10	11	12	13	14
Run A	0.00	0.01	0.07	0.28	0.68	0.95	1.00	0.86	0.60	0.34	0.15	0.07	0.04
Run B	0.00	0.01	0.07	0.27	0.73	0.96	1.00	0.94	0.73	0.39	0.19	0.11	0.07
Run C	0.00	0.01	0.04	0.16	0.39	0.60	0.77	0.92	1.00	0.93	0.58	0.21	0.14
Run D	0.00	0.01	0.05	0.20	0.55	0.83	0.98	1.00	0.84	0.51	0.20	0.12	0.08
Run E	0.00	0.01	0.05	0.20	0.53	0.80	0.91	1.00	0.90	0.72	0.34	0.18	0.13

Recruitment at age 3

Geometric mean of numbers at age 3 in 2001-2003 from the relevant SPA

Run A	24,015
Run B	27,255
Run C	22,138
Run D	22,255
Run E	21,779

Natural mortality

M = 0.2

Population weight at age (Jan 1)

Year/Age	2	3	4	5	6	7	8	9	10	11	12	13	14
2003	0.000	0.507	0.697	1.231	1.785	2.189	2.464	3.243	4.381	3.932	3.951	5.971	9.384
2004	0.000	0.507	0.757	1.057	1.822	2.341	2.645	2.952	3.835	5.197	4.676	4.643	7.224
2005	0.000	0.527	0.791	1.188	1.730	2.265	2.778	3.360	3.872	4.621	5.692	6.670	7.531
2006	0.000	0.527	0.791	1.188	1.730	2.265	2.778	3.360	3.872	4.621	5.692	6.670	7.531

Catch weights at age (mid-year)

Year/Age	2	3	4	5	6	7	8	9	10	11	12	13	14
2003	0.000	0.625	0.851	1.540	2.134	2.423	2.678	3.537	4.752	4.311	4.256	6.339	10.080
2004	0.125	0.639	0.968	1.486	2.068	2.507	3.022	3.671	4.218	5.082	6.167	7.060	8.084
2005	0.125	0.639	0.968	1.486	2.068	2.507	3.022	3.671	4.218	5.082	6.167	7.060	8.084
2006	0.125	0.639	0.968	1.486	2.068	2.507	3.022	3.671	4.218	5.082	6.167	7.060	8.084

Maturity at age

Year/Age	2	3	4	5	6	7	8	9	10	11	12	13	14
2003	0.001	0.006	0.082	0.850	0.963	0.956	0.975	0.996	1.000	1.000	1.000	1.000	1.000
2004	0.001	0.006	0.082	0.595	0.997	0.998	0.993	0.994	0.999	1.000	1.000	1.000	1.000
2005	0.001	0.006	0.082	0.595	0.905	1.000	1.000	0.999	0.999	1.000	1.000	1.000	1.000
2006	0.001	0.006	0.082	0.595	0.905	0.984	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 24. Comparison of results from 3-year deterministic projections (from 1 April 2003 to 1 April 2006) at fixed annual TAC options ranging from 10,000 to 20,000 t for the NAFO Subdiv. 3Ps cod stock. Results are given in terms of percent change in spawning stock biomass (SSB) relative to 1 April 2003 values for each of the five SPA models / formulations considered. Negative values (shaded cells) indicate lower SSB at the end of the projection period.

SPA Model/ Formulation	Starting value (SSB in tons)	Percent change in SSB 2003.3 to 2006.3 at fixed TAC (t) of:		
		10,000	15,000	20,000
A	125,075	-8	-16	-23
B	174,306	-8	-13	-19
C	76,004	27	15	3
D	118,586	-5	-13	-20
E	88,435	11	1	-10

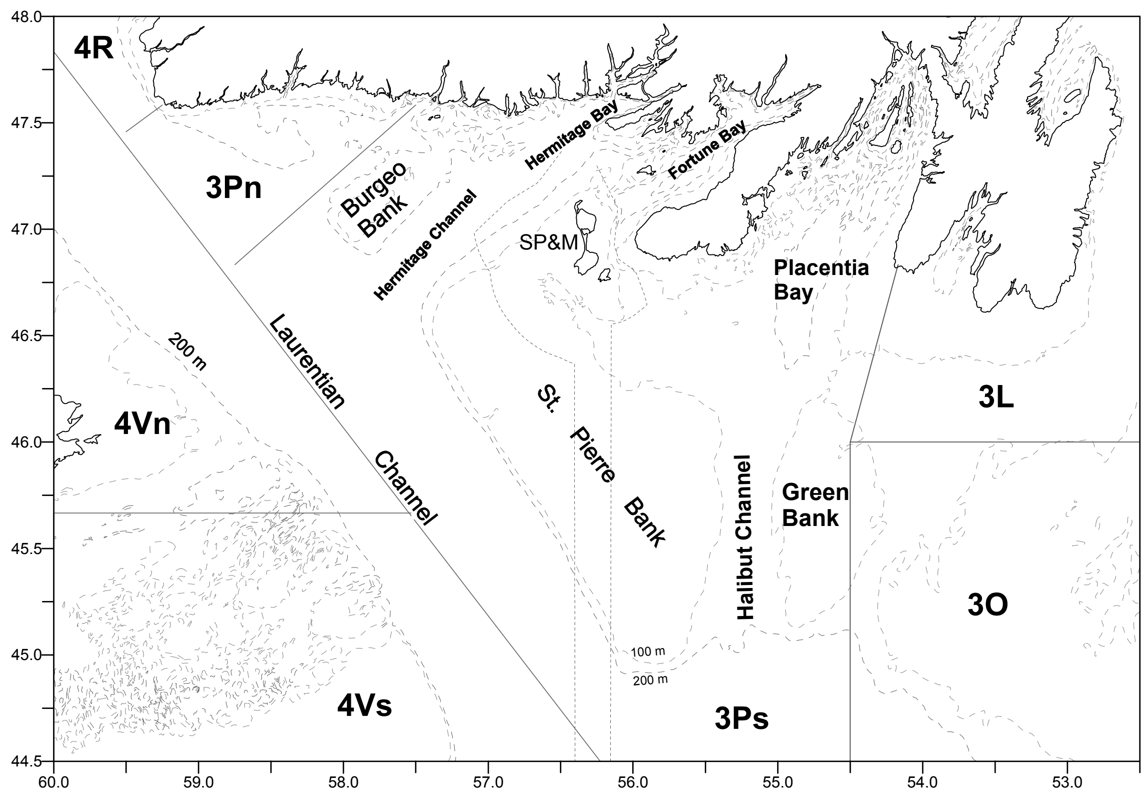


Fig. 1. NAFO Subdivision 3Ps management unit, boundaries of French economic zone (fine dashed line) and main fishing areas.

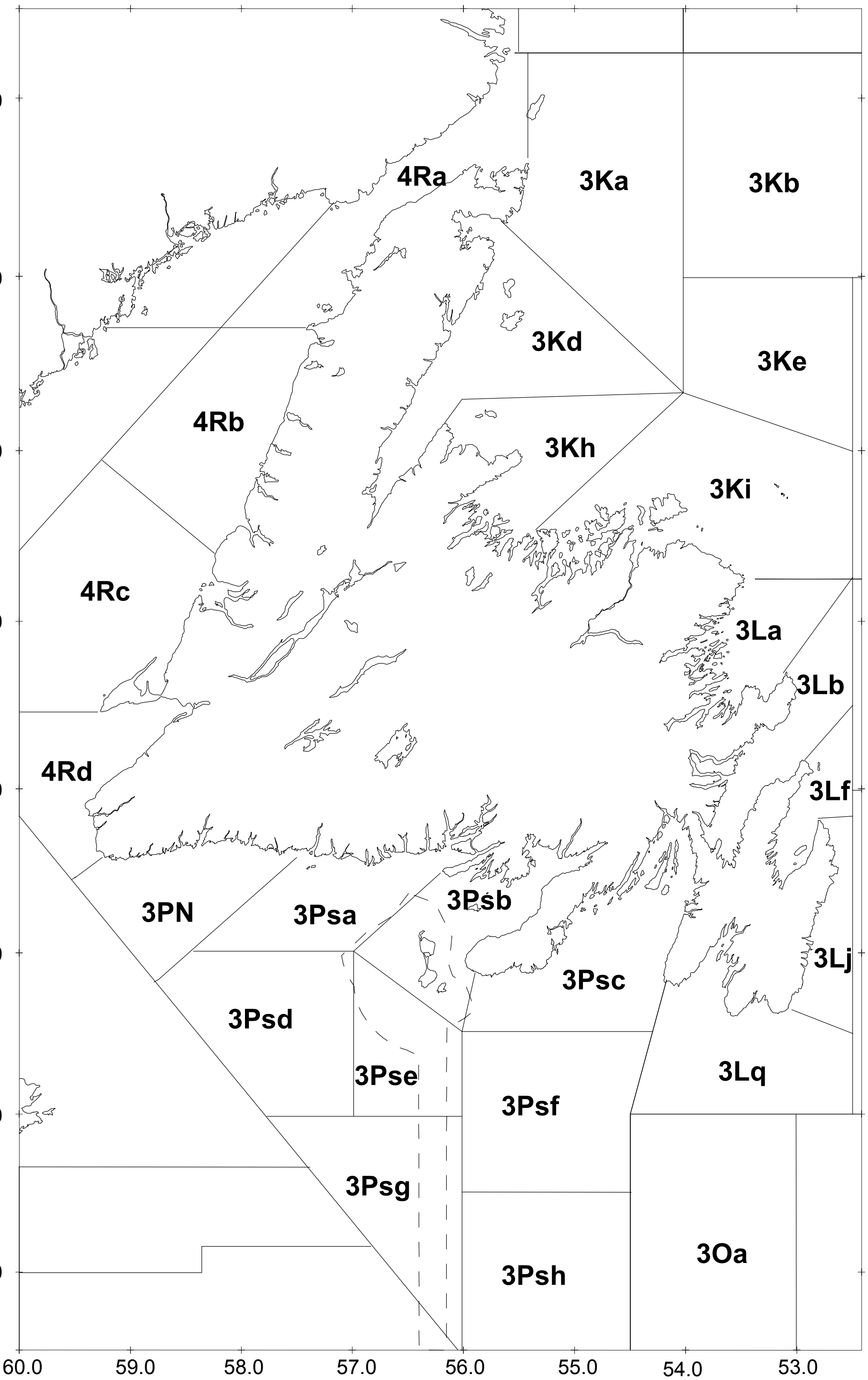


Fig. 2. Names and boundaries of NAFO statistical areas around insular Newfoundland. The dashed line indicates the boundary of the French economic zone.

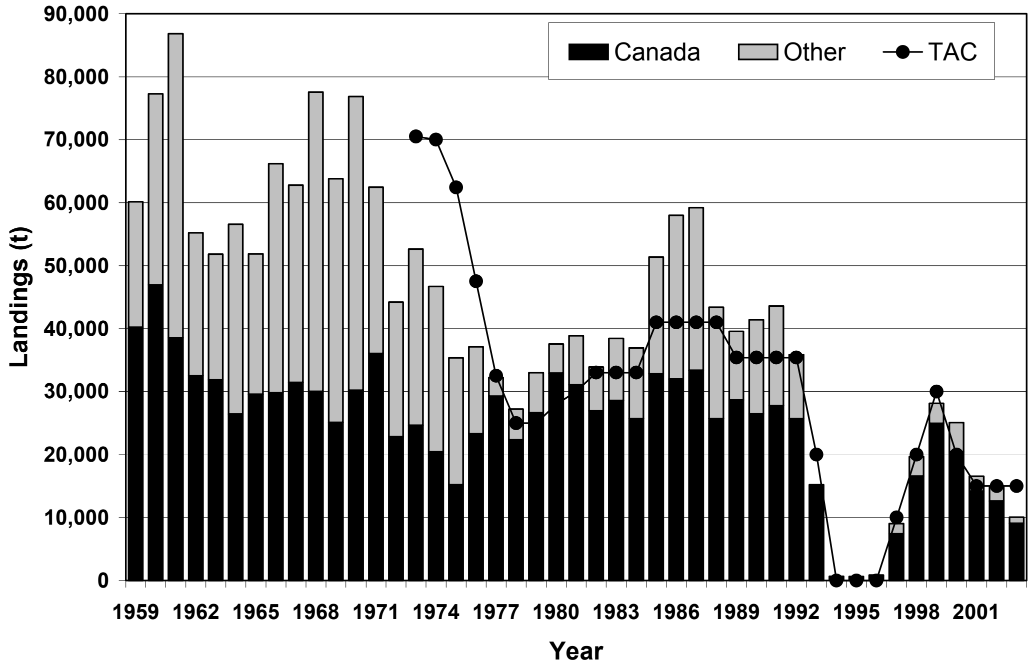


Fig. 3a. Reported landings of cod by Canadian and non-Canadian vessels in NAFO Subdiv. 3Ps during 1959 - 1 Oct 2003

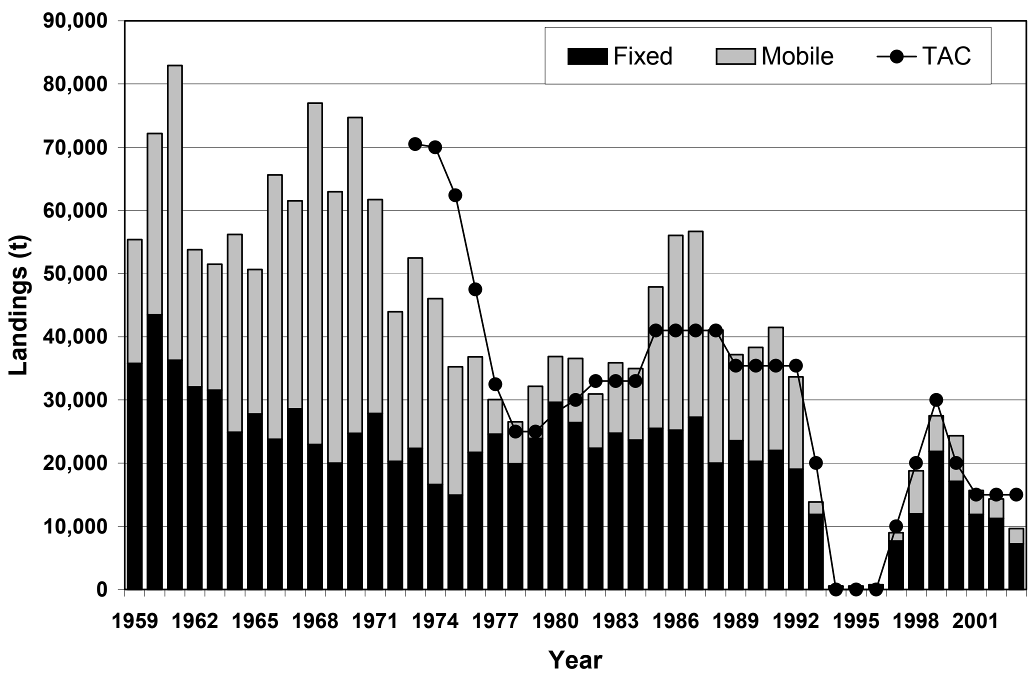


Fig. 3b. Reported landings of cod by fixed and mobile gear vessels in NAFO Subdiv. 3Ps during 1959 - 1 Oct 2003

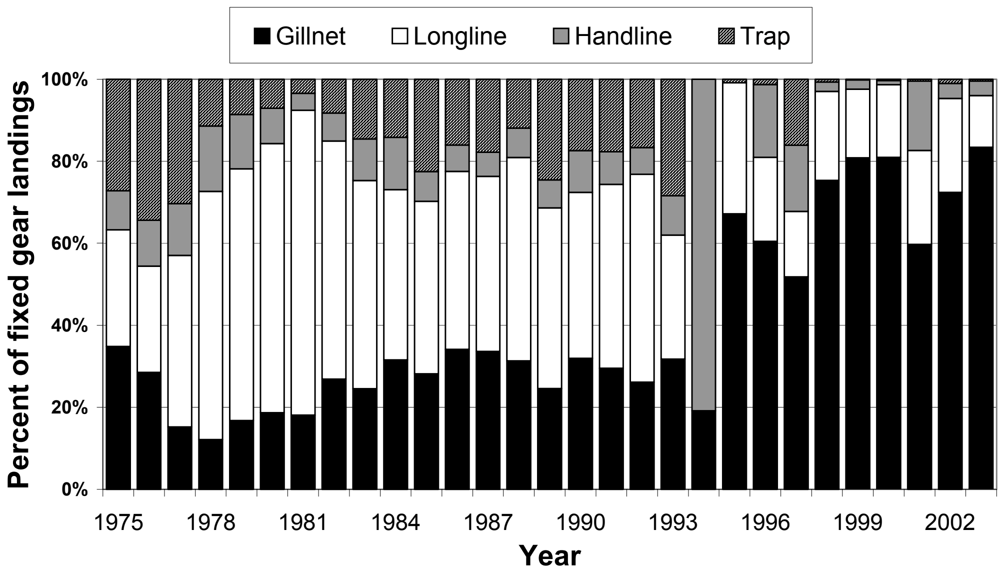


Fig. 4. Proportions of landings by various fixed gears in the cod fishery in NAFO Subdiv. 3Ps during 1975 - 1 October 2003. The fishery was under a mortaorium during August 1993 - 1996 and values for those years are based on sentinel nad by-catch fisheries only. The proportions for 2003 are based on landings to 1 October 2003 as the fishery was still in progress.

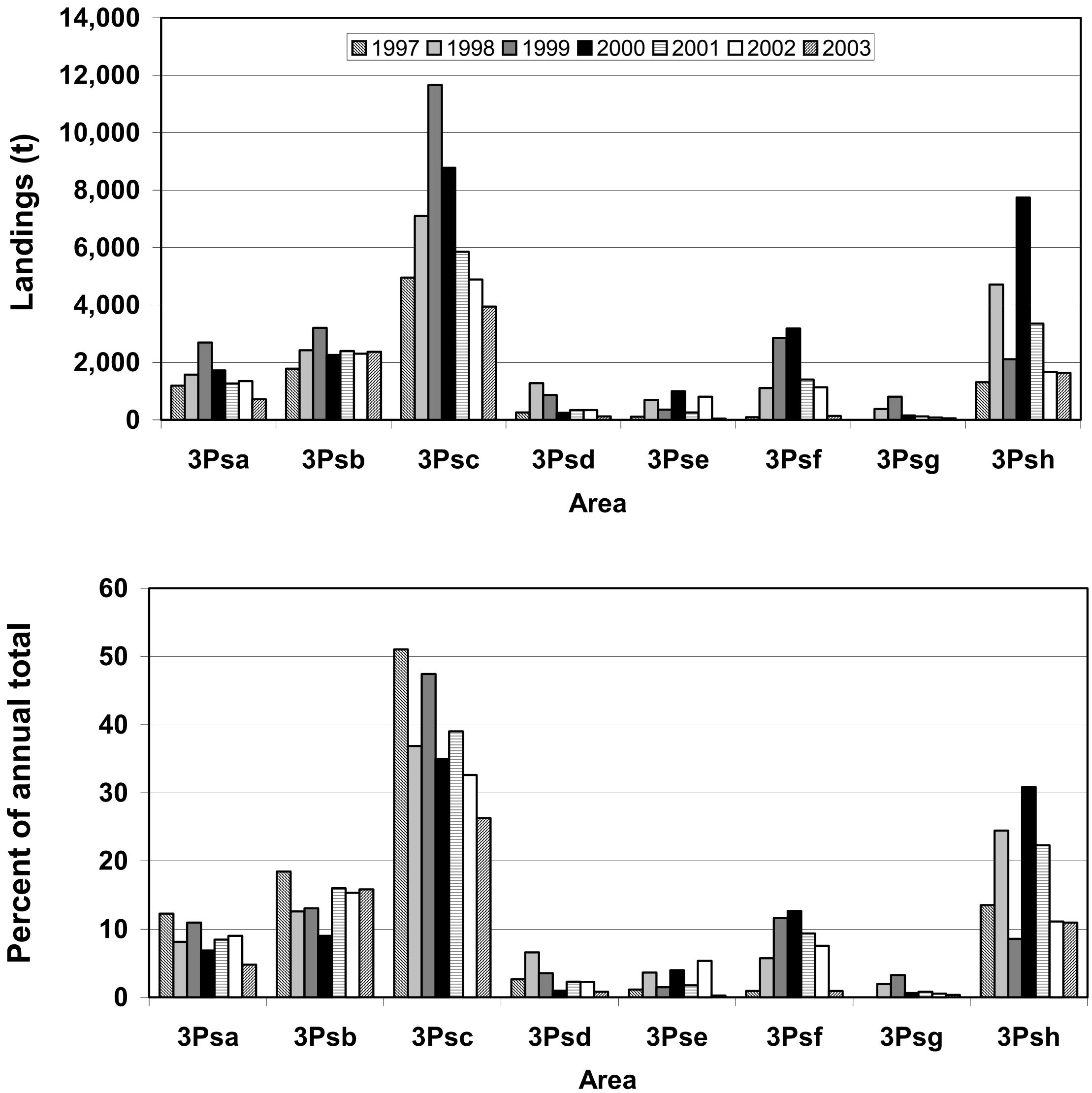


Fig. 5. Annual reported landings of cod by unit area from NAFO Subdiv. 3Ps during 1997-2003. Values for 2003 are to 1 October as the fishery was still in progress.

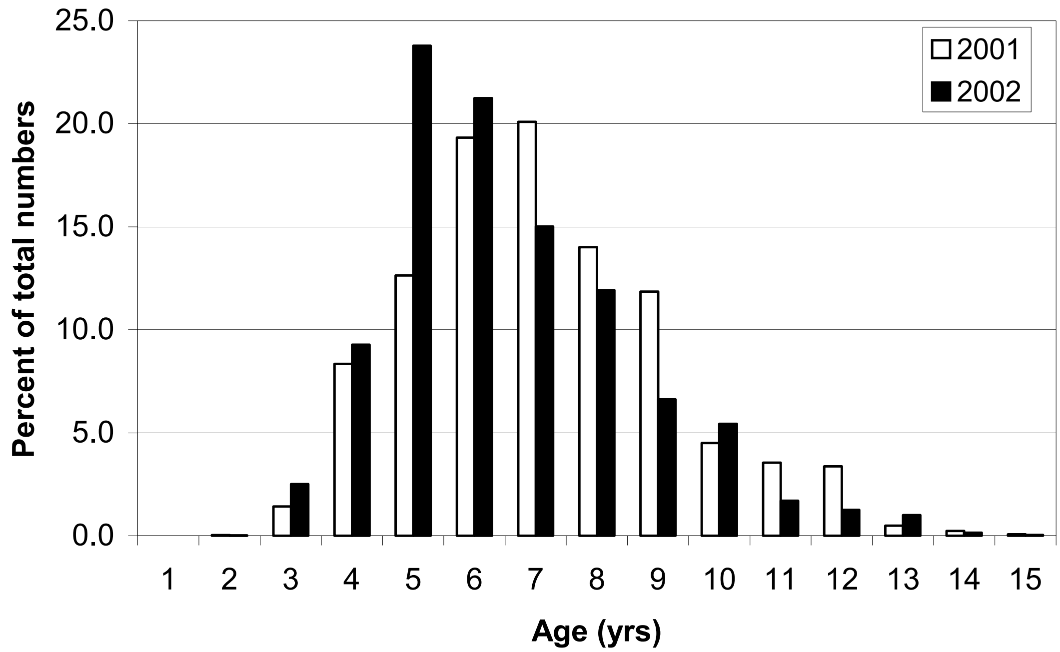


Fig. 6a. Catch proportions-at-age for the commercial cod fishery in 2001 and 2002.

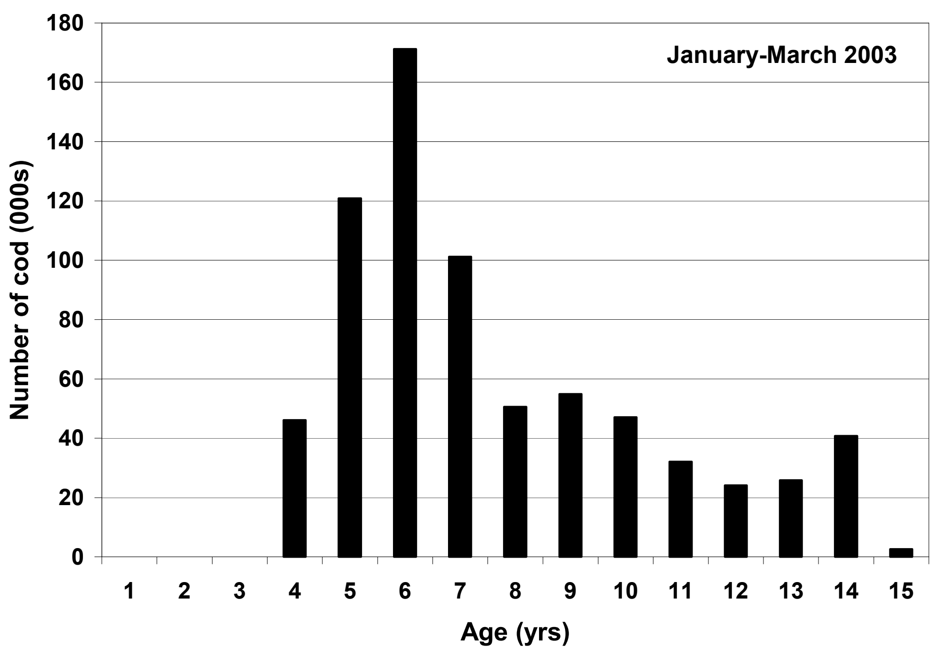


Fig. 6b. Catch numbers-at-age for the cod fishery in NAFO Subdiv. 3Ps during January-March 2002

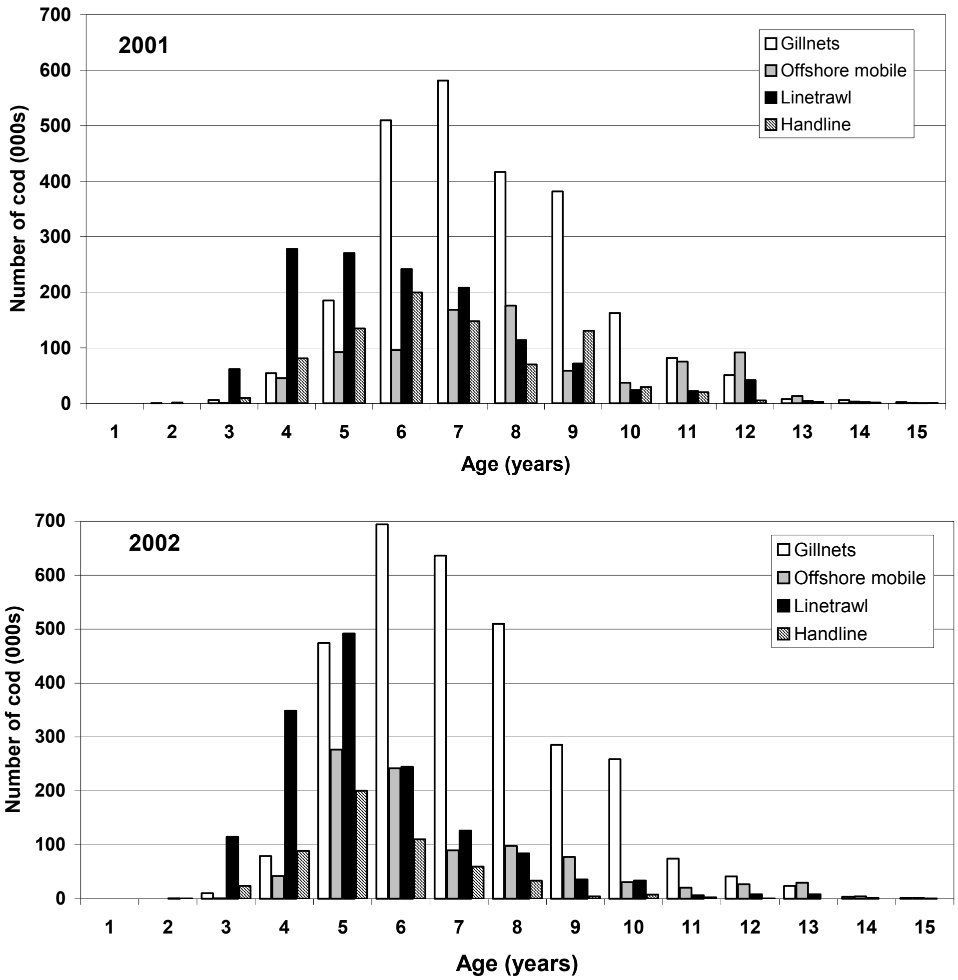


Fig. 7a. Catch numbers-at-age for the main gear types used in the cod fishery in NAFO Subdiv. 3Ps during 2001 and 2002. Offshore mobile is otter trawl and Norwegian seine.

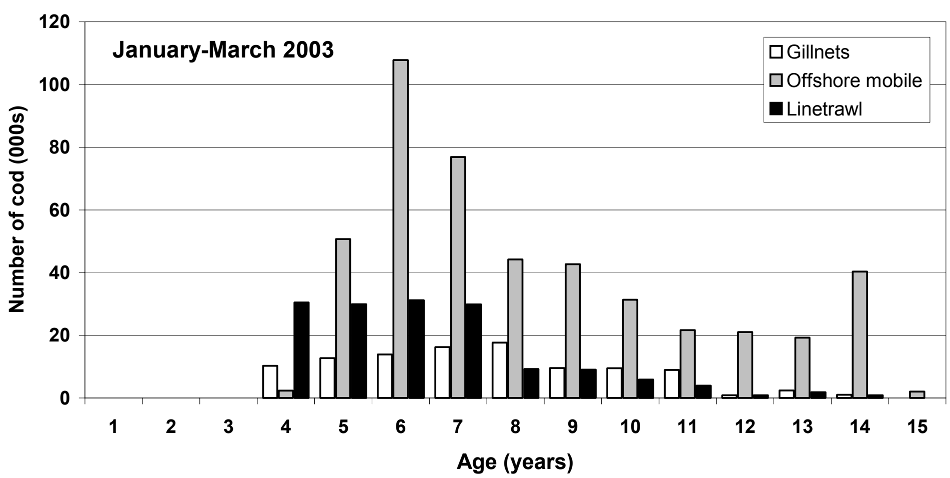


Fig. 7b. Catch numbers-at-age for the main gear types used in the cod fishery in NAFO Subdiv. 3Ps during the first quarter of 2003.

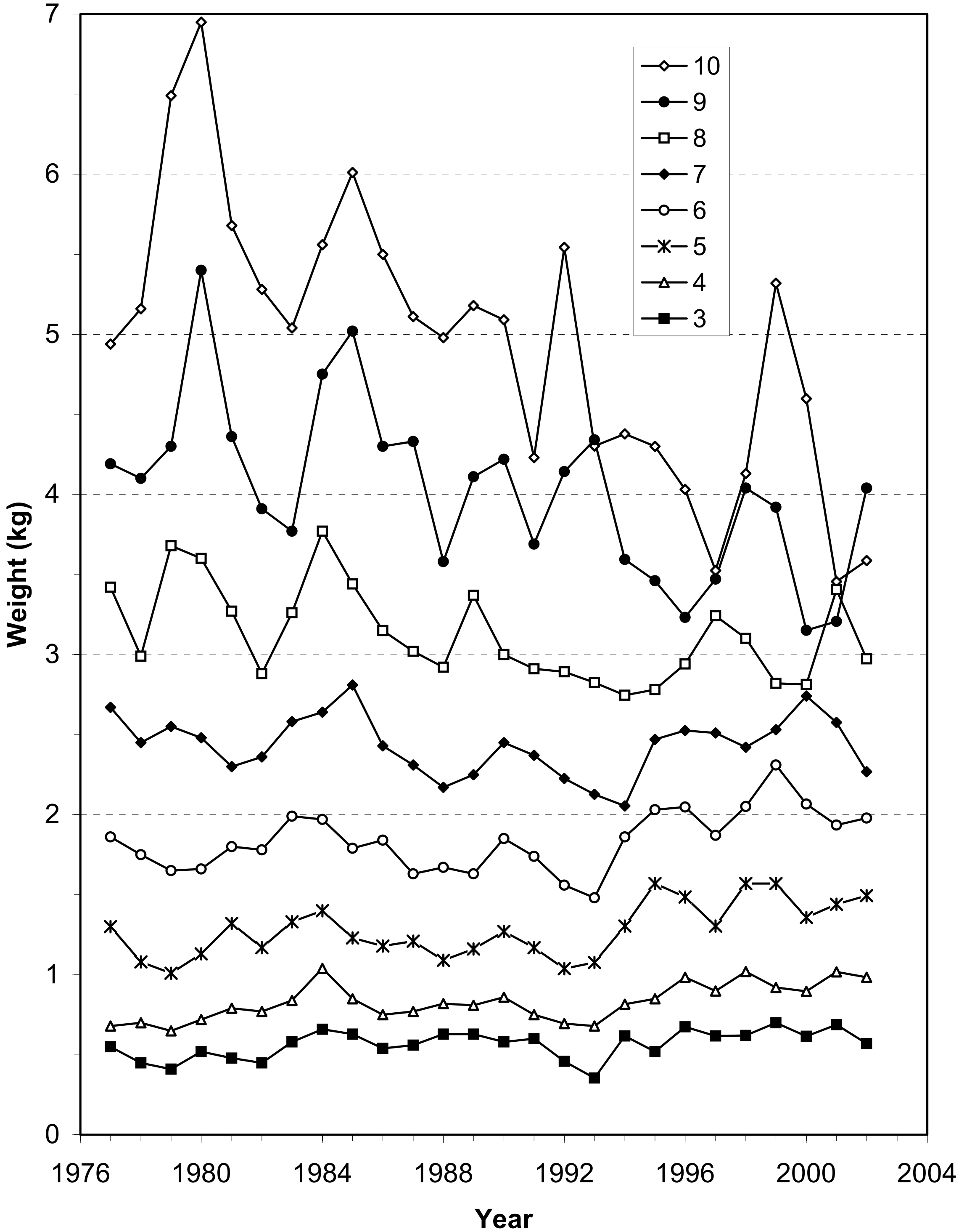


Fig. 8a. Mean weights-at-age calculated from mean lengths-at-age for the commercial catch of cod in NAFO Subdiv. 3Ps during 1976-2002.

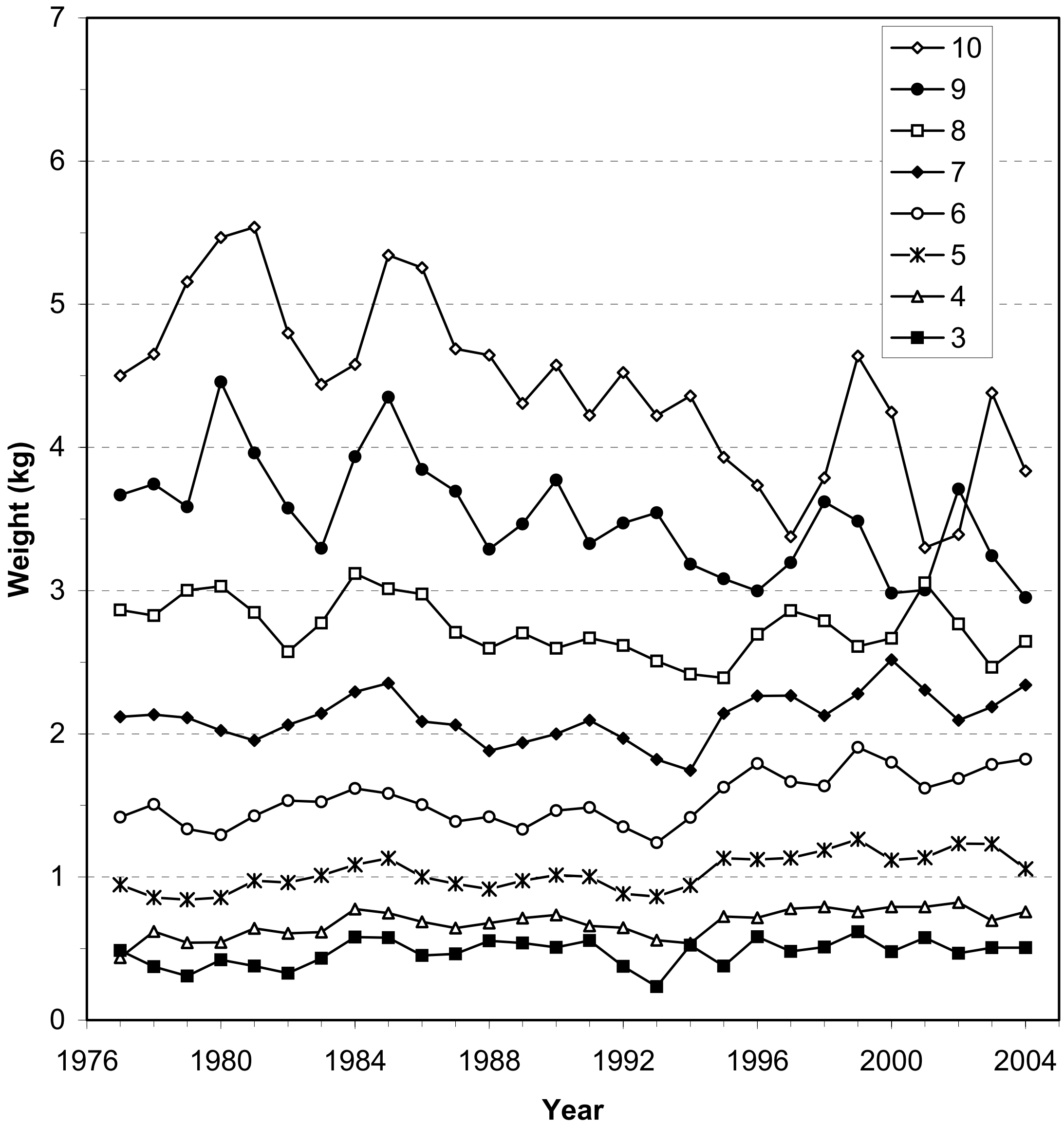


Fig. 8b. Beginning of year mean weights-at-age (3-10) from the commercial catch of cod in NAFO Subdiv. 3Ps during 1976-2003. The values for 2004 are extrapolated as described in the text.

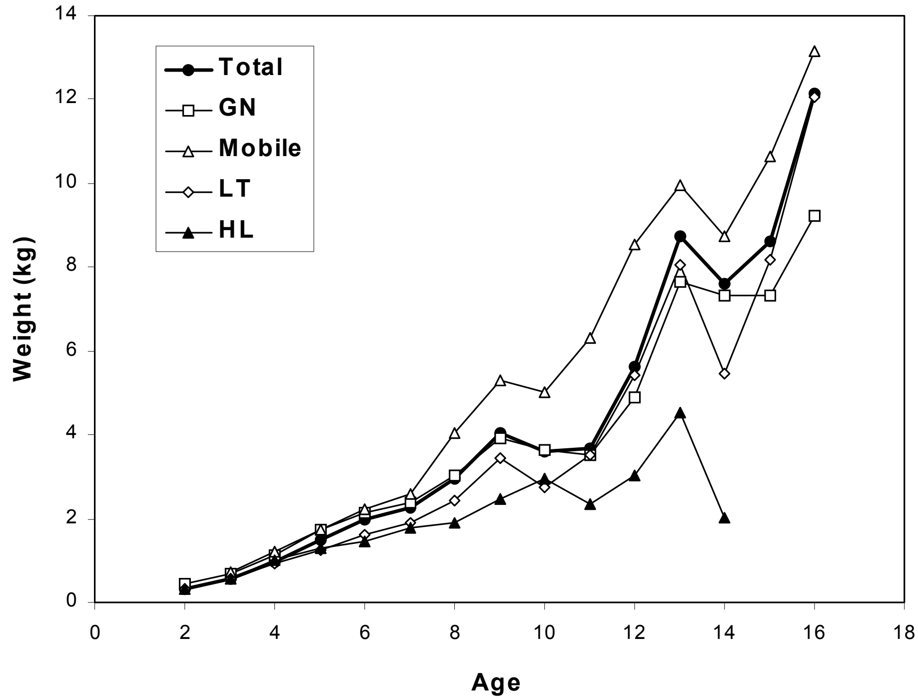


Fig. 8c. Mean weight-at-age by gear for 3Ps cod caught during the 2002 fishery.

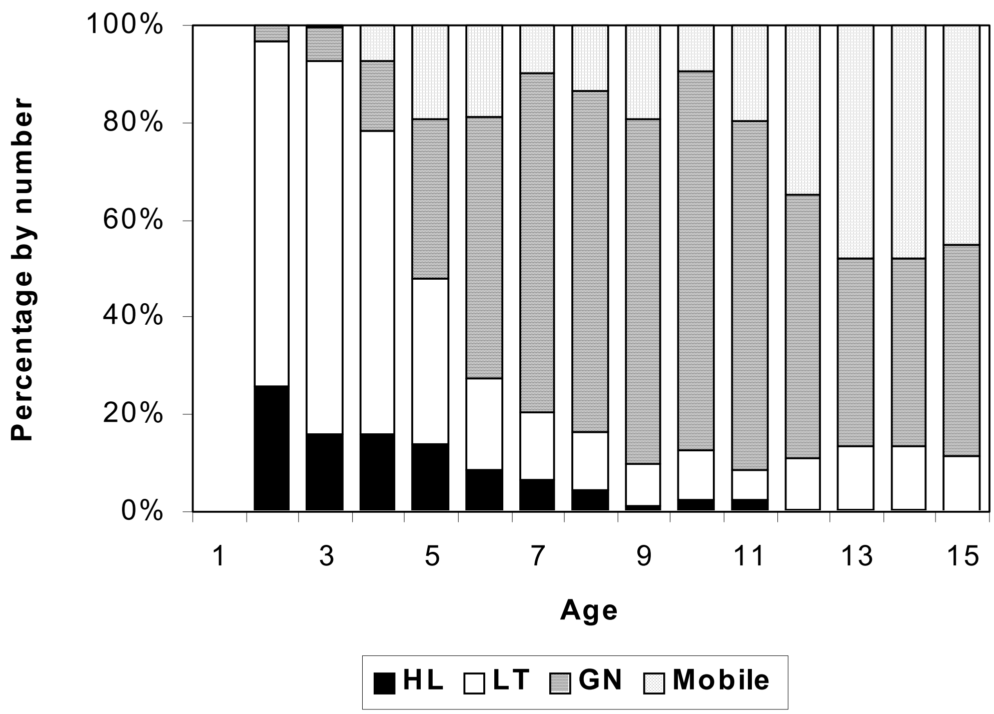


Fig. 8d. Percentage (by number) of 3Ps cod caught by each of 4 major gear types during the 2002 fishery.

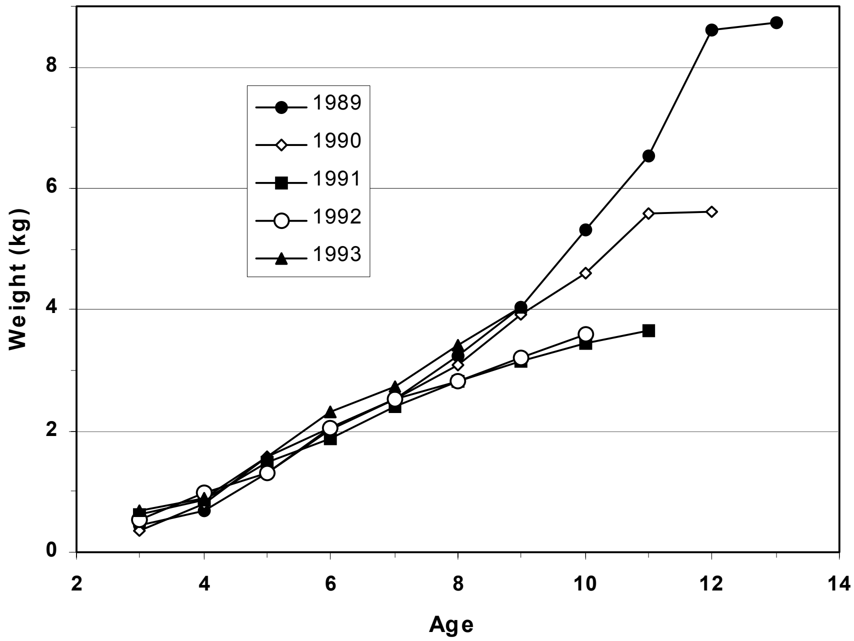


Fig. 8e. Weight-at-age of the 1989-1993 year-classes as computed from sampling of the 3Ps cod fishery.

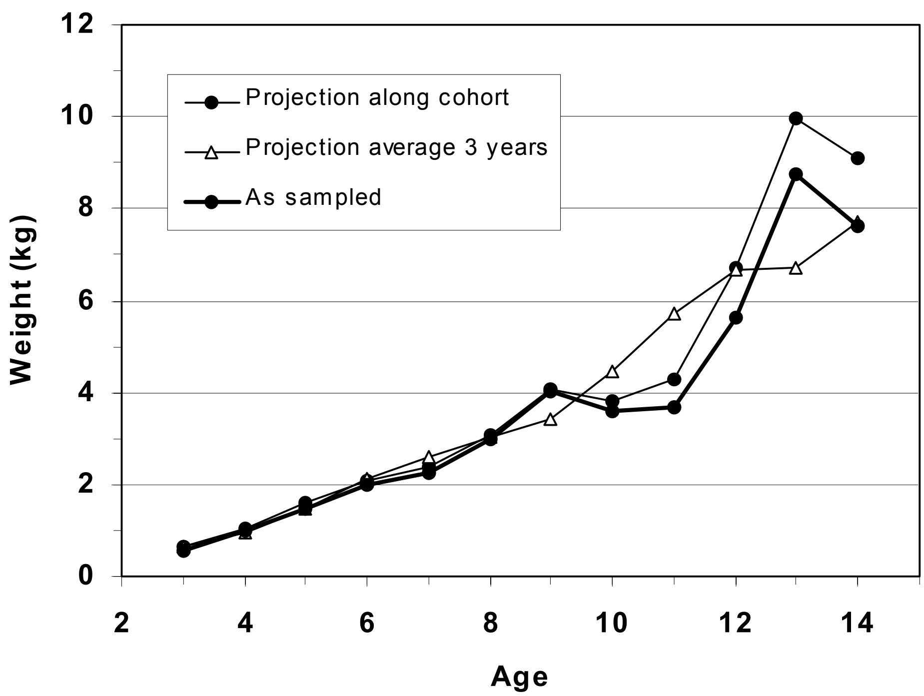
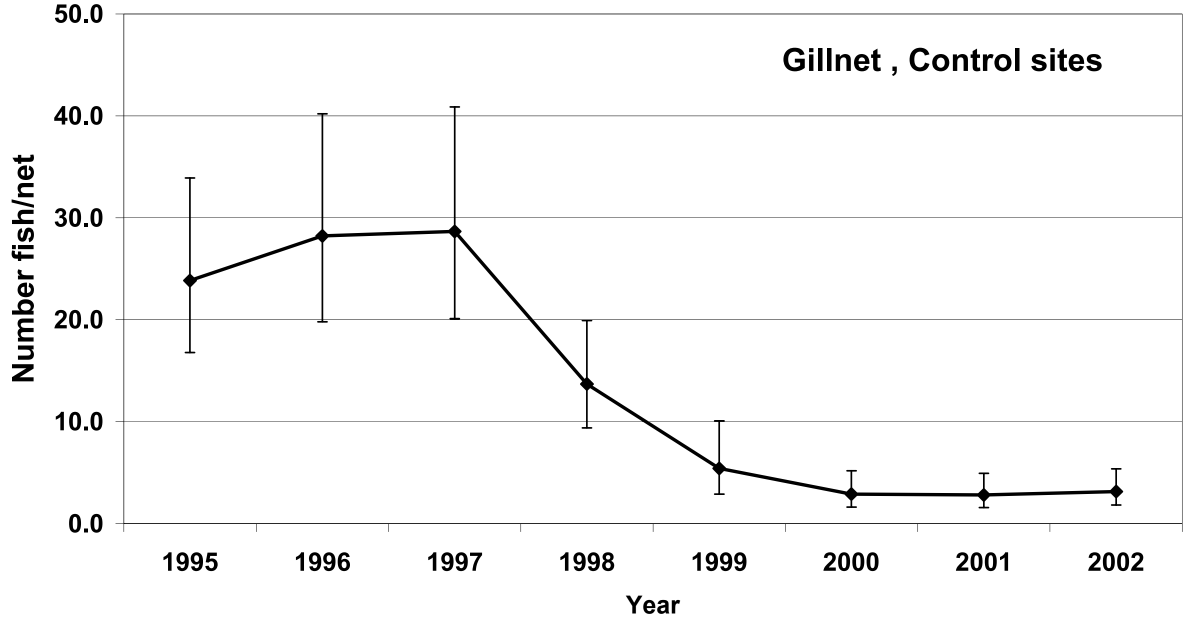


Fig. 8f. Fishery mid-year weights-at-age for 3Ps cod projected for 2002 by two methods. One method projected the weight at age *a* in 2002 from the weight at age *a*-1 in 2001, whereas the other method assumed that the weight at age *a* in 2002 would equal the average of the weight at age *a* in 1999-2001. Also shown are the weights-at-age computed from the catches in 2002.



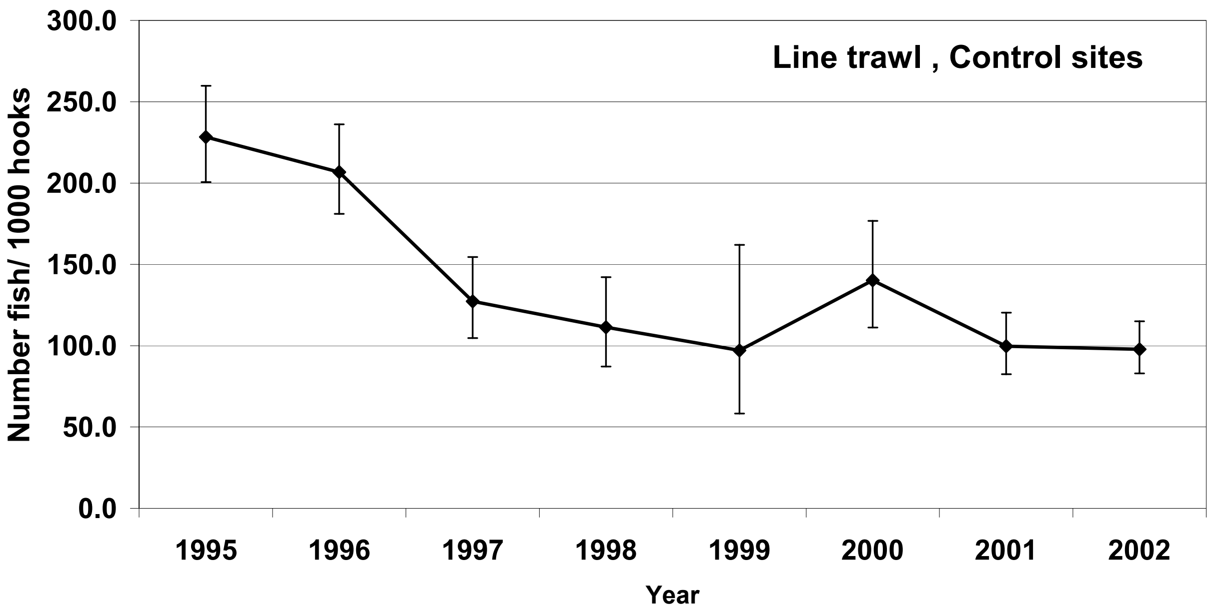


Fig. 9. Standardized age-aggregated catch rate indices for gill nets (5.5" mesh) and line-trawls (with 95% CL's) estimated using data from sentinel fishery fixed sites. Catch rates are fish per 50 fathom net for gill nets and fish per 1,000 hooks for line trawl.

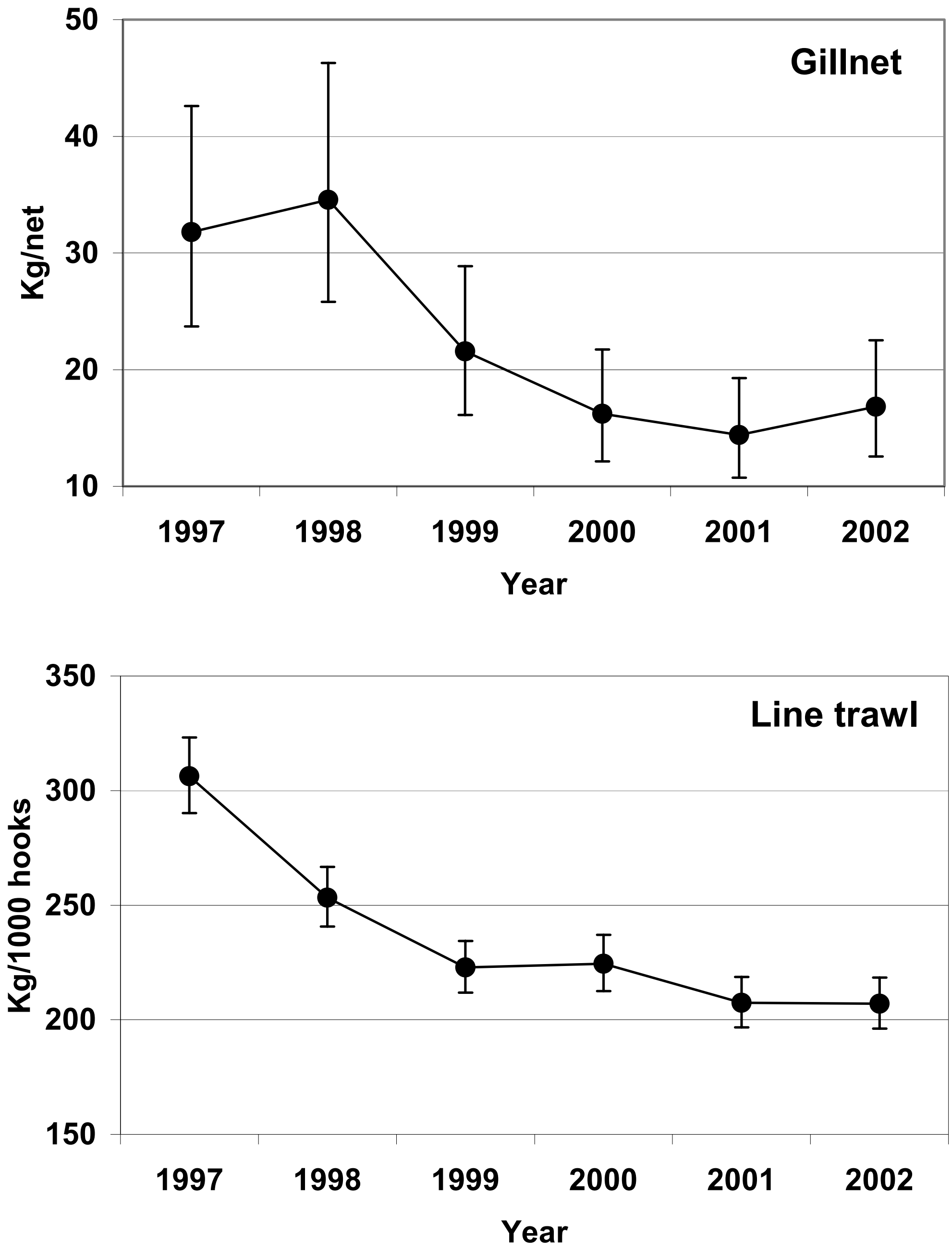


Fig. 10a. Standardized catch rate indices (with 95a% CL's) for gillnets and line-tawls using data from science logbooks for the <35ft sector. Catch is live weight equivalence (Kg)

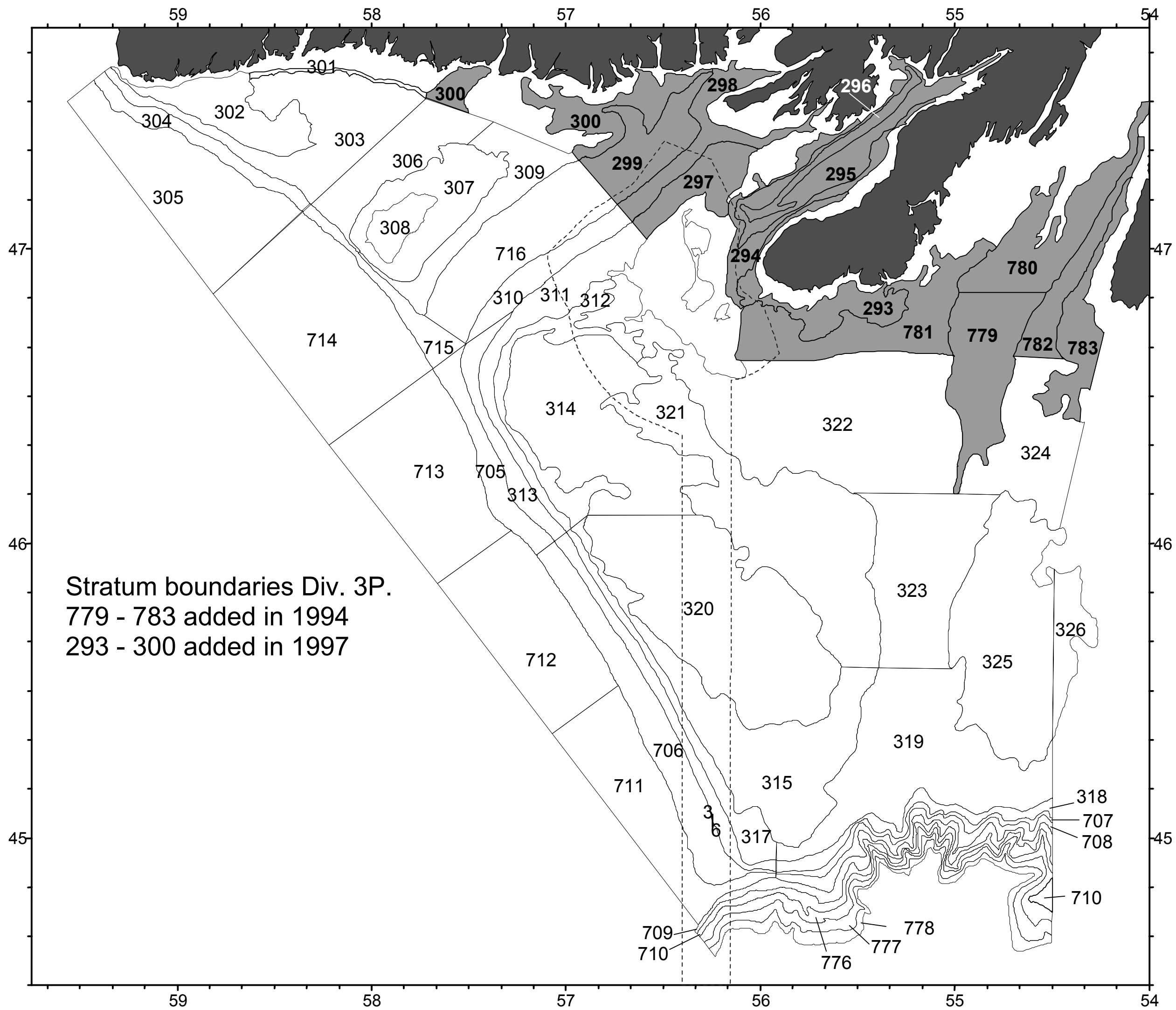


Fig. 11. Stratum area boundaries and area surveyed during the DFO research vessel bottom-trawl survey of NAFO Subdiv. 3Ps Dashed line is the boundary of the French economic zone which is included in the surveyed area.

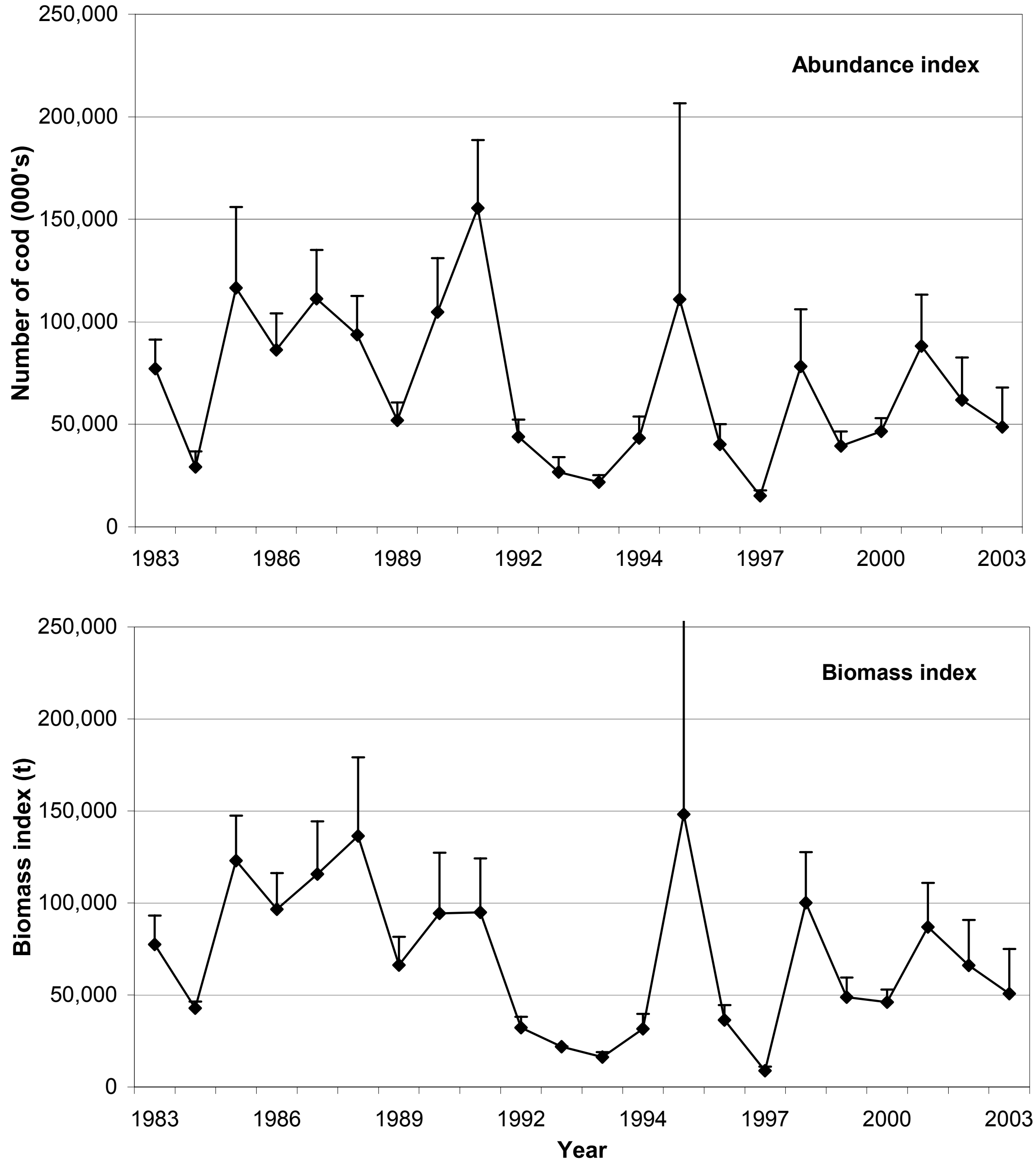


Fig. 12. Abundance and biomass indices for cod in NAFO Subdiv. 3Ps from DFO research vessel bottom trawl surveys during winter/spring from 1983-2003. There were two surveys in 1993. Error bars show plus one standard deviation.

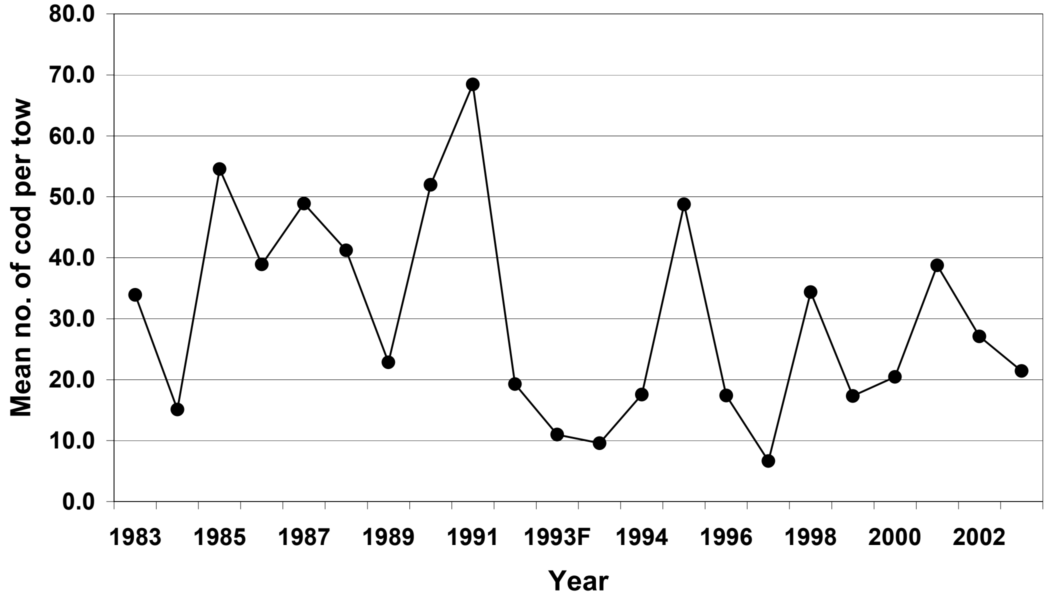


Fig. 13a. Age-aggregated catch rate index (mean numbers per tow in Campelen units) from the DFO research vessel bottom trawl survey of NAFO Subdiv. 3Ps conducted during winter/spring (1983-2003). There were two surveys in 1993 (February and April).

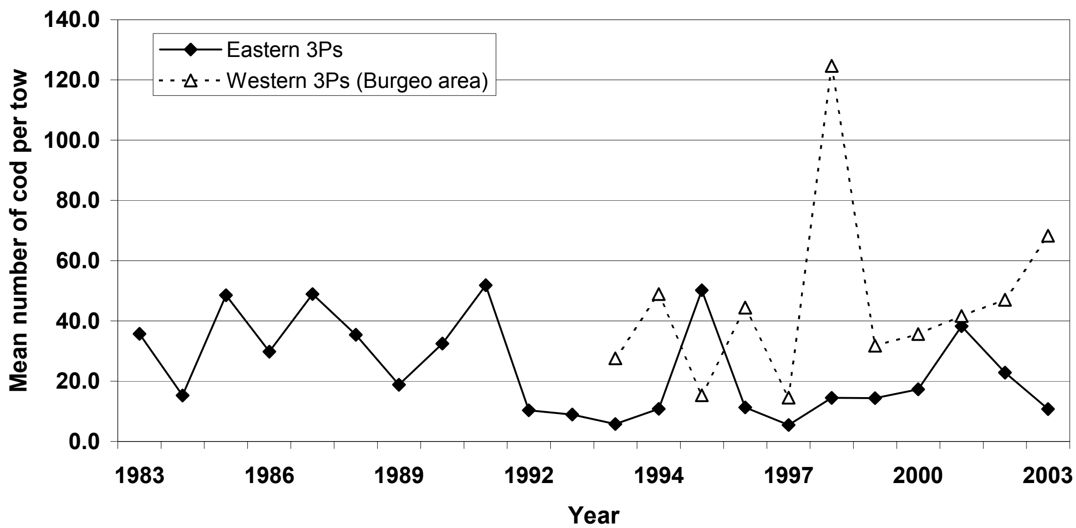


Fig. 13b. Age-aggregated catch rate index for the eastern and western (Burgeo area) portions of 3Ps from the DFO research vessel bottom trawl surveys. There were two surveys in 1993.

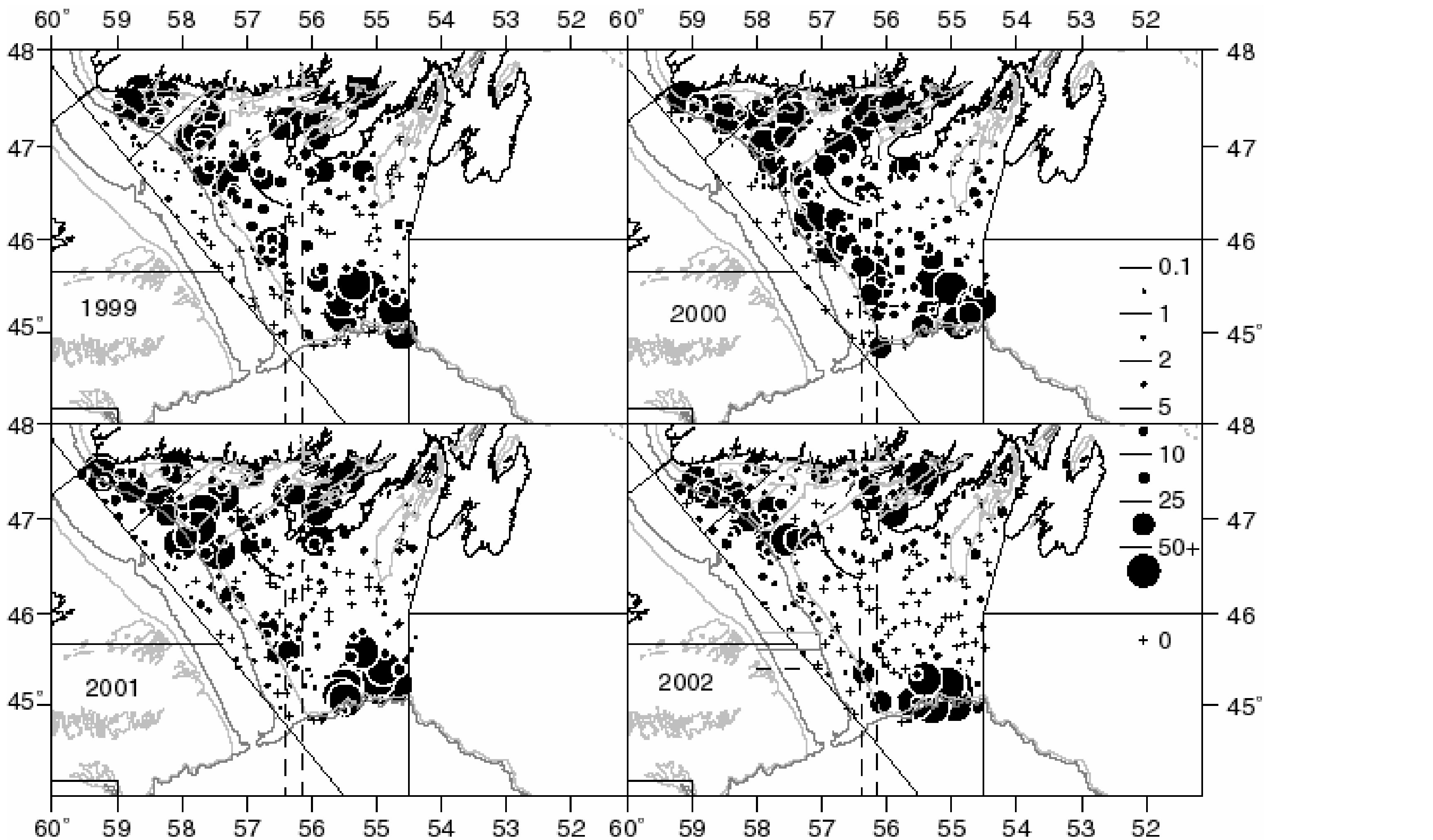


Fig. 14. Age-aggregated distribution of cod catches (numbers per tow) from the DFO RV survey of 3Pn and 3Ps during April 1999-2002.

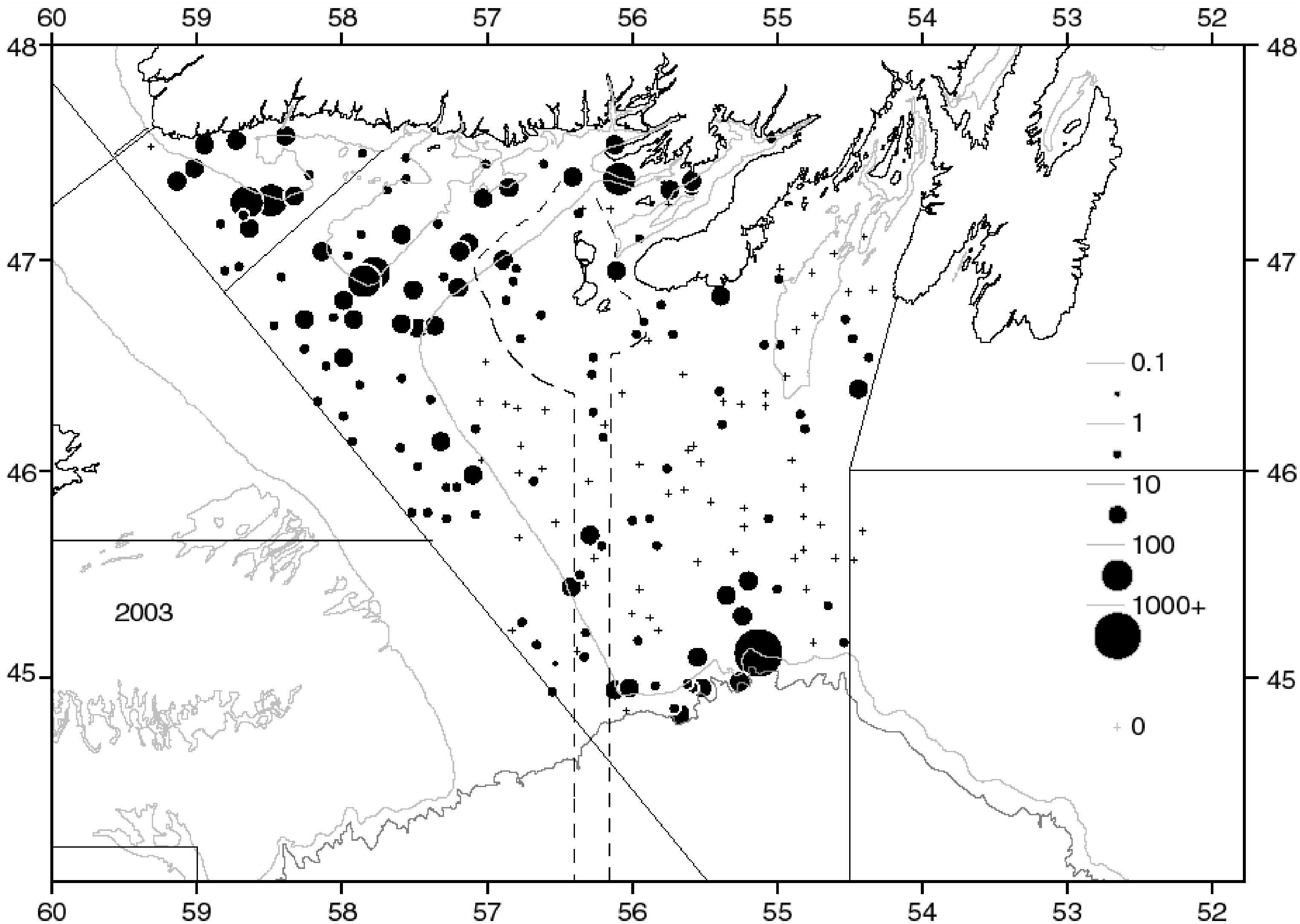


Fig. 15. Age-aggregated distribution of cod catches (numbers per tow) from the DFO RV survey of 3Pn and 3Ps during April 2003. Note that the scale differs from that used in Fig. 16a, c, and d.

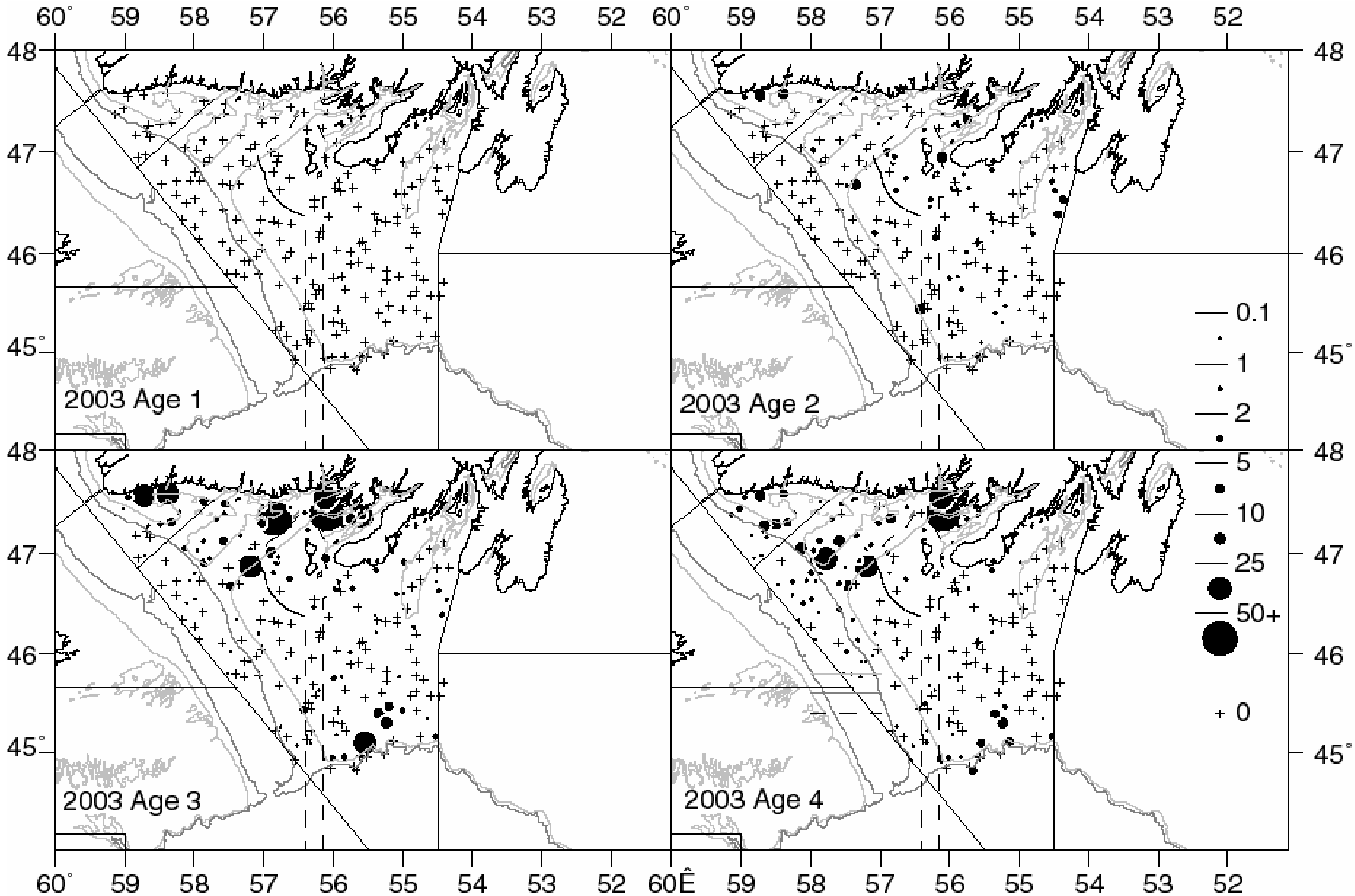


Fig. 16. Distribution of cod catches (numbers per tow) for ages 1-4 from the DFO RV survey of 3Pn and 3Ps during April 2003.

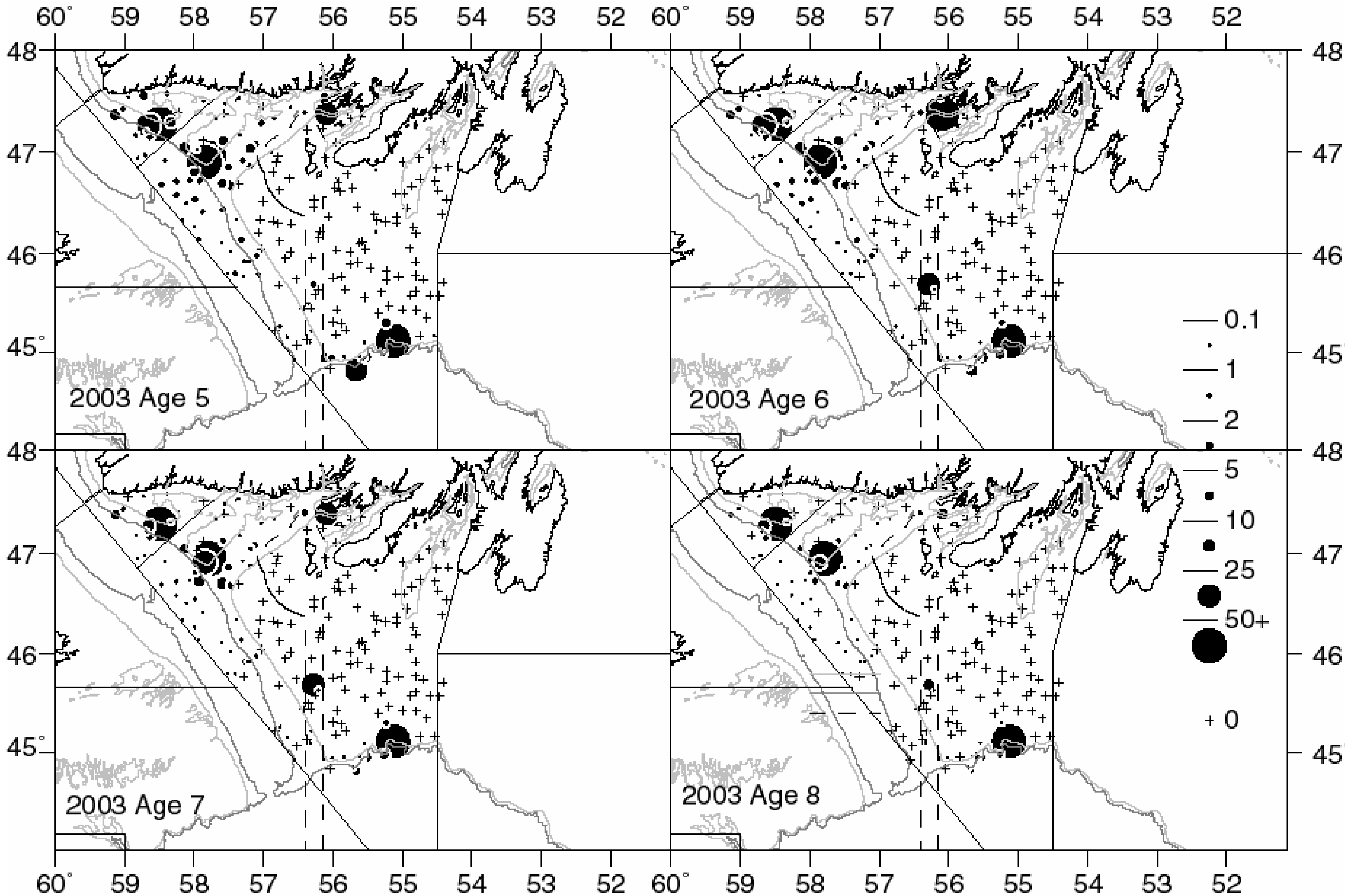


Fig. 17. Distribution of cod catches (numbers per tow) for ages 5-8 from the DFO RV survey of 3Pn and 3Ps during April 2003

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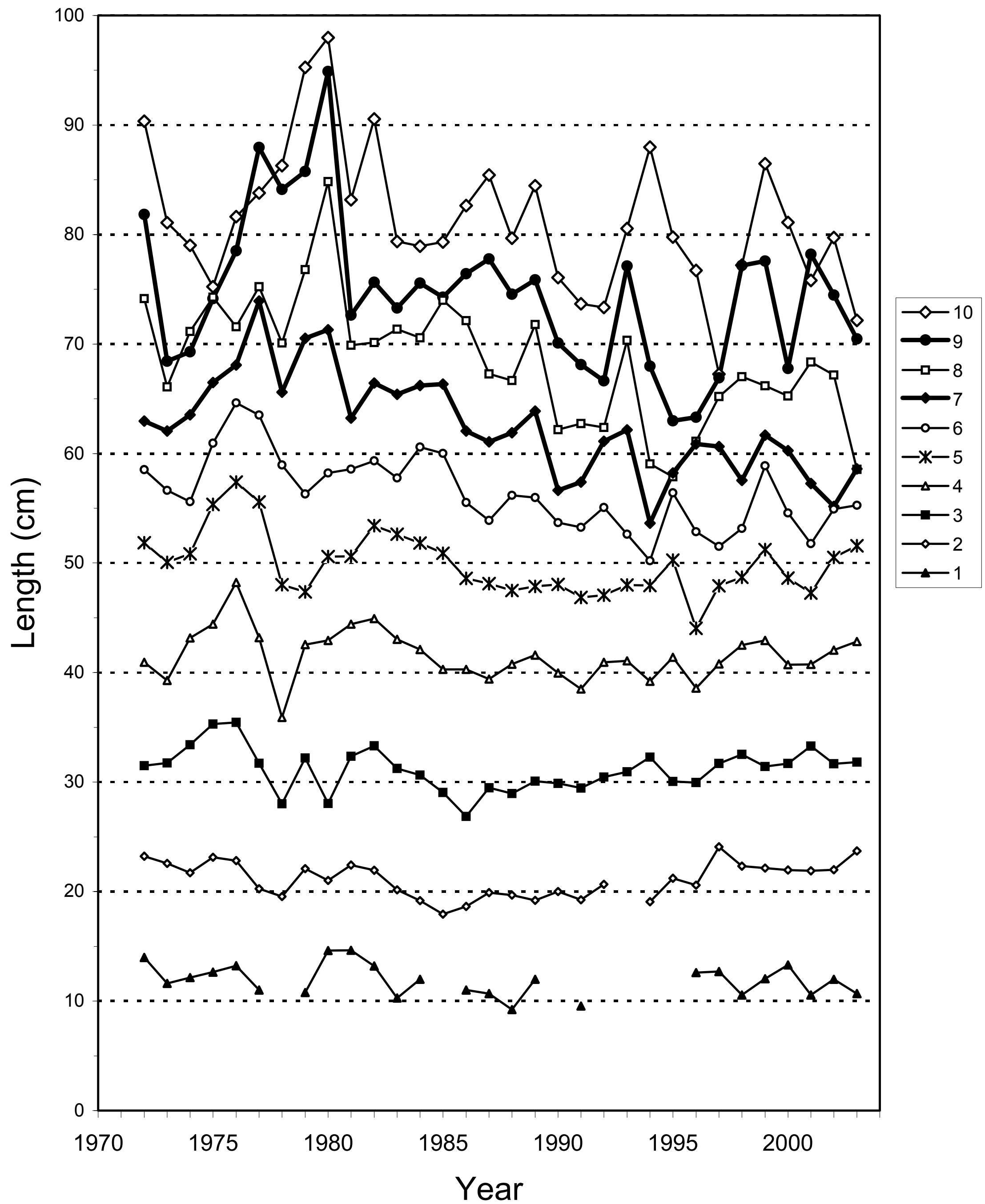


Fig. 18a. Mean length at ages 1-10 of cod in Subdivision 3Ps during 1972-2003, as determined from sampling during DFO bottom-trawl surveys in winter-spring.

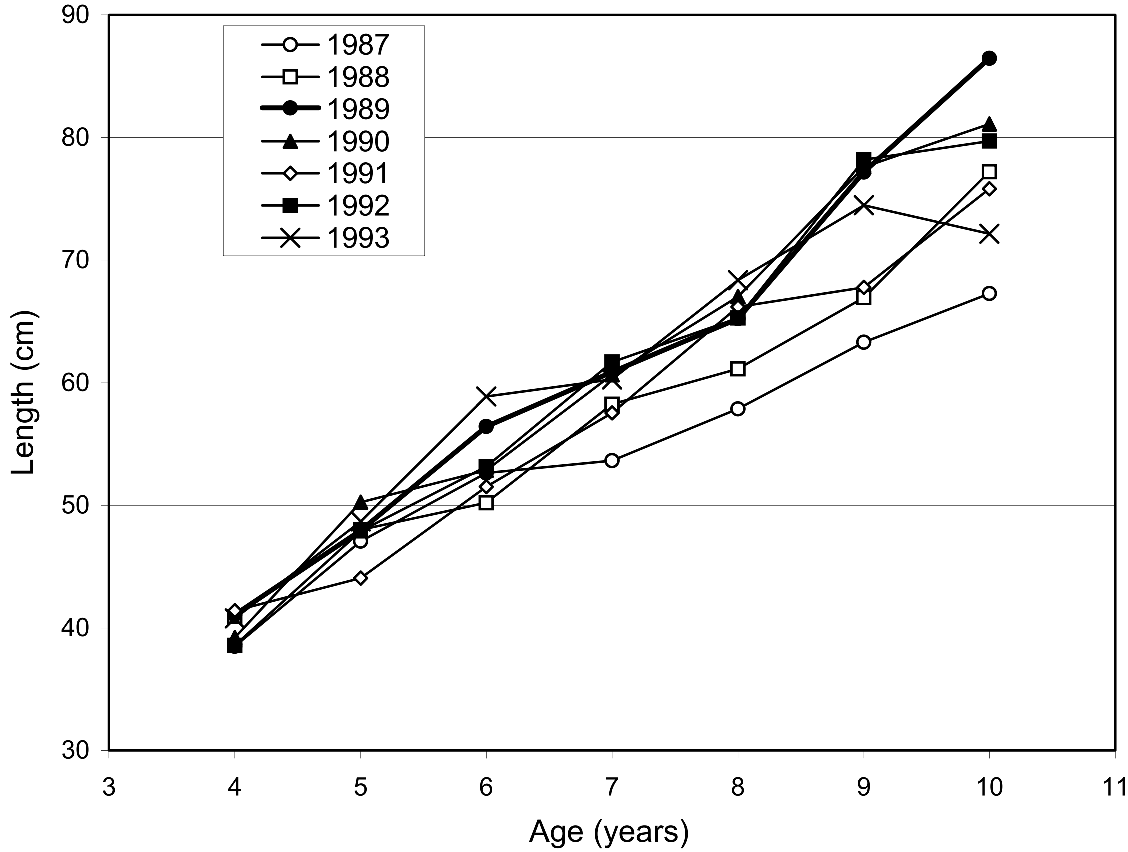


Fig. 18b. Mean length at ages 4-10 of the 1987-1993 year-classes, as determined from sampling during winter-spring surveys in Subdivision 3Ps.

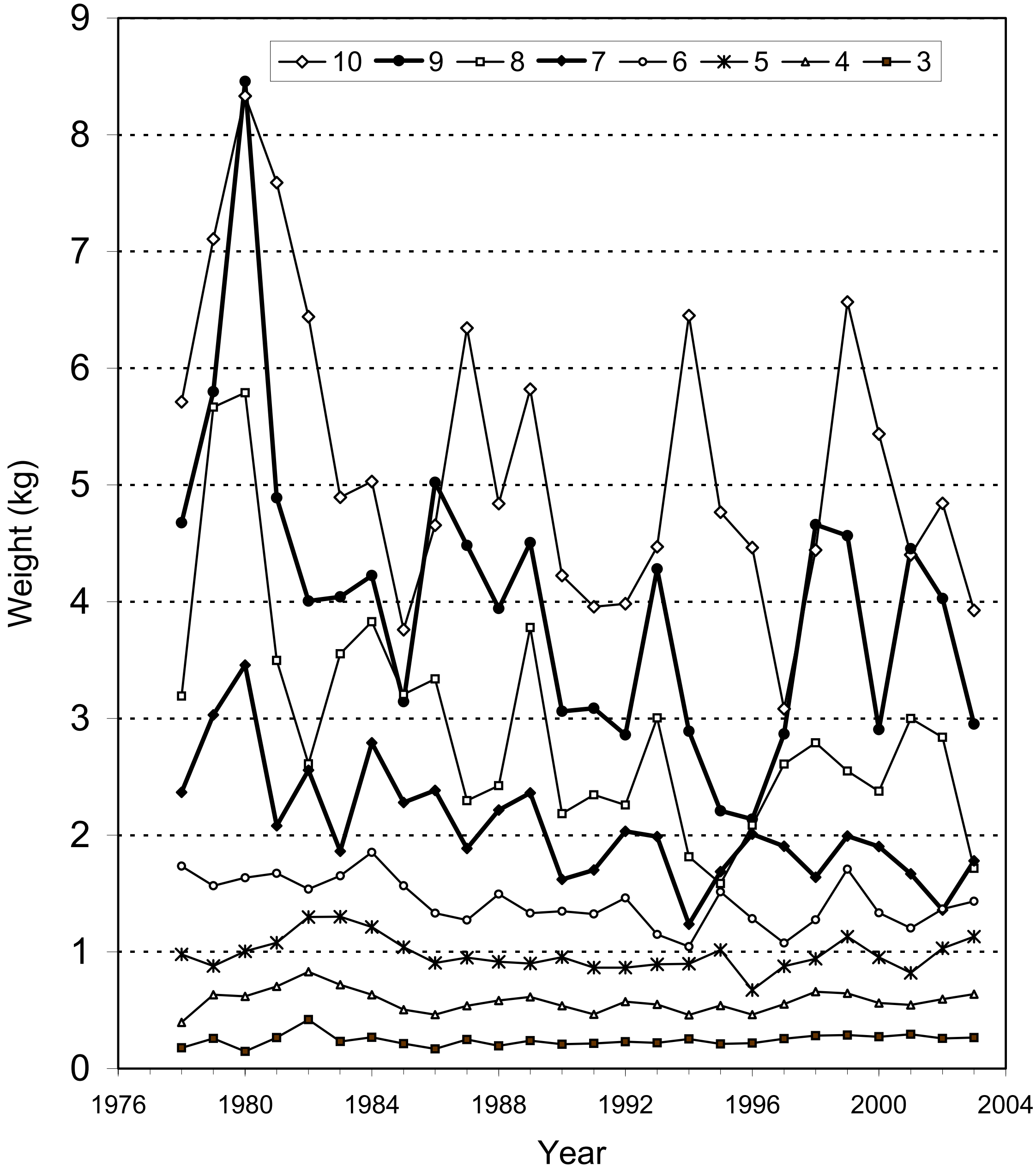


Fig. 19. Mean round weight-at-age (kg) of cod sampled during DFO bottom-trawl surveys in NAFO Subdivision 3Ps in winter-spring 1978-2003.

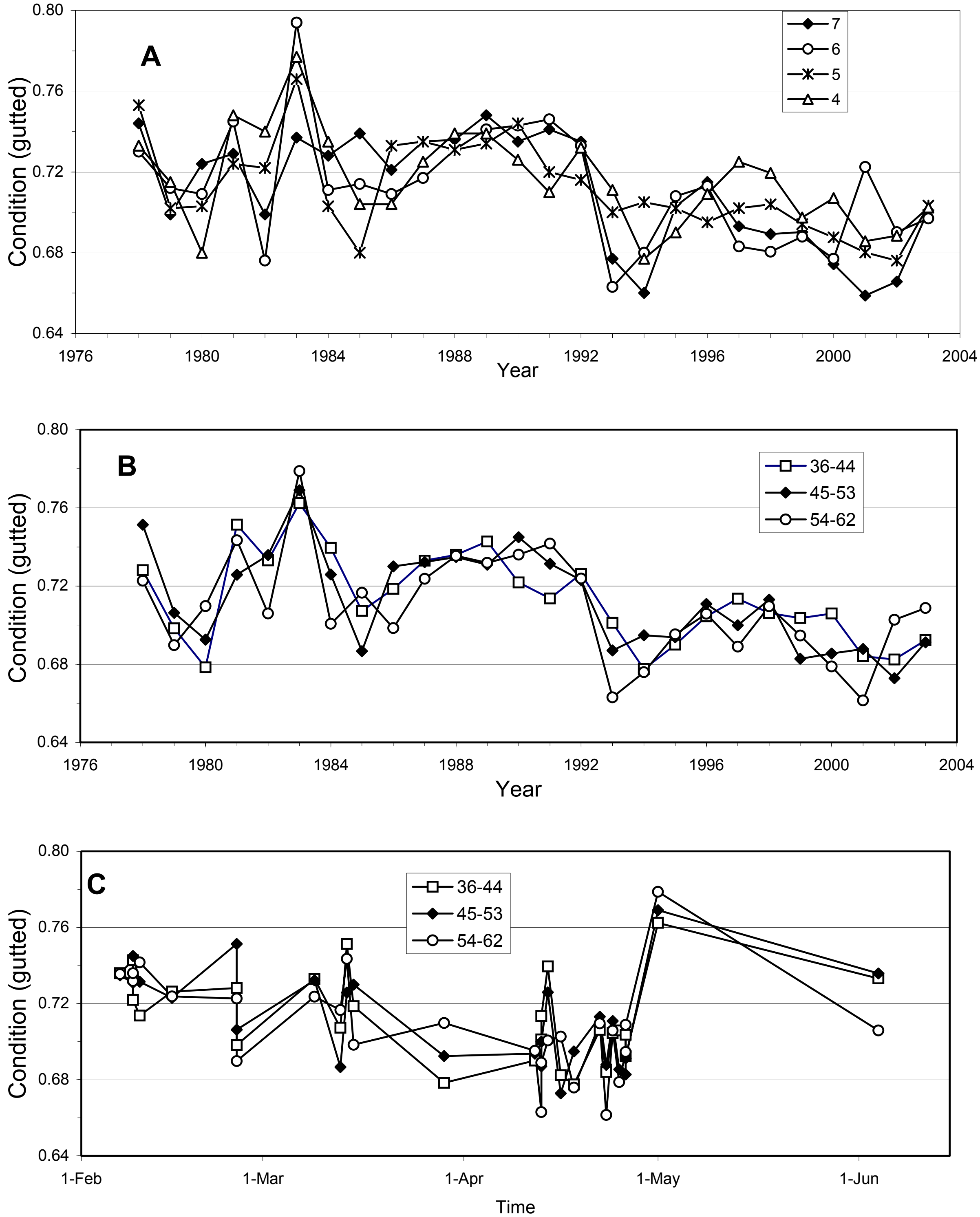


Fig. 20. Mean gutted condition of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in 1978-2003; (A) by age and year, (B) by length-group and year, and (C) by length-group and median date of collection.

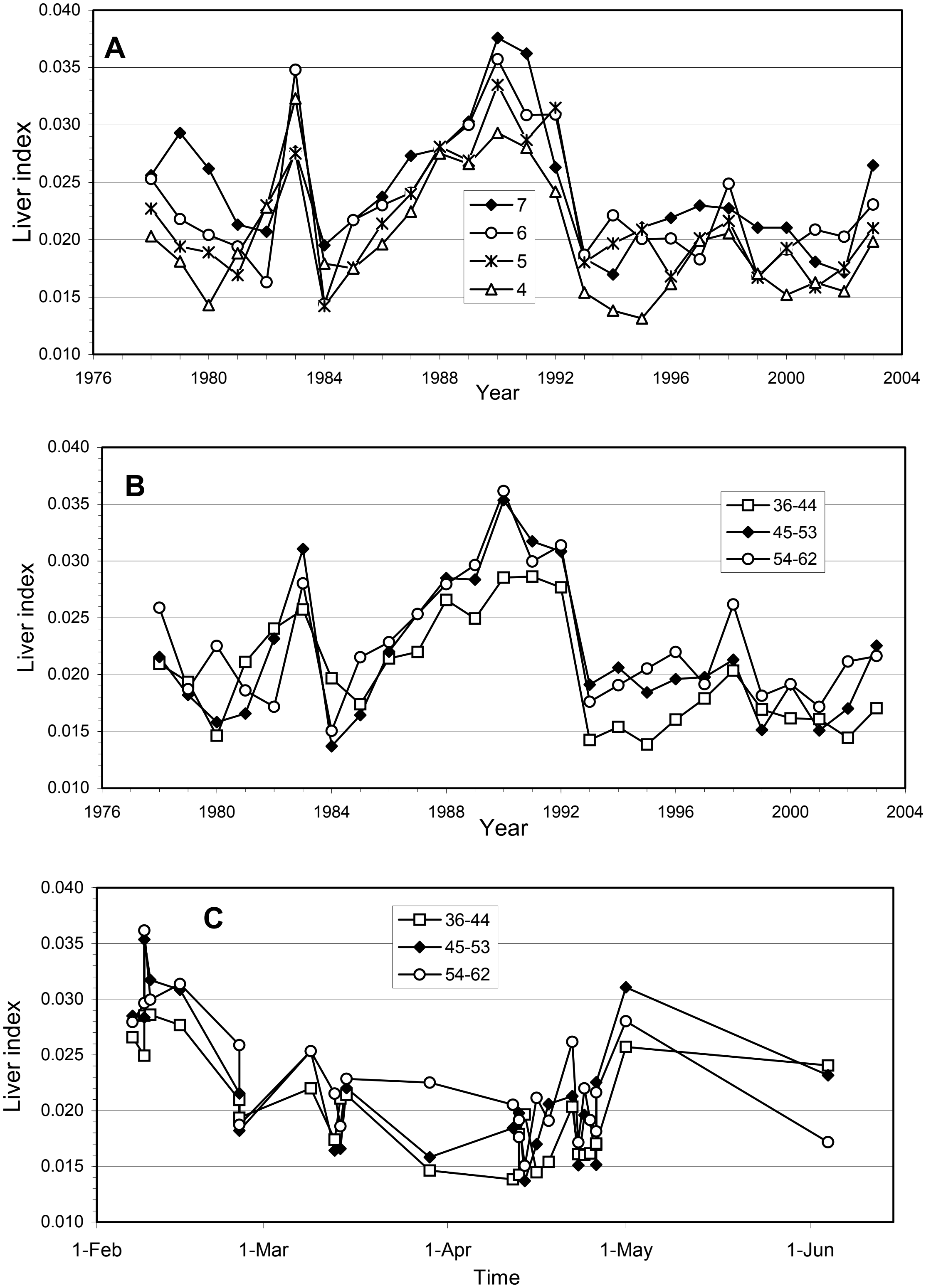
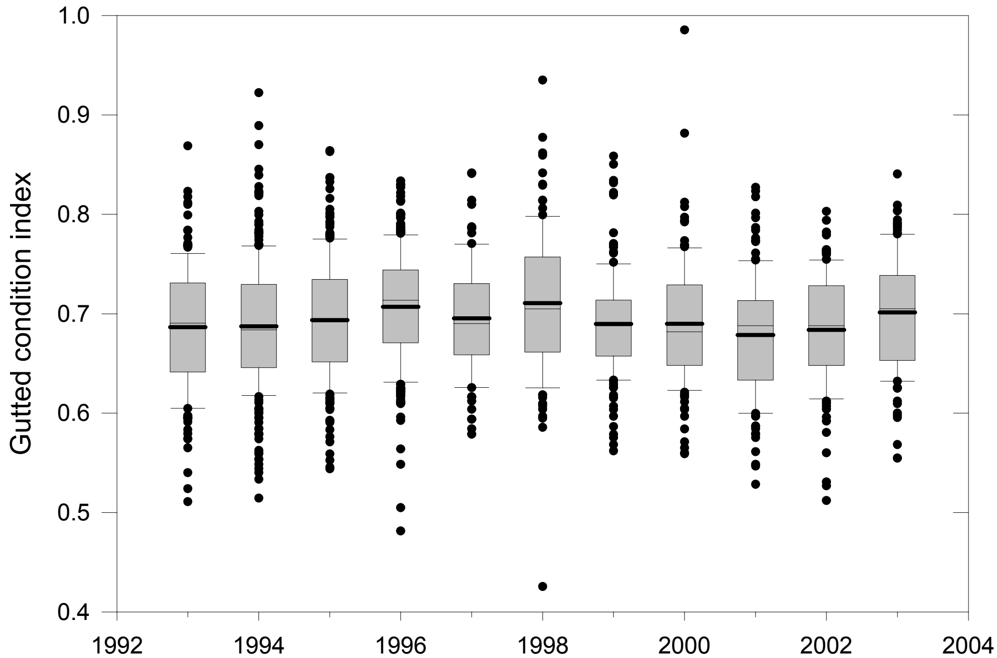


Fig. 21. Mean liver index of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in 1978-2003; (A) by age and year, (B) by length-group and year, and (C) by length-group and median date of collection.



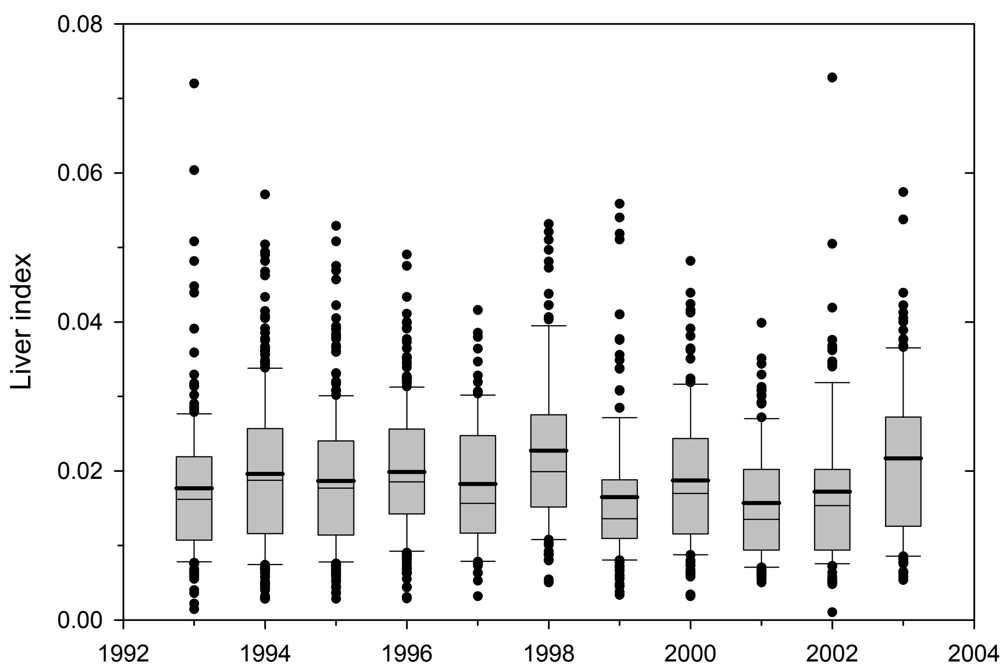


Fig. 22. Gutted condition (above) and liver index (below) of cod caught during DFO research surveys during April in 1993-2003. Each box plot illustrates the median (light line), mean (dark line), 25th and 75th percentiles (box), 10th and 90th percentiles (whisker caps) and all data beyond the 10th and 90th percentiles.

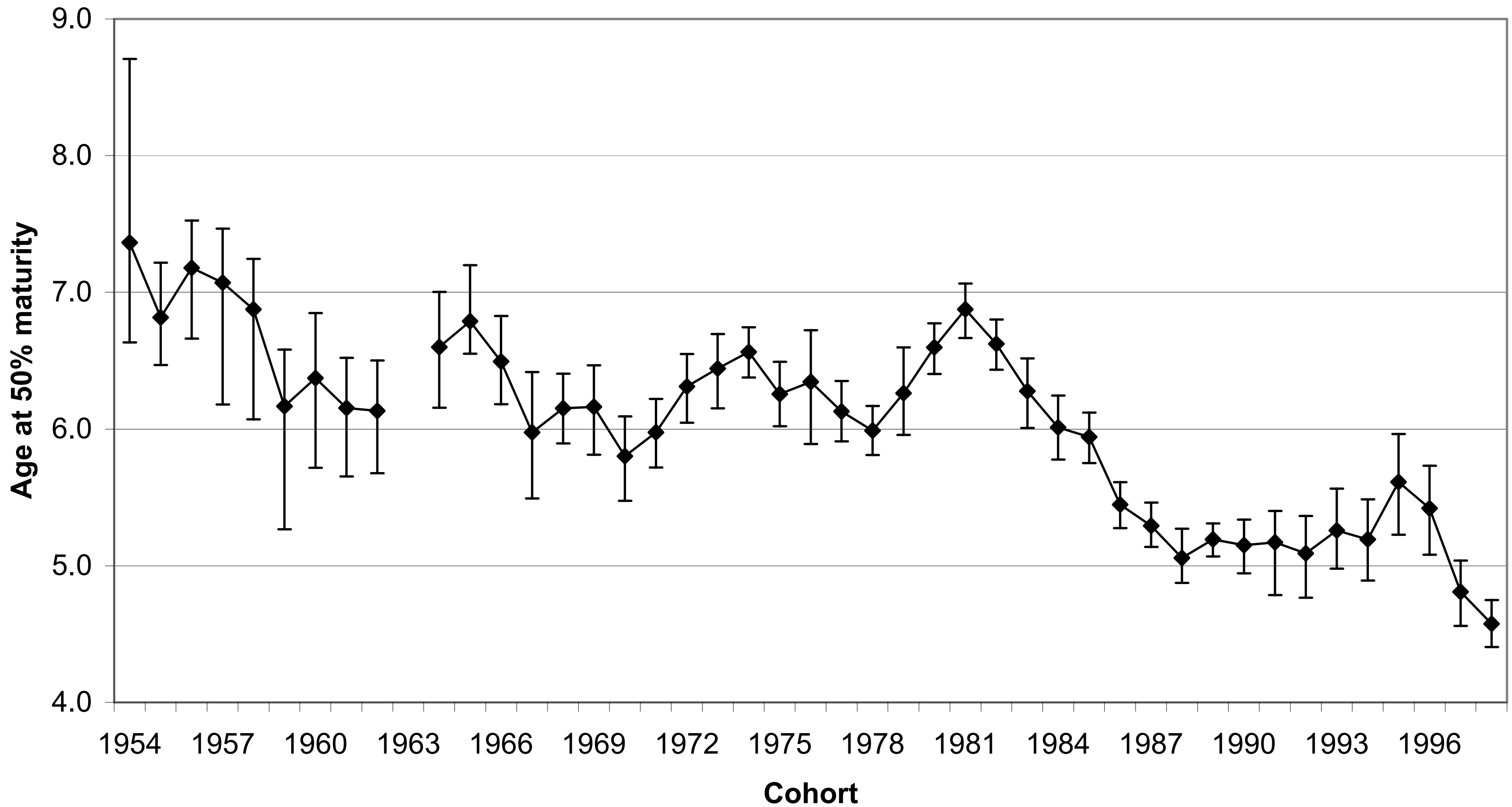


Fig. 23A. Age at 50% maturity by cohort (1954-1998) for female cod sampled during DFO research vessel bottom-trawl surveys of NAFO Subdiv. 3Ps during 1972-2003. Error bars are 95% fiducial limits. Only cohorts with a significant slope and intercept are shown.

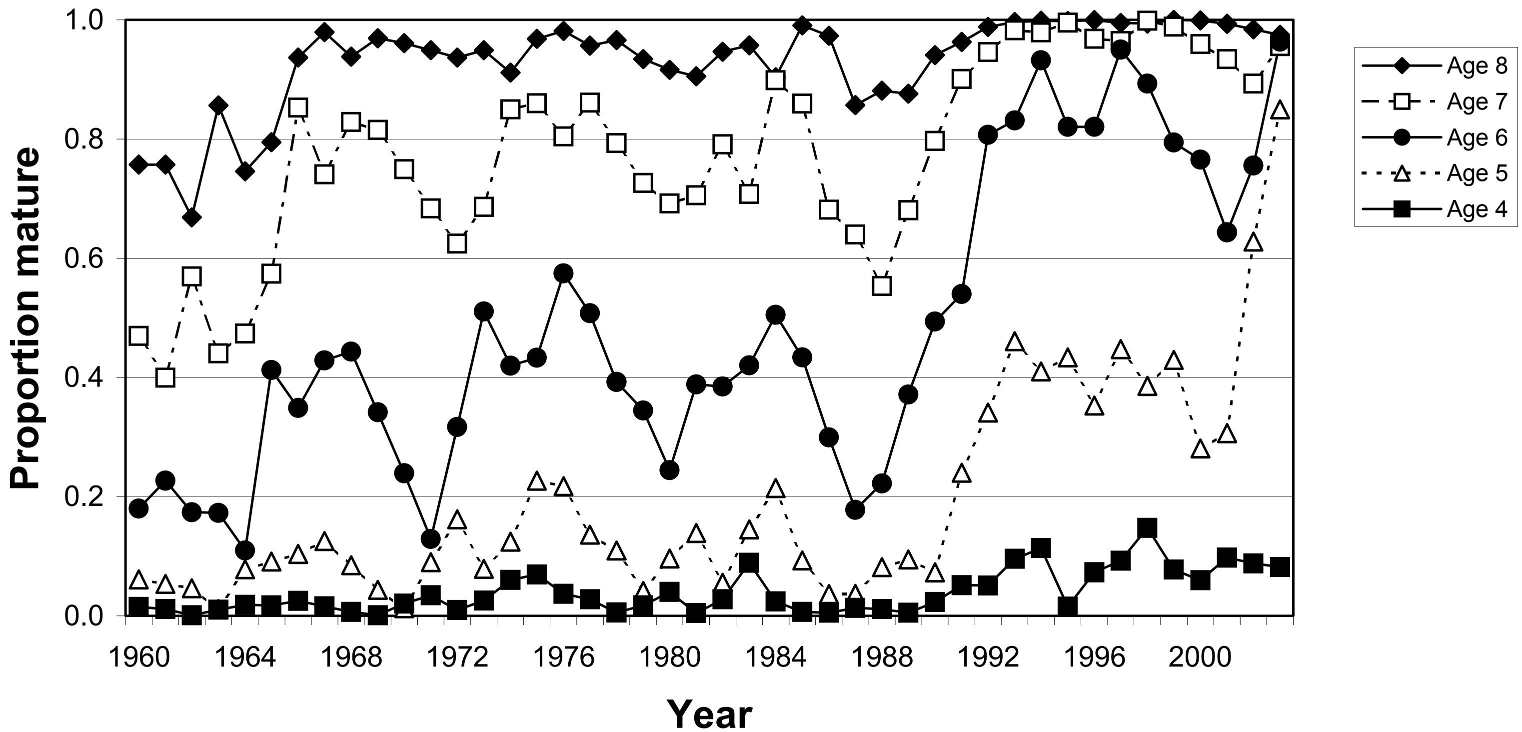
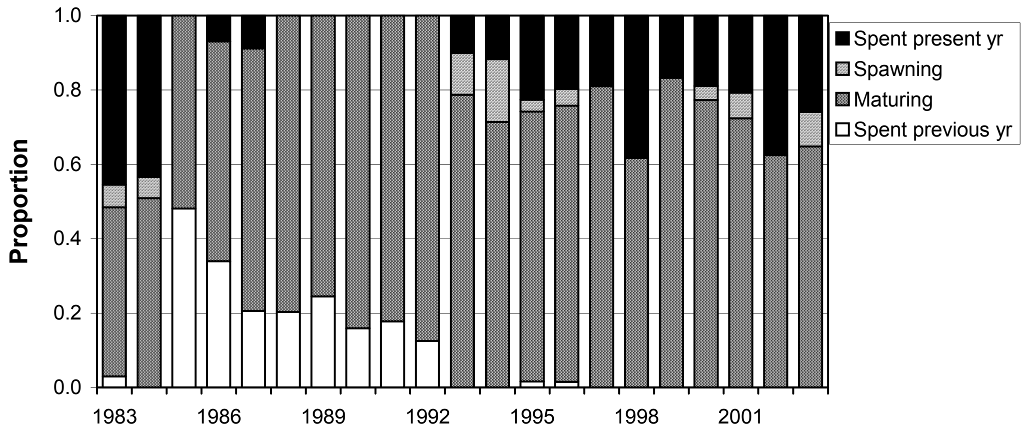
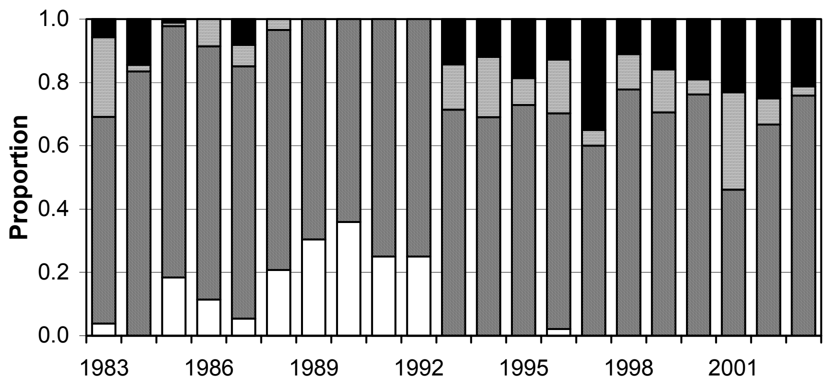


Fig. 23B. Estimated proportions mature at ages 4-8 from 1960-2003 for female cod sampled during DFO research vessel bottom-trawl surveys in NAFO Subdiv. 3Ps during 1972-2003. Estimates were obtained from a model fitted by cohort to observed proportions mature at age (see text for details).

Burgeo Bank / Hermitage Channel



Mid-3Ps (most of St. Pierre Bank)



Halibut Channel

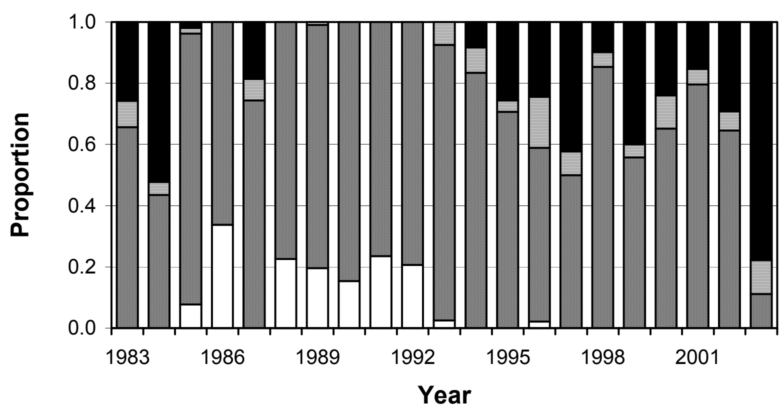


Fig. 24. Maturity stages of adult female cod sampled during DFO research vessel bottom-trawl surveys in three areas of 3Ps during winter/spring 1983-2003. There were two surveys in 1993 (Feb. and April); only the April one is shown here. Surveys were conducted in April in 1983, 1984 and 1993-2003 and in February-March in intervening years.

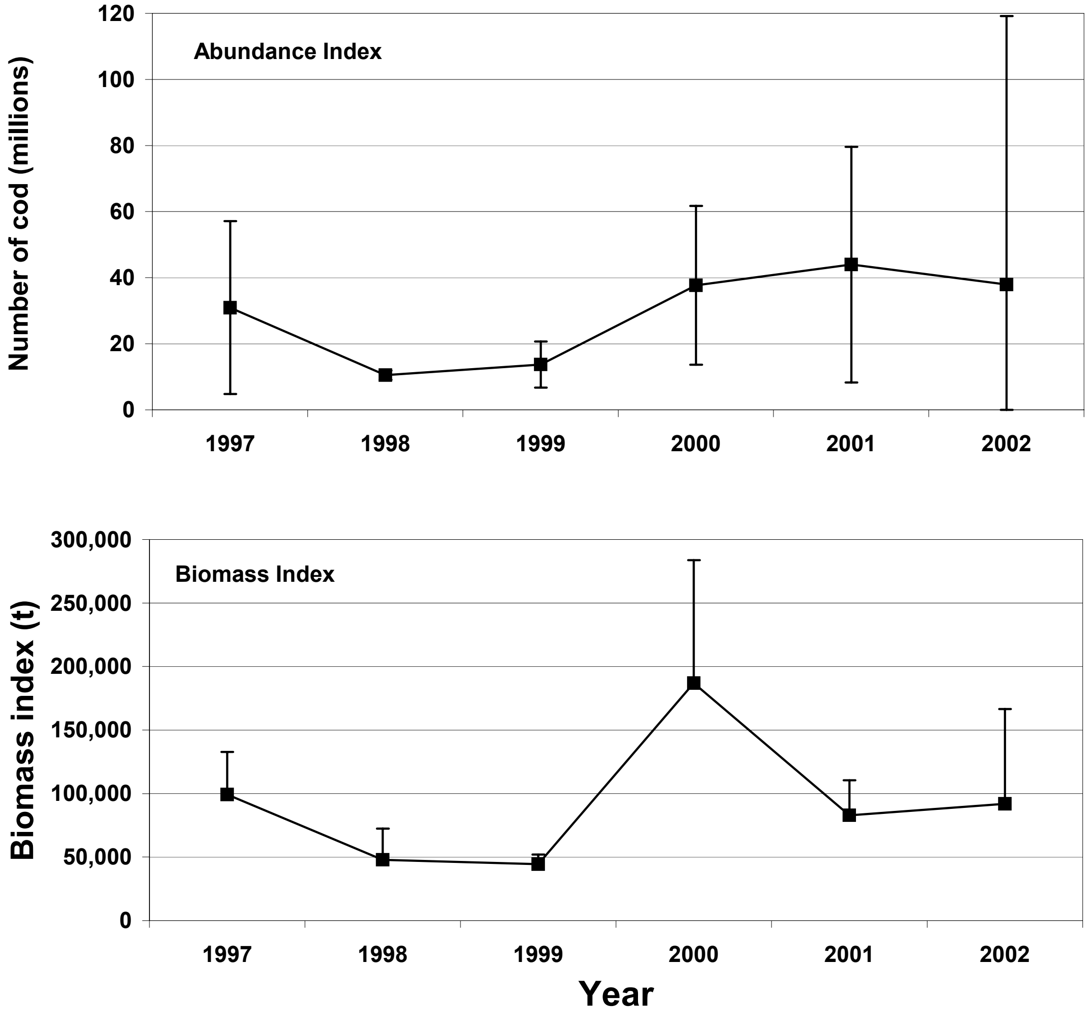


Fig. 25. Cod abundance and biomass indices (+SD) for the fall industry (GEAC) bottom trawl survey of the offshore portion of NAFO Subdiv. 3Ps.

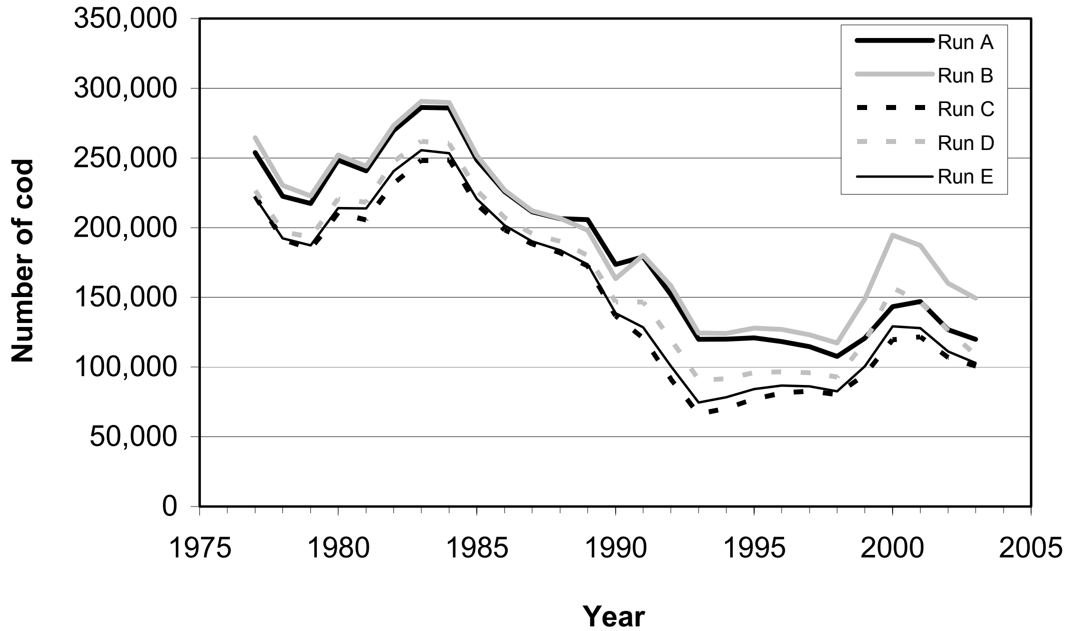


Fig. 26a. Comparison of the trends in 3+ population numbers estimated from the five SPA models/formulations considered at the October 2003 assessment.

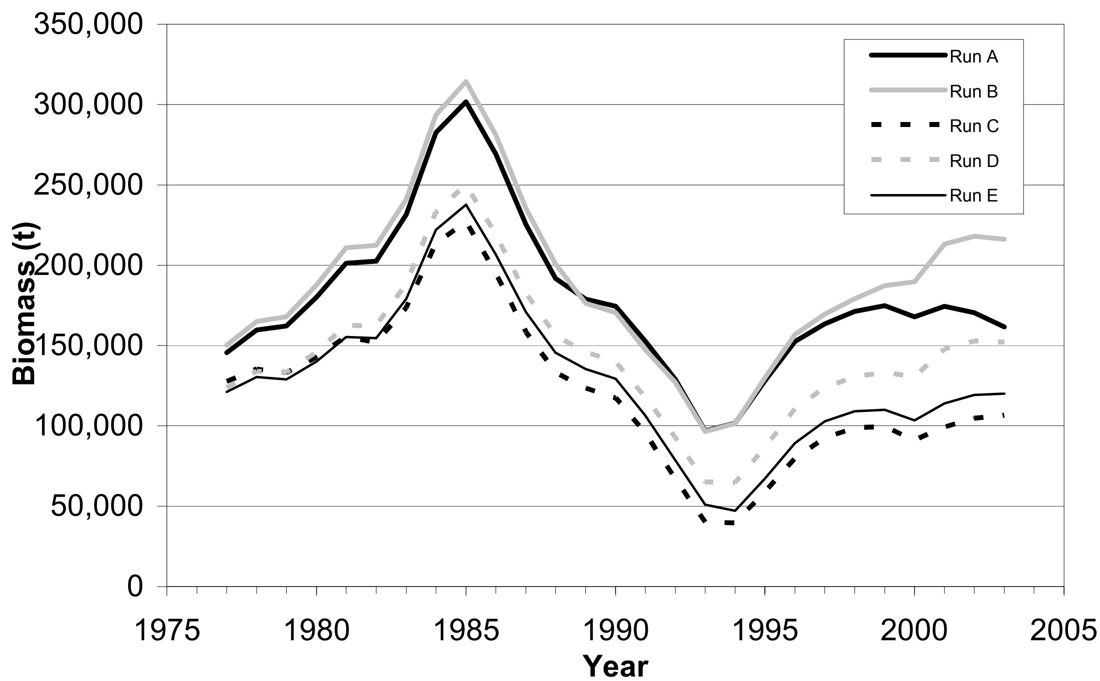


Fig. 26b. Comparison of the trends in 3+ biomass (t) estimated from the the five SPA models/formulations considered at the October 2003 assessment.

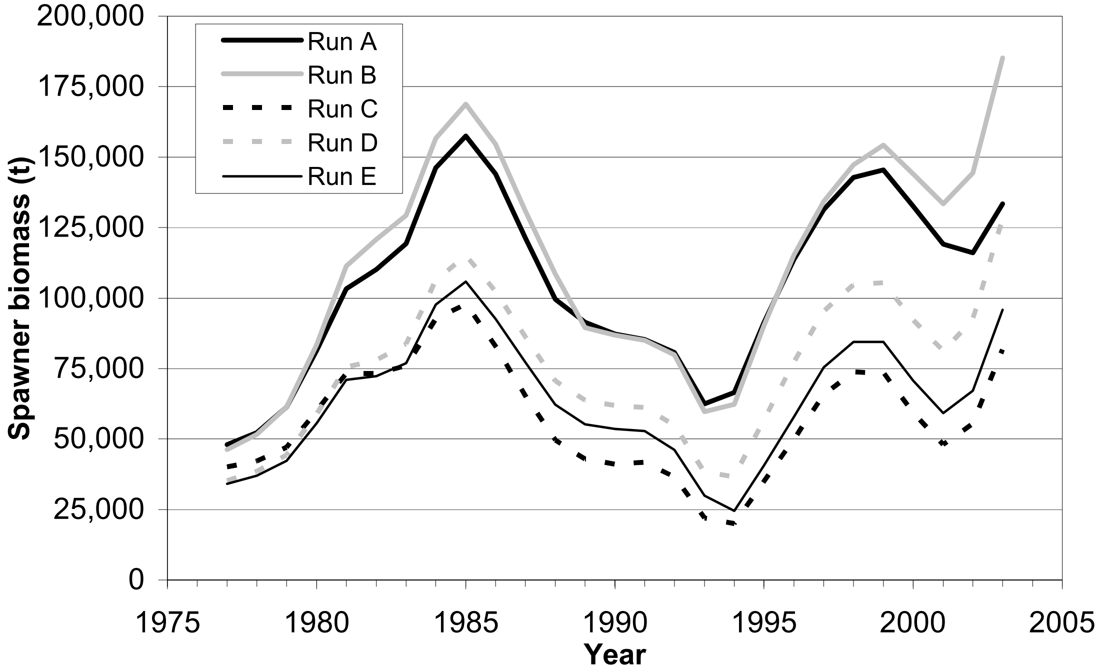


Fig. 26c. Comparison of the trends in spawner biomass (t) estimated from the the five SPA models/formulations considered at the October 2003 assessment.

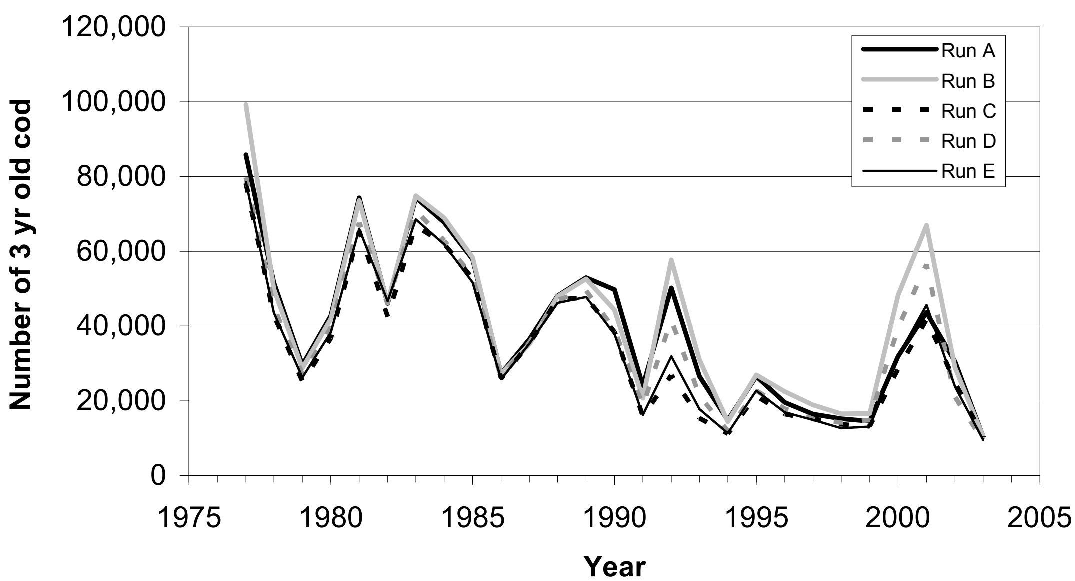


Fig. 26d. Comparison of the trends in recruitment (nos. of 3 year olds) estimated from the five SPA models/formulations considered at the October 2003 assessment.

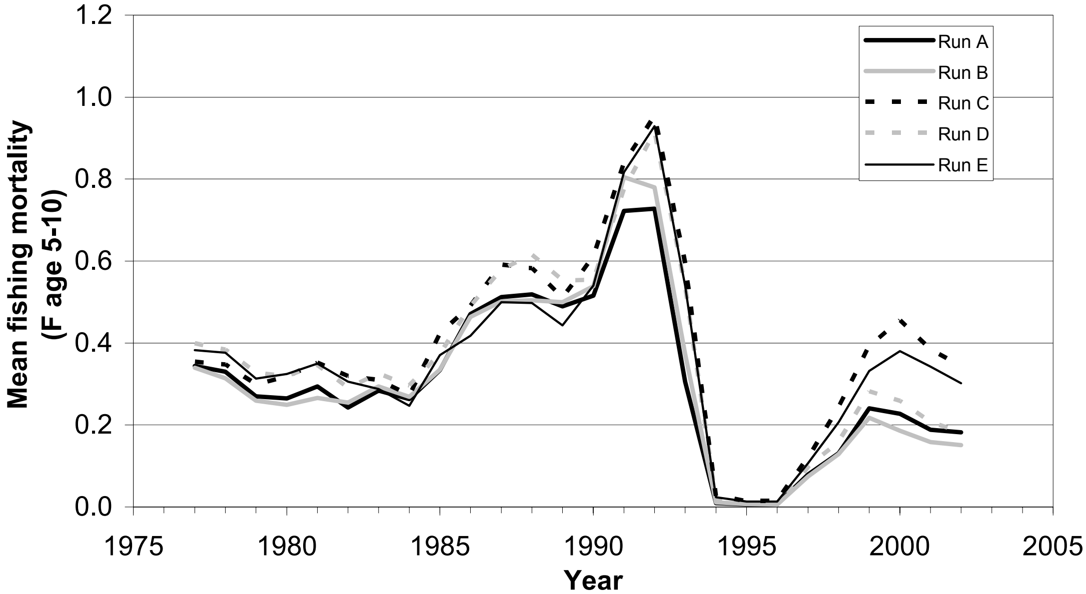


Fig. 26e. Comparison of the trends in fishing mortality (average F ages 5-10) estimated from the five SPA models/formulations considered at the October 2003 assessment.