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An assessment of the cod stock in NAFO Divisions 2J+3KL in February 2003

Évaluation de l'état du stock de morue des divisions 2J+3KL de l'OPANO en février 2003

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Abstract

The directed commercial fishery for northern (2J+3KL) cod was closed in 1992 and reopened for small boats in the inshore alone in 1998. In 2002, the total allowable catch (TAC) for commercial and recreational fisheries and sentinel surveys was 5,600 t. The reported catch was 4,200 t, of which 3,500 t were taken by the index (commercial) fishery. Because the dynamics of populations of cod in the inshore have been different from those in the offshore since about the mid-1990s, and the fishery has been conducted in the inshore alone, the status of populations in the inshore and offshore are reported separately. Populations in the offshore remain broadly spread at very low density. The indices of biomass from research bottom-trawl surveys in autumn (2J3KL) and spring (3L only) are at less than 2% of their levels during the 1980s. Mortality of fish in the offshore has been extremely high since the moratorium and few fish survive beyond age 5. Population trends of cod in the inshore have been monitored by fixed-gear sentinel surveys since 1995. Indices increased from 1995 to a peak in 1997-1998, and have since declined to levels below those in 1995. Catch rates in the index fishery declined steadily from 1998 to 2002. Catch rates in sentinel surveys and commercial fisheries have been consistently low in 2J and northern 3K. Since the fishery opened in 1998, catch rates have declined in both southern 3K and southern 3L, and have remained high only in northern 3L, most notably in southern Bonavista Bay and northern Trinity Bay. Hydroacoustic surveys in January in Smith Sound (Trinity Bay) provided average indices of biomass that increased from 1999 to a peak of 26,000 t in 2001 and then declined to 20,000 t in 2003. Results of tagging experiments indicate a harvest rate close to 20% in the inshore in 2002 and an exploitable biomass (approximately ages 4+) of 22,000 t in the inshore regions of 3KL. The tagging studies provided evidence of natural mortality of 55% in 3K and 33% in 3L. A sequential population analysis (SPA) was conducted based on those cod in the inshore since the mid-1990s. SPA estimates indicate that spawner biomass in the inshore increased from 1995 to 41,000 t in 1998, but has subsequently declined to only 14,000 t at the beginning of 2003. The estimate of 4+ biomass at the beginning of 2003 is about 30,000 t. Fishing mortality on older age classes has been increasing and is currently at approximately 35%. Both the SPA and a recruitment model indicate that the 1999 and 2000 year-classes are stronger than other year-classes since the mid-1990s, but are very weak compared to historic levels. Deterministic projections indicate that the stock will grow slightly in the short term as a consequence of the incoming recruits, but will decline thereafter if exploitation rates remain at current levels. Projections also indicate that even without fishing the spawner biomass will not grow during the next decade to the level reached in 1998. The stock as a whole is clearly far below a conservation limit reference level which, although not well-determined, is expected to be greater than 300,000 t of spawner biomass. The information on feeding by seals and trends in the harp seal population indicate that predation by seals is a factor contributing to the high total mortality of cod in the offshore and the high natural mortality of adult cod in the inshore.

RÉSUMÉ

La pêche commerciale dirigée de la morue du Nord (2J+3KL) a été fermée en 1992 puis rouverte aux petits bateaux dans les eaux côtières seulement en 1998. Le total autorisé des captures (TAC) en 2002 pour les pêches commerciales et récréatives et les relevés par pêche sentinelle s'élevait à 5 600 t, alors que les prises déclarées ont atteint 4 200 t, dont 3 500 t ont été réalisées dans le cadre de la pêche indicatrice (commerciale). Étant donné que la dynamique de la composante côtière de ce stock est différente de la composante hauturière depuis environ le milieu des années 1990 et que la pêche n'est plus pratiquée que dans les eaux côtières, l'état des deux composantes est rapporté séparément. Les bancs hauturiers, très peu denses, demeurent répartis sur une grande superficie. Les indices de biomasse issus des relevés de recherche au chalut de fond effectués en automne (2J+3KL) et au printemps (3L seulement) se chiffrent à moins de 2 % des niveaux observés dans les années 1980. Le taux de mortalité de la morue des eaux hauturières est extrêmement élevé depuis le début du moratoire et peu vivent plus de 5 ans. Les tendances de la composante des eaux côtières sont suivies par le biais de relevés par pêche sentinelle aux engins fixes depuis 1995. À partir de 1995, les indices pour cette composante ont augmenté, pour atteindre un pic en 1997-1998, puis ont diminué, se situant aujourd'hui à des niveaux inférieurs à ceux de 1995. Les taux de capture réalisés dans le cadre de la pêche indicatrice ont diminué régulièrement de 1998 à 2002, tandis que ceux réalisés dans le cadre des relevés par pêche sentinelle et des pêches commerciales pratiqués dans 2J et le secteur nord de 3K ont toujours été faibles. Depuis la réouverture de la pêche en 1998, les taux de capture dans les secteurs sud de 3K et 3L ont diminué, ne demeurant élevés que dans le secteur nord de 3L, plus particulièrement dans la partie sud de baie de Bonavista et la partie nord de la baie de la Trinité. Des relevés hydroacoustiques effectués en janvier dans le bras Smith (baie de la Trinité) ont donné des indices moyens de la biomasse; celle-ci a augmenté à partir de 1999 jusqu'à atteindre un pic de 26 000 t en 2001, pour ensuite diminuer, n'atteignant plus que 20 000 t en 2003. Les résultats d'études d'étiquetage indiquent un taux d'exploitation s'approchant de 20 % dans les eaux côtières en 2002, ce qui correspond à une biomasse exploitable (morue d'environ 4 ans et plus) de 22 000 t dans les secteurs côtiers de 3KL. Ces études ont fourni la preuve d'un taux de mortalité naturelle de 55 % dans 3K et 33 % dans 3L. On a effectué une analyse séquentielle de population (ASP) reposant sur la morue retrouvée dans les eaux côtières depuis le milieu des années 1990. Selon les estimations issues de cette analyse, la biomasse de géniteurs y a augmenté à partir de 1995, pour se chiffrer à 41 000 t en 1998, mais qu'elle a ensuite chuté, ne se chiffrant plus qu'à 14 000 t au début de 2003. L'estimation de la biomasse de morue de 4 ans et plus au début de 2003 la chiffre à quelque 30 000 t. Le taux de mortalité par pêche exercé sur les classes plus âgées, à hausse, se situe actuellement à environ 35 %. Les résultats de l'ASP et du passage d'un modèle du recrutement indiquent que les classes d'âge 1999 et 2000 sont plus abondantes que les autres depuis le milieu des années 1990, mais qu'elles demeurent très faibles par rapport aux niveaux historiques. Des projections déterministes révèlent que les effectifs du stock augmenteront légèrement à court terme à la suite de l'arrivée de recrues, mais qu'ils diminueront par la suite si les taux d'exploitation demeurent aux niveaux actuels. Les projections révèlent aussi que, même en l'absence de pêche, la biomasse de géniteurs ne reviendra pas pendant la prochaine décennie au niveau atteint en 1998. Le stock dans son ensemble se situe clairement au-dessous de la limite de référence propre à assurer sa conservation qui, bien qu'elle ne soit pas clairement établie, peut être supérieure à une biomasse de géniteurs de 300 000 t. Les données sur les quantités de morue consommées par les phoques et les tendances démographiques du phoque du Groenland indiquent que cette prédation contribue au taux élevé de mortalité totale de la morue dans les eaux hauturières et le taux élevé de mortalité naturelle des adultes dans les eaux côtières.

1 Introduction

Historically, many of the cod in NAFO Divisions 2J+3KL (the "northern cod") migrated between overwintering areas in deep water near the shelf break and feeding areas in shallow waters both on the plateau of Grand Bank and along the coasts of Labrador and eastern Newfoundland (Fig. 1a). Some cod remained inshore throughout the winter in deep water both within the bays and off the headlands. For several centuries various nations pursued the cod while they were in the shallow areas, first with hook and line and later with nets which evolved by the late 1800s into the highly effective Newfoundland cod trap. The deep waters, both inshore and offshore, remained refugia until the 1950s, when longliners designed to exploit populations of cod in deep coastal waters were introduced to eastern Newfoundland and distant water fleets from Europe started to employ bottom-trawlers to fish the deeper water of the outer banks, first mainly in summer/autumn but later in the winter and early spring when the cod were highly aggregated. Landings increased dramatically in the 1960s as large numbers of bottom-trawlers targeted the overwintering aggregations on the edge of the Labrador Shelf and the Northeast Newfoundland Shelf. At the same time, the numbers of large cod in deep nearshore waters are thought to have declined quickly as the longliner fleet switched to synthetic gillnets. Additional details on the history of the northern cod fishery, including changes in technology and temporal variability in the spatial distribution of fishing effort, may be found in Templeman (1966), Lear and Parsons (1993), Hutchings and Myers (1995), Lear (1998) and Neis *et al*. (1999).

The number and individual size of the fish declined through the 1960s and 1970s and the stock reached a very low biomass by the mid-1970s (Baird *et al*. 1991b). Following Canada's extension of fisheries jurisdiction to 200 nautical miles in 1977, the stock began to recover as a consequence of lower fishing mortality, entry of the strong 1973-1975 year-classes and an increase in the growth rate of individual fish. Fishing effort by an expanding Canadian trawler fleet increased dramatically following extension of jurisdiction and this fleet took a large portion of the total allowable catch, which almost doubled between 1978 and 1984. It became clear in retrospect that the stock size was overestimated during this period. Fishing mortality was about twice as high as the $F_{0.1}$ target level. In addition, the 1976-1977 year-classes were weak and individual growth rate declined. The 1978-1982 year-classes were moderate to strong but the 1983-1985 year-classes were weak. The spawner biomass did not increase after about 1982 and the 3+ population size peaked in 1984-1985.

Reasons for the overestimation of stock size include changes in the method by which the sequential population analysis (SPA) was calibrated and the "retrospective" problem, a phenomenon whereby adding additional data on each year-class results in downward revisions of population size. In addition, the 1986 research survey index was positively biased. It was recognized in 1988-1989 that the 1986 value had contributed to severe overestimation of stock size (Baird *et al*. 1991b; Lear and Parsons 1993; Bishop and Shelton 1997). The catch predicted for an $F_{0.1}$ fishing mortality in 1989 was much lower than the TAC's and catches of preceding years. The fixed fishing mortality approach was suspended in favour of an approach that reduced quotas more gradually in hopes of avoiding undue hardship to the fishing industry. Fishing mortality escalated. Simulations indicate that the change in the approach to setting the quota turned what might have been a severe stock decline under a fixed fishing mortality rate into a collapse (Shelton 1998).

By the early 1990s much hope was placed on the 1986 and 1987 year-classes, which appeared to be strong in the research vessel surveys and initially contributed strongly to commercial catches. However, in concert with older year-classes, these two year-classes appeared to decline very rapidly. Fishing mortality was very high but reported landings including documented discards were insufficient to account for the abrupt decline observed in the research vessel indices in 1990-1991. The stock was closed to directed Canadian fishing in July 1992. The research vessel index showed a further large decline in autumn 1992. It was thought that there might have been a substantial increase in natural mortality, especially during the first half of 1991 (Lear and Parsons 1993; Atkinson and Bennett 1994). Research vessel indices continued to decline in the absence of a directed Canadian fishery and reached a very low level by 1994.

Controversy continues regarding the time course and causation of the collapse. Some analyses found no support for a sudden increase in natural mortality in 1990-1991 (Myers and Cadigan 1995) and attributed the decline to fishing mortality alone (Hutchings and Myers 1994; Hutchings 1996; Myers *et al*. 1996a,b; Myers *et al*. 1997a,b). However, in the late 1980s and early 1990s the stock underwent several changes that may not have been related to fishing. For example, the distribution during the autumn was increasingly concentrated toward the outer edge of the banks (Lilly 1994; Taggart *et al*. 1994), the distribution during the winter was increasingly toward the south and to deeper water (Baird *et al*. 1992b; Kulka *et al*. 1995), the inshore fishery started late (Davis 1992) and fish experienced a pronounced decline in growth, condition and age at maturity, especially in the north (Taggart *et al*. 1994). In addition, declines in abundance and changes in distribution were experienced by many other groundfish, both commercial and non-commercial (Atkinson 1994; Gomes *et al*. 1995). Changes in the lightly exploited American plaice in Divisions 2J and 3K (Bowering *et al*. 1997) parallel many of the changes in cod. Capelin, the dominant pelagic species in the area and the major prey of cod, almost disappeared from Division 2J, increased in abundance in areas where they were previously uncommon (Flemish Cap and eastern Scotian Shelf), became inaccessible to acoustic surveys conducted at traditional times, arrived late in the inshore for spawning, and experienced low growth rates (Lilly 1994; Frank *et al*. 1996; Nakashima 1996; Carscadden *et al*. 1997; Carscadden and Nakashima 1997). Arctic cod, a cold water species, appeared to increase in abundance and expand its distribution (Lilly *et al*. 1994; Lilly and Simpson 2000). Changes were observed in salmon (Narayanan *et al*. 1995) and several other pelagic species, especially migrants from the south (Montevecchi and Myers 1996). These changes in cod and many other species may have been related to the prolonged period of low water temperatures starting in the early 1980s and to a particularly cold period in the early 1990s (Narayanan *et al*. 1995; Drinkwater 1996; Colbourne *et al*. 1997), but causal links between changes in water temperature and changes in fish biology remain to be established in many cases, especially for the cod (e.g. Lilly 1994). Although much of the published literature concludes that fishing was the major and even the sole cause of the collapse of the 2J+3KL cod during the late 1980s and early 1990s, the possible impacts of factors such as water temperature, the abundance and availability of prey (especially capelin) and predation by seals require additional study.

A thorough review of all analyses relating to the decline of cod in 2J+3KL from the mid-1980s to the early 1990s is beyond the scope of this paper. However, one specific aspect may be mentioned as illustrative of the degree of uncertainty. Various analyses have been presented in support of the hypothesis that the cod shifted southward (Kulka *et al*. 1995; Wroblewski *et al*. 1995), possibly in response to a decline in water temperature (deYoung and Rose 1993; Rose *et al*. 1994; Atkinson *et al*. 1997; Rose *et al*. 2000) or a southward shift in the distribution of capelin (Rose *et al*. 2000), and that this shift increased the vulnerability of the cod to both Canadian and non-Canadian fleets (Rose *et al*. 1994; Atkinson, *et al*. 1997; Rose and Kulka 1999). Other analyses find no support for the southward shift hypothesis (Hutchings and Myers 1994; Hutchings 1996; Myers *et al*. 1996a). There can be little progress in determining what caused the deaths of the fish until there is better understanding of where and when the deaths occurred.

Uncertainty about the time course of the decline lies at the heart of the inability to reconcile catch data and the autumn research vessel index within a sequential population analysis (SPA). One may class the various possibilities for the discrepancy into three groups. First, the stock decline may have been more gradual than indicated by the surveys. Under this scenario, the survey index had positive year effects for several years in the late 1980s and early 1990s. These effects may have been associated with the increased degree of aggregation toward the shelf edge at the time of the surveys. Hutchings (1996), for example, has conducted a modelling exercise that he suggests demonstrates how aggregation could cause overestimation in a random stratified survey. If, however, the autumn survey index accurately reflected the changes in cod abundance, then the decline occurred rapidly and a large number of fish remain unaccounted for in the catches. This leads to the second and third sets of hypotheses. The second is that catches in the late 1980s and early 1990s were grossly underestimated. This could include under-reporting of landings and the dumping of fish (including discarding of small fish) in Canadian fisheries (Hutchings 1996; Myers *et al*. 1997a; Hutchings and Ferguson 2000) and underestimation of the catch by distant water fleets on the Nose of the Bank. The third group of hypotheses involves an increase in natural mortality, caused for example by seal predation or a decrease in condition.

Shelton and Lilly (2000) conducted diagnostic studies to determine the magnitude of the departure from standard SPA assumptions required to allow the SPA to fit the data. They found that the departures were too large to be explained with independent data currently available. They concluded that unreported deaths caused by the offshore fishery may be most plausible as the main contributing factor to lack of model fit but that factors such as increased natural mortality, and possibly changes in survey catchability, also played a role.

The inshore region has gained a greatly increased degree of prominence in the assessment of 2J+3KL cod since the mid-1990s. By the autumn of 1994 there appeared to be very few cod left within the boundaries of the 2J+3KL stock complex. In spring 1995, a research vessel unexpectedly found a dense aggregation of cod in Smith Sound, Trinity Bay, and during summer/autumn of 1995 participants in the new sentinel survey program experienced good catch rates of commercial size cod over much of the area from central 3K to southern 3L. In 1998 a TAC was reintroduced to the inshore for vessels less than 65 feet in length, and this fishery continued through 2002.

Information on the general biology (e.g. distribution, spawning, feeding, growth, condition) of cod in the inshore may be found in Lilly *et al*. (1998a) and Lilly *et al*. (1999), and in the many sources cited therein. Our knowledge of the biology of cod in the inshore has increased rapidly through interviews with fishermen (e.g. Neis *et al*. 1999; Hutchings and Ferguson 2000; Jarvis and Stead 2001) and an intensification of study, including a tagging program, sentinel surveys, a logbook program for commercial vessels under 35 feet in length, acoustic surveys in specific areas, and an extension of the autumn survey into new strata in the inshore.

Attention must be drawn to one specific portion of the inshore. Gilbert Bay in southern Labrador (52º35' N; 56º00' W) has been shown to have a resident population of cod (Green and Wroblewski 2000; Morris and Green 2002) that is genetically distinct from other cod in the 2J3KL area (Ruzzante *et al*. 2000; Beacham, *et al*. 2002). Population biomass has been estimated at less than 70 t (Morris *et al*. 2003). Gilbert Bay has been designated as an Area of Interest, which is a step along the way to becoming a Marine Protected Area. Because of its small size, limited distribution and genetic distinctiveness, the Gilbert Bay population is not considered further in the present assessment of 2J+3KL cod. No other resident population of cod has yet been identified along the Labrador coast (Morris and Green 2002).

A narrative of the assessment process for 2J+3KL cod from extension of Canadian jurisdiction in 1977 to the moratorium in 1992 has been compiled by Bishop and Shelton (1997). Their report provides details of the annual assessments, including the data and methods used to determine stock status and the results of the assessments. The latter include TAC projections in terms of the standard requested reference points. The origin and evolution of the important databases such as catch at age, catch rate indices, and research survey data are discussed. Topics related to the assessments, such as the various committees and commissions that were struck to provide advice on scientific aspects of the assessments, and important issues such as the "retrospective problem", are also given attention. Documentation supporting assessments since 1992 may be found in Bishop *et al*. (1993; 1994; 1995a,b), Shelton *et al*. (1996), Murphy *et al*. (1997) and Lilly *et al*. (1998b; 1999, 2000b, 2001). Reports of the Canadian assessment meetings during 1993-1996, 1999 and 2001 may be found in Sinclair (1993), Shelton and Atkinson (1994a), Shelton (1996), Evans (1996), Rivard (1999) and Morgan (2001). NAFO deliberations are documented in NAFO Scientific Council Reports.

A full assessment of stock status was not conducted during 2002, but major indices were updated and reported in a Stock Status Report (DFO 2002). The update was not documented in greater detail in a CSAS research document, but the SSR was reproduced as a research document in the NAFO series (Shelton *et al*. 2002), where it was supplemented with information on total mortality computed from catch rates at age during the offshore portion of the standard autumn bottom-trawl surveys.

Although there was no formal assessment during 2002, analyses and syntheses of importance to understanding the biology, dynamics and management of 2J+3KL cod occurred in the context of two additional fora; a review meeting on species at risk issues and a workshop on reference points for gadoid stocks.

A major purpose of the review meeting on species at risk issues was to compile and summarize information held by DFO on (*inter alia*) population differentiation or structure, the magnitude of changes in population size and area of occupancy, and the causes and reversibility of those changes, with the intent of providing that information to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). An overview of findings and discussions is provided by Powles (2002), and the detailed information on 2J+3KL cod is provided by Smedbol *et al*. (2002). With respect to population structure, the review showed that various lines of evidence are consistent with the concept of substructure within the northern cod stock complex. However, unlike the presentation of information for some other cod stocks, the information on northern cod did not conclude with a statement as to whether the level of isolation observed within the stock is sufficient to have resulted in the formation of separate Evolutionarily Significant Units (ESUs). Nevertheless, it was stated elsewhere in Smedbol *et al*. (2002) that the review did not provide evidence to indicate the existence of ESUs within the current cod management units in Atlantic Canada. Analyses of northern cod were therefore undertaken at the level of the whole stock. This is emphasized here because the approach taken toward analyses during the 2003 assessment meeting was somewhat different. Regardless of whether one may recognize more than one ESU within the northern cod stock complex, it is apparent that the dynamics of populations in the inshore have been different from those of populations in the offshore since at least the mid-1990s. Following the procedure of the past few assessments, much of the information on distribution and stock dynamics is presented for the inshore and offshore separately, partly in recognition of the different dynamics and partly as a consequence of differences in the manner in which the information has been obtained.

The second forum of significance during 2002 was a workshop that considered the development of limit reference points under a precautionary approach (Rivard and Rice 2003). For 2J+3KL cod, it was not possible to identify a conservation limit for the spawning stock biomass, but it was agreed that such a limit would have to be higher than 300,000 t for the stock as a whole. No consideration was given to conservation limits for inshore populations alone.

The 2003 assessment updated the status of the 2J+3KL cod stock to the end of 2002 based on an additional one or two (as appropriate) years of data from research bottom-trawl surveys (spring and autumn), sentinel surveys, a prerecruit survey, acoustic surveys in specific areas, returns from tagging studies, a questionnaire completed by fishing communities, and catches and catch rates from the index fishery. Proceedings of the assessment meeting are documented by Rice and Rivard (2003), and a summary of the assessment is available in the Stock Status Report (DFO 2003). Technical details are provided in the present paper and in Brattey and Healey (2003), Cadigan and Brattey (2003), Chen *et al*. (2003), and Maddock Parsons and Stead (2003). These additional documents are referenced in relevant sections of the present paper.

During the assessment meeting there was a review of factors that have been postulated to have been instrumental in retarding the recovery of the stock. Some of these factors are discussed in Section 5, but there is as yet no extensive and detailed critique of factors specific to this stock.

2 The fishery

2.1 Nominal catches prior to the 1992 moratorium

Landings from this stock increased during the late 1950s and early 1960s and peaked at just over 800,000 t in 1968 (Table 1; Fig. 2). Landings then declined rapidly to a minimum of 139,000 t in 1978, increased to a plateau of approximately 250,000 t in the mid- to late 1980s and then declined very quickly in the early 1990s. The portion of the landings coming from each of the Divisions changed over time. During the 1960s, when the fishery was primarily by non-Canadian fleets (Fig. 3), landings were taken mainly from Divisions 2J and 3L (Fig. 4). Division 3K became prominent in the mid-1970s. Landings from Division 2J were relatively small in the mid-1980s. Division 3L dominated from the mid-1980s until the moratorium in 1992.

The fixed gear landings (Table 2; Fig. 5) increased from just 41,000 t in 1975 to a peak of 113,000 t in 1982, declined to 74,000 t in 1986, and increased again to a peak of 117,000 t in 1990, just 2 years before declaration of the moratorium. There was a substantial decline to 61,000 t in 1991. The commercial fishery was closed in July 1992 and only 12,000 t were landed that year. Some of the increase in the late 1980s was due to a resurgence of gillnet landings in southern Division 2J and trap landings in Division 3L, but much was due to an expansion of the gillnet fishery to the Virgin Rocks and other offshore areas in Division 3L (see Table 3 of Shelton *et al*. 1996).

2.2 Management advice, TAC's and catches during 1992-2002

Following is a narrative of the management advice, TAC's and catches from various sources during the period from just before imposition of the moratorium on commercial fishing in July 1992 to the start of fishing in 2002. As will be noted during the narrative, legal catches came from three sources: commercial fisheries, either directed or by-catch; food/recreational fisheries and sentinel surveys. Some of the management measures that were in effect each year are summarized in Appendix 1.

<u>1992 – the moratorium</u>

An assessment of 2J+3KL cod in 1991 provided evidence that the stock had declined rapidly in 1990 (see review by Bishop and Shelton 1997). In December 1991 the TAC for 1992 was set at 185,000 t. Following a scientific review in January 1992 the TAC was re-established at a ceiling of 120,000 t, pending further review in late spring. Meetings of both CAFSAC and NAFO in spring concluded that the stock had declined dramatically during 1991. No single factor was identified as the main cause of the decline, but the increase in mortality was considered to be consistent with extreme environmental conditions during 1991. Because it was not possible to predict whether the apparent increase in mortality would persist in 1992, no projections were carried past 1992. It was, however, recommended that catches should be kept to the lowest level possible to enhance the possibilities of stock re-building. The $F_{0.1}$ catch for 1992 was calculated to be about 50,000 t. By late June, 15,000 t had already been taken by Canadian offshore vessels, approximately 10,000 t had been set aside for by-catch, and 10,000 t had been taken by non-

Canadian vessels outside the 200 mile limit. This would leave only about 15,000 t for the inshore (fixed gear) fishery, which had harvested 115,000 t in 1990 and 75,000 t in 1991. The 15,000 t was considered uneconomic, since the catch per harvester would be very small, and also unfair, since the quota would probably be taken in the south before harvesters further to the north got a chance to fish. Conducting a fishery was considered to make even less sense in terms of the future of the resource. It was stated that scientists advised that "with a moratorium … for two years, the size of the stock should increase significantly, and the spawning stock should no longer be at dangerously low levels." On 2 July 1992, a moratorium was declared until the spring of 1994. (The above information was extracted from DFO (1992a,b)).

It may be noted that the moratorium was declared in consideration of danger to the stock and insufficient quota for the large industry that was dependent upon the resource. The moratorium did not come about because limit reference points based on spawning stock biomass or fishing mortality had been reached. Indeed, reference points were not in place at the time.

The fixed gear landings in 1992 were determined to be about 11,900 t. This included an estimate of 5,000 t from the inshore "recreational fishery" (Bishop *et al*. 1993). Note that an unregulated food fishery with jiggers and baited hooks had existed since time immemorial, and that the Canadian catch reported each year to NAFO (and ICNAF before it) had included an estimate of this food/recreational catch.

<u>1993</u>

With the moratorium in effect, fixed gear landings were estimated to be about 9,000 t, with the bulk coming from the recreational fishery. Most of the catch was taken by handline in Div. 3L during September-October (Bishop *et al*. 1994).

In 1993, a new process was established for the provision of management advice. The Minister of Fisheries and Oceans created the Fisheries Resource Conservation Council (FRCC) "as a partnership between government, the scientific community and the direct stakeholders in the fishery. Its mission is to contribute to the management of the Atlantic fisheries on a 'sustainable' basis by ensuring that stock assessments are conducted in a multi-disciplined and integrated fashion and that appropriate methodologies and approaches are employed; by reviewing these assessments together with other relevant information and recommending to the Minister total allowable catches (TACs) and other conservation measures, including some idea of the level of risk and uncertainty associated with these recommendations; and by advising on the appropriate priorities for science." (This definition of the mandate of the FRCC may be found in any recent FRCC publication in an Appendix entitled "FRCC Terms of Reference".)

In a letter to the Minister of Fisheries and Oceans in August, 1993, the FRCC (1993a) provided the following summary of stock status and advice regarding management of 2J+3KL cod.

> "Based upon the stock assessment report by scientists in the Department of Fisheries and Oceans, as well as the Report of the Scientific Council of NAFO, the situation of the 2J3KL cod (Northern Cod) stock can be characterized as follows:

1. The Stock continues to decline and is in a very depressed state, believed to be at the lowest level of abundance experienced during the 20th century.
2. Total biomass is estimated to be as low as 100,000 to 150,000 tonnes and the spawning biomass as low as 15,000 to 22,000 tonnes (these numbers are less than 10% of comparable numbers just a few years ago).
3. The distribution of the remaining fish is considerably different from historical patterns. The latest surveys show the reduced biomass to be approximately 2% in 2J; 15% in 3K; and 83% in 3L as compared to the longer term average of about 33% in each division. Furthermore, the fish have moved to deeper water in recent years. In fact, the only significant concentration of fish located by DFO acoustic surveys in February and June 1993 was on the "Nose" of the Grand Bank, outside the 200 mile limit.
4. The precise cause of this situation is not clear. Total mortality has been very high - higher than can be accounted for by known fishing mortality and the normal assumptions of natural mortality. To quote from the NAFO Scientific Council report, "Natural mortality may have increased as a result of harsh climatic conditions, poor feeding, predation by seals or competition with them, or emigration out of the area."
5. Environmental conditions are having an adverse impact on recruitment and the growth of young fish. After the 1986/87 year-classes there have been 5 consecutive years of observed, or predicted to be, poor recruitment. In addition, the spawning biomass has collapsed.
6. Stock recovery in the near future is unlikely and substantial recovery of the spawning biomass is unlikely before the year 2000 at the earliest. At this stage, there are no reasons to be optimistic about stock recovery even then.
7. Realistic projections about stock rebuilding are impossible until we better understand the reasons for the decline and until the various stock indicators reverse their downward trends.
From a conservation point of view, it is clear that given the continuing decline and continuing poor recruitment, it is prudent not to fish. Within Canadian waters, this means that the moratorium on commercial fishing will have to be continued past May 1994."

The FRCC (1993b) also made a recommendation regarding the recreational fishery. "In principle, from a pure conservation point of view, this "recreational" fishery should be closed. If this is considered impractical, the Council strongly recommends that increased efforts be undertaken to prevent abuse and to keep the amount of fish taken to an absolute minimum. The Council further notes that the fishery should be restricted to a fishery for personal consumption, rather than a "recreational" fishery." The unrestricted recreational fishery was indeed terminated at the end of 1993.

<u>1994</u>

The moratorium on directed fishing for cod was extended. A recreational fishery, also known as a food and subsistence fishery, was opened on a limited basis (10 fishing days) during August and September. The occurrence of low catches and small cod lead to the closure of this fishery after 8 fishing days. It was estimated that about 1,300 t were caught, mostly in Div. 3L (Bishop *et al*. 1995a).

The FRCC (1994) recommended "that the moratorium on fishing be continued in 1995; that, no recreational/food fishery be permitted; and, that a broad based sentinel fisheries program be implemented."

1995

In 1995 sentinel surveys were introduced to provide catch rates from fixed gear fished in a manner similar to a commercial fishery (Maddock Parsons and Stead 2003). The surveys caught 163 t. An additional 168 t were reported as by-catch (Shelton *et al*. 1996). There was no recreational fishery.

The FRCC (1995a) recommended "that the moratorium on fishing be continued in 1996 and that the Sentinel Fisheries program be continued."

The FRCC (1995b) also discussed criteria for reopening fisheries that had been closed. It stated that "for each stock, a set of re-opening rules will have to be arrived at to establish a safe threshold to re-open the fishery." No such re-opening rules were formulated for 2J+3KL cod.

1996

In 1996 the sentinel surveys caught 397 t and by-catch accounted for 142 t (Murphy *et al*. 1997). A food fishery was allowed on two consecutive 3-day weekends in September. Landings were estimated at 1,155 t.

The FRCC (1996) recommended that "the moratorium on fishing 2J3KL cod be continued during 1997" and that "the inshore Sentinel Fishery be continued with appropriate expansion and an offshore Sentinel Fishery program be initiated".

1997

In 1997 the sentinel surveys caught 346 t and by-catch accounted for 159 t (Lilly *et al*. 1998b). There was no food fishery.

1998 – an index fishery

During its consultations in late 1997 and early 1998, the FRCC (1998) learned that the fish harvesters in all areas except southern Labrador were of the opinion that the stock was in better shape than indicated in the 1998 Stock Status Report. "In all locations, except Port Hope Simpson, [fishers] reported that catch rates in the inshore sentinel fishery as well as by-catches in other fisheries inshore are exceptionally high. Fishers in Newfoundland requested a TAC of 15,000t which they estimated as close to $F_{0.1}$. Fishers in 2J recommended the continuation of the moratorium as stock would rebuild from south to north."

The FRCC recommended that “there be no directed commercial fishery for 2J3KL cod in 1998”, but that “an index program be established to provide additional information to supplement sentinel programs and to add confidence, inshore and offshore, in cod population estimates”, and that “as part of this program no more than 4,000 tonnes be caught”.

The Minister of Fisheries and Oceans announced that there would be a quota of 4,000 t, divided among by-catch (275 t), sentinel surveys (375 t), and a new index fishery, which was itself divided into an inshore component (3,000 t) and an offshore component (350 t).

Reported catches were 398 t from by-catch, 388 t from sentinel surveys, 3,019 t from the inshore index fishery, and essentially zero from the offshore index fishery (Lilly *et al*. 1999). In addition, there was a 3-day food fishery that is estimated to have taken 696 t.

It is important to note that a tagging program, designed to estimate exploitation rates, was initiated by DFO as soon as it became clear that there was to be a fishery sufficiently large to ensure recapture rates that would be much higher than might be expected from the sentinel surveys alone.

<u>1999 – reopening of a limited commercial fishery</u>

During its consultations in early 1999, the FRCC (1999) learned that fish harvesters were concerned about the low levels of fish north of White Bay, but that they felt that the high and increasing catch rates in the sentinel surveys from White Bay to St. Mary’s Bay indicated that a commercial fishery was sustainable. This opinion was supported by an undocumented report from a scientist contracted by the Fish, Food and Allied Workers (FFAW) Union. In this report it was stated that the fish in the inshore could be sustainably exploited at 35,000 – 40,000 t per year.

The FRCC recommended that “the TAC for 1999 be set between 6000 and 9000t to allow for a limited commercial fishery including a Sentinel fishery component for the coastal portions of 3L and 3K only, spread out over White Bay, Notre Dame, Bonavista, Trinity Bay, Conception Bay and the Southern Shore”

In its letter to the Minister of Fisheries and Oceans, the FRCC (1999) stated “Our deliberations on this stock were difficult this time, not because of the additional independent scientific analysis presented us, but because the data are inadequate as a basis for a scientific assessment and setting of a TAC for this stock. ... The setting of a TAC for this stock cannot be done in a defensible scientific manner, as is the typical procedure the Council follows for other stocks. ... The method we have chosen for setting the TAC for 1999 is regarded by the Council as a default method put forth only because of the unacceptable lack of quantitative data on the coastal biomass.”

The FRCC report was particularly problematic for the public perception of the quality of science regarding the status of 2J+3KL cod. The statement that “the data are inadequate as a basis for a scientific assessment and setting of a TAC for this stock” was broadly interpreted to indicate that the data and analyses presented in the SSR were less than expected and not as representative or broad-based as that which had been presented in the past. In fact, the problem was not in the information available for the stock as a whole. There was sufficient information to indicate that the stock was extremely low compared to levels in the 1980s, and far below levels in the late 1950s. (Indeed, the indices from the offshore research vessel surveys were much lower in 1998 than at the time the moratorium was imposed in July 1992.) The problem was that the information base was insufficient to address a new management desire, that being to subdivide the northern cod stock complex into smaller units and to assess the implications of opening a fishery in that small area adjacent to the coast in the southern half of the stock area where fish could be found in densities sufficient to support good catch rates with fixed gear (most notably gillnets).

The actual procedure used by the FRCC to generate a TAC range is not immediately clear, but a reading of FRCC (1999; p.11) indicates the following. The mortality level of about 5% indicated by the mark-recapture (tagging) experiments in 1998, the first year of those experiments, was regarded as acceptable. Therefore, removals at the same level as in 1998 could serve as a lower TAC option. The reported catch in 1998 was about 4,500 t, but the FRCC assumed that total removals in 1998 could be in the order of 6,000 t. (This would indicate that they assumed the unreported (illegal) catch was 1,500 t.) The FRCC also noted that "according to the sentinel gillnet fishery results the stock has expanded at a rate of 1.52 per year". Thus, if 6,000 t had been acceptable in 1998, then 9,000 t (a 50% increase) would be acceptable in 1999.

The Minister of Fisheries and Oceans announced the re-opening of a limited commercial fishery with a TAC of 9,000 t in the inshore portion of 2J3KL. The quota available for the commercial fishery was set at 8,600 t after allowances of 300 t for the sentinel survey and 100 t for by-catch.

Reported catches were about 8,050 t from the commercial fishery and 200 t from the sentinel survey. In addition, a recreational/food fishery was held during three weekends, and was estimated to have taken 220 t (Lilly *et al*. 2000b).

<u>2000 – back to an index fishery</u>

Based on their consultations during early 2000, the FRCC (2000) concluded that "Fishers are generally of the view that the region from southern 3L to southern 3K can support a commercial fishery at or above the level of 1999. However, this view is not universal." The FRCC (2000) recommended that "only sentinel and index fisheries be prosecuted in 3KL. Sentinel fisheries only must be prosecuted in 2J. The total fishing exploitation from all sources in 2J3KL should not exceed a rate of 10%. Therefore, the FRCC recommends that total catch for coastal 2J3KL should not exceed 7,000t." The FRCC also recommended that there not be a food fishery.

The derivation of the 7,000 t TAC is not entirely clear, but the number appears to derive from application of a 10% exploitation rate to population biomass estimates based on catch and exploitation rates, the latter being derived from mark-recapture (tagging) experiments. The 2000 SSR provided estimates of 10,000 t for Division 3K and 45,000 t for northern Division 3L. The 2000 SSR did not provide an estimate for southern 3L, because the catch appeared to be derived from fish which migrated into the area from 3Ps. However, the 1999 SSR had provided an estimate of 15,000 t available to the fishery in southern 3L during the 1998 index fishery. The sum of these estimates for the three areas is 70,000 t. If one assumes that the biomass available to the fishery in 2000 would again be 70,000 t, then a 10% exploitation rate would equate to a catch of 7,000 t.

The Minister of Fisheries and Oceans announced that an index fishery would be conducted in the inshore portion of 2J3KL and that sentinel surveys would continue. A TAC of 7,000 t was established for 2000-2001, with 6,600 t for the index fishery, 300 t for the sentinel survey and 100 t for by-catch.

Reported landings were approximately 4,700 t from the index fishery and 200 t from the sentinel surveys. In addition, a recreational/food fishery was held during three weekends, and was estimated to have taken 499 t (Lilly *et al*. 2001).

<u>2001</u>

Based on their consultations during early 2001, the FRCC (2001) concluded that "Fishermen hold mixed opinions as to whether a commercial fishery can be sustained at or above the level of 2000. Very few fishermen argue for an increased fishery."

The FRCC stated that it "believes that the maintenance of a small vessel coastal fishery and the scientific data provided by it are essential to monitoring of stock status." It recommended "that only sentinel and index fisheries be prosecuted in 3KL. Sentinel fisheries only should be prosecuted in 2J. The total fishing exploitation from all sources in 2J3KL should not exceed a rate of 10% on any sub-stock component. ... For 2J there should be no removals other than 100t for sentinel fishing. For 3K total removals should not exceed 1000t. For northern 3L, total removals should not exceed 3000t. For southern 3L total removals should not exceed 1500t. Total removals should include directed catch, bycatch, sentinel catch, and any recreational catch. ... The FRCC does not foresee any significant change in the recommended exploitation of this stock until there is significant improvement in stock distribution and abundance, especially in terms of spawning stock and recruitment."

The Minister of Fisheries and Oceans announced a quota of 5,600 t for the index fishery and sentinel surveys in 2J3KL. This quota would be in effect for three years. The Minister also announced a new licensing program for the recreational fishery. This fishery would operate outside the TAC.

Reported landings were 4,795 t from the index fishery (including by-catch) and 118 t from the sentinel survey. The catch from the recreational fishery, as estimated from logbook returns, was 1,975 t (Shelton *et al*. 2002). Thus, the catch from the index fishery was well inside the TAC, but addition of the estimated catch from the recreational fishery resulted in a total catch (6,888 t) that was considerably above the TAC.

<u>2002</u>

A full assessment of the status of the 2J+3KL cod stock was not conducted during winter of 2002, although an update was conducted and a SSR was produced (DFO 2002). The FRCC did not conduct a formal consultation process during the winter/spring. Its report on 2002/2003 conservation requirements for 2J+3KL cod was in the form of a letter to the Minister of Fisheries and Oceans (FRCC 2002). In this letter the FRCC reiterated "the need to limit removals to a maximum of 5,600t, including all directed catches, bycatch, sentinel and recreational catches". The Minister of Fisheries and Oceans announced that the TAC was set at 5,600 t, and that all components of the fishery (index, sentinel and recreational) will be managed within the TAC.

2.3 Catch since 1998, with emphasis on 2001/2002 and 2002/2003

A new fishing season (April 1 to March 31) was put in place for 2000/2001 and subsequent years. However, only very small by-catches have been reported during the first three months of any year since the mid-1990s, so it is convenient to continue to refer to the fishery year as the calendar year in which the first 9 months of the fishery season occurred (e.g. the 2001/2002 fishery season will be referred to simply as 2001).

2.3.1 Nominal catch by area and gear

Management regulations for the index and recreational fisheries in 1998 to 2002 are summarized in Appendix 1.

The index fisheries have been conducted on the basis of individual quotas. Participants have been licenced to fish only in the Division of their home port, with an additional restriction within 3L to either north or south of Grates Point (between Trinity Bay and Conception Bay). Thus, landings within each Division (or area within 3L) have reflected both the relative availability of fish and the number of licences in the area.

The percentage of landings taken in 2J has been less than 1% during each year. The percentage taken in 3K was relatively high (44%) during the first year of the fishery (1998), but has declined subsequently (43, 27, 25, and 16% during 1999 to 2002 respectively).

The geographic pattern of landings is illustrated in more detail in Fig. 6, where it may be seen that the bulk of the landings have come from the contiguous areas 3Ki (central Notre Dame Bay to the 3K/3L boundary), 3La (Bonavista Bay) and 3Lb (Trinity Bay). In terms of percentage of total landings, 3Ki has declined each year, whereas 3Lb has increased each year, reaching 36% in 2002. Note as well that a high portion of the catch in 2002 came from just to the 3La side of the 3La/3Lb boundary. During the summer there was an intense and highly localised fishery near Cape Bonavista, with 565 t recorded as landed in one community, Bonavista. This was more than twice the landings recorded at that community in each of the previous two years. Many fishermen from northern Bonavista Bay obtained much of their landings from the Bonavista area in 2002. There has clearly been a substantial reduction in the area in which fishable aggregations have been found during the period when the fishery was open.

The landings in 2001 from all sources (index fishery including by-catch, sentinel survey and food/recreational fishery) are presented by gear, unit area and month in Table 3a. Gillnets contributed 53% by weight, linetrawls 3%, handlines 41% and traps 3%. The contribution of handlines was much higher than in 2000 as a consequence of the great interest in the recreational fishery in the first year of the Marine Recreational Groundfish Licence Pilot Program.

The landings in 2002 were 3,504 t from the index fishery (including by-catch) and 96 t from the sentinel survey. The catch from the recreational fishery, as estimated from logbook returns, was 596 t. Interest in the recreational fishery was much lower in 2002 than it had been in 2001, probably in large part due to a halving of the number of fish tags provided to each licence holder (Appendix 1, Table 3). The total catch (4,196 t) was below the TAC (5,600 t).

The landings in 2002 from all sources (index fishery including by-catch, sentinel survey and food/recreational fishery) are presented by gear, unit area and month in Table 3b. Gillnets contributed 67% by weight, linetrawls 1%, handlines 29% and traps 3%.

Most of the landings in both 2001 and 2002 were taken from July to November. However, it is difficult to generalize about the temporal pattern in landings, because the time periods during which the index/commercial fishery has been open have changed each year (Appendix 1, Tables 1,2). This has resulted in considerable among-year differences in the temporal pattern of the catches. For example, the percentage of the gillnet catch (including sentinel catch) taken during August has increased from 3% in 2000 to 42% in 2001 to 67% in 2002. Such among-year differences in timing reduce the extent to which catch rates from index/commercial fisheries can be used to provide a standardized index of annual and geographic changes in fish density. Differences in fishing periods among geographic areas within a year, which was very pronounced during 2002 (Appendix 1, Table 2), exacerbate this even further.

2.3.2 By-catch, discards and illegal fisheries

By-catches of cod occur in ongoing Canadian and non-Canadian fisheries. All recorded by-catch has been incorporated into the catch (Tables 1,2).

In the inshore, by-catches are common in gillnet fisheries for lumpfish and especially winter (blackback) flounder. They also occur in the herring gillnet fishery and the capelin trap fishery. Note that for winter flounder and herring there are both commercial fisheries and bait fisheries. The only inshore fishery that has been studied specifically for by-catch is the herring gillnet bait fishery, in which by-catches of cod appear to be small (Reddin *et al*. 2002).

In the offshore, by-catches of cod by Canadian fleets have, in recent years, come from trawl fisheries for yellowtail flounder and both trawl and gillnet fisheries for Greenland halibut. The recorded by-catches in these fisheries have been small. The by-catch by Canadian otter trawl fleets, as recorded in log books and independently by the Canadian observer program, is being modelled (Chen *et al*. 2003) in hope of predicting the total by-catch by these fleets.

A by-catch of cod by non-Canadian fleets has been reported for the area outside the 200 mile limit on the Nose of Grand Bank in Division 3L. These catches are understood to be small (50-80 t annually in 2000-2002).

Discards

The discarding of cod in the shrimp fishery was dramatically reduced with the introduction of the Nordmore grate in 1993 (Kulka 1998). Total discards from the large-vessel shrimp fishery in 2J3K were 5 t in 1995 and 13 t in 1996 (Kulka 1998).

Shrimp quotas increased dramatically during the late 1990s, and a new fleet of smaller trawlers entered the fishery in 1997. The level of observer coverage in this fleet of smaller vessels has been low (Orr *et al*. 2002). Therefore, the total quantity of discards may have increased since the mid-1990s, and the opportunities for observing such discards have declined.

There have been no recent estimates of the amount of discarding by shrimp trawlers in 2J3K. In 3L, there was little overlap between the distributions of small cod and shrimp during the autumns of 1995-1998 (Orr *et al*. 1999), and the discards of small and large shrimp vessels combined was less than 1 t annually during 2000 and 2001 (Orr *et al*. 2002).

Additional unquantified sources of mortality include the fallout and discarding of low quality cod caught in gillnets, and the discarding of small cod caught by handlining.

Illegal fishing

It is known that in recent years there have been removals in inshore waters in excess of sentinel surveys and legal fisheries. The magnitude of poaching is not known.

The impact of unaccounted fishing mortality

In the offshore, cod appear to experience an extraordinarily high mortality rate (see Section 4.4.2). The extent to which this is attributable to mortality associated with unreported catch, discards and injury caused by contact with gear (e.g. shrimp trawls) is not known. However, any such deaths may be important because the abundance of cod in the offshore is so very low.

In the inshore, the magnitude of unreported bycatch and poaching is not known, so their impact cannot be assessed. However, there is concern that such catches may be impeding recovery, especially in 3K, where the local cod populations appear to have been greatly depleted compared to levels during the late 1990s.

2.3.3 Sampling of catch in 2001 and 2002

In both years, the sentinel survey was sampled intensively. Sampling of the index fishery was insufficient is some cases and had to be augmented by sentinel survey data. Sampling of the index fishery is difficult because landings tend to be small at any specific time and place, and it is difficult to predict when landings will occur. There was no sampling of the food/recreational fishery. This is an important shortcoming, because the catch from this fishery constituted a large portion of the total catch, especially in 2001, and the catch is taken by handline which is not extensively sampled in other fisheries.

The number of fish measured in 2001 and 2002 is given by gear, unit area and month in Tables 4a and 4b respectively. The number of fish aged in 2001 and 2002 is given by gear, unit area and quarter in Tables 5a and 5b respectively.

2.3.4 Catch numbers and weights at age

The age composition and mean length-at-age of the landings were initially calculated by gear, unit area and quarter as described in Gavaris and Gavaris (1983). The following relationship was applied in deriving average weight-at-age:

$$\log(\text{weight}) = 3.0879*\log(\text{length}) - 5.2106.$$

In terms of numbers of fish, the landings in 2001 were dominated by handline (48%), followed by gillnet (41%), trap (6%) and linetrawl (5%) (Table 6a). In 2002, landings were dominated by gillnet (50%), followed by handline (44%) and linetrawl (3%) (Table 6b).

The total catch-at-age in 2001 comprised a range of ages, with ages 3 to 11 each contributing at least 2% by number and age 4 most prominent (Table 6a; Fig 7a). Less than 1% (by number) of the total catch in 2001 was older than age 11 (the 1990 year-class). The gillnet catch was dominated by fish of age 6, but fish of age 9 (1992 year-class) were still prominent and those of age 11 (1990 year-class) were still readily discernable. Catches from linetrawl, handline and trap were dominated by young fish, with age 4 predominant.

The total catch-at-age in 2002 comprised a range of ages, with ages 3 to 12 each contributing at least 2% by number and age 5 most prominent (Table 6b; Fig 7b). Less than 1% (by number) of the total catch in 2002 was older than age 12 (the 1990 year-class). The gillnets tended to select fish of ages 5-7 but caught relatively large numbers of fish as old as age 12. Handlines selected mainly fish of ages 4 and 5.

The catch-at-age for fish in the reported landings (inshore and offshore) from 1962 to 2002 are presented in Table 7. The 1989 year-class was the most important contributor to the catch in 1993-1994. The 1990 year-class was the most important contributor in 1995-1997. The 1992 year-class was the most important contributor in 1998-1999.

The age compositions of the total landings from 1998 to 2002 (Table 7; Fig. 7c) illustrate the broadening of the age composition of the populations currently inshore. There had been a severe truncation of the age composition by the mid-1990s. When the index fishery opened in 1998, there were very few fish older than age 9 (the 1989 year-class). However, the 1990 and 1992 year-classes were moderately strong in the inshore and have persisted to the present, so that by 2002 there was good representation out to age 12, and there were even some age 13’s. This contrasts with the offshore, where fish older than about age 6 have been caught infrequently (see Section 4.2.1.2.2). Note, however, that the age composition of the fish currently inshore is still truncated compared with the age composition of the stock as a whole in the 1980s, and even more so when compared with the early 1960s.

The mean weights-at-age calculated from mean lengths-at-age in the landings have varied over time (Table 8; Fig. 8). There was an increase in the late 1970s and early 1980s, followed by a decline through the 1980s to low levels in the early 1990s. There has been substantial improvement in the latter half of the 1990s, and for some age-groups (e.g. ages 4-7) the weights-at-age calculated for recent years were at or near the highest levels in the time-series. Interpretation of changes in the weights-at-age is difficult because of changes in the relative contributions of the various gear components and changes in the location and timing of catches from each gear component. For example, much of the landings prior to the moratorium came from otter trawling offshore early in the year, whereas since the moratorium most of the catch has come from fixed gear inshore in the second half of the year. The high proportion of landings coming from gillnets in recent years will tend to increase the calculated mean weight-at-age of those age-classes entering the selection range of the gear. This may apply in particular to ages 5 and 6. There may also be an underestimate of weight-at-age for those age-classes leaving the selection range of gillnets. The influence of gillnet selectivity has probably been declining during the past 3-4 years.

There are clearly problems with the 1993 weights-at-age that remain to be resolved.

The biomass at age for fish in the reported landings from 1962 to 2002 is presented in Table 9.

2.3.5 Weights-at-age at the beginning of the year

Weights-at-age at mid-year and the beginning of the year were required in recent years for explorations of whole stock analyses employing sequential population analysis (SPA). Although whole-stock SPA's were not explored during the present meeting, it is thought that the weights-at-age employed in the earlier explorations should be recorded once again to document what has been used in the past and to assist additional explorations.

A satisfactory time-series of stock weights-at-age is not available. Estimates have in the past been obtained by adjusting to the beginning of the year those mean weights-at-age calculated from sampling during the commercial fishery (see, for example, Rivard 1982, p. 14). A problem with such data is that the commercial fishery may be conducted with a variety of gears, each with its peculiar selection pattern, and the temporal pattern of fishing may not centre on the time when the fish attains the mid-point of its annual length increment. In addition, both the relative contribution of each gear to the total catch and the temporal and spatial pattern of fishing may vary among years. Prior to preparation of the 1998 assessment of 2J+3KL cod it was thought that weights-at-age derived from sampling during research bottom-trawl surveys might provide a more representative measure of weight-at-age at the beginning of the year. Based on a comparison of data from research surveys and the commercial fishery in Subdivision 3Ps (Lilly 1998b), it was decided that data from the research vessel survey were too variable at older ages and that it would be prudent to continue to use estimates from commercial fishery data until more representative data were available. The use of survey data for the 2J+3KL stock in recent years is further constrained by poor or nil representation for some of the older age groups caught in the inshore fisheries from the mid-1990s to the present. This is most apparent in Divisions 2J and 3K. Even with the above concerns, it may be desirable to use information from the bottom-trawl surveys to provide estimates for the younger ages, since commercial gears tend to select the larger individuals at these ages, but to date the modeling of seasonal growth required to adjust the autumn survey data to mid-year and January 1 estimates has not been attempted. It was decided that the commercial weights-at-age would continue to be used to estimate January 1 weights-at-age.

As noted by Lilly (1998a), there are several aspects of the commercial weight-at-age data (Table 8; Fig. 8) that require particular attention. (1) Constant values have been assumed in some of the early years. Weights at ages 2-20 are constant from 1962 to 1971 and weights at ages 19 and 20 are constant from 1972 to 1977. The value for age 20 jumps from 7.19 kg in the first period to 17.46 in the second. (2) Some values seem unusually high or low compared with adjacent values. The most notable instances are values for ages 8 and 9 in 1993, which seem much too high, and the value for age 12 in 1995, which is too low. It is assumed that these outliers arise from sampling error, often associated with small sample sizes, although there may be other reasons not yet discovered.

There are some missing values for age 2 and ages 10-20, especially since 1991. Values for age 2 are required for reconstruction of the population biomass and have been set at 0.26 kg, which is the average of non-missing values in the period 1974-1997. Values are required for some of the other missing ages as well, and for consistency have been supplied for all instances of missing values in the matrix. Where possible a missing value was assumed to equal the average of the values in the nearest two non-missing years preceding and two non-missing years following. Where values were not available for following years, values were assumed to be equal to the average of the nearest three preceding non-missing years. The exception to this was age 20 in 1990-1997, which was set equal to the value of the nearest four preceding years because the value for 1988 seemed low compared to the others. The high values at ages 8 and 9 in 1993 and the low value for age 12 in 1995 were replaced with values calculated with the above protocol. The resulting matrix is presented in Table 10.

Weights-at-age at the beginning of the year were calculated from the commercial weights-at-age using formulae in Rivard (1982, p. 14). For ages 3-20, weight-at-age at the beginning of year t ($\hat{W}_{i,t}$) was approximated by

$$\hat{W}_{i,t} = e^{(\ln W_{i-0.5,t-0.5} + \ln W_{i+0.5,t+0.5})/2}$$

For age 2, the $\hat{W}_{2,t}$ were approximated by the relationship

$$\hat{W}_{2,t} = e^{(2\ln W_{i+0.5,t+0.5} - \ln \hat{W}_{i+1,t+1})}$$

The resultant matrix is presented in Table 11.

3 Industry perspective

A perspective on several aspects of the sentinel survey and the commercial index fishery is available from the responses to a questionnaire prepared by the Fish, Food and Allied Workers Union (FFAW). In 2001 this questionnaire was sent to the Fish Harvester Committees representing the 55 sites where a sentinel survey was conducted by the FFAW during 2000 (Jarvis and Stead 2001). In 2002 and 2003 the questionnaire was sent to all Fish Harvester committees in 2J3KL. Responses were received from about 50% of those committees in each year. Jarvis (2002) and Jarvis and Dalley (2003) provide unpublished summaries of the reponses and a compilation of the comments provided by the fish harvesters in individual communities. The following summarizes the response to some of the questions regarding the 2002 fishing season (Jarvis and Dalley 2003).

In response to whether commercial catch rates in 2002 were high, average or low compared with historical averages, 12% said high, 28% said average and 61% said low. All but seven responses from southern Labrador (2J) to northern Bonavista Bay (3L) were “low”. The appearance of average catch rates for a period at two sites in southern Labrador represents the first indication in many years of the presence of adult cod in 2J. From inner Bonavista Bay to the western side of Trinity Bay the majority of the responses were “high”. From inner Trinity Bay to the southern Avalon Peninsula the responses were “average” or “low”, with responses of “low” coming from almost all sites in Conception Bay and the eastern Avalon Peninsula.

In response to whether commercial catch rates were higher, the same or lower than during the 2001 fishery, 12% said higher, 44% said they were the same, and 44% said lower.

In response to whether “signs” of small (up to 18 inches) fish were better, the same or worse than in 2001, 64% said better, 26% said the same and 10% said worse. Improving signs of small fish have been noted for several years.

In response to whether the overall condition of cod caught during 2002 was good, average or poor, 60% said good and 40% said average. Good or average condition has been noted every year in these surveys.

In response to whether the trends seen in standardized sentinel and commercial catch rates are reflective of their perception of the overall trend in stock status, 72% said yes and 28% said no. Most of the “no” responses came from Bonavista Bay and Trinity Bay. It is understood that fish harvesters who said “no” meant that the actual status is better than reflected by those indices.

4 Resource Status

4.1 Stock structure

Numerous studies have indicated the likelihood of substock structure within the northern cod complex (see Lear 1986 for an overview). For example, there was a north-south cline in size-at-age and spawning time, there was a change in vertebral counts at approximately the north slope of Grand Bank, and cod tagged at specific locations in the offshore in winter tended to migrate to specific but broad areas of the inshore for feeding and then returned to approximately the area of tagging in subsequent winters. It was also known that cod overwintered in various locations inshore and that some spawning occurred inshore.

The stock collapsed during the late 1980s and early 1990s, and by 1994 there seemed to be very few cod anywhere in the stock area. Beginning in 1995 the perception of stock size and distribution changed when a large aggregation of cod was located in Smith Sound (Trinity Bay). The sentinel surveys, which started that year, achieved good catch rates in much of the area from White Bay in central 3K southward to the boundary with 3Ps.

Recent interest has focussed on whether those cod currently inshore are distinct from cod currently offshore. As summarized in the assessment documents for 1999 and 2000 (Lilly *et al*. 1999, 2000b), several sources of information are consistent with the hypothesis that there are distinct inshore or bay stocks along the east coast of Newfoundland. The information includes the presence of cod inshore in the winter, the historic existence of spring fisheries in the inner reaches of Bonavista and Trinity bays before cod arrived at the headlands from the offshore, the occurrence of spawning within the bays, and the paucity of returns offshore from cod tagged inshore in the winter. In addition, the aggregations sampled inshore by commercial fisheries, sentinel surveys, and research bottom-trawling contain older/larger individuals than are taken by research bottom-trawling in the offshore, especially in Divisions 2J and 3K.

Tagging studies, conducted during the post-moratorium period while the overall stock size has been extremely low (Brattey *et al*. 2001), indicate that the inshore of 3KL is currently inhabited by at least two groups of cod: (1) a northern resident coastal group that inhabits an area from western Trinity Bay northward to western Notre Dame Bay and (2) a migrant group from inshore and offshore areas of 3Ps that moves into southern 3L and less commonly into northern 3L and 3K during late spring and summer and returns to 3Ps during the autumn. Only a small number of tagged cod from 3Ps were caught north of Trinity Bay. The tagging also indicates considerable movement of cod among Trinity, Bonavista and Notre Dame Bays.

It is not known if there is currently movement between the inshore and the offshore in 2J3KL. Very few tags have been applied to cod in the offshore in recent years because no aggregations sufficiently large to warrant tagging have been located. In addition, there has been only one reported offshore recapture of a cod tagged inshore after the mid-1990s. Of course, this statement is tempered by the fact that there has been no directed fishery for cod in the offshore during this period, so recaptures could come only from fisheries directed at other species, and the by-catch of cod from these other fisheries is thought to be small relative to the cod-directed inshore catch.

There are two conflicting interpretations of genetic studies. One is that cod in the inshore and offshore are genetically distinct from one another; the other is that there is no differentiation among groups of 2J+3KL cod. These differences originate in part in methodology. The results of studies employing microsatellite loci are interpreted to support the existence of sub-stock structure between the inshore and the offshore and in various areas of the offshore (Bentzen *et al*. 1996; Ruzzante *et al*. 1996, 1997, 1998, 1999, 2000; Taggart *et al*. 1998; Beacham *et al*.

2002). Substock structure at the level of bays is less strongly supported. In contrast to the studies with microsatellites, the results of studies with mitochondrial DNA provide no evidence of substock structure within 2J3KL (Pepin and Carr 1993; Carr *et al*. 1995). The conflicting interpretations of stock structure are not just a consequence of the use of different methodologies. Carr and Crutcher (1998) state that "re-evaluation of (the) microsatellite data supports the conclusion of extremely limited genetic differentiation among populations in the Northwest Atlantic". Those who support the interpretation of considerable substock structure contend that the mitochondrial DNA approach lacks the ability to detect the structure that is there.

Neither interpretation of the genetic data would preclude the possibility that functional subpopulations exist without significant genetic differentiation.

An important question is whether the fish currently inshore can contribute to the recovery of fish in the offshore. Beacham *et al*. (2002) contend that "given the population substructure … detected between most inshore and offshore areas, and among offshore areas themselves, the likelihood that the inshore-spawning stock will contribute to offshore recovery is low."

4.2 Population indices

4.2.1 Bottom-trawl surveys

4.2.1.1 Survey design

Research vessel surveys have been conducted by Canada during the autumn in Divisions 2J, 3K and 3L since 1977, 1978 and 1981 respectively. No survey was conducted in Division 3L in 1984, but the results of a summer (August-September) survey in 1984 have been used for some analyses. The 1995 and 2002 autumn surveys continued into late January of the following years. Spring surveys have been conducted by Canada in Division 3L during the years 1971-1982 and 1985-present.

The autumn surveys in Divisions 2J and 3K were conducted by RV *Gadus Atlantica* until 1994. In 1995-2000 they were conducted mainly by RV *Teleost*, although RV *Wilfred Templeman* surveyed part of Division 3K. Surveys in Division 3L were conducted by RV *A.T. Cameron* (1971-1982) and RV *Wilfred Templeman* or its sister ship RV *Alfred Needler* (1985-2000 for spring and 1983-2000 for autumn). In recent years, RV *Teleost* occupied some of the 3L stations, particularly those in deep water. The surveying in Divisions 2J and 3K became increasingly complex in 2001 and 2002, with more individual trips required to complete the surveys and increased incidence of more than one ship contributing to the surveying of each Division.

During the autumn of 1995 both ships used for the first time the Campelen 1800 shrimp trawl with rockhopper footgear, replacing the Engel 145 Hi-rise trawl that had been used since the start of the surveys in 2J and 3K and since the change to the RV *Wilfred Templeman* in Division 3L. In addition, the Campelen trawl was towed at 3.0 knots for 15 min instead of 3.5 knots for 30 min. The selectivities of the two nets were found through comparative fishing experiments in 1995 and 1996 to be markedly different, with the Campelen being far more effective at catching small cod (Warren 1997; Warren *et al*. 1997). There were limited data for the comparison of larger cod. Conversion of Engel catches to Campelen equivalent catches was reported by Stansbury (1996, 1997).

The survey stratification scheme, illustrated in Fig. 9-11, is based on depth intervals intersected by lines of latitude and longitude (Doubleday 1981; Bishop 1994). The strata used in 1996 were similar to those in previous years except that the survey was extended to 1500 m and 25 new strata were added to the inshore in Divisions 3K and 3L to obtain an estimate of the cod landward of the standard survey area. The survey in 1997 was similar to that in 1996, except that some of the new inshore strata were modified and one stratum was added. The survey in 1998 was as in 1997. The survey in 1999 was as in 1997 and 1998 except that the new inshore strata were not fished. The surveys in 2000-2002 were again similar to the previous 5 years in the offshore, and the inshore strata in 3K and 3L were fished once again.

Prior to 1988, set allocation was proportional to stratum area, with the provision that each stratum be allocated at least 2 sets. In 1989 and 1990 an "adaptive design" was introduced in an attempt to minimize variance. It was found that this method introduced a bias and the additional sets fished during the second phase of these surveys have been excluded from analyses. In 1991-1994, additional sets were allocated in advance to certain strata based on past observed stratum variance (Gagnon 1991). In 1995-2000, set allocation was based once again on stratum area alone (with the provision that there be at least 2 sets in each stratum).

4.2.1.2 ***Autumn bottom-trawl surveys***

4.2.1.2.1 Autumn abundance and biomass

Abundance and biomass have been estimated by areal expansion of the stratified arithmetic mean catch per tow (Smith and Somerton 1981). To account for incomplete coverage of some strata in some years, estimates of biomass and abundance for non-sampled strata were obtained using a multiplicative model.

Estimates of abundance and biomass from the autumn surveys in 1978-1994 (Divisions 2J and 3K) and 1981-1994 (Division 3L) may be found in Tables 12-19 of Shelton *et al*. (1996). The data from 1983 to 1994 have been converted to Campelen equivalents and are presented in this paper along with the actual Campelen data from 1995-2002. Data for Division 2J are in Tables 12-15 and data for Division 3K are in Tables 16-19. Note that data for 1993-2002 are presented separately from earlier years for Divisions 2J and 3K because of the change in stratification scheme introduced in 1993 (Bishop 1994). Estimates for surveys in Division 3L in 1983-1998 are in Tables 16-18 of Lilly *et al*. (1999). Estimates for strata <= 200 fathoms in Division 3L in 1990-2002 are in Tables 20-21 of the present paper. Estimates for strata > 200 fathoms in Division 3L in 1992-2000 are in Table 22.

Because there have been changes over time in the depths fished, annual variability in the abundance and biomass of cod has been monitored for those strata that have been fished most consistently since the start of the surveys. These "index" strata are those in the depth range 100-500 m in Divisions 2J and 3K and 55-366 m (30-200 fathoms) in Division 3L. The inshore strata fished in 1996-1998 and 2000-2002 are not included in the index. Because an index has also been calculated for the inshore strata, the former "index" will now be referred to in this paper as the "offshore index".

Changes in abundance and biomass in the offshore index strata are shown by Division for the years 1983-2002 in Fig. 12. The patterns in abundance and biomass differ in detail, reflecting changes in the relative abundance of small and large fish. Of note are the positive anomaly in 2J and 3K in 1986, the very large increase in 3K in 1989 and the rapid decline during the early 1990s. Abundance and biomass have remained at extremely low levels in all Divisions since 1993.

Abundance and biomass estimates for the new inshore strata in 1996-1998 and 2000-2002 (Table 23) are less than estimated for the offshore but are relatively high given the much smaller area of the inshore strata. The total abundance and biomass of all strata fished in 1983-1998 are provided by Division and year in Table 20 of Lilly *et al*. (1999). The values for 1986-2002 are provided in Table 24 of the present paper.

The abundance and biomass for offshore index strata, deep offshore strata and inshore strata are provided in Table 25 by Division and year for the 8 years since introduction of the Campelen trawl. Abundance in offshore index strata declined from 1995 to 1997, increased from 1998 to 1999, and has remained rather stable. Biomass in offshore index strata increased from 1995 to 1997-1998, nearly doubled in 1999, remained relatively constant in 2000-2001, and declined somewhat in 2002. The biomass in offshore index strata in 2002 was about 23,000 t, which is about 2% of the average biomass of 1,200,000 t (in Campelen equivalents) in the period 1983-1988 (excluding the high value in 1986).

4.2.1.2.2 Autumn mean catch at age per tow

Offshore index strata

The divisional mean number caught at age per tow in offshore index strata during autumn surveys from 1979 (1981 in Division 3L) to 1994, and the mean number per tow for Divisions 2J, 3K and 3L combined, may be found in Tables 3-6 of Bishop *et al*. (1995b). The data from 1983 to 1994 have been converted to Campelen equivalents and are presented along with the actual Campelen data from 1995-2002 in Table 26 for Divisions 2J, 3K and 3L separately and for all three Divisions combined. Mean catch per tow has continued to be very low for each age in each Division during the past few years when compared with many years in the 1980s and early 1990s.

The weakness of recent year-classes is emphasized when mean catch at age per tow is plotted for the 1976-1999 year-classes at ages 1-3 (Fig. 13). For age 1, year-class strength declined from 1994 to 1996, increased to 1999, and then declined somewhat. The 1994 and 1999 year-classes at age 1 appear strong when compared with the actual catch rates of earlier year-classes, but look very weak compared to previous year-classes following conversion to Campelen equivalent numbers. At age 3 all year-classes from 1992 to 1999 look weak even when compared with unconverted catches of some of the year-classes from the early and late 1980s. Note that the

1994 and 1999 year-classes, which were relatively strong at age 1, do not appear relativley strong by age 3.

An index of spawner stock biomass in the offshore was derived from catches and sampling during autumn bottom-trawl surveys and commercial weights at age (Fig. 14). Because the surveys were conducted during the autumn, it was thought that the population biomass estimated in a given year would provide an appropriate index for spawner biomass in the following spring. The spawner biomass on January 1 in year y was computed as

$$\sum_{a=1}^{20}(N_{a-1,y-1} \times Pm_{a-1,y-1} \times W_{a,y})$$

where N is population number, Pm is proportion mature, W is individual weight, a is index of age (a=1-20) and year is index of year (y=1984-2003). N was computed by areal expansion of the stratified arithmetic mean catch per tow in index strata in Div. 2J, 3K and 3L combined (Table 26). Pm is the proportion of female cod that were mature, as estimated from a probit model fitted by cohort to observed proportions mature at age (see Section 4.3.2). W is the weight on January 1 as estimated from mid-year commercial weights (Table 11). Weights derived from sampling of the commercial catch are used so as to be consistent with the weights used in the inshore SPA (see Section 4.4.4). [Note that the computation of spawner biomass as described here differs from computation of the total biomass as illustrated in Fig. 12 in the use of commercial weights-at-age, rather than the actual weights-at-age in the survey catches, and in extrapolation from a mean catch per tow rather than a summation of biomass estimates calculated for individual strata. (In some years, some strata were not surveyed.) Note as well that Fig. 14 differs from the comparable Fig. 13 in Lilly *et al*. (2001) in that the present figure uses extrapolated population numbers rather than catch per tow, and the catches in a specific year are referenced to the following year (the year of spawning) rather than the year of the survey.]

The index declined quickly after 1990 to reach a minimum in 1995. There was a slight increase during the late 1990s and no trend during the past few years. Despite the increase in proportion of fish mature at age and the increase in commercial weights at age, the index in 2002 stood at only 1.7% of the average index in the period 1984-1989 (excluding the high value in 1987).

Inshore strata

Inshore strata in 3K and 3L were fished in 1996-1998 and 2000-2002. The mean catch at age per tow was calculated for 3K and 3L separately and for 3KL combined (Table 27). Each 3KL value is the mean of the divisional means, weighted by the divisional survey areas (where the area of inshore strata is 3,235 sq n miles in 3K and 3,107 sq n miles in 3L).

4.2.1.2.3 Autumn distribution

The distribution of cod at the time of the autumn surveys has been illustrated in numbers per standard tow (Shelton *et al*. 1996; Murphy *et al*. 1997) and in weight (kg) per standard tow (Lilly 1994, 1995). The catch from each tow in the period 1983-1994 has been recalculated to

Campelen equivalents, and plots of these recalculated catches for 1985-1994 are shown together with the actual catches in 1995-1998 in Lilly *et al*. (1999). The catches in 1987-1988 are presented in Fig. 15 of the present paper as an example of the relatively large catches that were obtained during the 1980s.

For the period 1981-1988 catches were widespread over the survey area (Lilly 1994). The first indication of the big changes to come occurred in 1988, when almost no fish were caught in the area of Harrison Bank in northwestern Division 2J (Lilly *et al*. 1999). Commencing in 1989 the fish in Divisions 2J and 3K became increasingly concentrated toward the edge of the bank. By 1991, concentrations on Hamilton Bank and the plateau of Grand Bank disappeared, leaving fish in inner Hawke Saddle and in the saddles between Belle Isle Bank and Funk Island Bank and between Funk Island Bank and Grand Bank. In 1992, only the concentration between Funk Island Bank and Grand Bank remained. This concentration was smaller in 1993 and disappeared in 1994.

Catches in 1995-2002 are presented in Fig. 16 a-d of the present paper. (Note the change in scale between Fig. 15 and Fig. 16.) During this period catches tended to be very small. On the southern Labrador Shelf and the Northeast Newfoundland Shelf the larger catches were broadly spread, with a tendency toward occurring off the banks. In Division 3L, catches tended to be small in 1995-1998, but somewhat larger and more broadly distributed in 1999 and 2000. In 2001, as in the previous 2 years, there was an area of aggregation on the outer shelf near the 3K/3L boundary. The pattern was similar in 2002, except that there was an aggregation a little further to the north and a little closer to the shelf break.

Much of the 2002 survey was actually conducted during January 2003. When catches during calendar 2002 are displayed separately from those during January 2003 (Fig. 16e), it can be seen that the larger catches to the east of Funk Island Bank, near 50º N, were taken in January. These catches may have come from the same group of fish that were see a little further to the south during 1999-2001.

4.2.1.3 Spring 3L bottom-trawl surveys

4.2.1.3.1 Spring 3L abundance and biomass

Abundance and biomass of cod in Division 3L in the spring have been estimated by areal expansion of the stratified arithmetic mean catch per tow. Estimates for the surveys from 1978 to 1995 may be found in Tables 20-21 of Shelton *et al*. (1996). The data from 1985 to 1995 have been converted to Campelen equivalents and are presented along with the actual Campelen data from 1996-1998 in Lilly *et al*. (2000b). The data from 1990 to 2002 for the index strata (depths <= 366 m or 200 fathoms) are provided in Tables 28-29 of the present document. The indices declined very rapidly from 1990 to 1994 and have remained very low in subsequent surveys (Fig. 17). The biomass index for 2002 was less than 1% of the average in the period 1986-1989.

Fishing in waters deeper than 200 fathoms started on a regular basis in 1991 (Table 30). In some years, most notably 1992, a substantial biomass was estimated to lie in these deeper strata. There may have been a large biomass in the deeper water in 1991 as well, because several sources of information indicate that cod were unusually deep in the early 1990s, and stratum 735 (201-300 f), which was estimated to contain 50,000 t in 1992, was not fished in 1991 because of ice cover. The percentage of the total estimated biomass found in depths greater than 200 f has been as high as 92% in 1994 and as low as 2% in 1999. The values in 2001 and 2002 were 43% and 49%.

4.2.1.3.2 Spring 3L mean catch at age per tow

The mean number caught at age per tow in index strata during 3L spring surveys from 1985 to 2002 are presented in Table 31. The values from 1985 to 1995 are Campelen equivalents and those from 1996 onward are based on actual Campelen catches. Mean catch per tow declined precipitously in the early 1990s and values continue to be well below levels obtained prior to 1993.

There is considerable variability in the data from recent years. For example, catch per tow increased from 1999 to 2000 for each of the 1996 to 1998 year-classes, indicating either sampling variability or immigration into the 3L survey area.

4.2.1.3.3 Spring distribution

The distribution of cod during spring surveys in Division 3L is shown together with distribution in Divisions 3NO for the years 1984-2000 in Figs. 18-20 of Lilly *et al*. (2001). During the second half of the 1980s the spring distribution in Division 3L was similar to that observed during the autumn, in that the highest densities were generally on the plateau of the bank and along the northern and northeastern slopes of the bank. However, there were in some years moderately large catches in the area between the northern slope and the plateau, a situation much less evident in the autumn. The spring of 1990 was unusual, in that few cod were taken on the plateau but very large catches were taken along the full length of the northeastern slope. Much of the northeastern slope could not be surveyed in 1991 because of ice cover, but catches seemed to be smaller. Catches continued to decline until 1995 when very few cod were caught. Catch rates increased with the introduction of the Campelen trawl in 1996, but have remained far below the levels of the 1980s. Starting in 1996 the cod in 3NO appeared to be further onto the bank at the time of the surveys than they were in the early 1990s. In 1999 there was a hint, for the first time in many years, of a continuous distribution of cod from the southwestern part of 3O across the 3L/3NO boundary into the area of the Virgin Rocks. In 2000 cod were caught from the southernmost part of the Northeast Newfoundland Shelf in northern 3L along the northeastern slope of Grand Bank and on the Nose of the Bank. Small catches were also taken on the plateau of the bank and in the Avalon Channel. In 2001 and 2002 the distribution was similar to that in 2000, except that there appeared to be even fewer cod on the plateau of Grand Bank (Fig. 18).

4.2.2 Acoustic surveys and observations

4.2.2.1 Offshore (Hawke Saddle and Tobins Point)

Hydroacoustic studies have been conducted in two specific study areas in the offshore. Biomass estimates from these studies are considered to be more uncertain than those from Smith Sound (next section).

Hydroacoustic studies were conducted in Hawke Channel in 2J in June 1994-1996 and 1998-2002. The biomass decreased by half from 1994 to 1995 and decreased further in 1996 (Anderson and Rose 2000). Biomass varied between 2,000 and 7,000 t during 1998-2002 (G. Rose, Memorial University of Newfoundland, St. John's, pers. comm.).

Hydroacoustic studies have also been conducted at various times since 1990 in the channel between Funk Island Bank and Grand Bank, an area that has been named the Bonavista Corridor. Estimates from spring studies declined from about 450,000 t in 1990 to less than 25,000 t in 1993 (Rose and Kulka 1999) and to less than 5,000 t in 1994 (G. Rose, Memorial University of Newfoundland, St. John's, pers. comm.). Biomass in the area was extremely low through the mid-1990s, but increased somewhat in recent years (about 1,000 t in June 2000 and 2001 and about 9,000 t in June 2002) (G. Rose, Memorial University of Newfoundland, St. John's, pers. comm.).

Most of the cod caught by bottom-trawling in support of the hydroacoustic surveys in recent years in Hawke Channel and the Bonavista Corridor have been younger than age 6 (G. Rose, Memorial University of Newfoundland, St. John's, pers. comm.).

4.2.2.2 Inshore (Smith Sound)

Hydroacoustic studies have been conducted in Smith Sound in western Trinity Bay at various times since the spring of 1995. The quantity of cod detected in the Sound at any specific time will depend not only on population size but also on where the cod are in their annual cycle of movements. Fish overwinter in deep water in the Sound and some of them spawn there in the spring. Most of them move into shallow water and northward along the coast from late spring to early autumn. They then return to the Sound in late autumn or early winter.

Estimates of the biomass of cod within Smith Sound have varied considerably. Hydroacoustic surveys reported by Rose (2000) provided biomass estimates of 13,000 t in May 1995, 14,000 t in June 1998, 15,000 t in January 1999, 1,000 t in June 1999, and 22,000 t in January 2000. Other winter/spring biomass estimates for Smith Sound have been as low as 150 t in April 1996 and as high as 21,000 t in April 1997 (Brattey and Porter 1997; Porter *et al*. 1998; Wheeler 2000). The quantity of cod detected in Smith Sound during autumn surveys was low in 1996 and 1997 but substantially higher in 1999 (Anderson *et al*. 1998; Wheeler 2000). Much of the variability among these estimates can be attributed to the seasonal migration described above, but it is also possible that some of the fish move into and out of the Sound on a short-term basis during the winter/spring, and that there is annual variability in the timing and extent of the seasonal migration. Some of the variability is also attributable to differences in acoustic gear and the method of data analysis.

If one focuses on recent hydroacoustic surveys in January, the average index of biomass increased rapidly from about 15,000 t in 1999 to 26,000 t in 2001 and then declined to 23,000 t in 2002 and 20,000 t in 2003 (G. Rose, Memorial University of Newfoundland, St. John's, pers. comm.). [Note that improved analyses have resulted in biomass estimates being revised downward compared with values reported previously (e.g. Rose 2000; DFO 2002)].

4.2.3 Beach seine surveys

A broadscale beach seine survey of demersal 0-group and 1-group cod was conducted in divisions 3KL during 1992-1997 (Methven *et al*. 1998) and again in 2000. Results of surveys on a much smaller spatial scale in Newman Sound (Bonavista Bay) in 1995-1996 and 1998 were consistent with the broadscale survey (Gregory *et al*. 1999, 2000). The Newman Sound studies have been continued (R. Gregory, DFO, St. John's, pers. comm.), and results have been incorporated into the computation of a recruitment index.

4.2.4 Sentinel surveys

Sentinel surveys for cod were conducted by fishing enterprises operating from many communities (Fig. 1d) in Divisions 2J, 3K and 3L at various times during summer and autumn 1995-2002. In 2002, there were 64 sentinel sites. Sampling was conducted for a minimum of 10 weeks at each site.

The primary goal of these surveys when they were initiated was to obtain information on catch rates on traditional inshore fishing grounds during the moratorium. The surveys continued during the period of index/commercial fishing (1998-2002). The surveys have been conducted primarily with gillnets. Linetrawls have been used extensively in only a few areas, and indeed the use of linetrawls has declined over time. Handlines and cod traps have been used much less.

The sentinel surveys were also intended to provide samples that would yield information on various aspects of the biology of cod in the inshore, including age compositions, size-at-age, condition, maturity and feeding. Various analyses were conducted on data collected in 1995-1997 (Lilly 1997; Lilly *et al*. 1998a), but these have not been updated. However, age compositions for the full time period are now available in the form of standardized catch rates at age (see Section 4.2.4.2).

Note that sampling for lengths and ages has been relatively intensive in the sentinel surveys. Without this sampling, it would have been very difficult to decompose the catch from the index/commercial fisheries into catch at age, particularly in 2002.

4.2.4.1 Sentinel catch rates by site and Division

Maddock Parsons *et al*. (2000) provided weekly average catch rates by sentinel survey site, gear and year (1995-1999). There is considerable among-site variability in the timing of fishing effort and in the seasonal and annual patterns in fishing success. Catch rates have been relatively low since the start of the survey in 2J and in 3K north of White Bay.

Maddock Parsons and Stead (2003) presented weekly average catch rates and annual relative length frequencies (number of fish at length divided by amount of gear) by NAFO division, gear and year (1995-2002).

In Division 2J, catch rates in 5 ½ inch gillnet and linetrawl have been very low relative to catch rates in the other Divisions. In 2002, there was no linetrawl effort. Catch rates in 3 ¼ inch gillnet have tended to be similar to the rates experienced with this gear in 3K and 3L. In 2002 catch rates with 3 ¼ inch gillnet were higher than in 1999-2001, but less than in 1997 and 1998.

In Division 3K, catch rates in 5 ½ inch gillnet peaked in 1998 and declined to the lowest level in the timeseries in 2001 and 2002. Catch rates in linetrawl peaked in 1997, and were almost unchanged between 2001 and 2002. Catch rates in 3 ¼ inch gillnets declined from the first year of deployment (1996) to the lowest level in the timeseries in 2001 and 2002.

In Division 3L, catch rates in 5 ½ inch gillnet peaked in 1998 and declined to the lowest level in the timeseries in 2001 and 2002. Catch rates in linetrawl peaked in 1997, declined in 1998, rose again to 2000, and subsequently declined to the lowest level in the timeseries in 2001 and 2002. Catch rates in 3 ¼ inch gillnets declined from the first year of deployment (1996) to the lowest level in the timeseries in 2001 and 2002.

Much of the decline in catch rates in 3 ¼ inch gillnets in both 3K and 3L has been due to a reduction in the catch of larger fish that tend to be entangled in the net.

4.2.4.2 Sentinel standardized (modelled) CPUE

An age-disaggregated index of standardized relative abundance for cod in the inshore of 2J3KL was calculated from data gathered from sentinel fishing with gillnets and linetrawls (Stansbury *et al*. 2000). The catch from 2J3KL was divided into cells defined by gear type (gillnet 5½ inch, gillnet 3¼ inch and linetrawl), NAFO Division (2J, 3K, 3L), statistical unit area (e.g. 3Ki, 3Lh), year (1995-2002) and quarter. Age-length keys were generated for each cell using fish sampled from both fixed and experimental survey methods. There were no fixed sites using 3¼ inch gillnets. Length frequencies and age-length keys are combined within cells. Numbers of fish at length were assigned ages using an age-length key. Because there were few or no discards in the sentinel fishery and the fish harvesters measured the length of all the fish caught with linetrawl and gillnet, obtaining catch numbers-at-age was relatively straight forward [see Stansbury *et al*. (2000) for details].

The catch per unit effort (CPUE) at age data were standardised to remove site and seasonal effects. For gillnets, only sets fished during July to November with a soak time between 18 and 24 hours were included in the analysis. For linetrawl, sets fished during August to November with a soak time less than or equal to 12 hours were selected. Sets with effort and no catch for some or all ages were considered valid entries in the model. Ages in the model ranged from 3 to 10 for 5½ inch gillnet, 2 to 10 for 3¼ inch gillnet and 3 to 9 for linetrawl. Fish older than age 10 were not included because of their rarity.

A generalized linear model (McCullagh and Nelder 1989) was applied to the catch and effort data for each gear and survey method. 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

$$\log(\mu_{jklm}) = \log(E) + \beta_{jk} + \beta_{lm}$$

where E is an offset parameter for fishing effort and j,k,l,m indicate the level for each of the four factors, for example June for the factor *month*, and where

$$month_i(j) = \begin{cases} 1 \text{ if month} = j \\ 0 \text{ if month} \neq j \end{cases}.$$

Site/month combinations where no fish were landed in all years where deleted from the analysis. The model was fit using the SAS procedure GENMOD. Amount of gear is expressed as number of nets for gillnet and number of hooks for line trawl. Estimates for age nested in year were adjusted for month nested in site effects and transformed to a linear scale to give the relative index at age for each year.

Additional details regarding the models (proportion of available data that was actually included, model output and residual plots) were reviewed but are not provided in the present paper. Such information from an earlier analysis of the 1995-1999 data are described in detail by Stansbury *et al*. (2000).

The standardized gillnet catch rates (Fig. 19) increased from 1995 to 1998 but then declined to 2002. Linetrawl catch rates (Fig. 19) showed relatively little change from 1995 to 1996, increased in 1997, and then declined to 2000. There was a small rise in 2001 followed by a small decline in 2002. Recall that the linetrawl catch rates are based on relatively small sample sizes. The point estimates of the catch rates with both gillnets and linetrawls were lower in both 2001 and 2002 than they were when the sentinel surveys started in 1995.

The standardized catch rates at age (Fig. 20) illustrate that the 1990 and 1992 year-classes were relatively strong and that subsequent year-classes have been weaker. The catch rate at age 3 in the small mesh (3 ¼ inch) gillnets in 2002 (the 1999 year-class) was the highest in the time-series, providing evidence of improved recruitment. (Note that it is not possible to compare the 1999 year-class at age 3 with the 1990 and 1992 year-classes at the same age because the sentinel surveys did not start to use the small mesh gillnets until 1996.)

The catch rates at age in the 5 ½ inch gillnets have been much smaller in recent years than they were during the period 1996-1998. This probably reflects two major processes. First, the relatively strong 1990 and 1992 year-classes have to a large extent passed through the selection range of the gear and been replaced by weaker year-classes. Second, the commercial and recreational fisheries have been having a larger impact on the survival of year-classes since 1998. It is also possible, however, that the decline in catch rates in recent years could be caused in part by decreased availability of fish to the gear, such as might occur if the fish were distributed over a greater range of depths.

4.2.5 Commercial fishery CPUE

Catch rates were calculated from catch and effort data recorded in logbooks maintained by commercial fishermen in the < 35 foot sector. Only catch rates from gillnet fisheries were examined in detail because the effort with other gears was relatively small and less representative in space. Median gillnet catch rates were calculated by statistical section (Fig. 1c) for each of the five years. The overall spatial pattern has been similar among years (Fig. 21). Catch rates have been consistently low in 2J (not illustrated) and northern 3K. Catch rates generally increased from White Bay across Notre Dame Bay and into Bonavista Bay, were highest from northern Bonavista Bay to western Trinity Bay, and were lower from eastern Trinity Bay to the eastern Avalon Peninsula, increasing again on the southern Avalon. Since the fishery opened in 1998, catch rates have declined in both southern 3K and southern 3L, and have remained high only in northern 3L, most notably in southern Bonavista Bay and northern Trinity Bay. The area in which high catch rates can be obtained has declined considerably since 1998.

The catch rates from logbooks were standardized by using a generalized linear model to remove spatial (unit area, Fig. 1b) and seasonal (month) effects and to produce annual estimates of average catch rate for 3K and 3L combined. The model approach was very similar to that applied to the sentinel data.

Gillnet catch rates declined from 1998 to 2002 (Fig. 22). Data were insufficient to fit the same model to catch rates from linetrawl.

4.3 Population Biology

4.3.1 Autumn size-at-age and condition

4.3.1.1 Size-at-age

The lengths-at-age and weights-at-age of cod sampled during the autumn surveys confirm the general pattern of a decline in the 1980s and early 1990s as observed in commercial weights-at-age (Fig. 8). The research survey data (Tables 32, 33; Figs. 23, 24) illustrate that the changes varied with Division; there was a strong decline in Division 2J, a lesser decline in Division 3K, and little or no decline in Division 3L. These Divisional differences are more apparent in Fig. 25, which focuses on changes in mean lengths and weights of cod of ages 4 and 6. Superimposed on the long-term decline are periods of relatively quicker or slower growth associated with changes in water temperature (Shelton *et al*. 1999). The trend toward low mean lengths-at-age and weights-at-age in the early 1990s appears to have been reversed during the latter half of the 1990s. Size-at-age has varied without trend in the past few years. Sample sizes at ages greater than age 4 have been very small since about 1992-1994 (Lilly 1998a), so the accuracy of these estimates is likely to be poor.

4.3.1.2 Condition

Condition can be expressed in various formulations. In this paper it is presented as W/L^3, where W is either the gutted weight of the fish or the liver weight, and L is the length. Arithmetic means by Division, year and age are presented for gutted condition (Table 34; Fig. 26) and liver index (Table 35; Fig. 27).

In Division 2J, both gutted condition and liver index declined in the early 1990s. During the second half of the 1990s gutted condition returned to approximately normal, whereas the liver index improved but did not fully recover. There has been variability with little trend since the mid-1990s.

In Division 3K, gutted condition declined during the early 1990s and improved during the latter half of the 1990s. Liver index changed little during the 1990s. As in Division 2J, there has been variability with little trend since the mid-1990s.

In Division 3L, gutted condition has remained relatively unchanged over time whereas liver index increased considerably in the early 1990s and has since declined to an intermediate level.

Historic trends in condition indices are complex and poorly understood (Lilly 1996, 1997, 2001).

4.3.2 Maturity at age

The gonads of samples of cod collected during annual DFO autumn 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 (NAFO Subdiv. 3Ps).

Annual estimates of age at 50% maturity (A50) for females from the 2J3KL cod stock, collected during annual fall DFO RV surveys, were calculated as described by Morgan and Hoenig (1997). Maturation is estimated by cohort rather than by year (Table 36); prior to 2001 maturation was estimated by year. In addition, data extending back to 1960 have been included in the current analyses. The estimated age at 50% maturity (A50) was generally between 6.0 and 7.0 among cohorts produced in the mid-1950s, around 6.0 among those produced during the late 1960's to the early 1980s, but declined dramatically thereafter to a low of 5.0 for the 1989 cohort (Fig. 28). Age at maturity by cohort remained low but variable during 1988 to 1998 with no clear trend. 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. 29). For example, the proportion of 6 yr olds that are mature has increased from about 15% during the early 1960's to 50% in the 1970's and 1980's and to about 80% during the 1990's. The overall age at maturity remains low among 2J+3KL cod. Currently, the age composition of the offshore components of 2J+3KL cod remain extremely protracted with very few cod older than age 6. 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).

Portions of the inshore of 2J+3KL have a more extended age distribution with some larger, older cod, particularly around the Bonavista Peninsula, where the ages of cod in the catch extend out to about age 14. Maturities are available from sampling the sentinel catch in the inshore of 3KL, mainly for cod aged 4 and older. A previous analysis of data collected by the inshore sentinel survey during 1995-1997, fitted by age rather than by cohort, showed a similar low age at maturity to that observed for the offshore portion of the stock (Lilly *et al*. 1998a).

4.4 Population Analysis

This section provides information on rates of change in population numbers and estimates of population size.

4.4.1 Recruitment index

Information regarding the rate at which fish are entering the population is available from a number of sources, including a variety of independent indices from both the offshore and the inshore (this section) and a sequential population analysis (SPA) for the inshore alone (section 4.4.4).

The relative strengths of recent year-classes were estimated by applying a multiplicative model to indices from the following studies that have been conducted since the early 1990s: experimental squid traps; experimental fixed-station bottom-trawling (FS BT) with a Campelen trawl, both inshore and offshore; beach seining from White Bay to St. Mary's Bay (Fleming survey); beach seining in Newman Sound, Bonavista Bay (BB) (see Section 4.2.3); pelagic 0-group monitoring with an IYGPT trawl, both inshore and offshore; sentinel survey linetrawl (LT); sentinel survey 5.5 inch gillnet (GN 5.5); sentinel survey 3.25 inch gillnet (GN 3.25); autumn stratified-random bottom-trawl monitoring with a Campelen trawl in the offshore of 2J3KL (SR BT 2J3KL aut offshore); autumn stratified-random bottom-trawl monitoring with a Campelen trawl in the inshore of 3KL (SR BT 3KL aut inshore); and spring stratified-random bottom-trawl monitoring with a Campelen trawl in the offshore of 3L (SR BT 3L spr offshore). For each source of information, catch rates were available for one or more ages of juvenile cod in the age range 0-3 (as appropriate for the gear and area). The years during which each series was operational and the ages of cod caught and considered during this analysis are provided in the following text table.

Data source	Cod age (s)	Years
Squid trap	0-3	1991-1994
FS BT inshore	0-3	1992-1995
FS BT offshore	0-3	1992-1995
Beach seine Fleming	0-2	1992-1997; 2001
Beach seine BB	0-1	1995-96, 1998-2002
IYGPT inshore	0	1994-1999
IYGPT offshore	0	1994-1999
Sentinel LT	3	1995-2002
Sentinel GN 5.5	3	1995-2002
Sentinel GN 3.25	2-3	1996-2002
SR BT 2J3KL aut offshore	0-3	1995-2002
SR BT 3KL aut inshore	0-3	1996-98, 2000-2002
SR BT 3L spr offshore	1-3	1996-2002

The squid trap data are from experimental studies during the Northern Cod Science Program (E. Dalley and E. Dawe, DFO, SOE Branch, Newfoundland Region, pers. comm.); the fixed station bottom-trawl data, both inshore and offshore, are from Dalley and Anderson (1997); the broad-scale beach seine data (Fleming survey) are updated from Methven *et al*. (1998); the beach seine data from Newman Sound are updated from Gregory *et al*. (2000); the IYGPT trawl data are from Dalley *et al*. (2000); the sentinel data are from Section 4.2.4.2 of the present paper; and the stratified-random bottom-trawl data are from Sections 4.2.1.2.2 and 4.2.1.3.2 of the present paper.

The recruitment data from inshore and offshore were treated together because the inshore appears to be an important nursery area for cod spawning in both the inshore and the offshore (Lilly *et al*. 2000a). The data were combined to produce a single index of relative year-class strength.

During the last full assessment of this stock (Lilly *et al*. 2001), an iteratively re-weighted multiplicative model was employed to determine year-class strength. Complete details of the method can be found in Shelton and Stansbury (2000). The present model is similar to that implemented by Healey *et al*. (2002) for Greenland halibut in NAFO Div. 2GHJ3KLMNO, and by Morgan *et al*. (2001) for American plaice in NAFO Div. 3LNO.

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

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

where:

μ = intercept
s = survey subscript
a = age subscript
y = year-class subscript
I = Index Value
Y = year-class effect
SA = Survey * Age effect, and
ε = error term.

We assume that $\varepsilon_{s,a,y} \sim N(0,\sigma^2_{SA})$, (independently and identically); that is, each survey-age combination has a different variance. The estimation uses inverse-variance weighting. The primary differences between this method and the previous method are the manner in which the maximum attainable weight is assigned and that fact that multiple variance parameters are estimated in the current model. Comparison runs conducted between the two methods using the data of the last assessment indicated trivial differences. Results were consistent for the year-class strength estimates, and also with respect to the weighting of each of the survey-age indices. For consistency with the last model implementation, index values of zero (totaling just 3 observations) were deleted.

Model estimates of relative year-class strength (Fig. 30) are back-transformed to a linear scale. Estimates of year-class strength indicate that recruitment was relatively strong from 1997 until 2000, and that the 2000 year-class appears to be the strongest during the 1989 to 2002 period. However, the 2001 year-class is among the weakest estimated over this time period. The 2002 year-class estimate is based on just three measurements and has a large standard error.

In the last assessment of this stock, the 1999 year-class was estimated to be the strongest over the period examined. Since that assessment, the information gathered on the 1999 year-class suggests that while it is still strong relative to other cohorts in the last decade, it is not quite as strong as it appeared based on the data available in 2001. However, the information collected on the 2000 year-class since the last assessment has been largely positive.

Sensitivity analyses were conducted to examine the effect of varying certain estimation parameters, such as varying the maximum weight any index can take, and exclusion of some of the down weighted indices. The results of these analyses are not appreciably different from those in Fig. 30.

It should be noted that strength of all of these year-classes is much lower than the strength of those that occurred during the 1980s. Moreover, the ability of the index to predict recruitment to the fishable population remains uncertain, particularly because it does not pick up the 1992 year-class, which was relatively strong in sentinel and commercial catches.

4.4.2 Offshore total mortality (Z)

Information on the rate at which fish are dying is available from a number of sources, including total mortality estimated from offshore survey data (this section), fishing mortality and natural mortality estimated for fish in the inshore from tag return data (section 4.4.3) and fishing mortality estimated for fish in the inshore from an inshore SPA (section 4.4.4).

Total mortality rates at age in each year, $Z_{a,y}$ (Fig. 31) were estimated from catch rate at age per tow during the autumn research bottom-trawl surveys in 2J3KL (combined) by applying the following equation:

$$Z_{a,y} = -\ln(RV_{a,y} / RV_{a-1,y-1})$$

where ages (a) = 2 to 15 and years (y) = 1984 to 2002.

[Note that this is different from recent years, when mortality was referenced to the start of a period:

$$Z_{a,y} = \ln(RV_{a,y} / RV_{a+1,y+1})$$

where ages (a) = 1 to 14 and years (y) = 1983 to xxxx.
For example, in Lilly *et al*. (2001), mortality of the 1991 year-class from the autumn of 1996 to the autumn of 1997 (Z = 2.16) was referenced to age 5 in 1996, whereas in the present document it is referenced to age 6 in 1997. This change is intended to reflect the likelihood that most of the deaths experienced by the 1991 year-class from autumn 1996 to autumn 1997 will have occurred in 1997.]

The change in the age and year of indexing may also help clarify statements regarding the temporal trend in mortality. For example, in Lilly *et al*. (2001), it was stated that "in general, the estimates increased up until 1992, coinciding with the beginning of the moratorium. The rates then declined until 1995, and since then have remained at levels similar to those observed in the late-1980s when there was a substantial fishery." The impression from these sentences is that the moratorium effected an immediate reduction in survey Z's, but in fact the end of the period referred to by "up until 1992" was from autumn 1992 to autumn 1993, which was after initiation of the moratorium (and was referenced to 1992 in the previous documents but is referenced to 1993 in the present document).

There is considerable variability in these data (Fig. 31). Prior to the collapse the various age groups tended to follow the same pattern, reflecting both trends in mortality and among-year variability (year effects). The most extreme instance of a year effect was the anomalously high index value in 1986, which resulted in the appearance of production of fish (negative mortality) from 1985 to 1986 and very high mortality from 1986 to 1987. Since the collapse of the stock the Z's show some year effects but considerable additional variability which is probably a consequence of sampling error associated with very low population level.

To illustrate more clearly the trend in survey Z's over time, the data for ages 4 and 6 are isolated in Fig. 32. These plots are taken from the SSR (DFO 2003). Note that the data are presented as age specific mortality rates (proportion of fish dying in a year) rather than as instantaneous rates because it was thought that many people may be better able to interpret a death rate of 0.88 than an instantaneous rate of 2.16.

Despite the absence of a directed fishery in the offshore, mortality at younger ages has remained very high (0.4-0.6 per year at age 4 and 0.6-0.8 per year at age 6). Note that the mortalities computed from survey catches should be interpreted as indicators of trends over time, rather than absolute values. Rates calculated for younger ages (e.g. from age 2 to age 3) may underestimate mortality for two reasons: the proportion of a year-class available to the survey increases with age as the fish move to the offshore from inshore nursery grounds, and the proportion of the available fish caught by the trawl increases with fish length.

Factors that may be contributing to the high apparent mortality in the offshore are not well understood.

4.4.3 Inshore harvest rates and biomass

A new series of tagging studies was initiated in 2J3KL and 3Ps in 1997. These studies provide information on migration patterns and exploitation.

Within the northern cod area, cod aggregations of sufficient size to warrant tagging have not been found in the offshore or in the inshore of 2J and northern 3K. However, approximately 90 individual tagging studies have been conducted in the inshore from central Notre Dame Bay in 3K to St. Mary's Bay in southern 3L. A total of 26,401 cod were tagged and released, and approximately 3,870 cod were reported as recaptured by 8 February 2003 (Brattey and Healey 2003).

Two approaches have been employed to estimate exploitation rate from the tag return data. One method (Brattey and Healey 2003) estimates annual exploitation of the fish tagged within each tagging experiment. This calculation takes into account all recaptures, irrespective of where and when the recaptures occurred. (For example, for a tagging experiment conducted in Smith Sound, the exploitation rate for that experiment would be calculated from all recaptures within a specific year. This would include not only those fish recaptured within Smith Sound, but also all those recaptured as the fish went through their annual migration out of Smith Sound, perhaps as far as Notre Dame Bay, and then back to the Sound.) The second approach attempts to estimate the exploitation rate of cod within a specific area and time when the commercial fishery has been open. With this approach, the exploitation is calculated from the recovery rate of all fish that are estimated to be within the area during the specified period. (For example, the exploitation rate that is calculated for 3K for a specific period in time would be based not only on fish that were tagged within 3K, but also fish that were estimated to have moved into 3K from other areas, such as northern 3L, southern 3L and even 3Ps. There would also be allowance for fish that were tagged within 3K but may have moved elsewhere.)

4.4.3.1 Exploitation rates from individual tagging studies

The annual exploitation rate was estimated for each tagging experiment in 3KL and summarized by geographic area (Brattey and Healey 2003). (Note that the summarizes are for 1999-2002, since relatively few cod were tagged in 3KL prior to 1999.)

Notre Dame Bay (3K): For cod tagged in 3K in 1999 prior to the fishery that year, exploitation rates were extremely high (29-63%) in 1999, but dropped dramatically during 2000 (7-11%) and 2001 (3-7%). No recoveries from these tagging experiments were reported during 2002. Cod concentrations suitable for tagging were not located in 3K prior to the fishery in either 2000 or 2001. Cod tagged in eastern 3K in 2002 after the fishery had started were heavily exploited (12-20%). Landings in 3K dropped from about 3,500 t in 1999 to only 600 t in 2002.

Bonavista Bay (3La): For cod tagged in 3La in 1999 prior to the fishery that year, exploitation rates were high (6-18%), with most values around 15%. Rates tended to decline from 2000 to 2002. However, for cod tagged in 2001 and 2002, exploitation rates in 2002 were high (12-17%).

Trinity Bay (3Lb): For cod tagged in 3Lb in 1999 prior to the fishery that year, exploitation rates tended to be lower (4-13%) than those for Bonavista Bay. However, exploitation rates for these experiments tended to increase from 2000 (7-8%) to 2001 (6-14%) and 2002 (9-15%). For the 13 experiments that had been conducted in Smith Sound in 1999-2002, five had exploitation rates greater than 20% in 2002.

Conception Bay (3Lf) and the eastern Avalon (3Lj): The exploitation estimates for Conception Bay and the eastern Avalon Peninsula tended to be low (<10%).

St. Mary's Bay (3Lq): Cod tagged in St. Mary's Bay (3Lq) were more heavily exploited throughout 1998-2002 than those in Conception Bay and off the eastern Avalon, with 19 of 25 annual estimates exceeding 15%. Most of the exploitation of cod tagged in southern 3L occurs in

Placentia Bay (3Psc), suggesting that many of the fish in this area overwinter in 3Ps and migrate into southern 3L during the summer.

4.4.3.2 Exploitation rates and exploitable biomass in specific areas

Exploitation rates and exploitable biomass were estimated for specific areas during periods when the commercial fishery was open in 1999-2002 (Cadigan and Brattey 2003). The exploitation rates were estimated as the number of tagged fish caught and reported, divided by the number of tagged fish estimated to be available, with adjustments for reporting rate, tagging mortality and tag loss. The number of tagged fish available to be caught by a specific gear type within a specific area and time interval was estimated from the tagging data, individual growth, gear selectivity and a model of rates of movement of fish among areas. There were eight geographic areas in the model. Three of these are within the northern cod stock area: inshore Div. 3K, inshore northern Div. 3L (Bonavista and Trinity bays) and inshore southern Div. 3L (Conception Bay, the eastern Avalon Peninsula, and St. Mary's Bay).

Exploitable biomass was estimated for each of the three regions in 3KL for weeks in which reported landings were sufficient to provide reasonable estimates. Catch-weighted averages (over weeks) of these estimates for 2002 were 3,000 t for inshore 3K, 14,000 t for inshore northern 3L and 7,000 t for inshore southern 3L, for a total of 24,000 t. This was substantially less than estimates for 1999 (43,000 t), 2000 (47,000 t) and 2001 (59,000 t). [Note that the values quoted here are from the "preferred" model run (Table 6 of Cadigan and Brattey 2003), whereas the values illustrated in the Stock Status Report (DFO 2003) were mistakenly taken from a sensitivity run (Table 7 of Cadigan and Brattey 2003). Results from the two runs were similar.]

Taken together, the estimates for the 4 years suggest that the biomass of cod available to the fishery in 3KL has been small (< 60,000 t). However, it could be argued that the biomass has been even lower than that, since the estimate for 3K in 2001 was 24,000 t, or 40% of the 59,000 t estimate for the whole of 3KL that year. There is concern that this estimate for 3K may be high, since there were no tagging experiments in 2000 and 2001 prior to the fisheries that year, and the increase in natural mortality applied to 3K (see next section) still did not fully account for the substantial decline over time in the rate of recapture of fish tagged in 1999 and after the start of the fishery in 2000 (Cadigan and Brattey 2003). Additional information supporting a low biomass for 3K includes the decline in catch (Section 2.3.1) and catch rates (Section 4.2.5), and the difficulty in finding fish to tag.

4.4.3.3 Evidence of high natural mortality from analysis of tagging data

The exploitation rates estimated from tagging experiments that were conducted in Notre Dame Bay (3K) and Bonavista Bay (3La) tended to be high in the year of tagging and then to decline in subsequent years, even though exploitation rates from tagging in later years tended to be high in the year of tagging (see Section 4.4.3.1 above). This was more evident in 3K than in 3La. One possible explanation for this phenomenon is that the proportion of the cod available to the fishery declined faster than estimated. This could be due to a movement out of the area, perhaps to the south or even to the offshore. A movement southward, perhaps to the Smith Sound population, is possible. A movement to the offshore seems unlikely, since very few cod of commercial size have been caught during the offshore research vessel surveys. A second possible explanation for the phenomenon above is that the level of natural mortality (assumed to be 0.2) has been set too low.

In contrast to findings in 3K and 3La, exploitation rates from specific tagging experiments in Trinity Bay (3Lb), and especially in Smith Sound, tended to increase over time. It seems that "disappearance" of cod was less noticeable for cod in Smith Sound.

This problem of the "disappearance" of cod was addressed by Cadigan and Brattey (2003), who made *ad hoc* adjustments to the level of natural mortality in their model to improve the fit between model output and the input data. They found that the best fit was achieved with a natural mortality of 0.8 in inshore 3K and 0.4 in both inshore northern 3L and inshore southern 3L.

4.4.4 Sequential population analysis

The history of assessments of 2J+3KL cod, from 1977 until the moratorium in 1992, is reported in considerable detail by Bishop and Shelton (1997). Results from the various SPA's explored during the assessment meetings in 1992 were used in projections of stock size under different levels of fishing mortality, even though a problem of lack of model fit in the most recent years was a serious concern (Baird *et al*. 1992a). The SPA in 1993 (Bishop *et al*. 1993) had a severe residual pattern and was not used as a basis for projection. By 1994 the residual pattern was so strong (Bishop *et al*. 1994) that it was concluded that the results did not adequately represent stock abundance. That is, the SPA was rejected. An SPA was again attempted in 1996 (Shelton *et al*. 1996), and again the residual pattern was so severe that it was considered that the results were "illustrative" of the population dynamics, but were not sufficiently well estimated to allow the projection of stock size. "Illustrative" SPA's were explored again in 1997, when the results were used as the basis for a projection to evaluate an F0.1 control rule (Murphy *et al*. 1997), and in 1998, when a tentative risk analysis was attempted (Lilly *et al*. 1998b).

An analytical assessment was not attempted in 1999 (Lilly *et al*. 1999). The inability to reconcile reported catches and the research vessel index in the late 1980s and early 1990s had not been resolved. In addition, it was felt that the research vessel bottom-trawl index, the only long-standing fishery-independent index available for this stock, may no longer be representative of the stock as a whole. It was thought that the index was adequately reflecting the status of the stock in the offshore, which constitutes the vast bulk of the stock area, but was not reflecting the status of cod found on traditional inshore fishing grounds from White Bay to St. Mary's Bay. It was decided that an analytical assessment of the inshore alone was not possible because inshore catches prior to the moratorium could not be apportioned into those coming from inshore components and those coming from components that migrated into the inshore from the offshore. An analytical assessment was not attempted in 2000 (Lilly *et al*. 2000b).

In 2001, several attempts were made to combine catch data and various indices in an SPA for the whole stock (Lilly *et al*. 2001; Morgan 2001). The formulations incorporated new indices from the inshore (research vessel inshore, sentinel gillnet and sentinel linetrawl) along with the autumn and spring research vessel offshore indices, but the attempts were considered unsuccessful. As noted above, during the latter half of the 1990s and early 2000s a high (but unquantified) proportion of the cod in the stock area was in the inshore, and almost all the catch was taken in the inshore. Thus, the offshore bottom-trawl survey no longer reflected a consistent proportion of the stock. Various new indices from the inshore were now available, but these were of short duration. Even if these indices were of longer duration, it is likely that they too would be considered not to reflect a consistent proportion of the stock because of their limited geographic coverage.

It is important to note that one of the models examined during the 2001 assessment meeting addressed the concern regarding the poor fit between SPA model estimates and the offshore research vessel index. As noted in Section 1 (Introduction) of this paper, Shelton and Lilly (2000) computed the number and age of fish that would have to be added to the reported catch during several years in the early 1990s to make the catch fit the survey index, without relaxing standard assumptions regarding natural mortality and catchability. P. Shelton has used this "missing fish" model in various exercises, most notably for computing metrics of population change in the provision of information to COSEWIC (Smedbol *et al*. 2002). Assumptions in this model result in the appearance of a stock collapse that was a little later than the collapse depicted by models that did not have added catch (e.g. Bishop *et al*. 1993; Lilly *et al*. 1998b). In addition, the 1986 and 1987 year-classes, which initially seemed to be strong at age 3 in SPA estimates (Baird *et al*. 1991a) but later (after their rapid disappearance from the surveys) seemed much weaker (Bishop *et al*. 1993, Lilly *et al*. 1998b), appear in the "missing fish" model to be strong (Morgan *et al*. 2000; Smedbol *et al*. 2002). This variability in perception is particularly dramatic for the 1987 year-class. Thus, the history of stock dynamics during the latter half of the 1980s and the early 1990s differs between the "missing fish" model and models that have not been altered by the addition of a substantial quantity of unreported catch.

While discussing the use of SPA output during a time when a whole stock SPA has not been accepted by the assessment meetings, it should be noted that an SPA was also required for analyses during the workshop that attempted to develop a limit reference point for spawning stock biomass (Rivard and Rice 2003). Although not stated in the documentation from that meeting, the figure illustrating limit reference points for 2J+3KL cod (Fig. 3 in Rivard and Rice 2003) was created by P. Shelton, who reproduced as closely as he could the SPA reported by Bishop *et al*. (1993). A limitation of that SPA is that it does not incorporate the very low levels of SSB and recruitment experienced by the stock during most of the 1990s.

Inshore SPA

During the 2001 assessment meeting (Morgan 2001), it was suggested that with additional time, it may be possible to use the inshore bottom-trawl survey and the sentinel surveys to tune an inshore SPA. A suggested approach would be to ignore the historic catch data and construct an inshore assessment using the most recent data in isolation. This was attempted in 2003.

Several models and formulations were explored. An analysis using ADAPT incorporated catch at age for ages 2 to 10 for years 1995-2002 (Table 37), mean numbers per tow from the autumn stratified random bottom trawl survey in inshore strata for ages 2 to 9 and years 1996 to 2002 (with the exception of 1999 when no survey was carried out; Table 38), sentinel survey 5 ½ inch gillnet catch rate index for ages 3 to 9 for years 1995 to 2002 (Table 39), sentinel survey 3 ¼ inch gillnet catch rate index for ages 2 to 9 for years 1996 to 2002 (Table 40), and sentinel line trawl catch rate index for ages 3 to 9 for years 1995 to 2002 (Table 41). The structure imposed on the ADAPT estimation included a 10+ age group in the population, a domed-shaped PR with respect to fishing mortality, $M = 0.5$, and catches assumed to be exact. The parameter estimates are given in Table 42. Estimates of bias corrected numbers at age and fishing mortality at age are given in Tables 43 and 44. The residuals are plotted in Fig. 33-36. Spawning stock biomass computed from the ADAPT bias-corrected numbers at age at the beginning of the year, cohort model estimates of proportion mature at age from survey data, and beginning of year weights-at-age derived from commercial sample data, indicate that spawner biomass in the inshore increased from 26,000 tons in 1995 to 41,000 tons in 1998, but has subsequently declined to only 14,000 tons at the beginning of 2003 (Fig. 37). The ADAPT estimate of 4+ biomass at the beginning of 2003 is about 30,000 tons. Fishing pressure on older age classes has been increasing and the exploitation rate is currently at approximately 35%, a level comparable to levels estimated during the stock collapse in the late-1980s and early-1990s. Recruitment declined from 1992 to the mid-1990s and increased again to 2000 (Fig. 38).

It should be noted that this SPA was based on all catches taken in 2J+3KL, including cod that overwintered in 3Ps. That is, the SPA represents more than the resident coastal group that overwinters within 3K and 3L (primarily northern 3L).

Medium-term stochastic projections were requested by the Fisheries Resource Conservation Council (FRCC). It was agreed during the assessment meeting that adding stochastic variation around the central trend would be unhelpful, and possibly misleading (Rice and Rivard 2003, Annex 7). Instead, deterministic projections were conducted to provide an illustration of the medium-term possibility for the stock.

Projections were conducted under the assumption that stock productivity would not increase above recent levels. Projected values for weights-at-age and proportion mature at age were averages of values in 2000-2002. Natural mortality was assumed to be 0.5. Projected recruitment was based on the size of the spawner stock biomass (SSB) and was computed using the average R/SSB for the years 1995-2000. It is important to note that for the projections the size of the 2000 year-class at age 2 was reduced under the assumption that the SPA estimates were uncertain. The number at age 2 in 2002 was estimated based on the same average R/SSB value as was used to project the size of later year-classes. This resulted in a reduction in the numbers at age 2 in 2002 by 56% relative to the value in the SPA.

Projections indicated that if exploitation rates remain at current levels (average F at age for 2000-2002) then the spawner biomass will grow slightly in the short term as a consequence of the incoming recruits, but will decline thereafter. There were no projections for specific TAC options. Projections also indicate that even without fishing the spawner biomass will not grow during the next decade to the level reached in 1998. (The projections may be seen in Shelton *et al*. 2003.)

5 Other considerations

An important part of the zonal assessment meeting was a review of factors that have been postulated to have contributed to the failure of several cod stocks to recover since the imposition of moratoria in the early 1990s. The proceedings document (Rice and Rivard 2003) provides a list of hypotheses and brief summary of discussion and conclusions. An extensive and detailed critique of such factors has not yet been written for northern cod. However, some relevant information is available within the following sections.

5.1 Temperature and other physical oceanography

The marine environment off Labrador and eastern Newfoundland has experienced considerable variability since the start of standardized measurements in the mid-1940s (Colbourne 2003). A general warming phase reached its maximum by the mid-1960s. Beginning in the early 1970s there was a general downward trend in ocean temperatures, with particularly cold periods in the early 1970s, early to mid-1980s and early 1990s. Ocean temperatures started to warm in 1995. The decade of the 1990s experienced some of the greatest extremes, with particularly cold conditions in 1991 and very warm conditions in various years of the late 1990s.

As summarized by Lilly and Carscadden (2002), temperature and other oceanographic factors have been shown or hypothesized to have influenced various elements of productivity (recruitment, individual growth and mortality) in the Atlantic cod off southern Labrador and eastern Newfoundland. Recruitment may be affected by the magnitude of the spawning stock and two easily measured oceanographic variables, temperature and salinity. Numerous studies have demonstrated a positive association between spawning stock biomass and recruitment (e.g. Rice and Evans 1988; Myers *et al*. 1993; Hutchings and Myers 1994; Morgan *et al*. 2000). However, Drinkwater (2002) pointed out that both spawning stock biomass and recruitment experienced a long-term decline from the 1960s to the late 1980s, and that a statistical demonstration of the influence of spawning biomass on recruitment does not hold if the data are first-differenced to remove trends. With respect to environmental influences, there is expectation that recruitment in 2J+3KL cod might be positively influenced by warm temperatures, because the stock is at the northern limit of the species' range in North America (Planque and Frédou 1999), but there have been conflicting reports of whether such a relationship can be detected (deYoung and Rose 1993; Hutchings and Myers 1994; Taggart *et al*. 1994; Planque and Frédou 1999). Similarly, a reported relationship between recruitment and salinity (Sutcliffe *et al*. 1983) was subsequently supported (Myers *et al*. 1993) and later rejected (Hutchings and Myers 1994; Shelton and Atkinson 1994b) as data for additional years became available. With respect to individual growth, a negative impact of temperature has been well documented (Krohn *et al*. 1997; Shelton *et al*. 1999). With respect to mortality, the possible influence of cold water is of considerable interest because of an apparent coincidence between the rapid disappearance of cod from research surveys and the low temperature and extensive ice cover of the early 1990s. While it seems unlikely that significant numbers of fish died as a direct consequence of exposure to cold water, there is still insufficient evidence to reject the possibility that the cold water and extensive ice cover led to a reduced duration of feeding opportunity, which itself led to poor body condition and death (Dutil and Lambert 2000; Lilly 2001).

The extent to which changes in the physical environment have retarded the recovery of northern cod during the period since initiation of the moratorium is not well understood (Lilly and Carscadden 2002). It is of interest that recruitment of cod to the inshore populations increased after the mid-1990s, corresponding in a general way to the warming of ocean temperatures following the severe cold of the early to mid-1990s.

5.2 Predators

A wide variety of predators are known to consume cod, mainly during the cod's juvenile stages (Pálsson 1994; Bundy *et al*. 2000). Cannibalism is well documented for 2J+3KL cod and is thought to be an important source of mortality in some cod stocks (Bogstad *et al*. 1994). However, the predator that has attracted the most interest and concern in recent years is the harp seal.

No new information regarding the predation by harp seals on cod was presented to the meeting. Much of the text in the following Sections (5.2.1 – 5.2.5) is repeated from the 2001 assessment (Lilly *et al*. 2001). Readers may consult the Report of the Eminent Panel on Seal Management (McLaren *et al*. 2001) for a more extensive overview of the relationships between seals and cod.

5.2.1 Quantity of cod consumed by harp seals

The quantity of cod consumed by harp seals during the period 1965-2000 was calculated using estimates of harp seal population numbers, energy requirements of individual seals, the average duration of seal occurrence within 2J3KL, the relative distribution of seals between inshore and offshore, and stomach contents of seals sampled in the inshore and offshore in winter and summer (Stenson and Perry 2001). An average diet was calculated for each of the four combinations of area (inshore and offshore) and season (winter and summer) using all stomach content data collected in 2J3KL during the years 1982 and 1986-1998. Stomachs collected since 1998 had not been analyzed at the time of the analyses. Uncertainty in the estimates of numbers at age, diets, residency time in 2J3KL and the proportion of seals in nearshore areas, were used to evaluate the possible range in consumption estimates. The only factor effecting annual changes in the estimates of prey consumption is the estimate of seal population numbers. Recent estimates of harp seal population size show that the population reached about 5 million in 1996 and has been fairly stable to 2000.

Based on the average diets, it is calculated that harp seals consumed 37,000 t of cod in 2000 (with a 95% confidence interval of 14,000 – 62,000 t). The estimate for 1998 is also about 37,000 t. This is less than previous estimates of consumption for that year (50,000 t estimated in 1999 and 108,000 t estimated in 1998). Reasons for the changes in the estimates were described in Lilly *et al*. (1999; 2001) and Stenson and Perry (2001).

Diet data from the inshore show that the per capita consumption of cod by harp seals has not declined with the collapse of the cod stock (Stenson and Perry 2001). In 1998 there was an increase in per capita consumption in the inshore, especially in the winter. This increase occurred in various areas from White Bay to Trinity Bay.

5.2.2 Observations of harp seals consuming cod bellies

In recent winters there have been many reports of harp seals in inshore waters, often very close to land, taking bites from the bellies of large cod, thereby removing the liver and stomach and leaving the rest of the body untouched (Lilly *et al*. 1999; p. 42). During the winters of 1997-1998 and 1998-1999 there were numerous instances of such observations, particularly in eastern Notre Dame Bay and southwestern Bonavista Bay (Lilly *et al*. 1999; p. 14-15). Additional observations were reported during the winter of 1999-2000, most notably in southwestern Bonavista Bay in early April 2000. Incidents reported during the winter of 2000-2001 were less dramatic than those in previous years. Most reports came from Bonavista Bay and the Smith Sound area of Trinity Bay.

During the winters of 2001-2002 and 2002-2003 (to the end of January) there were no large incidents of cod being consumed or "fatally harassed" (in the words of McLaren *et al*. 2002), but there were reports of seals around ice edges in southwestern Bonavista Bay and in Smith Sound. The number of seals in Smith Sound appears to vary a lot over time. One fisherman in the Smith Sound area reported that a lot of seals were in the area in November and December of 2002 and that "throughout the fall (of 2002) cod were observed by fishermen floating with bellies eaten out". It may be noted that most cod would sink after their bellies and livers were removed, and indeed underwater video shot in southwestern Bonavista Bay several years ago showed many cod lying on the bottom. Smith Sound is so deep that dead fish lying on the bottom would not be seen.

There are no estimates of the numbers of cod killed by "belly-feeding", so this form of predation has not been incorporated into the estimates of consumption.

5.2.3 Numbers at age eaten by harp seals

The revised estimates of the quantity of cod consumed by harp seals were used by Lilly *et al*. (2001) to estimate numbers of cod (at age) consumed by the seals in 1986-1998 using methods similar to those described by Stansbury *et al*. (1998).

Despite various inconsistencies in the estimates, there are some generalities that can be emphasized. From 1986 to 1996, cod age 0 and 1 were the predominant age groups found in harp seal stomachs. In 1997 and 1998 older fish (ages 3-5) were the dominant age groups and fish as old as age 7 were found more frequently than in previous years. With this shift to older, larger cod in recent years the estimates of total number of fish consumed have decreased while the estimates of total biomass consumed have been relatively constant.

5.2.4 Uncertainties regarding the estimation of cod consumption by seals

Information regarding the population size, distribution and feeding behaviour of seals increases each year and leads to changes in estimates of the number, size and age of cod and other species consumed by the seals. Changes in perception can be large, as illustrated by the considerable reduction over the past few years in the estimates of the quantity of cod consumed by seals. Much of the uncertainty associated with the consumption of cod arises because cod is a minor prey of the harp seal. This increases the possibility of sampling error leading to large among-year differences in the number of seals having cod otoliths in their stomachs and in the size composition of those otoliths that are found. The population of harp seals is large, so slight changes in the proportion of cod in the diet samples can lead to large changes in the quantity of cod which the seals are estimated to consume.

The estimates of cod consumption may be biased upwards because diet reconstruction relies on the presence and identification of hard parts (such as cod otoliths) in the stomachs of those seals that are sampled. Diet contributions from soft bodied animals or fish with small otoliths may be missed or under-represented.

On the other hand, the estimates of cod consumption may be biased downwards because incidences of belly-feeding may be undetected and therefore not incorporated into the diet reconstructions. It is recognized that the weight of cod killed by belly-feeding is much higher than the weight of cod consumed. The feeding on bellies also causes the size composition of the cod killed to move toward larger sizes compared with a size composition based solely on otoliths. At this time there is little information on the proportion of the seal population engaging in this form of predation, the number of days on which it happens and how many cod each of these seals kills per day.

5.2.5 The impact of seals on population dynamics of cod

In the absence of a sequential population analysis for the cod stock as a whole, Lilly *et al*. (2001) did not conduct additional explorations of the importance of seal predation to cod population dynamics. However, the estimates of removals of cod by harp seals, based on reconstructed diets, were high (37,000 t in 2000) and did not incorporate the mortality caused by seals feeding on cod bellies alone. Lilly *et al*. (2001) stated that "it appears that the number of cod eaten by seals annually has been high since at least 1986. It is assumed that the mortality imposed on the cod stock increased toward the mid-1990s as the removals by seals remained high and the cod population declined."

It is possibile that predation by seals is preventing the recovery of the cod stock. See Shelton and Healey (1999) for a discussion of the possibility that the lack of recovery is due to a decline in per capita reproductive success, perhaps as a result of increased predation on prerecruit fish by seals. It is also important to recognize that some of the cod eaten by seals are mature fish that have survived the juvenile years when natural mortality is high. That is, some of the predation by seals affects the cod spawning population directly.

It is speculated that belly-feeding may be an important source of mortality for local cod aggregations, especially in the area from White Bay to Bonavista Bay. The occurrence of harp seals is reported to have increased in Trinity Bay, notably in Smith Sound.

The hooded seal is also known to prey on cod, and estimates of their consumption of cod (34,000 t in 1996; Hammill and Stenson 2000) should be updated and incorporated into an analysis of the removals of cod by all predators, including cod itself. The potential impact of this predation on the population dynamics of cod should be explored through modelling.

5.3 Prey

Cod feed on a wide variety of prey (Lilly 1987). The major prey for small cod are planktonic crustaceans, notably hyperiid amphipods in the north and euphausiids on Grand Bank. For medium-size cod the major prey are schooling planktivorous fish. The most important of these is capelin, but Arctic cod are eaten in the north, herring are consumed in inshore waters, and sand lance are important on Grand Bank. Larger cod tend to feed on medium-sized fish and crabs, especially toad crabs and small snow crabs. Shrimp are consumed by a broad size range of cod. Cod also feed on smaller cod, but cannibalism is not an important aspect of the diet of northern cod.

The prey that has received most attention is capelin. As noted in the Introduction, during the early 1990s capelin almost disappeared from Division 2J, increased in abundance in areas where they were previously uncommon (Flemish Cap and eastern Scotian Shelf), became inaccessible to acoustic surveys conducted at traditional times, arrived late in the inshore for spawning, and experienced low growth rates (Lilly 1994; Frank *et al*. 1996; Nakashima 1996; Carscadden *et al*. 1997; Carscadden and Nakashima 1997). Hydroacoustic surveys and studies in the offshore have failed to find much capelin since that time. In contrast, capelin indices from the inshore (e.g. commercial catch rates; school areas derived from aerial surveys) did not show such precipitous declines. The status of the stock remains highly uncertain (DFO 2000, 2001).

The role of capelin in the failure of northern cod to recover in the period since its collapse is controversial. Studies of cod condition and feeding in specific areas and seasons have been interpreted as indicating that cod have not been faring well in certain areas, most notably off southern Labrador, and that this has been due to low availability of capelin (Rose and O'Driscoll 2002). In contrast, the routine monitoring of cod during autumn research surveys in the offshore have not identified any problems with cod growth or condition in recent years (see Sections 4.3.1.1 and 4.3.1.2). Cod in the inshore appear to have been faring well. Whatever the circumstances of recent cod growth and condition, there is concern that there may not be sufficient capelin to support a recovery of northern cod to its former level of high biomass, especially in the offshore and in the north.

5.4 Ecosystem approach

There has been very little progress in the adoption of an ecosystem approach in the context of biological interactions among capelin, cod and seals. It is likely that many of the questions regarding the recovery of northern cod and the sustainability of future fisheries can be answered only by developing a more complex realization of the ecosystem than that used in the 1980s and early 1990s. Vital data for developing an ecosystem approach include abundance of predators and prey and diet composition of predators. The current paucity of data on the abundance of forage species (especially capelin, Arctic cod and sand lance) and the diets of predators (e.g. harp seals, hooded seals, and cod) compromises any useful ecosystem modelling related to cod in the foreseeable future.

6 Outlook

The text for the outlook for the northern (2J+3KL) cod stock is taken directly from the Stock Status Report (DFO 2003).

The SPA indicates that the inshore spawner biomass has been decreasing since 1998 when the fishery reopened. Deterministic projections indicate that the stock will grow slightly in the short term as a consequence of the incoming recruits, but will decline thereafter if exploitation rates remain at current levels. Projections also indicate that even without fishing the spawner biomass will not grow during the next decade to the level reached in 1998, under the assumption that stock productivity does not increase above present levels.

The information on feeding by seals and trends in the harp seal population indicate that predation by seals is a factor contributing to the high total mortality of cod in the offshore and the high natural mortality of adult cod in the inshore.

Under a precautionary approach, conservation limit reference points need to be defined to demarcate when the stock is considered to have impaired productivity and is thus in a situation in which serious harm has occurred. Northern cod productivity is impaired and serious harm has occurred. When the spawner biomass of the 2J3KL cod stock as a whole approaches 150,000 t, the available data will be reviewed with the objective of determining appropriate spawner biomass limit reference points in keeping with a precautionary approach. Based on historic data, it is anticipated that appropriate conservation limit reference levels will be set at levels greater than 300,000 t for the stock as a whole. Recovery of spawner biomass to this level is expected to take many years. While the stock remains below this level, there is a high likelihood that the productivity of the stock will remain impaired.

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Table 1. Landings (t) of cod from NAFO Divisions 2J3KL for the period 1959-2002.

	2J				3K				3L				2J3KL			
	Offshore mobile gear		Fixed gear		Offshore mobile gear		Fixed gear		Offshore mobile gear		Fixed gear					
Year	Canada	Other	Canada	Total	Canada	Other	Canada	Total	Canada	Other	Canada	Total	Total Canada	Total Other	Total	TAC
1959	0	46372	17533	63905	0	97678	56264	153942	4515	51515	85695	141725	164007	195565	359572	
1960	1	164123	15418	179542	53	74999	47676	122728	7355	63985	94192	165532	164695	303107	467802	
1961	1	243144	17545	260690	0	64023	31159	95182	4675	73899	70659	149233	124039	381066	505105	
1962	0	226841	23424	250265	0	47015	42816	89831	4383	90276	72271	166930	142894	364132	507026	
1963	1	197868	23767	221636	0	79331	47486	126817	4446	83015	73295	160756	148995	360214	509209	
1964	13	197359	14787	212159	0	121423	40735	162158	10158	142370	75806	228334	141499	461152	602651	
1965	0	246650	25117	271767	21	50097	26467	76585	7353	130387	58943	196683	117901	427134	545035	
1966	39	226244	22645	248928	13	58907	32208	91128	8253	120206	55990	184449	119148	405357	524505	
1967	28	217255	27721	245004	114	78687	24905	103706	13478	200343	49233	263054	115479	496285	611764	
1968	4650	355108	12937	372695	1849	119778	40768	162395	15784	211808	47332	274924	123320	686694	810014	
1969	30	405231	4328	409589	56	80949	24923	105928	18255	151945	67973	238173	115565	638125	753690	
1970	0	212961	1963	214924	92	78274	21512	99878	14471	137840	53113	205424	91151	429075	520226	
1971	0	154700	3313	158013	31	61506	21111	82648	11976	148766	38115	198857	74546	364972	439518	
1972	0	149435	1725	151160	7	133369	14054	147430	4380	109052	46273	159705	66439	391856	458295	
1973	1123	52985	3619	57727	108	159653	13190	172951	1258	97734	24839	123831	44137	310372	354509	666000
1974	0	119463	1804	121267	19	149189	10747	159955	880	67918	22630	91428	36080	336570	372650	657000
1975	410	78578	3000	81988	189	112678	15518	128385	670	53770	22695	77135	42482	245026	287508	554000
1976	94	30691	3851	34636	771	79540	20879	101190	2187	40998	35209	78394	62991	151229	214220	300000
1977	525	39584	3523	43632	1051	26776	28818	56645	5362	26799	40282	72443	79561	93159	172720	160000
1978	4682	17546	6638	28866	7027	6373	29623	43023	9213	12263	45194	66670	102377	36182	138559	135000
1979	9194	6537	8445	24176	21572	16890	27025	65487	14184	12693	50359	77236	130779	36120	166899	180000
1980	13592	7437	17210	38239	21920	6830	37015	65765	15523	13963	42298	71784	147558	28230	175788	180000
1981	22125	4760	14251	41136	23112	3847	23002	49961	21754	15070	42827	79651	147071	23677	170748	200000
1982	58384	8923	14429	81736	8881	4074	42141	55096	27181	9271	56490	92942	207506	22268	229774	230000
1983	37276	4158	10748	52182	31621	2815	40683	75119	39123	10920	55001	105044	214452	17893	232345	260000
1984	9231	2782	13150	25163	48114	11059	35143	94316	47668	15973	49351	112992	202657	29814	232471	266000
1985	1466	78	10211	11755	68880	12945	30368	112193	36863	31176	39306	107345	187094	44199	231293	266000
1986	5734	7859	12916	26509	62086	5781	28384	96251	57805	53946	32202	143953	199127	67586	266713	266000
1987	39344	3999	16022	59365	39686	6160	27442	73288	44612	25916	36743	107271	203849	36075	239924	256000
1988	41468	9	17112	58589	40260	50	33820	74130	57805	26748	51405	135958	241870	26807	268677	266000
1989	33626	1003	23304	57933	37350	1179	20711	59240	40958	36621	59238	136817	215187	38803	253990	235000
1990	17883	183	14505	32571	26920	504	27516	54940	31187	25488	75266	131941	193277	26175	219452	199262

cont'd

Table 1. (cont'd)

	2J				3K				3L				2J3KL			
	Offshore mobile gear		Fixed gear		Offshore mobile gear		Fixed gear		Offshore mobile gear		Fixed gear					
Year	Canada	Other	Canada	Total	Canada	Other	Canada	Total	Canada	Other	Canada	Total	Total Canada	Total Other	Total	TAC
1991	621	82	2214	2917	30112	311	13332	43755	30264	49660 [2]	45416 [3]	125340	121959	50053	172012	190000
1992	0	0	18	18	584	273	884	1741	13627	14610 [4]	10960 [5]	39197	26073	14883	40956	0
1993	0	0	13	13	0	0	541	541	2	2425 [6]	8411 [7]	10838	8967	2425	11392	0
1994	0	0	9	9	0	0	368	368	0	1	936	937	1313	1	1314 [8]	0
1995	0	0	0	0	0	0	94	94	0	0	237	237	331	0	331 [9]	0
1996	0	0	3	3	0	0	739	739	1	1	655	656	1398	1	1398 [10]	0
1997	0	0	3	3	0	0	159	159	4	0	339	343	505	0	505	0
1998	0	0	16	16	0	0	1993	1993	1	6	2490	2497	4501	0	4507	4000
1999 [1]	0	0	36	36	0	0	3644	3644	0	1	4792	4793	8472	1	8473	9000
2000 [1]	0	0	5	5	0	0	1459	1459	13	54	3888	3955	5365	54	5419	7000
2001 [1]	0	0	21	21	0	0	1735	1736	7	82	5124	5212	6887	82	6969	5600
2002 [1]	0	0	13	13	0	0	647	647	3	50	3533	3586	4196	50	4246	5600

[1] Provisional catches.
[2] Includes French catch and other foreign catch as estimated by Canadian surveillance.
[3] Figure is 4000 t less than Canadian statistics (this quantity is considered 3NO catch misreported as 3
[4] Derived from reported catch and Canadian surveillance estimate of foreign catch.
[5] Includes 5000 t catch from the recreational fishery after the moritorium was declared.
[6] Canadian surveillance estimate of foreign catch .
[7] Includes 5053 t estimated for the recreational fishery additional to that recorded by Canadian statistics.
[8] 1300 t is from the food fishery; the remainder is bycatch
[9] Includes 163 t caught in the sentinel survey and 168 t caught as bycatch.
[10] Comprised of a sentinel survey catch of 397 t, a food fishery catch of 962 t and bycatch of 142 However, 103 t of sentinel catch remains to be allocated by division and gear.

Table 2. Fixed gear landings (t) by Division and gear type in Divisions 2J, 3K and 3L in 1975-2002. Landings from statistical areas other than Newfoundland are not included.

	2J					3K					3L					2J3KL
Year	Trap	GN	LL	HL	Total	Trap	GN	LL	HL	Total	Trap	GN	LL	HL	Total	Total
1975	642	2304	0	54	3000	4662	8645	565	1646	15518	10390	7552	1641	3112	22695	41213
1976	1022	2787	6	36	3851	7056	10666	718	2439	20879	18404	9066	2904	4835	35209	59939
1977	1285	2076	37	125	3523	11501	11611	1294	4412	28818	20988	8852	3591	6851	40282	72623
1978	2872	3376	55	335	6638	11329	11445	3647	3202	29623	23218	9023	5114	7839	45194	81455
1979	1333	5663	175	1274	8445	3532	11474	8414	3605	27025	20785	13488	7022	9064	50359	85829
1980	4679	11414	204	913	17210	12732	13549	8059	2675	37015	12871	11231	9394	8802	42298	96523
1981	3893	10105	72	181	14251	3952	10679	6360	2011	23002	10177	13579	11425	7646	42827	80080
1982	4464	9121	114	730	14429	16415	17571	6101	2054	42141	24248	20295	5704	6243	56490	113060
1983	3870	4854	842	1182	10748	10490	18305	2560	9328	40683	25690	16446	3834	9031	55001	106432
1984	5618	6116	379	1037	13150	9957	14362	2499	8325	35143	23103	14985	3824	7439	49351	97644
1985	4973	2992	252	1994	10211	13310	8082	2352	6624	30368	21594	8760	3245	5707	39306	79885
1986	4373	7804	109	630	12916	14555	7626	1555	4648	28384	15669	9865	2492	4176	32202	73502
1987	5158	9228	218	1418	16022	11278	10223	1590	4351	27442	11370	17419	3338	4616	36743	80207
1988	5907	9183	272	1750	17112	16261	11898	935	4726	33820	22148	18576	4004	6677	51405	102337
1989	6713	14846	290	1455	23304	8189	7921	700	3901	20711	23964	22231	4676	8367	59238	103253
1990	3616	9364	653	872	14505	11201	7726	3838	4751	27516	32158	28936	4545	9627	75266	117287
1991	1016	271	93	834	2214	7696	1384	1851	2401	13332	26524	11696 [2]	1247	5949	45416 [2]	60962
1992	0	0	2	16	18	27	103	9	745	884	1173	1131	16	8640 [3]	10960 [3]	11862
1993	0	0	1	12	13	3	37	9	492	541	11	93	80	8227 [3]	8411 [3]	8965
1994	0	0	0	9	9	0	8	0	359	367	6	38	22	870	936	1312
1995	<1	<1	0	0	0	13	52	28	2	95	12	176	33	16	237	332
1996	0	0	0	3	3	25	132	17	565	740	18	219	15	404	656	1500 [4]
1997	0	3	0	0	3	22	101	34	1	159	33	257	29	21	339	501
1998	0	3	5	8	16	24	1081	245	644	1994	31	1377	284	798	2490	4501
1999 [1]	0	21	3	12	36	4	3030	106	503	3644	4	4310	60	419	4792	8472
2000 [1]	0	4	0	1	5	15	1126	43	275	1459	63	2954	189	684	3891	5354
2001 [1]	0	3	1	17	21	28	796	90	822	1735	175	2844	110	1994	5124	6880
2002 [1]	0	7	0	6	13	2	272	30	342	647	128	2517	30	858	3533	4193

[1] Provisional catches.

[2] Catch is 4000 (t) less than Canadian statistics as this quantity is considered 3NO gillnet catch misreported in 3L.

[3] Estimate for recreational fishery has been reported as 3L Handline.

[4] Comprised of sentinel survey catch of 294 t, a food fishery catch of 1155 t and by-catch 142 t.
An amount of 103 t must still be allocated by gear type and division from the sentinel catches.

Table 3a. Catch (t) in 2001 from all sources (index fishery including by-catch, sentinel survey and food/recreational fishery), by gear, unit area and month.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Gillnet													
2JM							0.0	0.3	2.3	0.1			2.7
3KA							1.1	4.1	0.1		0.3		5.7
3KC								0.0					0.0
3KD						0.0	2.8	11.5	2.2	0.4		0.2	17.1
3KE							0.1	0.1	0.0				0.3
3KF							0.1	3.2	0.4	0.0			3.7
3KG							0.5	0.4	0.1				1.0
3KH					0.1	0.1	38.3	49.8	4.3	0.4	17.4		110.4
3KI		0.1			0.0	2.1	237.2	347.2	15.5	1.4	54.0		657.4
3LA						0.1	225.4	426.4	117.1	0.4	174.2		943.7
3LB				0.1	0.0	3.8	220.4	311.2	565.9	1.9	21.4		1124.8
3LC							0.0	0.5	9.3	0.0			9.8
3LD							0.8	5.9	2.3	0.1			9.2
3LF						0.2	94.6	124.8	20.4	0.4	5.9		246.3
3LG							0.0	0.0	0.1		0.4		0.5
3LJ						0.1	51.7	98.2	42.8	0.4	3.3	3.4	199.9
3LQ						2.1	146.1	133.6	11.3	1.3	13.6	2.2	310.2
Total		0.1		0.1	0.1	8.5	1019.3	1517.3	794.0	6.8	290.5	5.8	3642.5
Linetrawl													
2JM									0.1	0.0		0.7	0.9
3KA									0.2	0.9			1.1
3KD									2.0	1.1			3.1
3KH							0.1	0.5	2.5	4.6	0.7		8.5
3KI								4.9	28.1	37.7	6.1		76.8
3LA							0.2	0.8	6.6	26.5	0.9		35.1
3LB								0.8	9.4	12.7	2.2		25.1
3LF								0.1	0.1	6.8	2.1		9.1
3LJ								0.1	1.8	12.3	3.0		17.3
3LQ							1.3		1.0	8.4	8.1	4.8	23.5
Total							1.6	7.1	51.8	111.2	23.2	5.6	200.4
Handline													
2JA							0.8	0.7	1.4				2.8
2JD							0.0	0.3	0.3	0.1			0.6
2JM							1.1	6.0	6.6	0.1	0.1		13.9
3KA							2.1	9.4	8.8	0.5			20.7
3KD							6.1	51.9	65.7	2.9	0.4		127.0
3KH		0.1					7.7	76.9	136.3	58.2	17.7	0.0	297.0
3KI							13.5	118.4	131.0	104.8	9.8		377.5
3LA							45.3	174.2	255.4	37.2	6.4		518.6
3LB							37.6	287.8	432.2	26.0	7.6		791.2
3LF							16.6	99.7	161.3	49.1	12.9		339.7
3LJ	0.0						6.5	38.0	77.7	96.3	40.2		258.8
3LQ	0.0						13.2	40.8	15.1	6.7	9.1	1.2	86.1
Total	0.1	0.1					150.4	904.1	1291.7	381.9	104.4	1.3	2834.0
Trap													
3KD								5.8	17.0				22.8
3KH							0.1	1.4	0.6				2.1
3KI							2.8	0.4					3.2
3LA						3.8	46.7	12.2					62.7
3LB					3.2	0.3	56.5	30.6					90.6
3LJ							1.9	16.0	2.5				20.4
3LQ						1.4							1.4
Total					3.2	5.5	108.0	66.4	20.1				203.1
Otter trawl													
3KG		0.3											0.3
3LC									0.0				0.0
3LD	0.1	0.3	1.1						0.0				1.4
3LG									0.1				0.1
3LH									0.1				0.1
3LI									0.0				0.0
3LQ									0.1			0.0	0.1
3LR					0.8			2.5	0.2				3.6
3LS							0.6	0.6	0.1				1.3
3LT								0.2	0.0				0.2
Total	0.1	0.5	1.1		0.8		0.6	3.3	0.6			0.0	7.0
All Gears	0.1	0.7	1.1	0.1	4.2	14.0	1279.8	2498.2	2158.2	499.9	418.1	12.6	6887.0

Table 3b. Catch (t) in 2002 from all sources (index fishery including by-catch, sentinel survey and food/recreational fishery), by gear, unit area and month.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Gillnet													
2JM						1.0		2.0	2.0	0.1			5.1
3KA								2.0		0.0			2.0
3KB								2.0	7.1	5.8	0.1		15.0
3KD							0.5	0.8	2.3	0.3	0.0		4.0
3KG								1.3					1.3
3KH						0.0	1.9	4.0	5.8	10.5	7.0		29.2
3KI						0.7	28.4	157.8	15.8	6.9	9.5		219.1
3LA						0.9	44.7	843.5	0.7	91.0	40.2		1021.0
3LB					0.2	9.6	22.1	504.1	325.5	137.1	1.0		999.6
3LC										3.6			3.6
3LD								0.3					0.3
3LF		0.3				0.7	15.4	109.5	20.3	0.6			146.8
3LI								0.1					0.1
3LJ	1.8					0.0	9.6	75.1	22.9	5.8	0.2		115.4
3LQ	7.8				0.1	1.2	24.4	156.8	30.7	5.7	0.0	0.4	227.2
Total	9.6	0.3			0.3	14.2	147.1	1859.3	433.1	267.6	58.0	0.4	2789.9
Gillnet (small mesh)													
2JM							0.0	0.3	1.5	0.0			1.9
3KA								0.1	0.0				0.1
3KD							0.1	0.1	0.1	0.2			0.5
3KH							0.1	0.0	0.0	0.1	0.0		0.2
3KI						0.1	0.2	0.2	0.1	0.2	0.2		0.9
3LA							0.4	0.3	0.1		0.2		1.0
3LB						0.1	0.3	0.3	0.7	0.1			1.5
3LF						0.0	0.1	0.1	0.1				0.3
3LJ							0.0	0.1					0.1
3LQ							0.0	0.1	0.1				0.1
Total						0.2	1.2	1.6	2.6	0.5	0.5		6.6
Linetrawl													
2JM								0.0	0.4				0.4
3KA									0.1				0.1
3KB									0.2	0.9			1.2
3KD								0.0	0.3	1.3			1.7
3KH								0.1	1.3	1.9	0.4		3.7
3KI							0.5	2.6	16.6	3.5			23.1
3LA								0.4	1.0	0.3	2.0		3.8
3LB								0.3	6.3	1.6			8.2
3LF							0.1	0.1	2.9	2.1			5.2
3LJ								0.0	2.1	4.8			6.9
3LQ								0.1	0.8	1.4	0.6	2.9	5.8
3LT			0.0										0.0
Total			0.0				0.5	3.8	32.0	17.9	3.0	2.9	60.1

(cont'd)

Table 3b. cont'd

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Handline													
2JD								0.2	0.1				0.3
2JM								0.5	4.4	0.8			5.7
3KA								3.0	3.0				6.1
3KB								0.9	7.6	3.4	0.1		12.0
3KD								12.0	3.7	7.3	0.3		23.2
3KH								25.3	29.0	29.1	16.8		100.2
3KI							1.7	50.0	118.1	30.9	0.3		200.9
3LA		0.1					3.1	61.0	31.5	21.1	6.3		123.1
3LB							0.2	204.2	138.9	23.4	1.1		367.8
3LF		0.2						39.9	79.9	32.7	0.2		152.8
3LI									0.2				0.2
3LJ							0.6	24.4	64.2	69.9	4.5		163.6
3LQ		0.1						25.9	9.8	3.6	10.7		50.2
Total		0.4					5.6	447.5	490.3	222.3	40.3		1206.2
Trap													
3KD								2.3					2.3
3LB						3.7	116.2	4.0	0.2				124.2
3LF										0.1			0.1
3LJ							2.1	1.4					3.5
Total						3.7	118.3	7.8	0.2	0.1			130.1
Otter trawl													
3KG		0.1											0.1
3KK									0.0				0.0
3LC						0.0							0.0
3LD		0.0		0.0		0.0							0.1
3LR								1.7					1.7
3LS								1.0					1.0
Total		0.2		0.0		0.0		2.7	0.0				2.9
All Gears	9.6	0.8	0.0	0.0	0.3	18.1	272.7	2322.7	958.2	508.3	101.8	3.2	4195.8

Table 4a. Number of fish measured in 2001 from sentinel surveys and the index fishery, by gear, unit area and month.

	Month									
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Gillnet										
2JM	0	0	0	14	277	1022	163	0	0	1476
3KA	0	0	0	30	357	123	0	0	0	510
3KC	0	0	0	0	0	0	0	0	0	0
3KD	0	0	4	731	752	293	217	0	0	1997
3KE	0	0	0	0	0	0	0	0	0	0
3KF	0	0	0	0	0	0	0	0	0	0
3KG	0	0	0	0	0	0	0	0	0	0
3KH	0	32	52	403	1232	312	326	227	0	2584
3KI	0	4	870	2969	2193	154	264	1154	0	7608
3LA	0	0	57	4009	6522	317	0	946	0	11851
3LB	52	9	1138	2477	2770	2287	477	2	0	9212
3LC	0	0	0	0	0	0	0	0	0	0
3LD	0	0	0	0	0	0	0	0	0	0
3LF	0	0	79	1314	1182	54	0	0	0	2629
3LG	0	0	0	0	0	0	0	0	0	0
3LJ	0	0	49	2560	1724	110	0	0	0	4443
3LQ	0	0	867	5338	3198	23	0	118	0	9544
Total	52	45	3116	19845	20207	4695	1447	2447	0	51854
Linetrawl										
2JM						41	18			59
3KA										0
3KD							10			10
3KH						1231	151			1382
3KI					118	553	62	10		743
3LA					396	478	548			1422
3LB	17					108				125
3LF						12	1021	128		1161
3LJ					64	70	111			245
3LQ						191	46	139		376
Total	17	0	0	0	578	2684	1967	277	0	5523
Handline										
2JM	0	0	0	0	28	273	0	0	0	301
3KA	0	0	0	0	0	0	0	0	0	0
3KD	0	0	0	0	0	0	0	0	0	0
3KH	0	0	0	0	378	77	54	0	0	509
3KI	0	0	0	0	325	93	82	0	0	500
3LA	0	0	0	388	56	0	0	0	0	444
3LB	0	0	0	0	0	0	0	0	0	0
3LF	0	0	0	0	0	0	0	0	0	0
3LJ	0	0	0	780	1924	611	0	0	0	3315
3LQ	0	0	0	0	45	0	0	0	0	45
Total	0	0	0	1168	2756	1054	136	0	0	5114
Trap										
3KD					275	1159				1434
3KH				69	1487	621				2177
3KI				2660	502					3162
3LA			1247	338						1585
3LB		789	155	1248						2192
3LJ				634	385					1019
3LQ			701							701
Total	0	789	2103	4949	2649	1780	0	0	0	12270
All Gears	69	834	5219	25962	26190	10213	3550	2724	0	74761

Table 4 b. Number of fish measured in 2002 from sentinel surveys and the index fishery, by gear, unit area and month.

	Month									
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
Gillnet										
2JM						298	394			692
3KA						80		10		90
3KD					113	196	81	44	7	441
3KH				3	363	691	194	100	53	1404
3KI				154	1915	2680	294	90	39	5172
3LA					4363	9514	69	132	482	14560
3LB				767	2662	4648	3584	543		12204
3LF				18	1533	1007	168			2726
3LJ				11	987	1186	68	5		2257
3LQ				269	2943	2125	112	49	5	5503
Total				1222	14879	22425	4964	973	586	45049
Linetrawl										
3KD							3			3
3KH							1005	262		1267
3KI						79	710	109		898
3LA						425	546	117	104	1192
3LB							145			145
3LF							211	262		473
3LQ						43			34	77
Total						547	2620	750	138	4055
Handline										
3KH						89	725			814
3KI						117	619			736
3LB							67	99		166
3LF							1374			1374
3LJ					323	1691	2212	80		4306
3LQ						256				256
Total					323	2153	4997	179		7652
Trap										
2JM					4	522	2424	17		2967
3KA						201	8			209
3KD					98	171	149	443		861
3KH					94	37	10	94	79	314
3KI				54	389	302	174	279	371	1569
3LA					587	410	134		294	1425
3LB				70	201	274	886	88		1519
3LF				2	132	147	137			418
3LJ					17	249				266
3LQ					17	110	90			217
Total				126	1539	2423	4012	921	744	9765
All Gears	0	0	0	1348	16741	27548	16593	2823	1468	66521

Table 5a. Number of fish aged in 2001 from sampling of the sentinel surveys and the index fishery, by gear, unit area and quarter. Quarter 1 is January-February, Quarter 2 is March-May, Quarter 3 is June – August and Quarter 4 is September – December.

	Quarter				
	1	2	3	4	Total
Gillnet					
2JM				190	190
3KA				25	25
3KD				49	49
3KH				121	121
3KI				238	238
3LA			671	284	955
3LB			617	196	813
3LF			247	12	259
3LJ			185		185
3LQ			175	12	187
Total			1895	1127	3022
Linetrawl					
2JM				2	2
3KH				62	62
3KI				22	22
3LA				71	71
3LF				85	85
3LJ				13	13
3LQ				24	24
Total				279	279
Handline					
2JM			13	22	35
3KH			71	39	110
3KI				15	15
3LA			191		191
3LJ			57	63	120
Total			332	139	471
Trap					
3KD			46	51	97
3KH			58		58
3KI			86		86
3LA			134		134
3LB		119	65		184
3LJ					
3LQ			52		52
Total		119	441	51	611
All Gears		119	2668	1596	4383

Table 5b. Number of fish aged in 2002 from sampling of the sentinel surveys and the index fishery, by gear, unit area and quarter. Quarter 1 is January-February, Quarter 2 is March-May, Quarter 3 is June – August and Quarter 4 is September – December.

	Quarter				
	1	2	3	4	Total
Gillnet					
2JM				8	8
3KA			35	8	43
3KD			85	86	171
3KH			236	90	326
3KI			535	73	608
3LA			811	136	947
3LB			609	430	1039
3LF			268	57	325
3LJ			263		263
3LQ			156	37	193
Total			2998	925	3923
Linetrawl					
3KH				97	97
3KI				89	89
3LB				12	12
3LF				68	68
Total				266	266
Handline					
2JM			51		51
3KH				115	115
3KI			35	107	142
3LB				72	72
3LF				202	202
3LJ			76	183	259
3LQ			25		25
Total			187	679	866
All Gears	0	0	3185	1870	5055

Table 6a. Estimated average weight (kg), length (cm) and number (plus standard error and coefficient of variation) of the 2001 catch at age, for all gears combined and for individual gears.

	WEIGHT	LENGTH	NUMBER		
AGE	(kg.)	(cm.)	(000'S)	STD ERR.	CV
All gears combined					
1	0.00	0.00	0.0		
2	0.38	35.27	9.7		
3	0.63	41.54	244.7	9.99	0.00
4	0.91	46.78	764.0	18.35	0.02
5	1.36	53.22	697.6	18.12	0.03
6	2.02	60.58	600.3	13.56	0.02
7	2.54	65.39	358.4	10.63	0.03
8	3.24	70.47	186.6	8.35	0.04
9	3.93	75.12	267.0	9.55	0.04
10	4.43	78.01	78.5	5.05	0.06
11	5.06	81.54	115.0	6.98	0.06
12	6.56	88.97	32.7	2.52	0.08
13	7.21	91.64	2.7	0.66	0.25
14	5.46	84.12	0.9	0.37	
15	7.62	94.00	0.1	0.07	0.72
Total			3348.5		
Gillnet					
1	0.00	0.00	0.0		
2	0.44	37.15	3.2		
3	0.52	39.19	60.8	3.53	0.00
4	0.93	46.63	74.9	4.17	0.06
5	1.68	57.16	184.9	6.96	0.04
6	2.16	62.11	377.8	9.56	0.03
7	2.58	65.87	251.9	9.44	0.04
8	3.15	69.96	129.4	7.38	0.06
9	3.74	73.92	184.0	8.36	0.05
10	4.16	76.43	51.9	4.29	0.08
11	4.66	79.41	59.4	5.64	0.09
12	6.11	86.76	10.8	1.30	0.12
13	7.13	91.21	1.4	0.43	0.31
14	5.38	83.72	0.5	0.23	
15	7.62	94.00	0.1	0.07	1.04
Total			1387.6		
Linetrawl					
1	0.00	0.00	0.0		
2	0.31	32.76	2.8		
3	0.67	42.17	32.1	1.50	0.00
4	0.95	47.58	63.7	1.86	0.03
5	1.38	53.56	35.0	1.46	0.04
6	1.94	59.75	13.9	0.74	0.05
7	2.40	63.99	5.6	0.43	0.08
8	3.16	70.01	2.2	0.22	0.10
9	3.80	74.45	2.6	0.23	0.09
10	4.45	78.48	0.9	0.12	0.14
11	4.59	79.16	0.9	0.12	0.13
12	5.03	81.32	0.2	0.05	0.33
13	7.30	92.60	0.0	0.02	0.95
14	4.46	79.00	0.0	0.00	
Total			157.0		

(cont'd)

Table 6a (cont'd). Estimated average weight (kg), length (cm) and number (plus standard error and coefficient of variation) of the 2001 catch at age, for all gears combined and for individual gears.

AGE	WEIGHT (kg.)	LENGTH (cm.)	NUMBER (000'S)	STD ERR.	CV
Handline					
1	0.00	0.00	0.0		
2	0.38	35.51	3.7		
3	0.68	42.66	139.4	9.09	0.00
4	0.92	47.05	538.7	17.37	0.03
5	1.26	52.01	426.7	16.26	0.04
6	1.78	57.95	189.4	9.45	0.05
7	2.50	64.89	91.0	4.74	0.05
8	3.45	71.79	53.0	3.86	0.07
9	4.39	77.94	77.6	4.57	0.06
10	5.02	81.47	24.9	2.63	0.11
11	5.55	84.12	52.0	4.08	0.08
12	6.80	90.13	21.7	2.16	0.10
13	7.29	92.09	1.3	0.49	0.39
14	5.55	84.56	0.4	0.28	
15	7.62	94.00	0.0	0.02	0.62
Total			1616.3		
Trap					
1	0.00	0.00	0.0		
2	0.00	0.00	0.0		
3	0.50	38.72	12.2	1.50	0.00
4	0.78	44.63	86.0	3.67	0.04
5	1.04	48.87	50.3	3.58	0.07
6	1.65	56.83	18.6	1.55	0.08
7	1.80	58.38	9.6	0.96	0.10
8	2.99	68.54	1.8	0.38	0.21
9	4.12	76.65	2.5	0.42	0.17
10	3.48	72.16	0.8	0.22	0.29
11	4.63	79.44	2.4	0.41	0.17
12	4.58	78.82	0.0	0.02	0.63
13	0.00	0.00	0.0	0.00	
14	9.23	100.00	0.0	0.00	
15	0.00	0.00	0.0	0.00	
Total			184.2		

Table 6b. Estimated average weight (kg), length (cm) and number (plus standard error and coefficient of variation) of the 2002 catch at age, for all gears combined and for individual gears.

AGE	WEIGHT (kg.)	LENGTH (cm.)	NUMBER (000'S)	STD ERR.	CV
All gears combined					
1	0.13	25.00	0.0	0.00	0.00
2	0.41	36.23	6.1	1.58	0.00
3	0.63	41.61	165.6	7.90	0.00
4	0.91	46.78	296.1	9.70	0.03
5	1.56	55.76	399.2	9.31	0.02
6	2.09	61.35	335.0	8.63	0.03
7	2.70	66.78	234.9	7.82	0.03
8	3.24	70.76	123.8	6.24	0.05
9	3.83	74.62	77.4	4.91	0.06
10	4.45	78.40	112.6	5.28	0.05
11	4.77	80.07	50.1	3.56	0.07
12	5.13	82.04	52.4	3.54	0.07
13	5.90	85.12	10.3	1.41	0.14
14	5.70	84.51	1.9	0.62	0.32
15	6.10	87.00	0.5	0.26	0.52
Total			1859.9		
Gillnet					
1	0.18	28.00	0.0		
2	0.36	34.72	0.9		
3	0.53	39.37	8.3	0.42	0.00
4	1.08	49.02	19.4	1.17	0.06
5	1.84	58.97	151.9	4.92	0.03
6	2.24	62.87	213.6	6.61	0.03
7	2.76	67.26	180.7	6.89	0.04
8	3.24	70.79	98.5	5.74	0.06
9	3.84	74.75	64.5	4.58	0.07
10	4.46	78.47	95.7	4.84	0.05
11	4.80	80.21	41.7	3.28	0.08
12	5.16	82.17	44.9	3.27	0.07
13	5.97	85.49	8.3	1.28	0.15
14	5.85	85.30	1.5	0.57	
15	6.22	87.57	0.4	0.23	0.62
			929.4		

(cont'd)

Table 6b (cont'd). Estimated average weight (kg), length (cm) and number (plus standard error and coefficient of variation) of the 2002 catch at age, for all gears combined and for individual gears.

	WEIGHT	LENGTH	NUMBER		
AGE	(kg.)	(cm.)	(000'S)	STD ERR.	CV
Linetrawl					
1	0.09	22.00	0.0		
2	0.36	34.49	0.7		
3	0.55	39.94	15.6	0.92	0.00
4	0.78	44.49	20.7	1.01	0.05
5	1.31	52.71	11.1	0.61	0.05
6	1.76	57.94	5.2	0.41	0.08
7	2.29	62.98	2.3	0.30	0.13
8	2.79	67.39	0.7	0.10	0.13
9	3.55	72.86	0.4	0.09	0.23
10	3.98	75.70	0.3	0.08	0.25
11	4.21	77.21	0.1	0.04	0.34
12	4.25	77.50	0.0	0.01	0.44
13	3.79	73.96	0.0	0.01	0.65
14	1.46	55.00	0.0	0.00	
15	7.62	94.00	0.0	0.00	
			56.5		
Handline					
1	0.00	0.00	0.0		
2	0.43	36.82	4.3		
3	0.64	41.94	135.1	7.59	0.00
4	0.90	46.81	244.8	9.27	0.04
5	1.39	53.73	223.1	7.54	0.03
6	1.81	58.45	105.7	5.10	0.05
7	2.52	65.05	44.8	3.14	0.07
8	3.26	70.75	20.8	1.91	0.09
9	3.72	73.90	10.2	1.30	0.13
10	4.35	77.89	13.0	1.65	0.13
11	4.56	79.26	6.8	1.06	0.16
12	4.90	81.05	5.8	1.03	0.18
13	5.60	83.38	1.7	0.47	0.28
14	5.06	81.24	0.3	0.19	
15	5.64	84.94	0.1	0.10	0.92
			812.1		

Table 7. Catch numbers (thousands) at age for cod in 2J3KL in 1962-2002.

Age	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	301	1446	2872	85	819	790	288	59	6819	33	236	0	473	420
3	8666	5746	19338	5177	14057	15262	6142	4330	18104	12876	6737	3963	3231	3968
4	26194	27577	27603	28709	65992	77873	94291	39626	60102	71557	79809	40785	13201	14101
5	64337	60234	57757	46800	93687	100339	205805	100858	82357	95384	116562	94844	34927	25370
6	58163	118112	60681	66946	62812	96759	150541	163228	101249	98111	76196	59503	74403	34426
7	47314	58996	100147	64360	59312	54996	83808	107509	85696	57865	55984	35464	60539	39105
8	27521	29349	50865	68176	30423	38691	39443	52661	29218	25055	29553	27351	35687	36485
9	20142	15520	20892	33819	23844	17146	23171	19651	10857	11732	11750	14153	18854	13421
10	18036	11612	12264	14913	8762	16084	10984	12370	3825	4470	6393	7566	10492	7514
11	10444	8248	8698	6945	4528	5949	5591	6389	2000	2223	2987	3815	5818	2315
12	9468	4204	6352	3729	2280	3367	5249	4479	1200	1287	1660	2153	2934	1179
13	7778	3942	4989	3948	1825	2108	1939	3004	507	1140	1388	1173	1078	808
14	5785	2933	4036	3730	1186	1529	1334	1557	224	720	725	450	652	372
15	4669	2928	2703	2722	967	685	818	622	214	355	748	278	249	165
16	3888	1737	1456	1859	806	424	610	567	244	474	606	309	338	82
17	3955	1263	1918	575	416	193	127	319	124	124	452	85	162	5
18	2161	1352	1154	971	279	107	89	100	32	128	136	27	113	8
19	232	328	501	183	486	72	83	46	10	148	195	38	45	22
20	403	182	312	226	178	211	26	99	34	78	36	8	20	1
Total	319457	355709	384538	353873	372659	432585	630339	517474	402816	383760	392153	291965	263216	179767

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	15	108	0	0	92	0	0	18	3	0	1	42	25	8
3	13767	7128	1323	1152	2554	2185	1702	2585	782	650	831	2329	2779	1696
4	33727	65510	17556	12361	12025	7172	31286	13616	14871	14824	15219	9217	14651	17639
5	28049	40462	39206	37493	28814	13191	19003	42602	31760	36614	44168	32340	20184	21150
6	20898	12107	20319	29202	30016	24800	14397	19028	38624	33922	45869	49061	47917	25212
7	16811	5397	7711	10982	18017	22014	25435	12044	12503	28006	26025	28469	45725	38708
8	16022	3396	3078	3460	4830	11848	16930	14701	7246	7050	14722	19505	18608	28499
9	10931	2730	1530	1300	1217	3175	11936	8934	8910	3836	3104	5818	9026	8696
10	4637	1381	1083	757	520	779	1923	6341	4227	5162	2000	1346	4337	3640
11	1462	532	437	560	232	309	338	1018	2536	2905	1977	676	774	1695
12	631	296	219	183	229	195	156	248	451	1681	1101	873	422	572
13	292	149	105	116	56	125	90	90	146	254	574	391	366	244
14	251	75	62	51	65	48	153	41	48	107	116	200	223	180
15	100	42	40	43	37	14	40	29	41	39	29	37	100	94
16	50	21	21	38	13	28	12	11	30	20	18	22	32	43
17	40	20	7	7	10	20	13	9	7	17	11	3	5	4
18	64	14	8	7	14	5	4	6	7	1	9	1	10	9
19	30	2	2	4	4	5	0	2	4	3	2	4	5	0
20	20	6	7	9	10	5	0	3	3	5	2	0	5	1
Total	147797	139376	92714	97725	98755	85918	123418	121326	122199	135096	155778	150334	165194	148090

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2	58	35	0	0	0	0	1	0	3	7	5	10	6
3	7693	3111	430	940	105	7	40	8	96	70	141	249	166
4	40557	31654	3860	4993	379	30	237	23	229	238	258	778	296
5	36410	53805	14535	3343	575	71	297	54	395	638	419	710	399
6	22695	29553	12211	1940	177	55	341	56	689	795	437	611	335
7	16390	9064	4526	700	74	20	129	84	384	1157	328	365	235
8	17940	6164	1372	147	22	11	23	21	237	370	294	190	124
9	9156	4745	376	21	2	3	5	3	74	253	151	272	77
10	2865	1696	199	0	0	0	3	2	10	52	136	80	113
11	1084	641	104	0	0	0	0	0	5	13	33	117	50
12	478	250	18	0	0	0	0	0	2	3	5	33	52
13	103	88	9	0	0	0	0	0	1	0	3	3	10
14	98	39	4	0	0	0	0	0	0	0	1	1	2
15	36	21	0	0	0	0	0	0	0	0	0	0	0
16	25	9	0	0	0	0	0	0	0	0	0	0	0
17	8	3	0	0	0	0	0	0	0	0	0	0	0
18	7	2	0	0	0	0	0	0	0	0	0	0	0
19	1	2	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	155604	140882	37644	12084	1334	197	1076	252	2125	3596	2210	3418	1866

Table 8. Catch weights-at-age (kg) for cod caught in 2J3KL in 1962-2002.

Age	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14		0.11	0.26
3	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.44	0.32	0.35	0.45
4	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.53	0.47	0.68	0.63
5	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.64	0.71	0.91	0.96
6	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.08	0.96	1.11	1.18
7	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.52	1.30	1.27	1.39
8	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.13	1.80	1.56	1.74
9	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.86	2.20	2.05	2.21
10	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.29	2.82	2.75	2.61
11	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.95	3.19	3.13	3.34
12	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.12	3.79	3.41	3.66
13	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	5.00	4.53	4.92	4.78
14	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	9.32	6.93	4.40	5.20
15	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	9.40	7.22	6.33	5.20
16	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	6.89	7.05	5.50	5.46
17	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	14.67	9.45	7.57	8.51
18	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	12.04	11.16	11.07	9.24
19	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	7.62	7.62	7.62	7.62
20	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	17.46	17.46	17.46	17.46

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	0.25	0.09			0.41	0.00		0.31	0.34		0.21	0.32	0.29	0.26
3	0.45	0.45	0.40	0.46	0.53	0.55	0.53	0.62	0.59	0.48	0.51	0.43	0.49	0.48
4	0.61	0.60	0.72	0.74	0.77	0.78	0.84	0.87	0.88	0.73	0.72	0.66	0.73	0.74
5	0.93	0.97	1.04	1.13	1.16	1.17	1.20	1.32	1.20	1.10	1.04	1.03	1.08	1.03
6	1.32	1.66	1.58	1.67	1.71	1.64	1.77	1.75	1.79	1.43	1.54	1.32	1.38	1.44
7	1.75	2.33	2.46	2.46	2.38	2.23	2.10	2.28	2.28	2.06	1.85	1.87	1.67	1.83
8	2.07	2.82	3.26	3.57	3.56	2.86	2.66	2.61	2.71	2.66	2.35	1.93	2.21	2.07
9	2.24	3.46	4.05	4.41	5.01	3.81	3.09	3.18	2.96	3.23	2.94	2.80	2.51	2.64
10	2.99	3.88	4.46	5.25	5.49	5.32	4.18	3.50	3.65	3.32	3.47	3.51	3.04	3.02
11	3.67	4.78	5.02	5.80	6.72	6.29	6.16	4.79	4.28	4.06	3.80	4.80	4.37	3.96
12	4.56	6.13	6.72	7.03	7.87	7.06	7.19	7.76	6.19	4.55	4.54	4.64	5.49	5.41
13	6.18	7.31	8.10	8.96	8.38	7.32	8.00	9.07	8.39	7.03	5.34	5.74	6.55	7.50
14	8.19	8.40	7.42	8.54	10.03	10.01	8.36	9.14	10.26	9.67	7.12	6.13	8.60	9.24
15	9.77	8.81	8.20	9.46	11.31	8.99	7.86	10.62	11.44	11.37	11.77	8.53	9.76	10.05
16	11.23	11.75	11.26	10.70	13.87	11.54	7.91	10.57	11.61	11.27	11.24	13.51	9.73	9.34
17	12.44	10.63	11.61	13.12	10.68	10.48	9.58	13.13	17.47	12.68	14.15	9.10	12.58	15.74
18	11.16	12.27	8.92	13.49	16.09	11.15	12.95	15.97	12.94	12.42	16.14	21.77	16.01	18.66
19	7.62	7.62	10.57	15.51	12.04	9.82	0.00	9.73	15.21	14.38	12.30	17.66	16.60	
20	17.46	17.46	16.00	14.77	11.37	12.59	0.00	15.88	12.81	19.49	15.72	0.00	11.03	17.64

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2	0.29	0.17				0.21	0.40	0.32	0.29	0.32	0.26	0.38	0.41
3	0.42	0.36	0.29	0.57	0.40	0.49	0.72	0.51	0.63	0.59	0.66	0.63	0.63
4	0.69	0.61	0.58	0.71	0.68	0.79	0.99	0.84	0.94	1.05	0.97	0.91	0.91
5	1.06	0.97	0.81	0.97	0.98	1.51	1.30	1.49	1.51	1.62	1.71	1.36	1.56
6	1.50	1.41	1.19	1.25	1.41	1.95	1.90	2.01	2.14	2.12	2.14	2.02	2.09
7	1.94	1.88	1.73	1.59	1.85	2.24	2.38	2.44	2.48	2.51	2.79	2.54	2.70
8	2.22	2.27	2.05	8.40	2.05	2.47	2.77	2.87	3.02	2.96	3.39	3.24	3.24
9	2.44	2.63	2.66	9.23	3.05	2.53	3.30	3.78	3.35	3.66	3.95	3.93	3.83
10	3.06	3.14	2.24			2.93	3.19	4.30	4.18	4.70	4.54	4.43	4.45
11	3.58	3.80	2.68			4.51	5.44	4.23	4.01	5.17	4.88	5.06	4.77
12	4.68	4.96	4.95			2.01	4.35	6.33	3.87	5.57	6.03	6.56	5.13
13	6.23	5.49	5.34				7.63	6.22	6.42	6.23	5.63	7.21	5.90
14	8.51	7.61	7.02				4.46			7.66	4.80	5.46	5.70
15	9.78	11.58									9.42	7.62	6.10
16	12.58	11.01											
17	15.45	12.82									11.28		
18	13.58	13.00											8.40
19	17.26	13.10											
20													

Table 9. Catch biomass (t) at age for cod caught in 2J3KL in 1962-2002.

Age	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	42	202	402	12	115	111	40	8	955	5	33	0	52	109
3	2946	1954	6575	1760	4779	5189	2088	1472	6155	4378	2964	1268	1131	1786
4	14407	15167	15182	15790	36296	42830	51860	21794	33056	39356	42299	19169	8977	8884
5	56617	53006	50826	41184	82445	88298	181108	88755	72474	83938	74600	67339	31784	24355
6	71540	145278	74638	82344	77259	119014	185165	200770	124536	120677	82292	57123	82587	40623
7	78541	97933	166244	106838	98458	91293	139121	178465	142255	96056	85096	46103	76885	54356
8	58345	62220	107834	144533	64497	82025	83619	111641	61942	53117	62948	49232	55672	63484
9	53175	40973	55155	89282	62948	45265	61171	51879	28662	30972	33605	31137	38651	29660
10	57354	36926	39000	47423	27863	51147	34929	39337	12164	14215	21033	21336	28853	19612
11	39269	31012	32704	26113	17025	22368	21022	24023	7520	8358	11799	12170	18210	7732
12	39292	17447	26361	15475	9462	13973	21783	18588	4980	5341	6839	8160	10005	4315
13	47135	23889	30233	23925	11060	12774	11750	18204	3072	6908	6940	5314	5304	3862
14	32049	16249	22359	20664	6570	8471	7390	8626	1241	3989	6757	3119	2869	1934
15	28528	17890	16515	16631	5908	4185	4998	3800	1308	2169	7031	2007	1576	858
16	22667	10127	8488	10838	4699	2472	3556	3306	1423	2763	4175	2178	1859	448
17	25470	8134	12352	3703	2679	1243	818	2054	799	799	6631	803	1226	43
18	13117	8207	7005	5894	1694	649	540	607	194	777	1637	301	1251	74
19	1534	2168	3312	1210	3212	476	549	304	66	978	1486	290	343	168
20	2898	1309	2243	1625	1280	1517	187	712	244	561	629	140	349	17
Total	644926	590090	677428	655244	518248	593302	811698	774346	503047	475357	458793	327188	367583	262319

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	4	10	0	0	38	0	0	6	1	0	0	13	7	2
3	6195	3208	529	530	1354	1202	902	1603	461	312	424	1001	1362	814
4	20573	39306	12640	9147	9259	5594	26280	11846	13086	10822	10958	6083	10695	13053
5	26086	39248	40774	42367	33424	15433	22804	56235	38112	40275	45935	33310	21799	21785
6	27585	20098	32104	48767	51327	40672	25483	33299	69137	48508	70638	64761	66125	36305
7	29419	12575	18969	27016	42880	49091	53414	27460	28507	57692	48146	53237	76361	70836
8	33166	9577	10034	12352	17195	33885	45034	38370	19637	18753	34597	37645	41124	58993
9	24485	9446	6197	5733	6097	12097	36882	28410	26374	12390	9126	16290	22655	22957
10	13865	5358	4830	3974	2855	4144	8038	22194	15429	17138	6940	4724	13184	10993
11	5366	2543	2194	3248	1559	1944	2082	4876	10854	11794	7513	3245	3382	6712
12	2877	1814	1472	1286	1802	1377	1122	1924	2792	7649	4999	4051	2317	3095
13	1805	1089	851	1039	469	915	720	816	1225	1786	3065	2244	2397	1830
14	2056	630	460	436	652	480	1279	375	492	1035	826	1226	1918	1663
15	977	370	328	407	418	126	314	308	469	443	341	316	976	945
16	562	247	236	407	180	323	95	116	348	225	202	297	311	402
17	498	213	81	92	107	210	125	118	122	216	156	27	63	63
18	714	172	71	94	225	56	52	96	91	12	145	22	160	168
19	229	15	21	62	48	49	0	19	61	43	25	71	83	0
20	349	105	112	133	114	63	0	48	38	97	31	0	55	18
Total	196809	146023	131904	157091	170005	167661	224625	228118	227236	229191	244066	228564	264975	250632

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2	17	6	0	0	0	0	0	0	1	2	1	4	3
3	3231	1120	125	536	42	3	29	4	60	41	93	157	104
4	27984	19309	2239	3545	258	24	234	19	214	249	249	704	268
5	38595	52191	11773	3243	564	107	385	81	596	1032	716	967	623
6	34043	41670	14531	2425	250	107	647	112	1477	1687	936	1232	702
7	31797	17040	7830	1113	137	45	306	205	952	2908	915	926	635
8	39827	13992	2813	1235	45	27	63	61	714	1094	994	614	402
9	22341	12479	1000	194	6	8	18	11	248	927	598	1068	296
10	8767	5325	446	0	0	0	11	8	40	246	616	354	501
11	3881	2436	279	0	0	0	1	2	22	65	162	592	239
12	2237	1240	89	0	0	0	0	1	7	15	31	219	269
13	642	483	48	0	0	0	0	0	6	2	18	20	61
14	834	297	28	0	0	0	0	0	0	1	5	5	11
15	352	243	0	0	0	0	0	0	0	0	1	1	3
16	315	99	0	0	0	0	0	0	0	0	0	0	0
17	124	38	0	0	0	0	0	0	0	0	1	0	0
18	95	26	0	0	0	0	0	0	0	0	0	0	1
19	17	26	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	215096	168021	41200	12290	1301	321	1694	504	4338	8269	5335	6864	4117

Table 10. Mean weights-at-age (kg) of cod caught in commercial fisheries (including recreational fisheries and sentinel surveys) in 1962-2000. Highlighted entries indicate cells that have been filled or modified as described in the text (cf Table 8).

Age	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
2	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	**0.26**	0.11
3	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.44	0.32	0.35
4	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.53	0.47	0.68
5	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.64	0.71	0.91
6	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.08	0.96	1.11
7	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.52	1.30	1.27
8	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.13	1.80	1.56
9	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.86	2.20	2.05
10	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.29	2.82	2.75
11	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.95	3.19	3.13
12	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.12	3.79	3.41
13	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	5.00	4.53	4.92
14	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	9.32	6.93	4.40
15	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	9.40	7.22	6.33
16	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	6.89	7.05	5.50
17	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	14.67	9.45	7.57
18	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	12.04	11.16	11.07
19	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	7.62	7.62	7.62
20	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	17.46	17.46	17.46

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	0.26	0.25	0.09	**0.26**	**0.26**	0.41	**0.26**	**0.26**	0.31	0.34	**0.26**	0.21	0.32
3	0.45	0.45	0.45	0.40	0.46	0.53	0.55	0.53	0.62	0.59	0.48	0.51	0.43
4	0.63	0.61	0.60	0.72	0.74	0.77	0.78	0.84	0.87	0.88	0.73	0.72	0.66
5	0.96	0.93	0.97	1.04	1.13	1.16	1.17	1.20	1.32	1.20	1.10	1.04	1.03
6	1.18	1.32	1.66	1.58	1.67	1.71	1.64	1.77	1.75	1.79	1.43	1.54	1.32
7	1.39	1.75	2.33	2.46	2.46	2.38	2.23	2.10	2.28	2.28	2.06	1.85	1.87
8	1.74	2.07	2.82	3.26	3.57	3.56	2.86	2.66	2.61	2.71	2.66	2.35	1.93
9	2.21	2.24	3.46	4.05	4.41	5.01	3.81	3.09	3.18	2.96	3.23	2.94	2.80
10	2.61	2.99	3.88	4.46	5.25	5.49	5.32	4.18	3.50	3.65	3.32	3.47	3.51
11	3.34	3.67	4.78	5.02	5.80	6.72	6.29	6.16	4.79	4.28	4.06	3.80	4.80
12	3.66	4.56	6.13	6.72	7.03	7.87	7.06	7.19	7.76	6.19	4.55	4.54	4.64
13	4.78	6.18	7.31	8.10	8.96	8.38	7.32	8.00	9.07	8.39	7.03	5.34	5.74
14	5.20	8.19	8.40	7.42	8.54	10.03	10.01	8.36	9.14	10.26	9.67	7.12	6.13
15	5.20	9.77	8.81	8.20	9.46	11.31	8.99	7.86	10.62	11.44	11.37	11.77	8.53
16	5.46	11.23	11.75	11.26	10.70	13.87	11.54	7.91	10.57	11.61	11.27	11.24	13.51
17	8.51	12.44	10.63	11.61	13.12	10.68	10.48	9.58	13.13	17.47	12.68	14.15	9.10
18	9.24	11.16	12.27	8.92	13.49	16.09	11.15	12.95	15.97	12.94	12.42	16.14	21.77
19	7.62	7.62	7.62	10.57	15.51	12.04	9.82	**11.70**	9.73	15.21	14.38	12.30	17.66
20	17.46	17.46	17.46	16.00	14.77	11.37	12.59	**13.16**	15.88	12.81	19.49	15.72	**15.97**

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2	0.29	0.26	0.29	0.17	0.26	0.26	0.26	0.21	0.40	0.32	0.29	0.32	0.26
3	0.49	0.48	0.42	0.36	0.29	0.57	0.40	0.49	0.72	0.51	0.63	0.59	0.66
4	0.73	0.74	0.69	0.61	0.58	0.71	0.68	0.79	0.99	0.84	0.94	1.05	0.97
5	1.08	1.03	1.06	0.97	0.81	0.97	0.98	1.51	1.30	1.49	1.51	1.62	1.71
6	1.38	1.44	1.50	1.41	1.19	1.25	1.41	1.95	1.90	2.01	2.14	2.12	2.14
7	1.67	1.83	1.94	1.88	1.73	1.59	1.85	2.24	2.38	2.44	2.48	2.51	2.79
8	2.21	2.07	2.22	2.27	2.05	**2.21**	2.05	2.47	2.77	2.87	3.02	2.96	3.39
9	2.51	2.64	2.44	2.63	2.66	**2.72**	3.05	2.53	3.30	3.78	3.35	3.66	3.95
10	3.04	3.02	3.06	3.14	2.24	**2.87**	**2.87**	2.93	3.19	4.30	4.18	4.70	4.54
11	4.37	3.96	3.58	3.80	2.68	**4.11**	**4.11**	4.51	5.44	4.23	4.01	5.17	4.88
12	5.49	5.41	4.68	4.96	4.95	**5.15**	**5.15**	**5.15**	4.35	6.33	3.87	5.57	6.03
13	6.55	7.50	6.23	5.49	5.34	6.17	6.17	6.17	7.63	6.22	6.42	6.23	5.63
14	8.60	9.24	8.51	7.61	7.02	**7.71**	**7.71**	**7.71**	4.46	**7.71**	**7.71**	7.66	4.80
15	9.76	10.05	9.78	11.58	**10.47**	**10.47**	**10.47**	**10.47**	**10.47**	**10.47**	**10.47**	**10.47**	9.42
16	9.73	9.34	12.58	11.01	**10.98**	**10.98**	**10.98**	**10.98**	**10.98**	**10.98**	**10.98**	**10.98**	**10.98**
17	12.58	15.74	15.45	12.82	**14.67**	**14.67**	**14.67**	**14.67**	**14.67**	**14.67**	**14.67**	**14.67**	11.28
18	16.01	18.66	13.58	13.00	**15.08**	**15.08**	**15.08**	**15.08**	**15.08**	**15.08**	**15.08**	**15.08**	**15.08**
19	16.60	**16.16**	17.26	13.10	**15.65**	**15.65**	**15.65**	**15.65**	**15.65**	**15.65**	**15.65**	**15.65**	**15.65**
20	11.03	17.64	**15.97**	**15.97**	**15.97**	**15.97**	**15.97**	**15.97**	**15.97**	**15.97**	**15.97**	**15.97**	**15.97**

Table 11. Beginning-of-year (January 1) weights-at-age estimated from actual and assumed commercial weights-at-age (Table 10) as described in the text. Highlighted entries indicate values copied from adjacent cells.

Age	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
2	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.09	0.23	0.05
3	**0.22**	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.25	0.21	0.30
4	**0.43**	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.42	0.45	0.47
5	**0.70**	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.59	0.61	0.65
6	**1.04**	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	0.97	0.78	0.89
7	**1.43**	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.37	1.18	1.10
8	**1.88**	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.65	1.42
9	**2.37**	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.46	2.16	1.92
10	**2.90**	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.95	2.84	2.46
11	**3.46**	3.46	3.46	3.46	3.46	3.46	3.46	3.46	3.46	3.46	3.54	3.24	2.97
12	**3.95**	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.95	3.94	3.87	3.30
13	**5.01**	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	5.01	4.56	4.32	4.32
14	**5.79**	5.79	5.79	5.79	5.79	5.79	5.79	5.79	5.79	5.79	7.52	5.89	4.46
15	**5.82**	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	5.82	7.22	8.20	6.62
16	**5.97**	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	5.97	6.49	8.14	6.30
17	**6.13**	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	9.25	8.07	7.31
18	**6.25**	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	8.81	12.80	10.23
19	**6.33**	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.80	9.58	9.22
20	**6.89**	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	10.74	11.53	11.53

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	0.20	0.19	0.04	0.20	0.19	0.35	0.19	0.1719	0.22	0.29	0.1896	0.15	0.26
3	0.22	0.34	0.34	0.19	0.35	0.37	0.47	0.37	0.40	0.43	0.40	0.37	0.30
4	0.47	0.52	0.52	0.57	0.54	0.60	0.64	0.68	0.68	0.74	0.66	0.59	0.58
5	0.81	0.77	0.77	0.79	0.90	0.93	0.95	0.97	1.05	1.02	0.98	0.87	0.86
6	1.04	1.13	1.24	1.24	1.32	1.39	1.38	1.44	1.45	1.54	1.31	1.30	1.17
7	1.24	1.44	1.75	2.02	1.97	1.99	1.95	1.86	2.01	2.00	1.92	1.63	1.70
8	1.49	1.70	2.22	2.76	2.96	2.96	2.61	2.44	2.34	2.49	2.46	2.20	1.89
9	1.86	1.97	2.68	3.38	3.79	4.23	3.68	2.97	2.91	2.78	2.96	2.80	2.57
10	2.31	2.57	2.95	3.93	4.61	4.92	5.16	3.99	3.29	3.41	3.13	3.35	3.21
11	3.03	3.09	3.78	4.41	5.09	5.94	5.88	5.72	4.47	3.87	3.85	3.55	4.08
12	3.38	3.90	4.74	5.67	5.94	6.76	6.89	6.72	6.91	5.45	4.41	4.29	4.20
13	4.04	4.76	5.77	7.05	7.76	7.68	7.59	7.52	8.08	8.07	6.60	4.93	5.10
14	5.06	6.26	7.20	7.36	8.32	9.48	9.16	7.82	8.55	9.65	9.01	7.07	5.72
15	4.78	7.13	8.49	8.30	8.38	9.83	9.50	8.87	9.42	10.23	10.80	10.67	7.79
16	5.88	7.64	10.71	9.96	9.37	11.45	11.42	8.43	9.11	11.10	11.35	11.30	12.61
17	6.84	8.24	10.93	11.68	12.15	10.69	12.06	10.51	10.19	13.59	12.13	12.63	10.11
18	8.36	9.75	12.35	9.74	12.51	14.53	10.91	11.65	12.37	13.03	14.73	14.31	17.55
19	9.18	8.39	9.22	11.39	11.76	12.74	12.57	11.42	11.23	15.59	13.64	12.36	16.88
20	11.53	11.53	11.53	11.04	12.49	13.28	12.31	11.37	13.63	11.16	17.22	15.04	14.02

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
2	0.23	0.20	0.26	0.13	0.17	0.21	0.19	0.11	0.35	0.25	0.20	0.23	0.17	**0.17**
3	0.40	0.37	0.33	0.32	0.22	0.38	0.32	0.36	0.39	0.45	0.45	0.41	0.46	0.42
4	0.56	0.60	0.58	0.51	0.46	0.45	0.62	0.56	0.70	0.78	0.69	0.81	0.75	0.80
5	0.84	0.87	0.89	0.82	0.70	0.75	0.83	1.01	1.01	1.21	1.12	1.23	1.34	1.29
6	1.19	1.25	1.24	1.22	1.07	1.01	1.17	1.38	1.69	1.61	1.79	1.79	1.86	1.91
7	1.48	1.59	1.67	1.68	1.56	1.38	1.52	1.78	2.16	2.15	2.23	2.32	2.43	2.45
8	2.03	1.86	2.02	2.10	1.96	3.81	1.81	2.14	2.49	2.61	2.71	2.71	2.92	3.07
9	2.20	2.42	2.25	2.42	2.46	4.35	5.06	2.28	2.85	3.23	3.10	3.33	3.42	3.66
10	2.92	2.75	2.84	2.77	2.43	2.76	5.15	2.99	2.84	3.77	3.98	3.97	4.08	4.23
11	3.92	3.47	3.29	3.41	2.90	3.03	3.44	3.60	3.99	3.67	4.15	4.65	4.79	4.71
12	5.13	4.86	4.30	4.21	4.34	3.71	4.60	2.87	4.43	5.87	4.05	4.73	5.58	5.42
13	5.51	6.42	5.81	5.07	5.15	5.53	5.63	5.63	3.91	5.20	6.37	4.91	5.60	5.82
14	7.03	7.78	7.99	6.89	6.21	6.42	6.90	6.90	5.24	7.67	6.93	7.01	5.47	5.20
15	7.73	9.30	9.51	9.93	8.93	8.57	8.99	8.99	8.99	6.83	8.99	8.99	8.49	6.72
16	9.11	9.55	11.24	10.38	11.27	10.72	10.72	10.72	10.72	10.72	10.72	10.72	10.72	10.17
17	13.04	12.38	12.01	12.70	12.71	12.69	12.69	12.69	12.69	12.69	12.69	12.69	11.13	11.13
18	12.07	15.32	14.62	14.17	13.90	14.87	14.87	14.87	14.87	14.87	14.87	14.87	14.87	13.04
19	19.01	16.08	17.95	13.34	14.27	15.36	15.36	15.36	15.36	15.36	15.36	15.36	15.36	15.36
20	13.96	17.11	16.06	16.60	14.46	15.81	15.81	15.81	15.81	15.81	15.81	15.81	15.81	15.81

Table 12. Estimates of cod abundance (thousands) from surveys in Division 2J in 1983-1992, in Campelen equivalent units.

Stratum depth (meters)	Stratum number	Area sq. nautical miles	Gadus 86-88 1983	Gadus 101-102 1984	Gadus 116-118 1985	Gadus 131-132 1986	Gadus 145-146 1987	Gadus 159-160 1988	Gadus 174-176 1989	Gadus 190-191 1990	Gadus 208-209 1991	Gadus 224-226 1992
	Mean survey date		05-Nov-83	05-Nov-84	30-Oct-85	11-Nov-86	06-Nov-87	14-Nov-88	10-Nov-89	12-Nov-90	14-Nov-91	05-Nov-92
101-200	201	1427	87811	52543	82806	99720	25126	319	0	0	0	0
	205	1823	122517	182501	48964	44029	34532	38745	502	1223	0	0
	206	2582	55637	142654	68017	134937	17607	83620	48332	2874	3197	3339
	207	2246	145830	101693	171902	37826	38648	45550	9825	15492	0	1545
201-300	202	440	5387	8111	4086	31746	7838	1025	0	0	0	0
	209	1608	108766	14599	39668	142610	48249	47602	140710	8590	9006	2522
	210	774	389901	16929	772	97706	479	10221	43414	34603	24230	2783
	213	1725	62645	33648	67470	102247	36569	43632	183006	89430	25390	1948
	214	1171	18102	112678	78314	157299	128223	115524	70582	18267	2942	897
	215	1270	25616	42569	26380	293011	27603	90521	1689	9434	2271	2114
	228	1428	22525	8643	2582	61157	4153	6679	14364	15813	154727	1964
	234	508	50198	16841	11926	22187	6825	2690	0	0	0	256
301-400	203	480	990	1552	638	5745	3962	5910	0	0	66	110
	208	448	5947	760	4622	9768	12572	1849	53462	8012	986	2465
	211	330	4698	908	2361	4880	4835	6945	35386	23197	67475	8058
	216	384	18	740	396	317	9720	1347	2562	872	687	106
	222	441	0	20	698	61	849	182	33214	4853	1597	364
	229	567	6357	208	3536	1872	338	1222	6214	5577	11518	1508
401-500	204	354	1704	5235	0	1802	1242	5405	268	146	0	162
	217	268	0	38	0	0	184	0	0	0	74	0
	227	686	47	0	0	157	236	252	3350	18150	6810	582
	235	420	9620	404	144	0	780	462	664	3178	12537	212
total strata fished <= 500 meters			1124316	743236	615282	1249077	410570	508714	647594	260268	323637	30960
1 STD strata fished <= 500 meters			320612	112688	88262	261581	66519	74633	112157	45978	165231	5287
501-750	212	664	0	91	23	761	365	548	206	3562	41423	274
	218	420	0	**nf**	0	0	0	0	0	0	0	0
	224	270	0	0	0	0	0	0	0	0	130	0
	230	237	0	0	0	0	0	98	0	978	0	0
501-750		1591	0	91 [1]	23	761	365	646	206	4540	41553	274
751-1000	219	213	0	**nf**	0	0	0	0	0	0	0	0
	231	182	0	0	0	0	0	0	**nf** [1]	0	0	325
	236	122	0	0	0	34	0	0	**nf** [1]	0	0	0
751-1000		517	0	0	0	34	0	0	0 [1]	0	0	325
total strata fished > 500 meters			0	91	23	795	365	646	206	4540	41553	599
total all strata fished			1,124,317	743,328	615,304	1,249,871	410,936	509,360	647,797	264,807	365,191	31,560
1 STD all strata fished			320612	112687	88263	261582	66519	74635	112159	46014	170124	5304
mean number per tow			345.328	237.344	188.987	383.891	126.217	159.411	201.556	81.334	112.166	9.693

[1] Not all strata in the depth range have been fished. Strata not fished in the <= 500 meter depth range have been filled using a multiplicative model using data to 1992. Std are for strata fished in the depth range.

Table 13. Estimates of cod biomass (t) from surveys in Division 2J in 1983-1992, in Campelen equivalent units.

Stratum depth (meters)	Stratum number	Area sq. nautical miles	Gadus 86-88 1983	Gadus 101-102 1984	Gadus 116-118 1985	Gadus 131-132 1986	Gadus 145-146 1987	Gadus 159-160 1988	Gadus 174-176 1989	Gadus 190-191 1990	Gadus 208-209 1991	Gadus 224-226 1992
Mean survey date			05-Nov-83	05-Nov-84	30-Oct-85	11-Nov-86	06-Nov-87	14-Nov-88	10-Nov-89	12-Nov-90	14-Nov-91	05-Nov-92
101-200	201	1427	61842	41743	58556	88676	27395	208	0	0	0	0
	205	1823	53701	95026	30679	38754	31421	61555	691	182	0	0
	206	2582	33286	121643	49111	123683	16999	92563	38555	661	1333	1489
	207	2246	46134	55054	107180	25989	36773	18803	2352	6370	0	649
201-300	202	440	8365	7647	3064	32711	11398	1874	0	0	0	0
	209	1608	127333	17017	35398	119210	56901	28242	52339	1670	3966	990
	210	774	241006	21752	1521	87332	737	10667	36642	12536	13406	1116
	213	1725	50086	27703	55229	98497	41997	53146	120476	34360	11859	587
	214	1171	19316	104048	77051	189715	170212	137161	56924	13766	1018	399
	215	1270	30986	31690	30602	379256	36553	146322	315	8508	1073	760
	228	1428	8049	7695	1244	52833	4800	10296	12552	8973	65772	672
	234	508	16910	11930	9173	22705	7342	5157	0	0	0	68
301-400	203	480	2250	3445	582	7875	6300	9640	0	0	45	77
	208	448	7465	1115	4301	8575	16641	3653	22845	3699	455	1091
	211	330	6334	1570	3287	4661	7667	7283	56896	10465	35048	3629
	216	384	52	1592	429	435	13557	2201	3178	255	287	25
	222	441	0	32	784	59	1192	247	9028	2559	579	175
	229	567	2354	263	3823	2399	340	1889	6166	4265	4906	595
401-500	204	354	2458	5863	0	2174	1732	8318	36	37	0	48
	217	268	0	60		0	211	0	0	0	45	0
	223	180	0	0	0	0	0	57	23	212	107	13
	227	686	217	0	0	224	341	353	5407	17904	4643	311
	235	420	4348	332	133	0	1090	717	962	1930	5594	101
total strata fished <= 500 meters			722492	557160	472147	1285763	491599	598478	425387	128352	150136	12795
1 STD strata fished <= 500 meters			177183	83218	65293	325107	31381	97959	218324	25701	72612	2315
501-750	212	664	0	**nf**	0	0	0	0	0	2196	20693	159
	218	420	0	0	0	0	0	0	0	0	62	0
	224	270	0	0	0	0	0	193	0	0	0	0
	230	237	0	0	0	0	0	0	0	1395	0	0
501-750		1591	0	0 [1]	0	0	0	193	0	3591	20755	159
751-1000	219	213	0	nf	0	0	0	0	0	0	0	0
	231	182	0	0	0	0	0	0	**nf**	0	0	144
	236	122	0	0	0	62	0	0	**nf**	0	0	0
751-1000		517	0	0	0	62	0	0	0 [1]	0	0	144
total strata fished > 500 meters			0	0	0	62	0	193	0	3591	20755	303
total all strata fished			722491	557302	472214	1287042	492144	599436	425874	131943	170892	13096
1 STD all strata fished			177183	83218	65293	325108	84935	97963	85921	25746	74135	2326

[1] Not all strata in the depth range have been fished. Strata not fished in the <= 500 meter depth range have been filled using a multiplicative model using data to 1992. Std are for strata fished in the depth range.

Table 14. Estimates of cod abundance (thousands) from surveys in Division 2J in 1993-2002, in Campelen equivalent units for 1993 and 1994 and actual Campelen units for 1995-2002.

Stratum depth (meters)	Stratum number	Area sq. nautical miles	GADUS 236-238 1993	GADUS 250-252 1994	TELEOST 20-23 1995-6	TELEOST 39 1996	TELEOST 54-54 1997	TELEOST 72-73 1998	TELEOST 86-88 1999	TELEOST 340-343 2000	TEL 361 AN 399-400 2001	TEL 415,454, TEL457 2002-3
Mean survey date			07-Nov-93	17-Nov-94	28-Dec-95	30-Oct-96	27-Oct-97	27-Oct-98	13-Nov-99	07-Nov-00	28-Nov-01	24-Dec-02
101-200	201	633	0	0	nf	0	0	44	44	0	0	0
	205	1594	63	219	nf	110	110	32	37	37	37	0
	206	1870	547	0	0	184	257	294	110	115	171	37
	207	2246	2128	2699	350	588	138	751	666	1280	447	1032
	237	733	151	0	273	134	0	34	0	101	25	307
	238	778	nf	0	nf	107	36	0	0	0	36	0
201-300	202	621	0	0	49	0	0	0	0	0	0	0
	209	680	374	514	327	249	62	243	374	187	28	218
	210	1035	5731	854	1424	320	214	178	854	676	261	269
	213	1583	871	0	2504	835	1085	871	290	1161	416	954
	214	1341	1771	338	323	959	406	418	221	517	823	833
	215	1302	1719	358	90	2373	1381	498	788	609	191	466
	228	2196	436	0	949	2068	1347	2001	868	944	1847	1729
	234	530	0	0	nf	73	142	36	32	36	36	146
301-400	203	487	0	301	0	335	234	67	100	0	0	33
	208	588	0	162	768	566	0	40	40	335	144	0
	211	251	414	322	708	483	0	192	383	533	78	72
	216	360	0	173	927	715	99	74	275	198	303	297
	222	450	279	846	495	543	1021	272	371	495	954	836
	229	536	590	295	627	946	205	74	442	184	1180	885
401-500	204	288	0	0	16	20	0	0	14	0	0	20
	217	241	66	55	561	63	0	166	33	33	15	715
	223	158	0	0	880	91	54	19	0	nf	0	73
	227	598	795	0	370	1207	41	247	0	55	0	329
	235	414	1044	1006	541	101	85	85	0	0	0	159
	240	133	9	0	123	9	18	0	128	18	42	125
total strata fished <= 500 meters			16989	8145	12305	13081	6936	6636	6074	7516	7033	9534
upper			28803	16368	16365	17465	9046	8538	8163	10007	9222	12588
t-value			2.571	3.182	2.228	2.228	2.11	2.07	2.18	2.2	2.14	2.09
1STD strata fished <= 500 meters			4595	2584	1822	1968	1000	919	958	1132	1023	1461
501-750	212	557	77	128	69	136	77	0	0	38	0	72
	218	362	0	50	1660	75	0	0	0	0	0	100
	224	228	0	0	596	0	0	0	42	0	0	233
	230	185	0	34	13	0	0	0	13	13	0	480
	239	120	17	17	0	8	7	0	0	0	7	8
751-1000	219	283	0	0	0	0	0	0	0	0	0	0
	231	186	0	0	0	0	0	0	0	0	0	0
	236	193	0	0	12	0	0	0	0	0	0	0
1001-1250	220	330	nf	nf	nf	0	0		nf		0	0
	225	195	nf	nf	nf	0	0		0		0	0
	232	228	nf	nf	nf	0	0		0		0	0
1001-1250[1]		753	nf	nf	nf	0	0	0	0		0	
1251-1500	221	330	nf	nf	nf	0	0		0	0	0	0
	226	201	nf	nf	nf	0	0		0	0	0	0
	233	237	nf	nf	nf	0	0		0	0	0	0
1251-1500[1]		768	nf	nf	nf	0		0	0		0	
total strata fished > 500 meters			94	229	2350	219	84	0	55	51	7	893
total all strata fished			17082	8373	14654	13300	7020	6636	6129	7567	7040	10427
upper			28898	16608	19098	17696	9136	8538	8220	10060	9230	13495
t-value			2.571	3.182	2.16	2.228	2.11	2.07	2.18	2.2	2.14	2.09
1 STD all strata fished			4596	2588	2057	1973	1003	919	959	1133	1023	1468

[1] **Not all strata in the depth range have been fished . Because of the short time series with the revised stratification scheme and a switch in 1995 to a different vessel and gear no attempt has been made to use a multiplicative model to fill strata which were not fished.**

Table 15. Estimates of cod biomass (t) from surveys in Division 2J in 1993-2002, in Campelen equivalent units for 1993 and 1994 and actual Campelen units for 1995-2002.

Stratum depth (meters)	Stratum number	Area sq. nautical miles	GADUS 236-238 1993	GADUS 250-252 1994	TELEOST 20-23 1995-6	TELEOST 39 1996	TELOST 54-55 1997	TELOST 72-73 1998	TELOST 86-88 1999	TELEOST 340-343 2000	TEL 361 AN 399-400 2001	TEL 415,454, TEL457 2002-3
Mean survey date			07-Nov-93	17-Nov-94	28-Dec-95	30-Oct-96	27-Oct-97	27-Oct-98	13-Nov-99	07-Nov-00	28-Nov-01	24-Dec-02
101-200	201	633	0	0	nf	0	0	30	6	0	0	0
	205	1594	63	151	nf	16	42	5	4	42	41	0
	206	1870	155	0	0	62	125	186	24	47	90	20
	207	2246	452	507	44	57	110	406	156	220	107	26
	237	733	83	0	13	8	0	2	0	3	8	2
	238	778	nf	0	nf	21	27	0	0	0	11	0
201-300	202	621	0	0	9	0	0	0	0	0	0	0
	209	680	100	67	52	20	44	162	86	60	7	56
	210	1035	1158	139	108	26	112	98	168	271	77	72
	213	1583	346	0	336	214	586	639	180	398	208	389
	214	1341	700	174	39	273	186	289	127	303	355	460
	215	1302	443	210	21	773	586	404	625	436	88	371
	228	2196	294	0	263	665	747	1258	280	433	514	613
	234	530	0	0	nf	22	83	3	1	3	17	31
301-400	203	487	0	220	0	136	157	67	107	0	0	23
	208	588	0	41	123	200	0	4	12	268	63	0
	211	251	241	110	141	81	0	139	71	208	36	17
	216	360	0	96	234	194	54	73	82	95	148	134
	222	450	146	276	124	290	495	194	200	193	363	374
	229	536	109	124	184	305	138	54	172	63	469	339
401-500	204	288	0	0	1	8	0	0	19	0	0	25
	217	241	67	19	135	26	0	177	14	7	10	401
	223	158	0	0	135	32	35	25	0	nf	0	47
	227	598	441	0	109	748	33	197	0	23	0	146
	235	414	318	559	175	84	30	71	0	0	0	58
	240	133	13	0	68	2	19	0	192	10	32	77
total strata fished <= 500 meters			5129	2693	2312	4261	3609	4483	2527	3082	2646	3680
upper			7096	3824	2905	6472	4574	5924	4023	4171	3345	4790
t-value			2.228	2.201	2.179	2.776	2.086	2.08	2.45	2.23	2.09	2.13
1STD strata fished <= 500 meters			883	514	272	796	463	693	611	488	334	521
501-750	212	557	93	89	15	22	49	0	0	10	0	45
	218	362	0	51	519	12	0	0	0	0	0	77
	224	228	0	0	205	0	0	0	45	0	0	152
	230	185	0	32	14	0	0	0	18	6	0	307
	239	120	17	11	0	2	3	0	0	0	1	7
751-1000	219	283	0	0	0	0	0	0	0	0	0	0
	231	186	0	0	0	0	0	0	0	0	0	0
	236	193	0	0	2	0	0	0	0	0	0	0
1001-1250	220	330	nf	nf	nf	0	0	0	nf	0	0	0
	225	195	nf	nf	nf	0	0	0	0	0	0	0
	232	228	nf	nf	nf	0	0	0	0	0	0	0
1001-1250[1]		753	nf	nf	nf	0	0	0	0	0	0	
1251-1500	221	330	nf	nf	nf	0	0	0	0	0	0	0
	226	201	nf	nf	nf	0	0	0	0	0	0	0
	233	237	nf	nf	nf	0	0	0	0	0	0	0
1251-1500[1]		768	nf	nf	nf	0	0	0	0	0	0	
total strata fished > 500 meters			110	183	755	36	52	0	63	16	1	588
total all strata fished			5238	3448	3067	4298	3662	4483	2590	3098	2647	4270
upper			7217	4019	3927	6510	4629	5924	4091	4187	3346	5387
t-value			2.228	2.179	2.262	2.776	2.08	2.08	2.45	2.23	2.09	2.12
1 STD all strata fished			888	262	380	797	465	693	613	488	334	527

[1] Not all strata in the depth range have been fished . Because of the short time series with the revised stratification scheme and a switch in 1995 to a different vessel and gear no attempt has been made to use a multiplicative model to fill strata which were not fished.

Table 16. Estimates of cod abundance (thousands) from surveys in Division 3K in 1983-1992, in Campelen equivalent units.

Stratum depth (meters)	Stratum number	Area sq. nautical miles	GADUS 87-88 1983	GADUS 101-103 1984	GADUS 117-118 1985	GADUS 131-132 1986	GADUS 146-147 1987	GADUS 160-161 1988	GADUS 175-176 1989	GADUS 191-192 1990	GADUS 209-210 1991	GADUS 224-226 1992
Mean survey date			26-Nov-83	23-Nov-84	18-Nov-85	01-Dec-86	27-Nov-87	05-Dec-88	05-Dec-89	04-Dec-90	04-Dec-91	26-Nov-92
101-200	618	1455	**17028**	24569	26453	64689	14954	57577	14811	13210	721	1268
	619	1588	**3835**	9955	1155	17476	6826	19598	63705	2578	0	218
201-300	620	2709	126888	110535	4685	135397	32793	100337	253826	11304	3780	2236
	621	2859	33593	32109	8338	27811	16059	32525	44025	14230	2517	131
	624	668	10016	9786	2550	2573	1746	3982	4901	24948	7076	735
	632	447	30765	**9851**	4591	4735	7410	51959	4888	22044	10336	1438
	634	1618	61564	31160	29182	323578	60702	21441	269092	4610	99321	694
	635	1274	7711	29442	4682	14225	3593	9534	5934	3505	1490	701
	636	1455	8807	17788	3828	21566	6777	12743	13850	715	1134	133
	637	1132	31704	73889	15928	46132	15805	24915	13766	6634	5320	156
301-400	623	1027	29291	51057	3697	4026	11782	23649	102872	50690	3155	5557
	625	850	4677	1988	7156	3196	11400	5554	21251	11693	1676	546
	626	919	6953	3266	2705	62324	5815	5006	12566	9260	1264	632
	628	1085	7935	4670	6617	2687	1582	18448	12575	5522	9303	4179
	629	495	2357	2557	1647	5720	938	7276	3135	6521	978	1853
	630	544	1497	2170	262	262	524	524	7009	1085	499	150
	633	2179	15312	21312	38293	96780	49404	15737	220703	243039	185926	7410
	638	2059	53867	17476	37259	36467	24472	23650	137139	360185	200000	7511
	639	1463	12449	5283	8780	15127	5980	12176	19270	52757	91771	2262
401-500	622	632	304	1434	283	1652	174	3188	21561	12476	1449	1594
	627	1194	1032	1038	372	4658	2633	1173	10505	85313	4506	3692
	631	1202	1025	33	472	207	3059	6063	42471	28964	15157	992
	640	198	194	0	9	14	0	109	2982	150	1970	17459
	645	204	0	0	9	**90**	112	28	4686	379	0	75
total strata fished <=500 meters			447748	451517	208952	891302	284541	457191	1307523	971810	649350	61622
1 STD strata fished <=500 meters			61132	68574	27228	321032	44267	73335	270219	184614	159892	17726
501-750[1]		917	0	0	0	**nf**	107	**nf**	**nf**	92	122	263
751-1000[1]		1340	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	128	56	0
total strata fished > 500 meters			0	0	0	0	107	0	0	220	178	263
total all strata fished			447748	451517	208952	891302	284648	457191	1307523	972029	649529	61886
1 STD all strata fished			61132	68574	27228	321032	44267	73335	270219	184614	159892	17726

[1] Not all strata in the depth range have been fished. Strata not fished in the <= 500 meter depth range have been filled using a multiplicative model using data to 1992. Std are for strata fished in the depth range.

Table 17. Estimates of cod biomass (t) from surveys in Division 3K in 1983-1992, in Campelen equivalent units.

Stratum depth (meters)	Stratum number	Area sq. nautical miles	GADUS 87-88 1983	GADUS 101-103 1984	GADUS 117-118 1985	GADUS 131-132 1986	GADUS 146-147 1987	GADUS 160-161 1988	GADUS 175-176 1989	GADUS 191-192 1990	GADUS 209-210 1991	GADUS 224-226 1992
Mean survey date			26-Nov-83	23-Nov-84	18-Nov-85	01-Dec-86	27-Nov-87	05-Dec-88	05-Dec-89	04-Dec-90	04-Dec-91	26-Nov-92
101-200	618	1455	**7987**	18702	24894	53641	10200	2443	1575	1514	261	450
	619	1588	**1491**	4801	1113	3157	2538	1212	3363	154	0	119
201-300	620	2709	67557	87523	8223	131461	27088	13232	24447	1636	1158	847
	621	2859	18041	25813	6216	19356	3294	11590	7313	1021	359	194
	624	668	3920	3082	2340	2798	802	3087	1660	8649	3809	331
	632	447	33968	**10779**	4106	4540	7824	51549	2030	8677	5581	663
	634	1618	56301	24843	28663	436500	80357	19008	322401	1976	77639	450
	635	1274	4940	11970	3551	16754	3329	3843	2609	998	617	319
	636	1455	11657	13899	3977	13264	5871	9229	3577	431	334	138
	637	1132	36769	75369	15341	50718	15913	29982	13010	2665	2332	85
301-400	623	1027	23690	46679	5155	4602	17254	3662	22849	12857	1130	1960
	625	850	5410	2474	7062	3405	11136	5766	12105	4049	861	291
	626	919	5565	3377	4274	41267	4852	1188	5858	718	345	218
	628	1085	8807	4909	7807	2564	1484	7998	7102	2184	4028	1345
	629	495	2506	1739	955	5557	907	1391	1550	2003	95	535
	630	544	1452	1564	435	292	743	863	9065	644	267	85
	633	2179	15440	23201	39817	115810	66782	15297	148660	169097	132091	4366
	638	2059	56662	12773	35965	37822	31829	18946	184194	353107	150413	3564
	639	1463	17739	5242	8657	14185	6332	7526	7803	24244	74514	941
401-500	622	632	541	1487	215	1307	163	847	8794	2974	498	564
	627	1194	970	772	360	5307	1150	1208	4805	13523	1248	765
	631	1202	2700	138	493	273	3049	6448	31211	11300	8691	732
	640	198	**385**	0	16	22	0	299	2436	204	1231	16334
	645	204	0	0	50	**255**	139	122	1628	368	0	48
total strata fished <=500 meters			374634	370356	209686	964600	303038	216734	830045	624993	467505	35346
1 STD strata fished <=500 meters			51399	58138	26560	428297	61366	50225	289567	207590	128742	16146
501-750[1]		917	0	0	0	**nf**	174	**nf**	**nf**	72	133	258
751-1000[1]		1340	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	70	39	0
total strata fished > 500 meters			0	0	0	0	174	0	0	142	172	258
total all strata fished			374634	370356	209686	964600	303212	216734	830045	645136	649529	35604
1 STD all strata fished			51399	58138	26560	428297	61366	50225	289567	198748	159892	16146

[1] Not all strata in the depth range have been fished. Strata not fished in the <= 500 meter depth range have been filled using a multiplicative model using data to 1992. Std are for strata fished in the depth range.

Table 18. Estimates of cod abundance (thousands) from surveys in Division 3K in 1993-2002, in Campelen equivalent units for 1993 and 1994 and actual Campelen units for 1995-2002.

Depth range meters	Stratum number	Stratum area sq. mi.	GADUS 236-238 1993	GADUS 250-252 1994	WT 176-81 TELEOST 20-23 1995-6	WT 196-199 TELEOST 40-42 1996	WT 217 TELOEST 55-57 1997	TELEOST 73-75 1998	TELEOST 86-88 1999	TELEOST 340-343 2000	WT 376, 398 TEL 362 397 AN 399 2001	TEL 415,457 WT431,455 WT 456 2002-3
Mean survey date			23-Nov-93	07-Dec-94	26-Dec-95	14-Nov-96	18-Nov-97	14-Nov-98	30-Nov-99	23-Nov-00	08-Dec-01	20-Dec-02
101-200	618	1347	2409	159	1170	1887	1174	1065	865	2038	812	388
	619	1753	965	0	655	218	448	2411	281	2097	1021	512
201-300	620	2545	3268	350	1465	947	764	1814	2514	3383	3172	1246
	621	2736	0	251	2393	303	44	494	1301	1700	1196	988
	624	1105	391	152	813	2432	395	973	472	456	1277	924
	634	1555	468	642	214	1246	31	672	397	616	1497	937
	635	1274	467	0	88	386	243	491	245	361	70	257
	636	1455	734	200	286	133	267	367	300	291	392	371
	637	1132	4983	389	242	810	125	529	1093	**nf**	352	775
301-400	617	593	1876	184	693	109	1006	160	547	1332	2882	236
	623	494	1138	0	578	510	136	217	34	136	1446	755
	625	888	285	0	342	131	305	329	1160	275	912	1000
	626	1113	714	204	2709	1415	31	1868	4651	1217	3253	2927
	628	1085	1443	299	1556	826	358	1151	2507	2478	1791	2047
	629	495	908	375	545	68	69	102	272	393	230	847
	630	332	0	0	41	0	69	23	69	95	15	0
	633	2067	1153	2218	851	1381	885	695	1788	853	876	2428
	638	2059	8780	1187	1252	2155	472	661	5413	7308	5119	13407
	639	1463	1489	1711	712	1025	537	503	1540	786	690	7864
401-500	622	691	1141	57	542	230	63	507	405	665	602	383
	627	1255	2992	604	4924	1918	514	414	2463	9091	699	1746
	631	1321	0	182	501	273	84	0	784	54	99	199
	640	69	228	16	218	25	43	47	66	47	19	71
	645	216	79	119	134	30	15	43	59	104	66	45
	650	134	995	65	276	92	350	74	78	**nf**	46	1501
total strata fished <= 500 meters			36907	9361	23200	18550	8428	15612	29308	35774	28535	41853
upper			49711	14727	26817	22907	10868	19783	35059	59488	35927	64414
t-value			2.201	2.228	2.086	2.06	2.16	2.12	2.04	2.78	2.13	2.2
1 STD strata fished <= 500 meters			5817	2408	1734	2115	1130	1967	2819	8530	3470	10255
501-750	641	230	11	21	63	47	0	16	0	**nf**	16	662
	646	325	75	0	0	0	22	0	89	0	0	45
	651	359	16	123	691	25	0	198	0	**nf**	28	85
751-1000	642	418	115	0	0	0	0	0	0	0	0	0
	647	360	0	0	0	0	0	0	0	0	0	0
	652	516	142	106	0	0	0	71	35	0	0	0
1001-1250	643	733	**nf**	**nf**	0	0		0	0		0	0
	648								0		16	0
	653	531	0	**nf**	0	0		0	0		0	0
1001-1250[3]		1264	**nf**	**nf**	0	0	0	0	0	0		
1251-1500	644	474	**nf**	**nf**	0	0		0	0	0	0	0
	649	212						0	0	0	0	0
	654	479	**nf**	**nf**	0	0		0	0	0	0	0
1251-1500[3]		1165	**nf**	**nf**	0	0	0	0	0	0		
total strata fished > 500 meters			359	250	754	72	22	285	124	0	44	792
total all strata fished			37265	9612	23954	18621	8450	15896	29433	39110	28595	42644
upper			50073	14985	27678	22980	13883	20071	35187	61174	35987	65206
t-value			2.201	2.228	2.08	2.06	2.101	2.12	2.04	2.57	2.13	2.2
1 STD all strata fished			5819	2412	1790	2116	2586	1969	2821	8585	3470	10255

[1] Not all strata in the depth range have been fished. Because of the short time series with the revised stratification scheme and a switch in 1995 to a different vessel and gear no attempt has been made to use a multiplicative model to fill strata which were not fished.

Table 19. Estimates of cod biomass (t) from surveys in Division 3K in 1993-2002, in Campelen equivalent units for 1993 and 1994 and actual Campelen units for 1995-2002.

Depth range meters	Stratum number	Stratum area sq. mi.	GADUS 236-238 1993	GADUS 250-252 1994	WT 176-181 TELEOST 20-23 1995-6	WT 196-199 TELEOST 40-42 1996	WT 217 TELOEST 55-57 1997	TELEOST 73-75 1998	TELEOST 86-88 1999	TELEOST 340-343 2000	WT 376/ 398 TEL 362 397 AN 399 2001	TEL 415,457 WT431,455 WT 456 2002-3
Mean survey date			23-Nov-93	07-Dec-94	26-Dec-95	14-Nov-96	18-Nov-97	14-Nov-98	30-Nov-99	23-Nov-00	08-Dec-01	20-Dec-02
101-200	618	1347	721	40	87	221	291	170	56	252	99	72
	619	1753	708	0	32	42	36	158	20	154	97	101
201-300	620	2545	614	118	238	230	203	471	245	415	649	164
	621	2736	0	267	302	77	202	207	296	397	169	186
	624	1105	177	85	251	714	207	752	263	225	492	364
	634	1555	189	417	97	391	7	300	178	152	637	424
	635	1274	189	0	10	94	208	322	76	104	17	82
	636	1455	334	141	92	39	234	303	171	260	96	93
	637	1132	2039	74	74	358	38	321	575	**nf**	168	235
301-400	617	593	383	74	97	14	359	95	212	237	748	97
	623	494	213	0	32	144	37	70	10	41	309	153
	625	888	229	0	99	66	139	166	573	173	296	342
	626	1113	468	89	289	340	6	1034	1217	259	716	543
	628	1085	736	80	353	409	274	647	837	524	953	588
	629	495	343	20	70	12	45	54	116	192	97	176
	630	332	0	0	11	0	53	14	30	38	8	0
	633	2067	502	1067	420	535	516	624	1138	615	543	1105
	638	2059	3913	401	635	723	232	593	3372	3974	2863	3385
	639	1463	622	761	290	415	260	494	1124	780	418	2542
401-500	622	691	299	32	68	55	19	143	178	138	214	70
	627	1255	891	226	702	466	211	150	825	2917	135	438
	631	1321	0	208	99	45	90	0	481	27	59	36
	640	69	131	11	90	13	30	71	96	37	13	35
	645	216	84	87	48	14	11	44	62	84	63	48
	650	134	441	43	112	40	292	76	78	**nf**	30	613
total strata fished <= 500 meters			14227	4241	4578	5457	3978	7280	12230	11994	9890	11889
upper			18515	6644	5456	6695	5034	9559	14902	19284	12834	18138
t-value			2.228	2.262	2.056	2.037	2.145	2.23	2.07	2.45	2.14	2.18
1 STD strata fished <= 500 meters			1925	1062	427	608	492	1022	1291	2976	1376	2867
501-750	641	230	16	18	83	101	0	13	0	**nf**	14	438
	646	325	51	0	0	0	42	0	200	0	0	41
	651	359	25	116	317	30	0	133	0	**nf**	35	78
751-1000	642	418	72	0	0	0	0	0	0	0	0	0
	647	360	0	0	0	0	0	0	0	0	0	0
	652	516	208	62	0	0	0	96	89	0	0	0
1001-1250	643	733	**nf**	**nf**	0	0	0	0	0	0	0	0
	648							0	0	0	7	0
	653	531	0	**nf**	0	0	0	0	0	0	0	0
1001-1250[3]		1264	**nf**	**nf**	0	0	0	0	0	0	7	0
1251-1500	644	474	**nf**	**nf**	0	0	0	0	0	0	0	0
	649	212						0	0	0	0	0
	654	479	**nf**	**nf**	0	0	0	0	0	0	0	0
1251-1500[3]		1165	**nf**	**nf**	0	0	0	0	0	0	0	0
total strata fished > 500 meters			372	196	400	131	42	242	289	0	56	557
total all strata fished			14598	4437	4978	5588	4020	7522	12519	11994	9946	12446
upper			18892	6848	5986	6827	5583	9812	15222	19889	12892	18696
t-value			2.228	2.262	2.12	2.037	2.11	2.23	2.06	2.45	2.14	2.18
1 STD all strata fished			1927	1066	475	608	741	1027	1312	3222	1377	2867

[1] Not all strata in the depth range have been fished. Because of the short time series with the revised stratification scheme and a switch in 1995 to a different vessel and gear no attempt has been made to use a multiplicative model to fill strata which were not fished.

Table 20. Estimates of cod abundance (thousands) from surveys in Division 3L in 1992-2002 in depths <= 200 fathoms. The 1992-1994 data are in Campelen equivalent units and the 1995-2002 data are in actual Campelen units.

Stratum depth (fathoms)	Stratum number	Area sq. nautical miles	WT 129-130 1992	WT 145-146 1993	WT 160-162 1994	WT 176-181 1995	Tel 41 WT 196-198 1996	Tel 55-57 WT 213-217 1997	WT 230-233 1998	WT 245-247 1999	WT 321-323 Tel 342-343 2000	AN 399 WT 373-376 TEL 357-358 361 2001	Tel 412 ,413 Tel 415 WT 428-431 2002-3
Mean survey date			16-Nov-92	23-Nov-93	22-Nov-94	27-Nov-95	02-Nov-96	27-Nov-97	15-Nov-98	29-Nov-99	28-Nov-00	15-Nov-01	12-Nov-02
31-50	350	2071	1140	1804	122	1045	285	570	773	1587	936	1420	512
	363	1780	13036	408	367	365	82	1306	481	367	184	245	408
	371	1121	1079	103	0	31	0	0	0	39	0	0	77
	372	2460	2919	299	0	353	414	42	1114	1269	1523	926	550
	384	1120	146	154	0	0	0	0	0	385	77	0	39
51-100	328	1519	1114	488	139	0	334	376	334	1226	209	5391	775
	341	1574	217	1516	0	36	289	54	223	1256	476	1261	558
	342	585	54	0	80	40	121	40	80	724	201	188	40
	343	525	722	72	96	36	0	68	0	361	397	36	36
	348	2120	3208	**nf**	219	250	393	167	194	767	292	1333	287
	349	2114	58	1939	208	122	166	344	162	955	614	706	291
	364	2817	388	1421	323	43	116	525	0	775	1163	388	172
	365	1041	286	95	95	215	207	191	0	0	**nf**	95	239
	370	1320	484	666	0	73	0	91	0	0	257	45	40
	385	2356	648	0	0	0	36	0	41	41	0	162	0
	390	1481	136	0	0	34	0	0	0	204	0	0	0
101-150	344	1494	5446	2363	771	530	2950	914	715	1548	2023	968	1219
	347	983	676	439	34	199	391	541	406	316	371	496	225
	366	1394	44544	2972	115	230	236	652	443	345	671	5420	3209
	369	961	1884	227	0	78	0	220	39	1332	0	176	44
	386	983	766	135	0	0	45	0	0	45	0	45	45
	389	821	0	0	0	38	0	38	0	151	113	38	0
	391	282	129	116	0	0	0	19	0	97	19	0	17
151-200	345	1432	985	1510	542	2780	433	302	653	2863	4436	3467	1055
	346	865	33292	1417	136	754	379	1269	297	881	45577	3570	806
	368	334	30338	15627	88	299	128	459	368	980	9396	694	184
	387	718	2864	2601	779	66	44	1514	132	527	494	329	88
	388	361	579	414	177	99	0	135	0	5313	472	221	50
	392	145	20	27	0	19	18	20	0	928	130	104	18
total strata fished <= 200 fathoms			147159	36813	4292	7732	7066	9859	6454	25281	29010	27724	10984
ADJUSTED			147158	36813	4291	7735	7067	9859	6454	25281	29010	27724	10984
upper			215462	65605	6233	12328	12052	15027	8524	95232	52913	42861	15550
t-value			2.012	2.306	2.042	2.306	2.571	2.776	2.05	12.71	4.3	2.23	2.36
1 STD strata fished <= 200 fathoms			33948	12486	951	1993	1939	1862	1010	5504	5559	6788	1935

[1] **Not all strata in the depth range have been fished. Strata not fished in the <= 200 fathom depth range have been filled using a multiplicative model using data to 1992. Std are for strata fished in the depth range.**

Table 21. Estimates of cod biomass (t) from surveys in Division 3L in 1992-2002 in depths <= 200 fathoms. The 1992-1994 data are in Campelen equivalent units and the 1995-2002 data are in actual Campelen units.

Stratum depth (fathoms)	Stratum number	Area sq. nautical miles	WT 129-130	WT 145-146	WT 160-162	WT 176-181	Teleost 41 WT 196-199	Tel 55-57 WT 213-217	WT 230-233	WT 246-248	WT 321-323 Tel 342-343	AN 399 WT 373-376 TEL 357-358 361	Tel 412 ,413 Tel 415 WT 428-431
			1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002-3
Mean survey date			16-Nov-92	23-Nov-93	22-Nov-94	27-Nov-95	02-Nov-96	27-Nov-97	15-Nov-98	29-Nov-99	28-Nov-00	15-Nov-01	12-Nov-02
31-50	350	2071	1877	1522	179	1276	362	1355	997	1342	842	2442	367
	363	1780	7504	344	211	506	224	2895	152	80	28	588	1230
	371	1121	893	91	0	10	0	0	0	26	0	0	73
	372	2460	1896	287	0	54	557	29	431	608	66	1303	1074
	384	1120	127	67	0	0	0	0	0	212	4	0	0
51-100	328	1519	1748	166	248	0	537	1014	144	195	41	3995	145
	341	1574	253	289	0	2	248	16	290	1043	120	475	272
	342	585	123	0	36	22	184	66	5	164	135	79	13
	343	525	459	79	34	18	0	45	0	69	130	5	6
	348	2120	1504	**nf**	322	181	326	144	191	144	55	583	174
	349	2114	66	1755	54	88	117	327	357	531	228	658	114
	364	2817	526	873	302	1	95	353	0	331	403	59	82
	365	1041	347	54	114	129	147	72	0	0	**nf**	72	72
	370	1320	673	171	0	72	0	41	0	0	107	17	22
	385	2356	735	0	0	0	11	0	57	13	0	77	0
	390	1481	81	0	0	13	0	0	0	81	0	0	0
101-150	344	1494	3003	988	382	233	2214	221	409	802	908	274	601
	347	983	181	351	20	99	324	259	407	81	87	224	175
	366	1394	40824	2426	116	121	87	264	223	58	321	2527	1572
	369	961	937	180	0	174	0	170	4	1048	0	64	15
	386	983	366	194	0	0	20	0	0	26	0	18	10
	389	821	0	0	0	12	0	35	0	58	54	9	0
	391	282	18	53	0	0	0	21	0	178	1	0	31
151-200	345	1432	736	957	245	1441	370	76	512	1301	1299	2178	709
	346	865	29383	702	91	459	243	466	287	414	1359	2350	394
	368	334	29646	10776	80	129	48	181	240	954	8268	290	169
	387	718	2018	1984	321	25	19	851	99	284	227	180	30
	388	361	390	268	119	35	0	78	0	3080	335	140	97
	392	145	9	19	0	15	7	10	0	489	51	97	10
total strata fished <= 200 fathoms			126323	24594	2873	5114	6140	8991	4804	13611	15070	18706	7460
ADJUSTED			126323	24596	2874	5115	6140	8991	4804	13611		18706	7460
upper			193308	44710	3895	7661	9799	13920	6901	56006	83892	27204	10528
t-value			2.014	2.306	2.035	2.145	2.306	2.228	2.04	12.71	12.71	2.12	2.13
1 STD strata fished <= 200 fathoms			33260	8723	502	1187	1587	2212	1028	3336	5415	4008	1440

[1] **Not all strata in the depth range have been fished. Strata not fished in the <= 200 fathom depth range have been filled using a multiplicative model using data to 1992. Std are for strata fished in the depth range.**

Table 22. Estimates of cod abundance (thousands) and biomass (t) from surveys in Division 3L in 1992-2002 in depths > 200 fathoms. The 1992-1994 data are in Campelen equivalent units and the 1995-2002 data are in actual Campelen units.

Stratum	Stratum	Area sq.					Teleost 41	Tel 55-57				AN 399	Tel 412 ,413
depth	number	nautical	WT	WT	WT	WT	WT	WT	WT	WT	WT 321-323	WT 373-376	Tel 415
(fathoms)		miles	129-130	145-146	160-162	176-181	196-198	213-217	230-233	246-249	Tel 342-343	TEL 357-358 361	WT 428-431
			1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002-3
Mean survey date			16-Nov-92	23-Nov-93	22-Nov-94	27-Nov-95	02-Nov-96	27-Nov-97	18-Nov-98	29-Nov-99	28-Nov-00	15-Nov-01	12-Nov-02
			ABUNDANCE										
201-300	729	186	13	213	0	0	0	13	0	38	0	38	0
	731	216	168	277	21	13	**nf**	178	0	40	208	106	0
	733	468	494	1223	107	32	0	193	61	64	101	444	29
	735	272	886	9155	180	187	0	449	112	67	3528	692	83
301-400	730	170	0	0	8	0	0	0	0	0	0	0	0
	732	231	0	0	0	0	0	0	0	0	0	0	0
	734	228	0	31	42	0	0	167	0	0	0	0	0
	736	175	0	96	28	32	0	144	0	24	0	12	0
401-500	737	227	**nf**	**nf**	**nf**	16	0	0	0	0	0	0	0
	741	223	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
	745	348	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
	748	159	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
401-500		957	**nf**	**nf**	**nf**	16	0	0	0		0	0	
501-600	738	221	**nf**	**nf**	**nf**	0	0	0	0	0	0	0	0
	742	206	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
	746	392	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
	749	126	**nf**	**nf**	**nf**	**nf**	0	0	0	**nf**	0	0	0
501-600		945	**nf**	**nf**	**nf**	0	0	0	0	0	0	0	
601-700	739	254	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
	743	211	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
	747	724	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
	750	556	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
601-700		1745	**nf**	**nf**	**nf**	**nf**	0	0	0	0		0	
701-800	740	264	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
	744	280	**nf**	**nf**	**nf**	**nf**	0	0	0	**nf**	0	0	0
	751	229	**nf**	**nf**	**nf**	**nf**	0	0	0	**nf**	0	0	0
701-800		773	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
total strata fished > 200 fathioms			1561	10995	386	280	0	1144	173	233	3837	1292	112
total all strata fished offshore			148719	47809	4678	8013	7066	11003	6628	25514	32846	29017	11096
upper			217045	77554	6627	12630	12052	19944	8699	95474	58560	44211	15667
t-value			2.012	2.228	2.042	2.306	2.571	2.447	2.05	12.71	4.3	2.23	2.36
1 STD all strata fished offshore			33959	13351	954	2002	1939	3654	1010	5504	5980	6813	1937
			BIOMASS										
201-300	729	186	45	208	0	0	0	19	0	67	0	45	0
	731	216	131	177	23	5	**nf**	178	0	20	165	108	0
	733	468	316	837	85	14	0	161	68	66	110	261	36
	735	272	1233	4809	91	109	0	369	167	104	3973	697	155
301-400	730	170	0	0	8	0	0	0	0	0	0	0	0
	732	231	0	0	0	0	0	0	0	0	0	0	0
	734	228	0	18	42	0	0	313	0	0	0	0	0
	736	175	0	51	28	15	0	169	0	37	0	7	0
												0	
401-500	737	227	**nf**	**nf**	**nf**	17	0	0	0	0	0	0	0
	741	223	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
	745	348	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
	748	159	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
401-500		957	**nf**	**nf**	**nf**	17	0	0	0		0	0	
501-600	738	221	**nf**	**nf**	**nf**	0	0	0	0	0		0	0
	742	206	**nf**	**nf**	**nf**	**nf**	0	0	0	0		0	0
	746	392	**nf**	**nf**	**nf**	**nf**	0	0	0	0		0	0
	749	126	**nf**	**nf**	**nf**	**nf**	0	0	0	**nf**		0	0
501-600		945	**nf**	**nf**	**nf**	0	0	0	0	0	0	0	
601-700	739	254	**nf**	**nf**	**nf**	**nf**	0	0	0	0		0	0
	743	211	**nf**	**nf**	**nf**	**nf**	0	0	0	0		0	0
	747	724	**nf**	**nf**	**nf**	**nf**	0	0	0	0		0	0
	750	556	**nf**	**nf**	**nf**	**nf**	0	0	0	0		0	0
601-700		1745	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	
701-800	740	264	**nf**	**nf**	**nf**	**nf**	0	0	0	0		0	0
	744	280	**nf**	**nf**	**nf**	**nf**	0	0	0	**nf**		**0**	0
	751	229	**nf**	**nf**	**nf**	**nf**	0	0	0	**nf**		**0**	0
701-800		773	**nf**	**nf**	**nf**	**nf**	0	0	0	0	0	0	0
total strata fished > 200 fathoms			1725	6100	277	160	0	1209	235	294	4248	1118	191
total all strata fished offshore			128048	30694	3149	5275	6140	10200	5039	13904	19352	19824	7652
upper			195072	51127	4178	7834	9799	19797	7148	56316	91155	28382	10721
t-value			2.014	2.262	2.032	2.145	2.306	2.447	2.07	12.71	12.71	2.12	2.12
1 STD all strata fished offshore			33279	9033	506	1193	1587	3922	1019	3337	5649	4037	1448

Table 23. Estimates of cod abundance (thousands) and biomass (t) from surveys in inshore strata of divisions 3K and 3L in 1996-1998 and 2000-2002. Also shown are totals for offshore strata and for all strata fished.

Division 3K

Stratum depth (meters)	Stratum number	Area sq. nautical miles	WT 196-199 TELEOST 40-42 1996	WT 217 TELEOST 55-57 1997	WT 233 1998	WT 321-323 Tel 342-343 2000	WT 372-376 WT 398 2001	WT 428-431 2002	WT 196-199 TELEOST 40-42 1996	WT 217 TELEOST 55-57 1997	WT 233 1998	WT 321-323 2000	WT 372-376 WT 398 2001	WT 428-431 2002
Mean survey date			14-Nov-96	18-Nov-97	02-Dec-98	28-Nov-00	37210		14-Nov-96	18-Nov-97	02-Dec-98	28-Nov-00	15-Nov-01	
			abundance						biomass					
101-200	608	798	915	1061	1647	2023	3732	951	201	142	113	288	431	86
	612	445	510	92	367	184	284	153	111	3	18	7	20	8
	616	250	103	52	206	103	209	52	4	0	5	9	6	11
201-300	609	342	436	329	155	188	588	518	108	64	30	79	188	128
	611 [3]	600	122	578	169	428	254	631	25	129	9	136	83	118
	615	251	0	17	104	86	86	17	0	0	61	8	14	1
301-400	610	256	31	405	493	317	345	247	3	117	50	63	58	55
	614	263	16	0	18	0	0	0	2	0	33	0	0	0
401-500	613	30	0	0	12	7	0	0	0	0	1	1	0	0
total inshore strata			2133	2534	3171	3336	5498	2568	454	455	320	592	800	408
total offshore			18622	8450	15896	35774	28595	42934	5588	4020	7521	11994	9946	12523
total all strata fished			20756	10984	19067	39110	34093	45502	6039	4475	7843	12585	10746	12931
upper			25281	13883	23352	61173	41607	68034	7036	5583	10141	19889	13694	19174
t-value			2.048	2.101	2.1	2.57	2.12	2.2	2.032	2.11	2.23	2.45	2.14	2.18
STD all strata fished			2209	1380	2040	8585	3544	10242	491	525	1030	2981	1378	2864

Division 3L

Stratum depth (fathoms)	Stratum number	Area sq. nautical miles	Teleost 41 WT 196-198 1996	WT 213-217 TELEOST 57-58 1997	WT 233 1998	WT 321-323 Tel 342-343 2000	WT 372-376 WT 398 2001	WT 428-431 2002	Teleost 41 WT 196-198 1996	WT 213-217 TELEOST 57-58 1997	WT 233 1998	WT 321-323 2000	WT 372-376 WT 398 2001	WT 428-431 2002
Mean survey date			02-Nov-96	27-Nov-97	28-Nov-98	28-Nov-00	15-Nov-01	12-Nov-02	02-Nov-96	27-Nov-97	28-Nov-98	28-Nov-00	15-Nov-01	20-Dec-02
			abundance						biomass					
16-30	784	268	1161	977	203	1419	4737	250	80	40	3	597	378	6
31-50	785	465	3998	1279	352	1567	2910	959	6627	1786	109	564	181	150
51-100	786	84	12	97	532	58	56	116	2	36	54	43	17	39
	787	613	42	84	4005	1288	201	422	135	61	105	214	28	264
	788 [1]	252	2409	323	144	1849	1387	156	177	232	92	79	208	85
	790	89	55	444	61	208	318	402	56	222	24	67	53	181
	793	72	599	119	64	337	1362	594	155	56	24	35	84	171
	794	216	609	97	104	**nf**	1997	1119	84	122	31	**nf**	474	229
	797	98	20	27	101	440	162	150	11	13	24	25	8	25
	799	72	857	30	39	89	312	11	410	19	9	9	43	7
101-150	795	164	11	64	163	1277	429	654	5	50	58	69	80	145
	791 [2]	227		200	94	710	1102	281		154	53	274	626	148
101-200	789 [1]	81	0	0	0	4	10	0	0	0	0	1	2	0
	791 [2]	308	191	X	X	X	X	X	114	X	X	X	X	X
	798	100	14	0	34	107	227	360	47	0	11	33	53	173
151-200	796	175	0	23	12	138	686	300	0	8	2	34	136	85
	800 [2]	81		6	49	94	95	40		2	60	21	34	14
201-300	792	50	0	0	3	3	10	3	0	0	3	1	7	1
total inshore strata			9978	3770	5960	9588	16002	5817	7903	2801	662	2066	2412	1719
total offshore			7066	11004	6628	32846	29017	11096	6140	10200	5039	19352	19824	7652
total all strata fished			17044	14774	12588	42435	45019	16913	14044	13000	5702	21418	22236	9371
upper			27958	19944	61095	62955	61291	22146	92802	19797	7837	93444	30832	12376
t-value			2.776	2.447	12.71	3.18	2.14	2.2	12.706	2.447	2.06	12.71	2.11	2.11
STD all strata fished			3932	2113	3816	6453	7604	2379	6198	2778	1036	5667	4074	1424

changes below were made before 1997 fall survey

[1] Area of stratum 788 was increased by 9 sq. n. mi and the area of stratum 789 was decreased by 9 sq.n. mi.

[2] Stratum 791 in the 100-200 depth range was divided into two separate strata 791 101-150 with area =227 sq. n. mi.and strata 800 151-200 area = 81 sq. n.mi.

[3] Stratum 611 area was decreased by 27 sq. n. mi.

Table 24. Summary of estimates of cod abundance (thousands) and biomass (t) for all strata fished in 1984-2000. Data from 1984-1994 are in Campelen equivalent units and data from 1995-2000 are in actual Campelen units.

DIVISION	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total abundance all strata fished																	
2J	1,249,871	410,936	509,360	647,797	264,807	365,191	31,560	17082	8373	14654	13300	7020	6636	6129	7567	7040	10427
3K	891302	284648	457191	1307523	972029	649529	61886	37265	9612	23954	20756	10984	19067	29433	39110	34093	45212
3L	358606	325352	256383	172299	396008	145682	148719	47809	4678	8013	17044	14774	12588	25514	42435	45019	16913
2J3KL	2,499,779	1,020,936	1,222,934	2,127,619	1,632,844	1,160,402	242,165	102,156	22,663	46,621	51,100	32,778	38,291	61,076	89,112	86,152	72,552
Total biomass all strata fished																	
2J	1,287,042	492,144	599,436	425,874	131,943	170,892	13,096	5,238	2,877	3,067	4,298	3,662	4,483	2,590	3,098	2647	4270
3K	964,600	303,212	216,734	830,045	645,136	649,529	35,604	14,598	4,437	4,978	6,039	4,475	7,842	12,519	12,585	10746	12854
3L	387,438	284,230	274,553	160,688	406,730	123,108	128,048	30,694	3,149	5,275	14,044	13,000	5,701	13,904	21,418	22236	9371
2J3KL	2,639,080	1,079,586	1,090,723	1,416,607	1,183,809	943,529	176,748	50,530	10,463	13,320	24,381	21,137	18,026	29,013	37,101	35,629	26,495
Percent abundance																	
2J	50	40	42	30	16	31	13	17	37	31	26	21	17	10	8	8	14
3K	36	28	37	61	60	56	26	36	42	51	41	34	50	48	44	40	62
3L	14	32	21	8	24	13	61	47	21	17	33	45	33	42	48	52	23
Percent biomass																	
2J	49	46	55	30	11	18	7	10	27	23	18	17	25	9	8	7	16
3K	37	28	20	59	54	69	20	29	42	37	25	21	44	43	34	30	49
3L	15	26	25	11	34	13	72	61	30	40	58	62	32	48	58	62	35

Table 25. Summary of estimates of cod abundance (thousands) and biomass (t) for divisions 2J, 3K and 3L separately and combined in 1995-2002. Strata are aggregated into offshore index strata; those strata deeper than the offshore index strata and seaward of them; and those strata inshore of the offshore index strata. There are no inshore strata in Division 2J.

Division	Grouping	**Abundance (thousands)**							
		1995	1996	1997	1998	1999	2000	2001	2002
2J	index	12,305	13,081	6,936	6,636	6,074	7,516	7,033	9,534
	offshore deep	2,350	219	84	0	55	51	7	883
	total	14,654	13,300	7,020	6,636	6,129	7,567	7,040	10,417
3K	index	23,200	18,550	8,428	15,612	29,308	35,774	28,535	41,853
	offshore deep	754	72	22	285	124	0	60	792
	inshore	**nf**	2,133	2,534	3,171	**nf**	3,336	5,498	2,569
	total	23,954	20,755	10,984	19,068	29,432	39,110	34,093	45,214
3L	index	7,735	7,067	9,859	6,454	25,281	29,010	27,724	10,984
	offshore deep	280	0	1,144	173	233	3,837	1,293	112
	inshore	**nf**	9,978	3,770	5,960	**nf**	9,588	16,002	5,817
	total	8,015	17,045	14,773	12,587	25,514	42,435	45,019	16,913
2J3KL	index	43,240	38,698	25,223	28,702	60,663	72,300	63,292	62,371
	offshore deep	3,384	291	1,250	458	412	3,888	1,360	1,787
	inshore	**nf**	12,111	6,304	9,131	**nf**	12,924	21,500	8,386
	total	46,624	51,100	32,777	38,291	61,075	89,112	86,152	72,544

		Biomass (t)							
		1995	1996	1997	1998	1999	2000	2001	2002
2J	index	2,312	4,261	3,609	4,483	2,527	3,082	2,646	3,680
	offshore deep	755	36	52	0	63	16	1	588
	total	3,067	4,298	3,662	4,483	2,590	3,098	2,647	4,268
3K	index	4,578	5,457	3,978	7,280	12,230	11,994	9,890	11,889
	offshore deep	400	131	42	242	289	0	56	557
	inshore	**nf**	454	455	320	**nf**	592	800	408
	total	4,978	6,042	4,475	7,842	12,519	12,586	10,746	12,854
3L	index	5,115	6,140	8,991	4,804	13,611	15,070	18,706	7,460
	offshore deep	160	0	1,209	235	294	4,282	1,118	191
	inshore	**nf**	7,903	2,801	662	**nf**	2,066	2,412	1,719
	total	5,275	14,043	13,001	5,701	13,905	21,418	22,236	9,370
2J3KL	index	12,005	15,858	16,578	16,567	28,368	30,146	31,242	23,029
	offshore deep	1,315	167	1,303	477	646	4,298	1,175	1,336
	inshore	**nf**	8,357	3,256	982	**nf**	2,658	3,212	2,127
	total	13,320	24,382	21,137	18,026	29,014	37,102	35,629	26,492

Table 26. Autumn bottom-trawl mean number per tow at age in offshore index strata adjusted for missing strata (1983-2002). The 2J3KL total is the mean of the divisional means, weighted by the divisional survey areas.

2J

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	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	0.01	0.00	0.00	0.33
1	46.58	7.57	1.71	0.65	1.46	20.52	4.86	2.75	0.37	0.00	0.00	0.18	2.46	0.52	0.00	0.10	0.21	0.58	0.17	0.43
2	147.86	41.01	14.01	18.71	3.03	17.69	108.44	13.80	11.17	0.68	3.22	1.21	1.24	2.10	0.43	0.19	0.82	0.68	0.71	0.76
3	61.64	86.28	48.03	39.16	8.12	10.83	33.77	46.34	19.04	4.45	1.03	0.83	0.80	1.21	1.47	0.74	0.58	0.79	1.29	0.8
4	61.08	38.75	74.50	97.79	12.11	12.14	16.27	12.48	60.31	1.70	1.05	0.34	0.31	0.49	0.40	0.92	0.31	0.47	0.19	0.78
5	25.59	53.27	28.44	153.27	50.67	16.35	10.85	4.79	14.89	3.29	0.32	0.15	0.08	0.13	0.12	0.30	0.17	0.04	0.06	0.10
6	10.44	14.98	27.11	68.45	43.15	41.46	12.35	2.39	1.73	0.31	0.27	0.01	0.03	0.02	0.00	0.04	0.00	0.04	0.01	0.01
7	4.87	2.87	9.75	29.99	9.98	42.71	17.99	1.44	0.70	0.01	0.02	0.02	0.00	0.02	0.00	0.01	0.00	0.00	0.01	0.00
8	12.46	1.83	1.35	10.84	6.58	6.93	11.13	2.35	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	5.05	3.46	0.83	0.70	2.64	4.27	1.45	1.08	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	2.87	1.49	1.14	0.64	0.41	2.06	0.77	0.23	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.58	0.54	0.39	0.55	0.04	0.28	0.35	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.04	0.12	0.17	0.29	0.16	0.11	0.12	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.03	0.02	0.03	0.07	0.06	0.08	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
14	0.02	0.00	0.00	0.02	0.04	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
15	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
16	0.00	0.00	0.00	0.00	0.00	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
17	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	0.00	0.00	0.00
18	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	0.00	0.00	0.00
19	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	0.00	0.00	0.00
20	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	0.00	0.00	0.00
21	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	0.00	0.00	0.00
22	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	0.00	0.00	0.00
23	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	0.00	0.00	0.00
24	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	0.00	0.00	0.00
25	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	0.00	0.00	0.00
TOTAL	379.11	252.19	207.46	421.13	138.45	175.48	218.36	87.76	109.11	10.44	5.91	2.74	4.92	4.49	2.42	2.30	2.10	2.60	2.44	3.21

3K

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	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	0.08	0.15	0.28	0.71	0.05	0.04
1	22.84	8.27	0.28	7.91	7.35	37.54	36.91	22.21	0.59	0.65	0.28	0.20	2.78	0.70	0.07	1.13	1.07	2.61	1.46	2.09
2	32.49	32.45	5.07	18.35	6.63	29.28	111.95	32.45	15.74	2.85	4.67	0.39	1.56	2.28	0.92	0.80	2.71	2.33	2.22	5.19
3	27.87	24.34	13.32	21.13	8.34	18.49	58.16	83.98	23.97	4.12	2.24	1.16	0.97	1.20	0.85	0.92	2.01	2.24	2.37	2.03
4	15.09	22.21	12.39	65.26	10.01	8.40	44.92	48.74	70.05	2.33	1.27	0.38	0.34	0.34	0.20	0.59	0.87	1.17	0.71	0.92
5	17.24	11.98	10.93	56.87	17.27	6.92	25.69	23.11	37.29	4.01	0.30	0.14	0.10	0.10	0.09	0.20	0.36	0.27	0.30	0.21
6	4.39	8.97	4.13	29.01	11.21	7.54	17.17	12.35	9.09	1.16	0.34	0.02	0.02	0.00	0.00	0.06	0.03	0.05	0.03	0.02
7	2.58	3.12	3.23	13.32	4.17	3.70	14.93	7.74	2.80	0.16	0.09	0.03	0.00	0.01	0.00	0.05	0.02	0.01	0.00	0.00
8	4.26	1.41	0.86	6.66	2.67	1.00	7.06	7.62	1.03	0.03	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00
9	2.98	2.12	0.65	2.41	1.21	0.44	2.54	2.35	0.56	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00
10	0.91	1.06	0.55	0.64	0.52	0.22	1.41	0.68	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.22	0.34	0.40	0.79	0.21	0.04	0.65	0.22	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.12	0.11	0.09	0.58	0.08	0.04	0.16	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.02	0.05	0.01	0.09	0.06	0.01	0.09	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
14	0.01	0.02	0.00	0.07	0.02	0.02	0.07	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
15	0.01	0.01	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
16	0.00	0.00	0.00	0.00	0.00	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
17	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	0.00	0.00	0.00
18	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	0.00	0.00	0.00
19	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	0.00	0.00	0.00
20	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	0.00	0.00	0.00
21	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	0.00	0.00	0.00
22	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	0.00	0.00	0.00
23	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	0.00	0.00	0.00
24	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	0.00	0.00	0.00
25	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	0.00	0.00	0.00
TOTAL	131.02	116.45	51.91	223.09	69.75	113.64	321.74	241.51	161.39	15.31	9.20	2.34	5.78	4.63	2.21	3.91	7.36	9.39	7.16	10.50

(cont'd)

Table 26 (cont'd). Autumn bottom-trawl mean number per tow at age in offshore index strata adjusted for missing strata (1983-2002). The 2J3KL total is the mean of the divisional means, weighted by the divisional survey areas.

3L

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	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	0.32	0.30	0.04	0.03	0.03
1	17.62	7.68	0.15	1.03	3.87	1.26	0.54	0.82	1.06	0.08	0.00	0.00	0.11	0.04	0.07	0.14	0.79	1.18	0.67	0.30
2	27.24	75.48	11.11	9.71	22.54	12.57	5.36	6.54	5.27	3.25	1.66	0.19	0.34	0.21	0.64	0.17	1.51	1.59	1.66	0.90
3	40.89	56.42	32.05	9.02	7.70	13.43	12.73	22.12	5.02	8.14	2.44	0.28	0.52	0.36	0.61	0.32	1.86	1.62	1.49	0.37
4	9.53	35.05	24.62	22.23	6.96	4.08	7.03	24.38	7.89	7.96	2.46	0.23	0.27	0.43	0.27	0.17	0.20	0.98	0.95	0.31
5	9.21	6.44	13.18	13.13	10.93	5.57	2.17	11.06	5.59	5.64	0.79	0.09	0.15	0.19	0.15	0.04	0.15	0.31	0.45	0.18
6	1.50	10.12	5.23	10.20	6.81	5.91	2.30	5.29	2.66	3.07	0.32	0.04	0.11	0.09	0.04	0.03	0.08	0.09	0.10	0.05
7	1.45	1.48	3.04	2.97	2.86	4.19	2.20	3.21	0.44	0.79	0.05	0.02	0.03	0.05	0.07	0.01	0.01	0.03	0.02	0.01
8	2.36	1.02	0.57	2.09	1.10	1.86	0.81	2.38	0.22	0.06	0.01	0.00	0.01	0.01	0.09	0.05	0.02	0.03	0.01	0.00
9	1.26	0.88	0.69	0.80	0.85	0.90	0.56	1.31	0.23	0.04	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.01	0.02	0.00
10	0.44	0.94	0.35	0.32	0.09	0.46	0.17	0.51	0.09	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
11	0.13	0.38	0.25	0.41	0.12	0.12	0.06	0.24	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.06	0.00
12	0.06	0.22	0.11	0.22	0.19	0.10	0.03	0.15	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01
13	0.02	0.04	0.04	0.09	0.10	0.12	0.03	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
14	0.05	0.03	0.01	0.03	0.03	0.07	0.04	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
15	0.00	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.01	0.03	0.00	0.01	0.01	0.00	0.00	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
17	0.02	0.01	0.01	0.00	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	0.00
18	0.00	0.01	0.00	0.00	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
19	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	0.00	0.00	0.00
20	0.05	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	0.00	0.00
21	0.03	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	0.00
22	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	0.00	0.00	0.00
23	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	0.00	0.00	0.00
24	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	0.00	0.00	0.00
25	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	0.00	0.00	0.00
TOTAL	111.87	196.27	91.42	72.30	64.19	50.68	34.04	78.19	28.59	29.08	7.73	0.85	1.54	1.39	1.95	1.28	4.98	5.88	5.48	2.18

2J3KL

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	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	0.03	0.18	0.22	0.25	0.03	0.11
1	26.49	7.85	0.58	3.23	4.44	18.12	13.75	8.44	0.73	0.25	0.09	0.11	1.58	0.38	0.05	0.46	0.74	1.51	0.81	0.93
2	58.68	52.62	9.81	14.81	12.42	19.41	66.33	16.98	10.22	2.48	3.05	0.51	0.97	1.37	0.68	0.39	1.74	1.61	1.61	2.30
3	41.65	53.05	29.73	20.48	8.02	14.48	33.08	48.74	14.80	5.89	2.03	0.71	0.74	0.85	0.90	0.62	1.60	1.62	1.73	1.03
4	24.08	31.67	32.81	55.20	9.25	7.51	21.96	29.59	41.55	4.54	1.72	0.31	0.30	0.41	0.28	0.49	0.45	0.92	0.68	0.63
5	15.93	19.82	16.18	62.23	22.83	8.67	12.16	13.54	18.47	4.52	0.51	0.12	0.12	0.15	0.12	0.16	0.23	0.23	0.30	0.17
6	4.67	10.93	10.25	30.82	17.22	15.21	9.74	6.93	4.58	1.75	0.31	0.03	0.06	0.04	0.02	0.04	0.04	0.06	0.05	0.03
7	2.67	2.37	4.76	13.08	5.05	13.51	10.34	4.29	1.29	0.39	0.06	0.02	0.01	0.03	0.03	0.02	0.01	0.02	0.01	0.00
8	5.48	1.35	0.86	5.77	2.97	2.82	5.44	4.12	0.54	0.04	0.01	0.01	0.00	0.00	0.04	0.02	0.01	0.01	0.01	0.00
9	2.77	1.93	0.71	1.31	1.41	1.58	1.44	1.60	0.35	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.01	0.00
10	1.20	1.12	0.61	0.51	0.31	0.77	0.73	0.50	0.15	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
11	0.27	0.41	0.33	0.57	0.13	0.13	0.33	0.19	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
12	0.07	0.16	0.12	0.36	0.15	0.08	0.10	0.10	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
13	0.02	0.04	0.03	0.09	0.08	0.07	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.03	0.02	0.00	0.04	0.03	0.04	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.02	0.00	0.01	0.00	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
16	0.00	0.01	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
17	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	0.00	0.00
18	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	0.00	0.00	0.00
19	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	0.00	0.00	0.00
20	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	0.00	0.00
21	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	0.00	0.00
22	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	0.00	0.00	0.00
23	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	0.00	0.00	0.00
24	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	0.00	0.00	0.00
25	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	0.00	0.00	0.00
TOTAL	184.04	183.38	106.79	208.52	84.33	102.43	175.50	135.09	92.76	19.89	7.77	1.81	3.79	3.24	2.13	2.23	5.07	6.25	5.29	5.21

Table 27. Autumn bottom-trawl mean catch (number) per tow at age in inshore strata in 3K and 3L in 1996-1998 and 2000. For each year and Division, an age-length key was constructed from sampling conducted both inshore and offshore, and this key was applied to the catch rate at length from the inshore strata in the appropriate year and Division. The lower part of the table indicates with an X those strata that were fished during each year.

	3K							3L						
Age	1996	1997	1998	1999	2000	2001	2002	1996	1997	1998	1999	2000	2001	2002
0	0.04	0.70	0.64		0.48	0.15	0.46	0.04	1.53	6.54		2.34	1.79	1.69
1	1.87	2.15	4.76		3.27	7.38	2.73	10.28	1.31	4.77		10.83	23.63	3.77
2	1.70	2.19	1.33		2.43	2.55	2.29	5.67	1.39	1.47		6.20	7.86	5.66
3	0.76	0.49	0.31		1.15	1.79	0.19	2.50	1.75	0.57		2.90	2.07	1.39
4	0.33	0.05	0.08		0.10	0.51	0.09	2.12	1.54	0.34		1.18	1.31	0.61
5	0.10	0.07	0.04		0.12	0.07	0.05	1.49	0.86	0.08		0.32	0.57	0.30
6	0.02	0.00	0.02		0.00	0.00		2.06	0.12	0.10		0.12	0.09	0.08
7		0.08	0.02			0.00		1.10	0.15	0.02		0.09	0.03	0.00
8								0.54	0.11	0.02		0.07	0.01	0.02
9								0.48	0.10	0.02		0.03	0.04	0.03
10								0.11				0.00	0.02	0.01
11												0.01	0.03	0.00
12														0.00
13														0.00
14														0.00
15														0.01
Total	4.82	5.73	7.20		7.55	12.45	5.81	26.39	8.86	13.93		24.09	37.45	13.57

	3KL						
Age	1996	1997	1998	1999	2000	2001	2002
0	0.04	1.11	3.53		1.39	0.95	1.06
1	5.99	1.74	4.76		6.97	15.34	3.24
2	3.64	1.80	1.40		4.28	5.15	3.94
3	1.61	1.11	0.44		2.01	1.93	0.78
4	1.21	0.78	0.21		0.63	0.90	0.34
5	0.78	0.46	0.06		0.22	0.31	0.17
6	1.02	0.06	0.06		0.06	0.04	0.04
7	0.54	0.11	0.02		0.04	0.01	0.00
8	0.26	0.05	0.01		0.03	0.00	0.01
9	0.24	0.05	0.01		0.01	0.02	0.01
10	0.05	0.00	0.00		0.00	0.01	0.00
11	0.00	0.00	0.00		0.00	0.01	0.00
12	0.00	0.00	0.00		0.00	0.00	0.00
13	0.00	0.00	0.00		0.00	0.00	0.00
14	0.00	0.00	0.00		0.00	0.00	0.00
15	0.00	0.00	0.00		0.00	0.00	0.00
Total 0+	15.39	7.26	10.50		15.65	24.70	9.61
Total 1+	15.35	6.16	6.97		14.26	23.74	8.55
Total 5+	2.89	0.73	0.16		0.37	0.42	0.25

Table 28. Estimates of cod abundance (thousands) from spring surveys in Division 3L in 1990-2002 in depths <= 200 fathoms. The 1990-1995 data are in Campelen equivalent units and the 1996-2002 data are in actual Campelen units.

Depth range (fath)	Stratum number	Stratum area sq mi.	WT 96 1990	WT 106-107 1991	WT 119-122 1992	WT 137-138 1993	WT 152-154 1994	WT 168-170 1995	WT 189-191 1996	WT 207-208 1997	WT 223-224 1998	WT 240-241 1999	WT 317-318 2000	WT 365-370 2001	WT 422-424 2002
Mean Date			26-May-90	20-May-91	24-May-92	31-May-93	01-Jun-94	06-Jun-95	14-Jun-96	15-Jun-97	19-Jun-98	22-Jun-99	17-Jun-00	11-Jun-01	10-Jun-02
31-50	350	2071	8018	748	414	32	0	0	412	122	47	1268	71	297	81
	363	1780	3918	1504	789	306	0	0	111	0	0	281	420	82	0
	371	1121	3315	32260	123	93	0	0	0	0	0	0	0	39	39
	372	2460	2852	541	34	62	0	0	217	0	42	602	1203	42	0
	384	1120	193	270	0	31	0	0	102	0	0	0	77	0	0
51-100	328	1519	3194	1846	0	453	0	0	90	35	125	376	1254	139	84
	341	1574	2436	469	0	0	736	0	340	1728	172	577	476	909	43
	342	585	523	0	1314	322	188	0	0	121	80	121	322	241	40
	343	525	891	2239	1565	614	361	361	36	0	217	108	72	36	0
	348	2120	6575	73	227	109	365	510	151	65	328	231	109	0	167
	349	2114	10986	1066	711	905	0	0	424	145	73	646	332	249	166
	364	2817	4456	1902	0	97	0	0	234	49	106	201	155	254	129
	365	1041	2076	322	36	0	0	0	58	0	0	95	0	48	48
	370	1320	1219	34833	0	91	0	0	61	0	0	0	36	0	0
	385	2356	7808	17055	97	383	0	0	30	0	0	46	81	46	41
	390	1481	41	122	34	102	0	0	59	0	0	150	0	122	0
101-150	344	1494	4864	986	1165	514	0	822	565	300	355	509	260	392	485
	347	983	913	1690	34	304	0	0	0	34	203	336	135	676	45
	366	1394	15053	12651	415	384	0	0	245	447	141	133	1630	230	3545
	369	961	6134	3701	198	0	0	0	30	33	66	39	132	196	206
	386	983	32048	32544	68	54	0	0	0	30	34	265	406	260	45
	389	821	5788	9524	75	0	0	56	0	33	33	113	1412	1016	75
	391	282	45154	6750	0	0	0	0	0	0	0	19	0	78	19
151-200	345	1432	14232	3217	492	525	2167	197	773	972	460	1121	2151	2053	2403
	346	865	145882	10812	1577	833	278	476	487	579	71	670	948	996	2248
	368	334	51551	4992	10866	1355	184	23	402	158	46	92	863	1330	578
	387	718	241169	93995	23145	6288	0	560	142	1037	1635	684	3556	307	285
	388	361	36947	10809	4618	2235	0	174	84	0	72	372	564	695	290
	392	145	22130	4618	40	479	0	110	111	0	80	41	195	150	748
total strata fished <= 200 fath			680365	263087	48038	16569	4278	3289	5166	5888	4386	9096	16860	10884	11810
ADJUSTED			680366	291539	48037	16571	4279	3289	5164	5888	4386	9096	16860	10884	11810
upper			1169116	395962	105950	29261	7094	5694	6223	10529	10169	11449	52643	14422	16092
t-value			2.776	2.365	4.303	3.182	2.201	2.306	2.023	2.447	4.30	2.05	12.71	2.31	2.33
1 STD strata fished <= 200 fath			176063	56184	13459	3989	1279	1043	522	1897	1345	1148	2815	1532	1838

[1] Not all strata in the depth range have been fished. Strata not fished in the <= 200 fathom depth range have been filled using a multiplicative model using data to 1992. Std are for strata fished in the depth range.

Table 29. Estimates of cod biomass (t) from spring surveys in Division 3L in 1990-2002 in depths <= 200 fathoms. The 1990-1995 data are in Campelen equivalent units and the 1996-2002 data are in actual Campelen units.

Depth range (fath) Mean Date	Stratum number	Stratum area sq mi.	WT 96 1990 26-May	WT 106-107 1991 20-May	WT 119-122 1992 24-May	WT 137-138 1993 31-May	WT 152-154 1994 01-Jun	WT 168-170 1995 06-Jun	WT 189-191 1996 14-Jun	WT 207-208 1997 15-Jun	WT 223-224 1998 19-Jun-98	WT 240-241 1999 22-Jun	WT 317-318 2000 17-Jun	WT 365-370 2001 11-Jun	WT 422-424 2002 10-Jun
31-50	350	2071	14057	1636	315	35	0	0	359	135	6	3708	17	621	28
	363	1780	12388	2289	526	111	0	0	61	0	0	693	193	1	0
	371	1121	5149	44086	36	37	0	0	0	0	0	0	0	25	1
	372	2460	12849	1553	112	96	0	0	83	0	0	598	392	4	0
	384	1120	1029	653	0	71	0	0	65	0	0	0	20	0	0
51-100	328	1519	5670	180	0	243	0	0	6	5	115	739	89	37	3
	341	1574	5854	376	0	0	65	0	127	4497	9	1238	96	549	3
	342	585	1035	0	66	64	33	0	0	346	8	209	23	9	2
	343	525	255	207	70	52	46	42	9	0	36	254	27	0.361	0
	348	2120	6772	273	37	43	47	87	53	13	536	395	10	0	14
	349	2114	3835	836	125	158	0	0	303	419	101	1903	615	26	5
	364	2817	15553	1228	0	124	0	0	20	11	225	683	43	15	3
	365	1041	2210	154	81	0	0	0	5	0	0	178	0	17	1
	370	1320	1288	29422	0	74	0	0	6	0	0	0	1	0	0
	385	2356	2269	13797	95	256	0	0	4	0	0	227	2	4	42
	390	1481	129	604	58	83	0	0	31	0	0	6	0	5	0
101-150	344	1494	696	103	167	83	0	95	111	115	124	496	152	126	71
	347	983	669	199	35	83	0	0	0	8	150	52	9	182	3
	366	1394	12386	6899	111	121	0	0	104	173	61	83	210	25	292
	369	961	7693	3547	78	0	0	0	16	3	20	11	218	159	10
	386	983	59202	17066	154	66	0	0	0	16	183	94	311	131	10
	389	821	1529	1654	114	0	0	36	0	9	25	16	587	440	83
	391	282	6018	1220	0	0	0	0	0	0	0	4	0	41	2
151-200	345	1432	5601	466	332	120	437	108	149	294	159	359	956	725	605
	346	865	136822	4834	613	302	86	91	178	238	32	407	582	260	558
	368	334	41814	3318	4684	590	120	22	148	96	8	63	499	417	100
	387	718	101468	37550	18465	2329	0	227	84	303	1199	578	2057	191	112
	388	361	35162	4031	1078	1431	0	60	12	0	27	167	251	176	147
	392	145	6418	1107	22	63	0	37	18	0	23	30	19	74	332
total strata fished <= 200 fathoms			505819	164236	27374	6633	834	805	1951	6667	3048	12962	7378	4262	2428
ADJUSTED			505820	179288	27374	6635	834	805	1952	6667	3048	12962	7378	4262	2428
upper			742119	286846	71593	14791	1310	1234	2468	17631	6102	18566	30307	6164	3040
t-value			2.228	2.447	4.303	4.303	2.365	2.179	2.017	2.571	3.18	2.16	12.71	2.14	2.18
1 STD strata fished <= 200 fathoms			106059	50106	10276	1896	201	197	256	4264	960	2594	1804	889	281

[1] Not all strata in the depth range have been fished. Strata not fished in the <= 200 fathom depth range have been filled using a multiplicative model using data to 1992. Std are for strata fished in the depth range.

Table 30. Estimates of cod abundance (thousands) and biomass (t) from spring surveys in Division 3L in 1990-2002 in depths > 200 fathoms. The 1990-1995 data are in Campelen equivalent units and the 1996-2002 data are in actual Campelen units.

Depth		Stratum	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT
range	Stratum	area	96	106-107	119-122	137-138	152-154	168-170	189-191	207-208	223-224	240-241	317-318	365-370	422-424
(fath)	number	nautical miles	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Mean Date			26-May	20-May	24-May	31-May	01-Jun	06-Jun	14-Jun	15-Jun	19-Jun-98	22-Jun	17-Jun	11-Jun	10-Jun
							abundance								
201-300	729	186	**nf**	141	3876	192	77	0	13	0	13	0	2240	171	50
	731	216	**nf**	3046	267	416	9701	0	152	0	13	104	155	409	272
	733	468	**nf**	7339	2672	880	1513	483	41	89	0	258	315	626	1094
	735	272	**nf**	**nf**	92905	0	6080	673	5512	524	3480	35	580	3792	3138
301-400	730	170	**nf**	0	0	0	0	0	0	0	0	0	0	0	0
	732	231	**nf**	0	0	0	0	0	0	0	0	0	0	0	0
	734	228	**nf**	267	0	0	0	0	0	0	0	0	0	0	0
	736	175	**nf**	**nf**	60	0	0	0	0	0	0	0	0	0	0
401-500	737	227	**nf**	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	741	223	**nf**	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	745	348	**nf**	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	748	159	**nf**	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
Total >200 fathoms			0	10793	99780	1488	17371	1156	5718	613	3506	397	3290	4998	4554
Total all strata fished			680365	273879	147819	18056	21649	4445	10884	6501	7892	9493	20150	15881	16364
1 STD all strata fished			176063	56567	93188	4007	9990	1275	2473	1933	3694	1183	3007	4100	3500
							biomass								
201-300	729	186	**nf**	320	1683	78	29	0	2	0	31	0	858	78	15
	731	216	**nf**	1967	389	248	5913	0	69	0	15	57	51	321	117
	733	468	**nf**	6351	1959	345	556	219	28	74	0	111	172	290	351
	735	272	**nf**	**nf**	50199	0	3238	386	3823	352	2646	24	270	2557	1877
301-400	730	170	**nf**	0	0	0	0	0	0	0	0	0	0	0	0
	732	231	**nf**	0	0	0	0	0	0	0	0	0	0	0	0
	734	228	**nf**	437	0	0	0	0	0	0	0	0	0	0	0
	736	175	**nf**	**nf**	69	0	0	0	0	0	0	0	0	0	0
401-500	737	227	**nf**	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	741	223	**nf**	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	745	348	**nf**	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
	748	159	**nf**	**nf**	**nf**	**nf**	0	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**	**nf**
Total >200 fathoms			0	9075	54299	671	9736	605	3922	426	2692	192	1351	3246	2360
Total all strata fished			505819	173311	81673	7304	10570	1410	5874	7093	5740	13154	8728	7507	4788
upper			742119	296576	729549	15476	86302	7004	32789	18073	41373	18765	32059	41939	27442
t-value			2.228	2.447	12.706	4.303	12.706	12.706	4.303	2.571	12.71	2.16	12.706	12.706	12.71
1 STD all strata fished			106059	50374	50990	1899	5960	440	6255	4271	2804	2598	1836	2710	1782

nf Not all strata in the depth range were fished. Strata not fished in the greater than 200 fathom depth range have not been filled using a multiplicative model.

Table 31. Spring bottom-trawl mean number per tow at age in index strata (<=200 fath) in Division 3L adjusted for missing strata.

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0												0.00	0.00	0.00	0.00	0.02	0.00	0.00
1	0.00	0.00	0.24	0.05	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.05	0.23	0.69	0.28	0.76
2	24.66	4.71	6.20	4.56	6.56	8.14	4.82	1.29	0.08	0.19	0.25	0.43	0.18	0.08	0.54	0.87	0.86	0.89
3	85.66	17.70	11.95	24.30	23.92	46.84	13.81	2.26	1.71	0.33	0.19	0.23	0.43	0.25	0.26	0.86	0.35	0.43
4	48.28	31.74	11.45	10.16	20.06	41.76	19.67	1.82	0.79	0.12	0.16	0.15	0.16	0.25	0.17	0.69	0.13	0.16
5	23.76	18.51	19.07	9.93	5.23	18.34	9.80	2.54	0.34	0.06	0.05	0.05	0.07	0.11	0.11	0.08	0.11	0.07
6	8.24	9.85	13.15	17.32	3.62	5.05	4.25	1.09	0.24	0.01	0.01	0.05	0.03	0.07	0.08	0.08	0.01	0.02
7	7.17	3.96	6.27	7.39	8.32	4.30	1.07	0.36	0.07	0.00		0.03	0.20	0.02	0.08	0.01	0.00	
8	1.39	2.95	1.95	3.71	6.06	4.74	0.85	0.06	0.04				0.06	0.02	0.05	0.00	0.01	
9	0.65	0.65	1.52	1.25	1.58	2.53	0.80	0.01	0.00				0.02	0.01	0.16	0.00		
10	0.92	0.56	0.58	1.04	0.62	1.02	0.28	0.04					0.01	0.00	0.06	0.00		
11	1.04	0.96	0.41	0.30	0.54	0.44	0.28	0.00					0.01		0.03	0.01		
12	0.35	0.62	0.54	0.36	0.14	0.28	0.09	0.00							0.01	0.01		
13	0.14	0.21	0.33	0.32	0.19	0.21	0.03	0.01							0.01	0.01		
14	0.04	0.07	0.10	0.25	0.33	0.15	0.01	0.01							0.01			
15	0.06	0.06	0.05	0.10	0.13	0.13	0.02											
16	0.01	0.02	0.01	0.04	0.04	0.07	0.00											
17	0.00	0.00	0.00	0.03	0.03	0.05	0.00											
18	0.01	0.02	0.01	0.02	0.02	0.01	0.00											
19	0.00	0.00	0.01	0.00	0.01	0.01	0.01											
20	0.01	0.00		0.01			0.01											
21	0.01																	
22	0.00																	
23	0.01																	
24																		
25																		
TOTAL	202.41	92.59	73.84	81.14	77.40	134.23	55.80	9.49	3.27	0.71	0.66	1.00	1.17	0.86	1.80	3.33	1.75	2.33

Table 32. Mean length (cm) at age of cod sampled during autumn bottom-trawl surveys in divisions 2J, 3K and 3L in 1978-2002. Highlighted entries are based on fewer than 5 aged fish. There were no surveys in Division 3L in 1978-1980 and 1984.

Division 2J

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1																		19.9	19.8		22.9	21.5	22.0	22.8	20.9
2	29.3	30.1	30.6	29.9	30.0	26.6	27.4	27.0	28.2	29.4	30.3	28.1	26.5	28.1	26.5	26.2	25.8	26.2	28.0	30.7	23.9	27.4	27.8	29.3	28.0
3	38.0	41.3	39.4	38.7	37.9	38.8	34.3	33.6	35.5	36.5	37.3	36.9	33.8	32.9	33.8	32.6	36.8	33.1	34.5	37.6	38.7	33.7	37.6	34.8	37.3
4	45.6	47.3	49.6	47.0	47.0	46.1	44.4	40.1	41.1	43.4	44.2	43.7	41.9	38.7	38.8	40.1	42.3	42.1	41.8	43.2	44.4	42.5	44.2	43.7	43.2
5	54.0	55.3	54.5	54.4	53.4	53.9	50.9	48.5	47.6	48.9	48.5	50.1	46.9	43.9	41.8	43.9	46.6	46.7	49.3	48.0	47.7	52.3	**54.6**	49.9	47.8
6	59.7	60.9	60.7	58.2	59.3	60.0	56.6	53.2	52.7	52.4	53.6	53.8	53.4	51.1	47.0	47.5	**56.8**	**55.4**	**52.6**		**52.5**	**69.0**	**62.3**	**54.0**	**41.0**
7	66.4	67.9	64.3	62.8	61.3	62.9	63.4	57.5	56.7	57.3	55.8	57.0	56.6	56.9	**56.8**	**47.0**	**56.2**		**61.1**		**51.0**			**57.0**	
8	69.7	73.9	69.5	66.9	64.5	64.7	65.8	64.3	59.5	58.9	59.8	59.6	59.4	58.3								**79.0**			
9	79.3	69.2	82.0	73.6	68.9	68.6	66.9	67.2	67.6	61.7	63.8	62.7	61.1	63.8											
10	80.4	76.9	83.3	84.2	77.0	73.5	71.6	70.2	68.2	67.8	66.2	64.7	63.1	65.5											
11	87.7	87.6	86.5	90.1	85.5	75.0	78.4	72.8	72.2	77.5	73.9	69.8	73.6	**72.7**											
12	91.6	85.9	87.9	88.6	94.6	95.0	83.0	75.9	76.2	75.5	80.5	67.8	73.5	**68.5**											

Division 3K

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1																		18.6	19.2	21.6	19.2	20.5	20.9	20.1	22.2
2	27.9	30.9	30.7	31.3	29.3	28.5	26.5	28.7	29.5	29.7	25.9	27.3	28.1	29.2	28.5	28.5	29.3	25.6	28.7	29.5	25.3	29.1	27.7	28.1	28.4
3	37.6	42.1	39.9	42.2	40.3	40.5	36.8	36.0	36.5	38.1	36.5	37.2	36.2	36.6	36.4	37.5	36.5	34.2	34.9	39.2	39.0	36.8	36.7	34.6	35.3
4	47.0	49.5	47.2	50.4	50.1	47.9	47.0	43.9	43.8	44.6	44.2	45.0	44.0	42.7	42.4	43.6	42.2	41.8	43.3	47.9	45.4	45.7	45.4	42.6	41.6
5	54.8	55.4	54.7	56.1	54.0	56.2	54.3	51.8	49.9	50.9	51.5	51.5	49.7	47.9	47.0	50.0	51.1	46.8	50.0	56.2	51.4	52.5	52.0	52.1	47.6
6	62.4	62.8	61.8	60.3	60.5	62.3	61.6	57.3	56.1	54.3	56.0	56.3	56.1	54.9	51.8	51.4	**53.5**	**54.7**	**58.5**		58.6	**55.7**	60.8	**54.9**	**56.5**
7	69.5	69.9	69.7	65.2	64.3	66.8	64.4	62.5	58.8	60.1	58.6	59.9	58.4	59.7	57.9	53.0	**58.1**		**69.0**		62.4	**72.9**	**73.0**		**57.0**
8	74.4	76.8	76.3	69.2	69.0	67.7	68.8	69.6	64.1	62.9	66.3	63.1	61.2	62.7	65.2	**64.0**	**61.7**			**68.0**	**83.0**			**74.0**	
9	76.6	83.3	86.0	81.7	74.8	72.5	72.9	70.2	67.3	69.7	73.1	68.1	63.6	65.6	**64.0**			**68.0**			**80.0**	**81.0**		**73.0**	
10	81.9	78.3	87.6	90.5	79.8	76.4	78.1	73.1	76.8	74.5	78.7	74.0	64.7	69.1								**89.0**			
11	**88.4**	86.0	**103.4**	91.6	89.6	84.9	84.9	79.2	75.9	80.8	82.4	75.7	69.3	**80.7**											
12	92.1	**78.9**	94.2	92.1	97.0	85.1	90.2	87.1	73.7	86.6	88.5	82.2	71.1	**68.4**											

Division 3L

Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1															16.8	17.7	19.7	18.4	19.3	19.3	18.4	20.6
2	28.5	28.7	30.1		26.8	27.9	27.5	28.7	28.7	27.0	29.7	27.9	30.1	28.1	27.8	30.0	30.3	31.5	30.0	28.3	28.8	29.4
3	40.0	38.2	39.4		36.1	35.4	34.7	37.4	37.6	35.3	36.7	38.5	38.3	34.8	36.9	38.3	38.6	39.9	39.4	39.4	36.7	38.7
4	44.8	50.2	48.0		43.7	43.7	44.2	44.9	44.2	44.9	44.4	44.5	45.2	45.7	41.7	44.2	45.9	46.5	47.2	45.8	44.8	47.1
5	52.6	56.4	56.8		52.2	50.3	52.3	53.1	52.3	52.7	51.1	50.4	51.5	51.8	49.6	49.3	54.9	**54.5**	55.4	53.3	51.3	56.2
6	60.6	63.5	62.4		58.0	58.2	58.9	58.6	59.0	59.2	56.5	54.9	55.8	57.9	58.6	58.9	**62.3**	**58.4**	59.7	58.0	57.9	62.7
7	66.7	69.7	64.7		65.4	62.6	65.1	62.4	63.9	66.4	61.1	56.8	61.9	**66.7**	**66.7**	66.7	68.6	**78.0**	**64.0**	**65.4**	**65.9**	**68.0**
8	73.1	73.8	69.5		73.3	69.9	69.0	66.7	68.7	70.9	68.0	66.0	**61.4**	**67.0**	**74.0**	**70.0**	72.6	**74.3**	**72.9**	**77.9**	**67.9**	
9	82.2	83.0	73.6		72.8	73.1	75.2	69.6	74.4	75.3	71.5	77.3				**66.0**	**72.0**		**86.3**	**81.0**	**75.1**	
10	91.2	93.1	76.3		82.6	77.7	80.8	74.3	83.7	76.2	73.2	70.4	**87.0**						**90.7**			
11	**103.7**	94.1	90.0		86.5	81.5	87.9	88.9	88.1	82.5	74.5	**77.1**							**79.0**		**91.0**	
12	**119.2**	110.5	87.5		97.8	86.8	85.4	96.7	94.1	86.9	81.1	**94.5**							**100.0**		**101.0**	**98.0**

Table 33. Mean weight (kg) at age of cod sampled during autumn bottom-trawl surveys in divisions 2J, 3K and 3L in 1978-2002. Highlighted entries are based on fewer than 5 aged fish. There were no surveys in Division 3L in 1978-1980 and 1984.

Division 2J

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1																		0.064	0.064		0.100	0.091	0.086	0.101	0.086
2	0.223	0.263	0.240	0.228	0.215	0.176	0.153	0.200	0.254	0.266	0.253	0.204	0.158	0.187	0.139	0.153	0.155	0.162	0.193	0.258	0.121	0.196	0.194	0.229	0.196
3	0.487	0.682	0.528	0.548	0.501	0.587	0.384	0.363	0.350	0.545	0.553	0.488	0.355	0.307	0.318	0.300	0.433	0.319	0.371	0.480	0.544	0.358	0.472	0.382	0.471
4	0.947	1.023	1.046	1.077	0.955	0.956	0.829	0.622	0.645	0.913	0.819	0.810	0.697	0.518	0.482	0.575	0.646	0.671	0.670	0.733	0.796	0.758	0.776	0.726	0.733
5	1.580	1.593	1.363	**1.663**	1.601	1.554	1.303	1.138	1.054	1.355	1.145	1.263	0.987	0.743	0.620	0.751	0.909	0.898	1.160	1.052	1.006	1.382	**1.416**	1.166	1.030
6	2.199	2.379	2.055	1.982	2.004	1.853	1.782	1.486	1.660	1.483	1.653	1.567	1.462	1.139	0.844	0.923	**1.664**	**1.540**	**1.427**		**1.416**	**3.210**	**2.463**	**1.340**	**0.580**
7	2.515	2.748	2.548	2.519	2.392	**2.252**	2.388	1.880	1.914	2.067	1.690	1.907	1.784	1.540	**1.478**	**0.860**	**1.700**		**2.150**		**1.190**			**1.640**	
8	3.862	2.753	**3.090**	3.197	2.686	2.773	2.562	2.497	2.292	2.409	2.379	2.259	2.108	1.692								**5.180**			
9	4.365	6.193	5.986	3.944	3.872	3.346	3.023	2.652	**3.810**	1.818	2.717	2.616	2.299	2.367											
10	5.771	**5.428**	7.628	6.586	6.507	4.022	3.459	3.223	4.513	4.648	2.880	3.143	2.539	2.721											
11	6.358	7.191	6.546	**6.906**	**7.660**	4.165	5.669	4.178	4.638	**4.550**	3.868	3.771	4.397	**3.963**											
12	**9.736**	**6.206**	7.723	**10.797**	**10.055**	8.946	6.539	4.014	6.161	**4.649**	6.732	3.206	4.340	**3.391**											

Division 3K

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1																		0.054	0.057	0.085	0.060	0.074	0.075	0.069	0.092
2	0.171	0.207	0.238	0.275	0.234	0.227	0.146	0.209	0.192	0.204	0.177	0.193	0.190	0.213	0.205	0.205	0.217	0.153	0.206	0.230	0.150	0.238	0.194	0.201	0.207
3	0.410	0.577	0.578	0.720	0.738	0.540	0.404	0.466	0.454	0.493	0.476	0.491	0.414	0.423	0.398	0.473	0.434	0.362	0.380	0.543	0.547	0.468	0.443	0.363	0.402
4	0.876	1.190	0.950	1.222	1.218	1.120	0.867	0.891	0.817	0.904	0.838	0.874	0.761	0.705	0.665	0.735	0.688	0.649	0.721	0.979	0.868	0.888	0.818	0.714	0.653
5	1.478	1.644	1.410	**1.730**	1.555	1.670	1.412	1.219	1.154	1.350	1.411	1.325	1.100	1.006	0.947	1.119	1.188	0.907	1.161	1.619	1.299	1.346	1.189	1.256	0.999
6	2.393	2.259	2.011	2.051	1.966	2.114	2.041	1.818	1.993	1.409	1.734	1.821	1.630	1.517	1.301	1.296	**1.442**	**1.527**	**1.898**		1.874	**1.560**	2.060	**1.501**	**1.521**
7	2.938	3.161	3.462	2.620	2.445	2.804	2.343	2.590	2.421	2.580	2.264	2.190	1.908	1.923	1.828	1.461	**1.978**		**3.240**		2.550	**3.743**	**3.330**		**1.710**
8	**5.830**	4.281	3.179	5.051	3.151	3.440		3.396	3.739	2.784	3.012	2.566	2.203	2.274	2.561	**2.290**	**2.326**			**2.610**	**6.320**			**3.450**	
9	4.671	4.861	6.003	7.332	4.375	3.736	3.693	4.149	3.247	3.398	4.257	3.229	2.441	2.626	**2.190**			**3.280**			**5.310**	**6.130**		**3.710**	
10	6.499	4.608	7.532	6.321	6.192	4.862	4.667	4.890	4.920	5.354	4.888	4.204	2.711	3.107								**7.270**			
11	**5.243**	8.365	**13.000**	9.326	6.515	7.512	6.300	6.520	5.847	**10.631**	5.408	4.604	3.251	**4.933**											
12	**9.492**	**10.190**	7.097	8.103	**9.555**	**6.047**	6.089	6.329	**6.465**	7.017	7.628	5.593	3.665	**3.222**											

Division 3L

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1																		0.110	0.047	0.068	0.055	0.063	0.061	0.052	0.078
2				**0.224**	0.169	0.236		0.167	0.223	0.179	0.224	0.186	0.173	0.248	0.198	0.240	0.198	0.235	0.256	0.255	0.274	0.264	0.210	0.225	0.239
3				0.564	0.380	0.539		0.436	0.468	0.353	0.459	0.443	0.395	0.456	0.581	0.505	0.402	0.459	0.501	0.533	0.587	0.584	0.578	0.472	0.549
4				0.820	**0.480**	1.142		0.801	0.796	0.735	0.764	0.789	0.810	0.836	0.883	0.849	0.880	0.668	0.785	0.896	0.937	0.937	0.891	0.854	0.974
5				1.245		1.477		1.382	1.227	1.313	1.372	1.556	1.330	1.280	1.303	1.274	1.319	1.134	1.122	1.629	**1.589**	1.620	1.427	1.337	1.752
6				1.980		1.984		2.049	1.807	1.796	1.879	1.937	1.902	1.748	1.700	1.764	1.893	2.055	2.084	**2.633**	**1.814**	2.069	1.849	1.905	2.325
7				2.638		2.278		2.247	2.703	2.351	2.103	2.567	2.767	2.191	1.862	2.327	**2.986**	**3.253**	3.229	3.386	**4.250**	**2.615**	**2.757**	2.870	**3.020**
8				5.077	**5.440**	2.930		3.521	2.579	2.818	3.043	3.653	3.481	3.089	2.781	**2.550**	**3.160**	**4.200**	**3.440**	4.473	**4.601**	**3.904**	**5.164**	**3.231**	
9				5.804	6.647	4.005		4.111	4.197	3.801	3.015	3.666	4.274	3.678	4.926				**3.200**			**6.627**	**4.850**	**3.724**	
10				11.762	8.339	4.390		6.132	5.476	**7.540**	3.483	6.830	4.557	3.949	3.349	**6.440**						**8.278**			
11				**11.560**	7.486	8.333		5.312	4.460	7.402	7.471	7.461	5.847	4.471	**4.946**							**5.630**		8.264	
12				**18.553**	**10.653**	**9.902**		12.081	10.511	5.525	9.410	**11.395**	6.642	5.307	**8.652**							**10.050**		**12.800**	**9.950**

Table 34. Mean Fulton's condition (gutted weight) at age of cod sampled during autumn bottom-trawl surveys in divisions 2J, 3K and 3L in 1978-2002. Highlighted entries are based on fewer than 5 aged fish.

Division 2J

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2	0.733	0.718	0.738	0.781	0.735	0.731	0.713	0.722	0.718	0.730	0.753	0.745	0.714	0.710	0.666	0.741	0.803	0.740	0.733	0.743	0.733	0.729	0.721	0.728	0.742
3	0.729	0.755	0.788	0.811	0.775	0.772	0.758	0.741	0.779	0.813	0.786	0.764	0.741	0.736	0.710	0.758	0.755	0.743	0.755	0.758	0.776	0.754	0.734	0.759	0.751
4	0.762	0.763	0.718	0.810	0.757	0.803	0.774	0.755	0.814	0.792	0.816	0.772	0.745	0.735	0.693	0.759	0.745	0.758	0.791	0.755	0.750	0.751	0.755	0.738	0.741
5	0.771	0.750	0.764	**0.816**	0.816	0.774	0.784	0.769	0.816	0.770	0.786	0.786	0.744	0.724	0.709	0.752	0.773	0.736	0.809	0.787	0.754	0.776	**0.736**	0.797	0.747
6	0.747	0.785	0.750	0.821	0.801	0.729	0.767	0.757	0.815	0.783	0.812	0.789	0.753	0.702	0.678	0.717	**0.771**	**0.735**	**0.769**		**0.770**	**0.816**	**0.822**	**0.737**	**0.711**
7	0.731	0.762	0.738	0.795	0.757	**0.661**	0.776	0.751	0.814	0.783	0.798	0.782	0.743	0.707	**0.687**	**0.722**	**0.779**		**0.824**		**0.686**			**0.745**	
8	0.722	0.695	**0.743**	0.809	0.737	0.789	0.732	0.761	0.776	0.836	0.815	0.806	0.762	0.705								**0.842**			
9	0.764	0.823	0.806	0.749	0.729	0.789	0.751	0.669	**0.849**	0.768	0.811	0.793	0.771	0.738											
10	0.779	**0.794**	0.814	0.859	0.814	0.758	0.755	0.724	0.794	0.772	0.813	0.874	0.748	0.783											
11	0.834	0.831	0.760	**0.855**	**0.855**	0.801	0.786	0.730	0.870	**0.792**	0.798	0.806	0.817	**0.835**											
12	**0.904**	**0.766**	0.838	**0.845**	**0.858**	0.786	0.799	0.725	0.828	**0.795**	0.827	0.766	0.828	**0.830**											

Division 3K

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2	0.683	0.707	0.708	0.793	0.722	0.725	0.685	0.730	0.749	0.768	0.753	0.716	0.711	0.733	0.735	0.727	0.741	0.733	0.739	0.744	0.723	0.735	0.735	0.732	0.737
3	0.719	0.741	0.786	0.793	0.815	0.742	0.719	0.744	0.714	0.757	0.785	0.750	0.714	0.719	0.700	0.741	0.767	0.744	0.746	0.758	0.758	0.761	0.738	0.728	0.746
4	0.747	0.757	0.805	0.769	0.758	0.781	0.733	0.731	0.774	0.772	0.796	0.755	0.724	0.736	0.711	0.720	0.768	0.730	0.753	0.747	0.761	0.759	0.740	0.748	0.751
5	0.747	0.780	0.747	**0.826**	0.754	0.768	0.753	0.765	0.783	0.785	0.799	0.763	0.734	0.733	0.718	0.717	0.730	0.737	0.782	0.766	0.780	0.761	0.711	0.720	0.757
6	0.739	0.747	0.726	0.789	0.738	0.728	0.744	0.784	0.798	0.778	0.808	0.781	0.744	0.742	0.739	0.746	**0.765**	**0.766**	**0.745**		0.746	**0.740**	0.748	**0.747**	**0.721**
7	0.730	0.739	0.729	0.749	0.731	0.799	0.784	0.746	0.820	0.819	0.808	0.768	0.749	0.730	0.754	0.721	**0.780**		**0.801**		0.864	**0.784**	**0.743**		**0.826**
8	**0.773**	0.746	0.687	0.751	0.732	0.809		0.764	0.795	0.788	0.833	0.779	0.749	0.738	0.736	**0.732**	**0.799**			**0.706**	**0.867**			**0.748**	
9	0.784	0.738	0.758	0.847	0.721	0.760	0.781	0.841	0.821	0.796	0.819	0.791	0.732	0.755	**0.679**			**0.795**			**0.873**	**0.896**		**0.745**	
10	0.744	0.761	0.795	0.756	0.766	0.762	0.717	0.744	0.849	0.811	0.831	0.793	0.749	0.776								**0.817**			
11	**0.642**	0.752	**0.861**	0.836	0.749	0.838	0.822	0.778	0.840	**0.832**	0.788	0.808	0.771	**0.741**											
12	**0.845**	**0.812**	0.762	0.815	**0.813**	**0.755**	0.789	0.835	**0.785**	0.810	0.852	0.792	0.778	**0.803**											

Division 3L

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2				**0.718**	0.707	0.718		0.680	0.769	0.721	0.748	0.734	0.716	0.746	0.744	0.721	0.750	0.935	0.772	0.757	0.744	0.740	0.715	0.740	0.749
3				0.778	0.803	0.724		0.749	0.765	0.733	0.781	0.759	0.734	0.748	0.801	0.741	0.784	0.752	0.749	0.758	0.751	0.798	0.757	0.760	0.762
4				0.794	**0.765**	0.746		0.740	0.757	0.745	0.730	0.764	0.729	0.769	0.788	0.737	0.741	0.758	0.770	0.756	0.748	0.749	0.762	0.755	0.757
5				0.767		0.735		0.756	0.790	0.748	0.781	0.782	0.752	0.769	0.795	0.715	0.758	0.761	0.760	0.773	**0.814**	0.776	0.750	0.767	0.785
6				0.729		0.700		0.717	0.781	0.714	0.796	0.776	0.742	0.773	0.796	0.777	0.776	0.804	0.806	**0.770**	**0.751**	0.788	0.754	0.783	0.739
7				0.751		0.775		0.715	0.816	0.724	0.741	0.768	0.763	0.741	0.793	0.737	**0.775**	**0.861**	0.847	0.824	**0.748**	**0.790**	**0.771**	**0.768**	**0.776**
8				0.824	**0.767**	0.764		0.708	0.730	0.735	0.758	0.804	0.777	0.763	0.723	**0.741**	**0.725**	**0.780**	**0.825**	0.882	**0.861**	**0.822**	**0.806**	**0.767**	
9				0.798	0.800	0.744		0.790	0.775	0.743	0.781	0.729	0.773	0.779	0.803				**0.939**			**0.809**	**0.743**	**0.734**	
10				**0.888**	0.827	0.749		0.783	0.808	**0.852**	0.746	0.798	0.785	0.758	0.743	**0.787**						**0.890**			
11				**0.800**	0.807	0.793		0.774	0.775	0.803	0.736	0.802	0.795	0.817	**0.814**							**0.909**		0.809	
12				**0.885**	**0.771**	**0.752**		0.817	0.811	0.783	0.828	**0.822**	0.792	0.771	**0.808**							**0.750**		**0.956**	**0.813**

Table 35. Mean liver index at age of cod sampled during autumn bottom-trawl surveys in divisions 2J, 3K and 3L in 1978-2002. Highlighted entries are based on fewer than 5 aged fish. (Instances where fewer than 5 fish were available are not indicated for years prior to 1995.) There were no surveys in Division 3L in 1978-1980 and 1984.

Division 2J

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2		0.037	0.035	0.046	0.031	0.030	0.032	0.023	0.043	0.031	0.036	0.045	0.042	0.036	0.025	0.032	0.038	0.042	0.037	0.041	0.034	0.045	0.035	0.041	0.044
3		0.061	0.051	0.049	0.047	0.057	0.050	0.036	0.049	0.052	0.049	0.059	0.050	0.042	0.028	0.038	0.039	0.041	0.044	0.043	0.050	0.049	0.038	0.047	0.042
4		0.062	0.034	0.069	0.048	0.078	0.061	0.048	0.079	0.061	0.067	0.067	0.060	0.045	0.040	0.037	0.035	0.041	0.039	0.045	0.047	0.046	0.036	0.041	0.043
5		0.064	0.052	0.053	0.051	0.063	0.066	0.057	0.077	0.073	0.057	0.076	0.061	0.037	0.036	0.038	0.043	0.045	0.043	0.053	0.052	0.054	**0.035**	0.037	0.037
6		0.080	0.054	0.062	0.060	0.065	0.062	0.056	0.089	0.065	0.074	0.074	0.064	0.033	0.037	0.038	0.049	**0.017**	**0.037**		**0.065**	**0.069**	**0.042**	**0.023**	**0.044**
7		0.060	0.055	0.056	0.057	0.057	0.055	0.053	0.074	0.061	0.070	0.077	0.067	0.031	0.036	0.030	0.073		**0.047**		**0.057**			**0.036**	
8		0.040	0.041	0.067	0.051	0.077	0.055	0.061	0.051	0.077	0.076	0.089	0.066	0.033								**0.090**			
9		0.060	0.071	0.058	0.048	0.081	0.066	0.034	0.093	0.045	0.065	0.074	0.073	0.038											
10		0.083	0.084	0.083	0.058	0.053	0.063	0.052	0.071	0.060	0.072	0.097	0.058	0.034											
11		0.097	0.074	0.058	0.052	0.062	0.065	0.065	0.092	0.075	0.068	0.083	0.065	0.042											
12		0.076	0.083	0.061	0.099	0.050	0.053	0.052	0.098	0.089	0.082	0.073	0.084	0.043											

Division 3K

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2	0.030	0.019	0.021	0.040	0.020	0.024	0.013	0.035	0.029	0.029	0.025	0.032	0.035	0.037	0.035	0.042	0.034	0.045	0.039	0.040	0.037	0.046	0.036	0.042	0.048
3	0.020	0.033	0.038	0.044	0.033	0.039	0.032	0.053	0.049	0.046	0.044	0.047	0.042	0.044	0.037	0.043	0.044	0.046	0.044	0.045	0.043	0.052	0.042	0.041	0.048
4	0.032	0.054	0.047	0.041	0.045	0.052	0.037	0.053	0.061	0.049	0.056	0.056	0.052	0.052	0.048	0.045	0.049	0.047	0.044	0.045	0.050	0.054	0.042	0.044	0.045
5	0.040	0.066	0.046	0.035	0.061	0.047	0.046	0.054	0.069	0.056	0.069	0.057	0.051	0.054	0.055	0.051	0.053	0.050	0.046	0.049	0.055	0.052	0.037	0.039	0.048
6	0.037	0.062	0.052	0.054	0.044	0.035	0.041	0.054	0.082	0.064	0.070	0.071	0.055	0.052	0.059	0.058	0.054	**0.048**	**0.038**		0.061	**0.055**	0.041	**0.053**	**0.042**
7	0.040	0.061	0.045	0.043	0.049	0.035	0.047	0.044	0.082	0.078	0.061	0.071	0.057	0.043	0.064	0.050	0.065		**0.059**		0.070	**0.056**	**0.040**		**0.044**
8	0.057	0.058	0.049	0.049	0.052	0.066		0.055	0.074	0.051	0.078	0.072	0.066	0.046	0.059	0.032	0.071			**0.032**	**0.138**			**0.037**	
9	0.059	0.055	0.045	0.070	0.042	0.046	0.047	0.075	0.064	0.053	0.059	0.072	0.060	0.052	0.061			**0.036**			**0.073**	**0.113**		**0.030**	
10	0.062	0.061	0.047	0.059	0.057	0.049	0.037	0.049	0.081	0.070	0.069	0.071	0.064	0.054								**0.096**			
11	0.033	0.066	0.051	0.077	0.055	0.063	0.065	0.066	0.080	0.091	0.073	0.075	0.062	0.038											
12	0.071	0.080	0.066	0.066	0.062	0.024	0.046	0.052	0.097	0.073	0.070	0.071	0.079	0.034											

Division 3L

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2				0.021	0.013	0.025		0.029	0.030	0.026	0.025	0.026	0.039	0.046	0.041	0.043	0.039	0.039	0.039	0.042	0.040	0.046	0.039	0.043	0.050
3				0.041	0.025	0.022		0.031	0.032	0.032	0.028	0.036	0.038	0.056	0.067	0.053	0.078	0.048	0.040	0.047	0.045	0.056	0.043	0.047	0.048
4				0.038	0.042	0.024		0.039	0.035	0.031	0.035	0.039	0.037	0.062	0.073	0.062	0.053	0.049	0.044	0.049	0.051	0.050	0.048	0.050	0.051
5				0.039		0.027		0.039	0.047	0.035	0.043	0.052	0.042	0.059	0.076	0.066	0.052	0.050	0.044	0.055	**0.067**	0.055	0.047	0.052	0.062
6				0.039		0.030		0.033	0.040	0.030	0.045	0.045	0.048	0.060	0.071	0.075	0.074	0.066	0.064	**0.053**	**0.062**	0.047	0.052	0.051	0.051
7				0.041		0.041		0.030	0.045	0.029	0.051	0.053	0.057	0.059	0.073	0.066	0.044	**0.080**	0.078	0.069	**0.042**	**0.091**	**0.066**	**0.056**	**0.038**
8				0.065	0.039	0.032		0.046	0.033	0.032	0.043	0.058	0.055	0.069	0.065	0.033	0.035	**0.053**	**0.102**	0.068	0.079	**0.066**	**0.086**	**0.065**	
9				0.049	0.061	0.039		0.051	0.056	0.036	0.050	0.051	0.059	0.075	0.070				**0.137**	**0.087**	**0.080**	**0.076**	**0.051**	**0.041**	
10				0.077	0.054	0.041		0.066	0.052	0.091	0.039	0.059	0.057	0.066	0.074	0.098						**0.084**			
11				0.052	0.068	0.042		0.060	0.048	0.059	0.044	0.067	0.069	0.074	0.090						**0.082**	**0.081**		0.067	
12				0.068	0.066	0.045		0.071	0.060	0.050	0.070	0.055	0.065	0.056	0.068							**0.060**		**0.146**	**0.092**

Table 36. Estimated proportions mature for female cod from NAFO Divs. 2J+3KL from DFO surveys from 1960 to 2002 projected forward to 2010. Estimates were obtained from a probit model fitted by cohort to observed proportions mature at age. Shaded cells are extrapolations of the first or last three estimates for the same age group or are the average of adjacent estimates for the same age group.

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1958	0.00000	0.00000	0.00004	0.00067	0.01123	0.15759	0.76340	0.98747	0.99939	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1959	0.00000	0.00000	0.00004	0.00067	0.01123	0.15759	0.76340	0.98747	0.99939	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1960	0.00000	0.00000	0.00000	0.00067	0.01123	0.15759	0.76340	0.98747	0.99939	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1961	0.00000	0.00000	0.00004	0.00002	0.01123	0.15759	0.76340	0.98747	0.99939	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1962	0.00000	0.00002	0.00008	0.00076	0.00092	0.15759	0.76340	0.98747	0.99939	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1963	0.00007	0.00001	0.00029	0.00123	0.01305	0.03961	0.76340	0.98747	0.99939	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1964	0.00002	0.00042	0.00014	0.00348	0.01973	0.18629	0.64934	0.98747	0.99939	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1965	0.00034	0.00015	0.00262	0.00182	0.04024	0.24687	0.79859	0.98812	0.99939	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1966	0.00002	0.00166	0.00102	0.01602	0.02434	0.33472	0.84226	0.98565	0.99973	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1967	0.00000	0.00013	0.00814	0.00711	0.09165	0.25596	0.85790	0.98863	0.99916	0.99999	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1968	0.00000	0.00002	0.00106	0.03891	0.05208	0.38477	0.83292	0.98638	0.99929	0.99995	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1969	0.00001	0.00000	0.00030	0.00856	0.16636	0.32515	0.79494	0.98689	0.99885	0.99996	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1970	0.00023	0.00005	0.00001	0.00374	0.06565	0.49592	0.82859	0.96005	0.99910	0.99990	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1971	0.00008	0.00125	0.00046	0.00029	0.04464	0.36374	0.82906	0.97777	0.99333	0.99994	0.99999	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1972	0.01696	0.00043	0.00690	0.00420	0.00849	0.36775	0.82306	0.95986	0.99709	0.99892	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1973	0.00000	0.04213	0.00246	0.03713	0.03959	0.20038	0.87865	0.97426	0.99159	0.99959	0.99983	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1974	0.00003	0.00002	0.10084	0.01387	0.17639	0.31062	0.88003	0.98903	0.99676	0.99828	0.99994	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000
1975	0.00017	0.00022	0.00030	0.22237	0.07482	0.54326	0.86058	0.99536	0.99911	0.99960	0.99965	0.99999	1.00000	1.00000	1.00000	1.00000	1.00000
1976	0.00013	0.00095	0.00181	0.00364	0.42167	0.35142	0.86852	0.98622	0.99984	0.99993	0.99995	0.99993	1.00000	1.00000	1.00000	1.00000	1.00000
1977	0.00005	0.00082	0.00525	0.01501	0.04298	0.65023	0.86971	0.97346	0.99857	0.99999	0.99999	0.99999	0.99999	1.00000	1.00000	1.00000	1.00000
1978	0.00000	0.00034	0.00508	0.02847	0.11360	0.35541	0.82579	0.98501	0.99512	0.99984	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1979	0.00000	0.00001	0.00244	0.03083	0.13997	0.51879	0.87129	0.92358	0.99784	0.99912	0.99998	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1980	0.00003	0.00002	0.00022	0.01733	0.16553	0.47476	0.90069	0.98811	0.96857	0.99965	0.99984	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1981	0.00019	0.00025	0.00028	0.00314	0.11293	0.55297	0.83389	0.98706	0.99902	0.98743	0.99994	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000
1982	0.00000	0.00096	0.00217	0.00420	0.04362	0.47885	0.88523	0.96537	0.99844	0.99992	0.99503	0.99999	0.99999	1.00000	1.00000	1.00000	1.00000
1983	0.00000	0.00003	0.00486	0.01860	0.05876	0.39791	0.86897	0.97963	0.99358	0.99981	0.99999	0.99805	1.00000	1.00000	1.00000	1.00000	1.00000
1984	0.00001	0.00001	0.00037	0.02413	0.14166	0.48053	0.90545	0.97954	0.99668	0.99884	0.99998	1.00000	0.99923	1.00000	1.00000	1.00000	1.00000
1985	0.00001	0.00014	0.00018	0.00452	0.11138	0.58970	0.93200	0.99284	0.99711	0.99947	0.99979	1.00000	1.00000	0.99970	1.00000	1.00000	1.00000
1986	0.00004	0.00012	0.00142	0.00274	0.05334	0.38847	0.92602	0.99510	0.99950	0.99960	0.99991	0.99996	1.00000	1.00000	1.00000	1.00000	1.00000
1987	0.00003	0.00030	0.00126	0.01388	0.03944	0.41140	0.76300	0.99091	0.99967	0.99997	0.99994	0.99999	0.99999	1.00000	1.00000	1.00000	1.00000
1988	0.00000	0.00022	0.00215	0.01266	0.12231	0.37997	0.89660	0.94225	0.99895	0.99998	1.00000	0.99999	1.00000	1.00000	1.00000	1.00000	1.00000
1989	0.00000	0.00005	0.00195	0.01504	0.11515	0.57977	0.90144	0.99079	0.98805	0.99988	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1990	0.00000	0.00002	0.00100	0.01679	0.09763	0.56916	0.93178	0.99273	0.99925	0.99762	0.99999	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1991	0.00011	0.00005	0.00046	0.01790	0.13020	0.43385	0.93061	0.99266	0.99951	0.99994	0.99953	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1992	0.00228	0.00097	0.00138	0.01309	0.24998	0.56745	0.84443	0.99271	0.99925	0.99997	1.00000	0.99991	1.00000	1.00000	1.00000	1.00000	1.00000
1993	0.00002	0.00822	0.00856	0.03654	0.27554	0.85909	0.91998	0.97465	0.99928	0.99992	1.00000	1.00000	0.99998	1.00000	1.00000	1.00000	1.00000
1994	0.00001	0.00024	0.02914	0.07112	0.51058	0.91603	0.99111	0.99017	0.99634	0.99993	0.99999	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1995	0.00007	0.00013	0.00288	0.09803	0.40450	0.96633	0.99681	0.99951	0.99887	0.99948	0.99999	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1996	0.00202	0.00075	0.00200	0.03356	0.28243	0.85767	0.99873	0.99989	0.99997	0.99987	0.99993	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1997	0.00052	0.00789	0.00784	0.02921	0.29435	0.58769	0.98164	0.99995	1.00000	1.00000	0.99999	0.99999	1.00000	1.00000	1.00000	1.00000	1.00000
1998	0.00011	0.00267	0.03027	0.07634	0.31123	0.83363	0.83771	0.99790	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1999	0.00000	0.00083	0.01353	0.10911	0.46363	0.87156	0.98366	0.94922	0.99976	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2000	0.00021	0.00000	0.00646	0.06564	0.32461	0.90040	0.99028	0.99862	0.98544	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2001	0.00021	0.00117	0.00010	0.04832	0.26455	0.65351	0.98953	0.99935	0.99988	0.99594	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2002	0.00021	0.00117	0.00670	0.00893	0.28388	0.64813	0.88097	0.99899	0.99996	0.99999	0.99887	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2003	0.00021	0.00117	0.00670	0.04096	0.44757	0.75578	0.90414	0.96672	0.99990	1.00000	1.00000	0.99969	1.00000	1.00000	1.00000	1.00000	1.00000
2004	0.00021	0.00117	0.00670	0.04096	0.33200	0.98646	0.96025	0.97971	0.99130	0.99999	1.00000	1.00000	0.99991	1.00000	1.00000	1.00000	1.00000
2005	0.00021	0.00117	0.00670	0.04096	0.33200	0.79679	0.99985	0.99473	0.99597	0.99777	1.00000	1.00000	1.00000	0.99998	1.00000	1.00000	1.00000
2006	0.00021	0.00117	0.00670	0.04096	0.33200	0.79679	0.95475	1.00000	0.99932	0.99921	0.99943	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2007	0.00021	0.00117	0.00670	0.04096	0.33200	0.79679	0.95475	0.99148	1.00000	0.99991	0.99985	0.99985	1.00000	1.00000	1.00000	1.00000	1.00000
2008	0.00021	0.00117	0.00670	0.04096	0.33200	0.79679	0.95475	0.99148	0.99843	1.00000	0.99999	0.99997	0.99996	1.00000	1.00000	1.00000	1.00000
2009	0.00021	0.00117	0.00670	0.04096	0.33200	0.79679	0.95475	0.99148	0.99843	0.99971	1.00000	1.00000	0.99999	0.99999	1.00000	1.00000	1.00000
2010	0.00021	0.00117	0.00670	0.04096	0.33200	0.79679	0.95475	0.99148	0.99843	0.99971	0.99995	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table 37. Inshore SPA. Catch numbers at age (thousands). The 10+ group is the sum of ages 10-14.

Year	Age								
	2	3	4	5	6	7	8	9	10+
1995	0	7	30	71	55	20	11	3	0
1996	1	40	237	297	341	129	23	5	3
1997	0	8	23	54	56	84	21	3	2
1998	3	96	229	395	689	384	237	74	18
1999	7	70	238	638	795	1157	370	253	68
2000	5	141	258	419	437	328	294	151	178
2001	10	249	778	710	611	365	190	272	234
2002	6	166	296	399	335	235	124	77	227

Table 38. Inshore SPA. Research vessel inshore bottom-trawl survey mean numbers per tow at age index.

Year	Age							
	2	3	4	5	6	7	8	9
1996.92	3.64	1.61	1.21	0.78	1.02	0.54	0.26	0.24
1997.92	1.80	1.11	0.78	0.46	0.06	0.11	0.05	0.05
1998.92	1.42	0.42	0.20	0.06	0.06	0.02	0.01	0.01
1999.92								
2000.92	4.28	2.01	0.63	0.22	0.06	0.04	0.03	0.01
2001.92	5.15	1.93	0.90	0.31	0.04	0.01	0.00	0.02
2002.92	3.94	0.78	0.34	0.17	0.04	0.00	0.01	0.01

Table 39. Inshore SPA. Sentinel survey catch rate at age index for 5 ½ inch mess gillnets.

Year	Age							
	3	4	5	6	7	8	9	10
1995.5	0.001	0.038	0.852	1.112	0.455	0.259	0.064	0.014
1996.5	0.027	0.107	0.711	3.908	1.637	0.477	0.106	0.028
1997.5	0.015	0.069	1.144	1.708	3.048	0.756	0.099	0.042
1998.5	0.027	0.069	0.899	4.312	2.733	1.459	0.408	0.055
1999.5	0.011	0.076	0.818	1.358	1.921	0.586	0.314	0.078
2000.5	0.015	0.059	0.561	0.895	0.596	0.722	0.314	0.154
2001.5	0.008	0.048	0.255	0.607	0.363	0.175	0.242	0.073
2002.5	0.017	0.047	0.339	0.475	0.392	0.163	0.087	0.11

Table 40. Inshore SPA. Sentinel survey catch rate at age index for 3 ¼ inch mess gillnets.

Year	Age								
	2	3	4	5	6	7	8	9	10
1996.5	0.014	6.955	13.612	5.257	5.461	0.245	0.027	0	0
1997.5	0.011	6.264	9.195	4.341	3.016	2.218	0.354	0.044	0
1998.5	0.038	5.056	5.979	3.466	4.892	2.148	0.828	0.211	0.005
1999.5	0.243	5.487	4.377	2.897	1.286	1.113	0.261	0.094	0.021
2000.5	0.171	6.486	5.994	1.955	1.045	0.333	0.265	0.116	0.058
2001.5	0.245	6.423	6.201	1.845	0.719	0.167	0.052	0.059	0.014
2002.5	0.402	10.235	6.427	1.404	0.553	0.167	0.022	0.013	0.016

Table 41. Inshore SPA. Sentinel survey catch rate at age index for linetrawls. [Note that the comparable data in Table 6 of Lilly et al. (2003) are incorrect.]

Year	Age						
	3	4	5	6	7	8	9
1995.5	0.009	0.044	0.041	0.016	0.006	0.000	0.001
1996.5	0.021	0.033	0.039	0.019	0.005	0.001	0.000
1997.5	0.017	0.052	0.060	0.038	0.026	0.005	0.001
1998.5	0.018	0.030	0.019	0.017	0.004	0.006	0.002
1999.5	0.009	0.017	0.021	0.006	0.001	0.001	0.001
2000.5	0.008	0.017	0.009	0.008	0.001	0.001	0.000
2001.5	0.024	0.030	0.017	0.006	0.003	0.001	0.000
2002.5	0.013	0.019	0.012	0.005	0.001	0.000	0.001

Table 42. Inshore SPA. Parameter estimates and associated standard error for the ADAPT model fit for inshore catch and survey indices.

		MSE = 0.56					
		Parameter	Estimate	Standard error	Bias	Relative Bias	Relative error
	3	N[2003 3]	51437	31718	13578	0.26	0.62
	4	N[2003 4]	16060	6278	2398	0.15	0.39
	5	N[2003 5]	7058	2375	925	0.13	0.34
	6	N[2003 6]	3460	1188	478	0.14	0.34
	7	N[2003 7]	1176	471	199	0.17	0.40
	8	N[2003 8]	455	246	109	0.24	0.54
	9	N[2003 9]	233	149	70	0.30	0.64
	10	N[2003 10]	654	547	262	0.40	0.84
		Fratio[1995 10]	0.50	0.06	0.01	0.02	0.12
rv inshore	2	q ID#[1]	0.000143	5.54E-05	1.95E-07	0.00	0.39
	3	q ID#[2]	0.000102	3.77E-05	-3.48E-07	0.00	0.37
	4	q ID#[3]	8.1E-05	3E-05	-4.52E-07	-0.01	0.37
	5	q ID#[4]	6.04E-05	2.33E-05	-3.94E-07	-0.01	0.39
	6	q ID#[5]	3.21E-05	1.38E-05	-6.58E-08	0.00	0.43
	7	q ID#[6]	3.39E-05	1.68E-05	7.00E-07	0.02	0.50
	8	q ID#[7]	3.58E-05	2.03E-05	2.09E-06	0.06	0.57
	9	q ID#[8]	6.95E-05	4.44E-05	7.78E-06	0.11	0.64
gill 5.5	3	q ID#[9]	7.52E-07	2.51E-07	-1.31E-08	-0.02	0.33
	4	q ID#[10]	6.81E-06	2.30E-06	-1.31E-07	-0.02	0.34
	5	q ID#[11]	0.000107	3.8E-05	-2.02E-06	-0.02	0.36
	6	q ID#[12]	0.00039	0.000152	-5.52E-06	-0.01	0.39
	7	q ID#[13]	0.000553	0.000244	-1.16E-07	0.00	0.44
	8	q ID#[14]	0.000454	0.000228	1.1E-05	0.02	0.50
	9	q ID#[15]	0.000272	0.000156	1.86E-05	0.07	0.57
lt	3	q ID#[16]	0.000927	0.00031	-1.61E-05	-0.02	0.33
	4	q ID#[17]	0.003114	0.00105	-5.97E-05	-0.02	0.34
	5	q ID#[18]	0.003851	0.001368	-7.28E-05	-0.02	0.36
	6	q ID#[19]	0.003281	0.001278	-4.65E-05	-0.01	0.39
	7	q ID#[20]	0.001732	0.000766	-3.63E-07	0.00	0.44
	8	q ID#[21]	0.001416	0.000722	3.68E-05	0.03	0.51
	9	q ID#[22]	0.0018	0.001118	0.000181	0.10	0.62
gill 3.25	2	q ID#[23]	3.14E-06	1.15E-06	-2.20E-08	-0.01	0.37
	3	q ID#[24]	0.00049	0.000171	-5.38E-06	-0.01	0.35
	4	q ID#[25]	0.000825	0.000288	-1.08E-05	-0.01	0.35
	5	q ID#[26]	0.000539	0.000194	-7.87E-06	-0.01	0.36
	6	q ID#[27]	0.00053	0.000207	-6.52E-06	-0.01	0.39
	7	q ID#[28]	0.000276	0.000123	6.76E-08	0.00	0.44
	8	q ID#[29]	0.000125	6.31E-05	2.99E-06	0.02	0.51

Table 43. Inshore SPA. Bias corrected ADAPT estimates of numbers at age (thousands).

Year	Age								
	2	3	4	5	6	7	8	9	10+
1995	25111	35935	15741	18033	6267	1288	761	907	0
1996	22506	15231	21790	9524	10883	3759	766	453	548
1997	19545	13650	9207	13034	5548	6338	2181	447	601
1998	20060	11854	8273	5567	7864	3322	3780	1306	631
1999	27280	12165	7116	4841	3073	4241	1721	2111	1105
2000	29037	16541	7324	4133	2448	1261	1696	762	1704
2001	37496	17608	9924	4244	2186	1152	516	804	1244
2002	62427	22735	10488	5422	2032	863	423	170	857
2003		37859	13661	6133	2982	977	345	163	392

Table 44. Inshore SPA. Bias corrected ADAPT estimates of fishing mortality at age. [Note that the comparable data in Table 9 of Lilly et al. (2003) are the biased estimates.]

Year	Age								
	2	3	4	5	6	7	8	9	10
1995	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.00	0.00
1996	0.00	0.00	0.01	0.04	0.04	0.04	0.04	0.01	0.01
1997	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.01	0.00
1998	0.00	0.01	0.04	0.09	0.12	0.16	0.08	0.07	0.04
1999	0.00	0.01	0.04	0.18	0.39	0.42	0.31	0.16	0.08
2000	0.00	0.01	0.05	0.14	0.25	0.39	0.25	0.29	0.14
2001	0.00	0.02	0.10	0.24	0.43	0.50	0.61	0.55	0.27
2002	0.00	0.01	0.04	0.10	0.23	0.42	0.46	0.81	0.40

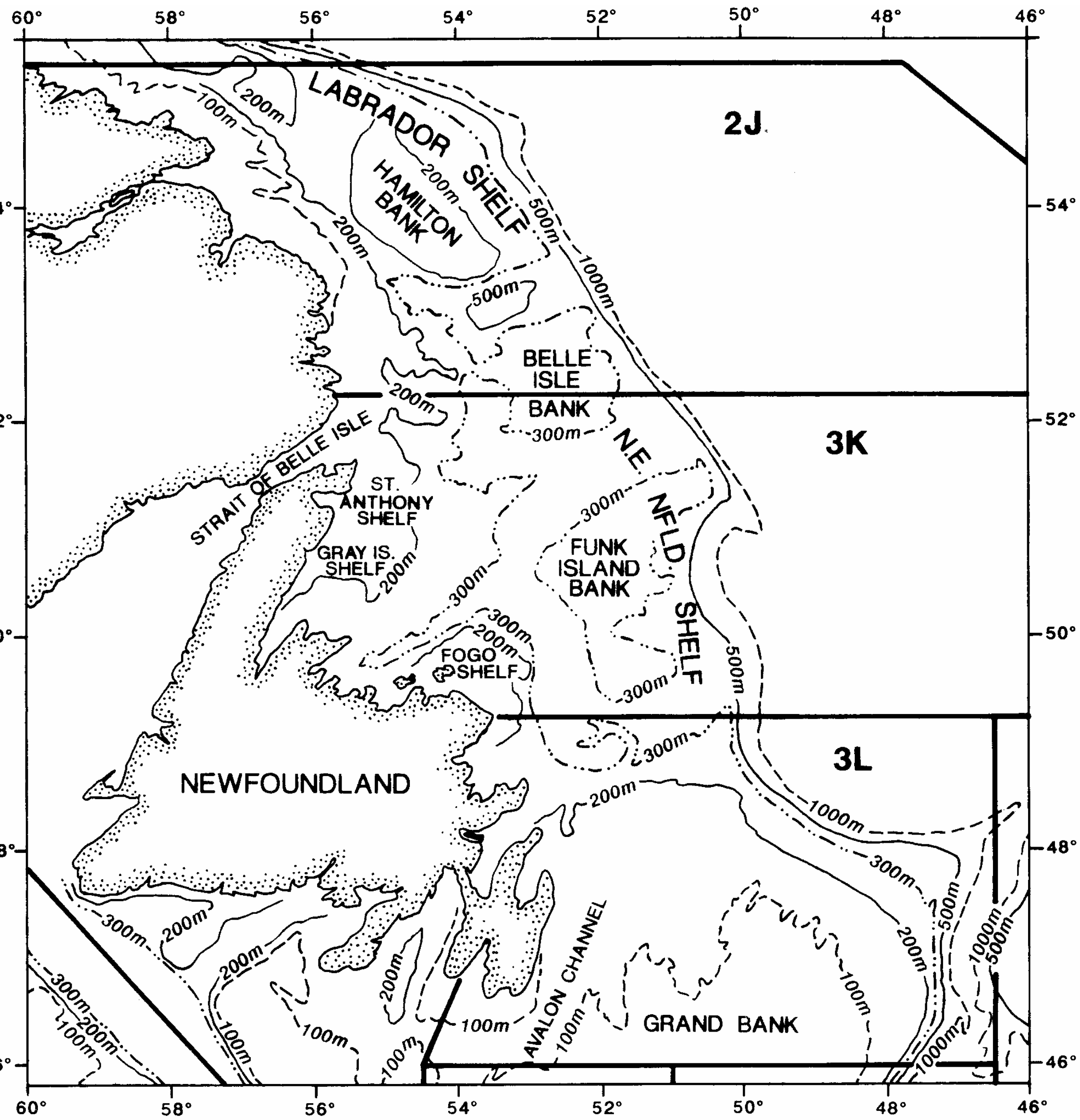


Fig. 1a. Map of the stock area, showing physiographic features and NAFO Divisions.

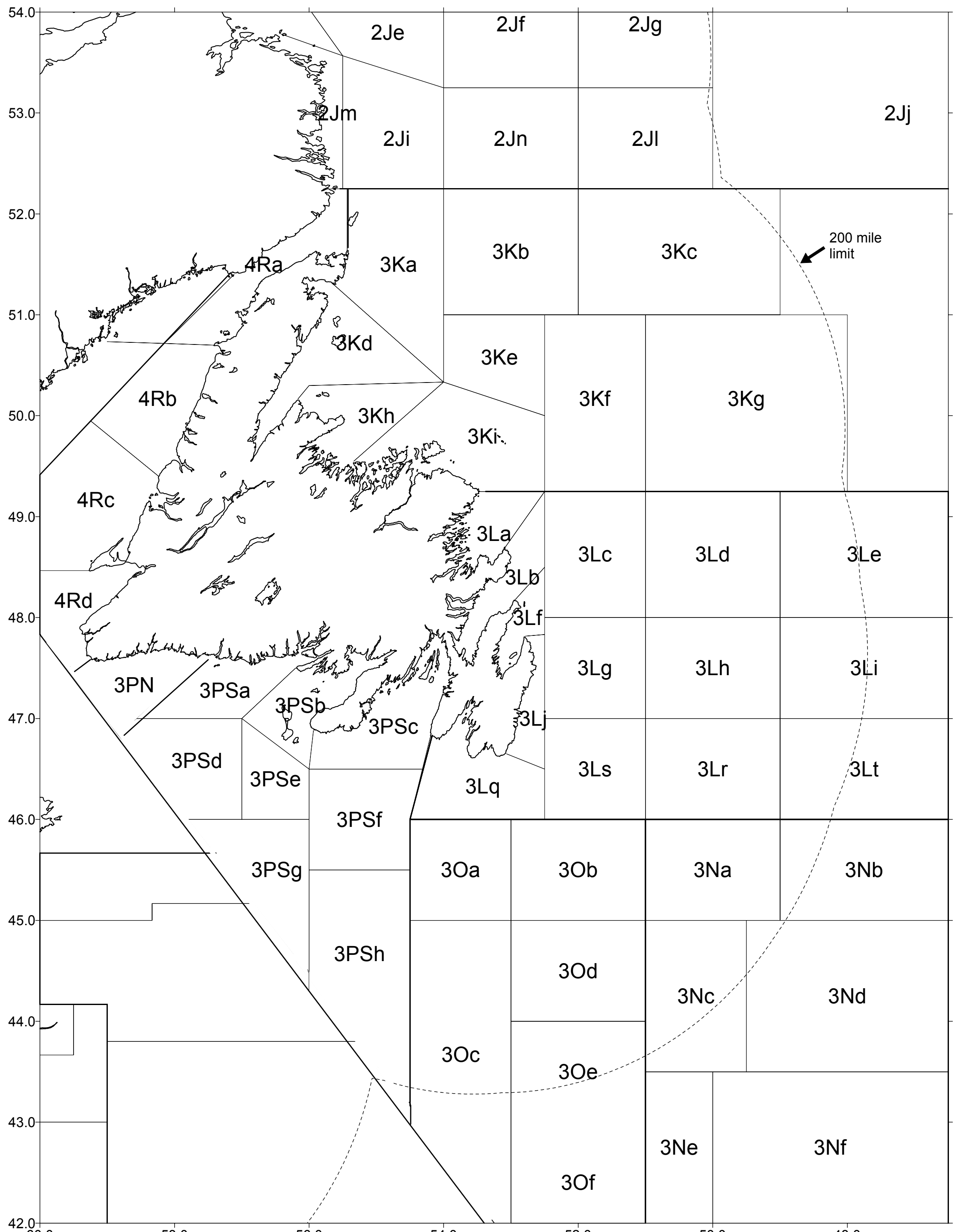


Fig. 1b. Map of the stock area, showing commercial fishery statistical unit areas.

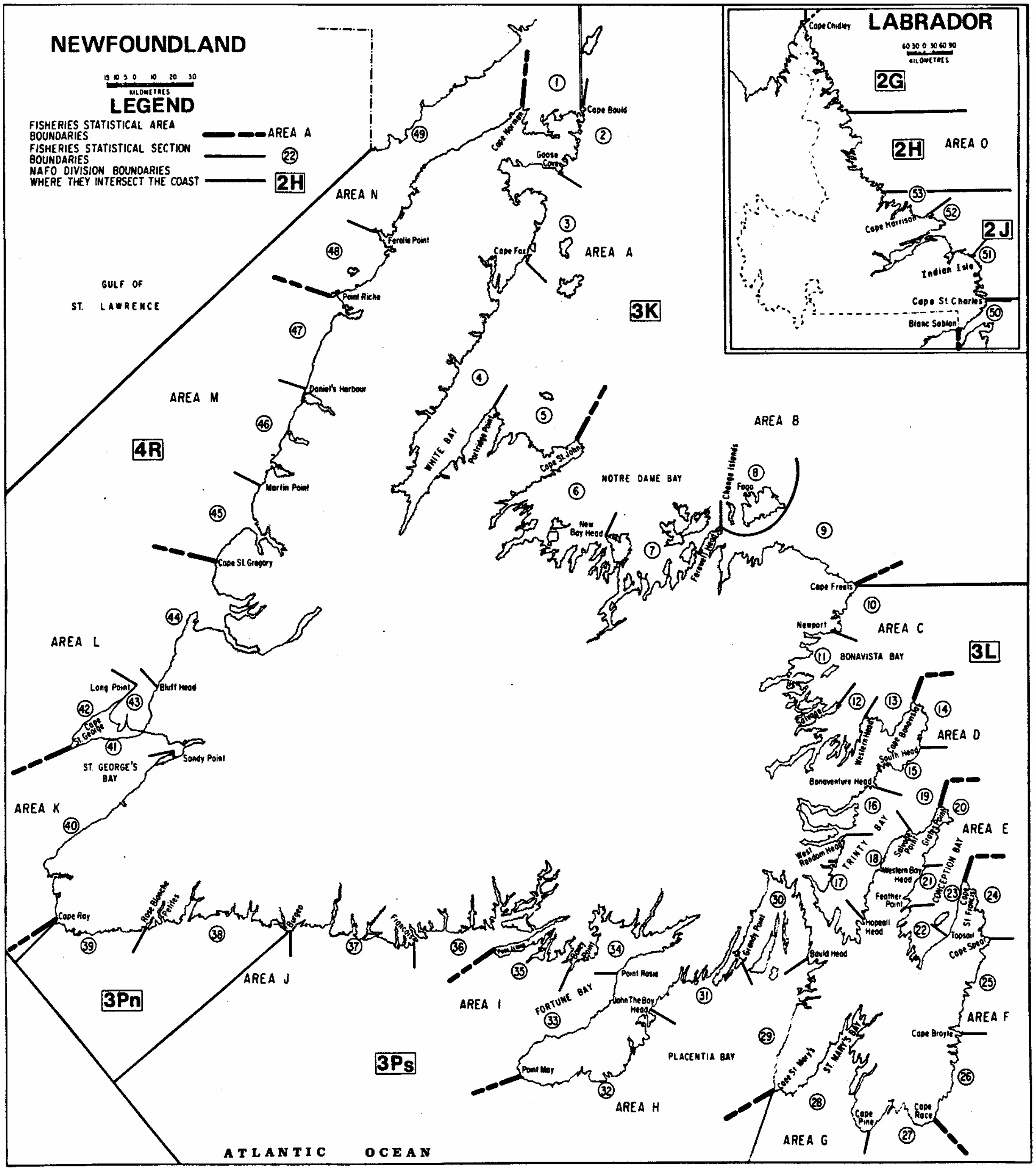


Fig. 1c. Map of the stock area, showing commercial fishery statistical sections.

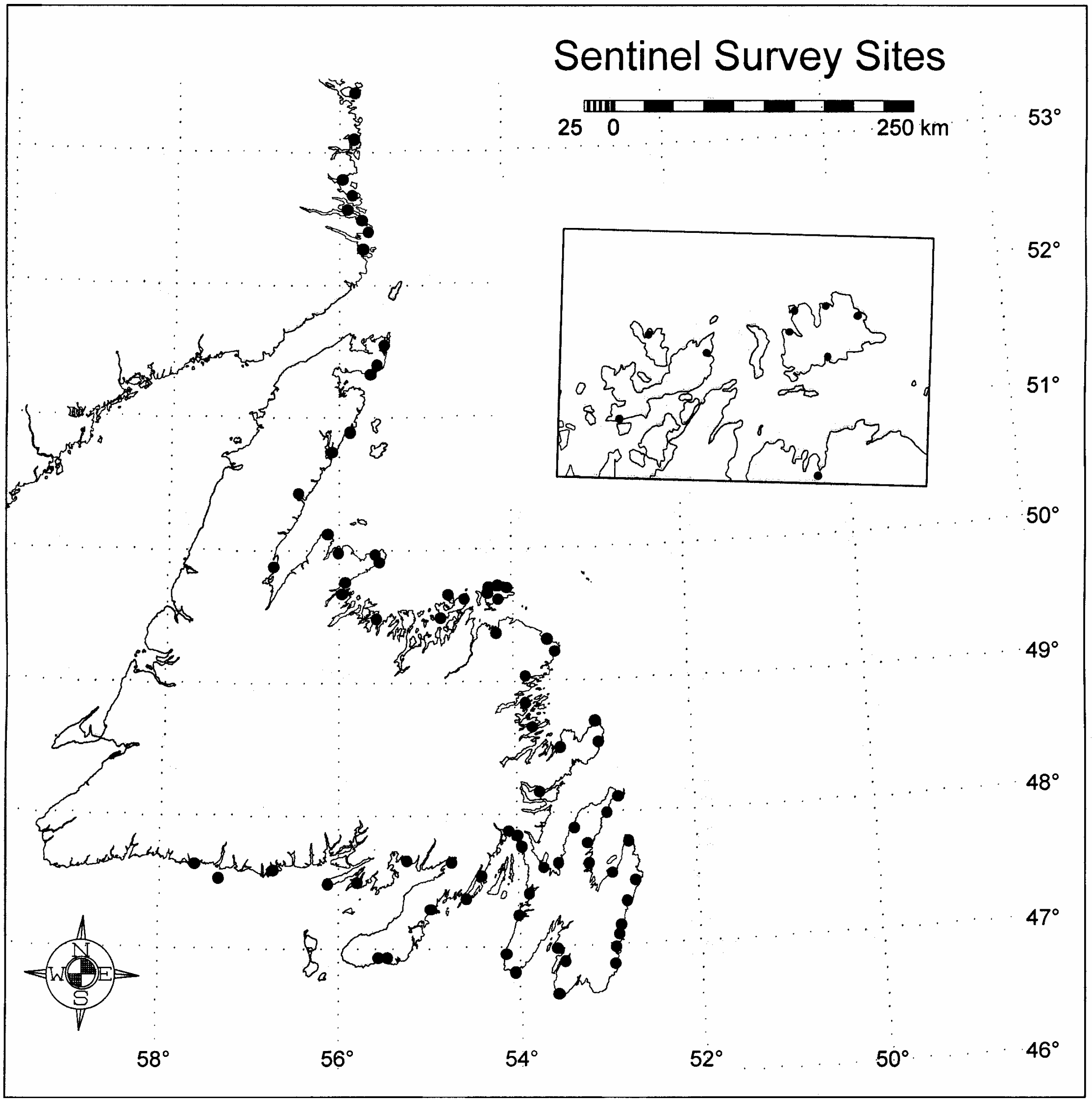


Fig. 1d. Map of the stock area, showing sentinel survey sites.

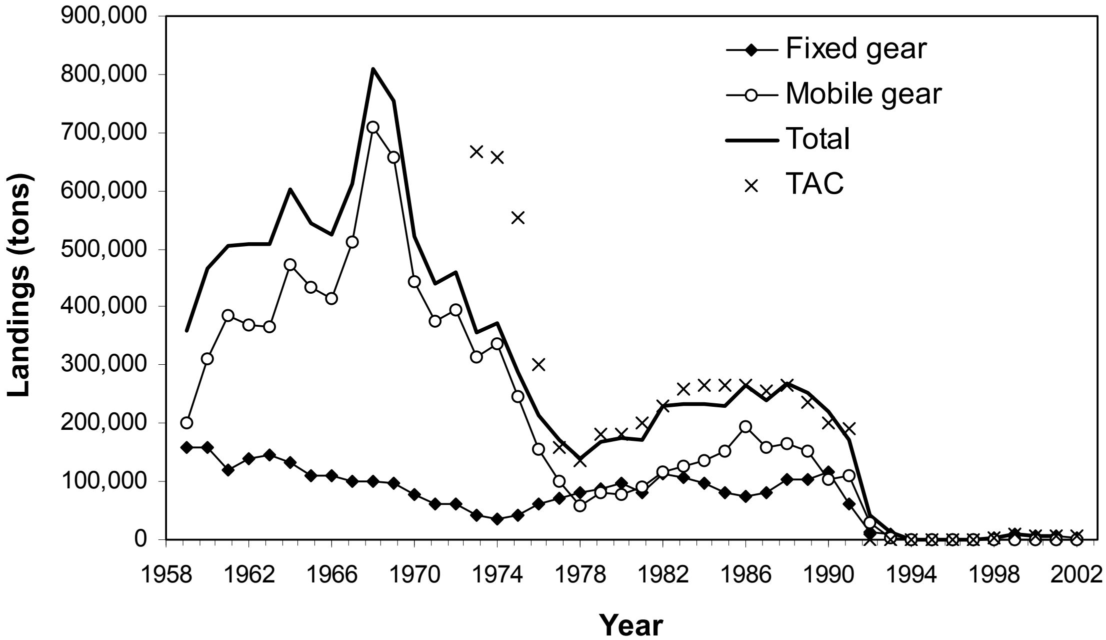


Fig. 2. Divisions 2J+3KL TAC and landings from fixed and mobile gear, 1959-2002.

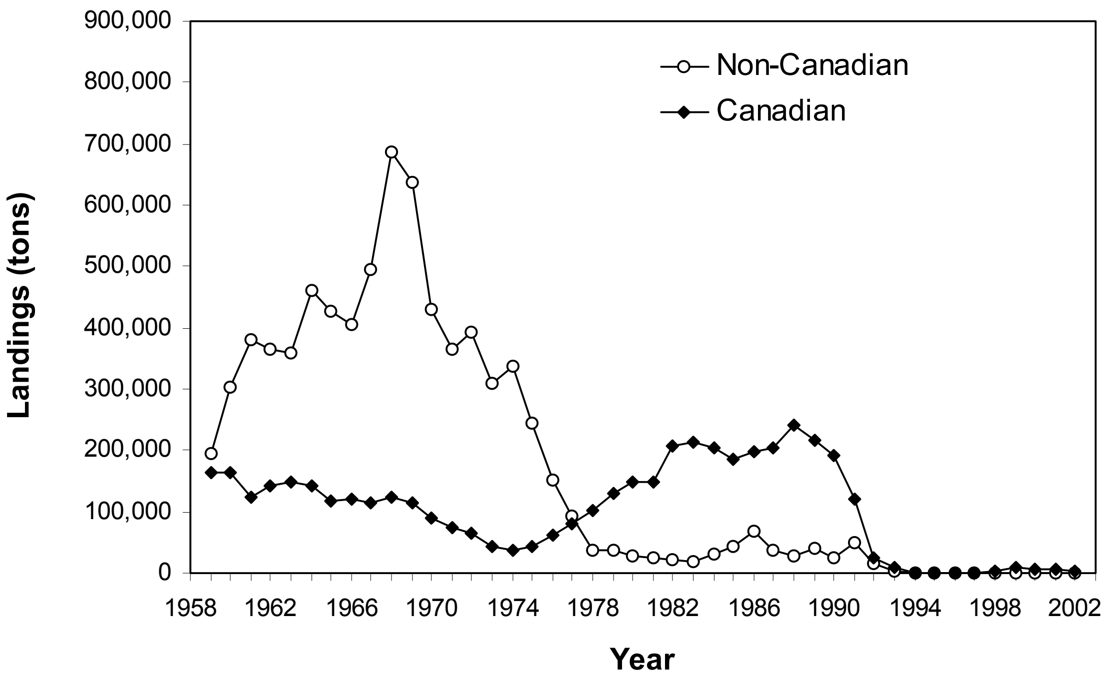


Fig. 3. Divisions 2J+3KL landings by Canadian and non-Canadian vessels, 1959-2000.

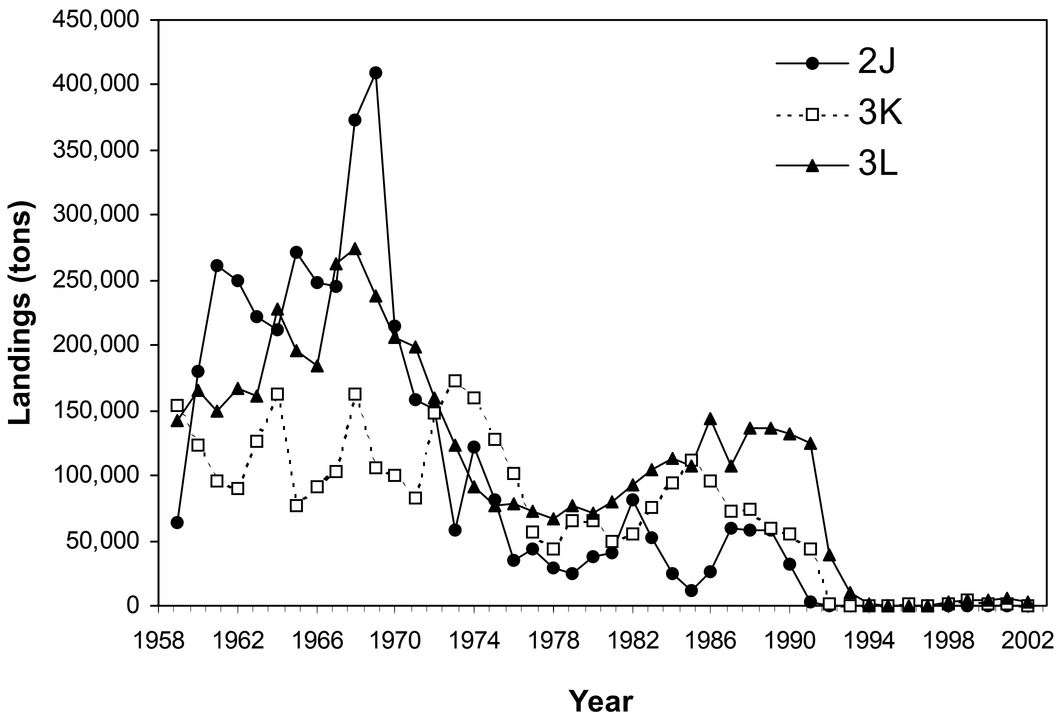


Fig. 4. Division 2J+3KL landings by Division, 1959-2002.

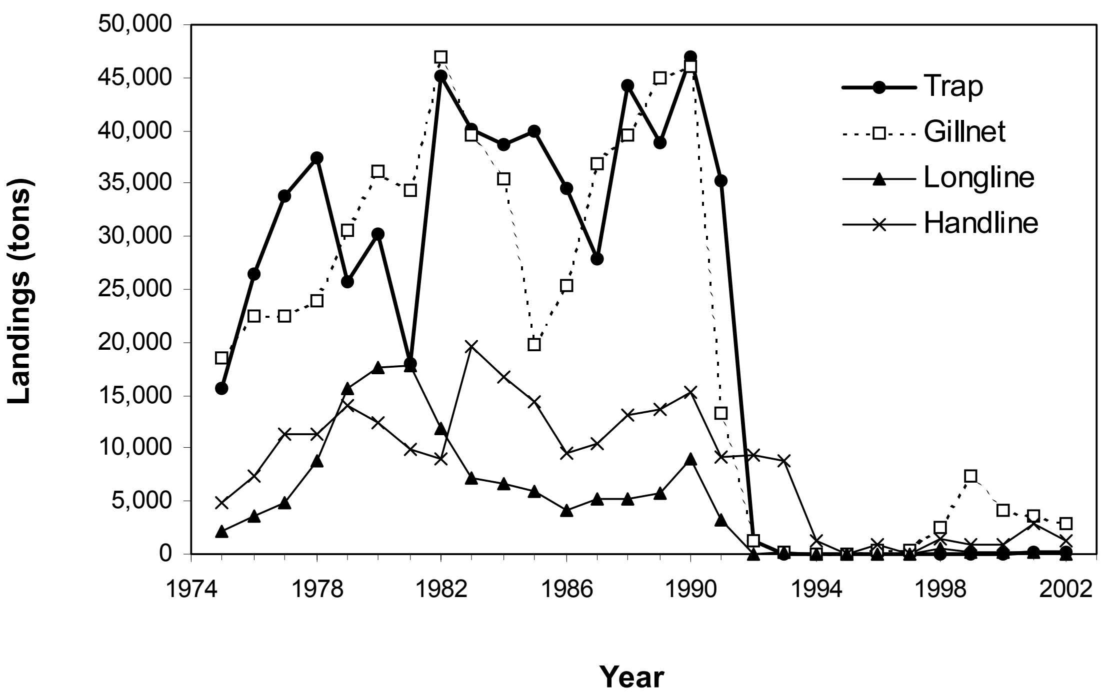


Fig. 5. Division 2J+3KL fixed gear landings by gear type, 1975-2002.

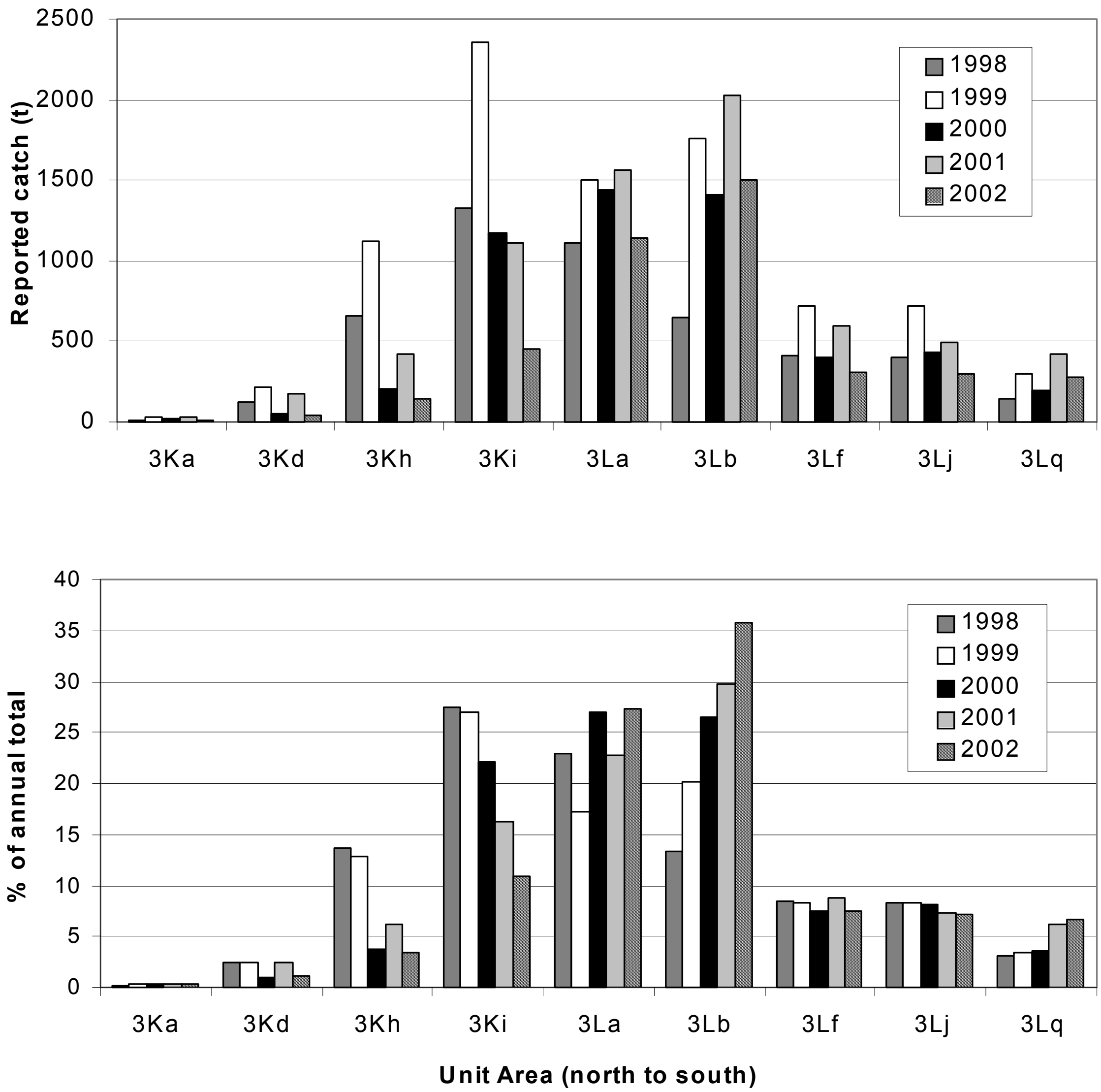


Fig. 6. Reported landings in Divisions 3K and 3L by unit area in 1998-2002. The unit areas are arranged from north to south (left to right). Unit areas are illustrated in Fig. 1(b). The upper panel shows landings. The lower panel shows the percentage of the annual total taken within each of the unit areas.

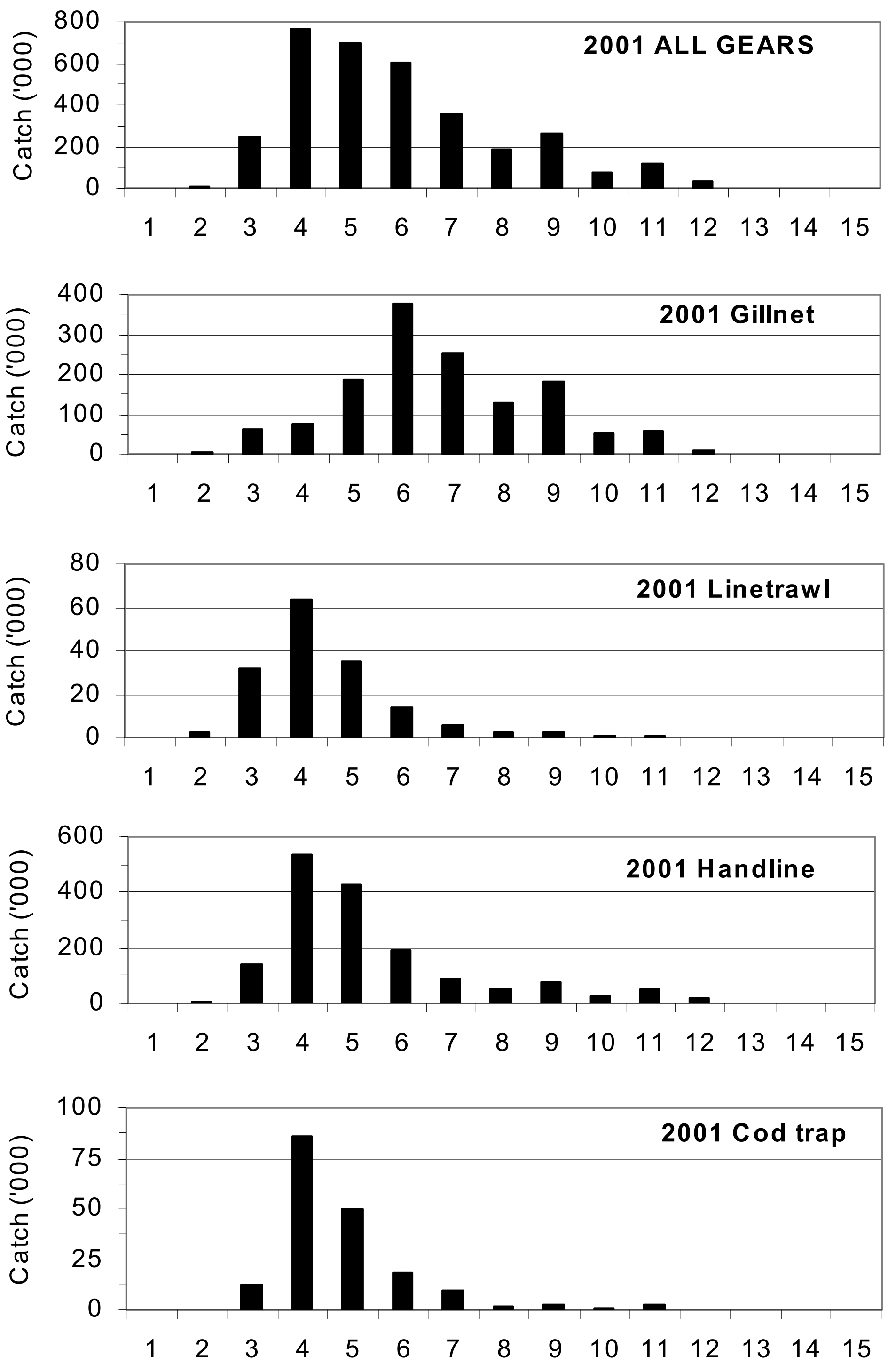


Fig. 7a. The estimated catch at age for all gears combined and for individual gears in 2J3KL in 2001. All sources of catch (commercial, sentinel survey and food / recreational) are combined.

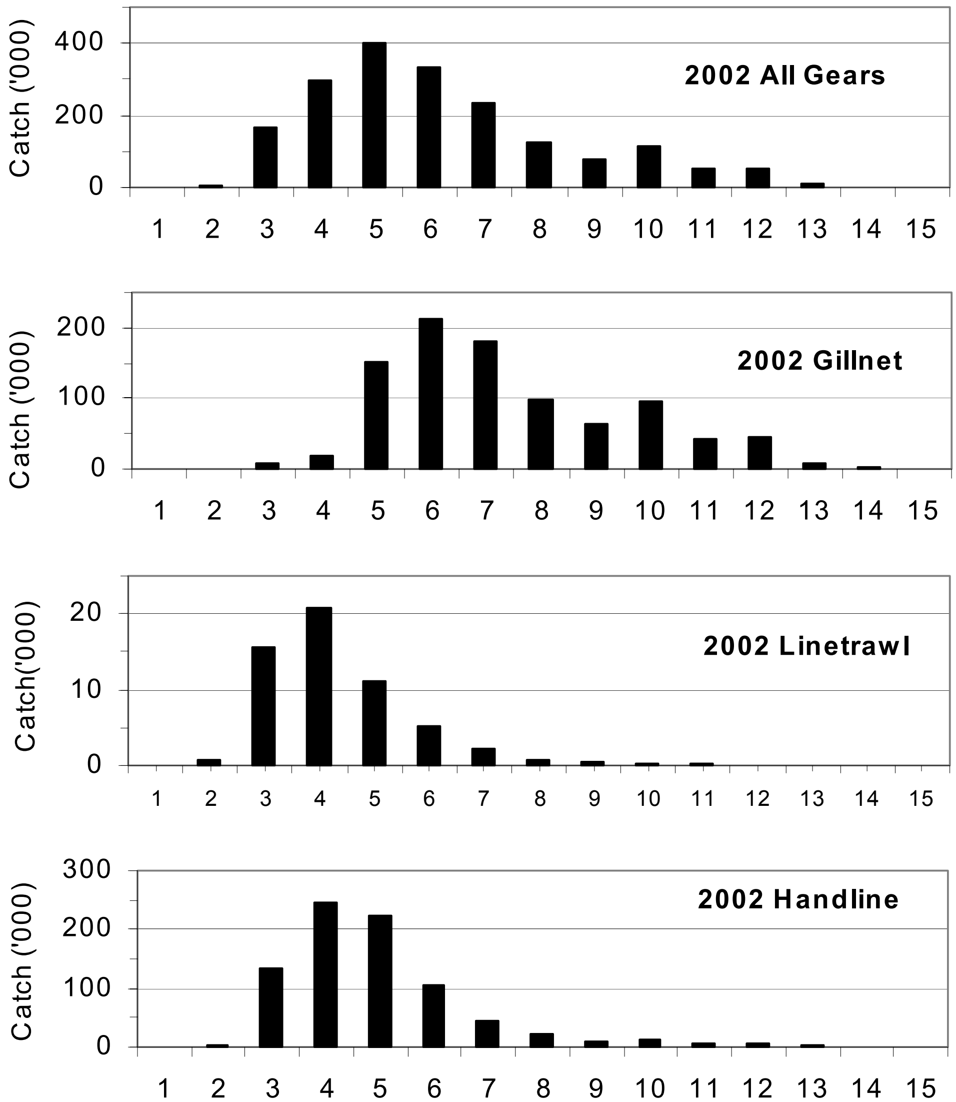


Fig. 7b. The estimated catch at age for all gears combined and for individual gears in 2J3KL in 2002. All sources of catch (commercial, sentinel survey and food / recreational) are combined.

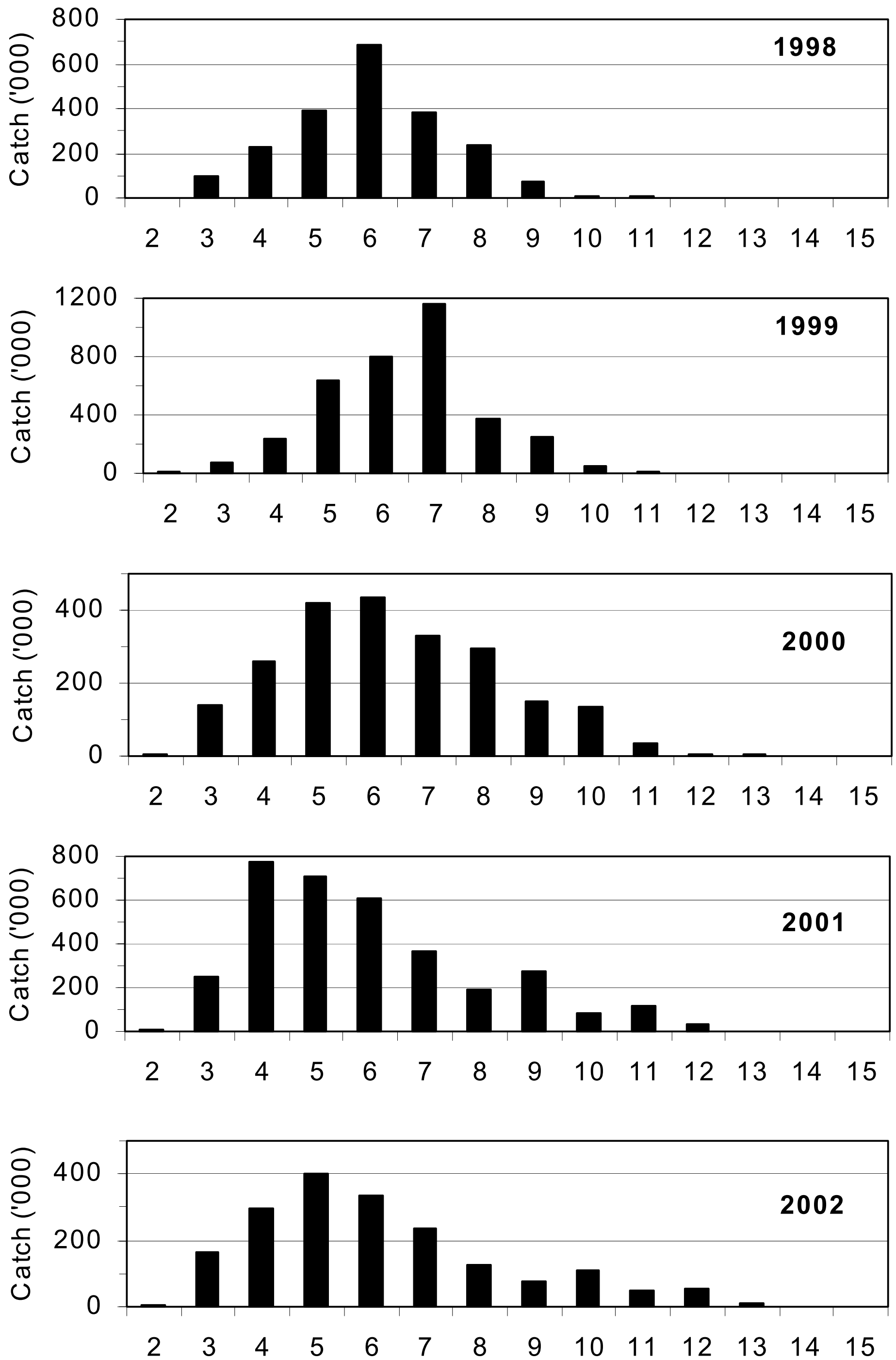


Fig. 7c. The estimated catch at age for all gears combined in 2J3KL in 1998-2002. All sources of catch (commercial, sentinel survey and food / recreational) are combined.

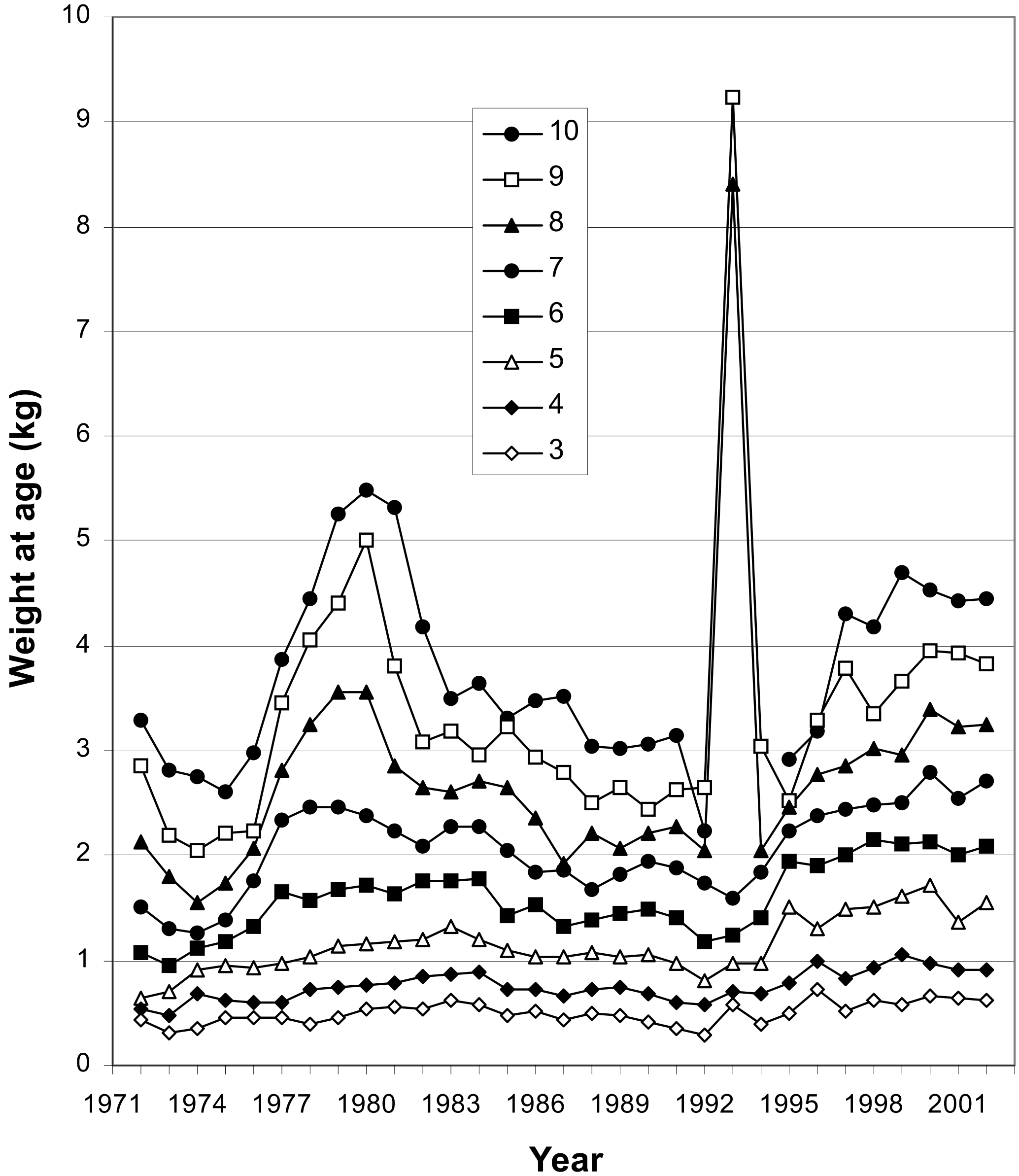


Fig. 8. Mean weights-at-age calculated from mean lengths-at-age in the catch, 1972-2002.

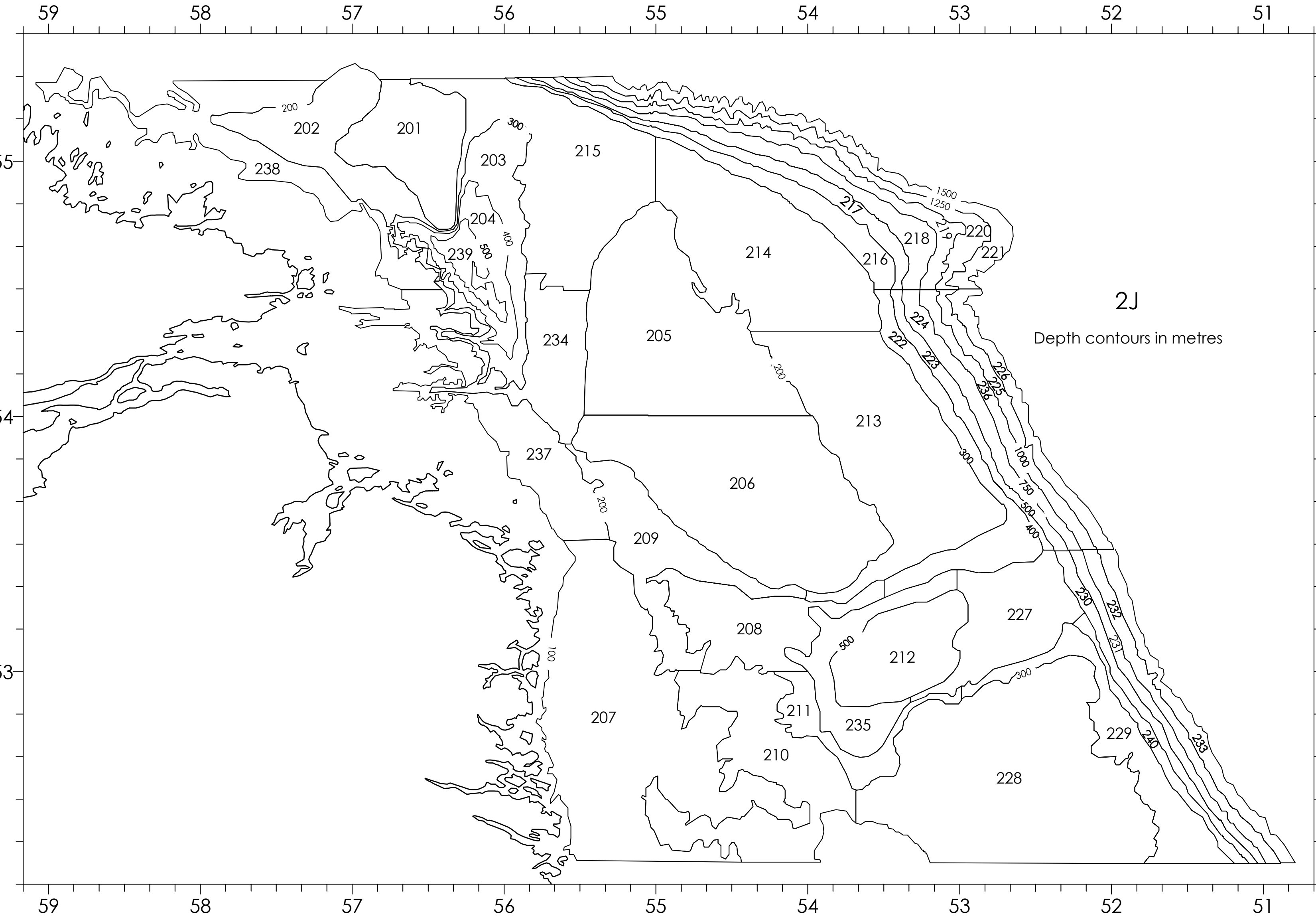


Fig. 9. Strata used for research bottom-trawl surveys in Division 2J.

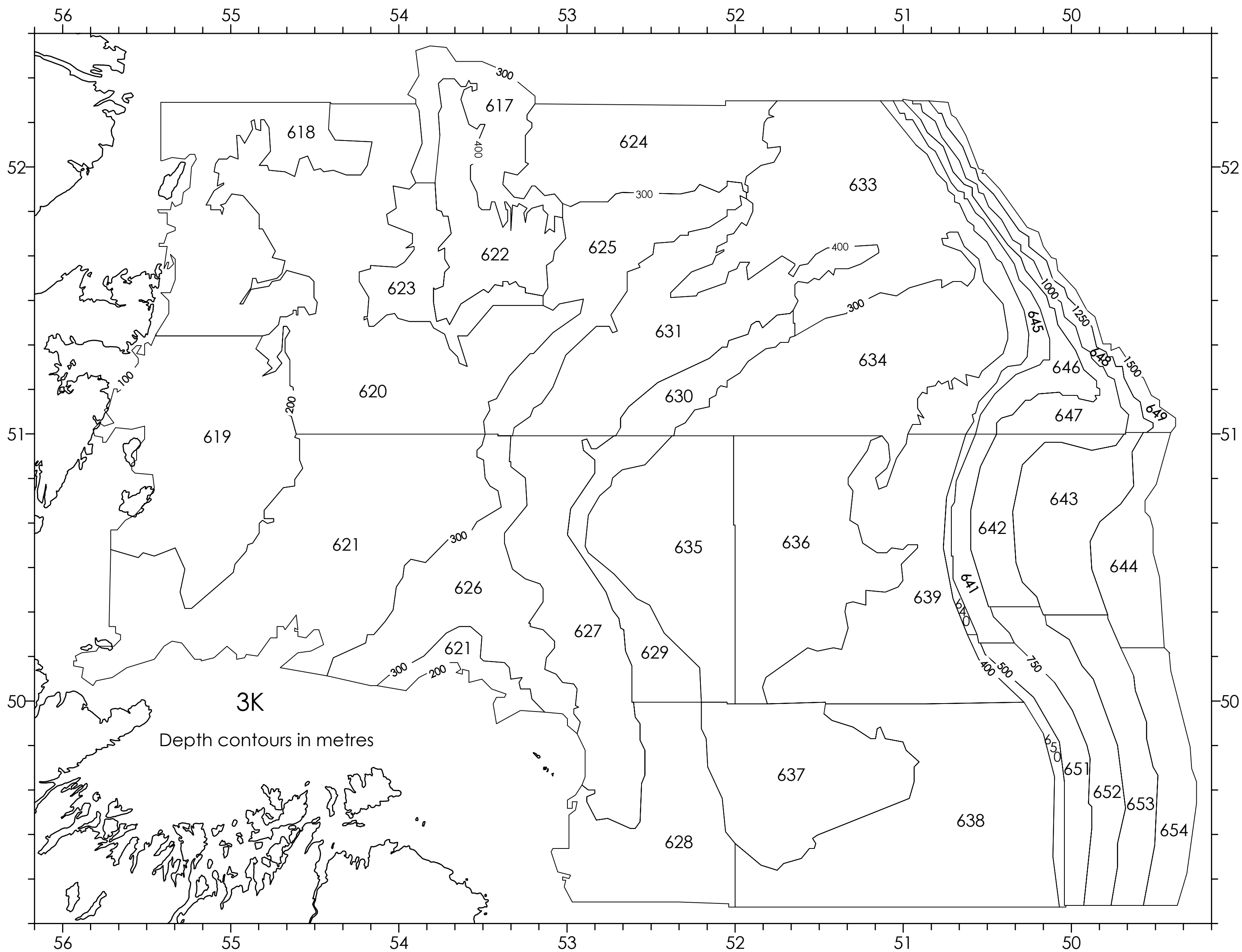


Fig. 10. Strata used for research bottom-trawl surveys in Division 3K.

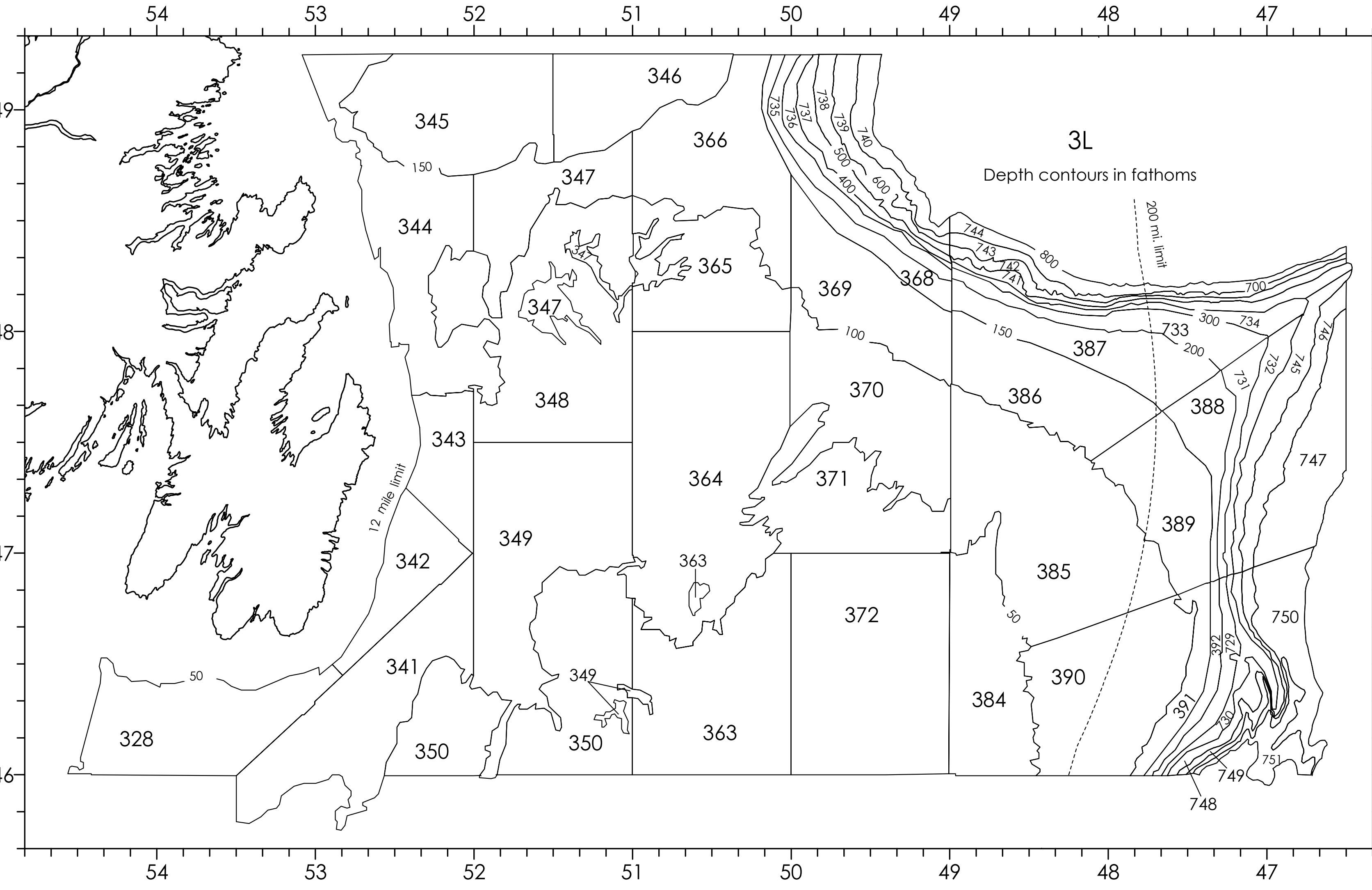


Fig. 11. Strata used for research bottom-trawl surveys in Division 3L.

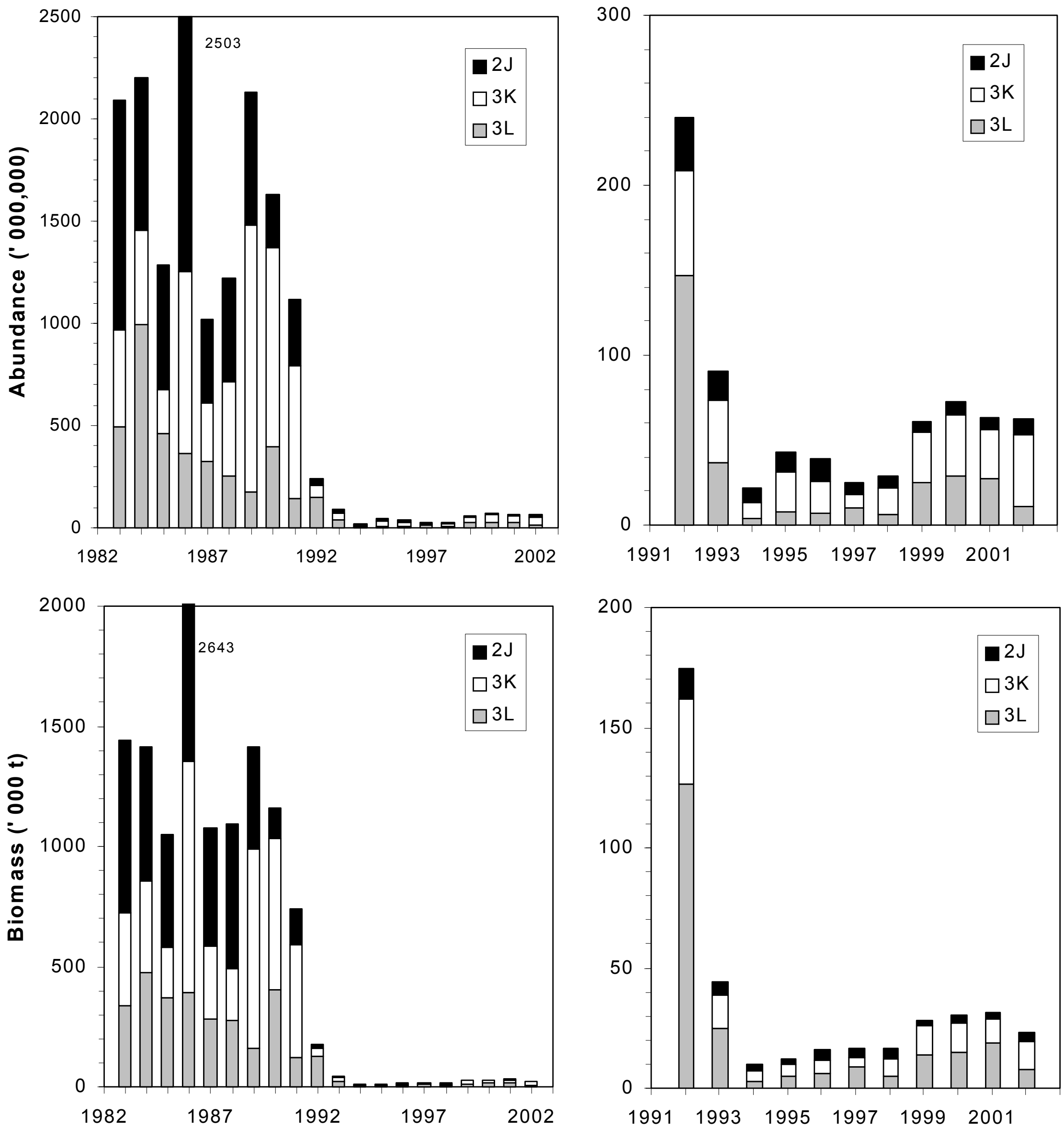


Fig. 12. Indices of abundance and biomass of cod from autumn bottom-trawl surveys in the offshore index strata of divisions 2J3KL in 1983-2002. The estimates for 1983-1994 are adjusted to Campelen equivalents.

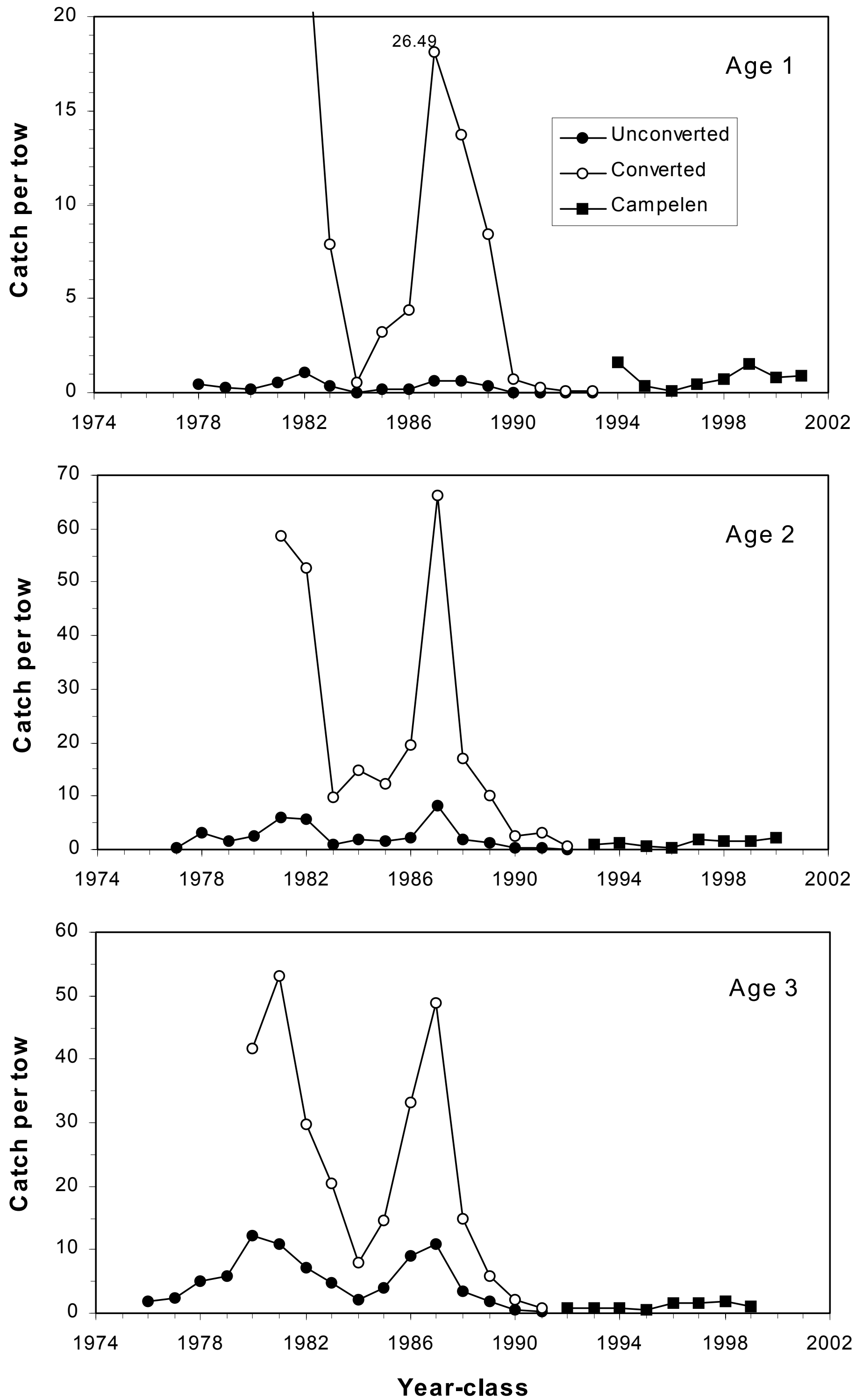
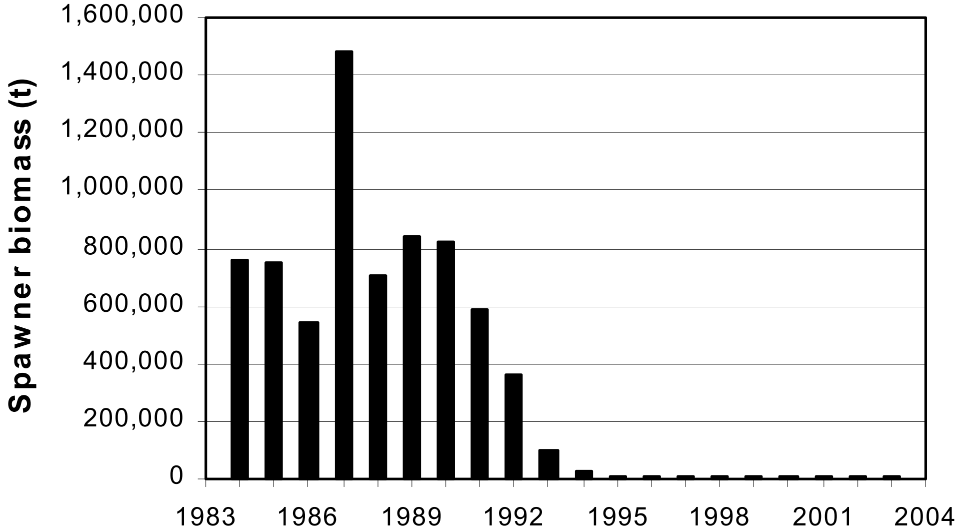


Fig. 13. Mean catch per tow of the 1976-2001 year-classes at ages 1-3 during autumn bottom-trawl surveys in divisions 2J, 3K and 3L combined. Data obtained prior to the introduction of the Campelen trawl in 1995 are shown as actual (unconverted) numbers (from Shelton et al. (1996)) and in numbers converted to Campelen equivalents.



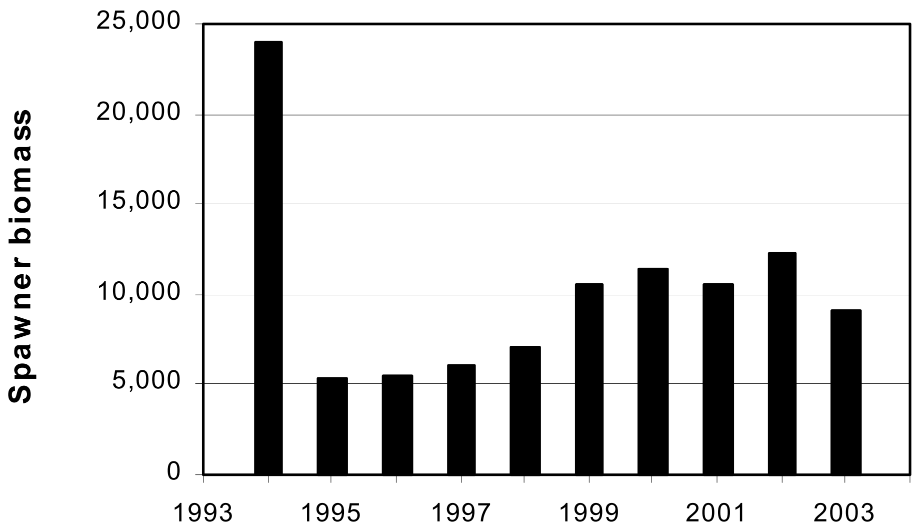


Fig. 14. Index of spawner biomass of cod from autumn bottom-trawl surveys in divisions 2J3KL in 1984-2003. The index in year t is computed from areal expansion of the stratified mean catch at age per tow in year t-1, the proportion mature at age in year t-1, and the commercial Jan. 1 weights-at-age in year t. Note that the survey trawl was changed during autumn 1995, and data collected prior to 1995 have been converted so as to be equivalent to data collected from 1995 onward.

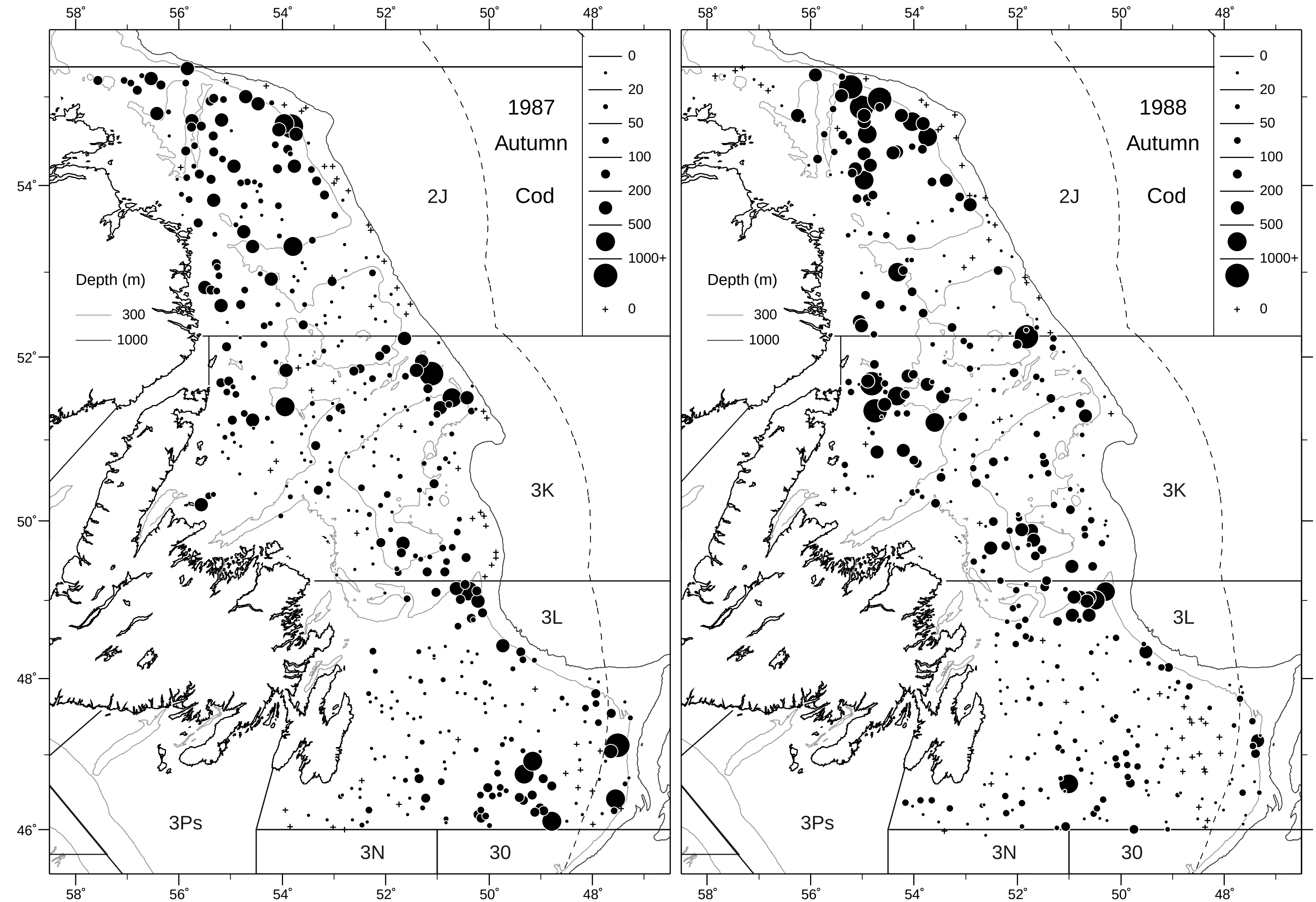


Fig. 15. Cod distribution (number per standard tow) during the autumn surveys in divisions 2J3KL in 1987 and 1988.

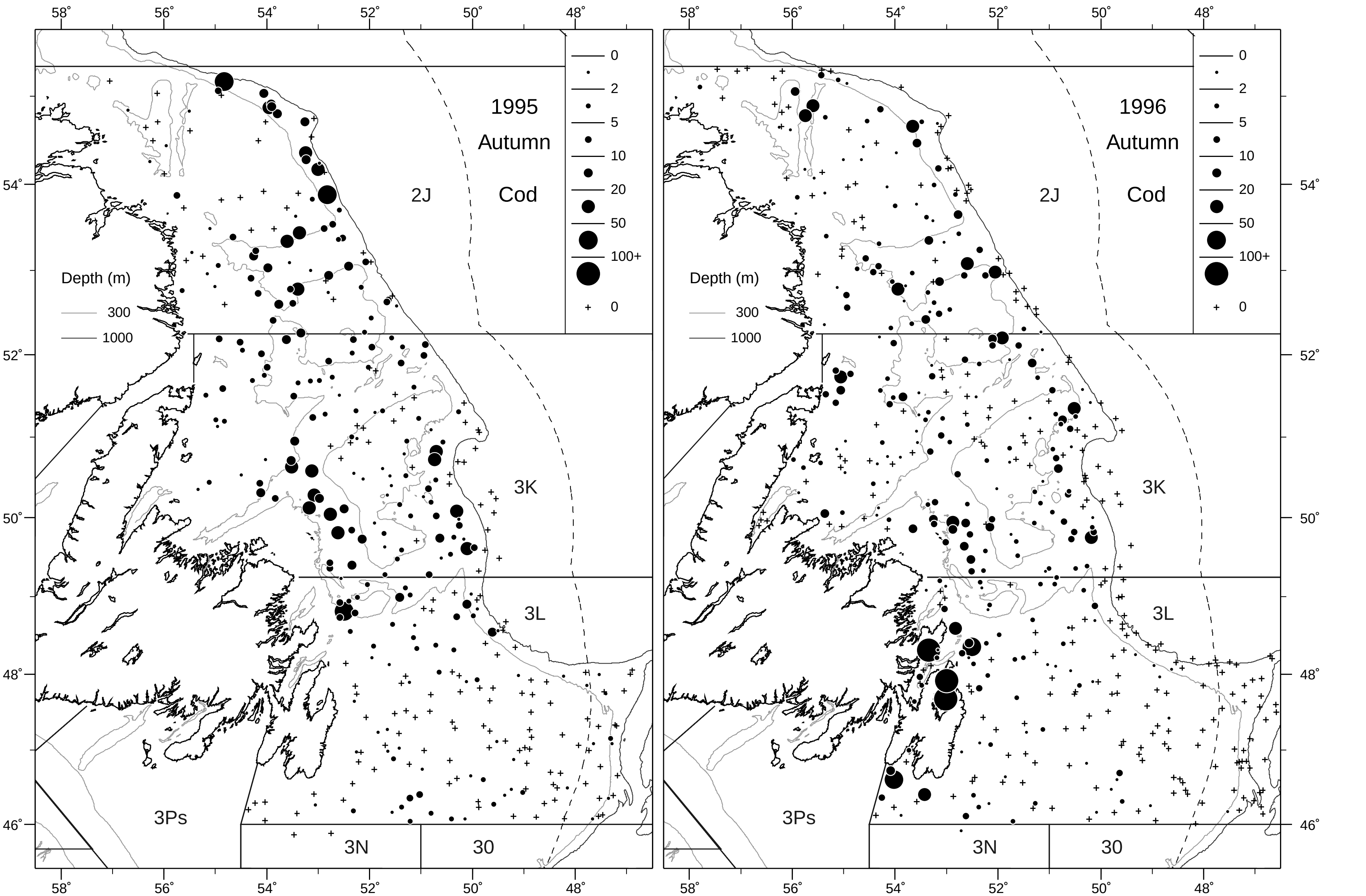


Fig. 16a. Cod distribution (number per standard tow) during the autumn surveys in divisions 2J3KL in 1995 and 1996.

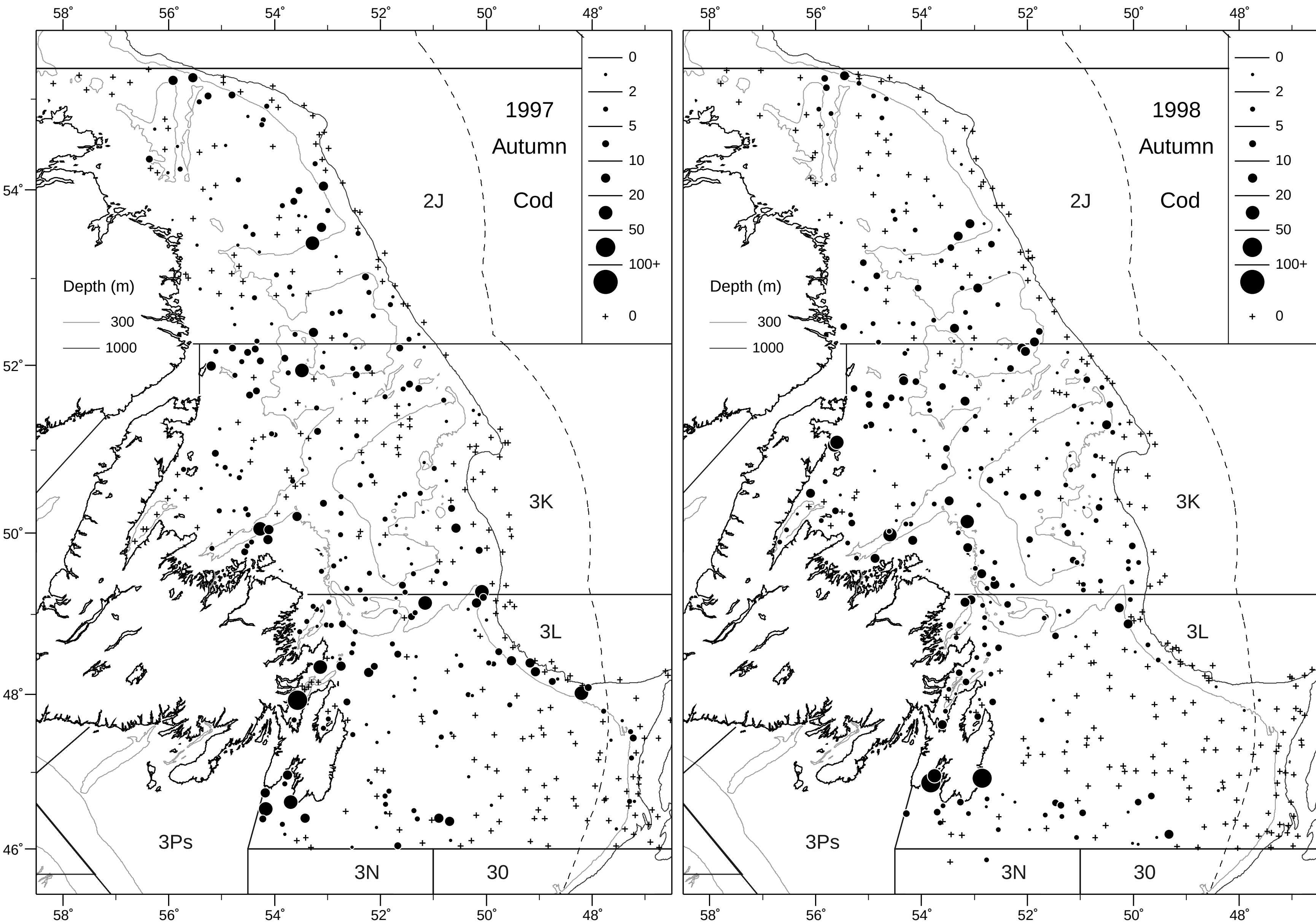


Fig. 16b. Cod distribution (number per standard tow) during the autumn surveys in divisions 2J3KL in 1997 and 1998.

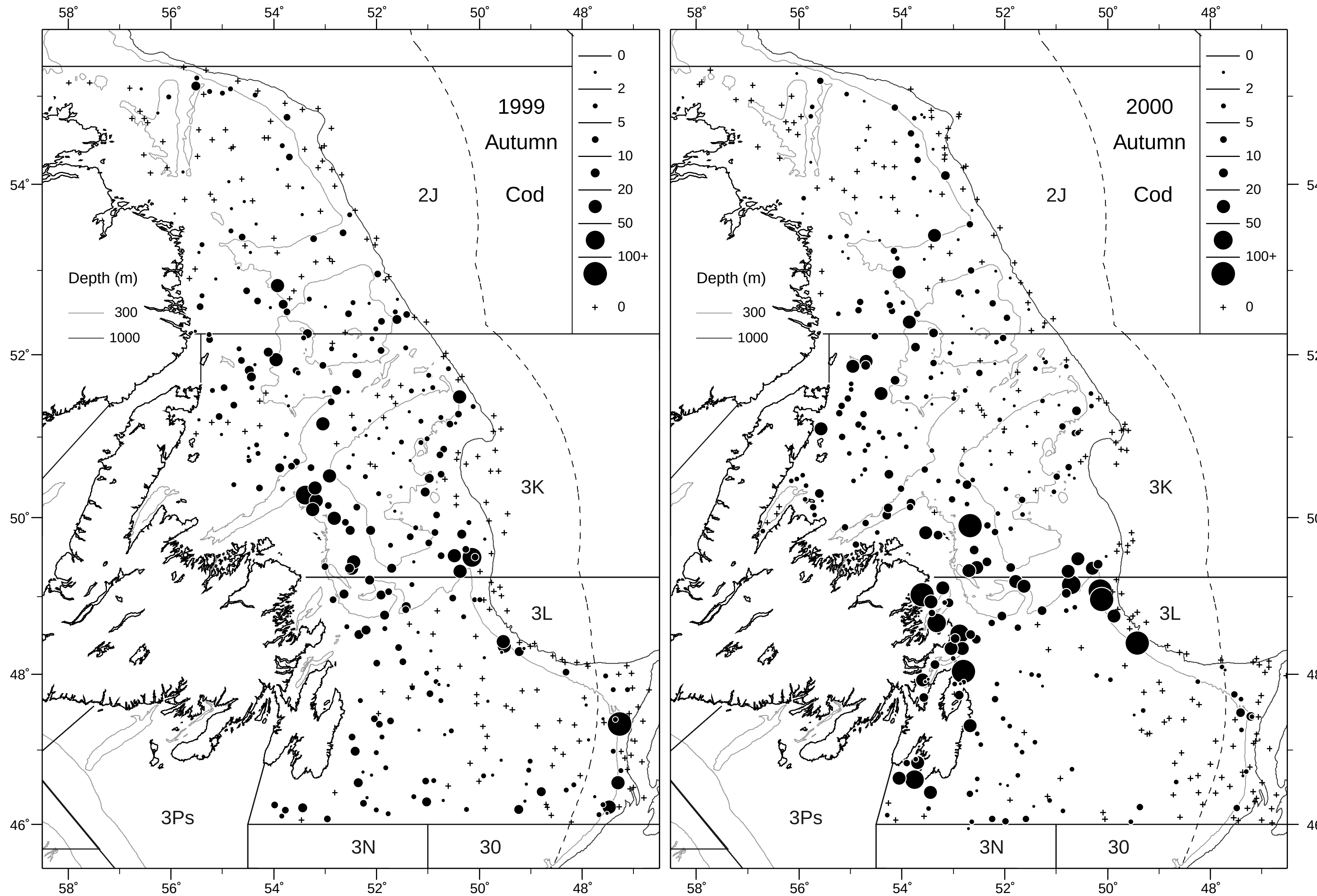


Fig. 16c. Cod distribution (number per standard tow) during the autumn surveys in divisions 2J3KL in 1999 and 2000.

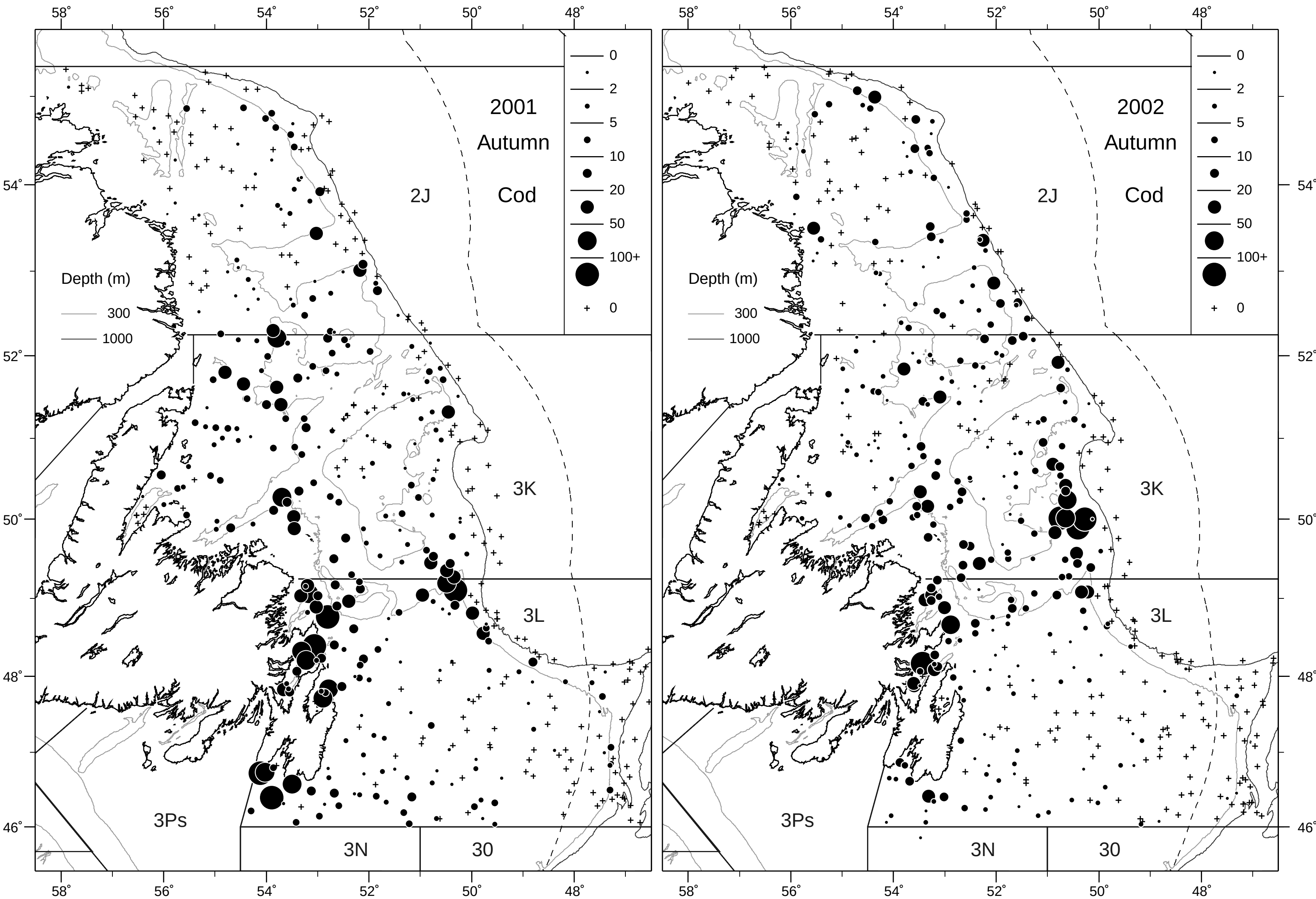


Fig. 16d. Cod distribution (number per standard tow) during the autumn surveys in divisions 2J3KL in 2001 and 2002.

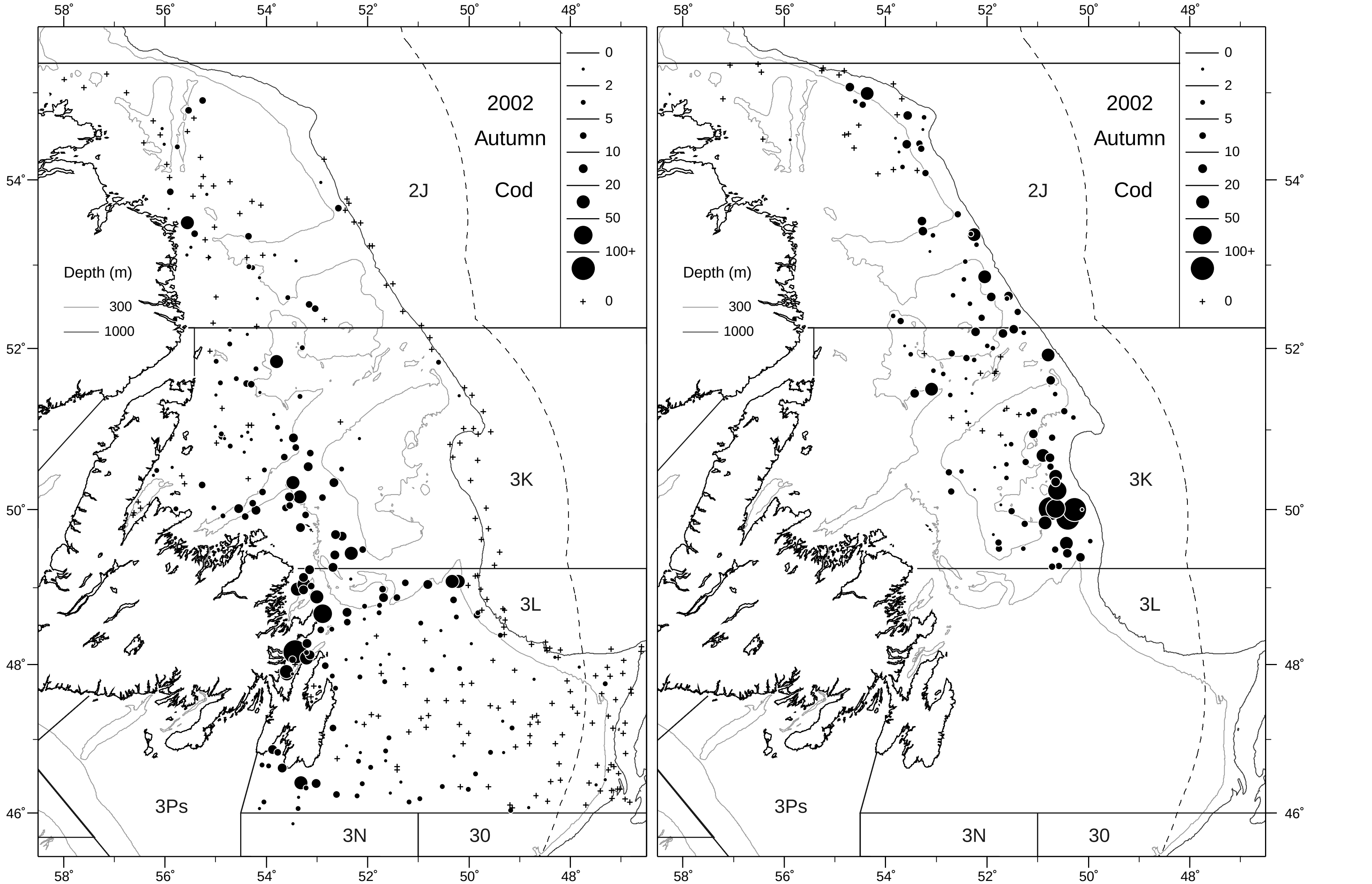


Fig. 16e. Cod distribution (number per standard tow) during the autumn surveys in divisions 2J3KL in 2002, showing those stations occupied during 2002 (left panel) and those occupied during January 2003 (right panel).

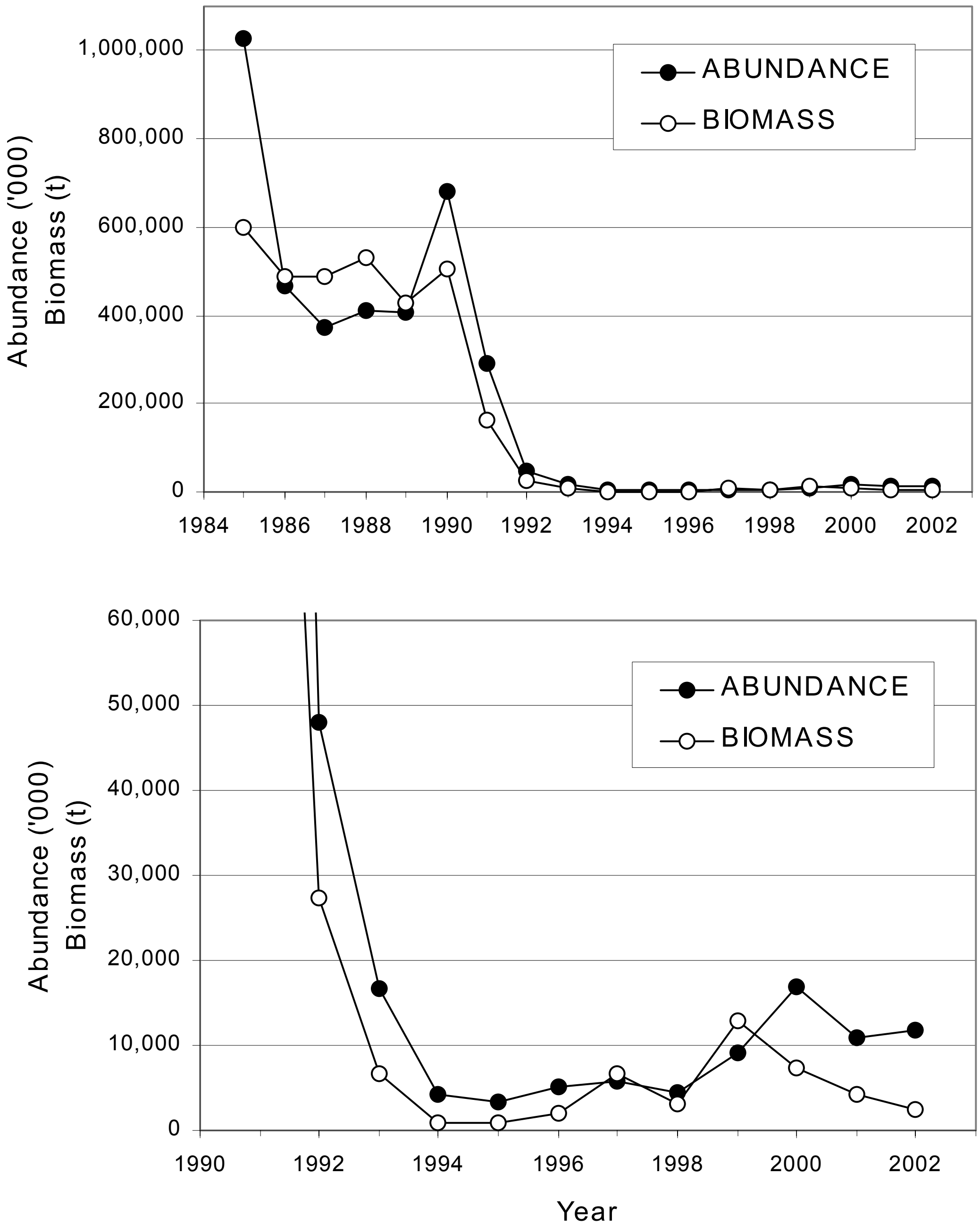


Fig. 17. Indices of abundance and biomass of cod from spring bottom-trawl surveys in Division 3L. The upper panel illustrates 1985-2002, and the lower panel illustrates 1992-2002 in more detail. Estimates for 1985-1995 are based on Campelen equivalents and those for 1996-2002 are based on actual catches.

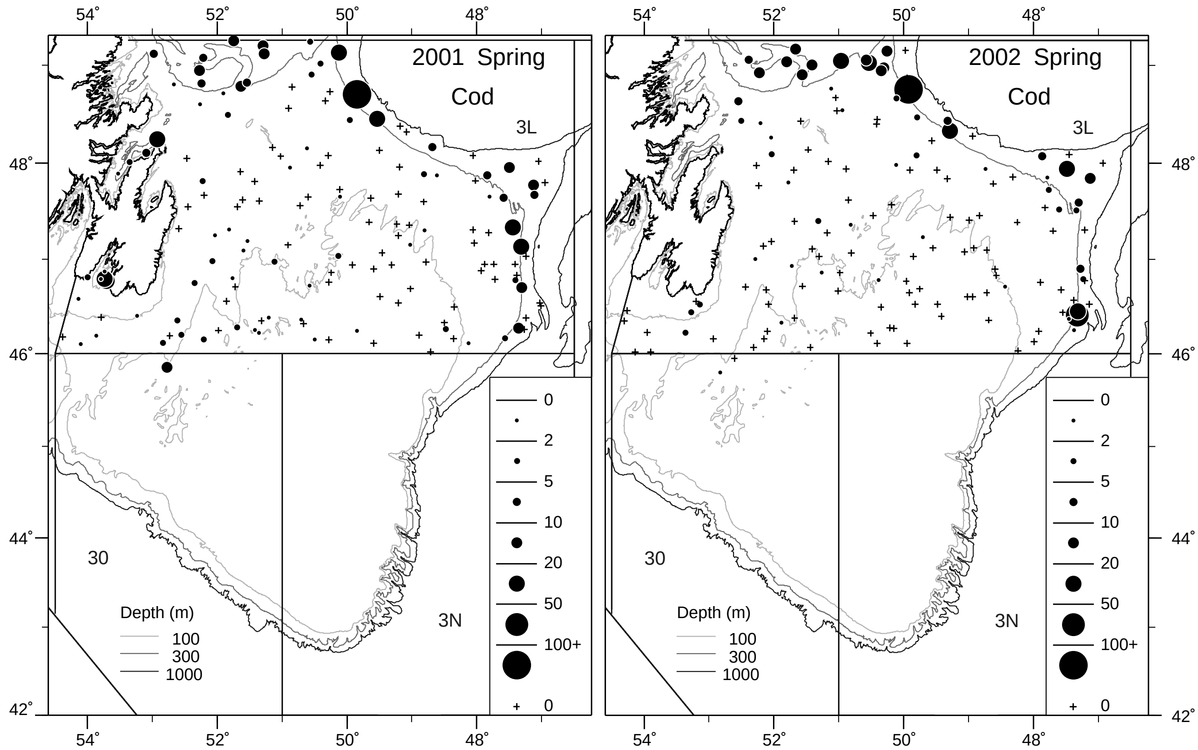


Fig. 18. Geographic distribution (number per standard tow) during the spring surveys in Division 3L in 2001 and 2002.

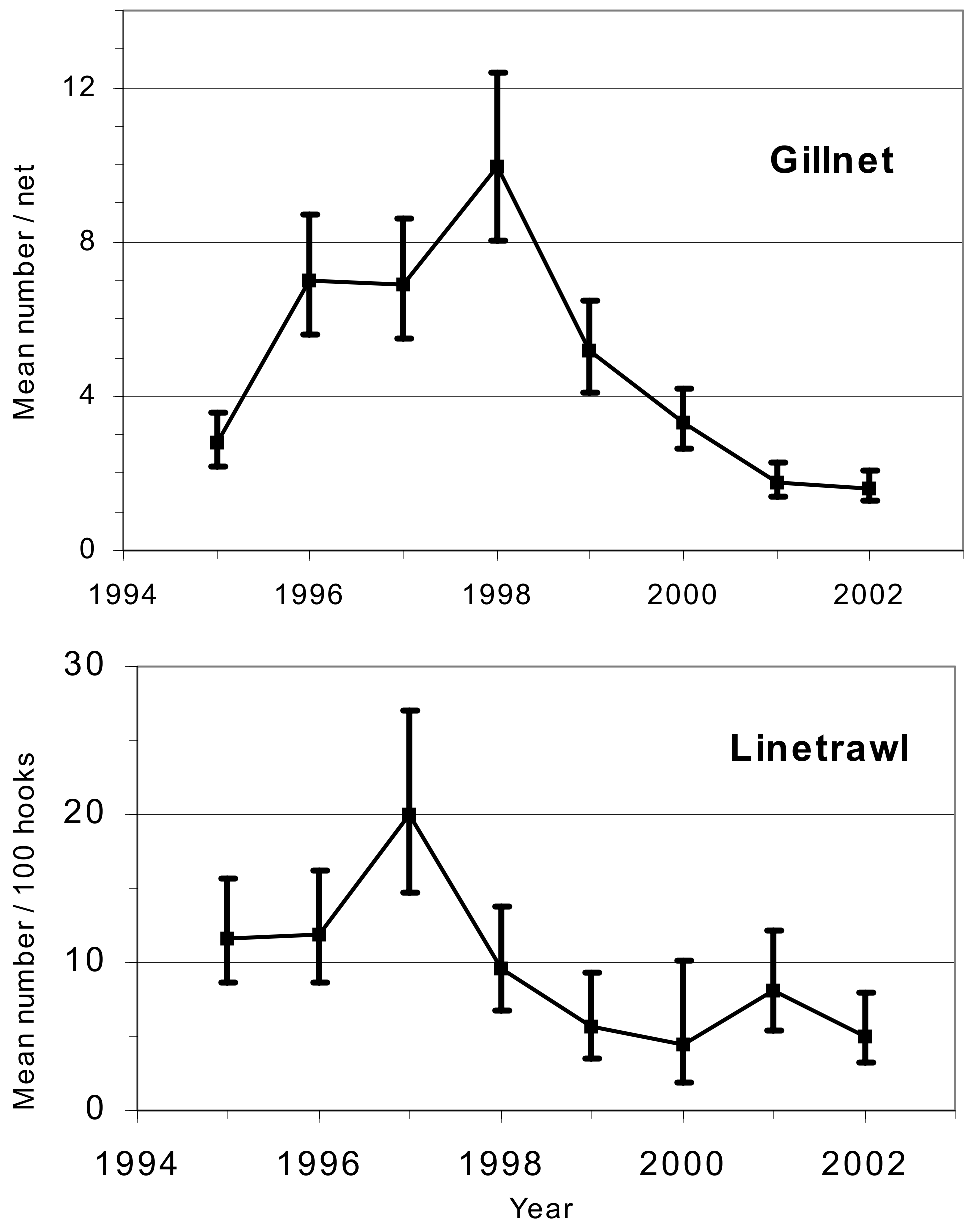


Fig. 19. Standardized catch rates from sentinel surveys in 3KL combined.

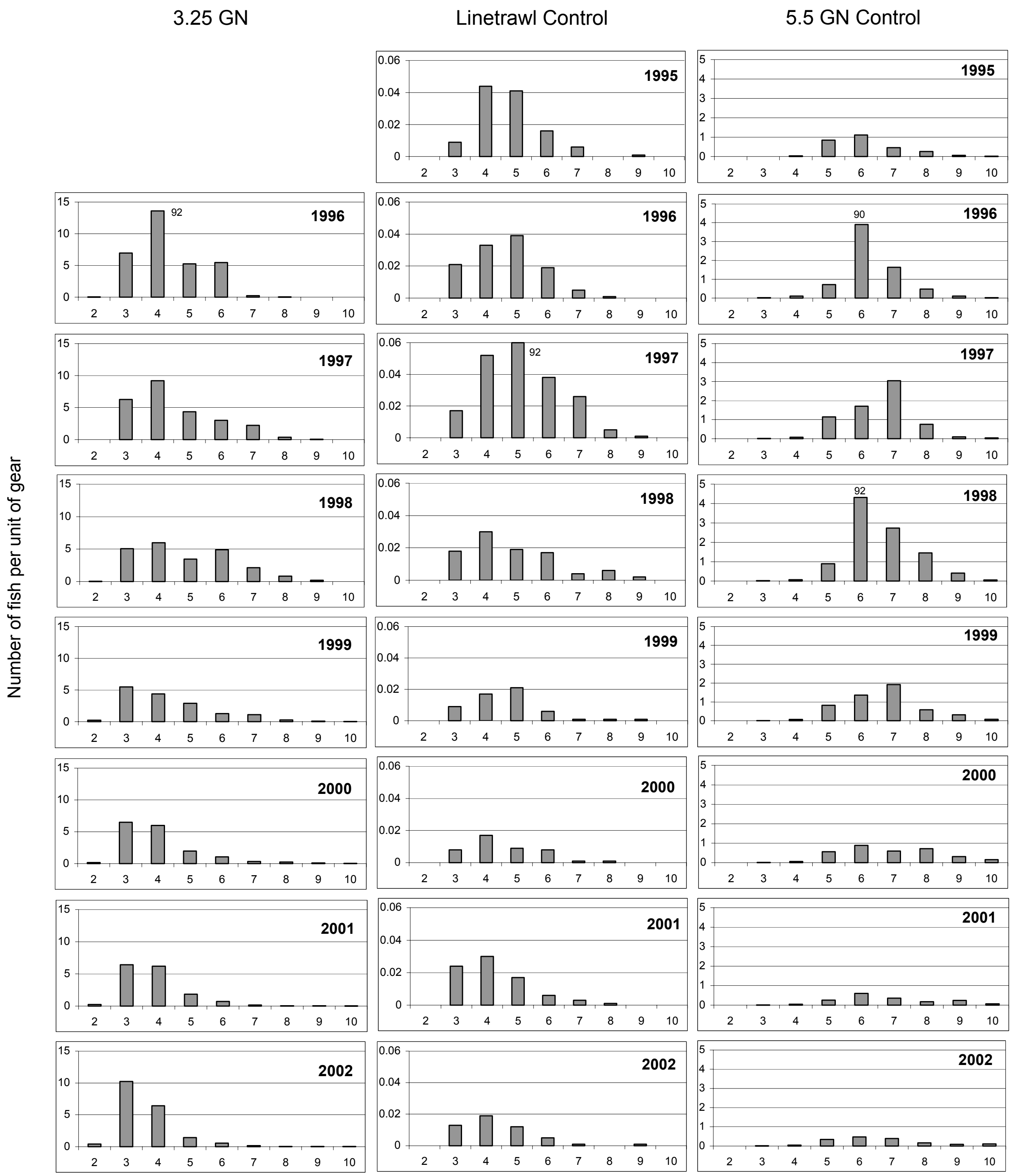


Fig. 20. Standardized catch rate at age for three gear types fished by the sentinel surveys in 1995-2002.

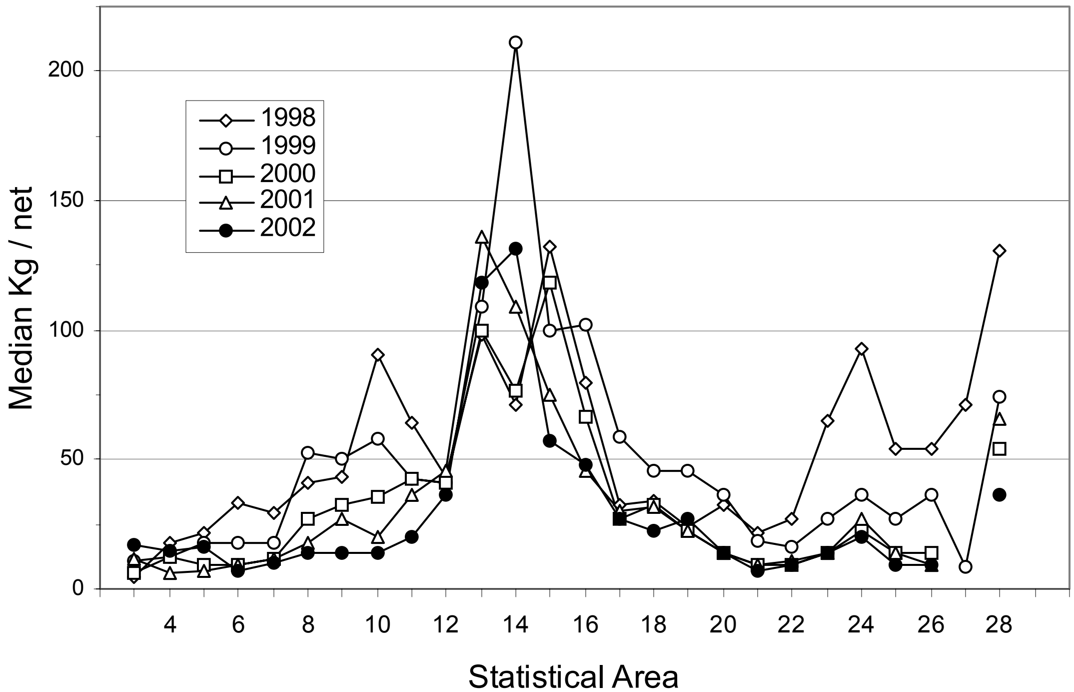


Fig. 21. Median catch rates by statistical section (Fig. 1c) from the gillnet fisheries for cod by vessels <35 feet during the 1998-2002 index/commercial fisheries.

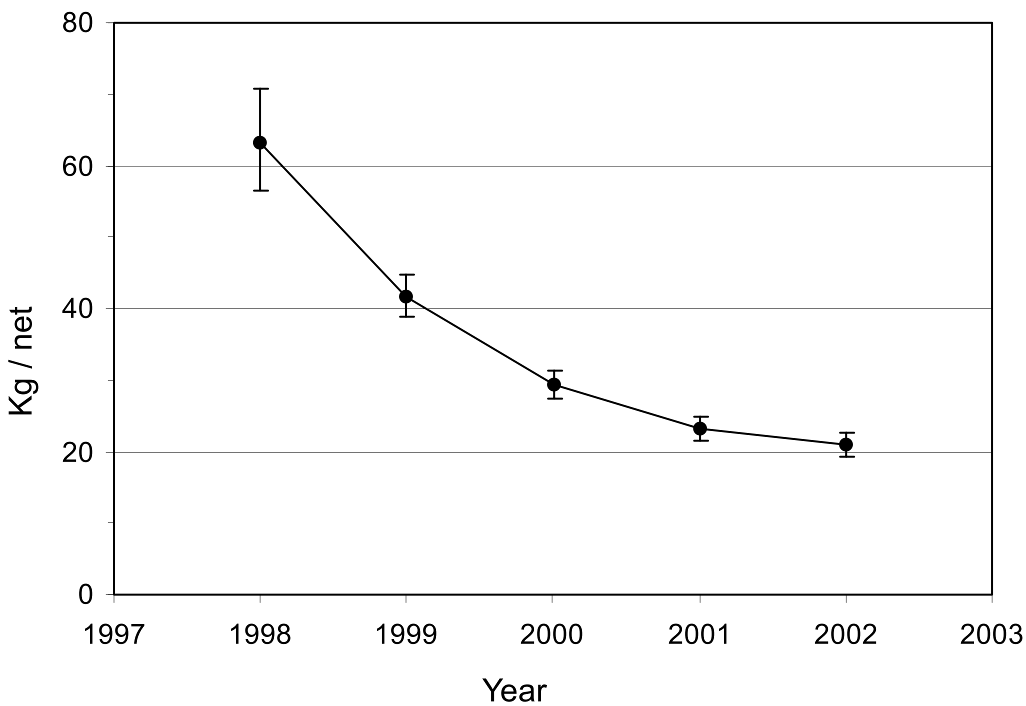


Fig. 22. Standardized catch rates from the gillnet fisheries for cod by vessels <35 feet in 3KL combined during the 1998-2002 index/commercial fisheries.

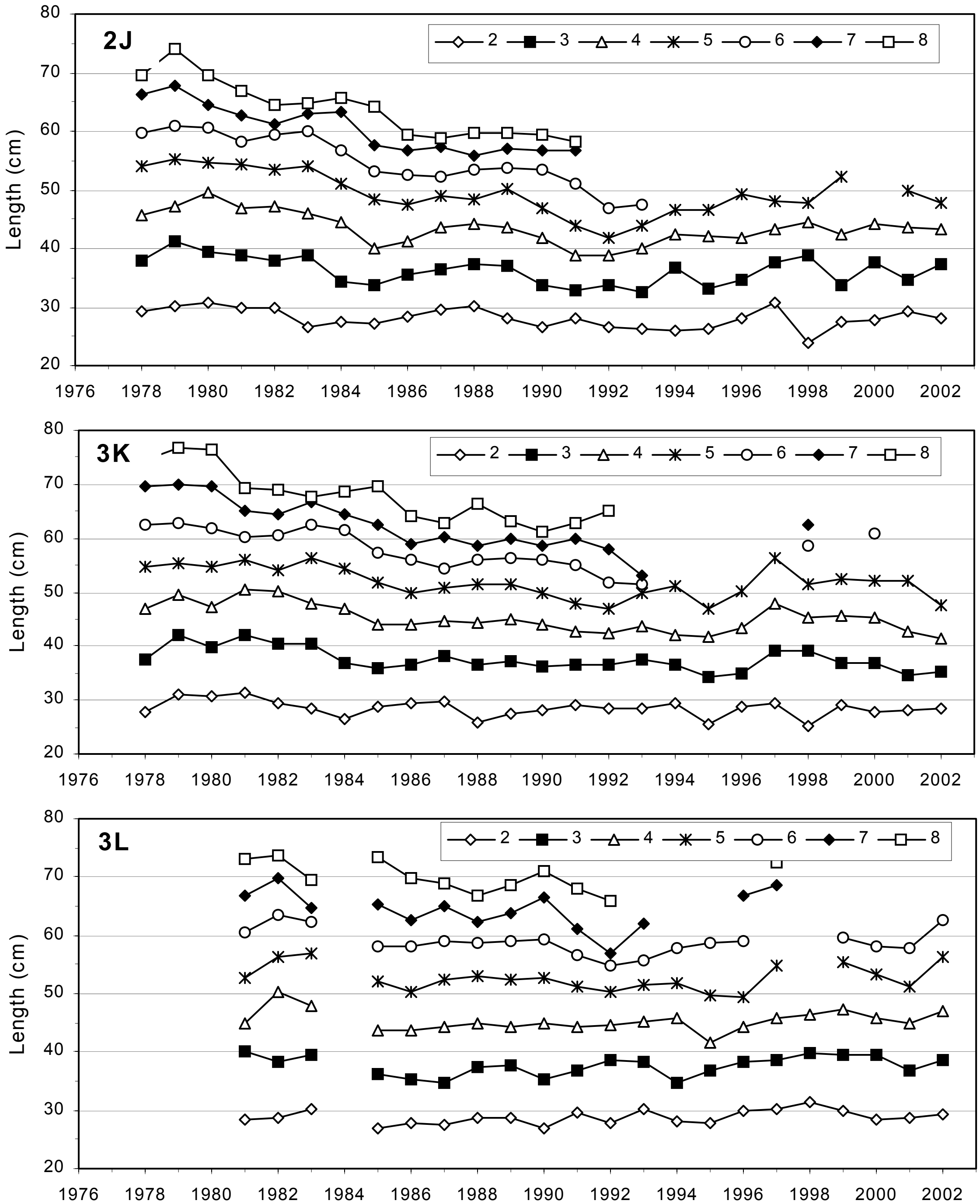


Fig. 23. Mean lengths at ages 2-8 of cod in Divisions 2J, 3K and 3L in 1978-2002, as determined from sampling during bottom-trawl surveys in autumn. Values calculated from fewer than 5 aged fish are not plotted. There were no surveys in Division 3L in 1978-1980 and 1984.

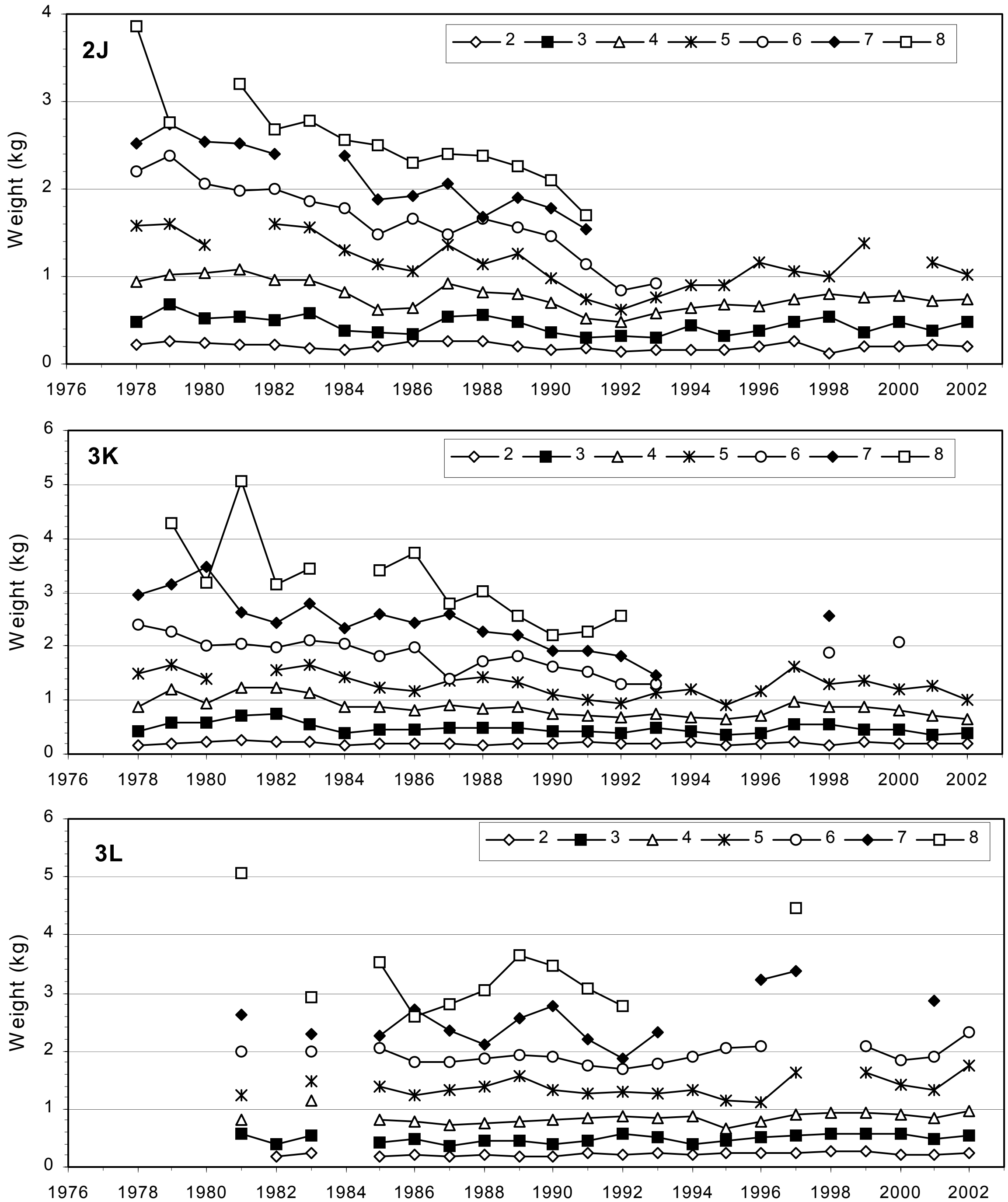


Fig. 24. Mean weights at ages 2-8 of cod in Divisions 2J, 3K and 3L in 1978-2002, as determined from sampling during bottom-trawl surveys in autumn. Values calculated from fewer than 5 aged fish are not plotted. There were no surveys in Division 3L in 1978-1980 and 1984.

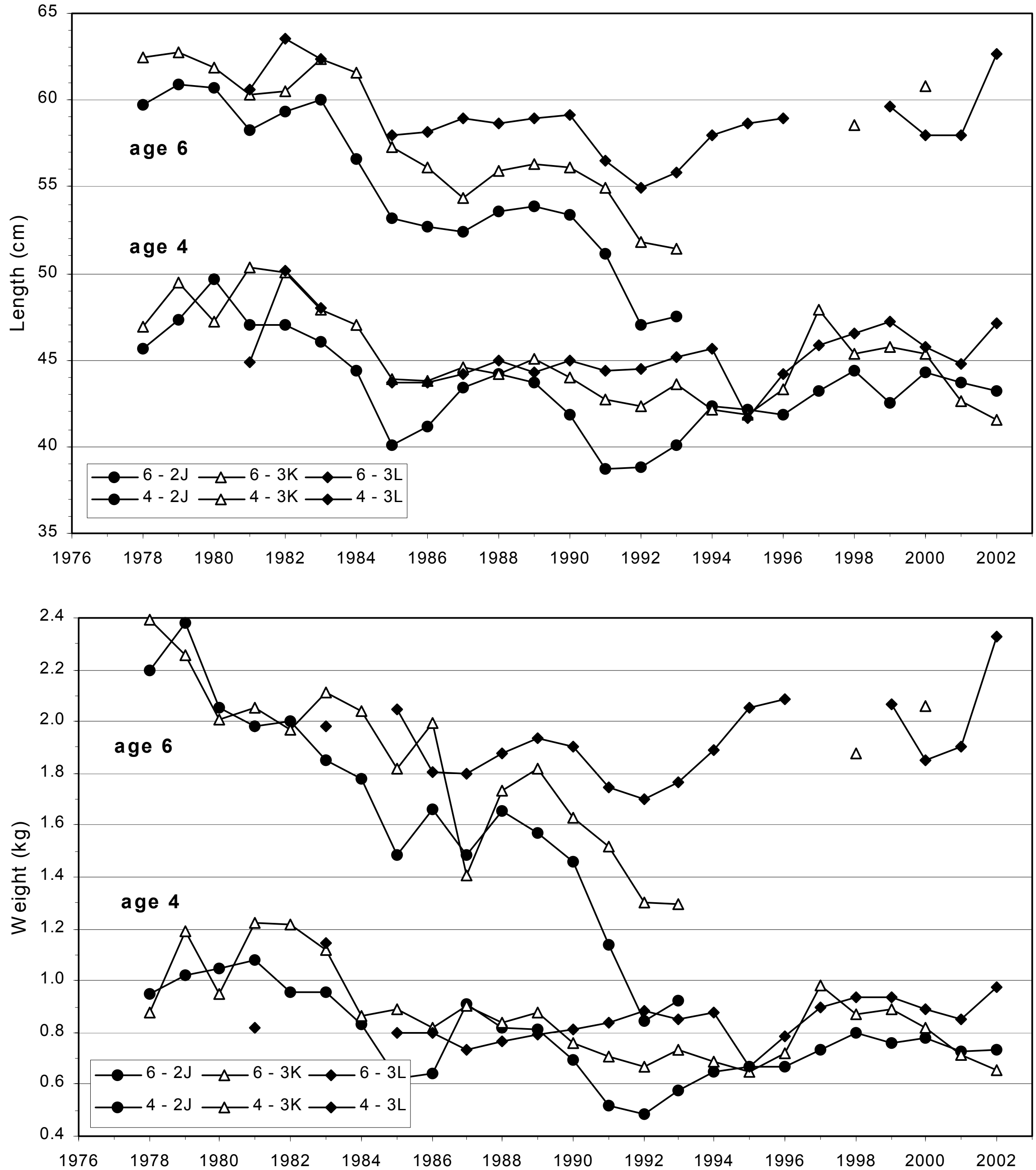


Fig. 25. Mean lengths and weights at ages 4 and 6 of cod in Divisions 2J, 3K and 3L in 1978-2002, as determined from sampling during bottom-trawl surveys in autumn. Values calculated from fewer than 5 aged fish are not plotted. There were no surveys in Division 3L in 1978-1980 and 1984.

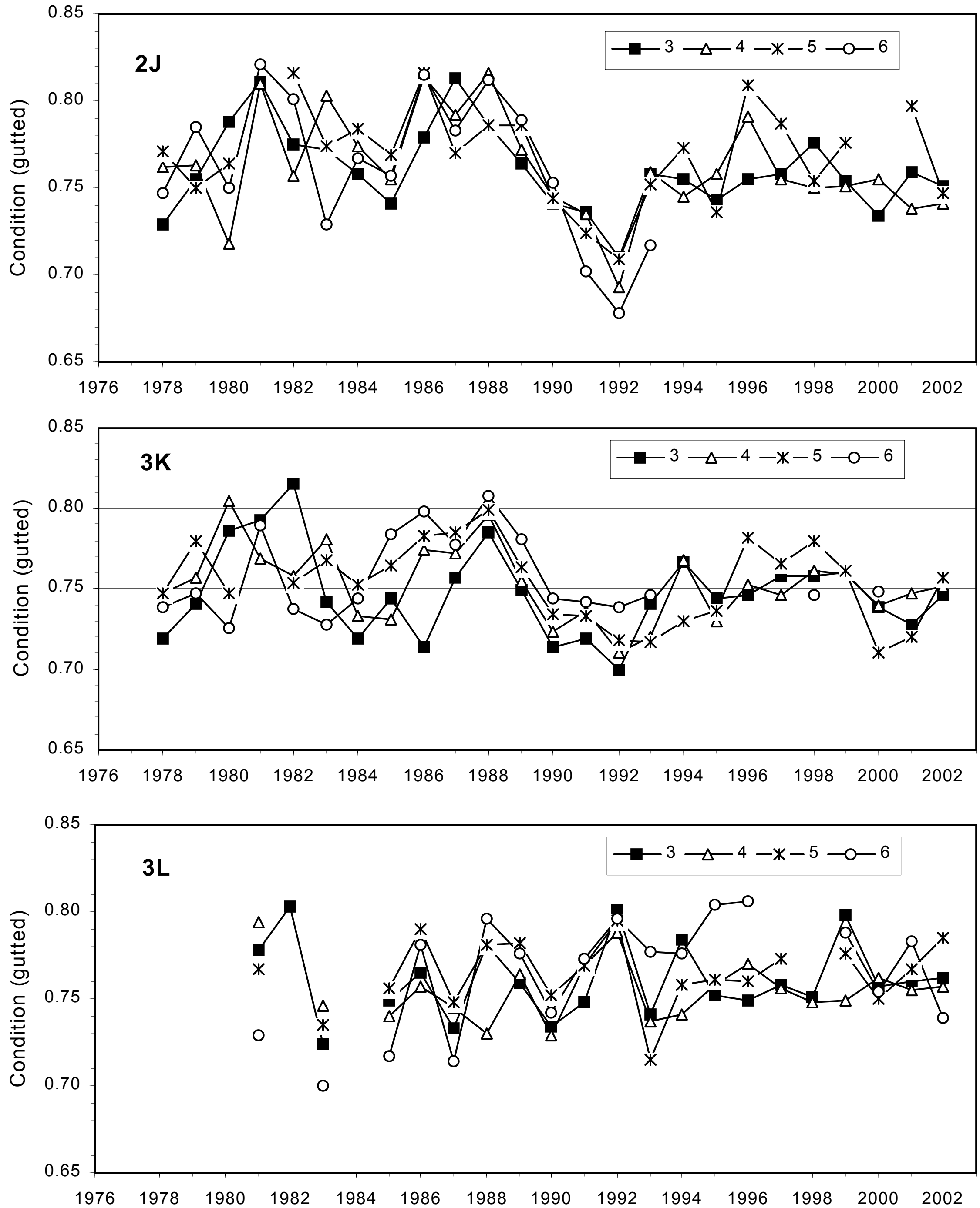


Fig. 26. Mean Fulton's condition (gutted weight) at ages 3-6 of cod in Divisions 2J, 3K and 3L in 1978-2002, as determined from sampling during bottom-trawl surveys in autumn. Values calculated from fewer than 5 aged fish are not plotted. There were no surveys in Division 3L in 1978-1980 and 1984.

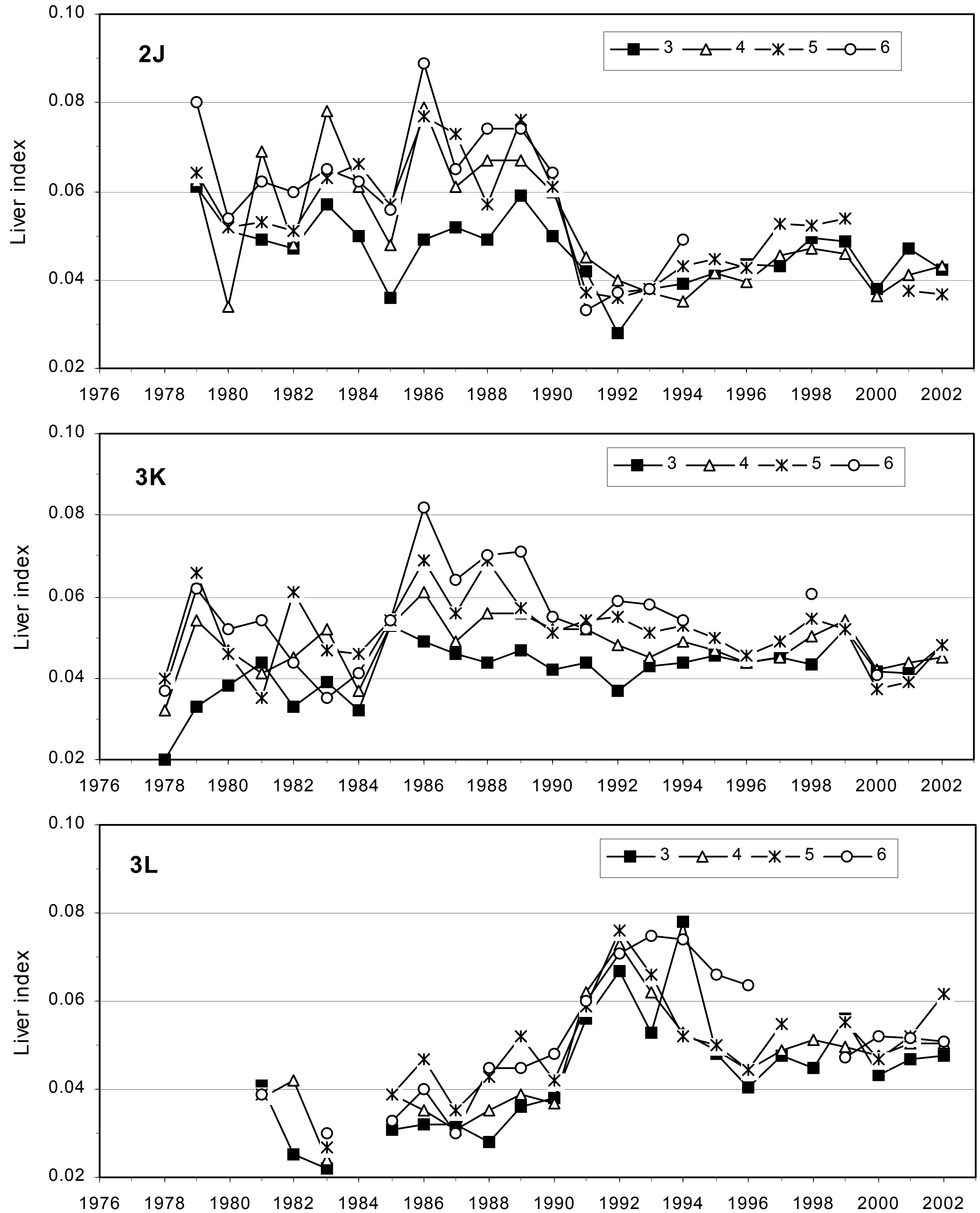


Fig. 27. Mean liver index at ages 3-6 of cod in Divisions 2J, 3K and 3L in 1978-2002, as determined from sampling during bottom-trawl surveys in autumn. Values calculated from fewer than 5 aged fish in 1995-1997 are not plotted. There were no surveys in Division 3L in 1978-1980 and 1984.

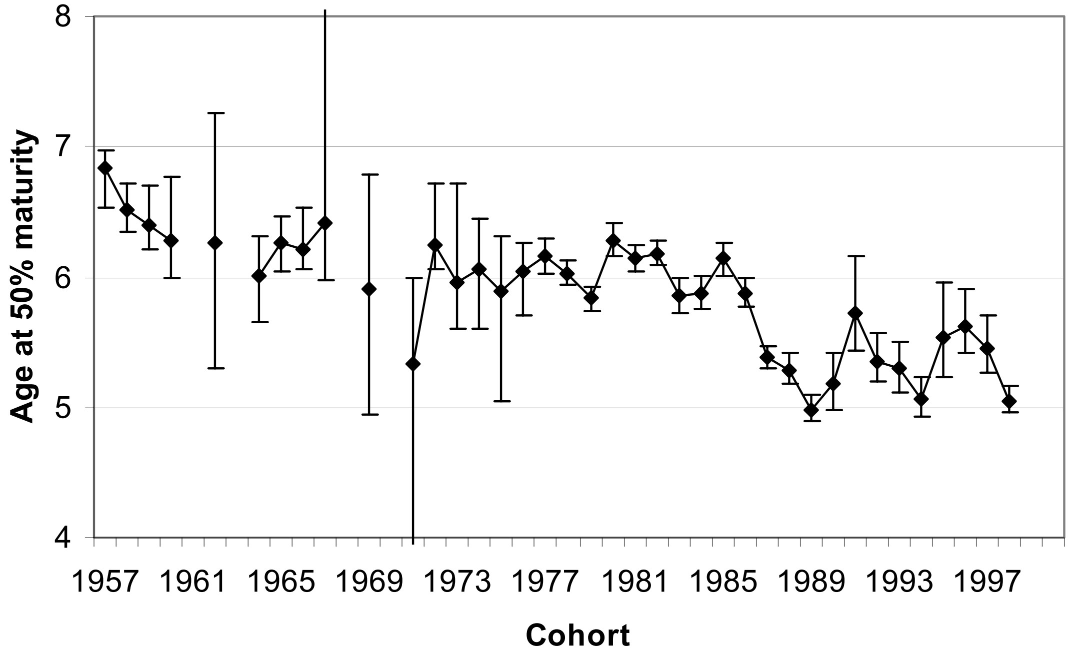


Fig. 28. Age at 50% maturity (± 95% CI) by cohort for female cod in divisions 2J3KL combined based on sampling during autumn research bottom-trawl surveys.

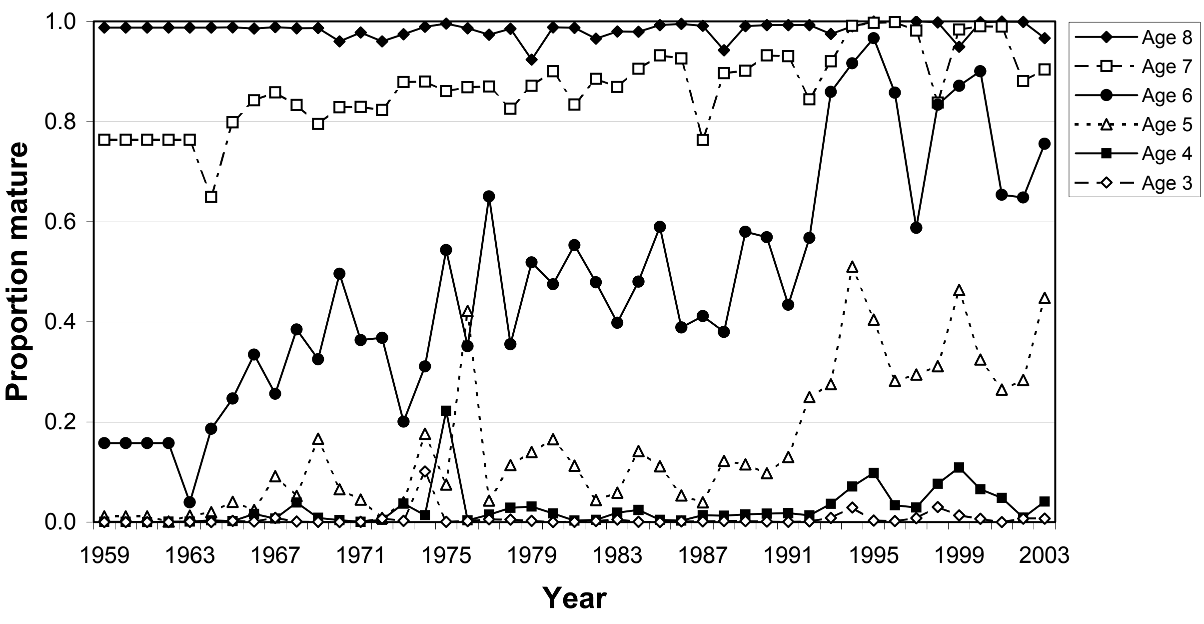


Fig. 29. Estimated percentage mature at ages 3-8 for female cod in divisions 2J3KL combined. The percentage mature at age estimated from sampling during the autumn research bottom-trawl survey in year t is displayed for spawning in year t+1.

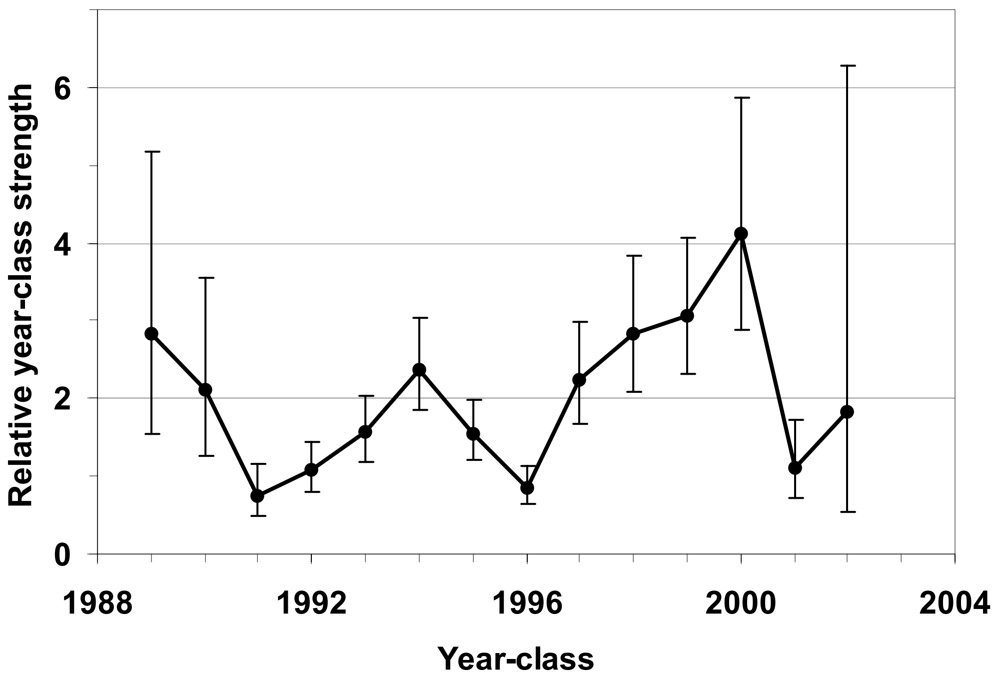


Fig. 30. Standardized year-class strength derived from modelling various survey/age indices.

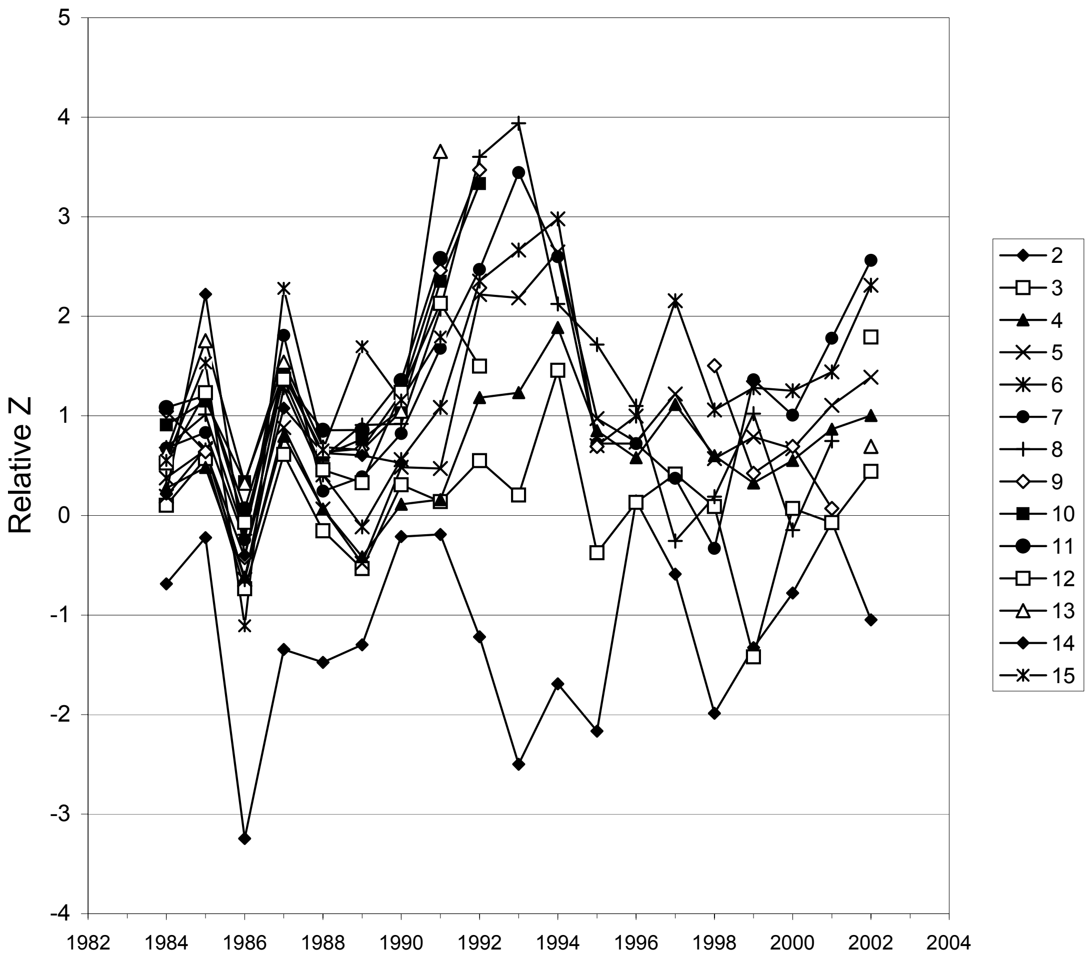
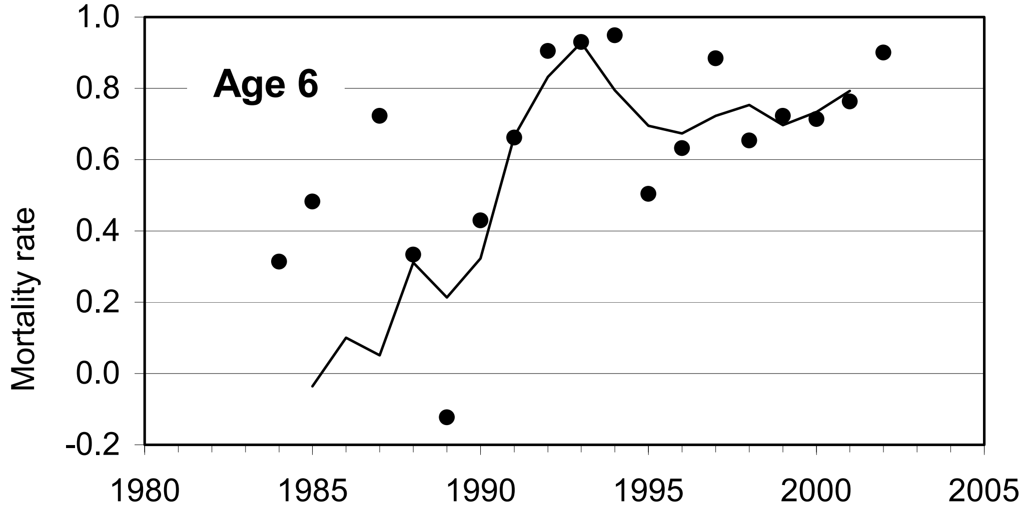


Fig. 31. Mortality rates experienced by fish aged 2 to 15 as calculated from catch rate per tow at age during the autumn research bottom-trawl surveys in 2J3KL combined in 1983-2002. For example, the value of 2.16 for age 6 in 1997 is the mortality experienced by the 1991 year-class from age 5 in the autumn of 1996 to age 6 in the autumn of 1997.



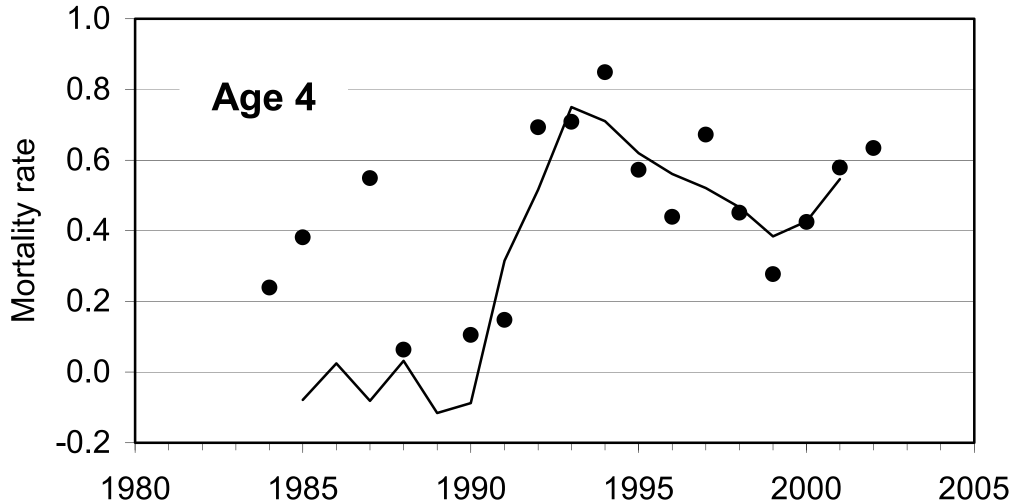


Fig. 32. Mortality rates experienced by fish aged 4 and 6 as calculated from catch rate per tow at age during the autumn research bottom-trawl surveys in 2J3KL (combined) in 1983-2002. As an example, the value of 0.88 for age 6 in 1997 is the proportion of age 5 fish alive in the autumn of 1996 that died by the autumn of 1997. The line is a 3-year moving average. Date points less than –0.2, which occurred only before 1990, are not shown.

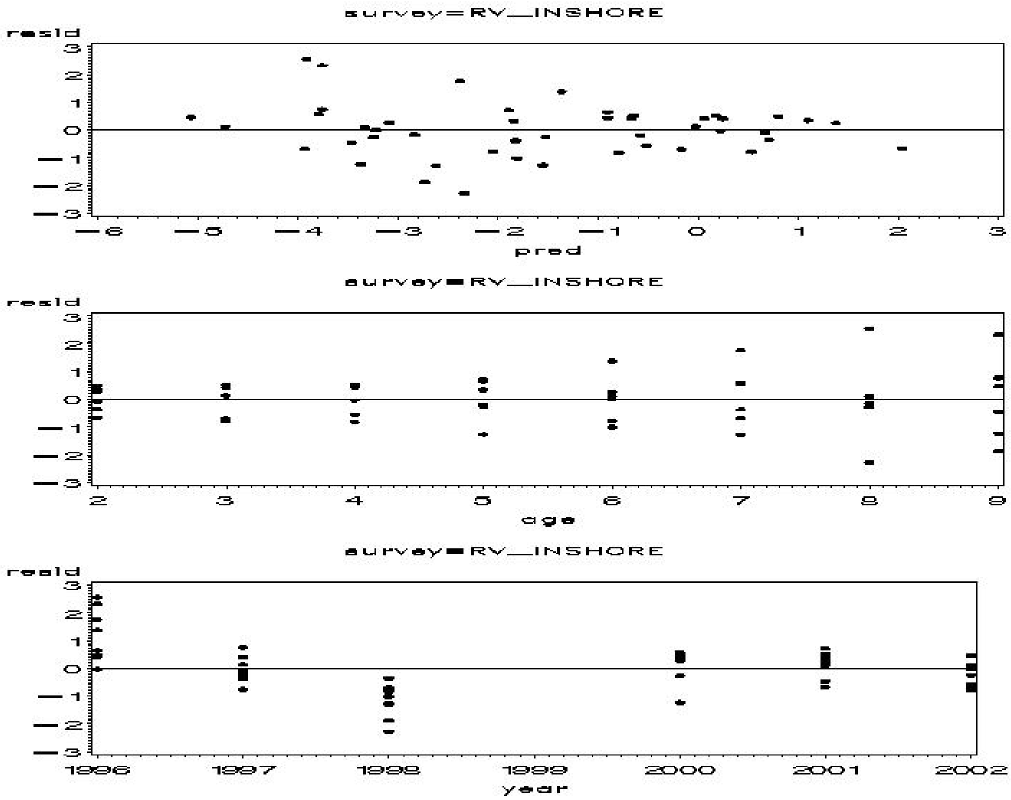


Fig. 33. Inshore SPA. Standardized residuals for the RV inshore bottom-trawl survey by predicted value, age and year.

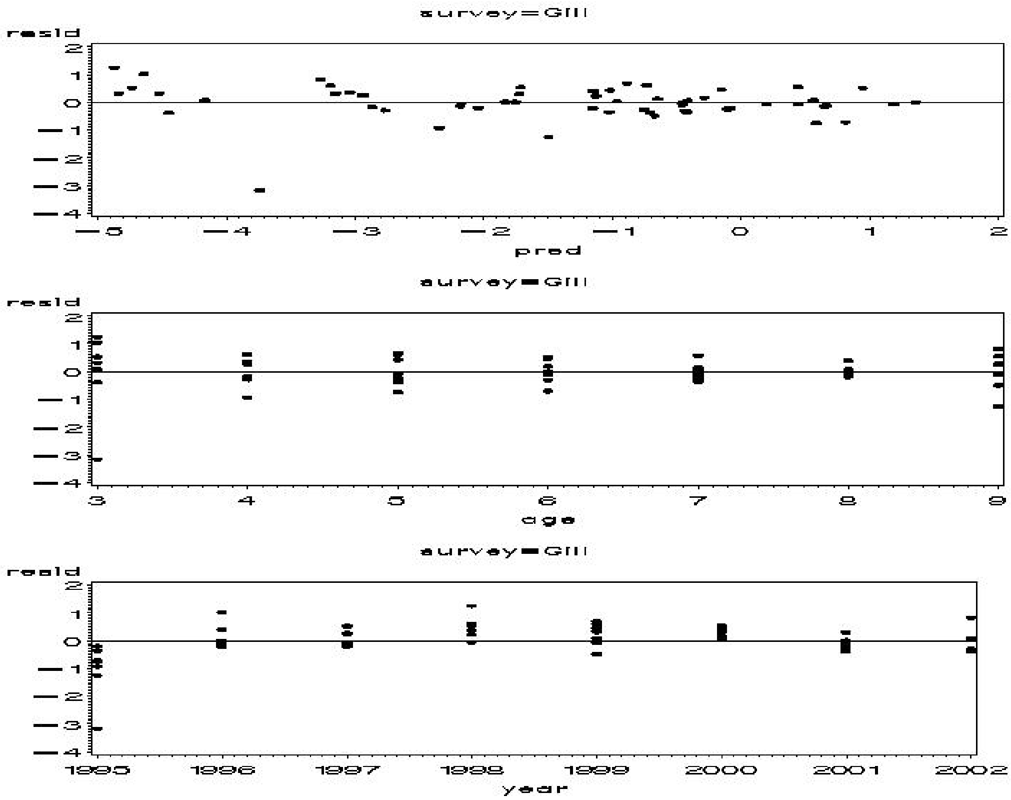


Fig. 34. Inshore SPA. Standardized residuals for the sentinel 5 ½ inch mesh gillnet survey by predicted value, age and year.

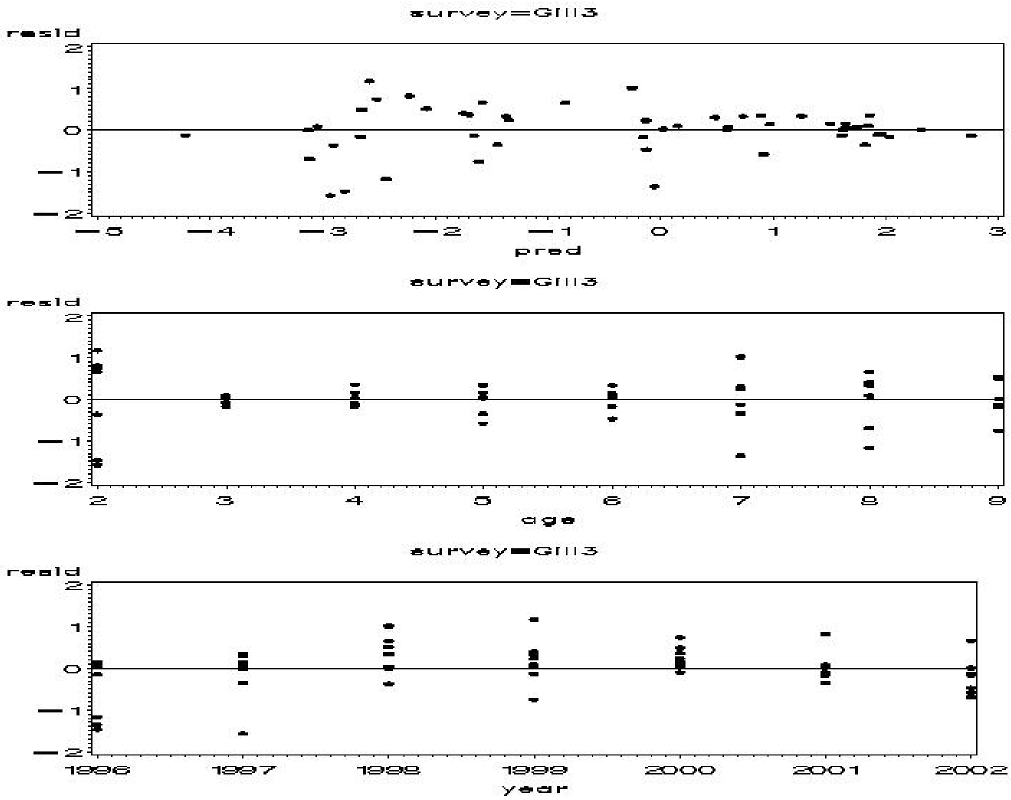


Fig. 35. Inshore SPA. Standardized residuals for the sentinel 3 ¼ inch mesh gillnet survey by predicted value, age and year.

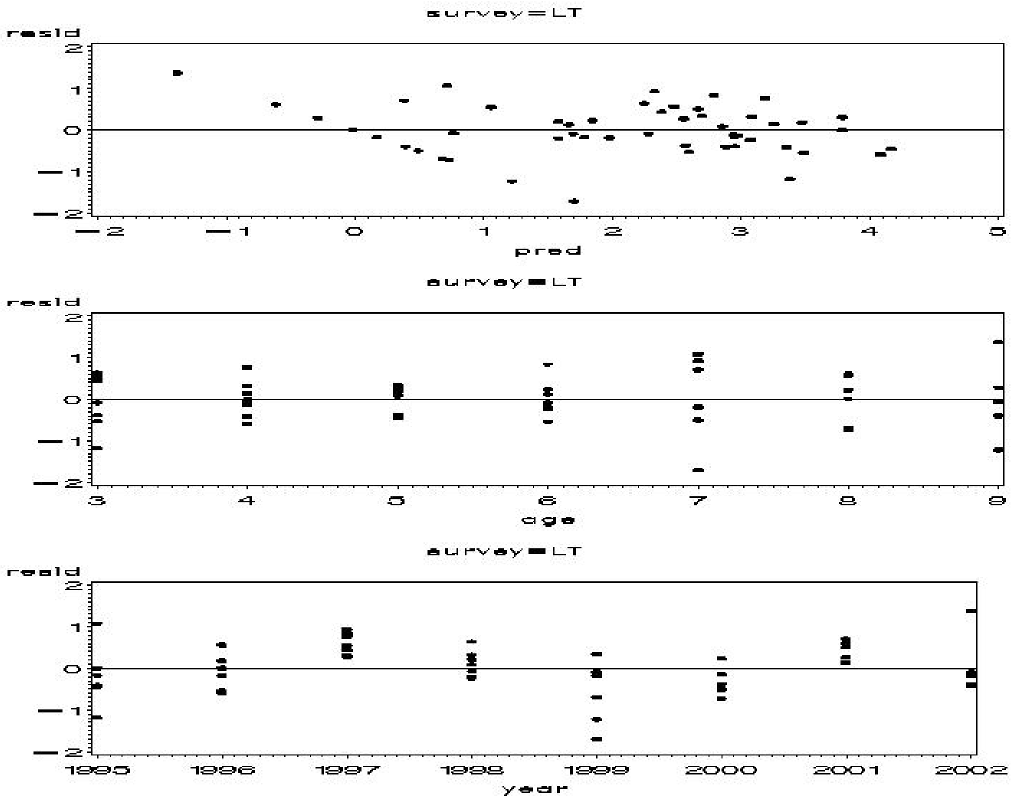


Fig. 36. Inshore SPA. Standardized residuals for the sentinel linetrawl survey by predicted value, age and year.

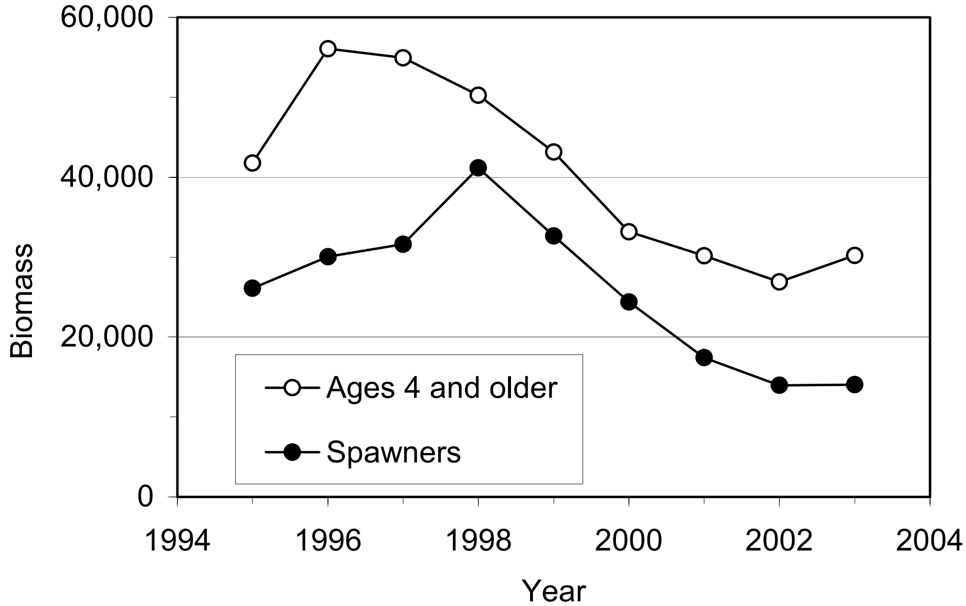


Fig. 37. Inshore SPA. Estimates of exploitable (4+) biomass and spawner stock biomass.

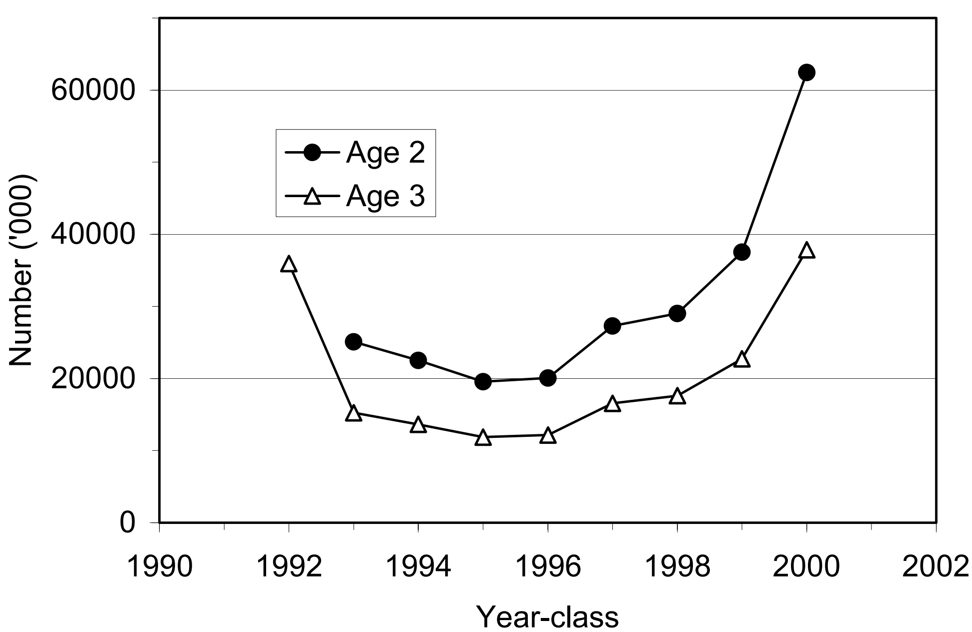


Fig. 38. Inshore SPA. Estimates of recruitment at ages 2 and 3.

Appendix 1. Table 1. Management regulations for the inshore index/commercial fishery in Div. 2J3KL in 1998-2002 (from J. Perry, Fisheries Management Branch, Newfoundland and Labrador Region, DFO).

Management	1998	1999	2000	2001	2002
TAC & Fishing Regime	TAC = 4,000t - Inshore = 3,000t (IQ=2,700lbs) - Offshore = 350t - By-catch = 275t - Sentinel = 375t	TAC = 9,000t - Inshore = 8,600t (IQ = 9,000lbs) - By-catch = 100t - Sentinel = 300t	TAC = 7,000t - Inshore = 6,600t - (IQ = 8,400lbs) - By-catch = 100t - Sentinel = 300t	TAC = 5,600t - Inshore = 5,200t - (IQ = 8,400lbs) - By-catch = 100t - Sentinel = 300t	Same
Fishing Restrictions	- Core fishers only to participate. - Fishers limited to the Lobster Fishing Area of their homeport (some exceptions for fishers near boundaries). - Fishing restricted to less than 12 miles from land.	- Fishers limited to NAFO division of their homeport. - Smith Sound and 5 mile buffer zone limited to residents.	- Fishers with access to Northern shrimp out of the fishery. - Efforts to limit concentration of effort around Cape Bonavista (3L split N/S).	Same	Same
Fishing Gear	Gillnets - Min 5 ½ inch mesh - 5 nets @ 50 fathoms - Gear tagging Longlines - #11 circle hook or 16J - 1,000 hooks	Gillnets - Mesh size 5 ½ - 6 ½ inch - 5 nets @ 50 fathoms Handlines - #11 circle hook - Max 3 per line Longlines - #11 circle hook - 2,000 hooks Gear tending requirements.	Gillnets - 6 nets permitted	Gillnets not permitted after September 30.	Same
By-Catch	- All cod charged against IQ. - When IQ taken, all groundfish fisheries closed to fisher.	Same	Same	Same	Same

cont'd

Appendix 1. (cont'd)

Management	1998	1999	2000	2001	2002
Small Fish Protocol	- Min 45cm - Closures when small fish >15% of catch (min 7 days). Test fisheries prior to re-opening.	- Min 43cm	Same	Same	Same
Monitoring	- 100% DMP - Hail in for >35ft vessels - Observer coverage	- 10% Observer coverage targetted.	Same	Same	Some ports 100% monitored, some random.
Seasons	Sept. 24 – Oct. 16	July 8 – July 31 Sept. 6 – Nov. 13	June 26 – July 29 Sept. 11 – Nov. 31	July 9 – Nov. 30	Varied by area (Appendix 1 Table 2)
Data Collection	- Mandatory logbooks - Dockside sampling	Same	Same	Same	Same
Administrative Sanctions	Overruns of IQ to be deducted from following year IQ.	Same	Same	Withdrawn due to legal challenge	

Appendix 1. Table 2. Index fishery in 2J3KL in 2002. Dates of openings, by area. (from J. Perry, Fisheries Management Branch, Newfoundland and Labrador Region, DFO).

AREA		SEASON DATES
2J		July 30 - October 13, 2002
3K(a)	Cape Bauld to Harbour Deep Head	July 30 - October 13, 2002
3K(b)	Harbour Deep to Cape John	September 3 – November 10, 2002
	Cape John to Little Bay Head	August 19 – October 26, 2002
	Little Bay Head to North Head	September 16 – November 24, 2002
	North Head to Cape Freels	July 30 - October 13, 2002
	Bay of Exploits (Swan Island – Farmers Head)	July 30 – September 03, 2002 October 14 - November 17, 2002
3L	Bonavista Bay	July 30 – September 1, 2002 October 2 - November 5, 2002
	Trinity Bay	July 30 - September 1, 2002 September 16 – October 19, 2002
	Conception Bay	July 30 – October 13, 2002
	Southern Shore	July 30 – October 13, 2002
	Petty Harbor (Defined Handline Area)	July 30 - August 13, 2002. September 9 – November 2, 2002
	St. Mary’s Bay	July 30 – October 13, 2002

Appendix 1. Table 3. Management regulations for the recreational/food fishery in Div. 2J3KL in 1996-2002 (from J. Perry, Fisheries Management Branch, Newfoundland and Labrador Region, DFO).

Management	1996-1998	1999	2000	2001	2002
Seasons	1996 – two weekends 1997 – no fishery 1998 – one weekend	July 30 – August 1 August 28 – August 30	August 25-27 September 2-4 September 23-24 (added due to poor weather)	July 18 – September 19 (Introduction of Marine Recreational Groundfish Licence Pilot Program)	August 1 – September 22 (Continuation of Marine Recreational Groundfish Licence Pilot Program)
Fishing Gear	Permitted: Hook and Line Rod and reel (baited hooks and artificial lures) Casting and trolling Not Permitted: Jiggers and jigging	Same	Same	Same	Same
Discarding	Not permitted for any species except Atlantic Halibut which must be released	Same	Same	Same	Same
Processing	Filleting not permitted.	Same	Same	Same	Same
Fishing Restrictions				Closure of Smith Sound and 5 mile buffer zone to non-residents	Closure of Smith Sound and 5 mile buffer zone to non-residents
Catch Limits	- 10 groundfish per day per individual - 50 groundfish per trip per boat - More than one trip per day is permitted	Same	Same	30 tags per licence holder	- 15 cod per licence holder in 2J3KL and 4RS3Pn - 30 cod per licence holder in 3Ps - Bag limit of 10 fish per person per day
Data Collection		Same	Same	Same Telephone survey	Same