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# An Assessment of the Cod Stock in NAFO Divisions 3NO

by

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## *Introduction*

The Divisions 3NO cod stock occupies the southern part of the Grand Bank of Newfoundland. Fish are distributed over the shallower parts of the bank in summer, particularly in the Southeast Shoal area (Div. 3N), and on the slopes of the bank in winter when cooling occurs. Some seasonal mixing between fish in Division 3O and Subdiv. 3Ps may occur. This stock declined in the late 1980's and early 1990's and is currently at a low biomass level. It has been under moratorium to all directed fishing both inside and outside the Regulatory Area since February 1994. This assessment updates the status of the stock, based mainly on the Canadian spring and fall research vessel surveys carried out in 1997. Preliminary estimates for the spring 1998 survey (age aggregated) are also presented for consideration in determining present stock status. Consideration is given to developing biological reference points for this stock based on alternative stock-recruit relationships.

## Nominal catch and catch at age

Catches from this stock peaked at 227,000 t in 1967, mainly by the former USSR and Spain, but declined steadily thereafter to a low of 15,000 t in 1978. From 1979 to 1991 catches ranged from 20,000 to 50,000 t (Table 1, Fig. 1). Continued reduction in recommended TAC's have contributed to reduced catches in recent years to a level of about 10,000 t in 1993. The fishery on this stock was suspended in February 1994 and has been under NAFO moratorium since then. The 1997 Scientific Council Report recommended that there should be no directed fishing for cod in Div. 3N and 3O in 1998. In addition it was recommended that by-catches in fisheries targeting other species should be kept at the lowest possible level.

Landings since 1994, including Canadian surveillance and NAFO Scientific Council estimates (Table 1) have been less than 500 t in each year. A total of 442 t was landed in 1997, 329 t by Canada (Table 2) and 113 by Portugal mainly as by-catch in gillnet and otter trawl fisheries for skate and redfish.

Sampling data for 1997 were extremely limited and were considered to be insufficient to prepare a reliable catch at age. The last year for which catch at age data have been presented is 1995. Catch-at-age, and mean weights-at-age from the fisheries in the 1959-95 period are presented in Tables 3 and 4.

## Research vessel survey data

Stratified-random research vessel surveys have been conducted in spring by Canada in Divs. 3N and 3O since 1971 and 1973 respectively with the exceptions of 1983 in Div. 3N and 1974 and 1983 in Div. 3O. Surveys from 1971 to 1982 were conducted by the research vessel *A.T. CAMERON* and those since 1984 were conducted by the sister ships *ALFRED NEEDLER* and *WILFRED TEMPLEMAN*. The stratification scheme used for these surveys is based on depth and is presented in Fig. 2. Fall surveys have been carried out in Divisions 3NO from 1990 to 1997.

In the fall of 1995, the Campelen 1800 shrimp trawl with rockhopper footgear was introduced in the Canadian groundfish survey, replacing the Engels 145 Hi-rise trawl that had been used previously. The Campelen trawl is towed at 3.0 knots for 15 min instead of 3.5 knots for 30 min in the case of the Engels trawl. 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 and slightly less effective at catching large cod (Warren 1997; Warren et al. 1997). Conversion of Engels catches to Campelen equivalent catches are reported by Stansbury (1996, 1997).

Abundance and biomass estimates for these surveys are presented in Tables 5-14 and plotted for the index strata in Figs. 3-4. Abundance and biomass have been extremely low in both Div. 3N and Div. 3O from 1994 onwards. The preliminary swept area biomass from all surveyed strata in 3N and 3O combined for May 1998 is 82,704 t with a CV of 45%. This biomass estimate is mainly from a few sets in the western region of 3O (Fig. 5).

The mean numbers per tow (age aggregated) for the index strata (i.e. strata with depths < 200 fathoms) are given in Table 15 for the spring survey and Table 16 for the fall survey and plotted in Fig. 6. Both the spring and fall indices have been extremely low in all years after 1993.

**Analysis**

Mean lengths at age in the surveys

Mean lengths-at-age are provided for Divisions 3N and 3O in Table 17. Because sampling for otoliths was stratified by length, mean length-at-age was determined for each division by weighting the value for each individual fish by the ratio of the population number per 3 cm length class to the number of fish sampled in the same length class, where the population number was calculated by areal expansion of the stratified mean catch at length per tow. (Note that population numbers for years prior to 1996 were calculated from the actual survey catch, not the catch adjusted to Campelen equivalents.) Many of the lengths-at-age in 1972-1982 and again in the 1990s are based on small sample sizes. Mean length-at-age for Division 3NO as a whole (Table 17; Fig. 7) was calculated for each year as the mean of the Divisional means, weighted by the Divisional population numbers at age. In general, mean lengths-at-age increased from the early 1970s to the early 1980s and then declined a little. There has been little consistent change since the mid-1980s.

Maturity at age

Female proportions mature at age sampled on the spring research vessel survey together with parameter estimates for a probit model with a logit link function fitted to the data are given in Table 18 and plotted in Fig. 8. The observed data are somewhat variable, particularly in recent years. The estimated age at 50% maturity declined in the late 1980's and early 1990's and there has been a further steady decline since 1994. The model predicted proportion mature at age is given in Table 19. These values are slightly different from those used to calculate spawner biomass for this stock in the NAFO Precautionary Approach Workshop in March 1998.

Estimates of relative year-class strength from survey data

Estimate of year class strength were obtained by fitting the following general linear model to the spring and fall survey mean numbers per tow index data:

$$\ln(N_{a,j,k,y}) = \mu + \alpha_a + \beta_j + \gamma_k + \varepsilon$$

where $N_{a,j,k,y}$ = mean numbers per tow of age a from survey index j, belonging to cohort k in year y , and $\mu$ = intercept, $\alpha_a$ = age effect for a = 1...14, $\beta_j$ = survey effect where j = 1 denotes the spring survey and j = 2 denotes the fall survey, $\gamma_k$ = cohort effect, and $\varepsilon$ = residuals from the fitted model.

The survey effect was found to be not significant and was dropped. The remaining factors (age and cohort) were both significant and the model explained 83% of the variance in the survey index. The estimated parameters for relative cohort strength were back-transformed (not corrected for bias) and plotted together with plus and minus

one standard error (Fig. 9). These plots show that year-class strength in recent years are extremely weak compared to values estimated for year-classes which arose in the 1970's. Year-classes subsequent to the 1990 year-class are estimated to be almost non-existent.

Estimates of total mortality (Z) from survey data

The spring and fall survey mean numbers per tow index was used to calculate total mortality ($Z$) by means of the equation

$$Z_{a,y} = \ln\left(\frac{RV_{a+1,y+1}}{RV_{a,y}}\right),$$

where $R_{a,y}$ is the research vessel mean number per tow index at age $a$ in year $y$.

For those ages that are not fully recruited to the survey, the relative $Z$ values provide an indication of possible changes in total mortality, although not reflective of the absolute mortality. For those ages that are fully recruited to the survey the estimate can be considered to an estimate of actual $Z$. The calculated $Z$'s for ages 1 to 14 over the period 1984 to 1996 for the spring survey are plotted in Fig. 10. The estimates are quite variable because of year effects in the survey data. However, an ANCOVA model with cohort (class) and age (continuous) effects (separate slopes model) was fitted to spring mean number per tow index for ages 3 to 8 for the period 1994 to 1997 (i.e. moratorium). The cohort effect was not significant at $\alpha = 0.05$. The model was rerun with only an age effect and gave an estimate of average $Z = 0.65$ (SE=0.23). A similar analysis for the fall survey data gave an estimate of $Z = 0.79$ (SE=0.29). These $Z$ estimates are high given that the stock is presently under a moratorium and must be considered cause for concern.

Spawner biomass estimates

The last time a SPA was applied and accepted for Div. 3NO cod was in the 1995 assessment (Stansbury et al. 1995). This preceded the change to the Campelen trawl and the conversion of Engels data to Campelen equivalent data. In the absence of recent catch at age data, it was decided that for this assessment it would be useful to estimate the current spawner biomass directly from the spring and fall 1997 surveys by dividing the indices at age by their respective catchabilities at age estimated from an SPA and applying recent estimates of weights and maturities at age. This requires that survey catchabilities at age for the spring and fall Campelen index be estimated. An ADAPT was therefore applied to the converted survey data. It was anticipated that there may be small differences in the estimates of population size and fishing mortality in the new SPA compared with that carried out in 1995 because the conversion to Campelen equivalent units is carried out on survey catches at length rather than age and the index at age is recalculated from the catch at length.

The adaptive framework (Gavaris 1988) applied to Campelen equivalent catch per tow data for the Canadian spring and fall research vessel surveys used the following formulation:

*Parameters estimated by ADAPT:*

- Year-class estimates
  $N_{i,1995}$ i = 3 to 12

- Catchabilities for RV numbers at age
  K(Can Spring)$_i$ i = 3 to 11, t=1984 to 1994, omitting 1993
  K(Can Autumn)$_i$ i = 3 to 11, t=1990 to 1994

*Additional structure imposed*

- Natural mortality was assumed to be 0.20.
- Error in the catch-at-age was assumed negligible.
- F on oldest age group (12) set at the mean weighted F for age group 7-10.
- Intercepts not fitted.

*Input data*

- $C_{i,t}$ i = 3 to 12 t = 1959-95

- $RV(Can\text{-}Spring)_{i,t}$ i = 3 to 11 t = 1984-95
- $RV(Can\text{-}Autumn)_{i,t}$ i = 3 to 11 t = 1990-95

*Objective function*

- Minimize
  $\Sigma_{age}\Sigma_{year}\{obs(lnRV(Can\text{-}spring)_{i,t})\text{-}pred(lnRV(Can\text{-}spring)_{i,t})\}^2 +$
  $\Sigma_{age}\Sigma_{year}\{obs(lnRV(Can\text{-}autumn)_{i,t})\text{-}pred(lnRV(Can\text{-}autumn)_{i,t})\}^2$

*Summary*

- Number of observations = 135
- Number of parameters estimated = 45

The estimated survivors and catchabilities together with standard errors of the estimates are provided in Table 20. Bias-adjusted ADAPT estimates of population numbers and fishing mortality at age are given in Tables 21 and 22. Beginning of year mean weights at age calculated from the commercial catches are given in Table 23.

Spawner biomass derived from the Campelen calibrated ADAPT using beginning of year mean weights at age from the commercial catches and model predicted maturities (Table 24) is compared with the spawner biomass derived from the Engels calibrated ADAPT in the 1995 assessment (which was based on only a single maturity ogive rather than year-specific ogives) in Fig. 11. Also shown is the estimate of spawner biomass derived from the 1995 ADAPT using slightly different estimates of annual proportions mature, as used in the NAFO Precautionary Approach Workshop (Dartmouth, March 1998).

Using the estimates of catchability at age for the Campelen survey in the spring and the fall, the calculated weights at age from the spring survey lengths at age using the equation

$$Log(weight) = 3.0879*log(length) - 5.2106,$$

and the model estimates of female maturity at age from the spring survey, the spawner biomass was calculated for the period 1984-97 directly from the spring and fall survey data and compared to the estimates of the beginning of year spawner biomass for the period 1959 to 1995 in Fig. 11. For the overlapping period there is, as would be expected, reasonable agreement, with the exception of the 1987 survey-derived estimate. The residuals for this year are positive in the SPA fit implying a year effect in the survey. It is clear that the current estimates of spawner biomass are extremely low compared to values estimated of the 1980s.

Biological reference points and present stock size

Decisions regarding biological reference points such as $B_{lim}$, $B_{buf}$, $G_{loss}$, $F_{crash}$ etc. generally require some description of data in spawner-recruit space. Indeed, if the stock-recruit data can be adequately modeled then further exploration of biological reference points and associated risk, while not trivial, is relatively straightforward. Cook (1998) investigated the application of $G_{loss}$ to 3NO cod using the output from the 1995 ADAPT (Stansbury et al. 1995). In addition to $G_{loss}$ analysis Cook (1998) fitted a Beverton-Holt stock-recruit curve to the data and calculated equilibrium SSB and yield. Using the same data as Cook (1998) two model fits to the data were compared (Fig. 12).

A non-parametric approach based on Evans and Rice (1988) was examined. This approach puts a smoother through the recruitment data with the smoothing parameter expressed with reference to the spawner biomass axis. Recruitment estimates that occur closer to the spawner biomass at which recruitment is being predicted get more weight than recruitment values that are further removed on the spawner biomass axis (see for examples Shelton and Morgan (1993a, b, 1994a, b)). The trajectory of the smoother through the stock-recruit data will depend on the probability density function (e.g. Cauchy, Gaussian etc.) and the associated shape parameter. Stiff smoothers (large value for the shape parameter) will more closely approximate a parametric fit, whereas less stiff smoothers (smaller value for the shape parameter) will more closely follow the data. An objective method for choosing the shape parameter is applied in Shelton and Morgan (1993a, b, 1994a, b) and is used here. The Cauchy PDF was arbitrarily selected. The shape parameter was then chosen to minimize the cross-validated prediction sums of squares using the weighted mean as the predictor. The sums of squares surface for the 3NO stock-recruit data is fairly flat in the vicinity of the minimum. A value of 7.648 t spawner biomass approximates the minimum. This smoother is not forced through the origin, so will be unreliable at very low spawner biomass levels. The Cauchy

smoother with the estimated shape parameter appears to describe the data reasonably well compared to the Beverton-Holt fit obtained by Cook (1998) (Fig. 12), however other PDF's should also be explored. The non-parametric fit indicates more resilience to recruit over-fishing at low stock size than would be predicted by parametric models. The Cauchy smoother has an inflection point around 65,000 t spawner biomass, below which the probability of good recruitment is reduced. A second inflection point occurs at about 90,000 t spawner biomass. Predicted recruitment declines steadily between 90,000 t and 65,000 t of spawner biomass.

If the Cauchy smoother description of the stock-recruit data is used, then a $B_{buff}$ = 90,000 t spawner biomass and a $B_{lim}$ = to 65,000 t spawner biomass may be considered appropriate. The recruitment probabilities from the Cauchy smoother could be used directly to explore fishing mortality reference points and alternative harvest control laws using standard stochastic simulation techniques. However such exercises would be premature before giving more consideration to the appropriate description of the stock-recruit data.

Precautionary plots

Based on the fitted Cauchy smoother to the stock recruit data (Fig. 12) and average values of catch weight, beginning of year weight and partial recruitment (average of values for 1991-93, partial recruitments adjusted to get a smooth function) as well as recent values of maturity at age from research vessel surveys (Text table) and an assumed M=0.2, it is possible to complete the "precautionary plots" described in Sissenwine and Shepherd (1987) (Fig. 13).

| Age | Catch weight | January weight | Maturity | Partial recruitmen |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.41 | 0.39 | 0.01 | 0.34 |
| 4 | 0.76 | 0.60 | 0.07 | 0.61 |
| 5 | 1.33 | 1.05 | 0.41 | 0.73 |
| 6 | 1.98 | 1.64 | 0.80 | 0.74 |
| 7 | 3.16 | 2.63 | 0.95 | 0.88 |
| 8 | 4.84 | 3.87 | 0.99 | 0.89 |
| 9 | 6.32 | 5.49 | 1.00 | 0.90 |
| 10 | 8.08 | 6.93 | 1.00 | 1.00 |
| 11 | 9.80 | 8.98 | 1.00 | 1.00 |
| 12 | 11.10 | 10.45 | 1.00 | 1.00 |
| 13 | 13.48 | 13.84 | 1.00 | 1.00 |
| 14 | 13.48 | 13.84 | 1.00 | 1.00 |

The following reference points were calculated: F0.1 = 0.17, Fmax = 0.25, Fmsy = 0.25, Bmsy (for spawner biomass) = 412, 000 t, MSY = 106,000 t, Bmax (for spawner biomass) = 1.4 million t. There is considerable difference in the equilibrium yield versus fishing mortality plot and the equilibrium yield versus spawner biomass plot for the Cauchy smoother compared with the conventional parametric stock-recruit function such as Beverton and Holt. For the smoother, there is an abrupt drop in the equilibrium yield level beyond an F of about 0.6 in the yield versus F plot, and in the yield versus spawner biomass plot the curve is skewed with an abrupt drop in equilibrium yield below a certain spawner biomass level (about 100,000 t). The reason for this is comparable to catastrophe theory and can be readily understood if it is recalled that the replacement line is a straight line through the origin in the stock-recruit plot, the slope being proportional to the total mortality rate (and also a function of weights and maturities at age). Where the replacement line intersects the smoother through the stock-recruit smoother, an equilibrium point, in theory, exists. As the slope increases with increasing F, the equilibrium point moves to the left. Because of the shape of the smoother, there is a sudden drop from an upper equilibrium to a lower equilibrium above an F of about 0.6 for the assumed values for weights, maturities and natural mortality.

## Conclusions

The 1996 and 1997 spring and fall research vessel surveys indicate that the current stock size remains at an extremely low level. Converting the survey estimates to spawner biomass estimates using the catchabilities at age from the ADAPT applied to Campelen-equivalent data and current estimates of maturity and weights at age indicates that the spawner stock biomass is at an extremely low level. Estimates of recent year-class size from survey data indicates that recruitment has been almost non-existent since the 1990 year-class. Estimates of total mortality for the post-moratorium period from survey data indicate that the current Z is substantially higher than the assumed natural mortality value used in the SPA. Low spawner biomass, low recruitment and high total mortality point to poor prospects for this stock in the medium term. Recovery will require a number of relatively strong year-classes that survive to maturity, rebuilding the spawner biomass.

The amount of spawner biomass rebuilding required before reopening of the fishery could be considered has not been determined in this assessment. Biological reference levels require an accepted description of the stock-recruit data. This description needs to be arrived at in an objective manner and be comparable across stocks that occur within the NAFO Regulatory Area and for which advice is provided.

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Table 1. Catch (t) of cod in NAFO Divisions 3NO. 1953 - 1997

| Year | Canada | Spain | Portugal | USSR | Others | Total | TAC |
|---|---|---|---|---|---|---|---|
| 1953 | 39884 | 12633 | 7919 | | 5761 | 66197 | |
| 1954 | 17392 | 88674 | 24045 | | 4650 | 134761 | |
| 1955 | 6053 | 64987 | 27711 | | 15605 | 114356 | |
| 1956 | 5363 | 42624 | 15505 | | 1390 | 64882 | |
| 1957 | 9641 | 51990 | 21740 | | 6819 | 90190 | |
| 1958 | 4812 | 29436 | 11608 | | 2195 | 48051 | |
| 1959 | 3687 | 39994 | 17730 | 48 | 2911 | 64370 | |
| 1960 | 3408 | 33972 | 14347 | 24204 | 3746 | 79677 | |
| 1961 | 5428 | 32284 | 9059 | 22854 | 3099 | 72724 | |
| 1962 | 3235 | 17413 | 3653 | 7971 | 2712 | 34984 | |
| 1963 | 5079 | 37632 | 10004 | 10184 | 6843 | 69742 | |
| 1964 | 2882 | 37185 | 8095 | 9510 | 6789 | 64461 | |
| 1965 | 4229 | 64652 | 1692 | 17166 | 11448 | 99187 | |
| 1966 | 6501 | 52533 | 5070 | 39023 | 5792 | 108919 | |
| 1967 | 3446 | 77948 | 9703 | 118845 | 16842 | 226784 | |
| 1968 | 3287 | 69752 | 6752 | 78820 | 6900 | 165511 | |
| 1969 | 3664 | 71160 | 4940 | 29173 | 8768 | 117705 | |
| 1970 | 4771 | 67034 | 3185 | 28338 | 8233 | 111561 | |
| 1971 | 2311 | 89915 | 6589 | 19307 | 8174 | 126296 | |
| 1972 | 1736 | 76324 | 11537 | 12198 | 1579 | 103374 | |
| 1973 | 1832 | 42403 | 7759 | 27849 | 586 | 80429 | 103000 |
| 1974 | 1360 | 38338 | 6602 | 26911 | 178 | 73389 | 101000 |
| 1975 | 1189 | 16616 | 5560 | 20785 | 24 | 44174 | 88000 |
| 1976 | 2065 | 9880 | 2620 | 8992 | 726 | 24283 | 43000 |
| 1977 | 2532 | 8827 | 1742 | 4041 | 462 | 17604 | 30000 |
| 1978 | 6246 | 5813 | 641 | 1819 | 199 | 14718 | 15000 |
| 1979 | 9938 | 13782 | 1140 | 2446 | 545 | 27851 | 25000 |
| 1980 | 5589 | 8999 | 1145 | 3261 | 997 | 19991 | 26000 |
| 1981 | 6096 | 13299 | 1091 | 3187 | 671 | 24344 | 26000 |
| 1982 | 10185 | 14361 | 2466 | 3985 | 608 | 31605 | 17000 |
| 1983 | 11374 | 12320 | 1109 | 3238 | 778 | 28819 | 17000 |
| 1984 | 8705 | 13590 | 1071 | 3306 | 431 | 27103 | 26000 |
| 1985 | 18179 | 13682 | 608 | 3968 | 462 | 36899 | 33000 |
| 1986 | 18035 | 23395 | 6890 | 1181 | 1144 | 50645 | 33000 |
| 1987 | 18652 | 15788 | 4108 | 764 | 2307 | 41619 | 33000 |
| 1988 | 19727 | 15889 | 3927 | 2973 | 634 | 43150 | 40000 |
| 1989 | 13433 | 17904 | 913 | 108 | 857 | 33215 | 25000 |
| 1990 | 10620 | 4678 | 2145 | 18 | 11385 | 28846 | 18600 |
| 1991 | 12056 [2] | 5448 | 1063 | 61 | 10824 [3] | 29454 [3] | 13600 |
| 1992 | 7859 | 1927 | 449 | 68 | 2449 [3] | 12752 [3] | 13600 |
| | | | | Russia | | | |
| 1993 [1] | 5370 | 3764 | 525 | 287 | 700 [3] | 10646 [3] | 10200 |
| 1994 [1] | 47 | 1783 | 50 | | 822 [3] | 2702 [3] | 6000 [4] |
| 1995 [1] | 64 | 29 | | | 79 [3] | 172 [3] | 0 [4] |
| 1996 [1] | 99 | | 33 | | 42 [3] | 174 [3] | 0 [4] |
| 1997 [1] | 329 | | 113 | | | 442 | 0 [4] |

[1] **Provisional**

[2] **Figure is 4000 t higher than Canadian Statistics as this is an amount deemed to be misreported as 3L catch.**

[3] **Includes Canadian Surveillance Estimates and NAFO Scientific Council Estimates**

[4] **The fishery for cod was suspended in February 1994 and has been under a NAFO moratiun since then.**

Table 2. Cod landings (t) by month and gear from NAFO Divisions 3NO by Canada in 1997.

| Month | Can/N | | | | | | All Gears 3NO |
|---|---|---|---|---|---|---|---|
| | 3N | | 3O | | | | |
| | GN | OT | GN | LL | OT | MWT | Can/N |
| Jan | | | 1 | | | | 1 |
| Feb | | | 3 | | | | 3 |
| Mar | | | | | | | 0 |
| Apr | | | 3 | | 0 | | 3 |
| May | | | 78 | | 32 | | 110 |
| Jun | 14 | | 57 | | 26 | | 98 |
| Jul | 45 | | 1 | | 20 | | 65 |
| Aug | | | 2 | | 1 | | 3 |
| Sep | | 0 | | | | | 0 |
| Oct | | | | | | | 0 |
| Nov | | | | | 3 | | 3 |
| Dec | | | | | | | 0 |
| Total | 59 | 0 | 144 | 0 | 83 | 0 | 286 |

| Month | Can/M | | | | | | All Gears 3NO | Totals 3NO |
|---|---|---|---|---|---|---|---|---|
| | 3N | | 3O | | | | | |
| | GN | LL | OT | MWT | GN | LL | Can/M | Cdn |
| Jan | | | 0 | | | | 0 | 1 |
| Feb | | 0 | | | | 1 | 1 | 3 |
| Mar | | | | | | 1 | 1 | 1 |
| Apr | | | | 2 | | 6 | 8 | 11 |
| May | | 0 | | | | 6 | 6 | 116 |
| Jun | | | | | | 1 | 1 | 99 |
| Jul | | 0 | 0 | | | 1 | 1 | 66 |
| Aug | | | | | | | 0 | 3 |
| Sep | | | | | | 1 | 1 | 1 |
| Oct | | 1 | 0 | | | 1 | 2 | 2 |
| Nov | | 3 | 0 | | | 4 | 8 | 11 |
| Dec | | | 0 | | | 14 | 15 | 15 |
| Total | | 4 | 0 | 2 | 0 | 36 | 43 | 329 |

Table 3. Catch-at-age for Divisions 3NO cod, 1959-1995 (000s) . Age 13 is a plus group

| | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 1711 | 1846 | 812 | 1026 | 313 | 6202 | 1013 | 753 | 20086 | 16359 | 8154 |
| 4 | 13036 | 6503 | 4400 | 3882 | 5757 | 15555 | 7611 | 18413 | 62442 | 56775 | 12924 |
| 5 | 5068 | 22050 | 11696 | 2206 | 11210 | 19496 | 7619 | 19681 | 50317 | 48608 | 26949 |
| 6 | 6025 | 3095 | 15258 | 1581 | 4849 | 7919 | 13258 | 11795 | 18517 | 18485 | 11191 |
| 7 | 3935 | 2377 | 2014 | 3594 | 1935 | 2273 | 9861 | 8486 | 4774 | 6337 | 2089 |
| 8 | 1392 | 2504 | 1672 | 773 | 3840 | 1109 | 4827 | 4467 | 4651 | 1592 | 1393 |
| 9 | 757 | 583 | 847 | 668 | 1165 | 788 | 1081 | 1829 | 236 | 505 | 518 |
| 10 | 926 | 387 | 196 | 433 | 608 | 328 | 1248 | 1694 | 180 | 178 | 292 |
| 11 | 1220 | 898 | 25 | 226 | 322 | 37 | 163 | 122 | 71 | 90 | 134 |
| 12 | 103 | 242 | 245 | 216 | 208 | 112 | 141 | 57 | 45 | 45 | 202 |
| 13 | 1128 | 1409 | 392 | 846 | 473 | 56 | 276 | 183 | 335 | 51 | 574 |
| 3+ | 35301 | 41894 | 37557 | 15451 | 30680 | 53875 | 47098 | 67480 | 161654 | 149025 | 64420 |
| 6+ | 15486 | 11495 | 20649 | 8337 | 13400 | 12622 | 30855 | 28633 | 28809 | 27283 | 16393 |

| | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 2105 | 950 | 69 | 10058 | 6425 | 671 | 4054 | 607 | 920 | 72 | 266 |
| 4 | 19703 | 26900 | 19797 | 27600 | 9501 | 8781 | 7534 | 2469 | 4337 | 3827 | 1055 |
| 5 | 10799 | 30300 | 12289 | 15098 | 10907 | 3528 | 5945 | 2531 | 2518 | 9208 | 3812 |
| 6 | 9481 | 11700 | 13432 | 5989 | 10872 | 2505 | 1084 | 1500 | 818 | 2784 | 2275 |
| 7 | 3646 | 3500 | 5883 | 1971 | 2247 | 3057 | 211 | 572 | 354 | 883 | 761 |
| 8 | 1635 | 2500 | 1686 | 972 | 2147 | 1059 | 238 | 177 | 102 | 265 | 222 |
| 9 | 541 | 500 | 285 | 707 | 1015 | 921 | 44 | 209 | 58 | 58 | 92 |
| 10 | 149 | 200 | 216 | 243 | 676 | 461 | 37 | 65 | 51 | 17 | 31 |
| 11 | 227 | 100 | 78 | 137 | 428 | 252 | 13 | 41 | 8 | 12 | 8 |
| 12 | 90 | 50 | 74 | 116 | 257 | 152 | 9 | 25 | 5 | 7 | 13 |
| 13 | 1472 | 700 | 350 | 173 | 881 | 396 | 17 | 36 | 21 | 16 | 2 |
| 3+ | 49848 | 77400 | 54159 | 63064 | 45356 | 21783 | 19186 | 8232 | 9192 | 17149 | 8537 |
| 6+ | 17241 | 19250 | 22004 | 10308 | 18523 | 8803 | 1653 | 2625 | 1417 | 4042 | 3404 |

| | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 505 | 305 | 1179 | 58 | 57 | 153 | 516 | 277 | 1917 | 1064 | 1103 |
| 4 | 1091 | 1978 | 647 | 1000 | 2953 | 2865 | 422 | 318 | 2182 | 4505 | 673 |
| 5 | 1262 | 1591 | 1893 | 1411 | 6203 | 6423 | 3491 | 1527 | 1502 | 4341 | 995 |
| 6 | 2297 | 1012 | 1204 | 2324 | 3036 | 4370 | 3445 | 6347 | 1260 | 895 | 544 |
| 7 | 1902 | 1528 | 686 | 1220 | 2519 | 1512 | 1213 | 3955 | 1887 | 422 | 282 |
| 8 | 574 | 1492 | 1152 | 720 | 797 | 948 | 653 | 1009 | 1284 | 721 | 368 |
| 9 | 192 | 595 | 774 | 918 | 459 | 558 | 845 | 567 | 485 | 581 | 568 |
| 10 | 94 | 211 | 238 | 551 | 533 | 373 | 494 | 425 | 233 | 439 | 502 |
| 11 | 41 | 162 | 81 | 106 | 261 | 349 | 398 | 249 | 168 | 150 | 383 |
| 12 | 13 | 27 | 41 | 42 | 97 | 135 | 404 | 142 | 100 | 83 | 202 |
| 13 | 32 | 52 | 36 | 70 | 71 | 86 | 188 | 298 | 285 | 106 | 337 |
| 3+ | 8003 | 8953 | 7931 | 8420 | 16986 | 17772 | 12069 | 15114 | 11303 | 13307 | 5957 |
| 6+ | 5145 | 5079 | 4212 | 5951 | 7773 | 8331 | 7640 | 12992 | 5702 | 3397 | 3186 |

| | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|
| 3 | 4508 | 1314 | 232 | 0 |
| 4 | 1769 | 3209 | 2326 | 72 |
| 5 | 837 | 637 | 1117 | 20 |
| 6 | 612 | 479 | 125 | 40 |
| 7 | 235 | 321 | 93 | 2 |
| 8 | 64 | 74 | 26 | 0 |
| 9 | 99 | 25 | 8 | 1 |
| 10 | 128 | 39 | 1 | 0 |
| 11 | 153 | 49 | 0.03 | 0 |
| 12 | 100 | 53 | 0.07 | 0 |
| 13 | 217 | 160 | 0.03 | 0 |
| 3+ | 8722 | 6360 | 3928.13 | 135 |
| 6+ | 1608 | 1200 | 253.13 | 43 |

Table 4. Mean weight-at-age for Divisions 3NO cod, 1959-1995. Values for age 13 is the average of the plus group

| | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 0.42 | 0.42 | 0.42 | 0.42 | 0.42 | 0.42 | 0.42 | 0.48 | 0.48 | 0.48 | 0.48 |
| 4 | 0.82 | 0.82 | 0.82 | 0.82 | 0.82 | 0.82 | 0.82 | 0.90 | 0.90 | 0.90 | 0.90 |
| 5 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.35 | 1.35 | 1.35 | 1.35 |
| 6 | 1.95 | 1.95 | 1.95 | 1.95 | 1.95 | 1.95 | 1.95 | 2.14 | 2.14 | 2.14 | 2.14 |
| 7 | 2.82 | 2.82 | 2.82 | 2.82 | 2.82 | 2.82 | 2.82 | 3.16 | 3.16 | 3.16 | 3.16 |
| 8 | 3.39 | 3.39 | 3.39 | 3.39 | 3.39 | 3.39 | 3.39 | 4.21 | 4.21 | 4.21 | 4.21 |
| 9 | 3.98 | 3.98 | 3.98 | 3.98 | 3.98 | 3.98 | 3.98 | 6.34 | 6.34 | 6.34 | 6.34 |
| 10 | 4.68 | 4.68 | 4.68 | 4.68 | 4.68 | 4.68 | 4.68 | 7.69 | 7.69 | 7.69 | 7.69 |
| 11 | 5.25 | 5.25 | 5.25 | 5.25 | 5.25 | 5.25 | 5.25 | 8.46 | 8.46 | 8.46 | 8.46 |
| 12 | 6.17 | 6.17 | 6.17 | 6.17 | 6.17 | 6.17 | 6.17 | 10.24 | 10.24 | 10.24 | 10.24 |
| 13 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 |

| | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 0.48 | 0.48 | 0.54 | 0.57 | 0.42 | 0.38 | 0.50 | 0.57 | 0.72 | 0.65 | 0.71 |
| 4 | 0.90 | 0.90 | 0.97 | 1.00 | 0.73 | 0.89 | 0.91 | 1.00 | 1.05 | 0.98 | 1.04 |
| 5 | 1.35 | 1.35 | 1.44 | 1.43 | 1.20 | 1.28 | 1.41 | 1.48 | 1.55 | 1.39 | 1.69 |
| 6 | 2.14 | 2.14 | 2.08 | 2.19 | 1.96 | 2.13 | 2.33 | 2.48 | 2.25 | 2.09 | 2.50 |
| 7 | 3.16 | 3.16 | 2.89 | 3.63 | 2.86 | 3.14 | 3.25 | 3.51 | 3.74 | 2.87 | 3.69 |
| 8 | 4.21 | 4.21 | 3.56 | 4.63 | 4.67 | 4.16 | 4.03 | 4.74 | 4.61 | 3.70 | 5.49 |
| 9 | 6.34 | 6.34 | 5.95 | 6.25 | 7.32 | 5.53 | 6.67 | 7.17 | 6.19 | 4.75 | 7.98 |
| 10 | 7.69 | 7.69 | 7.95 | 9.56 | 5.46 | 6.74 | 8.74 | 8.81 | 7.23 | 7.15 | 9.22 |
| 11 | 8.46 | 8.46 | 8.32 | 11.17 | 8.40 | 5.27 | 9.14 | 11.70 | 9.48 | 7.98 | 10.60 |
| 12 | 10.24 | 10.24 | 10.14 | 13.99 | 7.51 | 7.09 | 12.49 | 11.47 | 12.87 | 10.11 | 12.61 |
| 13 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 |

| | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 0.90 | 0.94 | 0.85 | 0.79 | 0.48 | 0.39 | 0.49 | 0.74 | 0.51 | 0.55 | 0.55 |
| 4 | 1.27 | 1.17 | 1.17 | 1.15 | 0.86 | 1.01 | 0.82 | 1.00 | 0.97 | 1.01 | 0.85 |
| 5 | 1.84 | 1.50 | 1.87 | 1.51 | 1.37 | 1.52 | 1.30 | 1.38 | 1.60 | 1.46 | 1.59 |
| 6 | 2.69 | 2.20 | 2.63 | 2.28 | 2.05 | 2.16 | 1.83 | 1.79 | 2.24 | 2.51 | 2.30 |
| 7 | 3.55 | 3.83 | 3.80 | 3.04 | 3.25 | 3.49 | 2.89 | 2.23 | 3.27 | 2.73 | 3.83 |
| 8 | 5.33 | 5.26 | 5.20 | 4.05 | 4.65 | 5.41 | 4.76 | 3.77 | 4.61 | 4.14 | 5.56 |
| 9 | 7.13 | 7.49 | 6.27 | 5.76 | 6.62 | 7.95 | 7.26 | 5.12 | 7.08 | 5.02 | 7.53 |
| 10 | 9.10 | 8.80 | 8.08 | 7.22 | 8.32 | 9.82 | 8.95 | 6.88 | 8.31 | 8.37 | 9.04 |
| 11 | 9.01 | 9.82 | 8.99 | 8.92 | 9.15 | 9.94 | 9.85 | 9.37 | 9.47 | 9.29 | 11.98 |
| 12 | 10.15 | 12.28 | 11.01 | 12.61 | 11.13 | 9.88 | 12.59 | 11.07 | 12.25 | 11.25 | 13.98 |
| 13 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 13.50 | 11.91 | 13.60 |

| | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|
| 3 | 0.33 | 0.36 | 0.27 | 0.00 |
| 4 | 0.65 | 0.78 | 0.46 | 0.75 |
| 5 | 1.06 | 1.35 | 0.91 | 1.21 |
| 6 | 1.80 | 1.84 | 1.63 | 2.03 |
| 7 | 2.82 | 2.82 | 1.84 | 2.29 |
| 8 | 4.85 | 4.11 | 4.04 | 2.08 |
| 9 | 5.56 | 5.87 | 4.94 | 6.60 |
| 10 | 7.43 | 7.76 | 7.54 | 6.22 |
| 11 | 8.64 | 8.79 | 3.44 | 0.00 |
| 12 | 10.65 | 8.67 | 7.52 | 0.00 |
| 13 | 14.11 | 12.74 | 10.00 | 0.00 |

Table 5. Cod abundance (000's) from Canadian **spring** RV surveys in Division **3N** for depths <200 fathoms.Shaded *Numbers are estimates for non sampled strata.*

| Depth range (fath) | Strata | Vessel Area Sq. mi. | AN 27 1984 | WT 29 AN 43 1985 | WT 47 1986 | WT 58-59 1987 | WT 70 1988 | WT 82 1989 | WT 95-96 1990 | WT 105-106 1991 | WT 119-120 1992 | WT 136-137 1993 | WT 152-153 1994 | WT 168-169 1995 | WT 188-189 1996 | WT 204-208 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mean survey date | | | 2-May-84 | 27-Apr-85 | 29-Apr-86 | 9-May-87 | 1-May-88 | 2-May-89 | 12-May-90 | 7-May-91 | 8-May-92 | 13-May-93 | 18-May-94 | 18-May-95 | 25-May-96 | 16-May-97 |
| 0-30 | 375 | 1593 | 22302 | 12390 | 2240 | 6223 | 3134 | 4868 | 3236 | 111 | 148 | 74 | 0 | 0 | 0 | 131 |
| | 376 | 1499 | 149223 | 149 | 787 | 88795 | 2533 | 599 | 268 | 119 | 0 | 0 | 0 | 69 | 165 | 0 |
| 31-50 | 360 | 2992 | 136658 | 27167 | 9750 | 31721 | 35911 | 1053 | 3020 | 900 | 2731 | 907 | 0 | 0 | 449 | 86 |
| | 361 | 1853 | 29339 | 50443 | 5585 | 47837 | 15405 | 9136 | 6634 | 2574 | 804 | 836 | 103 | 625 | 1077 | 549 |
| | 362 | 2520 | 68550 | 20045 | 5400 | 117654 | 6860 | 7054 | 8400 | 1120 | 58 | 117 | 0 | 0 | 39 | 50 |
| | 373 | 2520 | 27500 | 4161 | 1600 | 11738 | 2625 | 3096 | 1575 | 223 | 0 | 0 | 0 | 0 | 39 | 50 |
| | 374 | 931 | 10431 | 776 | 86 | 931 | 879 | 52 | 388 | 26 | 129 | 0 | 0 | 0 | 85 | 38 |
| | 383 | 674 | 62 | 0 | 0 | 967 | 686 | 499 | 47 | 62 | 0 | 0 | 0 | 0 | 0 | 0 |
| 51-100 | 359 | 421 | 2339 | 0 | 40375 | 7163 | 5584 | 1637 | 819 | 1199 | 1696 | 2193 | 0 | 0 | 33 | 138 |
| | 377 | 100 | 1771 | 2451 | 465 | 6396 | 0 | 424 | 0 | 0 | 0 | 28 | 49 | 0 | 0 | 0 |
| | 382 | 647 | 0 | 3572 | 22 | 60 | 180 | 1588 | 3325 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 101-150 | 358 | 225 | 2703 | 5766 | 4063 | 4359 | 5328 | 3984 | 8297 | 1047 | 16484 | 3391 | 109 | 156 | 310 | 261 |
| | 378 | 139 | 2481 | 43824 | 6313 | 2124 | 1921 | 1612 | 2751 | 875 | 3707 | 608 | 222 | 97 | 163 | 136 |
| | 381 | 182 | 1534 | 12968 | 8249 | 392 | 3185 | 3741 | 3665 | 202 | 88 | 0 | 13 | 114 | 160 | 13 |
| 151-200 | 357 | 164 | 0 | 11571 | 444 | [redacted] | 11 | 68 | 888 | 2528 | 2676 | 68 | 433 | 23 | 90 | 20 |
| | 379 | 106 | 788 | 3195 | 5010 | 7 | 44 | 206 | 1318 | 2311 | 8782 | 545 | 191 | 66 | 204 | 194 |
| | 380 | 116 | 209 | 3681 | 526 | 934 | 1498 | 967 | 2062 | 3859 | 870 | 20654 | 0 | 32 | 471 | 6239 |
| total all strata fished < 200 fathoms | | | 455890 | 202158 | 90915 | 327301 | 85786 | 40583 | 46692 | 17156 | 38174 | 29420 | 1120 | 1182 | 3283 | 7905 |
| 1 std dev | | | 157039 | 27576 | 35654 | 91793 | 15324 | 5543 | 7693 | 4176 | 5808 | 20213 | 520 | 651 | 787 | 6109 |

Table 6. Cod biomass (t) from Canadian **spring** RV surveys in Division **3N** for depths < 200 fathoms. Shaded Numbers are estimates for non sampled strata.

| Depth range (fath) | Strata | Vessel Area Sq. mi. | AN 27 1984 | WT 29 AN 43 1985 | WT 47 1986 | WT 58-59 1987 | WT 70 1988 | WT 82 1989 | WT 95-96 1990 | WT 105-106 1991 | WT 119-120 1992 | WT 136-137 1993 | WT 152-153 1994 | WT 168-169 1995 | WT 188-189 1996 | WT 204-208 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mean survey date | | | 2-May-84 | 27-Apr-85 | 29-Apr-86 | 9-May-87 | 1-May-88 | 2-May-89 | 12-May-90 | 7-May-91 | 8-May-92 | 13-May-93 | 18-May-94 | 18-May-95 | 25-May-96 | 16-May-97 |
| 0-30 | 375 | 1593 | 7018 | 26266 | 21041 | 13506 | 23154 | 25148 | 16134 | 1835 | 2331 | 1145 | 0 | 0 | 0 | 92 |
| | 376 | 1499 | 16673 | 713 | 2954 | 9148 | 6555 | 1256 | 3791 | 1483 | 0 | 0 | 0 | 51 | 62 | 0 |
| 31-50 | 360 | 2992 | 21843 | 17007 | 3781 | 4155 | 3792 | 2145 | 10488 | 1032 | 1445 | 46 | 0 | 0 | 457 | 15 |
| | 361 | 1853 | 20008 | 52794 | 61130 | 50358 | 25677 | 19517 | 30149 | 16646 | 399 | 3455 | 64 | 47 | 647 | 378 |
| | 362 | 2520 | 75781 | 29914 | 31327 | 144250 | 19890 | 26588 | 37344 | 4343 | 668 | 1522 | 0 | 0 | 21 | 317 |
| | 373 | 2520 | 33487 | 5274 | 4378 | 14596 | 9738 | 8996 | 5802 | 856 | 0 | 0 | 0 | 0 | 9 | 168 |
| | 374 | 931 | 14987 | 1523 | 1338 | 1832 | 5872 | 937 | 5050 | 516 | 30 | 0 | 0 | 0 | 11 | 136 |
| | 383 | 674 | 502 | 0 | 0 | 1664 | 236 | 574 | 615 | 224 | 0 | 0 | 0 | 0 | 0 | 0 |
| 51-100 | 359 | 421 | 308 | 0 | 2639 | 779 | 637 | 213 | 101 | 66 | 113 | 433 | 0 | 0 | 36 | 199 |
| | 377 | 100 | 145 | 219 | 138 | 1720 | 0 | 46 | 0 | 0 | 0 | 9 | 8 | 0 | 0 | 0 |
| | 382 | 647 | 0 | 257 | 84 | 42 | 59 | 782 | 298 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 101-150 | 358 | 225 | 822 | 906 | 1724 | 4255 | 1317 | 1701 | 1089 | 131 | 2650 | 1699 | 164 | 135 | 131 | 104 |
| | 378 | 139 | 692 | 4601 | 1084 | 358 | 441 | 432 | 399 | 145 | 413 | 247 | 64 | 76 | 84 | 109 |
| | 381 | 182 | 765 | 5397 | 2913 | 247 | 786 | 216 | 800 | 399 | 15 | 0 | 57 | 44 | 40 | 2 |
| 151-200 | 357 | 164 | 0 | 6352 | 640 | [redacted] | 33 | 64 | 274 | 331 | 706 | 46 | 237 | 24 | 18 | 9 |
| | 379 | 106 | 382 | 1198 | 1587 | 9 | 37 | 98 | 318 | 852 | 2592 | 205 | 121 | 46 | 66 | 104 |
| | 380 | 116 | 411 | 2128 | 366 | 1018 | 656 | 498 | 704 | 676 | 181 | 9823 | 0 | 9 | 100 | 3457 |
| total all strata fished < 200 fathoms | | | 193825 | 154547 | 137124 | 247937 | 98880 | 89212 | 113355 | 29536 | 11544 | 18629 | 714 | 433 | 1682 | 5090 |
| 1 std dev | | | 29836 | 18270 | 33801 | 37740 | 12640 | 12355 | 13694 | 8520 | 2748 | 9845 | 287 | 118 | 553 | 3439 |

Table 7. Cod abundance (000's) from Canadian **spring** RV surveys in Division **3N**
for depths > 200 fathoms.Shaded Numbers are estimates for non sampled strata.

| Depth range (fath) | Strata | Vessel Area Sq. mi. | WT 105-106 1991 | WT 119-120 1992 | WT 136-137 1993 | WT 152-153 1994 | WT 168-169 1995 | WT 188-189 1996 | WT 204-208 1997 |
|---|---|---|---|---|---|---|---|---|---|
| mean survey date | | | 7-May-91 | 8-May-92 | 13-May-93 | 18-May-94 | 18-May-95 | 25-May-96 | 16-May-97 |
| 201-300 | 723 | 155 | 1970 | 13573 | 43 | 32 | 0 | 46 | 77 |
| | 725 | 105 | 401 | **nf** | 0 | 95 | 73 | 34 | 16 |
| | 727 | 160 | 833 | 2144 | 1444 | 222 | 211 | 1394 | 109 |
| 301-400 | 724 | 124 | 69 | 112 | 9 | 34 | 17 | 0 | 50 |
| | 726 | 72 | 0 | 0 | 0 | 0 | 70 | 0 | 12 |
| | 728 | 156 | 0 | 0 | 0 | 0 | 43 | 0 | 0 |
| 401-500 | 752 | 134 | **nf** | **nf** | **nf** | 0 | **nf** | **nf** | **nf** |
| | 756 | 106 | **nf** | **nf** | **nf** | 0 | **nf** | **nf** | **nf** |
| | 760 | 154 | **nf** | **nf** | **nf** | 0 | **nf** | **nf** | **nf** |
| total all strata fished | | | 20429 | 54003 | 30916 | 1504 | 1597 | 4789 | 8165 |
| 1 STD | | | 4280 | 12445 | 20228 | 555 | 659 | 1519 | 6109 |

Table 8. Cod biomass (t) from Canadian **spring** RV surveys in Division **3N**
for depths >200 fathoms.Shaded Numbers are estimates for non sampled strata.

| Depth range (fath) | Strata | Vessel Area Sq. mi. | WT 105-106 1991 | WT 119-120 1992 | WT 136-137 1993 | WT 152-153 1994 | WT 168-169 1995 | WT 188-189 1996 | WT 204-208 1997 |
|---|---|---|---|---|---|---|---|---|---|
| mean survey date | | | 7-May-91 | 8-May-92 | 13-May-93 | 18-May-94 | 18-May-95 | 25-May-96 | 16-May-97 |
| 201-300 | 723 | 155 | 662 | 3415 | 30 | 26 | 0 | 35 | 80 |
| | 725 | 105 | 186 | **nf** | 0 | 32 | 8 | 19 | 9 |
| | 727 | 160 | 486 | 805 | 313 | 86 | 41 | 677 | 71 |
| 301-400 | 724 | 124 | 30 | 32 | 9 | 22 | 26 | 0 | 40 |
| | 726 | 72 | 0 | 0 | 0 | 0 | 31 | 0 | 5 |
| | 728 | 156 | 0 | 0 | 0 | 0 | 26 | 0 | 0 |
| 401-500 | 752 | 134 | **nf** | **nf** | **nf** | 0 | **nf** | **nf** | **nf** |
| | 756 | 106 | **nf** | **nf** | **nf** | 0 | **nf** | **nf** | **nf** |
| | 760 | 154 | **nf** | **nf** | **nf** | 0 | **nf** | **nf** | **nf** |
| total all strata fished | | | 30901 | 15795 | 18982 | 880 | 566 | 2430 | 5295 |
| 1 STD | | | 8541 | 3853 | 9846 | 295 | 125 | 866 | 3440 |

Table 9. Cod abundance (000's) from Canadian **Spring** RV Surveys in Division **3O** for depths <200 fathoms.Shaded Numbers are estimates for non-sampled strata.

| Depth range (fath) | Strata | Vessel Area Sq. mi | AN 27 1984 | AN 43 1985 | WT 47 1986 | WT 58-60 1987 | WT 70 1988 | WT 82 1989 | WT 95-96 1990 | WT 105-106 1991 | WT 119-120 1992 | WT 136-137 1993 | WT 152-154 1994 | WT 168-169 1995 | WT 188-189 1996 | WT 204-208 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mean survey date | | | 3-May-84 | 15-Apr-85 | 22-Apr-86 | 27-Apr-87 | 24-Apr-88 | 23-Apr-89 | 27-Apr-90 | 24-Apr-91 | 26-Apr-92 | 30-Apr-93 | 4-May-94 | 7-May-95 | 11-May-96 | 16-May-97 |
| 31-50 | 330 | 2089 | 7761 | 7892 | 3707 | 11315 | 5384 | 1609 | 4990 | 1424 | 203 | 373 | 0 | 0 | 4824 | 509 |
| | 331 | 456 | 3863 | 1921 | 744 | 1900 | 1425 | 792 | 1052 | 158 | 32 | 0 | 0 | 0 | 348 | 0 |
| | 338 | 1898 | 23356 | 9724 | 8933 | 20210 | 6623 | 20166 | 8436 | 24463 | 2285 | 835 | 132 | 264 | 2109 | 160 |
| | 340 | 1716 | 10606 | 9414 | 10282 | 146151 | 2826 | 1960 | 3628 | 2569 | 334 | 119 | 286 | 0 | 1441 | 529 |
| | 351 | 2520 | 78342 | 17578 | 117725 | 71723 | 13335 | 6112 | 6242 | 2071 | 1050 | 350 | 250 | 0 | 525 | 453 |
| | 352 | 2580 | 41362 | 17656 | 9803 | 35888 | 56193 | 10474 | 14499 | 9752 | 3852 | 1331 | 1299 | 1111 | 1115 | 927 |
| | 353 | 1282 | 0 | 2226 | 2773 | 29082 | 44478 | 4731 | 6499 | 1297 | 4229 | 223 | 0 | 285 | 677 | 0 |
| 51-100 | 329 | 1721 | 5928 | 2390 | 2838 | 133032 | 5259 | 5577 | 13147 | 22309 | 508 | 1673 | 13959 | 1100 | 330 | 765 |
| | 332 | 1047 | 436 | 3432 | 1115 | 30014 | 2908 | 3112 | 5700 | 683773 | 29607 | 296105 | 0 | 2399 | 3184 | 432 |
| | 337 | 948 | 1909 | 5688 | 1369 | 1799 | 2337 | 10402 | 2133 | 22436 | 6913 | 231602 | 132 | 527 | 2502 | 681 |
| | 339 | 585 | 14625 | 894 | 135 | 2383 | 488 | 27 | 1625 | 1571 | 609 | 406 | 0 | 0 | 46 | 0 |
| | 354 | 474 | 2238 | 1843 | 2216 | 65669 | 2271 | 593 | 395 | 9019 | 1679 | 1415 | 0 | 0 | 66 | 0 |
| 101-150 | 333 | 151 | 0 | 42 | 105 | 566 | 0 | 378 | 136 | 692 | 975 | 514 | 2205 | 10 | 688 | 1447 |
| | 336 | 121 | 0 | 17 | 126 | 17 | 8 | 8 | 143 | 160 | 5537 | 437 | 605 | 0 | 8 | 128 |
| | 355 | 103 | 0 | 4070 | 29 | 207 | 43 | 987 | 193 | 2339 | 944 | 236 | 50 | 7 | 2573 | 6 |
| 151-200 | 334 | 92 | 0 | 236 | 1323 | 26 | 121 | 141 | 543 | 1214 | 971 | 1137 | 533 | 200 | 184 | 94 |
| | 335 | 58 | 0 | 0 | 68 | 8 | 12 | 16 | 97 | 27 | 1275 | 342 | 157 | 52 | 490 | 211 |
| | 356 | 61 | 0 | 0 | 13 | 4 | 51 | 131 | 110 | 546 | 2665 | 424 | 491 | 13 | 93 | 70 |
| total strata fished < 200 fathoms | | | 190427 | 85023 | 163306 | 549997 | 143763 | 67215 | 68515 | 785821 | 63667 | 537522 | 20100 | 5967 | 21202 | 6412 |
| 1 std dev | | | 23492 | 12072 | 92856 | 118784 | 39030 | 10972 | 10310 | 669240 | 22549 | 271901 | 13845 | 1800 | 4574 | 1513 |

Table 10. Cod biomass (t) from Canadian **Spring** RV Surveys in Division **3O** for depths < 200 fathoms.Shaded Numbers are estimates for non-sampled strata.

| Depth range (fath) | Strata | Vessel Area Sq. mi | AN 27 1984 | AN 43 1985 | WT 47 1986 | WT 58-60 1987 | WT 70 1988 | WT 82 1989 | WT 95-96 1990 | WT 105-106 1991 | WT 119-120 1992 | WT 136-137 1993 | WT 152-154 1994 | WT 168-169 1995 | WT 188-189 1996 | WT 204-208 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mean survey date | | | 3-May-84 | 15-Apr-85 | 22-Apr-86 | 27-Apr-87 | 24-Apr-88 | 23-Apr-89 | 27-Apr-90 | 24-Apr-91 | 26-Apr-92 | 30-Apr-93 | 4-May-94 | 7-May-95 | 11-May-96 | 16-May-97 |
| 31-50 | 330 | 2089 | 7964 | 9372 | 4167 | 12075 | 4486 | 3318 | 5091 | 266 | 32 | 92 | 0 | 0 | 7103 | 357 |
| | 331 | 456 | 4536 | 4891 | 1295 | 1982 | 2176 | 481 | 1077 | 236 | 224 | 0 | 0 | 0 | 983 | 0 |
| | 338 | 1898 | 43090 | 13670 | 23245 | 20013 | 14538 | 25430 | 9315 | 10283 | 11883 | 4981 | 1841 | 3439 | 1535 | 196 |
| | 340 | 1716 | 13654 | 10780 | 12024 | 161120 | 16447 | 5478 | 10296 | 384 | 52 | 1936 | 160 | 0 | 239 | 186 |
| | 351 | 2520 | 68620 | 34516 | 90852 | 114632 | 25324 | 19777 | 22343 | 6595 | 2063 | 1198 | 131 | 0 | 104 | 286 |
| | 352 | 2580 | 51655 | 41868 | 24245 | 76430 | 82226 | 43865 | 38424 | 22512 | 16671 | 8225 | 1584 | 3784 | 1528 | 2869 |
| | 353 | 1282 | 0 | 9451 | 1831 | 15552 | 4512 | 4012 | 5892 | 1267 | 1780 | 3260 | 0 | 609 | 118 | 0 |
| 51-100 | 329 | 1721 | 1776 | 1931 | 1114 | 116331 | 16127 | 1690 | 4684 | 4195 | 97 | 219 | 10523 | 2187 | 191 | 614 |
| | 332 | 1047 | 4410 | 17134 | 4092 | 12848 | 11718 | 2156 | 11266 | 39264 | 3927 | 108245 | 0 | 1702 | 1534 | 1558 |
| | 337 | 948 | 741 | 2976 | 11644 | 4299 | 1005 | 5735 | 3354 | 5566 | 20721 | 79783 | 813 | 1659 | 3299 | 527 |
| | 339 | 585 | 3355 | 730 | 73 | 943 | 496 | 219 | 385 | 92 | 87 | 43 | 0 | 0 | 5 | 0 |
| | 354 | 474 | 955 | 660 | 569 | 6915 | 1211 | 87 | 562 | 3325 | 191 | 1319 | 0 | 0 | 85 | 0 |
| 101-150 | 333 | 151 | 0 | 330 | 411 | 1837 | 0 | 1486 | 381 | 877 | 273 | 1661 | 8549 | 26 | 1625 | 974 |
| | 336 | 121 | 0 | 81 | 120 | 35 | 39 | 44 | 318 | 111 | 1733 | 375 | 661 | 0 | 19 | 322 |
| | 355 | 103 | 0 | 724 | 29 | 259 | 38 | 538 | 198 | 329 | 63 | 169 | 32 | 31 | 2344 | 15 |
| 151-200 | 334 | 92 | 0 | 898 | 4773 | 120 | 473 | 294 | 826 | 1385 | 1018 | 1408 | 959 | 333 | 259 | 305 |
| | 335 | 58 | 0 | 0 | 159 | 38 | 82 | 16 | 110 | 10 | 276 | 2522 | 453 | 342 | 680 | 734 |
| | 356 | 61 | 0 | 0 | 42 | 15 | 178 | 154 | 219 | 88 | 308 | 387 | 257 | 16 | 46 | 47 |
| total strata fished < 200 fathoms | | | 200758 | 150013 | 180686 | 545446 | 181076 | 114780 | 113664 | 96783 | 61399 | 215824 | 25964 | 14127 | 21696 | 8990 |
| 1 std dev | | | 26557 | 18667 | 57045 | 107416 | 34873 | 32407 | 14933 | 35395 | 21352 | 92888 | 11823 | 3094 | 4742 | 3056 |

Table 11. Cod abundance (000's) from Canadian **Spring** RV Surveys in Division **3O**
for depths >200 fathoms

| Depth range (fath) | Strata | Vessel Area Sq. mi | WT 105-106 1991 | WT 119-120 1992 | WT 136-137 1993 | WT 152-154 1994 | WT 168-169 1995 | WT 188-189 1996 | WT 204-208 1997 |
|---|---|---|---|---|---|---|---|---|---|
| mean survey date | | | 24-Apr-91 | 26-Apr-92 | 30-Apr-93 | 4-May-94 | 7-May-95 | 11-May-96 | 16-May-97 |
| 201-300 | 717 | | 3701 | 336 | 1615 | 1441 | 242 | 27 | 176 |
| | 719 | | 274 | 749 | 301 | 443 | 164 | 21 | 39 |
| | 721 | | 190 | 72390 | 348 | 11 | 5 | 84 | 103 |
| 301-400 | 718 | | 15 | 0 | 100 | 503 | 102 | 0 | 7 |
| | 720 | | 0 | 569 | 15 | 211 | 29 | 6 | 103 |
| | 722 | | 0 | 149 | 0 | 0 | 0 | 11 | 6 |
| 401-500 | 764 | | **nf** | **nf** | **nf** | 0 | **nf** | **nf** | **nf** |
| | 772 | | **nf** | **nf** | **nf** | 0 | **nf** | **nf** | **nf** |
| total all strata fished | | | 790001 | 137860 | 539900 | 22708 | 6510 | 21352 | 6844 |
| 1 STD | | | 669243 | 75102 | 271903 | 13895 | 1823 | 4574 | 1519 |

Table 12. Cod biomass (t) from Canadian **Spring** RV Surveys in Division **3O**
for depths <200 fathoms.

| Depth range (fath) | Strata | Vessel Area Sq. mi | WT 105-106 1991 | WT 119-120 1992 | WT 136-137 1993 | WT 152-154 1994 | WT 168-169 1995 | WT 188-189 1996 | WT 204-208 1997 |
|---|---|---|---|---|---|---|---|---|---|
| mean survey date | | | 24-Apr-91 | 26-Apr-92 | 30-Apr-93 | 4-May-94 | 7-May-95 | 11-May-96 | 16-May-97 |
| 201-300 | 717 | 717 | 15218 | 436 | 1870 | 2094 | 339 | 57 | 238 |
| | 719 | 719 | 143 | 179 | 330 | 727 | 927 | 37 | 133 |
| | 721 | 721 | 88 | 12153 | 304 | 16 | 10 | 95 | 53 |
| 301-400 | 718 | 718 | 7 | 0 | 159 | 791 | 91 | 0 | 16 |
| | 720 | 720 | 0 | 139 | 9 | 222 | 34 | 3 | 164 |
| | 722 | 722 | 0 | 70 | 0 | 0 | 0 | 28 | 5 |
| 401-500 | 764 | 764 | **nf** | **nf** | **nf** | 0 | **nf** | **nf** | **nf** |
| | 772 | 772 | **nf** | **nf** | **nf** | 0 | **nf** | **nf** | **nf** |
| total all strata fished | | | 112240 | 74377 | 218496 | 29814 | 15528 | 21915 | 9598 |
| 1 STD | | | 36959 | 24453 | 92889 | 11890 | 3223 | 4742 | 3065 |

Table 13. Abundance ('000) and Biomass (t) of cod from autumn stratified random surveys in Division 3N.

| | | | abundance | | | | | | | | Biomass | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth Range | Strata | Area | WT 101-102 1990 6-Dec-90 | WT 113-115 1991 3-Nov-91 | WT 128-130 1992 29-Oct-92 | WT 144-146 1993 7-Nov-93 | WT 160-161 1994 2-Nov-94 | WT 176-177 1995 13-Oct-95 | Tel 42 AN253 WT 200 1996 1-Dec-96 | WT 212-214 1997 16-Oct-97 | WT 101-102 1990 6-Dec-90 | WT 113-115 1991 3-Nov-91 | WT 128-130 1992 29-Oct-92 | WT 144-146 1993 7-Nov-93 | WT 160-161 1994 2-Nov-94 | WT 176-177 1995 13-Oct-95 | Tel 42 AN253 WT 200 1996 1-Dec-96 | WT 212-214 1997 16-Oct-97 |
| 0-30 | 375 | 1593 | 5421 | 66596 | nf | 2047 | 1947 | 5001 | 0 | 603 | 31395 | 69276 | nf | 3305 | 9447 | 3162 | 0 | 594 |
| | 376 | 1499 | 32419 | 455280 | 354763 | 260 | 312 | 3956 | 93 | 41 | 5147 | 80732 | 116390 | 152 | 993 | 4035 | 806 | 12 |
| 31-50 | 360 | 2992 | 28703 | 12311 | 8311 | 3463 | 0 | 437 | | 137 | 7585 | 4456 | 4572 | 8072 | 0 | 1329 | 319 | 1226 |
| | 361 | 1853 | 6273 | 14155 | 20718 | 6177 | 7549 | 3788 | 2025 | 2156 | 24777 | 16326 | 12485 | 12996 | 12111 | 8626 | 1734 | 3255 |
| | 362 | 2520 | 12855 | 73045 | 49583 | 1300 | 622 | 910 | 104 | 898 | 9636 | 40955 | 22852 | 1576 | 1001 | 337 | 29 | 2581 |
| | 373 | 2520 | 1336 | 22575 | 1400 | 750 | 0 | 70 | 130 | 50 | 9722 | 26255 | 4114 | 254 | 0 | 39 | 49 | 26 |
| | 374 | 931 | 879 | 20754 | nf | 819 | 1034 | 57 | 65 | 43 | 2501 | 9699 | nf | 1102 | 2414 | 15 | 27 | 45 |
| | 383 | 674 | 530 | 530 | nf | 0 | 0 | 47 | 0 | 0 | 216 | 164 | nf | 0 | 0 | 54 | 0 | 0 |
| 51-100 | 359 | 421 | 702 | 0 | 497 | 88 | 0 | 29 | 52 | 29 | 39 | 0 | 156 | 39 | 0 | 12 | 36 | 25 |
| | 377 | 100 | 243 | nf | 493 | 0 | 7 | 7 | 12 | 0 | 122 | nf | 257 | 0 | 13 | 11 | 11 | 0 |
| | 382 | 647 | 210 | 359 | 270 | 494 | 0 | 0 | 33 | 0 | 129 | 73 | 115 | 168 | 0 | 0 | 93 | 0 |
| 101-150 | 358 | 225 | 766 | 1500 | 5063 | 47 | 94 | 56 | 14 | 15 | 404 | 430 | 2464 | 45 | 51 | 61 | 10 | 80 |
| | 378 | 139 | 550 | 2046 | 1602 | 48 | 10 | 10 | 0 | 17 | 362 | 635 | 461 | 12 | 11 | 8 | 0 | 21 |
| | 381 | 182 | nf | 0 | nf | 202 | 0 | 0 | 233 | 8 | nf | 0 | nf | 119 | 0 | 0 | 118 | 5 |
| 151-200 | 357 | 164 | 683 | 399 | 194 | 1526 | 57 | 20 | 39 | 0 | 370 | 205 | 120 | 629 | 42 | 46 | 19 | 0 |
| | 379 | 106 | 213 | nf | 596 | 655 | 81 | 33 | 52 | 79 | 318 | nf | 317 | 240 | 96 | 20 | 27 | 108 |
| | 380 | 116 | nf | 798 | nf | 48 | 16 | 57 | 24 | 16 | nf | 117 | nf | 32 | 10 | 26 | 12 | 10 |
| total strata fished <= 200 fathoms | | | 91783 | 670348 | 443490 | 17924 | 11729 | 14478 | 3359 | 4092 | 92723 | 249323 | 164303 | 28741 | 26189 | 17781 | 3290 | 7988 |
| 1 std | | | 29227 | 355442 | 286249 | 4041 | 3576 | 3221 | 1328 | 757 | 25023 | 64135 | 91007 | 7956 | 7249 | 4298 | 1185 | 1681 |
| 201-300 | 723 | 155 | nf | 0 | nf | 97 | 0 | 0 | 43 | 6 | nf | 0 | nf | 63 | 0 | 0 | 24 | 18 |
| | 725 | 105 | nf | nf | 0 | 80 | 0 | 12 | 22 | 0 | nf | nf | 0 | 90 | 0 | 10 | 13 | 0 |
| | 727 | 160 | nf | nf | nf | 878 | 11 | 9 | 267 | 0 | nf | nf | nf | 484 | 12 | 3 | 97 | 0 |
| 301-400 | 724 | 124 | nf | 0 | nf | 17 | 0 | 0 | 19 | 0 | nf | 0 | nf | 12 | 0 | 0 | 40 | 0 |
| | 726 | 72 | nf | nf | nf | 0 | 0 | 0 | 10 | 0 | nf | nf | nf | 0 | 0 | 0 | 15 | 0 |
| | 728 | 156 | nf | nf | nf | nf | 0 | 0 | 76 | 0 | nf | nf | nf | nf | 0 | 0 | 34 | 0 |
| Total strata > 200 fathoms | | | 0 | 0 | 0 | 1072 | 11 | 21 | 437 | 6 | 0 | 0 | 0 | 649 | 12 | 13 | 223 | 18 |
| Total all strata fished | | | 91783 | 670348 | 443490 | 18996 | 11741 | 14498 | 3795 | 4098 | 92723 | 249323 | 16303 | 29389 | 26200 | 17793 | 3510 | 8006 |
| 1 std | | | 29227 | 355442 | 286251 | 4137 | 3575 | 3221 | 1375 | 757 | 25023 | 64135 | 125400 | 7972 | 8397 | 4299 | 1186 | 1681 |

[1] Note the fall index has not been filled for missing strata .

nf strata not fished.

Table 14. Abundance (000's) and biomass (%) of cod form autumn stratified random surveys in Division 3O.

| Depth Range | Strata | Area | Abundance WT 101-102 | WT 113-115 | WT 128-130 | WT 144-146 | WT 160-161 | WT 176-177 | WT 200 Tel 41-42 AN 253 | WT 212-214 | Biomass WT 101-102 | WT 113-115 | WT 128-130 | WT 144-146 | WT 160-161 | WT 176-177 | WT 200 Tel 41-42 AN 253 | WT 212-214 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mean survey date | | | 1990 26-Nov-90 | 1991 24-Oct-91 | 1992 23-Oct-92 | 1993 27-Oct-93 | 1994 31-Oct-94 | 1995 10-Oct-95 | 1996 10-Dec-96 | 1997 16-Oct-97 | 1990 26-Nov-90 | 1991 24-Oct-91 | 1992 23-Oct-92 | 1993 27-Oct-93 | 1994 31-Oct-94 | 1995 10-Oct-95 | 1996 10-Dec-96 | 1997 16-Oct-97 |
| 31-50 | 330 | 2089 | 10709 | 10264 | 7036 | 5271 | 2072 | 3946 | 279 | 1006 | 6651 | 2374 | 2574 | 4278 | 1928 | 6035 | 302 | 1779 |
| | 331 | 456 | 507 | 6682 | 222 | 222 | 95 | 760 | 32 | 31 | 27 | 1047 | 191 | 267 | 172 | 1455 | 11 | 85 |
| | 338 | 1898 | 20199 | 10334 | 857 | 6221 | 330 | 2478 | 264 | 52 | 13966 | 7122 | 2760 | 3763 | 91 | 5283 | 26 | 167 |
| | 340 | 1716 | 4158 | 5625 | 7746 | 1859 | 763 | 1668 | 95 | 519 | 3635 | 6247 | 6711 | 1231 | 832 | 3149 | 37 | 951 |
| | 351 | 2520 | 29085 | 24185 | 3558 | 10450 | 661 | 2709 | 198 | 1684 | 17027 | 21473 | 3142 | 9895 | 679 | 5052 | 74 | 4806 |
| | 352 | 2580 | 10248 | 24761 | 2747 | 4710 | 717 | 972 | 287 | 1006 | 21151 | 32262 | 3137 | 4920 | 4775 | 3195 | 1353 | 3220 |
| | 353 | 1282 | 1781 | 223 | 0 | 0 | 0 | 415 | 0 | 0 | 4593 | 56 | 0 | 0 | 0 | 2238 | 0 | 0 |
| 51-100 | 329 | 1721 | 531 | 1605 | 558 | 239 | 1036 | 574 | 478 | 95 | 1291 | 1019 | 109 | 245 | 1546 | 1052 | 370 | 159 |
| | 332 | 1047 | 1721 | 1127 | 436 | 2036 | 242 | 0 | 0 | 48 | 767 | 74 | 254 | 1323 | 452 | 0 | 0 | 0 |
| | 337 | 948 | 1001 | 66 | 198 | 307 | 0 | 0 | 0 | 0 | 2331 | 70 | 373 | 176 | 0 | 0 | 0 | 0 |
| | 339 | 585 | 163 | 0 | 41 | 528 | 41 | 41 | 0 | 80 | 1242 | 0 | 64 | 447 | 56 | 46 | 0 | 276 |
| | 354 | 474 | 1580 | 0 | 1712 | 0 | 0 | 165 | 340 | 130 | 66 | 0 | 896 | 0 | 0 | 161 | 260 | 96 |
| 101-150 | 333 | 151 | 21 | 0 | 10 | 0 | 0 | 0 | nf | 0 | 12 | 0 | 12 | 0 | 0 | 0 | nf | 0 |
| | 336 | 121 | 6 | 0 | 0 | 67 | 0 | 0 | 8 | 0 | 29 | 0 | 0 | 107 | 0 | 0 | 11 | 0 |
| | 355 | 103 | nf | 887 | 64 | 172 | 0 | 13 | 342 | 0 | nf | 155 | 31 | 104 | 0 | 15 | 235 | 0 |
| 151-200 | 334 | 92 | 13 | 0 | 0 | 9 | 0 | 0 | nf | 0 | 16 | 0 | 0 | 21 | 0 | 0 | nf | 0 |
| | 335 | 58 | 12 | 4 | 0 | 0 | 0 | 0 | 133 | 12 | 13 | 8 | 0 | 0 | 0 | 0 | 303 | 16 |
| | 356 | 61 | nf | 4 | 0 | 102 | 0 | 0 | 40 | 0 | nf | 8 | 0 | 68 | 0 | 0 | 39 | 0 |
| Total strata fished <= 200 fathoms | | | 81735 | 85767 | 25185 | 32193 | 5957 | 13741 | 2496 | 4663 | 72817 | 71915 | 20254 | 26845 | 10531 | 27681 | 3021 | 11555 |
| 1 std | | | 17121 | 15463 | 6229 | 7605 | 2162 | 2367 | 562 | 916 | 11789 | 12726 | 4404 | 7412 | 3158 | 6346 | 1387 | 2467 |
| 201-300 | 717 | 93 | 0 | nf | nf | 0 | 0 | 0 | nf | 0 | 0 | nf | nf | 0 | 0 | 0 | nf | 0 |
| | 719 | 76 | 0 | 0 | nf | 0 | 5 | 0 | 37 | 0 | 0 | 0 | nf | 0 | 14 | 0 | 55 | 0 |
| | 721 | 76 | nf | 0 | nf | 0 | 0 | 0 | 0 | 0 | nf | 0 | nf | 0 | 0 | 0 | 0 | 0 |
| 301-400 | 718 | 111 | nf | nf | nf | 0 | 0 | 0 | nf | 0 | nf | nf | nf | 0 | 0 | 0 | nf | 0 |
| | 720 | 105 | nf | nf | nf | 0 | 0 | 0 | 0 | 0 | nf | nf | nf | 0 | 0 | 0 | 0 | 0 |
| | 722 | 93 | nf | 0 | nf | 0 | 0 | 0 | 0 | 0 | nf | 0 | nf | 0 | 0 | 0 | 0 | 0 |
| total strata fished > 200 fathoms | | | 0 | 0 | 0 | 0 | 5 | 0 | 37 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 55 | 0 |
| total all strata fished | | | 81735 | 85767 | 25185 | 32193 | 5961 | 13740 | 2534 | 4663 | 72817 | 7195 | 20254 | 26845 | 10546 | 27681 | 3078 | 11555 |
| 1 STD | | | 17574 | 15471 | 6229 | 7605 | 2163 | 2368 | 561 | 916 | 11789 | 43649 | 4404 | 7412 | 3158 | 6346 | 1386 | 2467 |

[1] Note the fall index has not been filled for missing strata.
nf strata not fished.

Table 15. Mean number per tow of cod from spring RV surveys in NAFO Divisions 3NO as calculated using the conversion from Warren 1997 for surveys in 1984-1995. 1996 and 1997 are actual Campelen surveys.

| | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.16 | 0.37 | 0.38 | 5 | 0.18 | 0.38 | 0.9 | 0.57 | 0 | 0 | 0 | 0 | 0.1 | 0.06 |
| 2 | 53.39 | 9.88 | 12.77 | 54.15 | 26.45 | 4.77 | 7.25 | 147.62 | 10.07 | 1.17 | 0.22 | 0.76 | 1.35 | 0.24 |
| 3 | 41.57 | 29.27 | 3.63 | 14.13 | 12.91 | 10.39 | 6.77 | 15.44 | 9.66 | 58.27 | 0.91 | 0.2 | 1.65 | 1.67 |
| 4 | 21.35 | 16.14 | 17.87 | 19.67 | 1.02 | 2.4 | 3.8 | 1.59 | 0.24 | 53.63 | 1.63 | 0.04 | 0.44 | 0.58 |
| 5 | 7.17 | 2.76 | 11.53 | 50.35 | 0.47 | 0.34 | 1.46 | 0.47 | 0.11 | 1.25 | 1.05 | 0.15 | 0.24 | 0.16 |
| 6 | 5.04 | 0.9 | 2.11 | 26.41 | 1.1 | 0.31 | 0.25 | 0.16 | 0.09 | 0.68 | 0.07 | 0.1 | 0.57 | 0.03 |
| 7 | 1.51 | 1.03 | 0.82 | 7.38 | 1.13 | 0.61 | 0.41 | 0.07 | 0.03 | 0.46 | 0.12 | 0.01 | 0.56 | 0.09 |
| 8 | 0.72 | 0.66 | 0.58 | 1.71 | 0.66 | 0.52 | 0.52 | 0.06 | 0.03 | 0.22 | 0.07 | 0.02 | 0.05 | 0.07 |
| 9 | 1.36 | 0.84 | 0.42 | 1.63 | 0.67 | 0.36 | 0.61 | 0.14 | 0.08 | 0.05 | 0.07 | 0.05 | 0.04 | 0.01 |
| 10 | 1.15 | 1.18 | 0.61 | 0.54 | 0.75 | 0.4 | 0.46 | 0.12 | 0.11 | 0.08 | 0.02 | 0.01 | 0.03 | 0.02 |
| 11 | 0.61 | 0.88 | 1.02 | 0.7 | 0.35 | 0.51 | 0.34 | 0.11 | 0.13 | 0.17 | 0.04 | 0.01 | 0.02 | 0.03 |
| 12 | 0.25 | 0.48 | 0.51 | 0.6 | 0.44 | 0.33 | 0.34 | 0.09 | 0.14 | 0.12 | 0.05 | 0.02 | 0 | 0.02 |
| 13 | 0.1 | 0.23 | 0.31 | 0.68 | 0.69 | 0.27 | 0.16 | 0.12 | 0.12 | 0.07 | 0.07 | 0.05 | 0 | 0.01 |
| 14 | 0.03 | 0.14 | 0.15 | 0.23 | 0.55 | 0.39 | 0.37 | 0.13 | 0.1 | 0.07 | 0.02 | 0.02 | 0.03 | 0 |
| 15 | 0.05 | 0.08 | 0.08 | 0.21 | 0.21 | 0.21 | 0.44 | 0.12 | 0.09 | 0.09 | 0.03 | 0.03 | 0.02 | 0.01 |
| 16 | 0.08 | 0.08 | 0.04 | 0.12 | 0.11 | 0.11 | 0.22 | 0.18 | 0.09 | 0.05 | 0.01 | 0.02 | 0 | 0 |
| 17 | 0.05 | 0.03 | 0.04 | 0 | 0.11 | 0.09 | 0.14 | 0.07 | 0.06 | 0.02 | 0 | 0 | 0.01 | 0 |
| 18 | 0.01 | 0.01 | 0.03 | 0.01 | 0.04 | 0.04 | 0.06 | 0.04 | 0.01 | 0.01 | 0.03 | 0 | 0 | 0.01 |
| 19 | 0 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.05 | 0 | 0.01 | 0.01 | 0.01 | 0 | 0 | 0 |
| 1+ | 134.6 | 64.98 | 52.93 | 183.54 | 47.87 | 22.46 | 24.55 | 167.1 | 21.17 | 116.42 | 4.42 | 1.49 | 5.11 | 3.01 |

Table 16. Mean number per tow of cod from autumn RV surveys in NAFO Divisions 3NO as calculated using the conversion from Warren 1997 for surveys in 1984-1994. 1995 -1997 are actual Campelen surveys.

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|
| 1 | 18.89 | 14.87 | 0.41 | 1.30 | 0.00 | 1.15 | 0.08 | 0.03 |
| 2 | 6.15 | 129.66 | 49.65 | 0.72 | 0.62 | 1.02 | 0.74 | 0.10 |
| 3 | 3.25 | 4.36 | 65.00 | 3.63 | 0.28 | 0.46 | 0.29 | 0.40 |
| 4 | 3.56 | 2.19 | 4.70 | 3.59 | 0.96 | 0.20 | 0.06 | 0.33 |
| 5 | 1.73 | 2.73 | 1.02 | 0.30 | 1.32 | 0.94 | 0.01 | 0.14 |
| 6 | 0.37 | 1.33 | 0.61 | 0.27 | 0.16 | 1.64 | 0.02 | 0.06 |
| 7 | 0.29 | 0.37 | 0.18 | 0.18 | 0.04 | 0.11 | 0.02 | 0.28 |
| 8 | 0.38 | 0.31 | 0.03 | 0.10 | 0.06 | 0.05 | 0.01 | 0.28 |
| 9 | 0.40 | 0.53 | 0.03 | 0.02 | 0.01 | 0.06 | 0.00 | 0.05 |
| 10 | 0.24 | 0.37 | 0.07 | 0.02 | 0.01 | 0.05 | 0.00 | 0.04 |
| 11 | 0.20 | 0.45 | 0.00 | 0.06 | 0.03 | 0.00 | 0.00 | 0.00 |
| 12 | 0.09 | 0.33 | 0.06 | 0.04 | 0.03 | 0.02 | 0.00 | 0.00 |
| 13 | 0.15 | 0.27 | 0.12 | 0.04 | 0.02 | 0.02 | 0.01 | 0.00 |
| 14 | 0.07 | 0.21 | 0.03 | 0.05 | 0.06 | 0.00 | 0.01 | 0.01 |
| 15 | 0.16 | 0.12 | 0.03 | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 |
| 16 | 0.21 | 0.38 | 0.02 | 0.02 | 0.03 | 0.00 | 0.01 | 0.01 |
| 17 | 0.07 | 0.16 | 0.03 | 0.01 | 0.02 | 0.00 | 0.00 | 0.00 |
| 18 | 0.02 | 0.06 | 0.08 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 |
| 19 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| 1+ | 36.3 | 158.7 | 122.1 | 10.4 | 3.7 | 5.7 | 1.3 | 1.7 |

Table 17. Mean length-at-age (cm) of cod caught during resource assessment bottom-trawl surveys in Divisions 3N and 3O during the springs of 1972-1997. Entries in shaded cells are based on a sample size of less than 5.

**Division 3N**

| Age | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | | | | | | | | | | | | 15.4 | 15.0 |
| 2 | 22.3 | 22.3 | 22.6 | 24.5 | 22.2 | 22.7 | 24.1 | 25.4 | 24.2 | 26.4 | 25.2 | | 23.1 | 22.2 | 21.8 | 21.2 | 22.2 | 20.3 | 23.7 | 22.5 | 21.6 | 24.5 | | 27.5 | 25.2 | 24.4 |
| 3 | 30.7 | 30.5 | 31.6 | 30.9 | 30.0 | 32.3 | 35.1 | 33.6 | 35.1 | 36.1 | 36.4 | | 28.3 | 31.1 | 30.5 | 33.0 | 31.4 | 32.9 | 30.1 | 33.8 | 31.5 | 32.5 | 30.2 | 29.4 | 32.8 | 38.1 |
| 4 | 39.9 | 37.7 | 39.7 | 43.6 | 38.6 | 41.1 | 43.9 | 44.6 | 44.8 | 48.7 | 45.5 | | 41.0 | 38.8 | 38.4 | 41.7 | 44.4 | 42.6 | 41.3 | 37.5 | 43.8 | 41.2 | 38.9 | 36.6 | 41.6 | 44.6 |
| 5 | 49.8 | 48.4 | 48.2 | 50.9 | 57.6 | 51.0 | 55.7 | 53.9 | 56.0 | 57.2 | 56.5 | | 49.3 | 51.6 | 45.7 | 48.6 | 51.9 | 51.6 | 52.1 | 48.6 | 48.7 | 48.2 | 45.7 | 45.8 | 46.6 | 49.4 |
| 6 | 61.9 | 57.8 | 58.1 | 61.1 | 62.5 | 60.7 | 67.2 | 62.7 | 63.4 | 66.2 | 67.3 | | 61.5 | 58.4 | 59.6 | 53.9 | 60.5 | 62.9 | 61.2 | 57.7 | 59.2 | 53.0 | 56.5 | 53.8 | 50.1 | 56.3 |
| 7 | 71.4 | 65.4 | 67.3 | 74.2 | 68.5 | 65.5 | 75.7 | 74.6 | 70.7 | 75.9 | 74.5 | | 69.3 | 70.7 | 74.6 | 60.3 | 68.4 | 66.6 | 68.9 | 65.5 | 59.9 | 59.2 | 65.5 | | 78.8 | 62.9 |
| 8 | 79.0 | 72.1 | 74.3 | 80.5 | | 74.5 | 78.1 | 87.0 | 83.2 | 85.3 | 87.2 | | 79.4 | 85.3 | 85.4 | 74.0 | 78.1 | 72.4 | 72.9 | 80.0 | 82.9 | 64.3 | | | | 74.9 |
| 9 | 87.3 | 84.0 | 88.2 | 86.6 | | 83.7 | 83.8 | 88.2 | 97.7 | 95.2 | 93.9 | | 89.4 | 96.0 | 98.4 | 83.5 | 90.6 | 82.0 | 78.8 | 76.6 | 74.9 | 85.3 | 98.1 | | | 89.6 |
| 10 | 96.1 | 90.7 | 87.2 | 88.5 | 102.0 | 96.0 | 103.0 | 106.0 | 99.8 | 103.9 | 101.1 | | 96.5 | 100.1 | 103.9 | 92.0 | 91.5 | 94.4 | 93.9 | 92.2 | 79.0 | 99.0 | | | | |
| 11 | 94.3 | 87.8 | 95.4 | 78.0 | | 106.0 | | 114.4 | 104.0 | 112.0 | 108.2 | | 100.3 | 102.0 | 105.4 | 95.9 | 100.3 | 99.7 | 106.2 | 101.4 | 81.0 | 106.5 | | | | |
| 12 | 102.8 | 97.1 | 101.8 | | | 103.7 | 113.4 | | 117.0 | 119.9 | 108.0 | | 106.5 | 108.5 | 108.0 | 103.2 | 108.5 | 112.7 | 108.9 | 107.0 | 109.0 | 94.2 | | | | |

**Division 3O**

| Age | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | | | | | | | | | | | | 13.3 | 14.7 |
| 2 | | 22.1 | | 22.6 | 22.2 | 18.6 | 22.6 | 24.6 | 22.0 | 22.2 | 21.3 | | 20.8 | 20.3 | 22.2 | 20.0 | 22.6 | 21.1 | 22.2 | 20.6 | 21.0 | 25.0 | 20.0 | 24.6 | 24.6 | 21.8 |
| 3 | | 30.7 | | 30.7 | 32.7 | 26.6 | 34.8 | 34.0 | 30.4 | 34.6 | 32.7 | | 31.7 | 30.8 | 32.8 | 30.9 | 30.8 | 31.7 | 28.7 | 29.2 | 30.0 | 31.3 | 32.3 | 31.1 | 30.7 | 33.0 |
| 4 | | 37.8 | | 41.5 | 42.3 | | 44.1 | 44.2 | 42.3 | 45.6 | 43.9 | | 41.3 | 36.6 | 39.3 | 40.0 | 39.9 | 39.3 | 39.0 | 38.6 | 34.8 | 39.6 | 38.9 | 40.4 | 39.0 | 39.6 |
| 5 | | 44.5 | | 48.6 | 52.6 | | 53.9 | 51.6 | 55.3 | 51.6 | 56.2 | | 49.7 | 49.6 | 45.0 | 46.9 | 51.2 | 49.5 | 49.0 | 50.2 | 50.1 | 49.7 | 48.1 | 50.3 | 48.0 | 51.2 |
| 6 | | 61.0 | | 60.6 | 64.4 | 70.5 | 62.6 | 61.2 | 64.1 | 60.2 | 64.3 | | 61.6 | 57.1 | 52.8 | 53.1 | 56.8 | 58.7 | 56.7 | 56.2 | 58.9 | 56.2 | 58.9 | 60.1 | 56.0 | 58.7 |
| 7 | | 74.2 | | 92.5 | 69.5 | 74.1 | 73.9 | 69.3 | 82.9 | 64.6 | 74.6 | | 69.5 | 73.4 | 60.0 | 64.5 | 67.7 | 66.7 | 64.6 | 62.3 | 65.5 | 67.9 | 61.9 | 68.5 | 67.0 | 61.6 |
| 8 | | 81.7 | | 76.7 | 75.6 | 85.8 | 97.5 | 80.7 | 83.5 | 73.0 | 82.9 | | 79.4 | 84.5 | 80.4 | 71.2 | 79.2 | 77.2 | 73.0 | 82.7 | 88.7 | 77.9 | 75.4 | 84.0 | 74.3 | 76.1 |
| 9 | | 87.1 | | 104.3 | 88.2 | 74.8 | 96.0 | 89.4 | 93.6 | 88.9 | 92.4 | | 89.6 | 92.9 | 89.4 | 82.1 | 87.9 | 91.3 | 82.1 | 88.0 | 95.8 | 90.7 | 86.7 | 82.5 | 70.1 | 89.5 |
| 10 | | 100.0 | | 107.4 | 100.0 | 82.7 | 103.0 | | 98.4 | 89.4 | 106.3 | | 95.2 | 96.6 | 96.1 | 89.4 | 91.8 | 94.7 | 89.3 | 94.0 | 94.9 | 93.7 | 85.0 | 84.6 | 82.3 | 93.3 |
| 11 | | 98.0 | | | 84.0 | | 113.8 | 108.5 | 97.4 | 108.0 | 103.8 | | 100.2 | 101.1 | 99.9 | 85.7 | 95.1 | 100.5 | 95.4 | 101.0 | 100.7 | 96.3 | 95.0 | 99.5 | 101.1 | 100.7 |
| 12 | | 105.8 | | 114.0 | | 106.0 | | | 106.9 | 97.4 | 112.5 | | 104.5 | 104.7 | 103.7 | 102.1 | 104.3 | 101.6 | 100.8 | 106.6 | 107.4 | 97.6 | 100.5 | 102.7 | | 92.6 |

**Divisions 3N and 3O combined**

| Age | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | | | | | | | | | | | | 14.1 | 14.8 |
| 2 | | 22.1 | | 23.8 | 22.2 | 22.3 | 23.2 | 24.9 | 23.2 | 25.2 | 23.9 | | 22.8 | 22.2 | 21.8 | 20.7 | 22.5 | 20.8 | 23.2 | 20.9 | 21.2 | 24.3 | 20.0 | 24.3 | 24.7 | 22.3 |
| 3 | | 30.6 | | 30.8 | 32.5 | 33.1 | 35.0 | 33.9 | 33.0 | 35.9 | 35.1 | | 29.2 | 31.0 | 31.9 | 31.9 | 31.1 | 32.2 | 29.2 | 31.0 | 30.5 | 31.4 | 32.2 | 30.9 | 31.2 | 35.9 |
| 4 | | 37.7 | | 42.4 | 42.4 | 41.1 | 44.0 | 44.3 | 44.0 | 48.2 | 44.6 | | 41.2 | 38.2 | 39.2 | 40.6 | 41.2 | 40.3 | 39.9 | 38.1 | 37.8 | 39.7 | 38.9 | 39.7 | 39.4 | 43.4 |
| 5 | | 46.7 | | 49.7 | 53.2 | 51.0 | 55.0 | 51.8 | 55.8 | 55.9 | 56.3 | | 49.5 | 50.7 | 45.1 | 47.5 | 51.4 | 50.5 | 50.3 | 49.7 | 49.1 | 49.5 | 48.0 | 48.4 | 47.6 | 50.1 |
| 6 | | 58.8 | | 61.0 | 64.2 | 61.2 | 65.1 | 61.4 | 63.6 | 64.7 | 65.4 | | 61.5 | 57.5 | 53.5 | 53.3 | 58.0 | 60.7 | 59.3 | 56.4 | 59.1 | 55.8 | 58.8 | 59.3 | 55.7 | 57.5 |
| 7 | | 69.6 | | 74.6 | 69.1 | 66.5 | 75.0 | 70.3 | 79.6 | 72.1 | 74.6 | | 69.4 | 72.5 | 62.3 | 63.3 | 67.8 | 66.6 | 67.0 | 63.1 | 62.4 | 65.9 | 62.0 | 68.5 | 67.3 | 62.1 |
| 8 | | 76.0 | | 79.5 | 75.6 | 77.0 | 82.3 | 83.3 | 83.4 | 81.0 | 85.1 | | 79.4 | 84.8 | 81.2 | 71.5 | 79.0 | 75.0 | 73.0 | 82.6 | 83.5 | 75.9 | 75.4 | 84.0 | 74.3 | 75.8 |
| 9 | | 85.8 | | 94.3 | 89.2 | 82.9 | 87.7 | 89.1 | 94.6 | 93.1 | 93.3 | | 89.5 | 94.1 | 93.6 | 82.3 | 88.4 | 89.2 | 80.8 | 87.3 | 91.9 | 90.1 | 86.8 | 82.5 | 70.1 | 89.5 |
| 10 | | 92.6 | | 100.6 | 100.7 | 94.4 | 103.0 | 109.0 | 98.6 | 99.2 | 102.3 | | 95.9 | 97.8 | 99.9 | 90.1 | 91.7 | 94.6 | 91.5 | 93.5 | 94.6 | 93.5 | 85.0 | 84.0 | 82.3 | 91.8 |
| 11 | | 90.6 | | 78.0 | 94.0 | 106.0 | 113.9 | 109.8 | 98.6 | 105.9 | 106.3 | | 100.3 | 101.5 | 103.2 | 87.4 | 96.5 | 100.3 | 99.1 | 101.1 | 100.5 | 96.6 | 95.0 | 90.5 | 101.1 | 100.7 |
| 12 | | 104.8 | | 114.0 | | 104.2 | 125.4 | | 108.0 | 109.6 | 111.5 | | 105.6 | 106.1 | 106.1 | 102.3 | 106.1 | 105.1 | 103.9 | 106.9 | 106.9 | 97.4 | 100.5 | 102.7 | | 92.6 |

Table 18. Proportion mature at age of female Atlantic cod (Gadus morhua) in NAFO Div. 3NO (1975-1997). A50=median age at maturity (years); L95% and U95%=lower and upper 95% confidence intervals. Parameter estimates of the logit model are shown: Int=intercept; SE=standard error; n=sample size; period=no fish sampled. Data are from spring RV surveys, are unconverted (Engels trawl prior to 1996, Campelen trawl thereafter) and incude all strata fished.

| AGE | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | . | . | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | . | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0 | 0 | . | 0 | 0 | 0 | 0 |
| 4 | 0 | 0.03 | 0 | 0 | 0.02 | 0 | 0.07 | 0.00 | . | 0 | 0 | 0 | 0 |
| 5 | 0 | 0.05 | 0.08 | 0.07 | 0.06 | 0.13 | 0.53 | 0.10 | . | 0.05 | 0.04 | 0.04 | 0.11 |
| 6 | 0.56 | 0.48 | 0.19 | 0.39 | 0.48 | 0.47 | 0.47 | 0.48 | . | 0.56 | 0.37 | 0.17 | 0.34 |
| 7 | 0.97 | 1 | 0.62 | 0.81 | 0.89 | 0.84 | 0.87 | 0.96 | . | 0.88 | 0.93 | 0.56 | 0.75 |
| 8 | 0.98 | 1 | 0.89 | 1 | 1 | 0.84 | 1 | 1 | . | 0.96 | 1 | 1 | 0.87 |
| 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.89 | . | 1 | 1 | 1 | 0.94 |
| 10 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | . | 1 | 1 | 1 | 1 |
| 11 | | 1 | | | 1 | 1 | 1 | 1 | . | 1 | 0.99 | 1 | 1 |
| 12 | 1 | | 1 | 1 | | 1 | 0.78 | 1 | . | 1 | 1 | 1 | 1 |
| 13 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | . | 1 | 1 | 1 | 1 |
| A50 | 5.98 | 6.09 | 6.74 | 6.24 | 6.06 | 6.14 | 5.73 | 6.00 | . | 5.98 | 6.17 | 6.70 | 6.45 |
| L 95% | 5.73 | 5.72 | 6.44 | 6.03 | 5.87 | 5.92 | 5.42 | 5.78 | . | 5.86 | 6.02 | 6.51 | 6.23 |
| U 95% | 6.19 | 6.93 | 7.15 | 6.55 | 6.30 | 6.42 | 6.09 | 6.23 | . | 6.11 | 6.33 | 6.90 | 6.69 |
| Slope | 3.50 | 2.34 | 1.70 | 2.25 | 2.32 | 1.69 | 1.24 | 2.46 | . | 2.48 | 2.74 | 2.22 | 1.49 |
| SE | 0.74 | 0.62 | 0.27 | 0.34 | 0.29 | 0.21 | 0.15 | 0.30 | . | 0.27 | 0.27 | 0.24 | 0.15 |
| Int | -20.90 | -14.26 | -11.48 | -14.08 | -14.05 | -10.37 | -7.12 | -14.78 | . | -14.86 | -16.90 | -14.90 | -9.62 |
| SE | 4.48 | 3.38 | 1.68 | 2.00 | 1.66 | 1.20 | 0.83 | 1.81 | . | 1.63 | 1.66 | 1.60 | 0.98 |
| n | 244 | 184 | 270 | 297 | 471 | 440 | 290 | 481 | . | 648 | 810 | 606 | 535 |

cont'd:-

Table 18. 3NO female cod maturities by age (cont'd.)

| AGE | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 0 | 0 | | | | | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0.01 | 0.03 | 0.07 | 0 | 0.01 | 0 | 0 | 0.07 | 0.34 |
| 5 | 0.09 | 0.20 | 0.03 | 0.30 | 0.35 | 0.43 | 0.30 | 0.44 | 0.53 | 0.25 |
| 6 | 0.28 | 0.85 | 0.61 | 0.41 | 0.58 | 0.48 | 0.62 | 0.85 | 0.98 | 1 |
| 7 | 0.50 | 0.95 | 0.87 | 0.84 | 1 | 0.97 | 0.79 | 0.7 | 1 | 1 |
| 8 | 0.93 | 0.98 | 0.85 | 1 | 1 | 0.97 | 1 | 1 | 1 | 1 |
| 9 | 0.98 | 1 | 1 | 1 | 1 | 0.84 | 1 | 1 | 1 | 1 |
| 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | . | 1 | 1 |
| 11 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | . | . | . |
| 13 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | . | 1 |
| A50 | 6.75 | 5.59 | 6.24 | 5.82 | 5.59 | 5.71 | 5.73 | 5.19 | 4.90 | 4.85 |
| L 95% | 6.47 | 5.34 | 5.97 | 5.51 | 5.25 | 5.45 | 5.42 | 4.65 | 4.70 | 4.56 |
| U 95% | 7.02 | 5.83 | 6.51 | 6.22 | 5.98 | 5.97 | 6.12 | 5.58 | 5.12 | 5.23 |
| Slope | 1.65 | 2.34 | 1.69 | 1.5 | 2.24 | 1.82 | 1.62 | 1.76 | 3.21 | 2.01 |
| SE | 0.22 | 0.28 | 0.18 | 0.21 | 0.43 | 0.22 | 0.27 | 0.51 | 0.49 | 0.30 |
| Int | -11.16 | -13.06 | -10.56 | -8.74 | -12.51 | -10.41 | -9.27 | -9.14 | -15.74 | -9.73 |
| SE | 1.53 | 1.64 | 1.14 | 1.12 | 2.39 | 1.27 | 1.47 | 2.74 | 2.39 | 1.34 |
| n | 409 | 567 | 552 | 379 | 268 | 318 | 188 | 76 | 303 | 233 |

Table 19. Model predicted proportion mature at age for female cod in Divisions 3NO from Canadian spring surveys.

| | OGIVE | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [1] | 1959 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1960 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1961 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1962 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1963 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1964 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1965 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1966 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1967 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1968 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1969 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1970 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1971 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1972 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1973 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| [1] | 1974 | 0.0001 | 0.0043 | 0.0616 | 0.3824 | 0.8056 | 0.9657 | 0.9965 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| | 1975 | 0.0000 | 0.0000 | 0.0230 | 0.4722 | 0.9683 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | 1976 | 0.0002 | 0.0075 | 0.0894 | 0.3997 | 0.7985 | 0.9730 | 0.9987 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | 1977 | 0.0002 | 0.0050 | 0.0518 | 0.2488 | 0.6069 | 0.8889 | 0.9850 | 0.9991 | 1.0000 | 1.0000 | 1.0000 |
| | 1978 | 0.0000 | 0.0018 | 0.0541 | 0.3821 | 0.8430 | 0.9897 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | 1979 | 0.0002 | 0.0070 | 0.0896 | 0.4091 | 0.8114 | 0.9770 | 0.9991 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | 1980 | 0.0015 | 0.0211 | 0.1347 | 0.4298 | 0.7737 | 0.9534 | 0.9954 | 0.9998 | 1.0000 | 1.0000 | 1.0000 |
| | 1981 | 0.0318 | 0.1141 | 0.2895 | 0.5378 | 0.7718 | 0.9184 | 0.9796 | 0.9965 | 0.9996 | 1.0000 | 1.0000 |
| | 1982 | 0.0001 | 0.0053 | 0.0935 | 0.4665 | 0.8752 | 0.9915 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| [2] | 1983 | 0.0001 | 0.0053 | 0.0935 | 0.4665 | 0.8752 | 0.9915 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | 1984 | 0.0000 | 0.0013 | 0.0666 | 0.5010 | 0.9340 | 0.9987 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | 1985 | 0.0000 | 0.0017 | 0.0513 | 0.3702 | 0.8340 | 0.9884 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | 1986 | 0.0000 | 0.0017 | 0.0327 | 0.2258 | 0.6321 | 0.9233 | 0.9941 | 0.9999 | 1.0000 | 1.0000 | 1.0000 |
| | 1987 | 0.0012 | 0.0154 | 0.1014 | 0.3490 | 0.6907 | 0.9168 | 0.9884 | 0.9992 | 1.0000 | 1.0000 | 1.0000 |
| | 1988 | 0.0003 | 0.0059 | 0.0550 | 0.2482 | 0.5940 | 0.8761 | 0.9809 | 0.9986 | 1.0000 | 1.0000 | 1.0000 |
| | 1989 | 0.0004 | 0.0192 | 0.2114 | 0.6795 | 0.9586 | 0.9987 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | 1990 | 0.0011 | 0.0166 | 0.1156 | 0.3960 | 0.7485 | 0.9456 | 0.9944 | 0.9997 | 1.0000 | 1.0000 | 1.0000 |
| | 1991 | 0.0070 | 0.0565 | 0.2381 | 0.5637 | 0.8493 | 0.9717 | 0.9973 | 0.9999 | 1.0000 | 1.0000 | 1.0000 |
| | 1992 | 0.0001 | 0.0128 | 0.2059 | 0.7223 | 0.9773 | 0.9997 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | 1993 | 0.0002 | 0.0147 | 0.2066 | 0.7058 | 0.9713 | 0.9994 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | 1994 | 0.0120 | 0.0576 | 0.2356 | 0.6087 | 0.8870 | 0.9754 | 0.9950 | 0.9990 | 0.9998 | 1.0000 | 1.0000 |
| | 1995 | 0.0207 | 0.1094 | 0.4168 | 0.8061 | 0.9603 | 0.9930 | 0.9988 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | 1996 | 0.0022 | 0.0520 | 0.5757 | 0.9711 | 0.9988 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1 |
| | 1997 | 0.0239 | 0.1541 | 0.5755 | 0.9098 | 0.9869 | 0.9982 | 0.9998 | 1 | 1 | 1 | 1 |

[1] Ogive for 1959 - 74 calculated as the mean of 1975-79

[2] Ogive for 1983 is the 1982 ogive

TABLE 20. Estimated survivors and catchabilities from ADAPT using Canadian spring and fall campelen data .

| | | LN(Q) | STD ERR | REL ERR | BIAS | REL BIAS |
|---|---|---|---|---|---|---|
| | 3 | -6.424 | 0.4055 | -0.06312 | -0.02787 | 0.004338 |
| FALL | 4 | -6.561 | 0.4152 | -0.06328 | -0.02169 | 0.003306 |
| | 5 | -6.834 | 0.4044 | -0.05917 | -0.02188 | 0.003201 |
| | 6 | -6.865 | 0.4101 | -0.05974 | -0.01877 | 0.002735 |
| | 7 | -7.308 | 0.412 | -0.05638 | -0.0151 | 0.002066 |
| | 8 | -7.367 | 0.4094 | -0.05557 | -0.0102 | 0.001385 |
| | 9 | -7.582 | 0.4071 | -0.05369 | -0.004004 | 0.0005281 |
| | 10 | -7.28 | 0.407 | -0.05591 | 0.003186 | -0.000438 |
| | 11 | -5.65 | 0.4487 | -0.07941 | 0.01097 | -0.001942 |
| | 3 | -6.619 | 0.2689 | -0.04062 | -0.01204 | 0.001819 |
| SPRING | 4 | -7.456 | 0.2667 | -0.03577 | -0.009582 | 0.001285 |
| | 5 | -8.062 | 0.2676 | -0.03319 | -0.007989 | 0.0009909 |
| | 6 | -8.288 | 0.2681 | -0.03235 | -0.008059 | 0.0009724 |
| | 7 | -8.173 | 0.2682 | -0.03281 | -0.007006 | 0.0008572 |
| | 8 | -8.215 | 0.2688 | -0.03272 | -0.004797 | 0.0005839 |
| | 9 | -7.73 | 0.268 | -0.03467 | -0.002771 | 0.0003584 |
| | 10 | -7.46 | 0.2678 | -0.0359 | 0.000107 | -1.43E-05 |
| | 11 | -7.044 | 0.2701 | -0.03835 | 0.0004799 | -6.81E-05 |

| Terminal Age | year-class run in June 98 PAR. | STD. ERR. | REL. ERR. | BIAS | REL.BIAS |
|---|---|---|---|---|---|
| 4 | 246 | 184 | 0.75 | 69 | 0.28 |
| 5 | 708 | 575 | 0.81 | 229 | 0.32 |
| 6 | 1777 | 1117 | 0.63 | 332 | 0.19 |
| 7 | 151 | 102 | 0.67 | 32 | 0.21 |
| 8 | 179 | 107 | 0.6 | 31 | 0.17 |
| 9 | 159 | 87 | 0.55 | 24 | 0.15 |
| 10 | 68 | 36 | 0.53 | 9 | 0.13 |
| 11 | 24 | 12 | 0.51 | 3 | 0.12 |
| 12 | 19 | 10 | 0.53 | 2 | 0.13 |
| 13 | 0 | 0 | 0.37 | 0 | 0 |

Table 21. Estimated bias adjusted population numbers from ADAPT for cod in Divisions 3NO.

| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 53221 | 93006 | 19268 | 16254 | 11749 | 4059 | 2806 | 3438 | 2276 | 337 | 0 |
| 1960 | 52468 | 42029 | 64404 | 11223 | 7912 | 6091 | 2076 | 1617 | 1983 | 777 | 184 |
| 1961 | 81291 | 41291 | 28554 | 32966 | 6410 | 4344 | 2747 | 1176 | 976 | 822 | 419 |
| 1962 | 106639 | 65822 | 29840 | 12916 | 13365 | 3441 | 2060 | 1489 | 786 | 777 | 453 |
| 1963 | 77754 | 86382 | 50388 | 22441 | 9150 | 7715 | 2122 | 1088 | 831 | 441 | 442 |
| 1964 | 111141 | 63377 | 65530 | 31174 | 14012 | 5751 | 2892 | 701 | 350 | 392 | 175 |
| 1965 | 160094 | 85398 | 37911 | 36155 | 18409 | 9426 | 3711 | 1660 | 281 | 253 | 220 |
| 1966 | 207082 | 130159 | 63055 | 24184 | 17726 | 6291 | 3415 | 2068 | 261 | 85 | 82 |
| 1967 | 181104 | 168864 | 89979 | 33969 | 9278 | 6940 | 1208 | 1167 | 211 | 105 | 19 |
| 1968 | 99474 | 130171 | 82330 | 28905 | 11329 | 3341 | 1567 | 776 | 793 | 109 | 45 |
| 1969 | 119062 | 66714 | 55832 | 24223 | 7283 | 3638 | 1315 | 830 | 476 | 568 | 49 |
| 1970 | 79306 | 95935 | 42993 | 21664 | 9839 | 4088 | 1731 | 613 | 418 | 269 | 284 |
| 1971 | 83263 | 63030 | 60822 | 25496 | 9264 | 4790 | 1884 | 932 | 368 | 140 | 140 |
| 1972 | 61009 | 67312 | 27555 | 22775 | 10426 | 4451 | 1694 | 1093 | 583 | 211 | 70 |
| 1973 | 34417 | 49887 | 37342 | 11581 | 6713 | 3303 | 2134 | 1131 | 701 | 407 | 107 |
| 1974 | 35973 | 19150 | 16284 | 17066 | 4144 | 3727 | 1832 | 1114 | 707 | 450 | 229 |
| 1975 | 22551 | 23669 | 7205 | 3682 | 4335 | 1393 | 1143 | 597 | 312 | 199 | 140 |
| 1976 | 27314 | 17857 | 11515 | 2752 | 800 | 851 | 209 | 129 | 84 | 35 | 29 |
| 1977 | 45008 | 18712 | 7883 | 4129 | 1283 | 465 | 483 | 131 | 73 | 57 | 20 |
| 1978 | 39909 | 36301 | 13095 | 4184 | 2037 | 539 | 222 | 208 | 50 | 23 | 24 |
| 1979 | 17247 | 31844 | 25813 | 8456 | 2690 | 1349 | 350 | 130 | 125 | 33 | 14 |
| 1980 | 19586 | 14055 | 22623 | 12884 | 4427 | 1411 | 866 | 234 | 91 | 91 | 21 |
| 1981 | 27228 | 15795 | 10556 | 15090 | 8500 | 2939 | 955 | 626 | 164 | 67 | 63 |
| 1982 | 21191 | 21836 | 11948 | 7505 | 10286 | 5249 | 1890 | 609 | 428 | 97 | 43 |
| 1983 | 34404 | 17074 | 16094 | 8349 | 5233 | 7045 | 2958 | 1014 | 310 | 205 | 55 |
| 1984 | 40697 | 27103 | 13395 | 11471 | 5751 | 3666 | 4731 | 1727 | 616 | 181 | 131 |
| 1985 | 31809 | 33267 | 21287 | 9695 | 7301 | 3611 | 2354 | 3047 | 920 | 409 | 110 |
| 1986 | 8483 | 25992 | 24574 | 11861 | 5214 | 3720 | 2240 | 1514 | 2015 | 519 | 248 |
| 1987 | 6283 | 6807 | 18698 | 14350 | 5797 | 2912 | 2194 | 1332 | 905 | 1336 | 303 |
| 1988 | 12353 | 4679 | 5192 | 12167 | 8652 | 3655 | 1797 | 1040 | 649 | 385 | 731 |
| 1989 | 12235 | 9863 | 3544 | 2881 | 4306 | 3552 | 2086 | 962 | 471 | 308 | 188 |
| 1990 | 5012 | 8291 | 6113 | 1558 | 1232 | 1839 | 1758 | 1272 | 579 | 235 | 163 |
| 1991 | 5102 | 3147 | 2778 | 1174 | 480 | 631 | 861 | 918 | 648 | 339 | 118 |
| 1992 | 13670 | 3185 | 1971 | 1383 | 475 | 143 | 189 | 202 | 305 | 190 | 98 |
| 1993 | 5208 | 7150 | 1034 | 866 | 585 | 179 | 60 | 67 | 52 | 113 | 67 |
| 1994 | 469 | 3084 | 2987 | 281 | 282 | 193 | 81 | 26 | 20 | 1 | 45 |
| 1995 | 3220 | 177 | 478 | 1445 | 119 | 148 | 135 | 59 | 21 | 16 | 0 |

Table 22. Estimated bias adjusted fishing mortality from ADAPT for cod in Divisions 3NO.

| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 0.036 | 0.167 | 0.34 | 0.52 | 0.457 | 0.471 | 0.351 | 0.35 | 0.874 | 0.407 |
| 1960 | 0.04 | 0.187 | 0.47 | 0.36 | 0.399 | 0.596 | 0.368 | 0.305 | 0.681 | 0.417 |
| 1961 | 0.011 | 0.125 | 0.593 | 0.703 | 0.422 | 0.546 | 0.412 | 0.202 | 0.029 | 0.396 |
| 1962 | 0.011 | 0.067 | 0.085 | 0.145 | 0.35 | 0.283 | 0.439 | 0.384 | 0.378 | 0.364 |
| 1963 | 0.004 | 0.076 | 0.28 | 0.271 | 0.264 | 0.781 | 0.908 | 0.935 | 0.551 | 0.722 |
| 1964 | 0.063 | 0.314 | 0.395 | 0.327 | 0.196 | 0.238 | 0.355 | 0.714 | 0.124 | 0.376 |
| 1965 | 0.007 | 0.103 | 0.25 | 0.513 | 0.874 | 0.815 | 0.385 | 1.651 | 0.994 | 0.931 |
| 1966 | 0.004 | 0.169 | 0.419 | 0.758 | 0.738 | 1.45 | 0.874 | 2.082 | 0.714 | 1.286 |
| 1967 | 0.13 | 0.518 | 0.936 | 0.898 | 0.821 | 1.288 | 0.242 | 0.186 | 0.459 | 0.634 |
| 1968 | 0.199 | 0.647 | 1.023 | 1.178 | 0.936 | 0.733 | 0.436 | 0.29 | 0.133 | 0.599 |
| 1969 | 0.016 | 0.239 | 0.747 | 0.701 | 0.378 | 0.543 | 0.563 | 0.486 | 0.37 | 0.492 |
| 1970 | 0.03 | 0.256 | 0.322 | 0.65 | 0.52 | 0.575 | 0.419 | 0.31 | 0.894 | 0.456 |
| 1971 | 0.013 | 0.627 | 0.782 | 0.694 | 0.533 | 0.839 | 0.344 | 0.269 | 0.354 | 0.496 |
| 1972 | 0.001 | 0.389 | 0.667 | 1.022 | 0.949 | 0.535 | 0.205 | 0.245 | 0.159 | 0.483 |
| 1973 | 0.386 | 0.92 | 0.583 | 0.828 | 0.388 | 0.389 | 0.451 | 0.269 | 0.242 | 0.374 |
| 1974 | 0.219 | 0.777 | 1.287 | 1.17 | 0.891 | 0.982 | 0.921 | 1.073 | 1.068 | 0.967 |
| 1975 | 0.033 | 0.521 | 0.762 | 1.327 | 1.429 | 1.697 | 1.98 | 1.765 | 2.001 | 1.718 |
| 1976 | 0.178 | 0.618 | 0.826 | 0.563 | 0.342 | 0.367 | 0.263 | 0.377 | 0.187 | 0.337 |
| 1977 | 0.015 | 0.157 | 0.433 | 0.507 | 0.667 | 0.538 | 0.64 | 0.774 | 0.952 | 0.655 |
| 1978 | 0.026 | 0.141 | 0.237 | 0.242 | 0.212 | 0.233 | 0.337 | 0.313 | 0.195 | 0.274 |
| 1979 | 0.005 | 0.142 | 0.495 | 0.447 | 0.446 | 0.243 | 0.201 | 0.155 | 0.112 | 0.261 |
| 1980 | 0.015 | 0.086 | 0.205 | 0.216 | 0.21 | 0.19 | 0.124 | 0.157 | 0.102 | 0.17 |
| 1981 | 0.021 | 0.079 | 0.141 | 0.183 | 0.282 | 0.242 | 0.25 | 0.18 | 0.321 | 0.238 |
| 1982 | 0.016 | 0.105 | 0.158 | 0.161 | 0.178 | 0.373 | 0.423 | 0.477 | 0.534 | 0.363 |
| 1983 | 0.039 | 0.043 | 0.139 | 0.173 | 0.156 | 0.198 | 0.338 | 0.298 | 0.338 | 0.248 |
| 1984 | 0.002 | 0.042 | 0.123 | 0.252 | 0.265 | 0.243 | 0.24 | 0.43 | 0.21 | 0.295 |
| 1985 | 0.002 | 0.103 | 0.385 | 0.42 | 0.474 | 0.278 | 0.241 | 0.214 | 0.373 | 0.302 |
| 1986 | 0.02 | 0.129 | 0.338 | 0.516 | 0.383 | 0.328 | 0.319 | 0.315 | 0.211 | 0.336 |
| 1987 | 0.095 | 0.071 | 0.23 | 0.306 | 0.261 | 0.283 | 0.547 | 0.52 | 0.654 | 0.403 |
| 1988 | 0.025 | 0.078 | 0.389 | 0.839 | 0.69 | 0.361 | 0.424 | 0.592 | 0.544 | 0.517 |
| 1989 | 0.189 | 0.278 | 0.622 | 0.649 | 0.651 | 0.503 | 0.295 | 0.309 | 0.495 | 0.439 |
| 1990 | 0.265 | 0.894 | 1.45 | 0.977 | 0.47 | 0.56 | 0.449 | 0.474 | 0.335 | 0.488 |
| 1991 | 0.271 | 0.268 | 0.498 | 0.704 | 1.014 | 1.003 | 1.251 | 0.903 | 1.025 | 1.04 |
| 1992 | 0.448 | 0.925 | 0.623 | 0.66 | 0.774 | 0.673 | 0.841 | 1.161 | 0.791 | 0.847 |
| 1993 | 0.324 | 0.673 | 1.102 | 0.92 | 0.907 | 0.599 | 0.613 | 1.002 | 4.429 | 0.715 |
| 1994 | 0.775 | 1.664 | 0.526 | 0.663 | 0.447 | 0.16 | 0.115 | 0.043 | 0.002 | 0.165 |

Table23. Beginning of year mean weights at age calculated form the commercial catches for cod in Divisions 3NO.

| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 0.301 | 0.664 | 1.001 | 1.622 | 2.572 | 3.129 | 3.670 | 4.419 | 4.843 | 5.691 | 6.689 |
| 1960 | 0.301 | 0.587 | 1.012 | 1.561 | 2.345 | 3.092 | 3.673 | 4.316 | 4.957 | 5.691 | 6.689 |
| 1961 | 0.301 | 0.587 | 1.012 | 1.561 | 2.345 | 3.092 | 3.673 | 4.316 | 4.957 | 5.691 | 6.689 |
| 1962 | 0.301 | 0.587 | 1.012 | 1.561 | 2.345 | 3.092 | 3.673 | 4.316 | 4.957 | 5.691 | 6.689 |
| 1963 | 0.301 | 0.587 | 1.012 | 1.561 | 2.345 | 3.092 | 3.673 | 4.316 | 4.957 | 5.691 | 6.689 |
| 1964 | 0.301 | 0.587 | 1.012 | 1.561 | 2.345 | 3.092 | 3.673 | 4.316 | 4.957 | 5.691 | 6.689 |
| 1965 | 0.301 | 0.587 | 1.012 | 1.561 | 2.345 | 3.092 | 3.673 | 4.316 | 4.957 | 5.691 | 6.689 |
| 1966 | 0.287 | 0.615 | 1.052 | 1.636 | 2.482 | 3.446 | 4.636 | 5.532 | 6.292 | 7.332 | 5.192 |
| 1967 | 0.351 | 0.657 | 1.102 | 1.700 | 2.600 | 3.647 | 5.166 | 6.982 | 8.066 | 9.308 | 11.266 |
| 1968 | 0.351 | 0.657 | 1.102 | 1.700 | 2.600 | 3.647 | 5.166 | 6.982 | 8.066 | 9.308 | 11.266 |
| 1969 | 0.351 | 0.657 | 1.102 | 1.700 | 2.600 | 3.647 | 5.166 | 6.982 | 8.066 | 9.308 | 11.266 |
| 1970 | 0.351 | 0.657 | 1.102 | 1.700 | 2.600 | 3.647 | 5.166 | 6.982 | 8.066 | 9.308 | 11.266 |
| 1971 | 0.351 | 0.657 | 1.102 | 1.700 | 2.600 | 3.647 | 5.166 | 6.982 | 8.066 | 9.308 | 11.266 |
| 1972 | 0.338 | 0.682 | 1.138 | 1.676 | 2.487 | 3.354 | 5.005 | 7.100 | 7.999 | 9.262 | 11.321 |
| 1973 | 0.397 | 0.735 | 1.178 | 1.776 | 2.748 | 3.658 | 4.717 | 7.542 | 9.423 | 10.789 | 9.530 |
| 1974 | 0.504 | 0.645 | 1.095 | 1.674 | 2.503 | 4.117 | 5.822 | 5.842 | 8.961 | 9.159 | 21.369 |
| 1975 | 0.289 | 0.611 | 0.967 | 1.599 | 2.481 | 3.449 | 5.082 | 7.024 | 5.364 | 7.717 | 7.308 |
| 1976 | 0.246 | 0.588 | 1.120 | 1.727 | 2.631 | 3.557 | 5.268 | 6.952 | 7.849 | 8.113 | 6.196 |
| 1977 | 0.354 | 0.707 | 1.161 | 1.870 | 2.860 | 3.925 | 5.375 | 7.666 | 10.112 | 10.239 | 15.236 |
| 1978 | 0.420 | 0.774 | 1.245 | 1.825 | 3.046 | 4.023 | 5.417 | 7.200 | 9.139 | 12.271 | 10.721 |
| 1979 | 0.617 | 0.840 | 1.208 | 1.800 | 2.541 | 3.720 | 4.679 | 6.653 | 7.596 | 9.790 | 16.919 |
| 1980 | 0.514 | 0.822 | 1.287 | 1.864 | 2.777 | 3.969 | 5.434 | 6.618 | 8.706 | 10.031 | 10.189 |
| 1981 | 0.531 | 0.950 | 1.383 | 2.132 | 2.979 | 4.435 | 6.256 | 8.522 | 9.114 | 10.373 | 15.330 |
| 1982 | 0.789 | 1.026 | 1.380 | 2.012 | 3.210 | 4.321 | 6.318 | 7.921 | 9.453 | 10.519 | 9.794 |
| 1983 | 0.843 | 1.049 | 1.479 | 1.986 | 2.891 | 4.463 | 5.743 | 7.779 | 8.894 | 10.398 | 14.503 |
| 1984 | 0.731 | 0.989 | 1.329 | 2.065 | 2.828 | 3.923 | 5.473 | 6.728 | 8.490 | 10.647 | 11.385 |
| 1985 | 0.757 | 0.824 | 1.255 | 1.759 | 2.722 | 3.760 | 5.178 | 6.923 | 8.128 | 9.964 | 15.959 |
| 1986 | 0.331 | 0.696 | 1.143 | 1.720 | 2.675 | 4.193 | 6.080 | 8.063 | 9.094 | 9.508 | 13.029 |
| 1987 | 0.269 | 0.566 | 1.146 | 1.668 | 2.498 | 4.076 | 6.267 | 8.435 | 9.835 | 11.187 | 8.726 |
| 1988 | 0.343 | 0.700 | 1.064 | 1.525 | 2.020 | 3.301 | 4.937 | 7.067 | 9.158 | 10.442 | 15.180 |
| 1989 | 0.646 | 0.847 | 1.265 | 1.758 | 2.419 | 3.206 | 5.166 | 6.523 | 8.072 | 10.714 | 11.438 |
| 1990 | 0.362 | 0.718 | 1.190 | 2.004 | 2.473 | 3.679 | 4.811 | 7.698 | 8.786 | 10.322 | 14.539 |
| 1991 | 0.442 | 0.684 | 1.267 | 1.832 | 3.101 | 3.896 | 5.583 | 6.737 | 10.014 | 11.396 | 11.106 |
| 1992 | 0.506 | 0.598 | 0.949 | 1.692 | 2.547 | 4.310 | 5.560 | 7.480 | 8.838 | 11.295 | 17.303 |
| 1993 | 0.215 | 0.507 | 0.937 | 1.397 | 2.253 | 3.404 | 5.336 | 6.569 | 8.081 | 8.655 | 13.105 |
| 1994 | 0.318 | 0.407 | 0.842 | 1.483 | 1.840 | 3.375 | 4.506 | 6.653 | 5.167 | 8.130 | 9.246 |
| 1995 | 0.326 | 0.229 | 0.520 | 0.983 | 1.791 | 1.840 | 4.836 | 5.416 | 8.546 | 2.290 | 24.690 |

Table 24. Spawner biomass for cod in Divisions 3NO

| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Campelen |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1959 | 2 | 263 | 1187 | 10078 | 24345 | 12264 | 10263 | 15189 | 11022 | 1918 | 0 | 86531 |
| 1960 | 2 | 105 | 4015 | 6700 | 14947 | 18187 | 7599 | 6977 | 9829 | 4422 | 1231 | 74015 |
| 1961 | 3 | 103 | 1780 | 19680 | 12110 | 12970 | 10055 | 5075 | 4838 | 4678 | 2803 | 74095 |
| 1962 | 4 | 165 | 1860 | 7711 | 25249 | 10274 | 7541 | 6425 | 3896 | 4422 | 3030 | 70577 |
| 1963 | 3 | 216 | 3141 | 13397 | 17286 | 23036 | 7768 | 4695 | 4119 | 2510 | 2956 | 79127 |
| 1964 | 4 | 158 | 4085 | 18611 | 26471 | 17172 | 10586 | 3025 | 1735 | 2231 | 1171 | 85249 |
| 1965 | 6 | 213 | 2364 | 21584 | 34778 | 28145 | 13584 | 7163 | 1393 | 1440 | 1472 | 112141 |
| 1966 | 7 | 341 | 4085 | 15125 | 35449 | 20933 | 15777 | 11439 | 1642 | 623 | 426 | 105847 |
| 1967 | 8 | 473 | 6108 | 22078 | 19437 | 24445 | 6219 | 8147 | 1702 | 977 | 214 | 89807 |
| 1968 | 4 | 364 | 5588 | 18786 | 23734 | 11768 | 8068 | 5417 | 6396 | 1015 | 507 | 81648 |
| 1969 | 5 | 187 | 3790 | 15743 | 15258 | 12814 | 6770 | 5794 | 3839 | 5287 | 552 | 70040 |
| 1970 | 3 | 269 | 2918 | 14080 | 20613 | 14399 | 8912 | 4279 | 3372 | 2504 | 3200 | 74548 |
| 1971 | 4 | 176 | 4128 | 16571 | 19408 | 16872 | 9700 | 6506 | 2968 | 1303 | 1577 | 79214 |
| 1972 | 2 | 196 | 1932 | 14593 | 20888 | 14417 | 8449 | 7758 | 4663 | 1954 | 792 | 75646 |
| 1973 | 2 | 156 | 2708 | 7864 | 14860 | 11668 | 10031 | 8528 | 6606 | 4391 | 1020 | 67835 |
| 1974 | 2 | 53 | 1098 | 10925 | 8355 | 14819 | 10628 | 6506 | 6336 | 4122 | 4894 | 67738 |
| 1975 | 0 | 0 | 160 | 2780 | 10413 | 4804 | 5809 | 4193 | 1674 | 1536 | 1023 | 32392 |
| 1976 | 1 | 79 | 1153 | 1900 | 1681 | 2946 | 1099 | 897 | 659 | 284 | 180 | 10878 |
| 1977 | 3 | 66 | 474 | 1921 | 2227 | 1622 | 2557 | 1003 | 738 | 584 | 305 | 11501 |
| 1978 | 0 | 51 | 882 | 2917 | 5230 | 2146 | 1202 | 1498 | 457 | 282 | 257 | 14922 |
| 1979 | 2 | 187 | 2794 | 6226 | 5547 | 4903 | 1636 | 865 | 949 | 323 | 237 | 23670 |
| 1980 | 15 | 244 | 3922 | 10323 | 9512 | 5340 | 4684 | 1548 | 792 | 913 | 214 | 37506 |
| 1981 | 460 | 1711 | 4227 | 17303 | 19544 | 11970 | 5853 | 5316 | 1494 | 695 | 966 | 69540 |
| 1982 | 2 | 119 | 1542 | 7044 | 28895 | 22489 | 11941 | 4824 | 4046 | 1020 | 421 | 82343 |
| 1983 | 3 | 95 | 2226 | 7736 | 13242 | 31173 | 16986 | 7888 | 2757 | 2132 | 798 | 85035 |
| 1984 | 0 | 35 | 1186 | 11867 | 15188 | 14363 | 25892 | 11620 | 5230 | 1927 | 1491 | 88798 |
| 1985 | 0 | 47 | 1371 | 6315 | 16575 | 13419 | 12186 | 21093 | 7478 | 4075 | 1755 | 84314 |
| 1986 | 0 | 31 | 919 | 4607 | 8815 | 14402 | 13539 | 12206 | 18324 | 4935 | 3231 | 81009 |
| 1987 | 2 | 59 | 2173 | 8353 | 10004 | 10881 | 13591 | 11227 | 8901 | 14946 | 2644 | 82779 |
| 1988 | 1 | 19 | 304 | 4607 | 10382 | 10570 | 8702 | 7340 | 5943 | 4020 | 11096 | 62984 |
| 1989 | 3 | 160 | 948 | 3442 | 9986 | 11374 | 10777 | 6275 | 3802 | 3300 | 2150 | 52218 |
| 1990 | 2 | 99 | 841 | 1236 | 2280 | 6398 | 8410 | 9789 | 5087 | 2426 | 2370 | 38938 |
| 1991 | 16 | 122 | 838 | 1213 | 1264 | 2389 | 4794 | 6184 | 6489 | 3863 | 1310 | 28482 |
| 1992 | 1 | 24 | 385 | 1690 | 1182 | 616 | 1051 | 1511 | 2696 | 2146 | 1696 | 12998 |
| 1993 | 0 | 53 | 200 | 854 | 1280 | 609 | 320 | 440 | 420 | 978 | 878 | 6033 |
| 1994 | 2 | 72 | 593 | 254 | 460 | 635 | 363 | 173 | 103 | 8 | 416 | 3080 |
| 1995 | 22 | 4 | 104 | 1145 | 205 | 270 | 652 | 320 | 179 | 37 | 0 | 2937 |

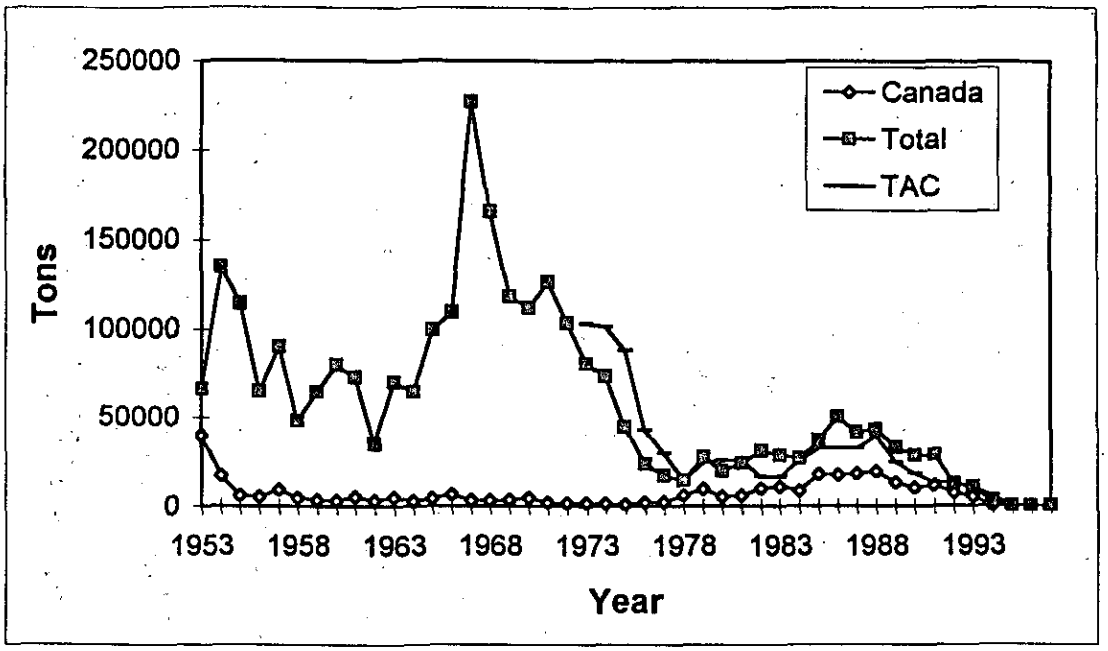



Fig 1. Landings of Cod in NAFO Divisions 3NO from 1953-1996.

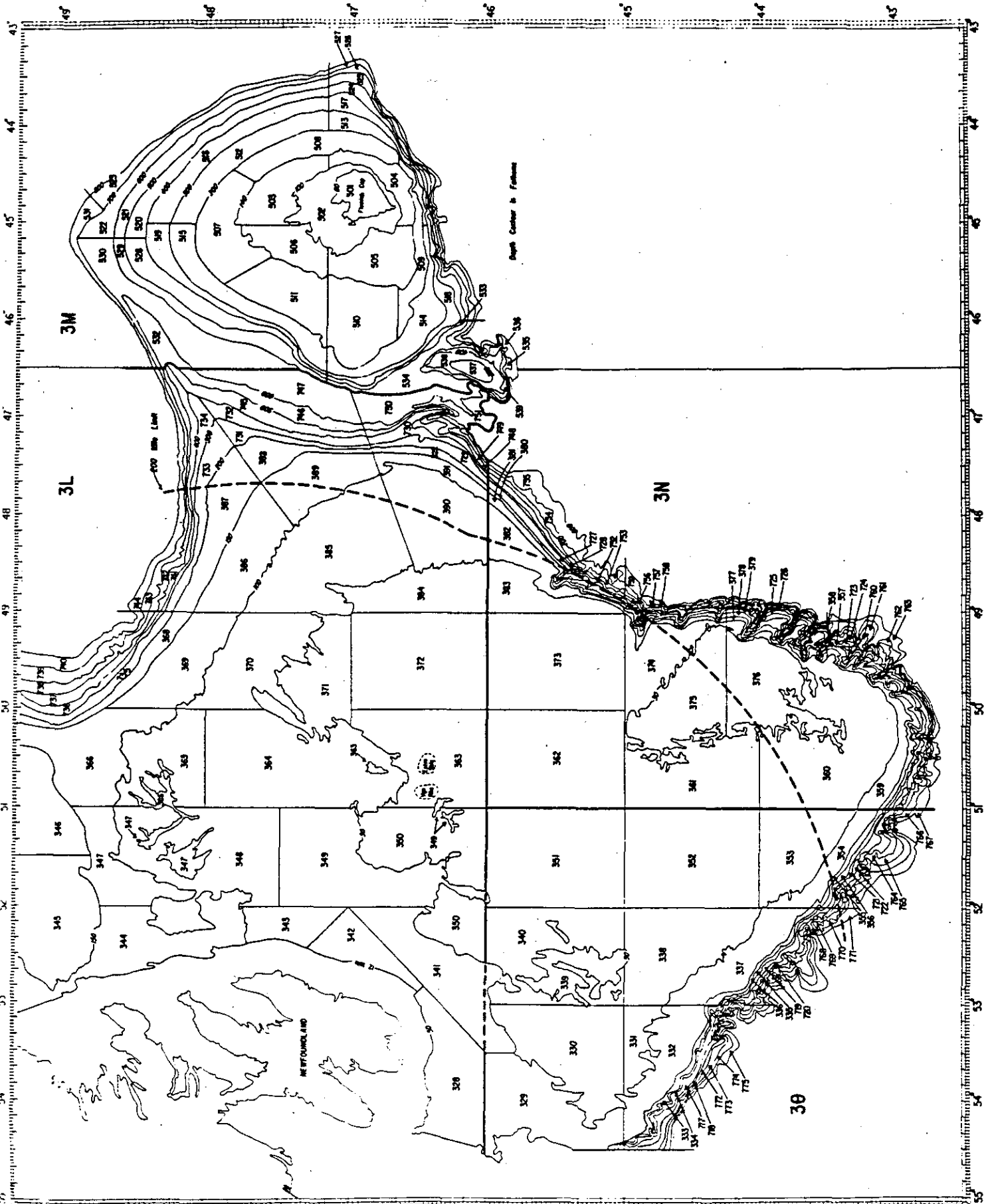



Fig 2. Stratification scheme for Divisions 3LMNO.

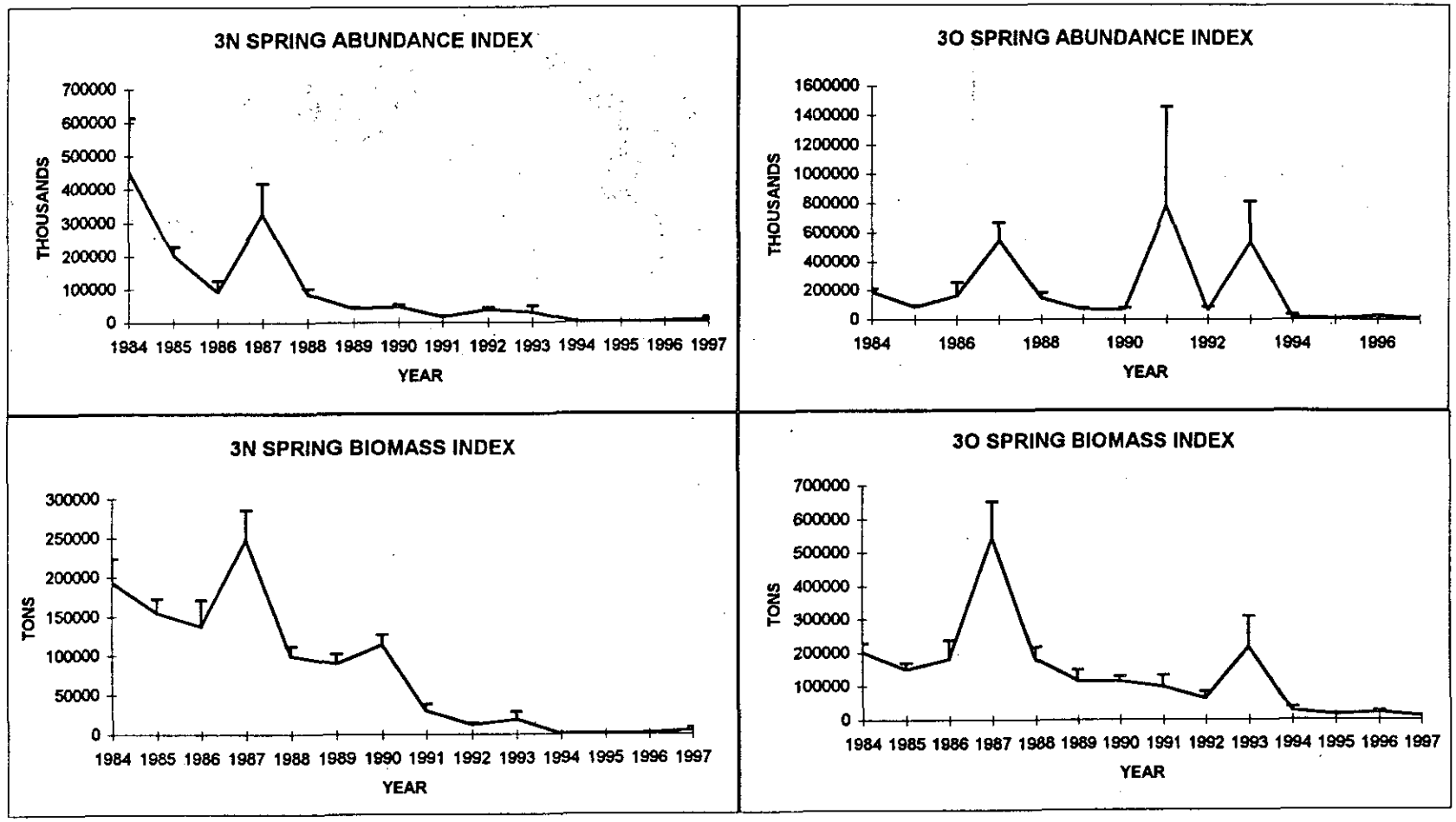



Figure 3. Abundance (000's) and biomass (t) for the Canadian Spring Research Vessel survey series with 1 standard deviation.

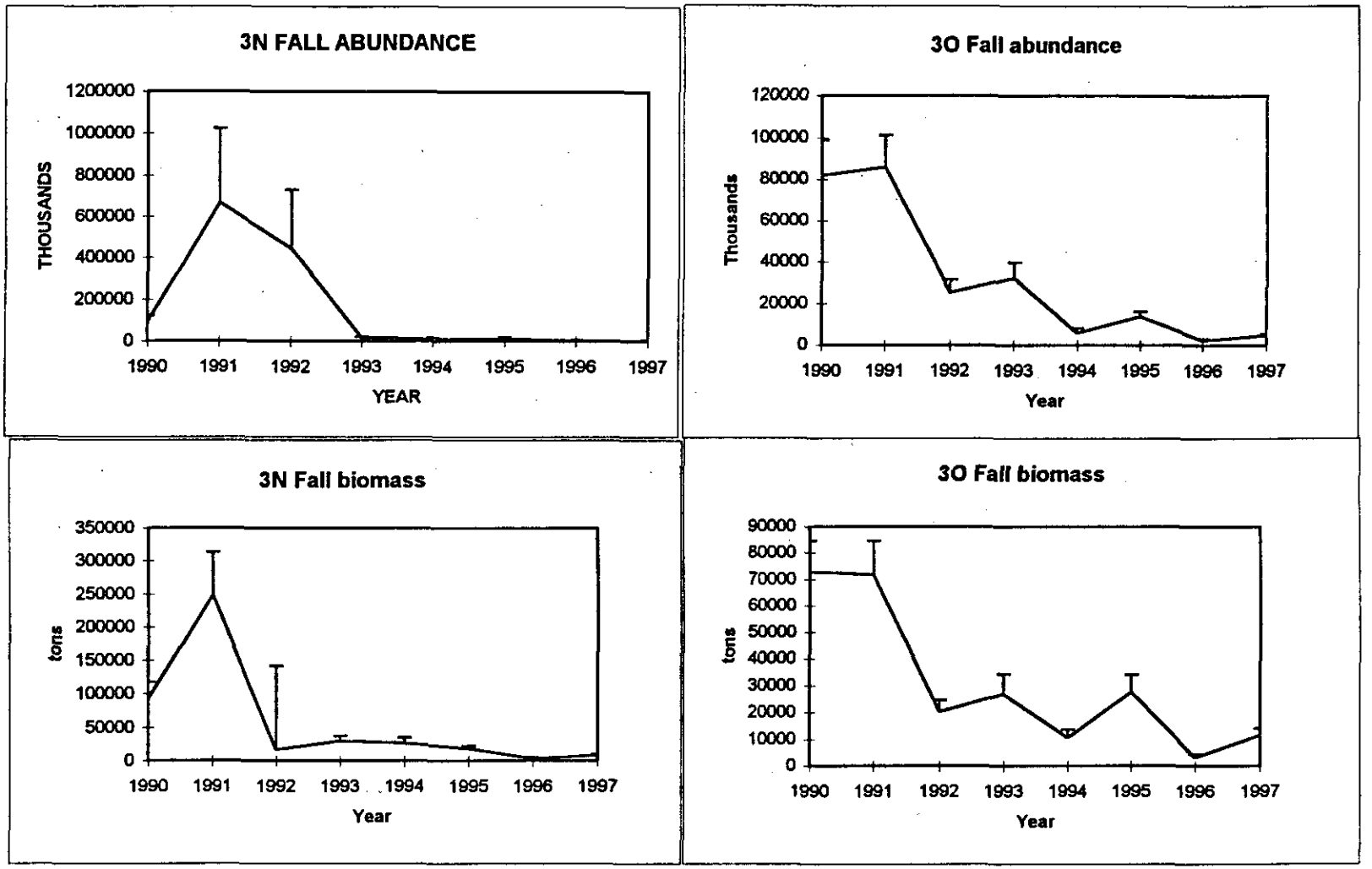
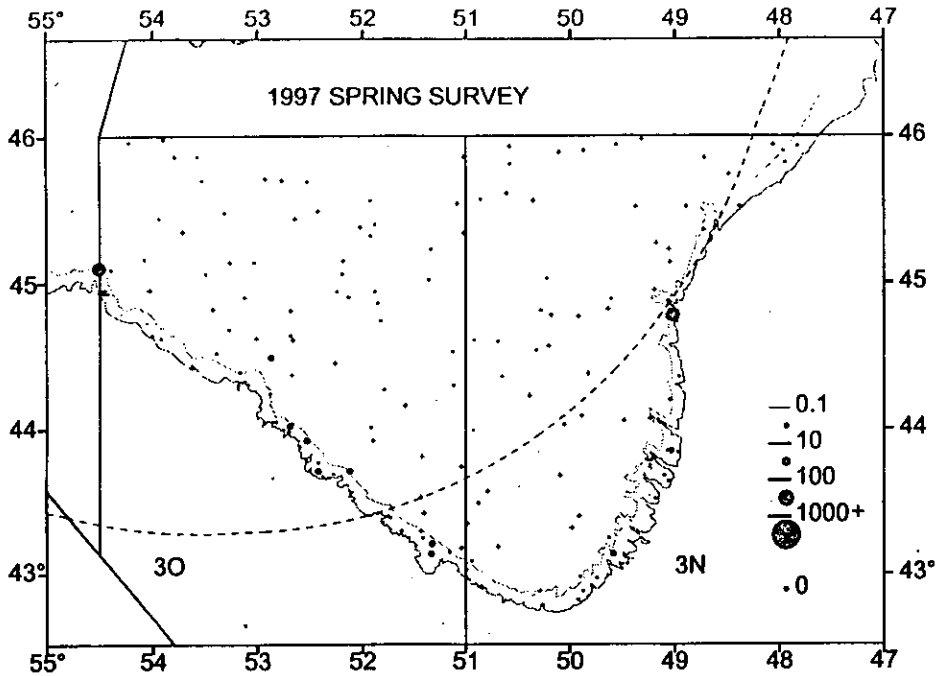
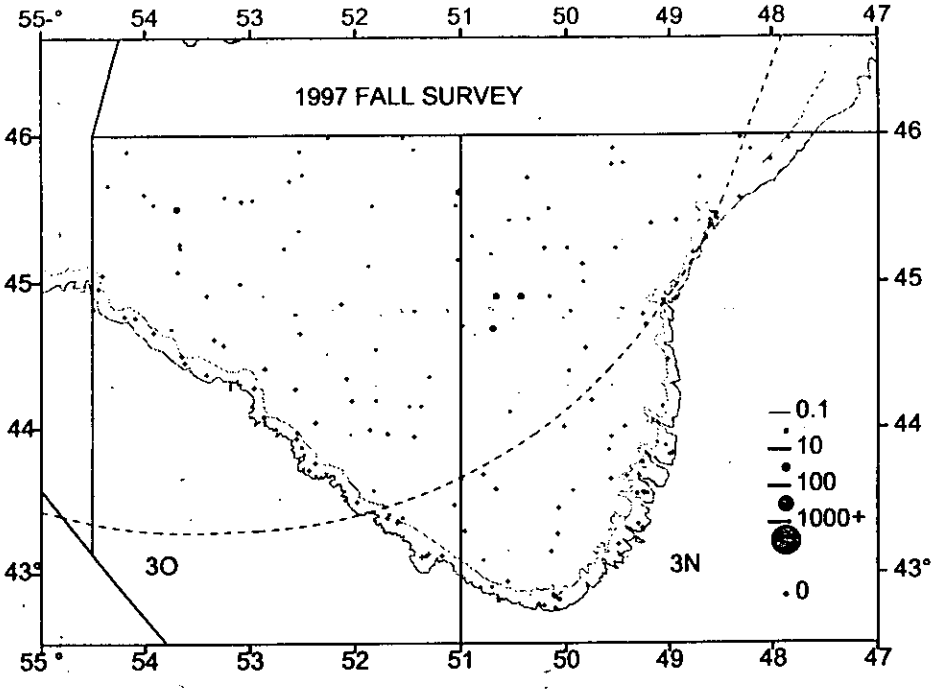



Figure 4. Abundance (000's) and biomass (t) for the Canadian Fall Research Vessel survey series. Vertical bars indicate 1 standard deviation.



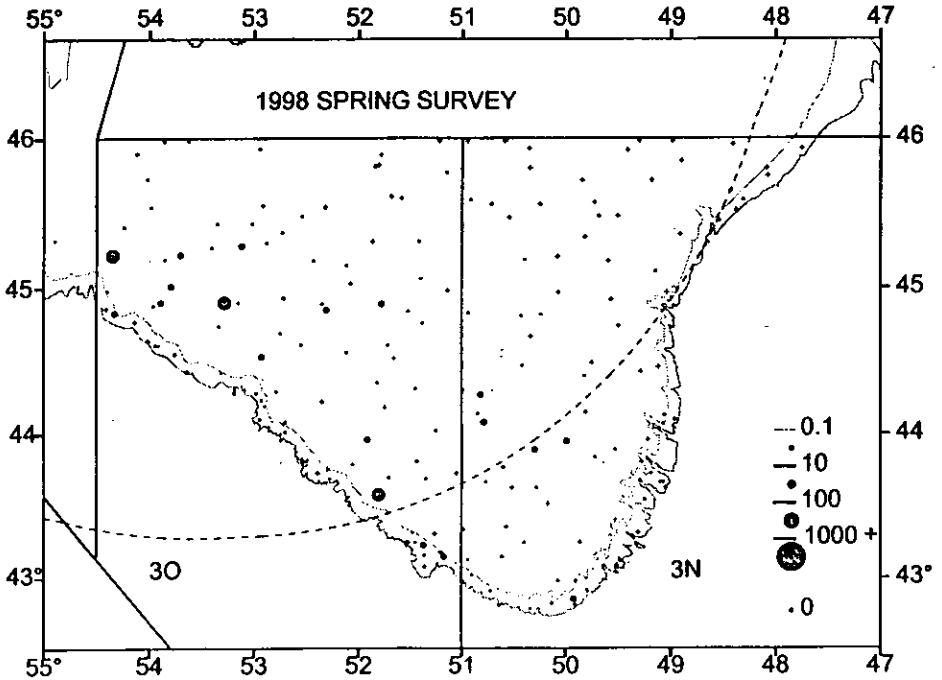




**Fig 5 . Cod distribution number per tow.**

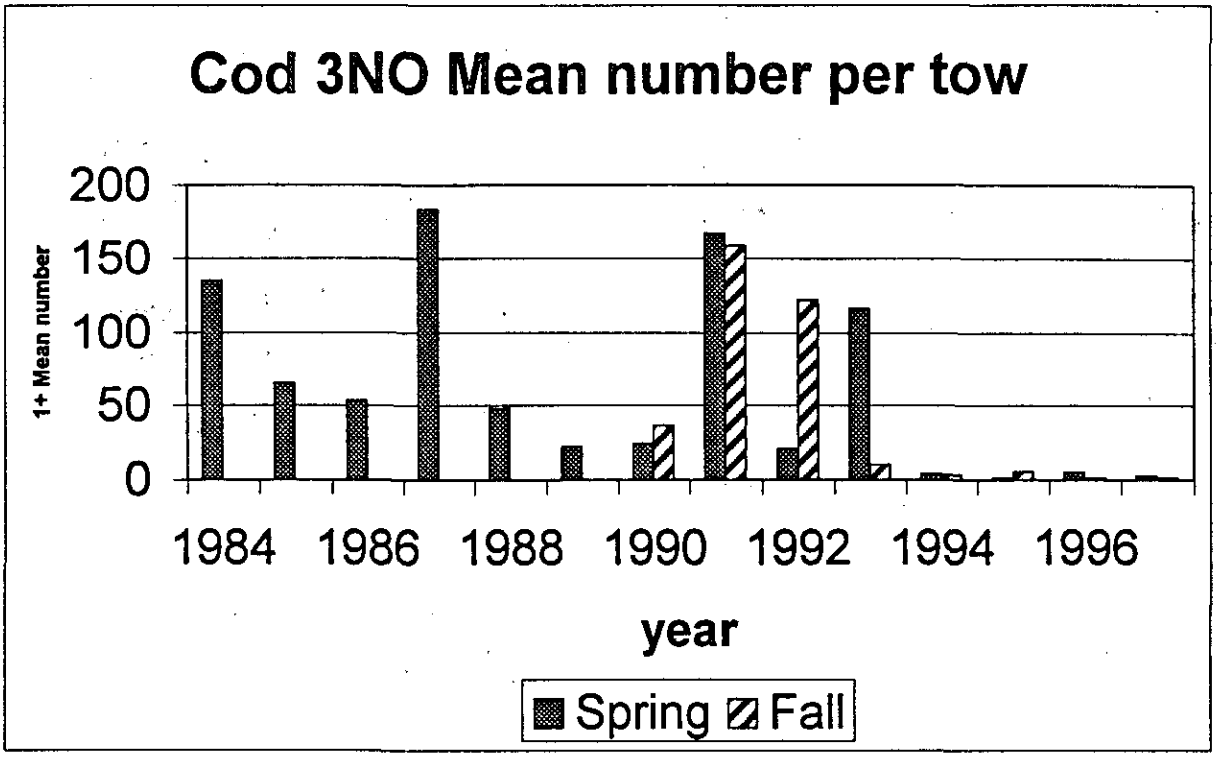



Fig 6. Spring and autumn Canadian RV estimates of 1+ mean number/tow of cod in Divisions 3NO

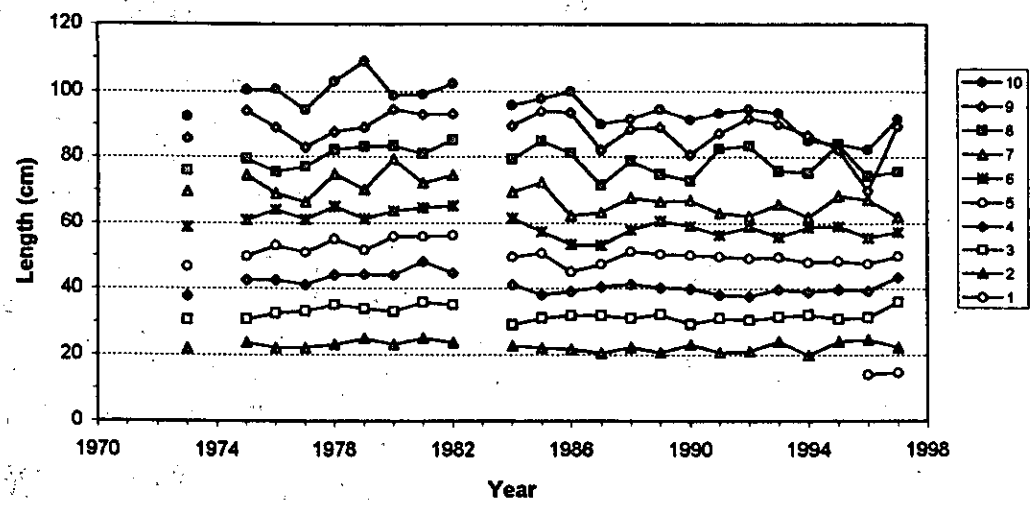



Fig. 7 Mean length at ages 1-10 of cod in Divisions 3N and 3O combined in 1973-1997, as determined from catches and sampling during bottom-trawl surveys in spring.

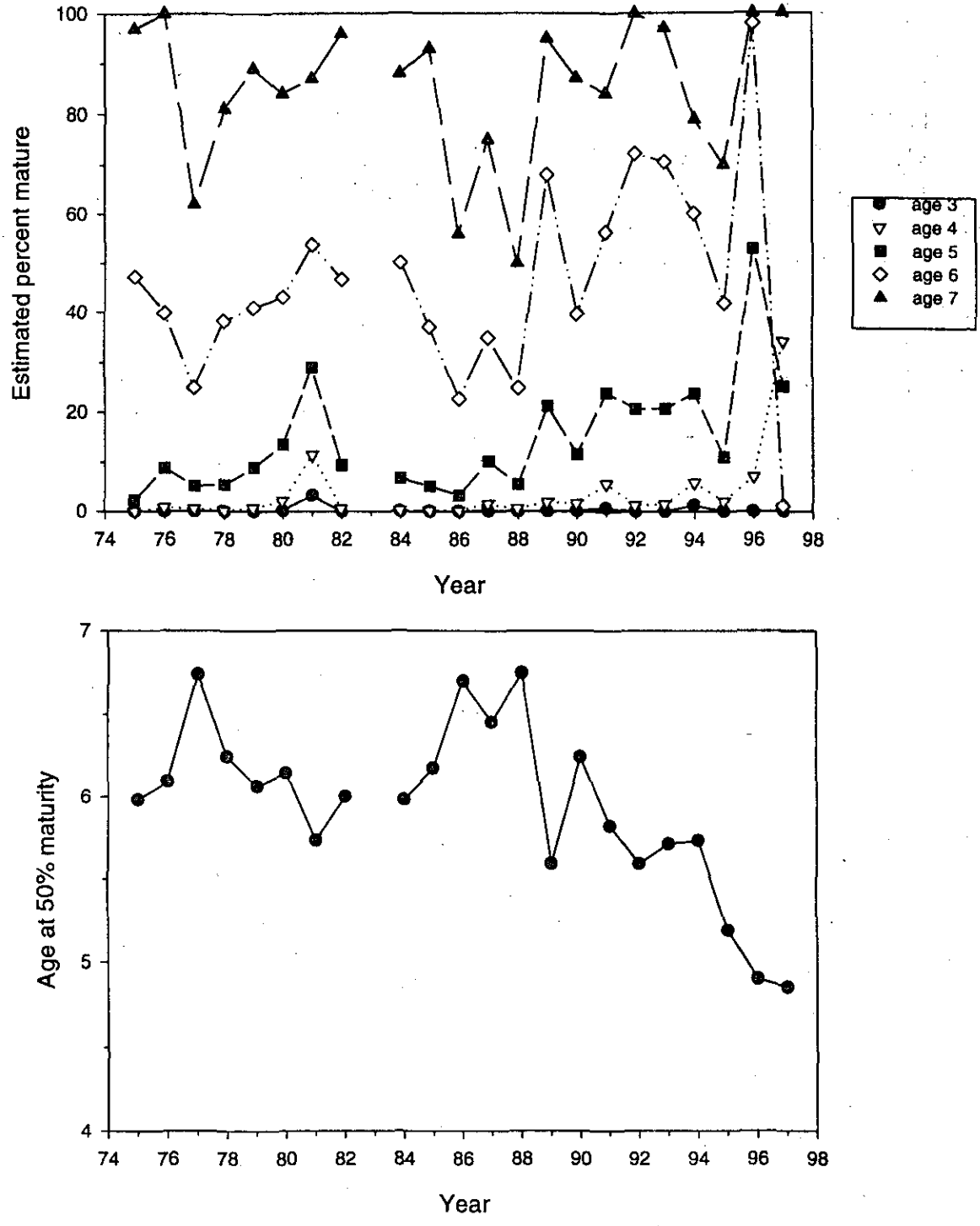
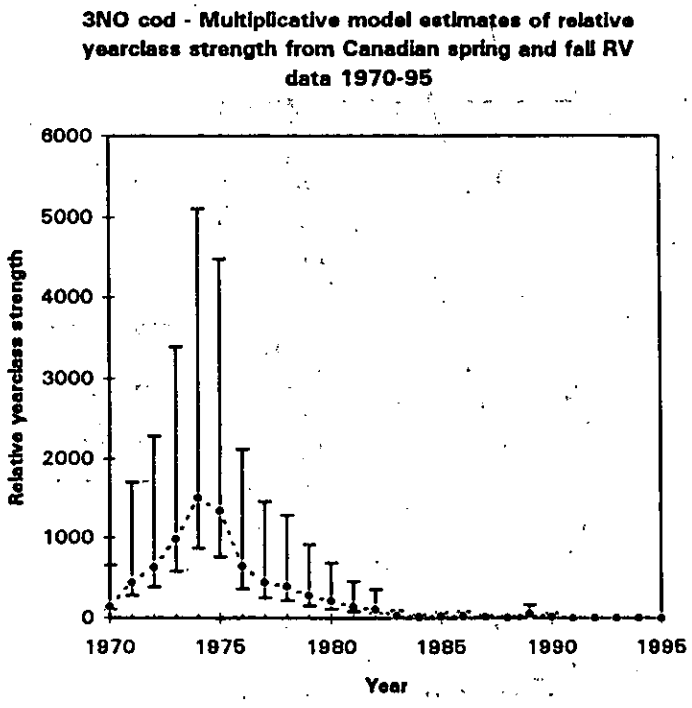



Fig. 8. Estimated proportion mature at ages 3-7 for female cod in NAFO Divs. 3NO for 1975 to 1997 (top). Age at 50% maturity over the same time period is shown in the bottom panel.



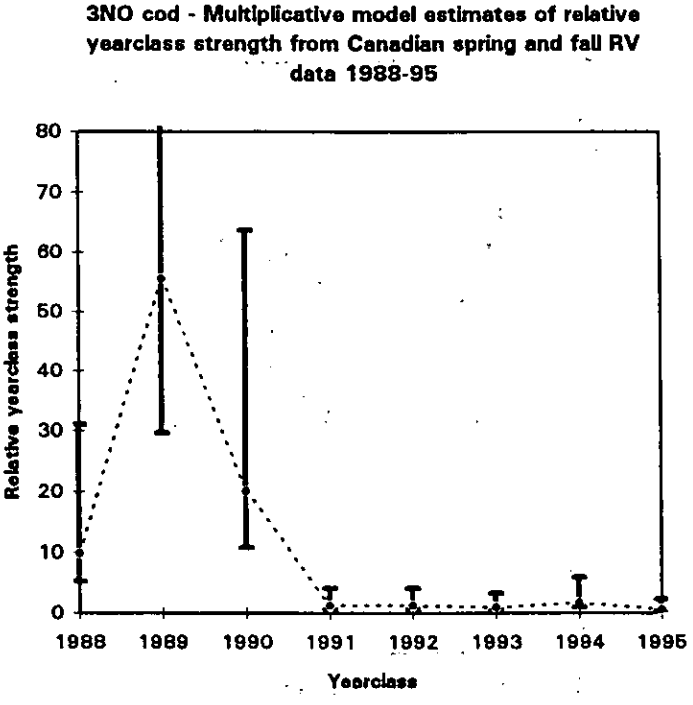
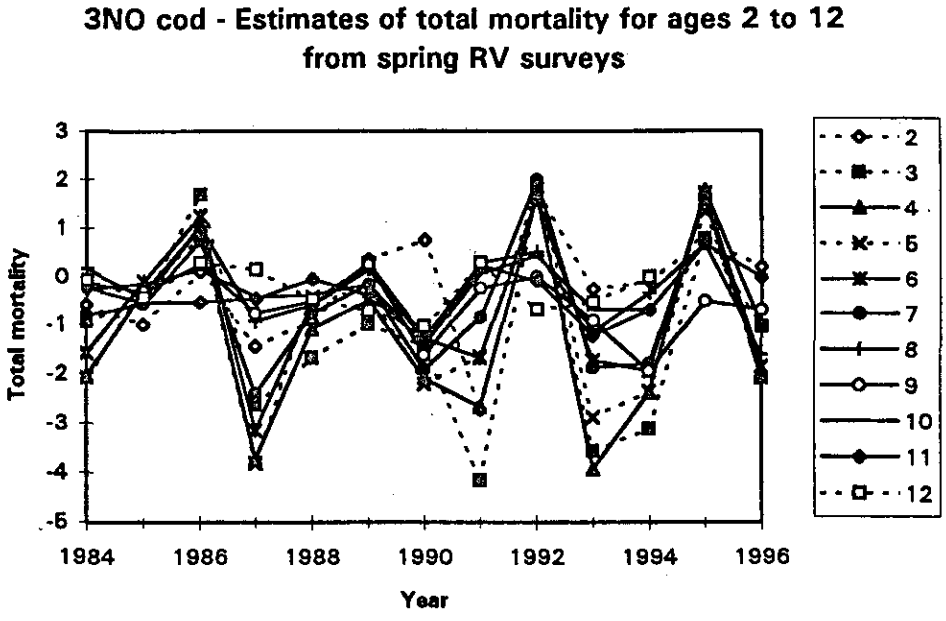




Fig. 9 . Relative yearclass strength estimated by fitting a multiplicative model to Canadian spring and fall research vessel survey catch at age for ages 1 to 14. Zero or missing values were replace with 0.007. Estimates are not bias- orrected.



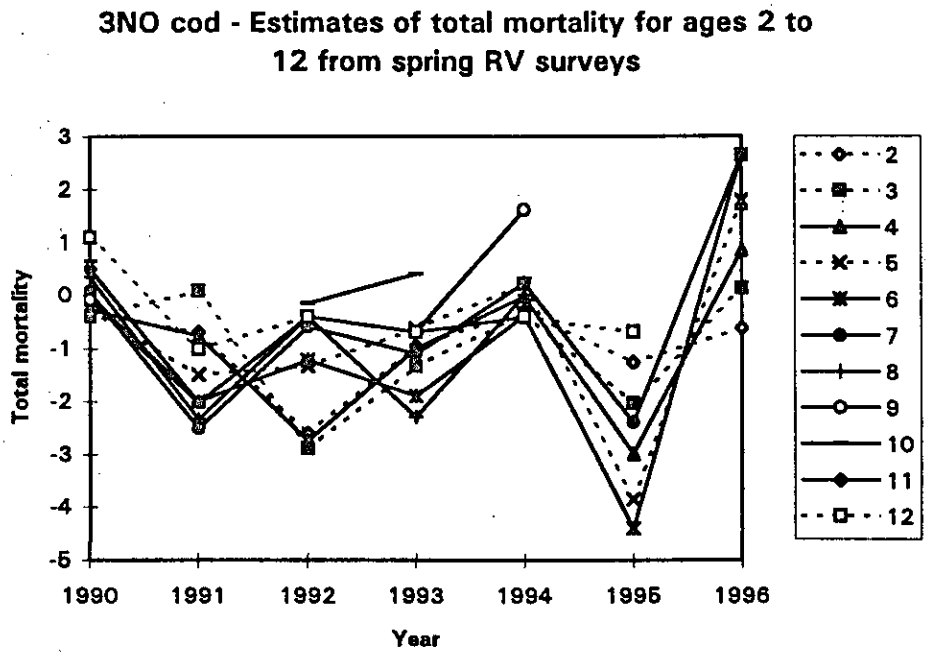




Fig. 10 . Estimates of total mortality (Z) from the spring and fall research vessel surveys in Divisions 3NO. Z's are calculated as log(RVa + 1,y + 1/RVa,y) plotted for age a alongside year y. For ages that are not fully recruited to the Campelen survey, the Z is relative. For fully recruited ages the Z can be considered absolute. Z's > 0 represent an increase rather than a decrease, a consequence of year effects in the survey or changes in selectivity with age.

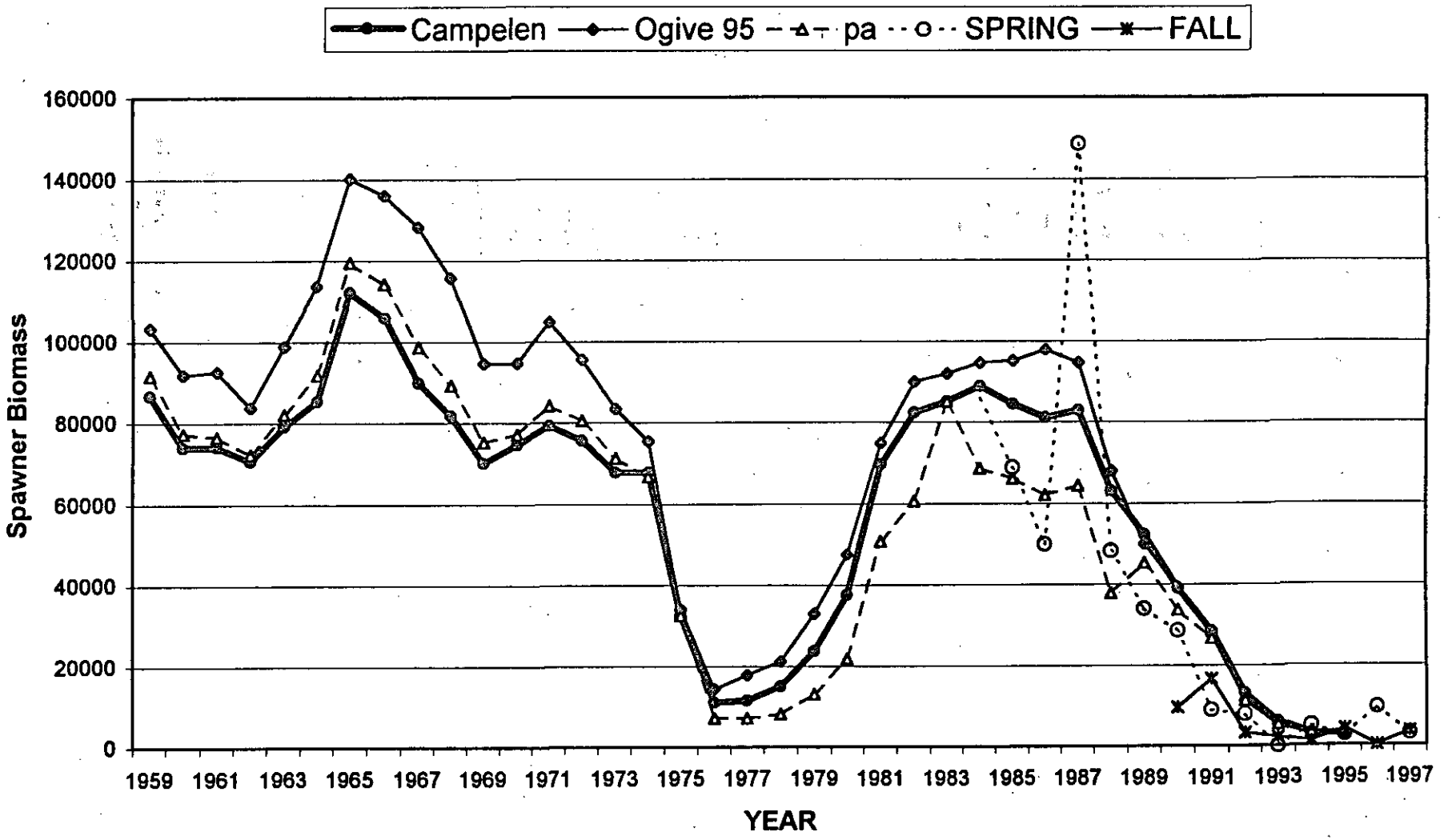



**Fig 11. Spawner biomass from Campelen using annual ogives, ogive in 95 used for all years , biomass from spa tuned using engels data and annual ogives as applied in the March NAFO workshop (pa), Q adjusted spring and fall surveys**

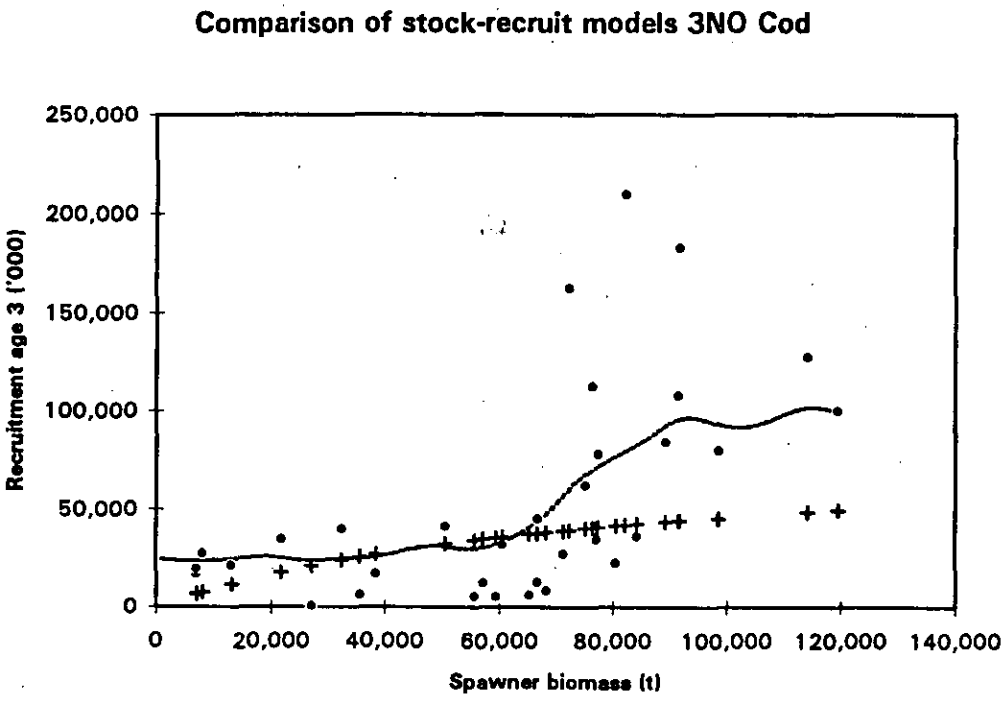



Fig. 12 . Comparison of alternative stock-recruit relationships fitted to the ADAPT estimates of spawner biomass and recruitment. The curve demarcated by "+" is the Beverton and Holt fit given in Cook (1998). The broken line is a Cauchy smoother of mean recruitment with the shape parameter selected by minimizing the cross-validated sums of squares (shape parameter =7,648 t)

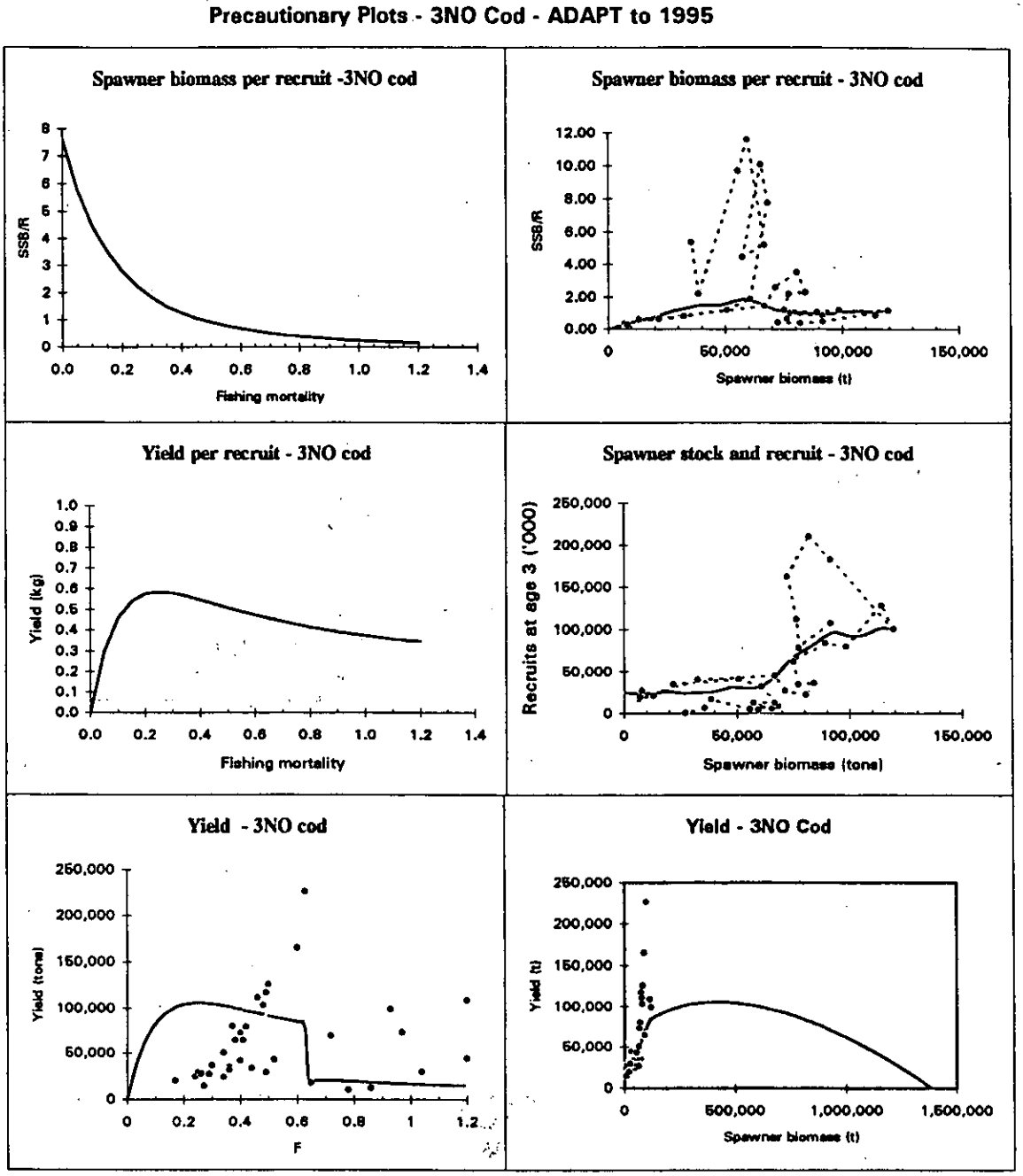



Fig. 13. Precautionary plots based on estimates of population size from an ADAPT fitted up to 1995. Weights, maturities and partial recruitment are recent values. The stock-recruit function is fit using a Cauchy smoother with the shape parameter selected by minimizing the cross-validated prediction sums of squares. Recruitment at spawner biomass above 120,000 t is assumed to be fixed at 1E9.