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An Assessment of the Cod Stock in NAFO Divisions 2J3KL

by

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Description of the Fishery

Historical data and the 1991 fishery

Nominal catches for this stock increased during the late 1950's and early 1960's and peaked at just over 800,000t during 1968 (Table 1, Figure 1). Catches rapidly declined thereafter and were at a low of 139,000 t in 1978. During 1982 to 1990 catches were in the range of 219,000 to 270,000t, however, a reduction to approximately 171,000t occurred during 1991. This reduction resulted in substantial shortfalls of catch relative to allowance/ allocation in the fixed gear and mobile gear fisheries (Table 2). These shortfalls in 1991 were 58,000t and 10,000t respectively. The total Canadian catch increased from a low of about 36,000t in 1974 to 214,000t in 1983. Catches then declined to 190,000t in 1986 but increased to a high of 242,000t in 1988. Since 1988 catches have again declined and in 1991 the Canadian catch was approximately 120,000t. This is the lowest Canadian catch since Canada extended its fisheries jurisdiction.

Total allowable catches (TAC's) were first introduced for this stock in 1973 (Table 1) and during the 1973-1976 period were ineffective in restricting catches. During 1977 Canada extended fisheries jurisdiction to 200 nautical miles and TAC's were reduced to more restrictive levels.

During the 1960's, when the fishery was dominated by non-Canadian fleets (Figure 3), most of the catch occurred in Divisions 2J and 3L with 2J generally predominating (Figure 2). Since that time catches have been mainly from Divisions 2J and 3K. Canadian landings by TC-5 otter trawlers have shown considerable fluctuation between these divisions during the 1977-1986 period. In 1987 a management plan was put in place to distribute otter trawl catches equally among all 3 divisions. As a result catches were more evenly distributed during 1987-1989. In 1990 and 1991 severe ice conditions prohibited the otter trawl fleet from fishing in Division 2J during the winter months and during other months catch rates were low. This resulted in a shortfall in the offshore allocation in this division. The Canadian catch distribution for large otter trawlers by division during 1990 was 23% in Division 2J, 34% in Division 3K, and 43% in Division 3L, while for 1991 the distribution was 1%, 49% and 50% respectively.

Information from Canadian surveillance indicate that the catch by foreign fleets, mainly the EEC (Spain, Portugal and Germany), outside the 200 mile limit in Div. 3L was in the vicinity of 48,900t in 1991. This was substantially higher than catches reported for recent years but was similar to the high catch reported in 1986 (51,555t). The reported EEC catch (Portugal - 9459t; Spain - 8546t; and Germany - 6459t) for 1991 is about 40% lower than that estimated by surveillance. Approximately 20% of the 48,900t was estimated to have been taken by non-reporting, non-member countries of NAFO.

The catch by fixed gears (traps, gillnets, handlines and longlines) increased from a low of 35,000t in 1974 to 113,000t in 1982 (Table 1; Figure 1). Catches subsequently decreased to about 75,000t between 1985 and 1987 but increased to about 100,000t in 1988-89. The catch of 112,500t in 1990 was the highest since 1982 while that for 1991 of 60,000t was the lowest since 1976. The predominant gears in the fixed gear fishery are traps and gillnets. The decline in catch from 1990 to 1991 was observed for all gears (Table 3; Figure 4) but was most

pronounced for gillnets with a decrease of over 70% from the 1990 level. Trap catches declined slightly from 1990 to 1991 but were comparable to those obtained in the 1986-89 period. In recent years a gillnet fishery has developed in the offshore area of Division 3L primarily in the area of the Virgin Rocks. In 1990 this fishery contributed about 20,000t of the total 27,000t gillnet catch for Div. 3L but in 1991 the catch by this gear component declined to about 7,900t from a total 3L gillnet catch of 10,900t. During 1991 an estimated 4,000t (Canadian Dept. of Fisheries and Oceans) of offshore gillnet catch, actually taken in Div. 3NO, was reported for Division 3L and was not included in the Division 3L catch. Some of the decline in gillnet catch could have been caused by the presence of poor to average year classes in the population at ages 6-8, ages which generally have been most abundant in Div. 2J3KL gillnet catches.

Catches by month for all gears for 1991 are presented in Table 4. Otter trawl landings were mainly in the autumn in Div. 2J, in the winter in Div. 3K and more widespread in Div. 3L with some preponderance toward the late autumn and winter periods. As in the past, fixed gear catches were mainly during the summer period. During 1991 the inshore fishery, relative to other years, was late starting, by about two to four weeks, in virtually all areas in the management unit (Davis, 1992). Drifting ice was a threat to fixed gear well into the month of July and grounded icebergs blocked some trap berths until about the same time. The codtrap fishery continued for some two to six weeks longer than usual.

A summary of catch and allocation/allowance data from recent years as obtained from the Canadian Management Plan is presented in Table 2. Canadian catches have been less than allocations for each year with major discrepancies occurring mainly between the fixed gear and its allowance. In 1991 the fixed gear catch was lower than the allowance by 49%, the largest discrepancy since an allowance was first introduced in 1978.

The fishery in 1992

The Canadian offshore fishery for cod in 1992 was virtually completed by March. Reduced catch rates, the presence of small fish and reduced allocations lead to reduction in fishing activity throughout the area. Cod were found mainly in southern 3K and northern 3L and predominantly in deeper waters. The total catch of cod to date in 1992 from Divisions 2J3KL was approximately 14,400t compared to 41,700t for the same months of 1991, a decline of about 65%. Virtually all the Canadian catch during these months, for both years, was taken by large (> 100') otter trawlers fishing in Divisions 3KL.

The foreign fleet fishing in the area outside the 200 mile zone on the Nose of the Grand Bank had also experienced lower catch rates along with catches of small fish during the early months of 1992. Low catch rates caused vessels from Germany to leave the zone early. The catch of cod by EC vessels in Division 3L for January to April of 1992, as estimated by Canadian surveillance, was approximately 6,900t, down from 21,600t estimated for the same months of 1991. This represents a decline of almost 70%. It can be seen from the following table that the total number of EC vessels observed in the NAFO Regulatory Area did not change much between 1991 and 1992, therefore the large decline in catch is more likely due to lower abundance in the area outside 200 miles than a reduction in fishing effort.

EC fishing vessels observed in the NAFO Regulatory Area				
Year	January	February	March	April
1991	51	55	80	85
1992	60	74	77	75

Environmental conditions in 1991

The following is a summary of some of the information presented at CAFSAC's Fisheries Oceanography Subcommittee meeting held in April, 1992. Environmental observations for the waters off northern and eastern Newfoundland indicated that water temperatures were below normal in 1991. The areal extent of ice coverage was greater than normal and persisted for a longer period of time. Ice was present in inshore waters well into the summer and records were set for last presence of ice. Low ocean temperatures persisted throughout the summer and early autumn and negative anomalies extended from the Labrador Shelf to southern Nfld. with the

largest occurring on the Grand Banks. Temperatures in the bottom water layers (75-175 m) continued a declining trend that commenced in the mid-1980's. The areal extent of the cold intermediate layer (CIL) of the Labrador Current (waters < 0° C) was at or near its long term maximum. Bottom temperatures for 1992 are expected to be slightly higher than in 1991 but will remain below normal. The extent of the CIL is expected to remain large in 1992 as well.

The influence of these conditions on the cod stock and the fisheries in Divisions 2J3KL has not been determined. Evidence from hydroacoustic surveys conducted during February and the commercial offshore fishery suggests that cod have been moving to deeper water on the slopes of offshore banks during winter months. Surveys conducted during autumn also indicate higher proportions of biomass in deep water strata, however, it is not clear whether this can be attributed to actual distributional changes or a reduction in biomass in the shallow water strata. Examination of research vessel length frequency data did not support the hypothesis of larger fish residing in the deeper water. The low inshore catches in the northern areas were coincidental with colder than normal water masses although other factors (eg. stock abundance) might have played a role either by themselves or in concert with the environment. The declining trend in survey biomass is most pronounced in the north. Data from surveys in Div. 2GH would also support this trend which may be the result of long term and large scale environmental changes.

Catch and weight at age

A summary of the sampling used to derive the catch at age in 1991 is given in Table 5. Sampling was spread spatially and temporally over all gears with a total of about 4000 fish aged and 170,000 fish measured. The following relationship was applied in deriving average weight at age: $\log \text{weight} = 3.0879 \log \text{length} - 5.2106$. Sampling of the commercial catch in 1991 also included information on the Canadian offshore gillnet fishery in Division 3L. Coefficients of variation on the estimated catch at age were less than 10% for most ages (Table 6). The 1985 to 1987 yearclasses were the most abundant in the commercial catch in 1991. The 1986 and 1987 yearclasses dominated the fixed gear fishery in 1991 while ages 5 and 6 (1985 and 86 yearclasses) were dominant in the offshore mobile gear fishery (Table 7, Figure 5).

The age composition of the catch by foreign fleets fishing outside the 200 mile zone in 1991 was estimated by applying age/length keys from the Canadian 3L offshore fishery or spring RV surveys to length frequencies provided by EEC countries (Spain, Portugal and Germany). For the January 1992 CAFSAC assessment, sampling data for the foreign catch outside 200 miles was not available for all countries. The 1992 revised total catch at age indicated fewer cod at ages 3-5 than was the case in January (Figure 6). Ages 5 and 6 dominated the Canadian and French otter trawl fisheries while ages 4 and 5 were dominant in the EEC catch (Table 7). The observed and predicted proportions at age for the 1991 catch are presented in Figure 7. Relatively fewer fish were caught at older ages than was expected.

Age compositions of the 1990 cod catch by Spain and Portugal outside 200 miles were made available at the 1991 June NAFO meeting and were included in a revision of the 1990 catch at age. A comparison of the original and revised age compositions indicates that more fish at younger ages were taken in 1991 than had previously been estimated (Figure 6).

At the 1991 assessment of this stock CAFSAC recommended that age compositions from Canadian spring RV surveys be evaluated for their potential use in adjusting foreign catches outside 200 miles. It was previously determined that autumn surveys were not appropriate for this purpose. Results showed, for years with enough information to make comparisons, that spring RV surveys included proportionately more fish at younger ages than was indicated by either Canadian or foreign sampling (Figure 8).

The catch numbers, biomass and average weights at age for years 1962 to 1991 are presented in Tables 8 to 10. The total catch at age for 1991 indicates that the 1986 yearclass was most abundant with the highest catch at that age since 1974. The relatively high catch at age 4 and low catches at age 7 and 8 are consistent with population age structure from the 1991 assessment of this stock (Baird et al., 1991) showing strong 1987 and weak 1983 and 84 yearclasses. Weights at age for the 1962-71 period are estimates obtained using weight-at-age data for 1964-68 from Division 2J and 1965-70 from Divisions 3KL weighted by divisional catch. Average weights increased from the early 1970s to the early 1980s and subsequently declined. The 1991

average weights at age compared with those from recent years are lower at ages 4 and 5 but slightly higher for ages 7 and older. In general no trend in commercial fishery mean weights at age has been observed during the past several years (Figure 9). The catch biomass at age for 1991 obtained using sampling data was approximately 98% of that reported.

Research vessel survey data

Stratified-random trawl surveys

Research vessel surveys have been conducted by Canada during autumn in Division 2J, 3K, and 3L since 1977, 1978, and 1981 respectively. The 1984 autumn survey in Division 3L was conducted earlier in the year than the other surveys (August-September as opposed to October-November). Spring surveys have been conducted by Canada in Division 3L for the years 1971-82 and 1985-91. Surveys in Divisions 2J3K have been conducted by R.V. GADUS ATLANTICA while those in Division 3L have been conducted by R.V. A.T. CAMERON (1971-82) and R.V. WILFRED TEMPLEMAN (1983-91). To account for incomplete coverage of strata in certain years, estimates of biomass and abundance for non-sampled strata were obtained using a multiplicative model. Stratification charts used for the surveys in the three NAFO Divisions are presented in Figures 10-12.

Divisional survey estimates of biomass and abundance have shown large fluctuations in recent years. The low values observed in 1991 in Division 2J were similar to those from the 1990 survey (Tables 11-12, Figure 13). Biomass estimates have indicated a declining trend since 1988, a similar trend for abundance to 1990 with a slight increase in 1991. Both biomass and abundance declined substantially in Divisions 3K and 3L from 1990 to 1991 (Tables 13-16, Figures 14-15). The 1991 estimates for Division 3L were the lowest in the time series. The total RV biomass for Division 2J3KL cod in 1991 was about half that estimated for 1990 (Figure 17) and the lowest since 1981, the first year that all three divisions were surveyed during the same season. In all the autumn surveys cod abundance and biomass were low in the shallow water strata. This was particularly true for Division 3L where in contrast to previous years, cod were found in low numbers in large strata in the 31-50 fathom depth range. The 1991 estimates for the Division 3L spring surveys also declined substantially and were the lowest in the time series since 1977 (Tables 17-18, Figure 16). However, several strata, which had high abundance estimates in previous years, particularly in 1990, could not be fished because of ice coverage.

Percent biomass by division (Table 19) was fairly stable for a period in the early 1980s and averaged about one third in each of the three divisions. In recent years the percentages have become quite variable with the highest and lowest percents for each of the three divisions occurring since 1987. The average percentages for the 1981-91 period are 36% in Division 2J, 36% in Division 3K, and 28% in Division 3L.

As recommended by the SSS Subcommittee of CAFSAC, the adaptive survey design used to minimize variance was discontinued in 1991. To meet similar objectives an alternate method of set to strata allocation for was used which selected sets based on previous years data (Gagnon, 1991). For the autumn 1991 surveys, data for the 1986-90 period were used in the selection procedure.

Tables 20-23 give the mean numbers per tow at age for the surveys conducted in all divisions. The values include adjustments to account for strata omitted during some surveys. In Divisions 2J and 3K the 1987 yearclass (age 4) dominated in 1991. In Division 3L during spring and autumn the 1986 and 1987 yearclass (ages 4 and 5) were dominant in 1991 at similar levels of abundance.

There were no autumn surveys in Division 3L for the years 1978-80, so an index for these years was estimated by averaging yearclass estimates in successive spring surveys in Division 3L for 1977-81. The total stock area index at age for autumn was then calculated by averaging (weighted by surveyed area) the results for all three divisions. The surveyed area, in square nautical miles, used as weights for this average are: 2J - 21,560; 3K - 29,256; 3L - 36,777. This 2J3KL index (Table 24) indicated that although the total abundance had declined substantially the 1987 yearclass, age 4 in 1990, was still above average while the 1986 yearclass was similar in abundance with the average. Coefficients of variation for the age-by age means

are also presented in Table 24. Numbers per tow at ages 1-5 are on par with those estimated from previous surveys and are slightly above the average for these ages in the RV time series. On the other hand, the numbers of cod at ages 6+ are the lowest in the series (Figure 18). The observed survey numbers per tow at age in 1991 are much lower at every age than those predicted from last years ADAPT. This is not surprising given the large decline in total RV biomass. What is surprising, however, is that the decline is much greater at older ages (Figure 19).

The reasons for this decline are not known. The 1991 survey was conducted using gear and methodologies similar to those of previous years to ensure no systematic change in catchability, though variation may occur. A fall survey in 1991 in Div. 2GH did not suggest migrations of cod to this area, as the biomass in 2GH was very low (Murphy et. al., 1992). A comparison of age structure and biomass distribution of cod from 1991 spring and fall RV surveys in Div. 3L and 3NO indicated that there may have been some movement from 3L to 3NO in 1991 but the increase in 3NO biomass in 1991 with it's associated age composition is insufficient to explain the decline in Division 3L (Bishop et. al, 1992). The 3NO fall survey has only been conducted during 1990 and 1991 and the differences observed could be the result of annual survey variation.

There was no information to suggest that vertical migration away from the area swept by the trawl was a factor. At the beginning of the 1991 autumn survey a hydroacoustic experiment was conducted in a small area in Div. 2J and 3K. The results indicated that densities were low in the area and very few cod were observed in the water column above the standard bottom trawl. In addition, sounder watches maintained throughout the survey did not indicate concentrations of cod in the water column above the trawl.

As reported previously, the inshore fishery was later in 1991 and in some areas good catches persisted until late in the fall. This might suggest that a higher proportion of the stock remained in inshore areas at the time of the autumn surveys. However, it was noted that abundance in survey strata close to inshore areas was low.

With the fishery by foreign countries on the Nose of the Grand Bank estimated to be almost 50,000t in 1991, the status of the biomass in this area is of increased interest. The proportion of cod biomass, as determined by RV surveys, that occurs outside 200 miles in Division 3L is usually less than 10% and often less than 5% of the divisional biomass during spring and autumn. However, two winter surveys in this division, conducted during 1985 and 1986, indicate that about 25% of the 3L biomass occurs outside 200 miles during that season (Figure 20). It is during winter that the foreign fishery is at its height.

Survey average weights at age are presented in Tables 25-28. In Division 2J and 3K average weights have declined since 1989 at ages 4 to 6 while remaining stable or showing some increase at older ages. Recent average weights are substantially lower than those observed in the early to mid 1980's. In Div. 3L a similar pattern of reduced average weights at ages 4-6 were seen from 1990 to 1991. Estimates were also lower than those from the early to mid 1980's.

Winter hydroacoustic surveys

An annual winter hydroacoustic survey series for cod in Divs. 2J3KL was started in 1987. Several years were involved in developing the appropriate acoustic hardware and vessel technology that would permit the acquisition of data necessary to estimate the abundance of cod from electronic records. The purpose of these surveys is to determine the abundance and distribution of cod on the seaward slopes of the offshore banks within the management unit (Figure 21). Only in 1991 and 1992 were sufficient data collected to produce such estimates. Similar information for years prior to 1991 could not be obtained because of problems encountered with hydroacoustic hardware and operation of vessel and gear particularly with respect to ice conditions. During all years, however, information was obtained on the general distribution of cod in the area surveyed (Baird et al, 1992).

In the initial survey (1987) a large concentration was observed in southern 2J and northern 3K at depths ranging from 300 to 500 meters. In 1988 and 1989 the major concentration was found slightly further south but in the same depth zone. In the 1990 survey commercial concentrations of cod were found still further south in Division 3K and mainly at 550m, about 150m deeper than in previous years. The general distribution and size range of cod encountered throughout

the survey area during 1991 and 1992 were similar to those determined from the trawl surveys conducted during the previous respective autumns. Mean densities in 2J were lower, about the same in 3K, and about 75% lower in 3L in 1992 compared to 1991. In general the 1992 acoustic data obtained from surveys conducted during February indicated that cod densities were lower in 1992 than in 1991 and that fish were smaller and more dispersed. The results for Div. 3K and 3L indicated levels of reduction from 1991 to 1992 similar to those observed from the autumn trawl surveys during these years. In 1991 a large concentration of commercial sized cod was found in the southern most area of 3K between the depths of 600 and 850 m. This concentration was most dense at 700-800 m and extended into the northern part of 3L. In 1992 cod were generally dispersed throughout 3K and 3L in depths from 350 to 550m, with some fairly dense aggregations observed in northern 3L. Length frequencies indicated that most of the cod were between 37 and 43 cm in length.

Migration Research - Summer Hydroacoustics

Research on the movement and distribution of 2J3KL cod during the post spawning onshore migration in the spring of 1990 and 1991 has indicated that during both years, cod migrated onshore in large size-structured aggregations through a "pathway" defined by the bathymetry and temperature (2°C) (George Rose, pers. comm.). The timing of the passage through the "pathway" was approximately two weeks later in 1991 than in 1990. However the 1990 inshore catch was itself two weeks later than average. The size distributions differed markedly between years. Large fish (>60 cm) observed in quantity in 1990 could not be found in 1991 despite widespread search patterns in northern 3L and 3K using 2 vessels equipped with dual-beam echosounders and bottom trawls. Average densities within the aggregations recorded in 1991 were well below those recorded for 1990 based on acoustic integration and counting methods and trawl catches.

Cod and seal scouting survey, 1992

A cod and seal scouting survey was conducted in 2J3KL by two Canadian commercial trawlers chartered to the Dept. of Fisheries and Oceans during April 1992. Using a line survey design these vessels covered an area similar to that surveyed during the February hydroacoustic survey (Figure 21). The results indicated the distribution and size range of cod observed was consistent with that observed in the hydroacoustic survey as well as with other surveys (cod tagging in January, 1992 and fall 1991 groundfish) and the commercial fishery. Observations on cod maturities gave comparable results with other recent studies and primarily indicated that cod were maturing at smaller lengths than had been observed in previous years.

Commercial catch rates

Multiplicative analysis of C/E

Offshore catch and effort data are analyzed using a multiplicative model (Gavaris, 1980) to account for country/gear, seasonal, and divisional differences for the years 1983-91. In previous assessments data for the years 1978-82 were also included in the C/E analysis. More recently the C/E for the 1978-82 period are not considered comparable to those of 1983-91 because of learning by the Canadian fleet during the late 1970's and the introduction of enterprise allocation and dockside grading during the early 1980's. It was recommended by CAFSAC that data for 1978-82 be excluded from future C/E standardization analyses. Information included in the current analysis was obtained from DFO and included Canadian (TC 4, 5, and 6) otter trawl catch rates. Plots of residuals indicated that data with greater catch and effort were less variable, therefore, estimated weights calculated according to Judge et al. (1980, p. 132) were applied in a weighted regression of the multiplicative model. To reduce the possible effects of truncation and rounding, data with less than 10 tons catch or 10 hours effort were excluded from the analysis.

The regression of ln catch rates explained about 68% of the variation in the data (Table 29). For the fleets included in this analysis Canadian (M) TC 6 otter trawlers were the most effective (Table 30), and the best catch rates overall occurred during the first quarter of the year. C/E increased from 1978 to 1985, declined to 1987-88 and increased again until 1990 (Table 31, Figure 22). The 1991 catch rate value is the lowest in the nine year time series.

A C/E index at age (Table 33) for 1983-91 was derived using the catch at age from the offshore fleet (Table 32) along with the calculated fishing effort from the C/E standardization (Table 31). This index indicates that the 1986 yearclass is relatively strong while the 1985 year class appears to be about average. The 1983 and 1984 yearclasses are weak. While this index indicates that the numbers of age 3-5 cod are a level similar to previous years the numbers of cod at ages 6 and older have declined and are at their lowest level since 1983 (Figure 23). The C/E at age observed during 1991 are lower than those predicted from the 1991 ADAPT (Figure 24). The reduction was relatively larger for older age groups, but the pattern is not as pronounced as that observed for the RV numbers at age.

Information derived from spatial techniques

Two additional pieces of commercial fishery information were evaluated for their potential use as abundance indicators. It was recommended by CAFSAC during the January, 1992 review of this stock, that an abundance index derived from application of the potential mapping techniques to observer data be made available for the current assessment. This was done using SPANS to derive an aggregate index of biomass from catch rates and area fished in the offshore fishery (Kulka et al., 1992). The information used was obtained by observers at sea. An abundance index at age (Table 34) was then developed by applying the Canadian otter trawl age compositions (Table 32) to the SPANS aggregate biomass values. This index indicates that the numbers of age 6+ cod increased from 1985 to 1988 and then declined rapidly to a 9-year time series low in 1991 (Figure 25). The numbers of cod at ages 3-5 in 1991 are in the range of those observed during 1983-90. The authors of this index consider that more analysis is required to refine this technique and suggest that the current index be only used in a preliminary fashion. Some of the additional analysis will include an evaluation of the impact: the size of the primary sampling unit ("scanning circle"); and varying amounts of observer coverage for some years.

An index from the codtrap fishery

The second piece of commercial fishery data evaluated for its potential as an abundance index was the catch at age of cod traps for the 1978-91 period (Table 35). A recent analysis (Rose, 1992) indicated that aggregate codtrap catch lagged and weighted appropriately could be used as a predictor of stock size. The basic assumption of the original analysis was that effective codtrap fishing effort remained virtually constant over time because all "good" trap berths have been previously identified and are fished consistently. The codtrap at age index shows the same high value at ages 6+ for 1988 as did the SPANS index (Figure 26), however the 1991 index, for the same ages, is on par with or larger than values from 1978 to 1987. This is in contradiction to other indices of abundance examined (RV, C/E, SPANS). The trap index also indicates that the numbers of cod at ages 3-5 in 1990 and 1991 are among the highest in this 14 year time period. Because of the inconsistencies noted above this index should also be considered preliminary until an evaluation of the internal consistency of yearclass strength is completed.

Estimation of stock parameters

Description of formulations used with ADAPT

Several formulations of the adaptive framework (Gavaris, 1988) were examined in an effort to evaluate the new abundance indices and for the determination of stock size. A description of the various indices used is as follows:

- (1) RV ages 3-12 1978-91; C/E ages 5-12 1983-91
- (2) RV ages 3-12 1978-91
- (3) SPANS ages 3-12 1983-91
- (4) TRAP ages 3-10 1978-91
- (5) Combination of (2) and (3)
- (6) Combination of (2), (3) and (4)

The following structure was imposed:

- Natural mortality assumed 0.2
- Error in catch at age assumed negligible

- F on Age 13 set to 50% F on ages 7-9 (unweighted)
- F on age 13 for TRAP set to flat-top ages 7-9
- Intercepts not fitted
- Autumn RV related to November population
- C/E and SPANS related to January population
- TRAP related to July population

Formulation 1 RV & C/E (Table 36)

CV's on the estimated age 4-12 abundance are in the range of 18% to 30% while that on age 3 is 43%. CV's on all catchabilities are less than 15%. Bias is almost 10% on the age 3 abundance and between 2% and 5% for older ages. Bias on catchabilities for both indices are less than 1%. As had been noted at previous assessments of this stock, residuals indicate several year effects in the RV index and the C/E data displays a lack of fit.

Formulation 2 RV (Table 37)

CV's and biases are all a little larger than the RV and C/E combined formulation. Patterns of residuals are similar to those for the RV in Formulation 1, while population abundance was marginally lower and fishing mortality slightly higher.

Formulation 3 SPANS (Table 38)

Coefficients of variation are higher than was indicated by the two previous formulations with those on estimated abundances in the range of 30% to 55% and on catchabilities in the range of 18% to 20%. The higher CV's may be due in part to the shortness of the SPANS time series. The residual pattern is similar to the RV residuals in the above formulations for comparable years. This index gives higher population estimates than any of the other formulations.

Formulation 4 TRAP (Table 39)

CV's are similar to those in the SPANS calibration. Bias on the age 3 population is about 17%, but on age 4 and older fish are all less than 10%. An interesting point is there appears to be a negative year effect in 1986, the same year which is associated with a positive year effect in the RV. There seems to be some inconsistency in the strengths of estimated year classes compared to other formulations. The 1986 year class in this analysis, for example, is estimated to be larger than the 1986 year class. This is different for all other analyses.

Formulation 5 RV & SPANS (Table 40)

CV's and biases are at levels similar to the RV and C/E combined formulation. Residual patterns are consistent with patterns when each index is evaluated separately. Population numbers and fishing mortalities are similar to those from the RV only analysis.

Formulation 6 RV, SPANS & TRAP (Table 41)

CV's and biases are of the same order of magnitude as previous formulations. Residual patterns are also similar. Population and fishing mortality estimated are approximately centered in the range of estimated parameters from all other calibrations.

Laurec-Shepherd

Two formulations of the Laurec-Shepherd calibration technique were also evaluated for comparison with ADAPT results. RV and C/E were included in a single L/S run and the RV data was also included in an analysis. The results of the 2 index Laurec-Shepherd are presented in Table 42 with the RV only results given in Table 43. The structure for both analysis was the same as used for the ADAPT analysis. There was one exception, the F on the oldest age was set to 50% the average of the 5 previous ages (8-12). The results of these analyses suggest the population abundance is lower than the corresponding ADAPT runs. This can be explained by the weight each model places on the terminal year in the abundance indices.

Summary of Calibrations

When the C/E index was included with the RV data in a single ADAPT analysis, the residuals

from the C/E relationships for the last three years of the series were virtually all positive, with 4 of the remaining 6 years having almost all negative residuals. Similar patterns in the C/E residuals, indicating lack of fit of this index to SPA, have been noted by the Subcommittee in the past. Because of the problems in interpreting this C/E series, it is recommended that this index be excluded from calibration. As the SPANS and codtrap indices at age are considered preliminary it was felt that their inclusion in a final calibration analysis would be premature.

Given the comments on the commercial C/E, SPANS index, and codtrap fishery data above, it was decided to use only the results of ADAPT and Laurec-Shepherd with RV data only for further analysis. If it can be determined that the large decline in RV biomass from 1990 to 1991 was caused by a change in availability then the results from ADAPT may be considered more appropriate. On the other hand if the drop in biomass was due to mortality then the Laurec-Shepherd results may be more indicative of stock status.

Regardless of the shortcomings of some of the calibration analyses, several of the features are similar (Table 44). Although the F's on ages 7-9 range from 0.30 to 1.42 in the various calibrations the total age 3+ population abundance only ranges from 780 to 1300 million fish. If the optimistic SPANS results are excluded the range of the remaining three analyses is much smaller (780 to 1080 million fish). An examination of estimated yearclass size indicated that estimates of the 1988 Y/C, age 3 in 1991, are all less than 200 million fish. In addition all calibrations indicate the 1987 yearclass to be strong, the 1986 yearclass to be above average, and the 1983 and 1984 yearclasses weak.

Impact of data and assumptions on calibrations

To determine the effect of the amount of catch in the terminal year on the results of calibration another formulation with RV only was attempted using 25,000t as the size of the catch by non-Canadian fleets outside 200 miles during 1991. The results of this analysis are presented in Table 45. The precision estimates and residual patterns are very similar to the results from the original analysis. The age 3+ population abundance is 927 million fish and the age 7-9 mean F is about 0.6. The population only differs by less than 2% from the original analysis while the F is less by about 12%.

It appears that the models which have been explored adequately represent an increase in effective natural mortality (including emigration). As a consequence, the resulting pattern of population abundance and fishing mortality for the recent years is distorted and its interpretation requires care. The model formulation used with ADAPT would be more sensitive to major shifts in natural mortality.

Assessment Results

Fishing mortality and stock abundance (Figures 27, 28)

The ADAPT assessment indicated that the 1991 age 7-9 unweighted mean F is about 0.7 with the age 3+ population numbering about 940 million cod. The age 3+ population biomass is about 640 thousand tons and the SSB (7+) is 110 thousand tons. The analysis conducted using the Laurec-Shepherd technique gave a somewhat more pessimistic view of total abundance (780 million fish), 3+ biomass (520,000t in 1991), and SSB (72,000t) than the ADAPT analysis. The age 7-9 fishing mortality is also considerably higher at about 1.4. Both analyses indicated a sharp increase in fishing mortality from levels in the mid 1980's of around 0.5 to values between 0.7 and 1.0 (ADAPT) or greater than 1.0 (L/S) in 1989-91. The ADAPT calibration shows a decline in F in 1991, while the L/S indicated a continued increase in F to 1991. Both calibrations gave a radically different view of the recent trends in F compared to that observed in recent assessments of this stock.

The reason for the differences in the results from both calibration techniques is the treatment of the terminal year values of the abundance indices rather than a methodological difference. The model formulation used with ADAPT considers all RV estimates of a cohort to determine yearclass strength. The Laurec-Shepherd method estimates the current population at the same level as the current catchability-adjusted RV. The difference in results therefore, can be attributed to differences in the degree of influence placed on each survey year. In this particular case, some of the disparity occurred because of different assumptions regarding the timing of the survey. The ADAPT formulation assumed that the survey index corresponded to the population fished until November (autumn RV) while the Laurec-Shepherd assumed that the survey corresponded to mid-year.

Although the use of the SPANS and codtrap indices in the calibration analyses should be treated with caution, both were included in exploratory analysis using ADAPT. The results of these preliminary calibration analyses were quite similar to ADAPT with only the RV data included (Table 44).

Recruitment (Figure 29)

The ADAPT calibration indicated the 1986 and 1987 yearclasses to be above average at 385 and 520 million cod respectively while the 1988 yearclass, age 3 in 1991, is well below average at approximately 175 million fish. The 1978-91 geometric mean recruitment for this stock since 1978 is now estimated to be about 270 million fish. The corresponding results from the L/S analysis were 300 and 450 million for the 1986 and 1987 year classes respectively. The 1988 year class was also estimated to be below average at about 165 million. The geometric mean recruitment since 1978 for the L/S analysis is 250 million fish.

Retrospective analysis

Retrospective analyses were conducted using both calibration techniques. Trends in mean F (Figure 30), population biomass (Figure 31), and catch, projected at an arbitrary F of 0.40 (Figure 32) were examined for retrospective patterns. Such patterns were present in some but not all years and it is quite clear that the terminal year population estimates, fishing mortalities and subsequent projected catches are very sensitive to changes in the abundance index used in calibration. In general, the ADAPT results are a little more optimistic than the L/S results. However, the ADAPT estimates were not adjusted for bias for this comparison. The L/S calibration gives more variable results when the index in the terminal year shows major changes from previous years, as seen in the 1986 and 1991 RV estimates.

The retrospective analysis from both methods indicates a sharp discontinuity between the 1990 and 1991 assessments. The analysis confirms that both models have not adequately captured the dynamics which occurred during 1990 and 1991. Estimates of mean F were similar with both methods, around 0.5, until 1989. The L/S shows a continual increase in F to 1991 while the F for the ADAPT analysis shows an increase in F followed by a decline. This difference is consistent with the different weighting of surveys in the terminal year by the two approaches.

Prognosis

In the face of uncertainty regarding which model formulation is most reliable, given the implications of either on the adult biomass, and the ancillary information suggesting a lack of fish in early 1992, catch projections to 1993 were not presented at this time. Before advice for 1993 can be provided data from the 1992 commercial fisheries and autumn research vessel survey should be reviewed. Therefore, only projections for various catch options for 1992 are provided.

With the uncertainty associated with the treatment of the terminal year in the calibration index, it was thought appropriate to conduct the standard suite of projections of catch, biomass and F using the results of both ADAPT and Laurec-Shepherd calibrations. Input parameters for projections are presented in Table 46. The weights at age were averages of values from the commercial fishery from 1989-1991. Partial recruitment values were determined for each analysis and were averages from fishing mortalities assuming full recruitment at ages 7-9 for the same period. Natural mortality was assumed to be 0.2. The 1989 and 1990 year classes at age 3 were set at 270 million for the ADAPT and 250 million for the L/S, each being the geometric mean recruitment from 1978-1991 from the respective analyses.

Projections were made at a range of fully recruited F's or catch options for 1992. Options included are $F_{0.1}$, twice $F_{0.1}$ (an approximation of F_{max}), 145,000t (the TAC with estimated foreign catch of 25,000t), and 100,000t (60,000t inshore catch, 15,000t offshore, and 25,000t foreign). The results of projections are shown in Table 47 and Figure 33. Regardless of which starting values are used the $F_{0.1}$ catch in 1992 is less than 100,000t and catches in the range of those taken in 1991 would generate fishing mortalities at or approaching 1.0.

There is little doubt that the stock is at a low level regardless of which calibration technique is

used. The age 3+ biomass and even more disturbing, the age 7+ biomass (approximately the SSB) are currently at or near the lowest levels ever observed for this stock. The fishery in 1992 will be dominated by only two year classes, those of 1986 and 1987. The limited information available indicated that the 1988 yearclass is below average, and is currently estimated to be about the level of the weak 1983 and 1984 year classes.

The biomass decline described by ADAPT is not as steep as that indicated by the RV index alone. The retrospective analysis suggested that large changes in RV indices are not reflected to the same degree in the estimated population from ADAPT as is the case for the L/S. If the 1991 survey is considered to accurately represent the current stock status, the results from the L/S analysis are likely more representative. If the large changes in the RV indices include a year effect, as was the case with the 1986 survey, then ADAPT would provide a more appropriate estimate. The information available from the commercial fishery in 1992, as well as additional surveys (scouting, acoustic) suggest that the 1991 survey may be representative of stock status. However, the discrepancy between 1990 and 1991 data, especially with regard to the decline in abundance of older fish has not been accounted for.

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Table 1. Historical catches of cod from NAFO Divisions 2J3KL for the period 1959-91.

Year	2J						3K						3L						2J3KL					
	Offshore mobile gear			Fixed gear			Offshore mobile gear			Fixed gear			Offshore mobile gear			Fixed gear			Total offshore mobile gear					
	Can.	Other	Total	Can.	Other	Total	Can.	Other	Total	Can.	Other	Total	Can.	Other	Total	Can.	Other	Total	Total Canada gear	Total fixed gear	Total offshore mobile gear	Total	TAC	
1959	-	46372	46372	17533	63905	81438	-	97678	97678	56264	153942	4515	51515	56030	85695	141725	164007	159492	200080	359572	-	-	-	-
1960	1	164036	164037	15418	179455	333593	53	69855	69908	47676	117584	7355	60213	67568	94192	161760	164695	157286	301513	458799	-	-	-	-
1961	1	243147	243148	17545	260693	418640	-	60574	60574	31159	91733	4675	70318	74993	70659	145652	124039	119363	378715	498078	-	-	-	-
1962	-	226841	226841	23424	250265	484265	-	45554	45554	42816	88370	4383	87463	91846	72271	164117	142894	138511	364241	502752	-	-	-	-
1963	1	197868	197869	23767	221636	435605	-	79331	79331	47486	126817	4446	83015	87461	73295	160756	148995	144548	364661	509209	-	-	-	-
1964	13	197359	197372	14787	212159	414538	-	121423	121423	40735	162158	10158	142370	152528	73806	228334	141499	131328	471323	602651	-	-	-	-
1965	-	246650	246650	25117	271767	522867	21	50097	50118	26467	76585	7353	130387	137740	58943	196683	117901	110527	434508	545035	-	-	-	-
1966	39	226244	226283	22645	248928	475172	13	58907	58920	32208	91128	8253	120206	128459	59990	184449	119148	110843	413662	524505	-	-	-	-
1967	28	217255	217283	27721	245004	502276	114	78687	78801	24905	103706	13478	200343	213821	49231	263054	115479	101859	509905	611764	-	-	-	-
1968	4650	355108	359758	12937	372695	732350	1849	119778	121627	40768	162395	15784	211808	227592	47332	274924	123320	101037	708977	810014	-	-	-	-
1969	30	405231	405261	4328	409589	814809	56	80949	81005	24923	105928	18255	151945	170200	67973	238173	115565	97224	656466	753690	-	-	-	-
1970	-	212961	212961	1963	214924	428987	92	78274	78366	21512	99878	14471	137840	152311	58113	205424	91151	76588	443638	520226	-	-	-	-
1971	-	154700	154700	3313	158013	311713	31	61506	61537	21111	82648	11976	148766	160742	38115	198857	74546	62539	376979	439518	-	-	-	-
1972	-	149435	149435	1725	151160	300595	7	133369	133376	14054	147430	4380	109052	113432	46273	159705	66439	62052	396243	458295	-	-	-	-
1973	1123	52985	54108	3619	57727	106421	108	159653	159761	13190	172951	1258	97734	98992	24839	123831	44137	41648	32861	354509	666000	-	-	-
1974	-	119463	119463	1804	121267	239731	19	149189	149208	10747	159955	870	67918	68798	22630	91428	36080	35181	337469	372650	657000	-	-	-
1975	410	78578	78988	3000	81988	159966	189	112678	112867	15518	128385	670	53770	54440	22695	77135	42482	41213	246295	287508	554000	-	-	-
1976	94	30691	30785	3851	34636	65426	771	79540	80311	20879	101190	2187	40998	43185	35209	78394	62991	59939	154281	214220	300000	-	-	-
1977	525	39584	40109	3523	43632	83162	1051	26776	27827	28818	56645	5362	26799	32161	40282	72443	79561	72623	100097	172720	160000	-	-	-
1978	4682	17546	22228	6638	28866	46414	7027	6373	13400	29623	43023	9213	12263	29486	42298	77236	130779	85822	81077	168899	180000	-	-	-
1979	9194	6537	15731	8445	24176	40905	21579	16890	38469	27018	65487	14184	12693	29486	42298	71784	147558	96523	79265	175788	180000	-	-	-
1980	13592	7437	21029	17210	38239	55449	21920	6830	28750	37015	65765	15523	13963	36830	42821	79651	147035	80038	90674	170712	200000	-	-	-
1981	22125	4760	26885	14215	41100	61090	23112	3847	26959	23002	49961	21760	15070	36830	42821	79651	207506	113049	116725	229774	230000	-	-	-
1982	58384	8923	67307	14429	81736	91812	8881	4074	12955	42141	55096	27192	9271	36463	56479	92942	214452	108423	125922	232345	260000	-	-	-
1983	37281	4158	41439	10743	52182	62925	31623	2815	34438	40681	75119	39125	10920	50044	54999	105043	214452	108423	125922	232345	260000	-	-	-
1984	10754	1259	12013	13150	25163	38163	48114	11059	59173	35143	94316	49620	13944	63564	49428	112992	206209	97721	134750	232471	266000	-	-	-
1985	1541	5	1546	10209	11755	12755	72111	9714	81825	30368	112193	39112	28927	68039	39306	107345	192647	79883	151410	231293	266000	-	-	-
1986	4627	7373	12011	12567	24578	36585	58239	2226	60465	28539	89004	55117	51555	106672	31263	137935	190352	72369	179137	251506	266000	-	-	-
1987	38216	3620	41836	16139	57975	74115	39240	6119	45359	27141	72500	43185	25883	69068	35467	104535	199388	78747	156263	235010	256000	-	-	-
1988	41468	9	41477	17112	58589	100007	40260	50	40310	33820	74130	59107	26748	85855	50103	135958	241870	101035	167642	268677	266000	-	-	-
1989	33584	1014	34598	22920	57518	60512	37280	1194	38474	20711	59185	40943	36540	77483	59238	136721	214676	102869	150555	253424	235000	-	-	-
1990	17863	689	18493	14332	32884	51315	26893	883	27691	27577	55353	33371	26456	59827	70624	130451	190660	112533	106155	218688	199262	-	-	-
1991	635	84	719	2195	2914	3633	29505	1009	30514	13318	43832	30146	49660*	79806	44317	124123	120116	59830	111039	170869	190000	-	-	-

*Includes French catches and estimates of foreign catch by Canadian surveillance.

- An estimate of 4000 t caught in 3N0 but reported in 3L is not included.

Table 2. Comparisons of catch relative to allowance/allocation by country and major gear component for 2J3KL cod over the period 1986-91.

Year	TAC	Canada				Foreign			
		Fixed gear		Mobile gear		Total		Allocation	Catch
		Allocation	Catch	Allocation	Catch	Allocation	Catch		
1986	266000	115000	72369	131700	118983	249700	190352	16300	51555
1987	256000	118000	78747	128500	120641	246500	199388	9500	25883
1988	266000	119180	101035	146820	140835	266000	241870	-	26748
1989	235000	121956	102869	113044	111807	235000	214676	-	36540
1990	199262	117545	112533	79455	78127	197000	190660	2262	26456
1991	190000	117408	59830	70451	60286	187860	120116	2140	48900

Table 3. Fixed gear cod catches (000't) by division and gear in NAFO Divisions 2J, 3K, and 3L from 1975 to 1991.

Year	2J				3K			
	Trap	GN	LL	HL	Trap	GN	LL	HL
1975	0.7	2.3	0	<0.1	4.7	8.5	0.6	1.6
1976	0.4	2.4	<0.1	<0.1	7.1	10.6	0.7	2.4
1977	1.5	1.9	<0.1	0.1	11.5	11.6	1.3	4.4
1978	3.0	3.2	0.1	0.3	11.3	11.4	3.6	3.2
1979	1.3	5.7	0.2	1.3	3.5	11.5	8.4	3.6
1980	4.7	11.4	0.2	0.9	12.7	13.5	8.1	2.7
1981	3.9	10.1	0.1	0.2	4.0	10.7	6.4	2.0
1982	4.5	9.1	0.1	0.7	16.4	17.6	6.1	2.1
1983	3.9	4.9	0.8	1.2	10.5	18.3	2.6	9.3
1984	5.3	6.0	0.4	1.0	9.9	14.3	2.4	8.4
1985	4.6	2.7	0.2	1.8	13.4	8.0	2.3	6.6
1986	4.3	7.6	0.1	0.6	14.8	7.6	1.4	4.7
1987	5.0	9.5	0.2	1.4	11.3	10.1	1.5	4.3
1988	5.9	9.1	0.3	1.8	16.2	11.7	0.9	4.7
1989	6.7	14.6	0.2	1.4	8.2	7.9	0.7	3.9
1990	3.6	9.2	0.6	0.9	11.2	7.8	3.8	4.7
1991	1.0	0.3	0.1	0.8	7.7	1.4	1.8	2.4

Year	3L				Total			
	Trap	GN	LL	HL	Trap	GN	LL	HL
1975	10.4	7.5	1.6	3.1	15.8	18.3	2.2	4.7
1976	18.4	9.1	2.9	4.8	25.9	22.1	3.6	7.2
1977	21.0	8.9	3.6	6.9	34.0	22.4	4.9	11.4
1978	23.2	9.0	5.1	7.8	37.5	23.6	8.8	11.3
1979	20.8	13.5	7.0	9.1	25.6	30.7	15.6	14.0
1980	12.9	11.2	9.4	8.8	30.3	36.1	17.7	12.4
1981	10.2	13.6	11.4	7.6	18.1	34.4	17.9	9.8
1982	24.2	20.3	5.7	6.2	45.1	47.0	11.9	9.0
1983	25.7	16.4	3.8	9.0	40.1	39.6	7.2	19.5
1984	23.0	14.9	3.8	7.4	38.2	35.2	6.6	16.8
1985	21.8	8.8	2.6	5.7	39.8	19.5	5.1	14.1
1986	15.8	8.9	2.4	4.1	34.9	24.2	3.9	9.4
1987	11.4	17.4	2.1	4.6	27.7	37.0	3.8	10.3
1988	22.2	18.1	2.7	6.7	44.3	38.9	4.1	13.2
1989	24.0	22.2	4.7	8.4	38.8	44.7	5.6	13.7
1990	32.1	26.7	2.2	9.7	46.9	43.7	6.7	15.3
1991	26.4	10.9	1.2	5.8	35.1	12.6	3.1	9.0

Table 4. Cod landings(t) in 1991 from Divisions 2J, 3K and 3L by country, gear and month.

	Can(SF)		Can(N)			France		Total
	OT	OT	GN	Trap	HL	LL	OT	
<u>2J</u>								
J								
F								
M								
A	1	11						12
M								
J		1						1
J			2	2	4		1	9
A			35	376	91			502
S		16	86	554	358	54		1068
O		180	160	64	334	32	8	778
N		425	25	5	6	7	75	543
D		1						1
TOTAL	1	634	308	1001	793	93	84	2914

<u>3K</u>								
J	271	6356	1				1009	7637
F	4864	6269						11133
M		3259						3259
A	413	375	42					830
M		2198	36	2				2236
J		319	11		1	1		332
J		1	46	112	11	1		171
A		45	718	3311	261	137		4472
S		98	205	3994	1386	1086		6769
O		9	146	276	671	584		1686
N	125	3131	108	2	64	30		3460
D		1772	69			6		1847
TOTAL	5673	23832	1382	7697	2394	1845	1009	43832

<u>3L</u>												
J	103	8		1125	3		1	32		703	1975	
F	925			2261	3		1				3190	
M	558			2239	7						2804	
A	288			4818	18	14		1			5139	
M	88			2653	37	282	3	402	1		3466	
J	0	35		1983	152	1152	28	404	2	15	3771	
J	28			1061	645	1885	396	10596	18	56	14685	
A	30		1	495	1093	1486	1389	14169	245	57	18965	
S	7		4	1020	512	1916	2645	812	520	75	7511	
O	7	59	4	2000	493	3160	1194	21	264	66	7268	
N		32	9	4883	50	1681	109		44	41	6849	
D	285			2961	8	277	2		10	57	3600	
Total	2319	134	18	27499	3021	11853	5768	26437	1104	310	760	79223

Notes:

- Foreign catch in 3L based on surveillance estimates = 48900
 - Estimated Misreported 3NØ catch in 3L = 4000t (subtract from offshore GN)
- Total estimate Canadian catch 120116
- Foreign (Reported & Estimated) 50753
- Total estimated 2J3KL catch 170869

Table 5. Commercial sampling for cod in Div. 2J3KL in 1991.

Div	Gear	Qtr.	Country	No.	Month	No.	Landings (t)	
				aged		meas.	Country/month	Total
2J	OT	4	CanN	77	Oct	728	180	699
					Nov	568	425	
		1-4		77 ^a		1296		699 ^b
[No inshore sampling. Catch (2183 t) numbers at age for fixed gears were estimated using sampling from 3K.]								
	OT + fixed gear	1-4		77		1296		2914
3K	OT	1	Can	377	Jan	23094	6627	6627
					Feb	12520	11133	11133
					Mar	6872	3259	3259
					Jan	1071	302	302
					Jan	2301	707	707
						377	45858	22028
		2	Can	130 ^c	Apr	115	788	788
					May	5806	2198	2198
					Jun	273	319	319
				130	6194	3305		
		4	Can	248	Nov	4396	3256	5037
					Dec	522	1772	
					4918			
		OT	1-4		755		56970	30514
	Trap GN	3	Can	335	Aug	2331	3311	3425
Aug					1061	718	854	
			335	3392		4279		
Trap GN HL	4	Can	317	Sep	3802	3994	4272	
				Sep	119	205	528	
				Sep	2004	1386	2394	
			317	10100		7194		
Trap, GN HL, LT ^d	1-4		652		13492		13318	
OT + fixed	1-4		1407		70462		43832	
3L	OT	1	Can	32	Jan	3716	1228	1228
					Feb	3624	3186	3186
					Mar	2177	2797	2797
					Jan	2378	703	703
						32 ^e	11895	7914
3L	OT	2	Can	365	Apr	5983	5106	9845
					May	3746	2741	
				365	9729	9845		
		3	Can	163	Aug	530	583	2834
	Sep				1346	1106		
	4	Can	490	Oct	9138	2000	2077	
				Nov	10083	4883	4933	
				Dec	285	2961	3303	
			1-4		1050		19506	30906
	Trap	2	Can	259	May	2700	402	435
Trap GN(I) HL	3	Can	661	Jul	6216	10596	25169	
				Aug	8769	14169		
				Aug	506	1093	1958	
			661	Aug	4793	1389	1818	
					20284		28945	

Table 5. (Cont'd.)

Div	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings (t)	
							Country/month	Total
3L	Trap GN(i) HL	4	Can	384	Sep	211	812	833
					Sep	1069	512	1063
					Sep	4418	2645	3950
					<u>384</u>	<u>5698</u>		<u>5846</u>
	GN(o)	3 4	Can	129 ^f g	Jul	431	1885	4819
					Sep	2103	1916	7034
					Oct	960	3160	
						<u>129</u>	<u>3494</u>	<u>7853^h</u>
	Fixed gear ⁱ	1-4		1433		32176		44317
	OT	1	FRG	k	Jan		2967	2967
Feb						1607	1607	
Mar						1771	1771	
							<u>6459</u>	
3L	PT	1	Spain	l	Feb	2102	830	830
					Mar	3221	1256	1256
								<u>2494</u>
		2	Port	l	Apr	2769	957	957
					May	186	227	227
					Jun	<u>1069</u>	473	<u>473</u>
		1-4				<u>9347</u>		<u>9459</u>
	OT + PT	1	Spain	k	Feb	3370	1867	1867
					Mar	4002	2034	2034
								<u>4227</u>
		2	Spain	l	Apr	4052	1231	1231
					May	445	1570	1570
Jun					15785	456	456	
	3	Spain	l	Jul	<u>959</u>	281	<u>281</u>	
	1-4				<u>28613</u>		<u>8546</u>	
	1-4	Foreign outside 200-mile			80295		48900	
	OT + fixed	1-4	Can+Fra	2483		51682	75223	
	All	1-4	All	2483			124123	
2J3KL	All	1-4	All	3967		95083	170869	

^aA/L key used was a combination of 2J and 3K qtr. 4 OT keys.

^bIncludes French landings for 2J (84 t).

^cA/L key used was a combination of qtrs. 1 and 2.

^dLT age composition was obtained using the age composition of other inshore fixed gears combined.

^eA/L key used was a combination of qtrs. 1 and 2.

^fA/L key used was a combination of qtr. 3 GN(o) and qtr. 3 OT.

^gA/L key used was qtr. 4 OT.

^hThe reported catch with an estimate of 4000 t misreported from 3N0 removed.

ⁱAge composition for LL(1238 t) was obtained using the age composition of other inshore fixed gears combined.

^jEstimate of foreign catch on the "Nose" as obtained from surveillance.

^kA/L key from Can(N)-3L qtrs. 1 and 2 was used.

^lAn A/L key from the Can(N) spring research vessel survey in 3L was used.

TABLE 8. CATCH NUMBERS AT AGE (THOUSANDS) FROM THE COMMERCIAL COD FISHERY IN NAFO DIVISIONS 2J3KL FOR THE YEARS 1962-91

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
2	301	1446	2872	85	819	790	288	59	6819	33	236	0	473	420	15
3	8666	5746	19338	5177	14057	15262	6142	4330	18104	12876	6737	3953	3231	3968	13767
4	26194	27577	27603	28709	65992	77873	94291	39626	60102	71557	79809	40785	13201	14101	33727
5	64337	60234	57757	46800	93687	100339	205805	100858	82357	95384	116562	94844	34927	25370	28049
6	58163	118112	60681	66946	62812	96759	150541	163228	101249	98111	76196	59503	74403	34426	20898
7	47314	58996	100147	64360	59312	54996	83808	107509	85696	57865	55984	35464	60539	39105	16811
8	27521	29349	50865	68176	30423	38691	39443	52661	29218	25055	29553	27351	35687	36485	18022
9	20142	15520	20892	33819	23844	17146	23171	19651	10857	11732	11750	14153	18854	13421	10931
10	18036	11612	12264	14913	8762	16084	10984	12370	3825	4470	6393	7566	10492	7514	4637
11	10444	8248	8698	6945	4528	5949	5591	6389	2000	2223	2987	3815	5818	2315	1462
12	9468	4204	6352	3729	2280	3367	5249	4479	1200	1287	1660	2153	2934	1179	631
13	7778	3942	4989	3948	1825	2108	1939	3004	507	1140	1388	1173	1078	808	292
14	5785	2933	4036	3730	1186	1529	1334	1557	224	720	725	450	652	372	251
15	4669	2928	2703	2722	967	685	818	622	214	355	748	278	249	165	100
16	3888	1737	1456	1859	806	424	610	567	244	474	606	309	338	82	50
17	3955	1263	1918	575	416	193	127	319	124	124	452	85	162	5	40
18	2161	1352	1154	971	279	107	89	100	32	128	136	27	113	8	64
19	232	328	501	183	486	72	83	46	10	148	195	38	45	22	30
20	403	182	312	226	178	211	26	99	34	78	36	8	20	1	20
2+	319457	355709	384538	353873	372859	432585	630339	517474	402816	383760	392153	291965	263216	179767	147797
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
2	108	0	0	92	0	0	18	3	0	1	42	25	8	58	35
3	7128	1323	1152	2554	2185	1702	2585	782	650	831	2329	2779	1696	7693	3111
4	65510	17556	12361	12025	7172	31286	13616	14871	14824	15219	9217	14651	17639	40557	31654
5	40462	39206	37493	28814	13191	19003	42802	31760	36614	44168	32340	20184	21150	36410	53805
6	12107	20319	29202	30016	24800	14397	19028	38624	33922	45869	49061	47917	25212	22695	29553
7	5397	7711	10982	18017	22014	25435	12044	12503	28006	26025	28469	45725	38708	16390	9064
8	3396	3078	3460	4830	11848	16930	14701	7246	7050	14722	19505	18608	28499	17940	6164
9	2730	1530	1300	1217	3175	11936	8934	8910	3838	3104	5818	9026	8696	9156	4745
10	1381	1083	757	520	779	1923	6341	4227	5162	2000	1346	4337	3640	2865	1696
11	532	437	560	232	309	338	1018	2536	2905	1977	676	774	1695	1084	641
12	296	219	183	229	195	156	248	451	1681	1101	873	422	572	478	250
13	149	105	116	56	125	90	90	146	254	574	391	366	244	103	88
14	75	62	51	65	48	153	41	48	107	116	200	223	180	98	39
15	42	40	43	37	14	40	29	41	39	29	37	100	94	36	21
16	21	21	38	13	28	12	11	30	20	18	22	32	43	25	9
17	20	7	7	10	20	13	9	7	17	11	3	5	4	8	3
18	14	8	7	14	5	4	6	7	1	9	1	10	9	7	2
19	2	2	4	4	5	0	2	4	3	2	4	5	0	1	2
20	6	7	9	10	5	0	3	3	5	2	0	5	1	0	0
2+	139376	92714	97725	98755	85918	123418	121326	122199	135096	155778	150334	165194	148090	155604	140882

TABLE 9. AVERAGE WEIGHTS AT AGE (KILOGRAMS) FROM THE COMMERCIAL COD FISHERY IN NAFO DIVISIONS 2J3KL FOR THE YEARS 1962-91

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
2	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.00	0.11	0.26	0.25	0.09	0.00	0.00	0.41
3	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.44	0.32	0.35	0.45	0.45	0.45	0.40	0.46	0.53
4	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.53	0.47	0.68	0.63	0.61	0.60	0.72	0.74	0.77
5	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.84	0.71	0.91	0.96	0.93	0.97	1.04	1.13	1.16
6	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.08	0.96	1.11	1.18	1.32	1.66	1.58	1.67	1.71
7	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.52	1.30	1.27	1.39	1.75	2.33	2.46	2.46	2.38
8	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.13	1.80	1.56	1.74	2.07	2.82	3.26	3.57	3.56
9	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.64	2.86	2.20	2.05	2.21	2.24	3.46	4.05	4.41	5.01
10	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.29	2.82	2.75	2.61	2.99	3.88	4.46	5.25	5.49
11	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.95	3.19	3.13	3.34	3.67	4.78	5.02	5.80	6.72
12	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.15	4.12	3.79	3.41	3.66	4.56	6.13	6.72	7.03	7.87
13	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	6.06	5.00	4.53	4.92	4.78	6.18	7.31	8.10	8.96	8.38
14	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54	9.32	6.93	4.40	5.20	8.19	8.40	7.42	8.54	10.03
15	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	9.40	7.22	6.33	5.20	9.77	8.81	8.20	9.46	11.31
16	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	6.89	7.05	5.50	5.46	11.23	11.75	11.26	10.70	13.87
17	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	14.67	9.45	7.57	8.51	12.44	10.63	11.61	13.12	10.68
18	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	6.07	12.04	11.16	11.07	9.24	11.16	12.27	8.92	13.49	16.09
19	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	6.61	7.62	7.62	7.62	7.62	7.62	7.62	10.57	15.51	12.04
20	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19	17.46	17.46	17.46	17.46	17.46	17.46	16.00	14.77	11.37

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
2	0.00	0.00	0.31	0.34	0.00	0.21	0.32	0.29	0.26	0.29	0.17
3	0.55	0.53	0.62	0.59	0.48	0.51	0.43	0.49	0.46	0.42	0.36
4	0.78	0.84	0.87	0.88	0.73	0.72	0.66	0.73	0.74	0.69	0.61
5	1.17	1.20	1.32	1.20	1.10	1.04	1.03	1.08	1.03	1.06	0.97
6	1.64	1.77	1.75	1.79	1.43	1.54	1.32	1.38	1.44	1.50	1.41
7	2.23	2.10	2.28	2.28	2.06	1.85	1.87	1.67	1.83	1.94	1.88
8	2.86	2.66	2.61	2.71	2.66	2.35	1.93	2.21	2.07	2.22	2.27
9	3.81	3.09	3.18	2.96	3.23	2.94	2.80	2.51	2.64	2.44	2.63
10	5.32	4.18	3.50	3.65	3.32	3.47	3.51	3.04	3.02	3.06	3.14
11	6.29	6.16	4.79	4.28	4.06	3.80	4.80	4.37	3.96	3.58	3.80
12	7.06	7.19	7.76	6.19	4.55	4.54	4.64	5.49	5.41	4.68	4.96
13	7.32	8.00	9.07	8.39	7.03	5.34	5.74	6.55	7.50	6.23	5.49
14	10.01	8.36	9.14	10.26	9.67	7.12	6.13	8.60	9.24	8.51	7.61
15	8.99	7.86	10.62	11.44	11.37	11.77	8.53	9.76	10.05	9.78	11.58
16	11.54	7.91	10.57	11.61	11.27	11.24	13.51	9.73	9.34	12.58	11.01
17	10.48	9.58	13.13	17.47	12.68	14.15	9.10	12.58	15.74	15.45	12.82
18	11.15	12.95	15.97	12.94	12.42	16.14	21.77	16.01	18.66	13.58	13.00
19	9.82	0.00	9.73	15.21	14.38	12.30	17.66	16.60	0.00	17.26	13.10
20	12.59	0.00	15.88	12.81	19.49	15.72	0.00	11.03	17.64	0.00	0.00

TABLE 10. CATCH BIOMASS AT AGE (TONS) FROM THE COMMERCIAL COD FISHERY IN NAFO DIVISIONS 2J3KL FOR THE YEARS 1962-91

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
2 1	42	202	402	12	115	111	40	8	955	5	33	0	52	109	4
3 1	2946	1954	6575	1760	4779	5189	2088	1472	6155	4378	2964	1268	1131	1786	6195
4 1	14407	15167	15182	15790	36296	42830	51860	21794	33056	39356	42299	19169	8977	8884	20573
5 1	56617	53006	50826	41184	82445	88298	181108	88755	72474	83938	74600	67339	31784	24355	26086
6 1	71540	145278	74638	82344	77259	119014	185165	200770	124536	120677	82292	57123	82587	40623	27585
7 1	78541	97933	166244	106838	98458	91293	139121	178465	142255	96056	85098	46103	76885	54356	29419
8 1	58345	62220	107834	144533	64497	82025	83619	111641	61942	53117	62948	49232	55672	63484	33166
9 1	53175	40973	55155	89282	62948	45265	61171	51879	28662	30972	33605	31137	38651	29660	24485
10 1	57354	36926	39000	47423	27863	51147	34929	39337	12164	14215	21033	21336	28853	19612	13865
11 1	39269	31012	32704	26113	17025	22368	21022	24023	7520	8358	11799	12170	18210	7732	5366
12 1	39292	17447	26361	15475	9462	13973	21783	18588	4980	5341	6839	8160	10005	4315	2877
13 1	47135	23889	30233	23925	11059	12774	11750	18204	3072	6908	6940	5314	5304	3862	1805
14 1	32049	16249	22359	20664	6570	8471	7390	8626	1241	3989	6757	3119	2869	1934	2056
15 1	28528	17890	16515	16631	5908	4185	4998	3800	1308	2169	7031	2007	1576	858	977
16 1	22667	10127	8488	10838	4699	2472	3556	3306	1423	2763	4175	2178	1859	448	561
17 1	25470	8134	12352	3703	2679	1243	818	2054	799	799	6831	803	1226	43	498
18 1	13117	8207	7005	5894	1694	649	540	607	194	777	1637	301	1251	74	714
19 1	1534	2168	3312	1210	3212	476	549	304	66	978	1486	290	343	168	229
20 1	2898	1309	2243	1625	1280	1517	187	712	244	561	629	140	349	17	349
2+1	644926	590090	677428	655244	518248	593302	811698	774346	503047	475357	458793	327188	367583	262319	196809
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
2 1	10	0	0	38	0	0	6	1	0	0	13	7	2	17	6
3 1	3208	529	530	1354	1202	902	1603	461	312	424	1001	1362	814	3231	1120
4 1	39306	12640	9147	9259	5594	26280	11846	13086	10822	10958	6083	10695	13053	27984	19309
5 1	39248	40774	42367	33424	15433	22804	56235	38112	40275	45935	33310	21799	21785	38595	52191
6 1	20098	32104	48767	51327	40672	25483	33299	69137	48508	70638	64761	66125	36305	34042	41670
7 1	12575	18969	27016	42880	49091	53414	27460	28507	57692	48146	53237	76361	70836	31797	17040
8 1	9577	10034	12352	17195	33885	45034	38370	19637	18753	34597	37645	41124	58993	39827	13992
9 1	9446	6197	5733	6097	12097	36882	28410	26374	12390	9126	16290	22655	22957	22341	12479
10 1	5358	4830	3974	2855	4144	8038	22193	15429	17138	6940	4724	13184	10993	8767	5325
11 1	2543	2194	3248	1559	1944	2082	4876	10854	11794	7513	3245	3382	6712	3881	2436
12 1	1814	1472	1286	1802	1377	1122	1924	2792	7649	4999	4051	2317	3095	2237	1240
13 1	1089	851	1039	469	915	720	816	1225	1786	3065	2244	2397	1830	642	483
14 1	630	460	436	652	480	1279	375	492	1035	828	1226	1918	1663	834	297
15 1	370	328	407	418	126	314	308	469	443	341	316	976	945	352	243
16 1	247	236	407	180	323	95	116	348	225	202	297	311	402	315	99
17 1	213	81	92	107	210	125	118	122	216	156	27	63	63	124	38
18 1	172	71	94	225	56	52	96	91	12	145	22	160	168	95	26
19 1	15	21	62	48	49	0	19	61	43	25	71	83	0	17	26
20 1	105	112	133	114	63	0	48	38	97	31	0	55	18	0	0
2+1	146023	131904	157091	170005	167681	224625	228118	227236	229191	244066	228564	264975	250632	215096	168021

Table 11. Cod abundance estimates (No. x 10³) from research vessel surveys in NAFO Division 2J (Fall). Numbers in brackets are estimates for non-sampled strata. Only 0-500 m strata used in estimating non-sampled strata.

Depth range (m)	Stratum number	Stratum area (mi ²)	GADUS 1978	GADUS 1979	GADUS 1980	GADUS 1981	GADUS 1982	GADUS 1983	GADUS 1984	GADUS 1985	GADUS 1986	GADUS 1987	GADUS 1988	GADUS 1989	GADUS 1990	GADUS 1991	
101-200	201	1427	3071	1500	5749	8377	16692	16246	10533	15246	21638	6784	54	0	0	0	
	205	1823	8039	1574	787	4550	21765	13547	25230	8159	9481	7841	13707	164	68	0	
	206	2582	1634	1236	2104	6220	5868	8694	30077	12764	29985	4222	21638	9363	211	420	
	207	2246	5100	2664	3406	5479	9094	13024	14210	27850	6310	9027	4504	711	1740	0	
	Total	8078	17844	6974	12046	24626	53419	51511	80050	64019	67414	27874	39903	10238	2019	420	
201-300	202	440	462	396	5681	2378	2378	1833	1866	760	7663	2626	(746)	0	0	0	
	209	1608	3531	21485	3410	10099	7681	29567	3863	8599	28567	13594	6711	14318	583	1224	
	210	774	4169	2760	2982	445	4703	59785	4953	299	21187	145	2401	8686	3776	3976	
	213	1725	19714	18516	19811	2158	5807	12806	6915	14028	23624	10316	12334	30271	10278	3663	
	214	1171	10680	6527	10958	3956	5900	4659	25667	19030	43496	40024	31805	13844	3621	334	
	215	1270	34281	9986	25692	35768	27583	7233	8040	7424	85617	8593	32304	111	2069	337	
	228	1428	(3509)	6780	8254	10701	2187	2269	1853	352	12702	1164	2272	3001	2358	20652	
	234	508	553	267	1506	534	2250	4698	3005	2339	5415	1760	1125	0	0	0	
	Total	8924	76899	66717	78294	66039	58489	122850	56162	52831	228271	78222	89698	70231	22685	30186	
301-400	203	480	(299)	(236)	3081	81	1117	462	703	156	1784	1405	2090	0	0	12	
	208	448	247	1480	202	303	1368	1749	224	1043	2051	3918	757	6356	1073	146	
	211	330	5450	2737	4659	1746	2415	1325	297	776	1090	1709	1647	12299	3109	10582	
	216	384	(152)	202	3603	86	14	10	331	115	94	3127	476	749	86	96	
	222	441	1479	149	1258	132	11	11	11	182	17	281	66	2847	712	188	
	229	567	234	2873	1319	447	298	670	71	936	539	85	440	1475	1085	1518	
	Total	2650	7861	7677	14122	2795	5212	4227	1637	3208	5575	10525	5476	23726	6065	12542	
	401-500	204	354	(151)	(118)	(163)	1342	142	540	1422	0	518	425	1860	13	13	0
		217	268	(1)	(0)	(1)	0	0	0	(5)	0	0	50	0	0	0	13
223		180	(1)	(0)	(2)	0	0	0	0	0	0	0	14	7	68	32	
227		686	(98)	(73)	(108)	0	21	26	0	0	51	77	86	1146	4446	1337	
235		420	(146)	(114)	(158)	158	126	1135	63	32	0	268	173	236	567	1734	
Total	1908	397	305	432	1500	289	1701	1490	32	569	820	2133	1402	5094	3116		
501-750	Total	1591	nf	nf	nf	50	50	0	33 ^a	12	249	125	218	100	936	6350	
751-1000	Total	517	nf	nf	nf	0 ^a	0 ^a	0	0 ^a	0	14	0	0	0 ^a	0	0	
Total ^b		102999	81672	104895	94961	117410	180291	139339	120092	301831	117446	137209	105601	35865	46264		
Mean no. per tow ^b		63.64	50.47	64.82	58.68	72.55	111.40	86.10	74.21	186.50	72.57	84.78	65.25	22.16	28.59		
Unadjusted total for all sampled strata		98643	81130	104461	95010	117459	180290	139366	120103	302093	117569	136682	105699	36801	52613		
Upper limit		135651	129789	139530	162767	151075	744685	184179	154187	468811	163856	183268	149747	51757	126298		
Lower limit		61634	32470	69392	27253	83843	384105	94553	86020	135374	71282	90096	61651	21845	-21071		

^aAll strata not fished.
^bTotal and mean from multiplicative model.
 nf = Not fished.

Table 12. Cod biomass estimates (t) from research vessel surveys in NAFO Division 2J (Fall). Numbers in brackets are estimates for non-sampled strata. Only 0-500 m strata used in estimating non-sampled strata.

Depth range (m)	Stratum number	Stratum area (mi ²)	GADUS 15	GADUS 29	GADUS 44	GADUS 58	GADUS 71	GADUS 86-88	GADUS 101-102	GADUS 116-118	GADUS 131-132	GADUS 145-146	GADUS 159-160	GADUS 174-176	GADUS 190-191	GADUS 208-209
			1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
101-200	201	1427	4847	3256	11319	15998	18085	16764	12033	14952	24712	9158	84	0	0	0
	205	1823	16200	2669	1676	10126	39216	17742	25093	7526	11016	9456	27403	240	11	0
	206	2582	2074	2671	3849	13153	8533	11442	39133	13186	34327	5313	36617	13183	107	221
	207	2246	8209	4192	7738	12284	12612	12608	18136	27954	7864	11883	7613	465	1770	0
Total	8078	31330	12788	24582	51561	78446	78446	58556	94395	63618	77919	35810	71717	13888	1888	221
201-300	202	440	525	749	12964	6292	5681	3798	2948	850	10363	4533	(1436)	0	0	0
	209	1608	5384	43569	12810	22275	18351	53925	7678	12245	37475	19297	11006	13957	228	746
	210	774	5572	5771	5810	823	10428	97578	9448	782	25147	360	4532	13125	2115	2932
	213	1725	31627	31100	34068	5622	8073	14748	9401	16121	27904	13819	20289	36371	6159	2227
	214	1171	20791	13231	25096	9669	10593	6944	33853	24715	61918	62937	52313	19424	4369	175
	215	1270	55780	19546	64301	96161	60996	12584	10471	10732	131984	14279	65032	40	3013	228
	228	1428	(5671)	12374	16972	23904	4357	2215	3012	299	15920	1749	4845	4582	3096	11877
	234	508	1030	553	3699	1192	4614	5370	3657	2402	7178	2790	2521	0	0	0
Total	8924	126380	126893	175720	165938	123493	123493	197162	80468	68146	317789	119764	161974	87499	18980	18185
301-400	203	480	(649)	(641)	7467	230	3141	1369	2054	192	2982	2798	4396	0	0	10
	208	448	438	3341	631	908	3750	3153	454	1454	2589	6120	1816	5189	682	82
	211	330	10285	5685	9384	4747	6490	3016	954	1400	1462	3573	3412	26274	2162	6930
	216	384	(311)	484	10204	454	86	24	908	180	142	5462	937	1356	48	52
	222	441	2029	653	2780	281	0	105	22	281	15	463	91	1199	656	84
	229	567	319	7394	3150	1144	467	516	106	1397	816	96	786	2525	1641	916
Total	2650	14031	18198	33616	7764	13934	13934	8183	4498	4904	8006	18512	11438	36543	5189	8074
401-500	204	354	(261)	(258)	(397)	3149	316	1506	2192	0	829	683	3514	2	3	0
	217	268	(3)	(3)	(9)	0	0	0	(7)	0	0	80	0	0	0	9
	223	180	(2)	(2)	(7)	0	0	0	0	0	0	0	19	4	39	34
	227	686	(186)	(183)	(291)	0	36	129	0	0	101	117	137	2483	6291	1063
	235	420	(252)	(249)	(385)	347	315	1584	121	24	0	497	334	410	465	925
Total	1908	704	695	1089	3496	667	667	3219	2320	24	930	1377	4004	2899	6798	2031
501-750	Total	1591	nf	nf	nf	137	140	0	58 ^a	31	515	202	388	269	1097	3817
751-1000	Total	517	nf	nf	nf	0 ^a	0 ^a	0	0 ^a	0	27	0	0	0 ^a	0	0
Total ^b		172443	158574	235005	228757	216540	216540	267123	181681	136693	404642	175466	249135	140829	32853	28511
Mean wt. per tow ^b		106.55	97.98	145.21	141.35	133.80	133.80	165.06	112.26	84.46	250.03	108.42	153.94	87.02	20.30	17.62
Unadjusted total for all sampled strata		165109	157237	233916	228894	216680	216680	267121	181731	136723	405185	175668	248085	141098	33950	32327
Upper limit		228826	255091	314420	424722	288881	288881	1174856	241662	174398	667127	248495	336941	234034	51160	74147
Lower limit		101392	59384	153412	33067	144479	144479	-640615	121800	99048	143243	102841	159229	48162	16739	-9493

^aAll strata not fished.

^bTotal and mean from multiplicative model.

nf = Not fished.

Table 13. Cod abundance estimates (No. x 10⁻³) from research vessel surveys in NAFO Division 3K. (Fall). Numbers in brackets are estimates for non-sampled strata. Only 0-500 m strata used in estimating non-sampled strata.

Depth range (m)	Stratum number	GADUS 15	GADUS 29	GADUS 44	GADUS 58-59	GADUS 71-72	GADUS 87-88	GADUS 101-103	GADUS 117-118	GADUS 131-132	GADUS 146-147	GADUS 160-161	GADUS 175-176	GADUS 191-192	GADUS 209-210
101-200	618	(2031)	(2855)	(1580)	(1699)	(1407)	(2063)	4806	6458	12975	2652	1074	560	573	87
	619	(521)	(751)	(396)	(429)	(348)	(530)	1243	221	930	671	460	1430	72	30
Total	3043	2552	3606	1755	2593	6049	6679	13905	3323	1534	1990	645	117		
201-300	620	2709	17749	26203	15206	12689	4248	17610	22825	1728	6449	4236	9368	606	378
	621	14655	25646	2739	7453	6472	4603	6070	1531	4654	930	2854	2512	441	129
	624	668	13121	23166	627	3686	2470	1128	978	552	602	769	520	2733	1128
	632	447	727	2265	5078	3171	2494	8321	(2236)	1029	1158	1879	604	2684	1631
	634	1618	4057	18157	13651	19455	11384	14186	6229	7112	99787	18660	4676	77314	625
	635	1274	3921	1492	3706	4743	3175	1227	3275	874	3727	829	1033	319	192
	636	1455	1820	2446	6051	3695	7001	2603	3413	928	3440	1482	1136	109	109
	637	1132	2634	5778	3909	4744	6409	8718	19062	3824	11939	3781	6936	816	708
Total	12162	58684	105153	50967	59636	43653	58396	64088	17578	156465	34244	35332	95376	8333	25675
301-400	623	1027	6142	2981	7593	876	1557	5769	11764	1015	1060	1172	6877	4390	360
	625	850	1340	2488	1515	1021	2169	1276	574	1723	808	2760	3238	1308	255
	626	919	3191	759	1012	2235	911	1276	770	826	10451	1173	317	1628	310
	628	1085	1433	2891	1008	1371	570	1955	1140	1826	624	375	2101	1853	684
	629	495	724	449	144	50	412	562	459	272	1348	237	431	425	37
	630	544	(255)	388	315	225	(172)	306	414	82	65	177	191	2151	204
	633	2179	4283	3044	2944	3106	3552	3748	5954	10059	26717	15375	3660	39354	46720
	638	2059	2720	8081	3246	9158	5699	13643	3323	9189	9080	4637	41590	91652	41601
	639	1463	1603	3075	741	1303	2921	4095	1304	2128	3423	1459	1977	2320	20390
Total	10621	21691	24156	18518	19345	17963	32630	25702	27120	53576	32799	15826	99436	153187	101022
401-500	622	632	(306)	(436)	(234)	356	190	142	308	59	332	47	237	2499	158
	627	1194	(478)	(685)	(365)	104	152	193	178	89	1262	341	284	1304	403
	631	1202	(561)	(801)	(430)	162	0	523	18	103	68	752	1585	8185	3564
	640	198	(24)	(37)	(18)	0	0	(25)	7	10	7	59	632	52	352
	645	204	(19)	(29)	(13)	0	5	8	15	15	(32)	31	15	505	0
Total	3430	1388	1988	1060	622	347	891	526	276	1701	1178	2180	13125	9716	3500
501-750	Total	917	nf	nf	nf	0	15	0	0	0	44	nf	nf	25	33
751-1000	Total	1340	nf	nf	nf	0	0	0 ^a	0	0	0 ^a	nf	nf	23	10
Total ^b		84311	134903	72521	81732	63717	94508	96355	51652	225648	71544	54871	209692	171919	130316
Mean no. per tow ^b		38.39	61.43	33.02	37.22	29.01	43.04	43.88	23.52	102.75	32.58	24.99	95.49	78.29	59.34
Unadjusted total for all sampled strata		80120	129310	69485	79602	61791	91908	94131	51653	225616	71587	54871	209925	171930	130355
Upper limit		118124	219416	93324	104929	75262	119956	125238	65202	498233	101570	207965	360927	287775	204411
Lower limit		42115	39204	45645	54276	48320	63859	63023	38104	-47002	41603	-98223	58923	56085	56300

^aAll strata not fished.
^bTotal and mean from multiplicative model.
 nf = Not fished.

Table 15. Cod abundance estimates (No. x 10⁻³) from research vessel surveys in NAFO Division 3L (Fall). Numbers in brackets are estimates for non-sampled strata. Only 0-200 fath. strata used in estimating non-sampled strata.

Depth range (fath)	Stratum number	Stratum area (mi ²)	ATC 323-325 1981	ATC 333-334 1982	WT 7-9 1983	WT 16-18 1984	WT 37-39 1985	AN 72 1986	WT 65 1987	WT 78 1988	WT 87 1989	WT 101 1990	WT 114-115 1991
31-50	350	2071	4923	2332	6335	15455	13698	15197	4785	3902	3327	1498	1825
	363	1780	802	1960	13050	19374	40659	2439	6770	9193	12159	12259	1377
	371	1121	105	1010	4679	8018	1058	151	1330	1963	105	2844	168
	372	2460	14256	8679	37532	27415	21453	6039	21406	5128	8956	54511	781
	384	1120	168	273	6025	20303	452	52	8589	336	67	19295	103
Total		8552	20254	14254	67621	90565	77320	23878	42880	20522	24614	90407	4254
51-100	328	1519	(299)	(375)	(554)	285	385	4598	257	928	309	114	76
	341	1574	1930	975	1359	1512	945	1287	144	266	74	217	236
	342	585	381	1039	274	439	205	219	176	132	44	417	66
	343	525	897	(223)	328	2089	236	617	131	210	13	236	53
	348	2120	1724	3310	1953	7002	1284	1999	1008	1194	1432	984	557
	349	2114	2154	1492	1622	8059	3047	2739	681	2257	730	1111	1587
	364	2817	963	1113	1629	8162	1774	964	1012	2145	442	2397	159
	365	1041	8693	2090	578	8400	684	1583	521	375	234	195	547
	370	1320	173	413	727	7799	561	248	380	255	66	357	66
	385	2356	44	309	318	1827	118	702	197	27	16	354	106
	390	1481	37	111	111	2483	48	241	764	125	79	111	0
Total		17452	17295	11450	9453	48057	9287	15197	5271	7914	3439	6493	3453
101-150	344	1494	2075	5047	1103	3701	2978	2464	1654	977	881	2093	336
	347	983	2706	2915	2041	2976	576	1290	553	2966	1476	7600	148
	366	1394	5197	8022	4447	6221	18207	23099	9433	23992	6278	2703	5454
	369	961	2669	1371	2525	2803	1960	21671	5194	3203	418	866	4408
	386	983	861	553	(1443)	1513	1269	5737	1107	1004	1550	2287	49
	389	821	(933)	1756	(1622)	811	961	985	3374	1017	1263	801	1335
	391	282	(72)	95	635	32	635	95	169	32	64	191	28
Total		6918	14513	19759	13816	18057	26586	55341	21484	33191	11930	16541	11758
151-200	345	1432	2015	3637	2929	2300	4658	5105	3386	4208	2319	2826	618
	346	865	5822	2337	4389	1731	3441	5089	11834	10259	4091	4523	10631
	368	334	1316	1429	(2645)	602	2871	6168	1617	1580	928	4162	9540
	387	718	808	3000	(1797)	3072	1253	10618	880	377	305	1590	1046
	388	361	(263)	253	(460)	528	461	(446)	149	339	935	420	271
	392	145	(20)	147	33	103	60	16	5	38	16	65	47
Total		3855	10244	10803	12253	8336	12744	27442	17871	16801	8594	13586	22153
201-300	Total	1142	nf	20 ^a	nf	410	90	0 ^a	nf	nf	nf	180 ^a	404
301-400	Total	804	nf	nf	0 ^a	0 ^a	0	0 ^a	nf	nf	nf	0 ^a	13
Total ^b			62303	56265	103140	165002	125933	121853	87504	78420	48577	127023	41616
Mean no. per tow ^b			22.57	20.38	37.37	59.78	45.62	44.14	31.70	28.41	17.60	46.02	15.08
Unadjusted total for all sampled strata			60719	55689	94623	165427	126027	121411	87505	78427	48578	127207	42036
Upper limit			83412	67092	123050	197373	175608	169896	109122	98525	65582	185198	53941
Lower limit			38025	44285	66195	133482	76446	72925	65889	58329	31575	69216	30131

^aAll strata not fished.

^bTotal and mean from multiplicative model.

nf = Not fished.

Table 16. Cod biomass (t) from research vessel cruises in NAPO Division 3L (Fall). Numbers in brackets are estimates from non-sampled strata. Only 0-200 fath. strata used in estimating non-sampled strata.

Depth range (fath)	Stratum number	Stratum area (mi ²)	ATC 323-325 1981	ATC 333-334 1982	WT 7-9 1983	WT 16-18 1984	WT 37-39 1985	AN 72 1986	WT 65 1987	WT 78 1988	WT 87 1989	WT 101 1990	WT 114-115 1991
31-50	350	2071	6244	3848	8463	16498	11219	21047	6486	8216	4815	3270	3165
	363	1780	852	2009	17993	20017	40414	4605	11261	15379	13532	14606	2065
	371	1121	137	1363	6126	11210	1304	89	2710	4404	231	4906	230
	372	2460	20737	6882	44364	27045	29915	11255	40873	9964	13626	99532	1636
	384	1120	112	1090	5941	27463	583	53	13690	911	76	33264	293
Total		8552	28082	15192	82887	102233	83435	37049	75020	38874	32280	155578	7389
51-100	328	1519	(334)	(370)	(699)	299	656	3128	131	1215	437	130	84
	341	1574	2146	901	1949	1760	957	1793	309	561	69	582	463
	342	585	834	951	263	736	205	233	167	237	60	257	186
	343	525	1419	(237)	661	2261	99	690	194	269	39	234	30
	348	2120	2651	4249	3125	11537	1995	2384	1512	1973	1312	1026	645
	349	2114	3604	3174	2266	8257	3856	3211	1069	3835	1238	1681	2444
	364	2817	1932	1800	1946	4536	1419	1298	1521	3309	773	2536	482
	365	1041	17904	3702	961	3624	977	1512	1087	1035	316	205	1288
	370	1320	300	446	1184	7891	597	69	842	562	116	520	160
	385	2356	38	43	1019	1886	94	1095	951	326	64	711	124
	390	1481	9	58	852	1130	9	35	277	204	108	65	0
Total		17452	31171	15931	14925	43917	10864	15448	8060	13526	4532	7947	5906
101-150	344	1494	3869	7701	1682	6121	4010	3623	2019	897	854	1485	140
	347	983	4550	4805	3167	5731	996	1833	701	3852	2332	5735	122
	366	1394	9313	11920	8999	7101	27549	34160	15868	39741	8412	3593	6226
	369	961	7755	2290	5849	3962	4557	33585	12236	6341	2034	1683	6328
	386	983	1414	1430	(3892)	2546	4162	13630	2869	4044	4007	5653	49
	389	821	(1428)	3428	(2791)	2737	2521	1723	1733	704	2009	1875	907
	391	282	(63)	487	159	79	325	370	70	6	23	165	15
Total		6918	28392	32061	26539	28277	44120	88924	35496	55585	19671	20189	13787
151-200	345	1432	4703	7686	6443	3673	8104	9106	5375	7693	4028	3034	520
	346	865	12012	4212	7746	3003	5805	7670	19771	18031	7978	6309	10622
	368	334	5948	3604	(7481)	1222	6011	12300	5353	4319	3165	7317	11827
	387	718	1334	9216	(5379)	7465	4056	20225	2740	1289	476	8644	1733
	388	361	(415)	461	(815)	616	1951	(592)	115	366	1362	1066	258
	392	145	(27)	220	109	68	106	11	8	41	22	120	30
Total		3855	24439	25399	27973	16047	26033	49904	33362	31739	17031	26490	24990
201-300	Total	1142	nf	20 ^a	nf	1224	721	0 ^a	nf	nf	nf	522 ^a	647
301-400	Total	804	nf	nf	0 ^a	0 ^a	0	0 ^a	nf	nf	nf	0 ^a	32
Total ^b			112086	88586	152325	190480	164451	191326	151936	139727	73512	210203	52073
Mean wt. per tow ^b			40.60	32.09	55.18	69.00	59.57	69.31	55.04	50.61	26.63	76.14	18.86
Unadjusted total			109819	87997	131268	191702	165169	190732	151936	139726	73514	210725	52750
Upper limit			153245	105967	175408	226109	213267	264592	191200	172522	92871	319223	67681
Lower limit			66392	70027	87127	157294	117071	116872	112672	106929	54156	102228	37820

^aAll strata not fished.

^bTotal and mean from multiplicative model.

nf = Not fished.

Table 17. Cod abundance estimates (No. x 10⁻³) from research vessel surveys in NAFO Division 3L (Spring). Numbers in brackets are estimates for non-sampled strata. Only 0-200 strata used to estimate non-sampled strata.

Depth range (fath)	Stratum number	Stratum area (mi ²)	ATC 276 1978	ATC 290 1979	ATC 304-305 1980	ATC 317-318 1981	ATC 329 1982	WT 28-30 1985	WT 48 1986	WT 59-60 1987	WT 70-71 1988	WT 83 1989	WT 96 1990	WT 106-107 1991
31-50	350	2071	1373	7756	2798	829	1221	15883	5893	6685	32355	9836	2199	369
	363	1780	2378	7649	1817	3296	1924	7182	7429	11194	14621	3982	2119	363
	371	1121	477	1599	2917	0	189	8061	926	1647	1178	1501	996	15483
	372	2460	9022	6135	3293	5032	1477	27099	12451	9290	13346	4281	1794	203
	384	1120	56	2711	1555	28	42	98	1906	2174	387	280	84	147
Total		8552	13306	25850	12380	9185	4853	58323	28605	30990	61887	19880	7192	16565
51-100	328	1519	(104)	296	(243)	0	342	257	443	794	285	0	1124	76
	341	1574	325	827	1024	1004	2150	3505	1661	2599	8330	1669	591	59
	342	585	922	132	417	(132)	278	586	454	307	176	454	176	0
	343	525	867	768	1399	887	2374	1103	719	381	801	1340	105	99
	348	2120	2361	3687	3456	887	2467	4986	5450	10702	8391	4367	1345	60
	349	2114	4628	4035	2997	595	3729	7016	6767	4616	5951	11148	1092	175
	364	2817	599	4705	2996	1128	1304	5821	3483	8064	5286	7250	2115	308
	365	1041	391	2481	1035	977	4689	1797	1516	5798	5236	2683	430	59
	370	1320	363	817	1486	0	248	7394	805	4742	2715	4013	212	11593
	385	2356	59	783	3139	59	0	2087	258	514	849	3493	611	4863
	390	1481	1056	2223	1223	389	139	358	97	79	0	125	22	67
Total		17452	11675	20754	19415	6058	17720	34910	21653	38596	38020	36542	7823	17359
101-150	344	1494	11607	15981	7947	29001	9168	695	4864	449	841	5239	299	45
	347	983	6272	5737	10212	3247	10773	1668	5519	2410	5003	1439	221	92
	366	1394	(9200)	11118	5232	56749	18521	41420	20339	13214	4133	10215	3645	(4238)
	369	961	577	2813	6757	7286	1876	10950	9534	6810	10929	5134	1890	(1205)
	386	983	615	2749	2066	2693	812	5372	1783	3011	3320	6924	14920	6911
	389	821	1130	1464	5259	1140	2712	8677	1380	1150	1335	1430	447	760
	391	282	201	1117	1757	688	191	476	603	286	127	191	2593	445
Total		6918	29602	40979	39230	100804	44053	69258	44022	27330	25688	30572	24015	13696
151-200	345	1432	5321	1800	6385	15264	2714	2107	13160	21498	7820	12860	2069	(1496)
	346	865	(1676)	1380	1125	2727	801	714	16999	6324	4058	3360	52513	(760)
	368	334	(374)	56	113	1880	639	1492	4250	5382	238	1270	14491	(167)
	387	718	198	256	108	296	1419	24226	5686	189	552	2878	43939	17660
	388	361	257	190	41	393	989	488	2520	14	244	289	13603	1805
	392	145	44	178	5	196	218	1818	403	5	234	98	2961	528
Total		3855	7870	3860	7777	20756	6780	30845	43018	33412	13146	20755	129576	22416
201-300	Total	1142	nf	nf	nf	204 ^a	nf	329	nf	nf	nf	nf	nf	3498 ^a
301-400	Total	804	nf	nf	nf	nf	nf	0	nf	nf	nf	nf	nf	144 ^a
Total ^b			62452	91444	78804	136800	73406	193336	137303	130329	138742	107747	168602	70035
Mean no. per tow ^b			22.62	33.12	28.54	49.55	26.59	70.03	49.74	47.21	50.26	39.03	61.07	25.37
Unadjusted total for all sampled strata			51099	91444	78561	136875	73406	193665	137300	130329	138741	107747	168604	65810
Upper Limit			72936	113863	93294	267984	94173	255913	161283	179958	177548	126081	263989	110424
Lower Limit			29262	69024	63828	5766	52638	131418	113317	80699	99933	89414	73220	21196

^aAll strata not fished.

^bTotal and mean from multiplicative model.

nf = Not fished.

Table 18. Cod biomass estimates (t) from research vessel surveys in NAFO Division 3L (Spring). Numbers in brackets are estimates for non-sampled strata. Only 0-200 fath. strata used in estimating non-sampled strata.

Depth range (fath)	Stratum number	Stratum area (mi ²)	ATC 276 1978	ATC 290 1979	ATC 304-305 1980	ATC 317-318 1981	ATC 329 1982	WT 28-30 1985	WT 48 1986	WT 59-60 1987	WT 70-71 1988	WT 83 1989	WT 96 1990	WT 106-107 1991
31-50	350	2071	2108	13637	7124	2539	4775	31785	16344	19008	56567	22760	8359	1059
	363	1780	3923	11237	4182	7082	6721	14881	12152	19419	23096	8070	8270	1433
	371	1121	1492	2439	8148	0	789	15647	3184	4122	4005	4080	3282	25696
	372	2460	7015	8342	7448	7155	3978	44792	19171	22017	27917	12397	8981	883
	384	1120	19	3521	2480	308	231	284	3667	3681	844	549	578	381
Total		8552	14557	39176	29382	17084	16494	107389	54518	68247	112429	47856	29470	29452
51-100	328	1519	(105)	518	(398)	0	893	74	838	1897	456	0	3577	59
	341	1574	1007	2468	3291	2038	8495	4735	8022	12076	16947	4772	3291	167
	342	585	3014	409	961	(277)	871	429	1639	604	307	483	509	0
	343	525	1791	1190	2936	946	4768	795	1502	1064	1346	1511	92	31
	348	2120	3551	7129	7855	1966	5709	7904	11590	33966	23118	9796	3958	229
	349	2114	8890	8800	7282	1321	10182	16005	27730	14008	17951	28008	1622	573
	364	2817	929	7884	7154	2361	3938	9837	9223	20328	13755	18200	10495	709
	365	1041	533	2953	2442	2090	6056	2160	3329	9791	8361	5262	1373	68
	370	1320	368	1046	2807	0	99	7054	3511	7679	5896	6663	980	12956
	385	2356	80	1118	6278	413	0	2084	424	1066	2133	3088	792	6510
	390	1481	796	2125	2798	500	217	261	406	503	0	197	63	367
Total		17452	21064	35640	44202	11912	41228	51338	68214	102982	90270	77980	26752	21669
101-150	344	1494	20390	19398	10172	50712	19583	648	8032	1023	1121	5808	183	6
	347	983	8502	7705	16019	8043	21435	3416	10419	4919	8818	2386	312	15
	366	1394	(7733)	11509	5912	81497	21817	45178	30705	19201	7551	13832	5895	(4074)
	369	961	1000	2448	7406	9378	4959	19297	11488	11564	16889	9252	3960	(1318)
	386	983	252	2881	2361	4593	1279	3877	1906	4368	3274	6748	38420	6640
	389	821	1065	1098	6923	478	1664	6169	900	647	692	616	513	226
	391	282	356	1048	2064	1212	95	429	826	201	41	95	621	283
Total		6918	39298	46087	50857	155913	70832	79014	64276	41923	38386	38737	49904	12562
151-200	345	1432	10700	4844	11674	29493	6060	2939	17444	28741	11340	18456	2048	(2323)
	346	865	(1660)	2137	2154	4307	1223	341	20427	8298	5203	4496	57484	(865)
	368	334	(542)	239	796	1761	809	1536	6412	7166	652	2503	18601	(281)
	387	718	184	459	256	243	2353	21491	6555	195	520	2506	28531	9249
	388	361	182	349	108	190	1321	346	1572	10	179	122	14910	1005
	392	145	66	189	0	128	256	2237	435	3	98	57	1162	179
Total		3855	13334	8217	14988	36122	12022	28890	52845	44413	17992	28140	122736	13900
201-300	Total	1142	nf	nf	nf	225a	nf	887	nf	nf	nf	nf	nf	3434 ^a
301-400	Total	804	nf	nf	nf	nf	nf	0	nf	nf	nf	nf	nf	258 ^a
Total ^b			88251	129116	139428	221031	140580	266632	239860	257568	259082	192713	228864	77583
Mean wt. per tow ^b			31.97	46.77	50.51	80.07	50.92	96.58	86.89	93.30	93.85	69.81	82.90	28.10
Unadjusted total for all sampled strata			78212	129117	139030	220979	140578	267516	239857	257566	259080	192713	228865	72416
Upper limit			102912	155685	166966	407989	171827	338672	278798	321060	325467	226139	335403	141984
Lower limit			53513	102549	111095	33969	109329	196360	200917	194071	192693	159288	122327	2847

^aAll strata not fished.

^bTotal and mean from multiplicative model.

nf = Not fished.

Table 19. Biomass estimates (000 t) of cod from autumn research vessel surveys in NAFO Division 2J, 3K and 3L.

Biomass											
Division	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
2J	229	217	267	182	137	405	176	249	141	33	29
3K	178	136	176	180	86	356	123	75	291	193	126
3L	112	89	152	191	165	191	152	140	74	210	52
Total	519	442	596	553	388	952	451	464	506	436	207

Percentage												Ave.
2J	44	49	45	33	35	43	39	54	28	8	14	36
3K	34	31	30	32	22	37	27	16	58	44	61	36
3L	22	20	25	35	43	20	34	30	14	48	25	28
Total	100	100	100	100	100	100	100	100	100	100	100	100

TABLE 20. MEAN NUMBERS PER TON (ADJUSTED FOR MISSING STRATA) OF COD AT AGE FROM AUTUMN RV SURVEYS IN DIVISION 2J.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0.00	0.00	0.00	0.36	0.00	1.06	1.99	0.52	0.06	0.03	0.08	0.75	0.24	0.12	0.01
2	3.34	0.50	0.31	1.54	4.16	3.09	14.10	5.30	1.51	2.28	0.41	2.55	12.85	1.39	1.29
3	9.66	7.45	1.37	1.32	3.08	18.26	16.83	16.75	9.06	8.48	1.93	2.63	8.09	8.64	3.35
4	29.14	13.75	11.46	4.48	2.29	6.42	25.91	16.55	22.07	31.24	4.43	4.62	5.67	4.08	16.09
5	13.33	27.80	18.81	20.37	4.22	4.47	16.48	26.70	13.65	70.31	24.93	7.74	5.89	2.14	5.48
6	2.93	9.52	16.19	20.80	17.01	4.28	6.85	10.19	16.54	41.29	25.18	25.28	7.85	1.50	0.89
7	1.36	2.11	2.31	12.34	15.23	13.24	4.54	2.46	7.32	21.61	7.37	29.34	13.26	1.07	0.56
8	1.23	0.77	0.73	1.79	9.63	11.65	12.34	1.55	1.26	6.71	5.29	5.48	9.01	1.98	0.35
9	0.96	0.61	0.50	0.52	2.00	7.91	5.61	3.50	0.86	0.72	2.21	3.91	1.28	0.97	0.26
10	0.53	0.44	0.28	0.38	0.51	1.33	3.58	1.50	1.18	0.66	0.38	1.92	0.67	0.21	0.14
11	0.20	0.24	0.28	0.24	0.08	0.36	0.74	0.66	0.43	0.60	0.05	0.31	0.33	0.06	0.02
12	0.10	0.11	0.11	0.29	0.14	0.17	0.24	0.32	0.22	0.35	0.18	0.14	0.11	0.04	0.03
13	0.04	0.13	0.04	0.09	0.15	0.10	0.11	0.05	0.03	0.11	0.08	0.08	0.00	0.00	0.01
14	0.06	0.21	0.08	0.31	0.21	0.22	0.13	0.02	0.02	0.11	0.09	0.02	0.00	0.00	0.01
1+	62.88	63.64	50.47	64.82	58.68	72.55	111.40	86.10	74.21	186.50	72.57	84.78	65.25	22.16	26.59
2+	62.88	63.64	50.47	64.46	58.68	71.49	109.41	85.58	74.15	186.47	72.49	84.03	65.01	22.04	26.58
3+	59.54	63.14	50.16	62.92	54.32	68.40	95.31	80.27	72.63	184.19	72.08	81.49	52.16	20.65	27.29
4+	49.88	55.68	48.79	61.61	51.46	50.14	78.49	63.52	63.59	175.70	70.16	78.65	44.07	12.02	23.94
5+	20.74	41.93	37.33	57.12	49.17	43.72	52.57	46.97	41.52	144.48	65.72	74.23	38.20	7.96	7.84
6+	7.41	14.13	20.52	38.76	44.95	39.25	36.12	20.28	27.87	74.15	40.80	66.49	32.51	5.82	2.36

TABLE 21. MEAN NUMBERS PER TON (ADJUSTED FOR MISSING STRATA) OF COD AT AGE FROM AUTUMN RV SURVEYS IN DIVISION 3K.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0.00	0.00	0.18	0.01	0.22	0.83	0.26	0.01	0.35	0.38	1.14	1.79	1.08	0.02
2	0.25	0.13	1.01	1.25	1.71	3.36	3.23	0.65	2.41	0.90	2.43	14.38	3.82	2.05
3	2.59	2.13	1.37	5.14	1.66	7.29	5.58	2.96	4.84	2.15	4.12	15.80	18.77	5.59
4	11.29	14.46	1.98	3.22	4.72	6.17	9.64	4.56	24.10	3.88	3.18	15.91	18.07	24.42
5	13.78	23.80	11.16	3.51	4.65	10.88	7.77	6.21	29.07	9.38	3.91	11.98	12.00	17.25
6	6.31	14.15	12.19	11.72	2.61	3.33	7.98	3.09	20.18	7.26	5.36	10.53	8.75	5.82
7	2.02	3.63	2.64	8.48	5.50	2.25	2.96	2.88	10.33	3.48	2.89	11.60	6.01	2.32
8	0.94	1.82	1.27	2.83	5.36	3.96	1.48	0.92	6.22	2.44	0.97	6.62	6.65	0.93
9	0.59	0.44	0.47	0.48	1.58	3.07	2.37	0.69	2.37	1.25	0.46	3.00	2.17	0.55
10	0.46	0.38	0.32	0.23	0.60	1.07	1.43	0.64	0.79	0.62	0.27	2.18	0.66	0.25
11	0.03	0.26	0.03	0.19	0.18	0.38	0.59	0.54	0.98	0.32	0.07	0.94	0.24	0.01
12	0.09	0.08	0.18	0.18	0.07	0.18	0.28	0.18	0.88	0.17	0.09	0.38	0.08	0.02
13	0.03	0.04	0.07	0.08	0.08	0.07	0.10	0.08	0.25	0.11	0.03	0.26	0.00	0.01
14	0.03	0.12	0.13	0.11	0.12	0.23	0.21	0.05	0.18	0.23	0.07	0.17	0.00	0.01
1+	38.39	61.43	33.02	37.22	29.01	43.04	43.88	23.52	102.75	32.58	24.89	95.49	78.29	59.34
2+	38.39	61.43	32.84	37.21	28.79	42.21	43.62	23.51	102.40	32.20	23.85	93.70	77.21	59.32
3+	38.14	61.30	31.83	35.98	27.08	38.85	40.39	22.87	99.89	31.30	21.41	79.35	73.39	57.27
4+	35.56	59.18	30.48	30.83	25.42	31.58	34.82	19.90	95.15	29.15	17.30	63.54	54.82	51.68
5+	24.27	44.71	28.48	27.80	20.70	25.38	25.17	15.34	71.05	25.27	14.12	47.63	36.55	27.26
6+	10.51	20.91	17.32	24.09	16.05	14.51	17.40	9.13	41.98	15.89	10.22	35.65	24.54	10.01

TABLE 22. MEAN NUMBERS PER TOW (ADJUSTED FOR MISSING STRATA) OF COD AT AGE FROM AUTUMN RV SURVEYS IN DIVISION 3L.

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0.37	0.41	0.64	0.36	0.01	0.04	0.18	0.05	0.02	0.03	0.05
2	0.38	2.74	3.52	7.58	1.22	1.15	2.77	1.68	0.70	0.89	0.80
3	6.31	1.97	13.43	11.43	9.65	2.53	2.02	4.54	4.08	6.03	1.58
4	2.62	6.58	5.18	18.89	12.84	11.81	3.91	2.38	3.68	14.08	4.41
5	2.50	2.80	7.49	5.18	10.91	10.18	9.43	4.96	1.89	9.71	4.49
6	3.73	2.07	1.39	10.52	5.17	10.44	7.13	6.09	2.58	5.60	2.59
7	5.26	1.72	1.33	1.69	3.43	3.27	3.33	4.62	2.60	3.86	0.46
8	0.98	1.58	2.32	1.18	0.71	2.47	1.31	2.18	0.89	3.05	0.25
9	0.20	0.29	1.25	1.03	0.81	0.95	1.00	1.03	0.71	1.69	0.25
10	0.07	0.09	0.44	1.08	0.40	0.38	0.10	0.54	0.21	0.67	0.08
11	0.04	0.05	0.12	0.43	0.29	0.48	0.13	0.13	0.08	0.31	0.07
12	0.03	0.08	0.08	0.25	0.11	0.26	0.22	0.10	0.04	0.20	0.02
13	0.12	0.06	0.18	0.18	0.07	0.18	0.18	0.13	0.03	0.10	0.01

1+	22.57	20.38	37.37	59.78	45.62	44.14	31.70	28.41	17.60	48.04	15.08
2+	22.20	19.97	38.73	59.42	45.61	44.10	31.54	28.36	17.58	48.01	15.03
3+	21.84	17.23	33.20	51.65	44.39	42.95	28.77	26.68	16.88	45.32	14.22
4+	15.54	15.28	19.77	40.42	34.74	40.42	28.75	22.15	12.80	38.29	12.65
5+	12.92	8.68	14.59	21.53	21.90	28.61	22.83	19.77	9.12	25.21	8.24
6+	10.42	5.88	7.10	16.35	10.99	18.43	13.41	14.81	7.23	15.50	3.75

TABLE 23. MEAN NUMBERS PER TOW (ADJUSTED FOR MISSING STRATA) OF COD AT AGE FROM SPRING RV SURVEYS IN DIVISION 3L.

	1977	1978	1979	1980	1981	1982	1985	1986	1987	1988	1989	1990	1991
1	0.00	0.00	0.08	0.09	0.17	0.03	0.00	0.00	0.01	0.00	0.00	0.01	0.00
2	0.91	0.08	0.08	1.90	0.50	1.73	1.39	0.25	0.42	0.28	0.30	0.48	0.22
3	4.15	3.65	0.84	0.88	6.98	1.57	12.17	3.44	2.39	5.15	4.17	7.74	2.47
4	5.96	6.82	9.19	3.42	7.19	9.28	18.23	12.62	5.24	4.50	8.25	18.52	7.26
5	4.63	5.43	13.94	10.48	6.40	2.35	16.44	12.73	13.43	7.48	3.51	13.17	7.27
6	2.18	3.51	6.50	8.44	10.96	2.97	8.25	9.27	12.62	16.68	3.31	4.79	4.12
7	0.65	1.58	1.54	2.13	11.17	4.17	8.16	4.39	6.68	8.03	8.88	4.61	1.22
8	0.67	0.51	0.46	0.77	2.97	3.09	1.72	3.48	2.34	4.10	6.64	5.76	1.00
9	0.44	0.43	0.12	0.15	0.77	0.93	0.78	0.77	1.63	1.47	1.85	3.30	0.97
10	0.15	0.25	0.19	0.07	0.25	0.20	1.08	0.65	0.67	1.21	0.76	1.35	0.36
11	0.10	0.19	0.06	0.12	0.08	0.07	1.20	1.11	0.48	0.34	0.64	0.59	0.34
12	0.08	0.13	0.04	0.07	0.06	0.05	0.40	0.70	0.81	0.40	0.15	0.34	0.10
13	0.05	0.03	0.03	0.02	0.04	0.12	0.16	0.25	0.38	0.35	0.21	0.26	0.04
14	0.02	0.02	0.04	0.04	0.00	0.03	0.06	0.08	0.10	0.27	0.35	0.17	0.01

1+	19.96	22.62	33.12	28.55	49.55	26.59	70.03	49.74	47.21	50.26	39.03	61.07	25.37
2+	19.96	22.62	33.08	28.46	49.38	26.56	70.03	49.74	47.20	50.28	39.03	61.08	25.37
3+	19.05	22.54	32.98	26.56	48.88	24.83	68.64	48.49	48.78	49.98	38.73	60.60	25.15
4+	14.90	18.69	32.14	25.88	39.90	23.27	56.47	46.05	44.39	44.63	34.56	52.66	22.68
5+	8.93	12.07	22.94	22.27	32.72	13.98	38.23	33.43	39.15	40.33	26.31	34.34	15.42
6+	4.30	6.65	9.00	11.81	26.32	11.63	21.79	20.70	25.72	32.65	22.79	21.17	8.15

TABLE 24. MEAN NUMBERS PER TOW OF COD AND COEFFICIENTS OF VARIATION FROM AUTUMN RV SURVEYS IN DIVISIONS 2J3KL.

MEAN NUMBERS PER TOW														
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0.02	0.41	0.27	0.18	0.51	1.04	0.36	0.02	0.14	0.21	0.59	0.66	0.40	0.03
2	0.40	0.32	3.00	1.59	2.48	6.07	5.57	1.10	1.85	1.56	2.14	8.25	1.91	1.34
3	5.39	1.94	2.48	5.12	5.87	12.22	10.79	7.27	4.77	2.04	3.93	6.88	10.93	3.35
4	11.51	11.78	3.83	2.74	5.92	10.62	15.23	12.35	20.70	4.03	3.20	8.30	12.95	13.97
5	13.95	16.79	13.23	3.26	3.83	10.83	11.34	10.01	31.29	13.23	5.29	6.20	8.61	9.00
6	5.51	10.53	13.31	9.67	2.79	3.87	9.59	7.28	21.28	11.81	10.57	6.52	5.64	3.31
7	1.62	2.27	4.89	8.79	5.82	2.43	2.30	4.24	10.14	4.38	10.13	8.23	3.90	1.10
8	0.63	0.92	1.19	3.86	5.31	5.33	1.37	0.92	5.26	2.67	2.58	4.84	3.98	0.50
9	0.47	0.31	0.37	0.74	2.59	2.93	2.08	0.78	1.37	1.38	1.55	1.62	1.68	0.35
10	0.33	0.26	0.23	0.23	0.57	1.42	1.30	0.67	0.98	0.34	0.79	0.98	0.55	0.16
11	0.12	0.19	0.11	0.10	0.16	0.36	0.54	0.41	0.88	0.17	0.15	0.43	0.23	0.04
12	0.09	0.06	0.16	0.11	0.09	0.14	0.28	0.15	0.42	0.19	0.11	0.16	0.12	0.02
13	0.08	0.04	0.05	0.10	0.07	0.13	0.12	0.06	0.19	0.13	0.08	0.10	0.04	0.01
1+	40.11	45.80	43.21	36.28	36.01	57.38	60.87	45.25	98.67	41.98	41.11	55.28	50.93	33.18
2+	40.09	45.39	42.94	36.10	35.50	56.34	60.51	45.23	98.53	41.74	40.53	54.62	50.53	33.15
3+	39.69	45.07	39.94	34.51	33.02	50.27	54.94	44.13	98.68	40.18	38.38	46.37	48.82	31.81
4+	34.30	43.13	37.47	29.40	27.14	38.05	44.15	36.86	91.81	38.14	34.46	37.39	37.70	28.48
5+	22.79	31.35	33.64	26.88	21.22	27.43	28.93	24.52	71.21	34.11	31.26	28.09	24.75	14.49
6+	8.84	14.57	20.41	23.39	17.39	16.61	17.59	14.50	39.93	20.88	25.97	22.89	16.14	5.49

COEFFICIENTS OF VARIATION - PERCENT

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	25	18	33	34	23	46	26	64	28	38	33	22	25	56
2	27	22	39	22	23	28	17	16	18	24	12	15	16	24
3	21	17	53	22	18	19	16	20	16	15	17	23	17	28
4	21	22	38	20	14	23	16	18	24	13	21	36	21	29
5	24	26	27	24	17	26	20	16	31	16	19	44	31	27
6	26	32	28	29	19	28	15	14	35	18	18	37	38	25
7	24	33	24	29	20	24	15	12	36	18	17	32	40	28
8	22	32	21	32	18	25	14	9	33	18	14	31	41	27
9	21	25	22	28	16	22	13	9	32	16	14	36	37	26
10	20	26	24	26	11	25	12	9	29	17	14	47	35	29
11	27	23	33	23	15	26	12	10	25	16	13	46	30	26
12	32	28	26	23	26	24	13	11	30	15	14	54	32	43
13	43	27	32	20	15	7	13	13	23	13	13	71	29	97

TABLE 25. AVERAGE WEIGHTS AT AGE OF COD - DIVISION 2J AUTUMN RV.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
2	0.21	0.23	0.24	0.22	0.22	0.15	0.17	0.16	0.19	0.21	0.24	0.19	0.17	0.19
3	0.48	0.60	0.52	0.50	0.47	0.50	0.34	0.32	0.38	0.41	0.44	0.46	0.35	0.32
4	0.83	0.93	1.06	0.90	0.92	0.84	0.75	0.55	0.59	0.70	0.75	0.72	0.62	0.50
5	1.38	1.50	1.40	1.42	1.32	1.36	1.14	0.99	0.93	1.02	0.98	1.07	0.87	0.71
6	1.88	2.02	1.99	1.75	1.83	1.92	1.60	1.31	1.28	1.25	1.33	1.37	1.29	1.19
7	2.61	2.79	2.35	2.19	2.02	2.22	2.26	1.69	1.60	1.65	1.53	1.60	1.55	1.65
8	2.95	3.61	3.03	2.67	2.37	2.42	2.52	2.35	1.87	1.83	1.88	1.81	1.78	1.78
9	4.51	2.99	4.94	3.54	2.93	2.90	2.68	2.74	2.81	2.05	2.27	2.05	1.99	2.19
10	4.60	4.18	5.17	5.45	4.13	3.61	3.30	3.10	2.82	2.78	2.51	2.05	2.03	2.42
11	6.11	6.07	5.84	6.69	5.71	3.75	4.30	3.46	3.33	4.20	3.63	2.95	3.23	3.69
12	6.78	5.75	5.96	6.46	7.80	7.93	5.27	3.94	4.04	3.84	4.56	2.72	3.07	2.42

TABLE 26. AVERAGE WEIGHTS AT AGE OF COD - DIVISION 3K AUTUMN RV.

I	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
2 I	0.18	0.24	0.24	0.25	0.21	0.19	0.15	0.20	0.22	0.22	0.14	0.18	0.20	0.23
3 I	0.45	0.64	0.55	0.64	0.56	0.57	0.44	0.39	0.41	0.47	0.41	0.44	0.41	0.43
4 I	0.89	1.05	0.90	1.11	1.09	0.96	0.82	0.72	0.73	0.79	0.74	0.77	0.74	0.69
5 I	1.47	1.48	1.42	1.55	1.38	1.57	1.42	1.19	1.07	1.16	1.19	1.20	1.09	0.96
6 I	2.14	2.18	2.09	1.95	1.92	2.16	1.92	1.64	1.54	1.40	1.53	1.56	1.56	1.43
7 I	3.00	3.04	3.04	2.45	2.35	2.67	2.29	2.16	1.78	1.90	1.76	1.91	1.79	1.91
8 I	3.66	4.07	4.00	2.97	2.93	2.74	2.90	2.99	2.34	2.21	2.57	2.25	2.11	2.17
9 I	4.00	5.15	5.75	5.04	3.77	3.38	3.35	3.04	2.69	2.96	3.49	2.77	2.44	2.49
10 I	5.04	4.17	6.15	6.78	4.51	4.00	3.70	3.45	4.10	3.67	4.35	3.63	2.77	2.90
11 I	6.29	5.67	10.57	7.02	6.60	5.49	6.18	4.46	3.91	4.76	4.94	3.78	3.40	4.37
12 I	7.02	4.10	7.67	7.09	8.29	5.53	6.69	6.05	3.61	5.86	6.35	5.00	3.43	2.96

TABLE 27. AVERAGE WEIGHTS AT AGE OF COD - DIVISION 3L AUTUMN RV.

I	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
2 I	0.20	0.20	0.21	0.14	0.16	0.18	0.17	0.18	0.20	0.17	0.23
3 I	0.54	0.47	0.52	0.31	0.39	0.37	0.35	0.44	0.45	0.36	0.44
4 I	0.78	1.10	1.01	0.72	0.72	0.72	0.75	0.78	0.75	0.79	0.75
5 I	1.28	1.59	1.63	1.17	1.25	1.11	1.25	1.31	1.27	1.25	1.14
6 I	1.97	2.26	2.16	1.85	1.72	1.74	1.81	1.74	1.80	1.82	1.57
7 I	2.63	3.04	2.49	2.50	2.49	2.17	2.46	2.13	2.32	2.59	1.93
8 I	3.49	3.64	2.99	2.83	3.48	3.05	2.91	2.66	2.90	3.21	2.74
9 I	5.17	5.27	3.51	4.04	3.43	3.54	3.81	2.99	3.64	3.91	3.16
10 I	7.62	7.33	3.92	4.25	5.10	4.22	4.87	3.64	5.27	4.05	3.39
11 I	9.90	7.78	6.83	5.67	5.88	4.98	6.18	6.31	6.15	5.15	3.51
12 I	15.39	12.99	6.33	4.47	8.43	6.09	5.65	8.24	7.38	5.96	4.91

TABLE 28. AVERAGE WEIGHTS AT AGE OF COD - DIVISION 3L SPRING RV.

I	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
2 I	0.07	0.11	0.12	0.10	0.09	0.00	0.00	0.08	0.08	0.10	0.09	0.06	0.08	0.07
3 I	0.22	0.30	0.36	0.32	0.33	0.00	0.00	0.22	0.27	0.28	0.29	0.25	0.23	0.26
4 I	0.52	0.66	0.76	0.63	0.74	0.00	0.00	0.50	0.52	0.60	0.59	0.54	0.57	0.46
5 I	0.97	1.15	1.33	1.17	1.25	0.00	0.00	0.98	0.94	0.97	1.04	0.91	0.98	0.94
6 I	1.74	1.79	1.99	1.74	1.92	0.00	0.00	1.67	1.54	1.56	1.55	1.35	1.45	1.42
7 I	2.57	2.99	3.00	2.42	2.70	0.00	0.00	2.33	2.34	2.04	2.13	1.94	1.83	2.03
8 I	3.33	4.25	4.60	2.95	3.38	0.00	0.00	3.32	3.01	3.32	2.48	2.19	2.46	2.61
9 I	4.23	4.98	6.83	3.91	5.13	0.00	0.00	4.55	3.89	3.88	3.75	3.19	3.11	3.21
10 I	5.57	5.98	8.56	6.40	7.11	0.00	0.00	5.10	5.08	4.35	3.81	4.20	3.64	3.99
11 I	7.04	7.70	10.17	7.48	10.23	0.00	0.00	6.09	5.86	6.42	6.55	4.60	4.67	3.77
12 I	6.99	8.59	11.11	8.29	8.86	0.00	0.00	8.64	8.40	7.98	6.80	7.96	7.33	8.43

TABLE 29. ANALYSIS OF VARIANCE FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIVISIONS 2J3KL FOR THE YEARS 1983-91.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.824
 MULTIPLE R SQUARED..... 0.678

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	6.816E1	6.816E1	
REGRESSION	26	1.081E2	4.157E0	49.306
TYPE 1	5	1.175E1	2.349E0	27.865
TYPE 2	2	7.825E0	3.913E0	46.406
TYPE 3	11	4.651E1	4.228E0	50.149
TYPE 4	8	1.270E0	1.588E-1	1.883
RESIDUALS	608	5.126E1	8.431E-2	
TOTAL	635	2.275E2		

TYPE 1 - CATEGORY 1 - COUNTRY/GEAR/TONNAGE CLASS
 2 - 2 - NAFO DIVISIONS
 3 - 3 - MONTHS
 4 - 4 - YEARS

NOTE - SEE TABLE OF REGRESSION COEFFICIENTS FOR CATEGORY NUMBERS

TABLE 30. REGRESSION COEFFICIENTS FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIVISIONS 2J3KL FOR THE YEARS 1983-91.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	27124	INTERCEPT	1.338	0.198	635
2	23				
3	1				
4	83				
1	3124	1	-0.186	0.182	111
	3125	2	0.096	0.174	244
	3126	3	0.154	0.217	27
	27125	4	0.451	0.176	154
	27126	5	0.806	0.185	80
2	31	6	-0.080	0.070	211
	32	7	-0.523	0.068	314
3	2	8	0.180	0.097	71
	3	9	-0.293	0.097	64
	4	10	-0.374	0.093	78
	5	11	-0.887	0.098	64
	6	12	-1.096	0.103	59
	7	13	-1.369	0.116	38
	8	14	-1.400	0.132	28
	9	15	-1.332	0.135	26
	10	16	-1.538	0.118	40
	11	17	-1.172	0.115	40
	12	18	-1.067	0.103	58
4	84	19	0.126	0.093	77
	85	20	0.255	0.100	62
CODE 27124 - CAN-M/OT/TC 4	86	21	0.139	0.095	70
27125 - CAN-M/OT/TC 5	87	22	0.048	0.093	83
27126 - CAN-M/OT/TC 6	88	23	0.045	0.092	87
03124 - CAN-N/OT/TC 4	89	24	0.134	0.095	76
03125 - CAN-N/OT/TC 5	90	25	0.210	0.102	59
03126 - CAN-N/OT/TC 6	91	26	-0.068	0.108	52

TABLE 31. COMMERCIAL CATCH RATE INDEX FOR COD IN DIVISIONS 2J3KL FOR THE YEARS 1983-91.

YEAR	LN TRANSFORM		RETRANSFORMED		CATCH	EFFORT
	MEAN	S.E.	MEAN	S.E.		
	1983	1.3535	0.0101	4.018		
1984	1.4794	0.0096	4.558	0.446	108488	23803
1985	1.6084	0.0108	5.182	0.538	112764	21761
1986	1.4927	0.0095	4.619	0.448	117983	25543
1987	1.4016	0.0100	4.216	0.422	120641	28617
1988	1.3982	0.0097	4.202	0.414	140835	33517
1989	1.4875	0.0100	4.594	0.458	111807	24339
1990	1.5635	0.0115	4.953	0.530	78127	15774
1991	1.2854	0.0120	3.749	0.410	60286	16079

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.102

TABLE 32. CATCH AT AGE FOR CANADIAN OTTER TRAWLERS OF COD IN NAFO DIVISIONS 2J3KL FOR THE YEARS 1983-91.

	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	630	277	352	40	30	144	142	309	84
4	3015	4521	4675	4570	1056	872	4153	5390	4111
5	19407	15361	19196	23005	19324	6744	7628	14612	13733
6	9815	23964	23388	35409	37099	32688	14439	12342	11769
7	6112	7383	19772	20277	19951	33154	25082	9771	4132
8	9349	4061	4690	11681	14904	12757	20033	11195	3335
9	5837	6478	2579	2317	3357	6233	6079	5603	2851
10	4984	2743	3993	1623	820	3049	2445	1836	1012
11	606	1788	2232	1596	450	389	1197	624	329
12	103	306	1406	911	585	267	408	332	117
13	49	80	203	491	289	246	173	74	49
3+	59907	66962	82486	101920	97865	96543	81779	62088	41522
4+	59277	66685	82134	101880	97835	96399	81637	61779	41438
5+	56262	62164	77459	97310	96779	95527	77484	56389	37327
6+	36855	46803	58263	74305	77455	88783	69856	41777	23594

TABLE 33. COMMERCIAL CATCH RATE INDEX AT AGE FOR COD IN NAFO DIVISIONS 2J3KL FOR THE YEARS 1983-91.

	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.40	0.20	0.28	0.03	0.02	0.07	0.10	0.33	0.09
4	1.92	3.25	3.67	3.06	0.63	0.44	2.92	5.84	4.37
5	12.34	11.04	15.08	15.40	11.55	3.44	5.36	15.84	14.61
6	6.24	17.22	18.38	23.70	22.17	16.68	10.14	13.38	12.52
7	3.89	5.30	15.54	13.57	11.92	16.91	17.62	10.59	4.39
8	5.95	2.92	3.69	7.82	8.91	6.51	14.07	12.14	3.55
9	3.71	4.65	2.03	1.55	2.01	3.18	4.27	6.07	3.03
10	3.17	1.97	3.14	1.09	0.49	1.56	1.72	1.99	1.08
11	0.39	1.28	1.75	1.07	0.27	0.20	0.84	0.68	0.35
12	0.07	0.22	1.10	0.61	0.35	0.14	0.29	0.36	0.12
13	0.03	0.06	0.16	0.33	0.17	0.13	0.12	0.08	0.05
3+	38.10	48.11	64.82	68.23	58.48	49.26	57.46	67.31	44.16

TABLE 34. INDEX OF ABUNDANCE DERIVED FROM SPATIAL ANALYSIS AND OFFSHORE CATCH AT AGE.

I	1983	1984	1985	1986	1987	1988	1989	1990	1991
3 I	2.5	0.7	0.7	0.1	0.1	0.8	0.6	1.7	0.3
4 I	11.8	12.0	9.7	12.1	4.4	4.7	17.2	29.3	15.7
5 I	76.2	40.6	40.0	61.0	81.4	36.3	31.6	79.5	52.4
6 I	38.5	63.4	48.7	93.9	156.2	176.2	59.8	67.1	44.9
7 I	24.0	19.5	41.2	53.8	84.0	178.7	103.9	53.2	15.8
8 I	36.7	10.7	9.8	31.0	62.8	68.8	83.0	60.9	12.7
9 I	22.9	17.1	5.4	6.1	14.1	33.6	25.2	30.5	10.9
10 I	19.6	7.3	8.3	4.3	3.5	16.4	10.1	10.0	3.9
11 I	2.4	4.7	4.7	4.2	1.9	2.1	5.0	3.4	1.3
12 I	0.4	0.8	2.9	2.4	2.5	1.4	1.7	1.8	0.4
13 I	0.2	0.2	0.4	1.3	1.2	1.3	0.7	0.4	0.2
3+I	235.1	177.1	171.9	270.4	412.1	520.3	338.7	337.8	158.5
4+I	232.7	176.4	171.2	270.3	412.0	519.5	338.1	336.1	158.1
5+I	220.8	164.5	161.4	258.2	407.5	514.8	320.9	306.7	142.5
6+I	144.7	123.8	121.4	197.1	326.2	478.5	289.3	227.3	90.0

TABLE 35. CATCH AT AGE FROM THE COD TRAP FISHERY IN DIVISIONS 2J3KL.

I	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3 I	748	810	2142	1609	1167	1176	214	182	609	1641	2168	1047	1139	457
4 I	8795	4385	8278	4242	22282	7807	7685	8335	8450	6193	11212	10829	18143	12014
5 I	17053	9188	8024	3800	9261	15317	10716	13643	16095	8388	9725	9720	15616	17748
6 I	5241	4524	4340	2556	3283	4041	5532	6277	5914	5830	8560	5479	5705	5761
7 I	1396	1439	2350	1586	2161	1473	1412	3144	1803	2519	5118	4614	2322	1128
8 I	253	287	298	853	1098	954	777	610	502	1017	1396	2043	1714	321
9 I	102	76	38	157	419	351	437	256	66	347	525	459	700	161
10 I	64	36	15	16	76	127	236	179	23	41	166	138	144	38
3+I	34652	20745	25485	14829	39727	31246	28009	32626	33462	25976	38870	34329	45483	37628
4+I	33904	19935	23343	13220	38560	30070	27795	32444	32853	24335	36702	33282	44944	37171
5+I	25109	15550	15065	8978	16278	22263	20110	24109	24403	18142	25490	22453	26201	25157
6+I	8056	6362	7041	5178	7017	6946	9394	10466	8308	9754	15785	12733	10585	7409

TABLE 36. RESULTS FROM ADAPT USING AUTUMN RV INDEX AND COMMERCIAL C/E DERIVED USING A MULTIPLICATIVE MODEL.

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.001387
 MEAN SQUARE RESIDUALS 0.174526

PARAMETER	AGE	ESTIMATE	STD. ERR.	T-STAT	C.V.	BIAS
NUMBERS						
	3	180583	77083	2.343	0.427	9.52
	4	431624	127436	3.387	0.295	4.77
	5	233875	47998	4.873	0.205	2.54
	6	85800	15238	5.631	0.178	2.05
	7	26849	4917	5.460	0.183	2.21
	8	15514	2738	5.666	0.176	2.30
	9	12557	2335	5.377	0.186	2.50
	10	4933	974	5.065	0.197	2.68
	11	1561	289	5.408	0.185	2.64
	12	787	159	4.962	0.202	2.53
INDEX 1: RV1						
	3	2.27E-5	2.72E-6	8.350	0.120	0.47
	4	4.59E-5	5.32E-6	8.630	0.116	0.47
	5	8.25E-5	9.46E-6	8.724	0.115	0.51
	6	1.21E-4	1.38E-5	8.725	0.115	0.56
	7	1.35E-4	1.55E-5	8.731	0.115	0.55
	8	1.53E-4	1.76E-5	8.699	0.115	0.57
	9	1.64E-4	1.89E-5	8.669	0.115	0.58
	10	1.69E-4	1.95E-5	8.647	0.116	0.60
	11	1.43E-4	1.67E-5	8.603	0.116	0.71
	12	1.56E-4	1.80E-5	8.669	0.115	0.80
INDEX 2: CE1						
	5	5.99E-5	8.56E-6	7.005	0.143	0.73
	6	1.42E-4	2.02E-5	7.054	0.142	0.76
	7	1.79E-4	2.53E-5	7.062	0.142	0.77
	8	2.17E-4	3.07E-5	7.069	0.141	0.77
	9	2.13E-4	3.02E-5	7.056	0.142	0.78
	10	2.20E-4	3.13E-5	7.036	0.142	0.81
	11	1.85E-4	2.63E-5	7.030	0.142	0.85
	12	1.62E-4	2.31E-5	7.026	0.142	1.01

LOG RESIDUALS FROM RV1

3/ 5/92

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.08	0.40	0.20	0.29	0.04	0.81	0.25	0.08	0.34	0.39	0.14	0.17	0.09	0.00
4	0.15	0.27	0.12	0.54	0.53	0.11	0.38	0.07	0.68	0.26	0.32	0.20	0.17	0.09
5	0.15	0.34	0.17	0.50	0.37	0.07	0.03	0.24	0.65	0.01	0.16	0.23	0.18	0.30
6	0.20	0.08	0.20	0.09	0.58	0.16	0.00	0.35	0.74	0.20	0.03	0.33	0.50	0.51
7	0.12	0.19	0.48	0.20	0.13	0.20	0.12	0.23	0.49	0.27	0.32	0.48	0.58	0.57
8	0.04	0.11	0.42	0.43	0.21	0.29	0.22	0.40	0.64	0.11	0.01	0.58	0.65	0.83
9	0.14	0.19	0.35	0.41	0.20	0.21	0.02	0.15	0.66	0.08	0.27	0.57	0.64	1.08
10	0.21	0.15	0.00	0.32	0.10	0.15	0.00	0.37	0.28	0.09	0.31	0.90	0.65	1.05
11	0.02	0.10	0.12	0.18	0.08	0.20	0.39	0.24	0.53	0.19	0.03	0.96	0.82	1.00
12	0.12	0.25	0.08	0.30	0.09	0.14	0.35	1.09	0.37	0.14	0.18	1.05	0.48	1.08

SUM OF RV RESIDUALS : 0.000002938472113 MEAN RESIDUAL : 2.097480081E-8

LOG RESIDUALS FROM CE1

3/ 5/92

	1983	1984	1985	1986	1987	1988	1989	1990	1991
5	0.00	0.07	0.16	0.07	0.14	0.63	0.01	0.65	0.09
6	0.34	0.07	0.02	0.17	0.17	0.24	0.03	0.55	0.09
7	0.53	0.13	0.19	0.03	0.13	0.11	0.22	0.55	0.02
8	0.48	0.39	0.00	0.04	0.01	0.21	0.33	0.56	0.13
9	0.38	0.07	0.05	0.08	0.53	0.11	0.34	0.67	0.20
10	0.18	0.37	0.22	0.01	0.55	0.12	0.25	0.68	0.06
11	0.47	0.24	0.32	0.13	0.47	0.62	0.46	0.62	0.27
12	1.03	0.33	0.31	0.18	0.14	0.46	0.63	0.83	0.03

SUM OF RV RESIDUALS : 2.977842282E-7 MEAN RESIDUAL : 4.135892055E-9

TABLE 36. CONTINUED.

POPULATION NUMBERS (000S)														3/ 5/92
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3 I	304772	154833	162011	362172	323630	353982	443981	361426	179421	162119	241757	403248	534071	180225
4 I	277645	248329	125724	130333	294544	263426	287477	362794	296322	146146	130624	195419	328617	430300
5 I	215401	211431	192130	92053	100218	212844	203355	221910	283617	228019	111314	93689	144835	232351
6 I	65923	140881	139180	131231	63431	64857	135714	137755	148555	192241	157423	72873	57569	84981
7 I	20791	35588	88920	86791	85003	38906	35883	76185	82090	80123	113001	85530	36851	26598
8 I	8388	10045	19200	56499	51140	46580	20956	18085	37017	43662	39839	51144	35002	15341
9 I	4604	4083	5094	11349	35537	26551	24834	10601	8412	16986	18098	15780	18086	12424
10 I	4029	2385	2166	3069	6419	18295	13654	12270	5208	4078	8643	6651	5051	4886
11 I	1405	2319	1267	1303	1808	3515	9241	7354	5375	2454	2121	3152	2151	1543
12 I	1031	755	1392	828	787	1174	1957	5271	3393	2612	1398	1036	1047	781
13 I	522	646	453	932	501	503	737	1194	2795	1781	1349	763	331	425
3+I	904512	811294	737537	876561	863019	1030634	1177789	1214806	1051206	880221	825568	929285	1160812	989854

FISHING MORTALITY														3/ 5/92
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3 I	0.005	0.008	0.018	0.007	0.006	0.008	0.002	0.002	0.005	0.016	0.013	0.005	0.016	0.019
4 I	0.072	0.057	0.112	0.063	0.125	0.059	0.059	0.046	0.059	0.072	0.132	0.105	0.147	0.085
5 I	0.225	0.218	0.181	0.172	0.235	0.250	0.189	0.201	0.189	0.170	0.224	0.287	0.328	0.293
6 I	0.416	0.260	0.272	0.234	0.289	0.392	0.378	0.318	0.411	0.331	0.440	0.482	0.572	0.479
7 I	0.527	0.417	0.254	0.329	0.402	0.419	0.488	0.522	0.431	0.499	0.593	0.693	0.676	0.467
8 I	0.520	0.479	0.326	0.264	0.456	0.429	0.481	0.564	0.579	0.681	0.726	0.957	0.836	0.578
9 I	0.458	0.434	0.307	0.370	0.464	0.465	0.505	0.511	0.524	0.476	0.801	0.939	0.992	0.541
10 I	0.352	0.432	0.308	0.329	0.402	0.483	0.419	0.625	0.552	0.454	0.809	0.929	0.986	0.478
11 I	0.421	0.310	0.226	0.304	0.231	0.386	0.381	0.574	0.522	0.363	0.516	0.902	0.814	0.605
12 I	0.267	0.312	0.201	0.302	0.247	0.266	0.294	0.435	0.444	0.461	0.406	0.942	0.702	0.432
13 I	0.250	0.220	0.146	0.160	0.229	0.219	0.245	0.266	0.256	0.276	0.353	0.432	0.417	0.258

TABLE 37. RESULTS FROM ADAPT USING AUTUMN RV INDEX.

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.002633
 MEAN SQUARE RESIDUALS 0.182859

PARAMETER	AGE	ESTIMATE	STD. ERR.	T-STAT	C.V.	BIAS
NUMBERS						
	3	176379	77044	2.289	0.437	10.07
	4	421640	127334	3.311	0.302	5.09
	5	221840	52598	4.218	0.237	3.49
	6	72282	14460	4.999	0.200	3.09
	7	23311	4937	4.722	0.212	3.44
	8	13228	2542	5.204	0.192	3.42
	9	9935	1907	5.210	0.192	3.58
	10	3946	831	4.749	0.211	3.86
	11	1209	212	5.698	0.176	3.47
	12	613	134	4.581	0.218	3.82
INDEX 1: RV1						
	3	2.33E ⁻⁵	2.86E ⁻⁶	8.142	0.123	0.39
	4	4.70E ⁻⁵	5.59E ⁻⁶	8.409	0.119	0.40
	5	8.50E ⁻⁵	1.00E ⁻⁵	8.474	0.118	0.45
	6	1.26E ⁻⁴	1.49E ⁻⁵	8.445	0.118	0.52
	7	1.41E ⁻⁴	1.66E ⁻⁵	8.458	0.118	0.51
	8	1.61E ⁻⁴	1.91E ⁻⁵	8.429	0.119	0.51
	9	1.74E ⁻⁴	2.08E ⁻⁵	8.393	0.119	0.52
	10	1.79E ⁻⁴	2.13E ⁻⁵	8.390	0.119	0.52
	11	1.54E ⁻⁴	1.85E ⁻⁵	8.324	0.120	0.64
	12	1.66E ⁻⁴	1.98E ⁻⁵	8.383	0.119	0.80

LOG RESIDUALS FROM RV1

3/ 5/82

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.09	0.43	0.22	0.31	0.06	0.59	0.24	0.06	0.38	0.37	0.06	0.19	0.09	0.00
4	0.12	0.24	0.15	0.58	0.55	0.09	0.38	0.09	0.66	0.25	0.29	0.30	0.19	0.08
5	0.12	0.32	0.14	0.53	0.40	0.10	0.06	0.29	0.63	0.01	0.15	0.27	0.30	0.26
6	0.16	0.10	0.16	0.14	0.60	0.20	0.04	0.39	0.71	0.23	0.02	0.36	0.60	0.26
7	0.06	0.22	0.50	0.16	0.17	0.24	0.15	0.26	0.46	0.29	0.31	0.53	0.67	0.38
8	0.09	0.06	0.47	0.48	0.17	0.24	0.26	0.44	0.60	0.14	0.03	0.61	0.83	0.59
9	0.06	0.25	0.41	0.46	0.28	0.16	0.06	0.20	0.61	0.12	0.25	0.60	0.79	0.71
10	0.27	0.09	0.06	0.38	0.16	0.21	0.06	0.42	0.24	0.13	0.30	0.84	0.84	0.73
11	0.05	0.17	0.19	0.26	0.14	0.14	0.48	0.31	0.48	0.23	0.06	1.00	0.78	0.55
12	0.16	0.30	0.00	0.24	0.03	0.08	0.30	1.14	0.32	0.16	0.16	1.09	0.66	0.74

SUM OF RV RESIDUALS : 0.000006509125644 MEAN RESIDUAL : 6.077946888E⁻⁶

TABLE 37. CONTINUED.

POPULATION NUMBERS (000S)														3/ 5/92
I	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3 I	304568	154579	161755	361469	322572	352233	439976	352702	173195	154239	217099	385309	521897	176028
4 I	277516	248162	125516	130123	293989	262559	286045	359514	288180	141049	124173	175231	313929	420332
5 I	215282	211326	191993	91883	100046	212373	202645	220738	280932	222171	107141	88407	127507	220326
6 I	65892	140783	139094	131119	63292	64716	135328	137174	147595	190043	152636	69456	53244	71449
7 I	20782	35562	88841	86721	84911	38792	35768	75849	81615	79337	111202	81611	34053	23058
8 I	8385	10038	19179	56434	51082	46505	20862	17971	36759	43272	39196	49671	31793	13050
9 I	4601	4080	5087	11332	35484	26503	24773	10524	8334	16775	17779	15253	14880	9797
10 I	4023	2383	2164	3064	6405	18251	13615	12220	5146	4015	8470	6389	4620	3898
11 I	1401	2314	1266	1301	1804	3504	9205	7322	5334	2403	2069	3010	1938	1190
12 I	1026	752	1388	827	786	1171	1948	5242	3367	2578	1356	994	931	606
13 I	519	642	450	929	500	502	734	1187	2771	1760	1321	728	296	329
3+I	903996	810620	736732	875201	960850	1027109	1170899	1200444	1033228	857642	782441	876060	1105088	940063

FISHING MORTALITY														3/ 5/92
I	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3 I	0.005	0.008	0.018	0.007	0.006	0.008	0.002	0.002	0.005	0.017	0.014	0.005	0.016	0.020
4 I	0.072	0.057	0.112	0.063	0.125	0.059	0.059	0.047	0.060	0.075	0.140	0.118	0.154	0.087
5 I	0.225	0.218	0.181	0.173	0.236	0.251	0.190	0.203	0.191	0.175	0.233	0.307	0.379	0.312
6 I	0.417	0.260	0.272	0.235	0.290	0.393	0.379	0.319	0.421	0.336	0.426	0.513	0.637	0.601
7 I	0.528	0.417	0.254	0.329	0.402	0.420	0.488	0.524	0.435	0.505	0.606	0.743	0.759	0.562
8 I	0.520	0.480	0.326	0.264	0.456	0.430	0.484	0.568	0.585	0.689	0.744	1.005	0.977	0.724
9 I	0.458	0.434	0.307	0.371	0.465	0.466	0.507	0.516	0.530	0.483	0.823	0.994	1.140	0.750
10 I	0.353	0.432	0.309	0.330	0.403	0.484	0.420	0.629	0.561	0.463	0.835	0.993	1.156	0.644
11 I	0.423	0.311	0.226	0.304	0.232	0.387	0.363	0.577	0.527	0.372	0.533	0.974	0.963	0.881
12 I	0.269	0.313	0.201	0.302	0.248	0.267	0.296	0.438	0.449	0.469	0.422	1.011	0.838	0.600
13 I	0.251	0.221	0.147	0.160	0.220	0.219	0.247	0.268	0.258	0.280	0.362	0.457	0.479	0.347

TABLE 38. RESULTS FROM ADAPT USING INDEX OF BIOMASS DERIVED FROM SPATIAL ANALYSIS (SPANS).

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.001761
 MEAN SQUARE RESIDUALS 0.258621

PARAMETER	AGE	ESTIMATE	STD. ERR.	T-STAT	C.V.
NUMBERS					
	3	193868	105670	1.835	0.545
	4	571112	222373	2.568	0.389
	5	280402	95070	2.949	0.339
	6	151638	48732	3.112	0.321
	7	27695	10687	2.592	0.386
	8	18440	7357	2.507	0.399
	9	22096	9186	2.405	0.416
	10	7735	3546	2.181	0.458
	11	2997	1353	2.215	0.452
	12	1167	530	2.202	0.454
INDEX 1: SPANS					
	3	1.69E ⁻⁶	3.35E ⁻⁷	5.029	0.199
	4	4.03E ⁻⁵	7.50E ⁻⁶	5.374	0.186
	5	2.71E ⁻⁴	4.91E ⁻⁵	5.529	0.181
	6	6.44E ⁻⁴	1.15E ⁻⁴	5.605	0.178
	7	8.50E ⁻⁴	1.53E ⁻⁴	5.550	0.180
	8	9.97E ⁻⁴	1.80E ⁻⁴	5.525	0.181
	9	9.40E ⁻⁴	1.71E ⁻⁴	5.495	0.182
	10	9.76E ⁻⁴	1.81E ⁻⁴	5.396	0.185
	11	8.05E ⁻⁴	1.49E ⁻⁴	5.389	0.186
	12	7.27E ⁻⁴	1.34E ⁻⁴	5.422	0.184

LOG RESIDUALS FROM SPANS 28/ 5/92

	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	1.42	-0.03	0.12	-1.07	-0.77	0.26	-0.29	0.36	0.00
4	0.12	0.03	-0.41	-0.04	-0.30	-0.10	0.40	0.66	-0.36
5	0.31	-0.28	-0.40	-0.23	0.21	0.17	0.24	0.30	-0.33
6	-0.04	-0.28	-0.57	0.01	0.24	0.49	0.24	0.64	-0.73
7	-0.28	-0.40	-0.40	-0.22	0.23	0.64	0.27	0.50	-0.34
8	-0.19	-0.62	-0.56	-0.13	0.42	0.56	0.50	0.33	-0.30
9	-0.04	-0.26	-0.58	-0.22	-0.09	0.72	0.48	0.59	-0.60
10	0.14	-0.56	-0.31	-0.15	-0.13	0.70	0.45	0.48	-0.62
11	-0.14	-0.42	-0.19	0.01	-0.07	0.20	0.66	0.54	-0.61
12	-0.72	-0.54	-0.23	0.01	0.28	0.30	0.79	0.71	-0.60

SUM OF RV RESIDUALS : 0.00009747720987 MEAN RESIDUAL : 1.08308011E⁻⁷

TABLE 38. CONTINUED.

POPULATION NUMBERS (000S)												3/ 5/92
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3 I	162674	363699	325928	361091	455339	393086	187383	164000	361644	472584	704166	193488
4 I	126443	130875	295794	265307	293297	372093	321243	152664	132165	293575	385385	569562
5 I	192534	92642	100662	213867	204895	226676	291230	249241	116651	94951	224398	279829
6 I	139412	131561	63913	65220	136552	139016	152456	198474	174799	77243	58602	150777
7 I	89107	86981	85273	39301	36181	76851	83123	83317	118105	99756	40428	27444
8 I	19258	56652	51295	46801	21279	18309	37579	44507	42454	55322	46649	18269
9 I	5113	11397	35662	26678	25016	10865	8611	17446	18790	17921	19507	21960
10 I	2173	3085	6458	18397	13758	12419	5425	4242	9019	7217	6804	7686
11 I	1269	1309	1821	3548	9325	7440	5497	2632	2255	3460	2615	2979
12 I	1391	829	792	1185	1983	5340	3463	2712	1543	1146	1299	1160
13 I	451	931	503	507	746	1216	2851	1839	1430	881	420	631
3+I	739824	879961	968101	1041903	1198370	1263309	1098861	921073	978856	1124056	1490274	1272785

FISHING MORTALITY

3/ 5/92

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3 I	0.018	0.007	0.006	0.008	0.002	0.002	0.005	0.016	0.009	0.004	0.012	0.018
4 I	0.111	0.062	0.124	0.058	0.058	0.045	0.054	0.069	0.131	0.069	0.124	0.063
5 I	0.181	0.171	0.234	0.249	0.188	0.197	0.183	0.155	0.212	0.283	0.198	0.238
6 I	0.272	0.234	0.286	0.389	0.375	0.314	0.404	0.319	0.361	0.447	0.559	0.243
7 I	0.253	0.328	0.400	0.414	0.481	0.515	0.425	0.474	0.558	0.560	0.594	0.449
8 I	0.325	0.263	0.454	0.426	0.472	0.554	0.567	0.662	0.662	0.842	0.553	0.461
9 I	0.305	0.368	0.462	0.462	0.500	0.495	0.508	0.460	0.757	0.768	0.731	0.271
10 I	0.307	0.327	0.399	0.480	0.415	0.615	0.523	0.432	0.758	0.815	0.626	0.278
11 I	0.226	0.302	0.230	0.381	0.357	0.565	0.507	0.334	0.477	0.780	0.613	0.270
12 I	0.201	0.301	0.246	0.263	0.289	0.428	0.433	0.440	0.360	0.802	0.522	0.270
13 I	0.147	0.160	0.219	0.217	0.242	0.261	0.250	0.266	0.330	0.362	0.313	0.167

TABLE 39. RESULTS FROM ADAPT USING CODTRAP INDEX.

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.000070
 MEAN SQUARE RESIDUALS 0.314781

PARAMETER	AGE	ESTIMATE	STD. ERR.	T-STAT	C.V.	BIAS
NUMBERS						
	3	156957	90523	1.734	0.577	17.37
	4	330786	132677	2.493	0.401	8.79
	5	297675	100209	2.971	0.337	6.24
	6	178080	56010	3.179	0.315	5.16
	7	70153	22485	3.120	0.321	5.10
	8	24693	8419	2.933	0.341	6.40
	9	15662	5630	2.782	0.359	7.97
	10	6635	2590	2.562	0.390	8.63
INDEX 1: TRAP						
	3	3.32E ⁻³	5.44E ⁻⁴	6.103	0.164	0.82
	4	4.16E ⁻²	6.59E ⁻³	6.317	0.158	0.84
	5	7.29E ⁻²	1.14E ⁻²	6.403	0.156	0.93
	6	5.96E ⁻²	9.23E ⁻³	6.453	0.155	0.97
	7	4.99E ⁻²	7.71E ⁻³	6.466	0.155	0.98
	8	3.88E ⁻²	6.05E ⁻³	6.408	0.156	1.11
	9	2.75E ⁻²	4.36E ⁻³	6.319	0.158	1.39
	10	1.92E ⁻²	3.04E ⁻³	6.310	0.158	1.79

LOG RESIDUALS FROM TRAP

3/ 5/92

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.17	0.59	1.51	0.41	0.20	0.11	1.83	1.80	0.01	0.77	0.59	0.34	0.05	0.00
4	0.10	0.89	0.65	0.09	0.79	0.19	0.31	0.47	0.25	0.04	0.41	0.10	0.25	0.05
5	0.38	0.25	0.32	0.34	0.50	0.25	0.10	0.04	0.04	0.50	0.27	0.04	0.04	0.05
6	0.87	0.31	0.35	0.84	0.16	0.40	0.13	0.03	0.07	0.39	0.22	0.40	0.12	0.37
7	0.80	0.22	0.31	0.86	0.30	0.12	0.18	0.24	0.46	0.10	0.33	0.52	0.36	0.92
8	0.28	0.22	0.51	0.80	0.15	0.23	0.40	0.33	0.59	0.02	0.36	0.61	0.87	0.78
9	0.33	0.18	0.61	0.21	0.35	0.26	0.03	0.38	0.80	0.11	0.59	0.53	0.93	0.62
10	0.44	0.40	0.45	0.71	0.09	0.43	0.40	0.33	0.88	0.20	0.61	0.63	0.66	0.89

SUM OF RV RESIDUALS : 0.00001464825867 MEAN RESIDUAL : 1.307889078E-8

POPULATION NUMBERS (000S)

3/ 5/92

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	300838	152840	161272	361757	325230	359628	450882	371740	204373	258392	409764	498320	411102	156638
4	273047	245108	124092	129127	294204	264743	292100	368443	303767	166575	209448	332972	406456	329821
5	209259	207667	189493	90717	99722	212565	204433	225695	288242	234933	128040	158223	256654	296080
6	63741	135852	136098	129072	62331	64451	135486	138638	151654	198020	163084	86567	110405	177185
7	19888	33801	84803	84268	83235	38011	35551	75978	82813	82680	116102	90165	48062	69856
8	7745	9126	17737	53129	49074	45132	20223	17793	36865	44254	41916	53883	38798	24520
9	4074	3556	4341	10152	32177	24059	23849	10000	8189	16861	18583	17481	18165	15531
10	3181	1951	1735	2453	5439	16036	12269	11300	4717	3896	8540	7047	6444	6587
11	1056	1624	913	950	1303	2113	7381	6220	4581	2052	1972	3068	2476	2683
12	637	469	823	537	498	761	1300	3757	2464	1962	1068	914	978	1047
13	269	324	219	467	263	267	399	656	1555	1021	816	493	231	368
3+	883516	792318	721526	863228	954093	1029167	1183683	1230223	1089221	1008633	1099332	1248933	1299769	1080117

FISHING MORTALITY

3/ 5/92

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.005	0.008	0.018	0.007	0.006	0.008	0.002	0.002	0.005	0.010	0.008	0.004	0.021	0.022
4	0.074	0.057	0.113	0.063	0.125	0.059	0.058	0.045	0.057	0.063	0.080	0.060	0.117	0.112
5	0.232	0.223	0.184	0.175	0.236	0.250	0.188	0.188	0.186	0.165	0.191	0.160	0.171	0.223
6	0.434	0.271	0.279	0.239	0.295	0.395	0.378	0.315	0.407	0.324	0.393	0.388	0.258	0.293
7	0.568	0.445	0.268	0.341	0.412	0.431	0.492	0.523	0.427	0.479	0.571	0.643	0.473	0.154
8	0.578	0.543	0.358	0.283	0.480	0.446	0.504	0.576	0.582	0.668	0.675	0.884	0.715	0.323
9	0.536	0.518	0.371	0.424	0.515	0.506	0.539	0.552	0.543	0.480	0.770	0.798	0.814	0.408
10	0.472	0.560	0.402	0.432	0.496	0.575	0.479	0.703	0.632	0.481	0.824	0.846	0.676	0.332
11	0.611	0.480	0.330	0.445	0.338	0.536	0.477	0.726	0.648	0.453	0.569	0.943	0.661	0.304
12	0.478	0.584	0.387	0.513	0.425	0.448	0.484	0.682	0.681	0.677	0.574	1.176	0.717	0.304
13	0.557	0.498	0.330	0.348	0.469	0.461	0.512	0.550	0.517	0.542	0.672	0.775	0.668	0.304

TABLE 40. RESULTS FROM ADAPT USING AUTUMN RV INDEX AND SPANS.

MEAN SQUARE RESIDUALS 0.197185

PARAMETER	AGE	ESTIMATE	STD. ERR.	T-STAT	C.V.	BIAS
NUMBERS						
	3	178047	80757	2.205	0.454	10.76
	4	425551	133448	3.189	0.314	5.39
	5	213067	45932	4.639	0.216	2.86
	6	79273	14705	5.391	0.185	2.34
	7	25164	4838	5.201	0.192	2.53
	8	15090	2807	5.376	0.186	2.61
	9	12113	2367	5.117	0.195	2.83
	10	4635	954	4.857	0.206	3.03
	11	1450	275	5.281	0.189	2.97
	12	717	150	4.777	0.209	2.88
INDEX 1: RV1						
	3	2.31E-5	2.93E-6	7.863	0.127	0.52
	4	4.66E-5	5.73E-6	8.126	0.123	0.53
	5	8.41E-5	1.02E-5	8.208	0.122	0.58
	6	1.23E-4	1.49E-5	8.203	0.122	0.63
	7	1.37E-4	1.67E-5	8.209	0.122	0.63
	8	1.54E-4	1.89E-5	8.184	0.122	0.64
	9	1.66E-4	2.04E-5	8.159	0.123	0.65
	10	1.72E-4	2.11E-5	8.140	0.123	0.66
	11	1.46E-4	1.81E-5	8.093	0.124	0.80
	12	1.59E-4	1.95E-5	8.151	0.123	0.90
INDEX 2: INDEX						
	5	3.05E-4	4.63E-5	6.597	0.152	0.81
	6	7.21E-4	1.09E-4	6.641	0.151	0.85
	7	9.02E-4	1.36E-4	6.647	0.150	0.87
	8	1.09E-3	1.64E-4	6.653	0.150	0.87
	9	1.07E-3	1.61E-4	6.643	0.151	0.88
	10	1.11E-3	1.68E-4	6.627	0.151	0.90
	11	9.36E-4	1.41E-4	6.624	0.151	0.94
	12	8.23E-4	1.24E-4	6.617	0.151	1.12

LOG RESIDUALS FROM RV1

28/ 5/92

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.08	0.42	0.21	0.30	0.05	0.59	0.24	0.05	0.34	0.38	0.10	0.23	0.09	0.00
4	0.13	0.25	0.14	0.55	0.54	0.09	0.37	0.09	0.65	0.27	0.31	0.24	0.24	0.08
5	0.13	0.33	0.15	0.52	0.39	0.09	0.05	0.25	0.63	0.03	0.17	0.24	0.22	0.20
6	0.18	0.07	0.19	0.11	0.58	0.18	0.02	0.36	0.73	0.22	0.03	0.32	0.55	0.40
7	0.11	0.20	0.47	0.18	0.14	0.22	0.13	0.24	0.48	0.27	0.31	0.48	0.57	0.48
8	0.05	0.10	0.43	0.44	0.20	0.28	0.23	0.41	0.63	0.11	0.01	0.59	0.68	0.79
9	0.13	0.20	0.36	0.42	0.22	0.20	0.03	0.16	0.65	0.09	0.27	0.59	0.68	1.03
10	0.23	0.13	0.01	0.34	0.11	0.17	0.02	0.38	0.27	0.11	0.31	0.92	0.71	0.96
11	0.00	0.12	0.14	0.21	0.10	0.18	0.41	0.26	0.52	0.20	0.04	0.97	0.69	0.88
12	0.14	0.27	0.04	0.28	0.07	0.12	0.33	1.10	0.35	0.15	0.17	1.05	0.53	0.96

SUM OF RV RESIDUALS : 7.753288345E-9 MEAN RESIDUAL : 5.538063617E-11

LOG RESIDUALS FROM INDEX

28/ 5/92

	1983	1984	1985	1986	1987	1988	1989	1990	1991
5	0.20	0.39	0.49	0.31	0.19	0.11	0.17	0.69	0.16
6	0.14	0.38	0.67	0.08	0.17	0.50	0.20	0.58	0.17
7	0.33	0.45	0.45	0.26	0.21	0.63	0.38	0.56	0.29
8	0.27	0.70	0.63	0.20	0.35	0.54	0.50	0.57	0.18
9	0.16	0.38	0.69	0.32	0.19	0.64	0.50	0.70	0.10
10	0.02	0.69	0.42	0.23	0.21	0.63	0.43	0.71	0.22
11	0.27	0.56	0.33	0.11	0.14	0.12	0.63	0.65	0.01
12	0.83	0.64	0.33	0.08	0.20	0.29	0.79	0.85	0.21

SUM OF RV RESIDUALS : 0.03607218046 MEAN RESIDUAL : 0.0005010025064

TABLE 40. CONTINUED.

		POPULATION NUMBERS (000S)													28/ 5/92
I		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	I	304701	154766	161954	361966	323206	353431	442772	359950	178268	158366	229856	372232	526665	177693
4	I	277601	248271	125669	130285	294376	263079	287026	361803	294114	145202	127552	185675	303223	424236
5	I	215367	211395	192082	92009	100179	212706	203070	221541	282806	227029	110541	91174	136058	211560
6	I	65915	140853	139151	131192	63395	64825	135601	137522	148253	191577	156614	72240	55509	78450
7	I	20789	35581	88897	86767	84971	38876	35857	76072	81900	79875	112458	84867	36333	24912
8	I	8387	10043	19194	56481	51120	45554	20931	18044	36942	43505	39636	50699	34459	14916
9	I	4603	4082	5092	11345	35522	26535	24813	10581	8394	16924	17970	15614	15722	11980
10	I	4028	2384	2166	3068	6415	18283	13641	12253	5192	4064	8592	6546	4915	4587
11	I	1404	2318	1267	1303	1807	3512	9231	7343	5361	2441	2109	3110	2066	1432
12	I	1030	754	1391	827	787	1173	1955	5263	3384	2600	1387	1027	1013	710
13	I	521	645	452	931	501	503	736	1192	2788	1774	1339	754	323	397
3+		904345	811091	737315	876174	962278	1029477	1175633	1211565	1047401	873359	808054	883938	1116286	950874

FISHING MORTALITY

28/ 5/92

I		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	I	0.005	0.008	0.018	0.007	0.006	0.008	0.002	0.002	0.005	0.016	0.013	0.005	0.016	0.019
4	I	0.072	0.057	0.112	0.063	0.125	0.059	0.059	0.046	0.059	0.073	0.136	0.111	0.160	0.086
5	I	0.225	0.218	0.181	0.173	0.235	0.250	0.190	0.202	0.189	0.171	0.225	0.296	0.351	0.327
6	I	0.417	0.260	0.272	0.234	0.289	0.392	0.378	0.318	0.418	0.333	0.413	0.487	0.601	0.531
7	I	0.528	0.417	0.254	0.329	0.402	0.419	0.487	0.522	0.433	0.501	0.597	0.701	0.690	0.508
8	I	0.520	0.479	0.326	0.264	0.456	0.429	0.482	0.565	0.581	0.684	0.732	0.971	0.857	0.600
9	I	0.458	0.434	0.307	0.370	0.464	0.465	0.506	0.512	0.525	0.478	0.810	0.956	1.032	0.567
10	I	0.353	0.432	0.308	0.329	0.402	0.483	0.419	0.627	0.555	0.456	0.816	0.953	1.033	0.518
11	I	0.422	0.311	0.226	0.304	0.232	0.386	0.362	0.575	0.523	0.365	0.520	0.922	0.867	0.670
12	I	0.268	0.312	0.201	0.302	0.247	0.266	0.294	0.435	0.446	0.464	0.410	0.956	0.737	0.486
13	I	0.250	0.220	0.147	0.160	0.220	0.219	0.246	0.267	0.256	0.277	0.356	0.438	0.430	0.279

TABLE 41. RESULTS FROM ADAPT USING AUTUMN RV, SPANS AND TRAP INDICES.

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.000045
 MEAN SQUARE RESIDUALS 0.234866

PARAMETER	AGE	ESTIMATE	STD. ERR.	T-STAT	C.V.	BIAS
NUMBERS						
	3	163654	57420	2.850	0.351	6.46
	4	368455	89510	4.116	0.243	3.26
	5	243074	44725	5.435	0.184	2.00
	6	107656	18027	5.972	0.167	1.66
	7	34667	6053	5.727	0.175	1.78
	8	17256	2941	5.867	0.170	1.98
	9	14210	2935	4.842	0.207	2.69
	10	4945	1120	4.413	0.227	3.49
	11	1503	316	4.764	0.210	3.53
	12	734	169	4.354	0.230	3.43
INDEX 1: RV1						
	3	2.26E ⁻⁵	3.05E ⁻⁶	7.422	0.135	0.70
	4	4.53E ⁻⁵	5.99E ⁻⁶	7.550	0.132	0.71
	5	7.97E ⁻⁵	1.05E ⁻⁵	7.589	0.132	0.74
	6	1.15E ⁻⁴	1.51E ⁻⁵	7.598	0.132	0.76
	7	1.30E ⁻⁴	1.71E ⁻⁵	7.598	0.132	0.75
	8	1.50E ⁻⁴	1.98E ⁻⁵	7.559	0.132	0.76
	9	1.62E ⁻⁴	2.16E ⁻⁵	7.507	0.133	0.78
	10	1.69E ⁻⁴	2.27E ⁻⁵	7.460	0.134	0.80
	11	1.44E ⁻⁴	1.95E ⁻⁵	7.414	0.135	0.95
	12	1.56E ⁻⁴	2.09E ⁻⁵	7.470	0.134	1.06
INDEX 2: SPANS						
	5	2.86E ⁻⁴	4.70E ⁻⁵	6.086	0.164	1.10
	6	6.74E ⁻⁴	1.10E ⁻⁴	6.112	0.164	1.13
	7	8.56E ⁻⁴	1.40E ⁻⁴	6.117	0.163	1.13
	8	1.06E ⁻³	1.73E ⁻⁴	6.115	0.164	1.11
	9	1.05E ⁻³	1.72E ⁻⁴	6.091	0.164	1.11
	10	1.10E ⁻³	1.81E ⁻⁴	6.068	0.165	1.09
	11	9.24E ⁻⁴	1.52E ⁻⁴	6.063	0.165	1.13
	12	8.10E ⁻⁴	1.34E ⁻⁴	6.057	0.165	1.35
INDEX 3: TRAP						
	3	3.54E ⁻³	4.77E ⁻⁴	7.425	0.135	0.69
	4	4.46E ⁻²	5.90E ⁻³	7.561	0.132	0.70
	5	7.97E ⁻²	1.05E ⁻²	7.609	0.131	0.72
	6	6.54E ⁻²	8.58E ⁻³	7.624	0.131	0.74
	7	5.33E ⁻²	6.99E ⁻³	7.626	0.131	0.73
	8	3.92E ⁻²	5.15E ⁻³	7.605	0.131	0.74

LOG RESIDUALS FROM RV1

28/ 5/92

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.06	0.40	0.19	0.28	0.03	0.81	0.26	0.05	0.32	0.49	0.29	0.14	0.26	0.11
4	0.16	0.28	0.11	0.53	0.51	0.12	0.40	0.08	0.88	0.27	0.43	0.05	0.14	0.10
5	0.18	0.38	0.20	0.47	0.34	0.04	0.00	0.20	0.68	0.00	0.16	0.11	0.03	0.32
6	0.25	0.01	0.25	0.05	0.51	0.11	0.04	0.30	0.79	0.18	0.01	0.32	0.30	0.80
7	0.16	0.15	0.43	0.23	0.09	0.17	0.08	0.19	0.53	0.22	0.35	0.48	0.49	0.90
8	0.02	0.13	0.40	0.41	0.23	0.31	0.20	0.39	0.66	0.08	0.02	0.60	0.56	0.99
9	0.15	0.18	0.34	0.39	0.19	0.23	0.01	0.14	0.88	0.08	0.29	0.60	0.65	1.26
10	0.21	0.15	0.00	0.33	0.10	0.16	0.01	0.37	0.28	0.11	0.30	0.93	0.69	1.05
11	0.02	0.10	0.13	0.20	0.08	0.19	0.40	0.25	0.53	0.20	0.05	0.93	0.68	0.94
12	0.12	0.24	0.06	0.30	0.09	0.14	0.35	1.09	0.37	0.13	0.17	1.01	0.42	0.88

SUM OF RV RESIDUALS : 1.23438002E-8 MEAN RESIDUAL : 8.817000092E-11

LOG RESIDUALS FROM SPANS

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	1983	1984	1985	1986	1987	1988	1989	1990	1991
5	0.26	0.33	0.43	0.25	0.24	0.14	0.08	0.53	0.24
6	0.08	0.32	0.60	0.01	0.23	0.54	0.22	0.45	0.43
7	0.28	0.40	0.40	0.21	0.28	0.68	0.39	0.53	0.58
8	0.24	0.67	0.61	0.17	0.38	0.57	0.52	0.52	0.29
9	0.14	0.36	0.67	0.30	0.18	0.66	0.52	0.69	0.25
10	0.03	0.67	0.41	0.22	0.21	0.63	0.43	0.70	0.27
11	0.26	0.55	0.31	0.10	0.14	0.12	0.61	0.65	0.02
12	0.62	0.63	0.32	0.07	0.21	0.29	0.78	0.80	0.22

SUM OF RV RESIDUALS : 6.674629294E-9 MEAN RESIDUAL : 9.27031778E-11

LOG RESIDUALS FROM TRAP

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	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.25	0.51	1.44	0.35	0.14	0.06	1.88	1.85	0.05	1.07	0.90	0.22	0.22	0.11
4	0.18	0.78	0.57	0.16	0.72	0.26	0.36	0.52	0.31	0.08	0.74	0.23	0.38	0.14
5	0.24	0.38	0.42	0.44	0.40	0.18	0.19	0.02	0.11	0.57	0.31	0.41	0.41	0.20
6	0.73	0.44	0.47	0.95	0.04	0.30	0.03	0.06	0.14	0.46	0.15	0.48	0.65	0.13
7	0.65	0.08	0.44	0.78	0.39	0.02	0.09	0.16	0.52	0.12	0.30	0.49	0.59	0.17
8	0.18	0.08	0.61	0.68	0.21	0.28	0.35	0.30	0.60	0.00	0.44	0.70	0.74	0.32

SUM OF RV RESIDUALS : 0.0561122704 MEAN RESIDUAL : 0.000668003219

POPULATION NUMBERS (000S)

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	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	304735	154867	162113	362374	323307	353892	444031	366918	184162	179513	281575	416957	457039	183323
4	277636	248299	125752	130416	294709	263162	287239	362834	299819	150027	144865	228020	339841	367231
5	215426	211424	192105	92077	100286	212979	203138	221716	283650	231700	114492	105349	170727	241541
6	65931	140901	139174	131211	63450	64913	135824	137578	148336	192268	160438	75475	67115	106834
7	20793	35594	88937	86786	84968	38922	35929	76255	81945	79992	113024	87998	38981	34414
8	8388	10046	19205	56513	51136	46566	20969	18103	37092	43543	39732	51162	37022	17084
9	4802	4083	5094	11353	35548	26547	24823	10811	8442	17047	18001	15893	16101	14079
10	4022	2384	2166	3070	6423	18304	13651	12261	5217	4103	8693	6571	4980	4898
11	1400	2313	1267	1303	1808	3518	9249	7352	5368	2461	2142	3193	2086	1485
12	1026	751	1387	827	787	1175	1959	5278	3391	2606	1404	1053	1080	727
13	520	641	449	928	501	503	737	1196	2800	1780	1344	767	345	452
3+	904478	811303	737650	876858	962942	1030281	1177551	1220103	1060282	905041	885709	992238	1135317	952068

FISHING MORTALITY

28/ 5/92

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.005	0.008	0.018	0.007	0.006	0.008	0.002	0.002	0.005	0.014	0.011	0.005	0.019	0.021
4	0.072	0.057	0.112	0.063	0.125	0.059	0.059	0.046	0.058	0.070	0.119	0.089	0.141	0.100
5	0.225	0.218	0.181	0.172	0.235	0.250	0.190	0.202	0.189	0.168	0.217	0.251	0.269	0.281
6	0.416	0.260	0.272	0.234	0.289	0.392	0.377	0.318	0.418	0.331	0.401	0.461	0.468	0.362
7	0.527	0.417	0.253	0.329	0.402	0.419	0.485	0.521	0.432	0.500	0.593	0.666	0.625	0.341
8	0.520	0.479	0.326	0.264	0.456	0.429	0.481	0.563	0.577	0.683	0.729	0.956	0.767	0.502
9	0.458	0.434	0.307	0.370	0.464	0.465	0.505	0.510	0.521	0.474	0.808	0.948	0.990	0.461
10	0.353	0.432	0.308	0.329	0.402	0.483	0.419	0.626	0.551	0.450	0.802	0.947	1.010	0.477
11	0.423	0.311	0.226	0.304	0.231	0.385	0.361	0.574	0.523	0.362	0.510	0.884	0.854	0.637
12	0.269	0.314	0.201	0.302	0.247	0.266	0.294	0.434	0.444	0.482	0.404	0.917	0.672	0.472
13	0.251	0.222	0.148	0.180	0.220	0.219	0.245	0.268	0.255	0.276	0.355	0.428	0.397	0.241

Table 42. Laurec/Shepherd calibration analysis for 2J3KL cod using commercial catch rates derived from a multiplicative model and research vessel survey abundance.

DISAGGREGATED Qs
 LOG TRANSFORMATION
 ND explanatory variate (Mean used)
 Fleet 1, fleet is 2J3kl cpue, has terminal q estimated as the mean
 Fleet 2, fleet is 2J3kl rv, has terminal q estimated as the mean
 FLEETS COMBINED BY ** VARIANCE **
 Terminal Fs estimated using Laurec/Shepherd method
 Regression weights
 , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000
 Oldest age F = 0.500*average of 5 younger ages. Fleets combined by variance of predictions
 Fishing mortalities
 Age, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 3, 0.005, 0.009, 0.018, 0.007, 0.006, 0.008, 0.002, 0.002, 0.005, 0.018, 0.015, 0.006, 0.018, 0.021
 4, 0.073, 0.057, 0.114, 0.064, 0.126, 0.060, 0.060, 0.047, 0.062, 0.079, 0.150, 0.123, 0.177, 0.098
 5, 0.225, 0.218, 0.181, 0.176, 0.237, 0.252, 0.192, 0.204, 0.195, 0.182, 0.248, 0.334, 0.400, 0.374
 6, 0.409, 0.261, 0.271, 0.234, 0.296, 0.394, 0.381, 0.322, 0.425, 0.344, 0.447, 0.557, 0.726, 0.664
 7, 0.547, 0.407, 0.254, 0.327, 0.398, 0.430, 0.490, 0.528, 0.440, 0.512, 0.624, 0.806, 0.882, 0.738
 8, 0.492, 0.519, 0.312, 0.263, 0.450, 0.423, 0.500, 0.576, 0.590, 0.700, 0.758, 1.066, 1.190, 1.065
 9, 0.404, 0.395, 0.336, 0.353, 0.462, 0.455, 0.493, 0.541, 0.538, 0.492, 0.845, 1.034, 1.374, 1.318
 10, 0.384, 0.393, 0.259, 0.393, 0.367, 0.477, 0.404, 0.605, 0.618, 0.454, 0.848, 1.040, 1.327, 1.104
 11, 0.237, 0.373, 0.159, 0.244, 0.250, 0.336, 0.352, 0.543, 0.497, 0.457, 0.565, 1.029, 1.146, 1.207
 12, 0.245, 0.178, 0.204, 0.237, 0.255, 0.263, 0.280, 0.431, 0.408, 0.437, 0.517, 1.168, 1.037, 1.249
 13, 0.176, 0.186, 0.127, 0.149, 0.178, 0.195, 0.203, 0.270, 0.265, 0.254, 0.353, 0.534, 0.607, 0.594
 Combined normalised q values

Age 3
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 2, -17.75, -18.07, -17.88, -17.96, -17.71, -17.06, -17.40, -17.56, -17.25, -17.97, -17.68, -17.34, -17.46, -17.62

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
q			F	F		Slope		Intrcpt
1	No data for this age							
2	-17.62	0.306	0.0000	0.0206	0.000	0.000	-17.622	0.079
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
	0.021	0.306	0.000	0.306	0.000			

Age 4
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 2, -16.86, -16.74, -17.13, -17.54, -17.55, -16.88, -16.61, -17.04, -16.28, -17.18, -17.24, -16.66, -16.69, -16.95

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
q			F	F		Slope		Intrcpt
1	No data for this age							
2	-16.95	0.369	0.0000	0.0984	0.000	0.000	-16.954	0.095
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
	0.098	0.369	0.000	0.369	0.000			

Age 5
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 1, -12.36, -12.45, -12.22, -12.44, -12.48, -12.91, -12.22, -11.49, -12.04
 2, -16.34, -16.14, -16.30, -16.95, -16.86, -16.56, -16.50, -16.70, -15.80, -16.41, -16.55, -16.14, -16.17, -16.59

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
q			F	F		Slope		Intrcpt
1	-12.29	0.405	0.0739	0.2896	0.000	0.000	-12.290	0.128
2	-16.43	0.320	0.0000	0.4380	0.000	0.000	-16.429	0.083
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
	0.374	0.251	0.201	0.251	0.642			

Age 6
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 1, -11.79, -11.52, -11.49, -11.26, -11.61, -11.61, -11.24, -10.60, -11.01
 2, -16.01, -16.18, -15.93, -16.21, -16.67, -16.34, -16.17, -16.49, -15.44, -16.33, -16.13, -15.75, -15.53, -16.41

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
q			F	F		Slope		Intrcpt
1	-11.35	0.387	0.1896	0.4753	0.000	0.000	-11.348	0.122
2	-16.11	0.366	0.0000	0.8947	0.000	0.000	-16.114	0.094
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
	0.664	0.266	0.316	0.316	1.412			

Age 7
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 1, -11.72, -11.32, -10.97, -11.22, -11.29, -11.21, -10.75, -10.30, -10.78
 2, -15.98, -16.29, -16.47, -15.85, -16.21, -16.26, -16.22, -16.34, -15.58, -16.36, -15.79, -15.58, -15.37, -16.23

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
q			F	F		Slope		Intrcpt
1	-11.06	0.434	0.2524	0.5558	0.000	0.000	-11.062	0.137
2	-16.04	0.358	0.0000	0.8962	0.000	0.000	-16.038	0.093
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
	0.738	0.276	0.235	0.276	0.721			

Table 43. Laurec/Shepherd calibration analysis for 2J3KL cod research survey abundance at age.

DISAGGREGATED qs
 LOG TRANSFORMATION
 NO explanatory variate (Mean used)
 Fleet 1, fleet is 2j3kl rv, has terminal q estimated as the mean
 FLEETS COMBINED BY ** VARIANCE **
 Terminal Fs estimated using Laurec/Shepherd method
 Regression weights
 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000
 Oldest age F = 0.500*average of 5 younger ages. Fleets combined by variance of predictions
 Fishing mortalities
 Age, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 3, 0.005, 0.009, 0.018, 0.007, 0.006, 0.008, 0.002, 0.002, 0.006, 0.018, 0.017, 0.006, 0.019, 0.021
 4, 0.073, 0.057, 0.114, 0.064, 0.126, 0.060, 0.060, 0.048, 0.063, 0.081, 0.157, 0.141, 0.204, 0.101
 5, 0.225, 0.218, 0.181, 0.176, 0.237, 0.253, 0.193, 0.205, 0.196, 0.184, 0.258, 0.354, 0.480, 0.454
 6, 0.409, 0.261, 0.272, 0.234, 0.296, 0.394, 0.382, 0.323, 0.426, 0.346, 0.454, 0.589, 0.803, 0.929
 7, 0.547, 0.407, 0.254, 0.327, 0.398, 0.431, 0.491, 0.530, 0.441, 0.515, 0.630, 0.829, 0.993, 0.922
 8, 0.492, 0.519, 0.312, 0.264, 0.451, 0.424, 0.501, 0.578, 0.594, 0.705, 0.766, 1.089, 1.287, 1.531
 9, 0.405, 0.395, 0.336, 0.354, 0.462, 0.456, 0.494, 0.544, 0.541, 0.497, 0.857, 1.063, 1.483, 1.798
 10, 0.384, 0.393, 0.259, 0.394, 0.368, 0.478, 0.405, 0.608, 0.623, 0.459, 0.865, 1.079, 1.458, 1.464
 11, 0.237, 0.373, 0.160, 0.244, 0.250, 0.336, 0.353, 0.546, 0.500, 0.463, 0.575, 1.083, 1.282, 1.771
 12, 0.245, 0.178, 0.204, 0.237, 0.255, 0.263, 0.280, 0.433, 0.411, 0.441, 0.528, 1.218, 1.204, 1.958
 13, 0.176, 0.186, 0.127, 0.149, 0.179, 0.196, 0.203, 0.271, 0.267, 0.256, 0.359, 0.553, 0.671, 0.852
 Combined normalised q values:

Age 3
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 1, -17.75, -18.07, -17.88, -17.96, -17.71, -17.06, -17.40, -17.55, -17.22, -17.93, -17.55, -17.21, -17.43, -17.59

SUMMARY STATISTICS
 Fleet, Pred., SE(q), Partial, Raised, SLOPE, SE, INTRCPT, SE
 q, F, F, Slope, Intrcpt
 1, -17.59, 0.318, 0.000, 0.0212, 0.000, 0.000, -17.593, 0.082
 Fbar SIGMA(int.) SIGMA(ext.) SIGMA(overall) Variance ratio
 0.021 0.318 0.000 0.318 0.000

Age 4
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 1, -16.86, -16.73, -17.13, -17.54, -17.55, -16.88, -16.61, -17.04, -16.27, -17.15, -17.19, -16.52, -16.55, -16.93

SUMMARY STATISTICS
 Fleet, Pred., SE(q), Partial, Raised, SLOPE, SE, INTRCPT, SE
 q, F, F, Slope, Intrcpt
 1, -16.93, 0.387, 0.000, 0.1013, 0.000, 0.000, -16.925, 0.100
 Fbar SIGMA(int.) SIGMA(ext.) SIGMA(overall) Variance ratio
 0.101 0.387 0.000 0.387 0.000

Age 5
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 1, -16.36, -16.14, -16.30, -16.95, -16.86, -16.56, -16.49, -16.70, -15.79, -16.40, -16.51, -16.08, -15.99, -16.39

SUMMARY STATISTICS
 Fleet, Pred., SE(q), Partial, Raised, SLOPE, SE, INTRCPT, SE
 q, F, F, Slope, Intrcpt
 1, -16.39, 0.335, 0.000, 0.4537, 0.000, 0.000, -16.394, 0.086
 Fbar SIGMA(int.) SIGMA(ext.) SIGMA(overall) Variance ratio
 0.454 0.335 0.000 0.335 0.000

Age 6
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 1, -16.01, -16.18, -15.93, -16.21, -16.67, -16.34, -16.17, -16.48, -15.44, -16.32, -16.12, -15.70, -15.43, -16.08

SUMMARY STATISTICS
 Fleet, Pred., SE(q), Partial, Raised, SLOPE, SE, INTRCPT, SE
 q, F, F, Slope, Intrcpt
 1, -16.08, 0.373, 0.000, 0.9290, 0.000, 0.000, -16.077, 0.096
 Fbar SIGMA(int.) SIGMA(ext.) SIGMA(overall) Variance ratio
 0.929 0.373 0.000 0.373 0.000

Age 7
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 1, -15.98, -16.29, -16.47, -15.85, -16.21, -16.25, -16.22, -16.34, -15.58, -16.35, -15.78, -15.55, -15.25, -16.01

SUMMARY STATISTICS
 Fleet, Pred., SE(q), Partial, Raised, SLOPE, SE, INTRCPT, SE
 q, F, F, Slope, Intrcpt
 1, -16.01, 0.375, 0.000, 0.9221, 0.000, 0.000, -16.010, 0.097
 Fbar SIGMA(int.) SIGMA(ext.) SIGMA(overall) Variance ratio
 0.922 0.375 0.000 0.375 0.000

Age 8
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991
 1, -16.12, -15.81, -16.38, -16.32, -15.77, -15.69, -16.17, -16.41, -15.36, -16.15, -16.06, -15.50, -15.07, -15.91

SUMMARY STATISTICS
 Fleet, Pred., SE(q), Partial, Raised, SLOPE, SE, INTRCPT, SE
 q, F, F, Slope, Intrcpt
 1, -15.91, 0.413, 0.000, 1.5309, 0.000, 0.000, -15.907, 0.107
 Fbar SIGMA(int.) SIGMA(ext.) SIGMA(overall) Variance ratio
 1.531 0.413 0.000 0.413 0.000

Table 43. Continued.

Age 9
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991

1, -15.88, -16.18, -16.08, -16.32, -16.11, -15.71, -15.97, -16.01, -15.25, -15.95, -15.73, -15.43, -15.12, -15.83

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.83	0.362	0.000	1.7975	0.000	0.000	-15.826	0.094
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
	1.798	0.362		0.000	0.362			0.000

Age 10
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991

1, -15.98, -15.87, -15.94, -15.99, -16.02, -16.04, -15.89, -16.36, -15.53, -15.94, -15.66, -15.04, -15.10, -15.80

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.80	0.375	0.000	1.4644	0.000	0.000	-15.797	0.097
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
	1.464	0.375		0.000	0.375			0.000

Age 11
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991

1, -16.46, -15.95, -16.25, -16.32, -15.83, -15.93, -16.39, -16.38, -15.59, -16.00, -16.04, -15.11, -15.13, -15.95

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.95	0.444	0.000	1.7707	0.000	0.000	-15.952	0.115
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
	1.771	0.444		0.000	0.444			0.000

Age 12
 Fleet, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991

1, -16.02, -16.74, -15.63, -15.85, -15.98, -15.51, -15.67, -17.08, -15.67, -16.19, -15.74, -14.94, -15.06, -15.85

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-15.85	0.587	0.000	1.9576	0.000	0.000	-15.852	0.151
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
	1.958	0.587		0.000	0.587			0.000

END OF TUNING PASS

JANUARY 1 POPULATION NUMBERS.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	304640	153838	161266	360268	320793	350443	433813	340428	180743	139325	183627	297493	451793	165115
4	278374	248221	124910	129722	292966	281103	284580	354466	278131	130853	111962	147827	242032	362936
5	214885	212028	192041	91387	99718	211568	201453	219538	276801	213944	98794	78410	105070	161461
6	65846	140458	139669	131158	62885	64448	134669	136198	146613	186660	145900	62622	45059	53079
7	21245	35525	88574	87192	84943	38459	35548	75309	80816	78533	108432	76096	28458	16356
8	8531	10417	19148	56216	51467	46531	20590	17791	36317	42618	38537	47403	27277	8469
9	4832	4200	5398	11307	35305	26819	24794	10301	8187	18413	17244	14714	13024	6100
10	4141	2572	2262	3318	6384	18105	13674	12238	4963	3894	6173	5951	4179	2378
11	1501	2411	1421	1362	2012	3487	9086	7534	5349	2254	1971	2768	1579	829
12	1160	834	1467	953	852	1341	1934	5144	3540	2590	1233	913	732	312
13	716	752	517	994	604	556	874	1175	2691	1902	1331	828	230	167
3+	905873	811255	736673	873898	957950	1022861	1161214	1180126	1004150	818986	717204	734824	919432	777202
4+	601233	657417	575407	513629	637157	672418	727401	839698	843407	679661	533577	437331	487639	612087
5+	322859	409196	450498	383907	344172	411315	442822	485229	565276	548808	421615	289505	225607	249151
6+	107973	197168	258456	292520	244453	199747	241369	265691	288475	334864	322821	211095	120538	87889

Table 44. Comparison of the results of several calibration formulations for 2J3KL cod.

Form.	1991 Mean F (Ages 7-9)	1991 Age 3+ Population	YEARCLASS SIZE						
			1988	1987	1986	1985	1984	1983	1982
AD-1	0.53	990	180	534	403	241	162	179	361
AD-2	0.68	940	176	522	385	217	154	173	353
AD-3	0.39	1273	193	704	472	361	164	187	393
AD-4	0.30	1080	157	411	498	410	258	204	372
AD-5	0.56	951	177	527	372	230	158	178	360
AD-6	0.43	952	163	457	417	282	180	184	367
LS-1	1.04	835	165	465	339	208	145	165	343
LS-2	1.42	777	165	452	297	184	139	161	340

Description of calibration

AD-1 RV 1978-91 ages 3-12; C/E 1983-91 ages 5-12
 AD-2 RV 1978-91 ages 3-12
 AD-3 SPANS 1983-91 ages 3-12
 AD-4 TRAP 1978-91 ages 3-10
 AD-5 RV 1978-91 ages 3-12; SPANS 1983-91 ages 3-12
 AD-6 RV 1978-91 ages 3-12; SPANS 1983-91 ages 5-12; TRAP 1978-91 ages 3-8
 LS-1 Same as AD-1 above
 LS-2 Same as AD-2 above

TABLE 45. RESULTS FROM ADAPT USING AUTUMN RV INDEX AND CATCH OUTSIDE 200 MILES OF 25,000 TONS.

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET.....				0.001274	
MEAN SQUARE RESIDUALS				0.190826	
PARAMETER	AGE	ESTIMATE	STD. ERR.	T-STAT	C.V.
NUMBERS					
	3	174517	78386	2.226	0.449
	4	417498	129726	3.218	0.311
	5	217926	54103	4.028	0.248
	6	69988	15164	4.616	0.217
	7	22879	5183	4.414	0.227
	8	13002	2738	4.748	0.211
	9	9845	2077	4.740	0.211
	10	3921	896	4.374	0.229
	11	1154	237	4.878	0.205
	12	606	146	4.164	0.240
INDEX 1: RV1					
	3	2.34E ⁻⁵	2.94E ⁻⁶	7.960	0.126
	4	4.72E ⁻⁵	5.74E ⁻⁶	8.223	0.122
	5	8.51E ⁻⁵	1.03E ⁻⁵	8.291	0.121
	6	1.26E ⁻⁴	1.52E ⁻⁵	8.269	0.121
	7	1.40E ⁻⁴	1.69E ⁻⁵	8.278	0.121
	8	1.60E ⁻⁴	1.94E ⁻⁵	8.251	0.121
	9	1.73E ⁻⁴	2.11E ⁻⁵	8.213	0.122
	10	1.79E ⁻⁴	2.18E ⁻⁵	8.202	0.122
	11	1.53E ⁻⁴	1.88E ⁻⁵	8.146	0.123
	12	1.65E ⁻⁴	2.01E ⁻⁵	8.209	0.122

TABLE 45. CONTINUED.

LOG RESIDUALS FROM RV1 28/ 5/92

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.09	0.43	0.22	0.31	0.06	0.59	0.23	0.06	0.35	0.36	0.04	0.20	0.10	0.00
4	0.12	0.24	0.15	0.57	0.55	0.08	0.38	0.09	0.66	0.25	0.29	0.32	0.21	0.09
5	0.12	0.31	0.14	0.53	0.40	0.10	0.08	0.26	0.63	0.01	0.14	0.28	0.33	0.29
6	0.16	0.10	0.16	0.13	0.80	0.20	0.04	0.39	0.71	0.23	0.02	0.37	0.61	0.32
7	0.08	0.22	0.50	0.16	0.16	0.24	0.15	0.26	0.46	0.28	0.31	0.54	0.69	0.42
8	0.09	0.06	0.47	0.48	0.17	0.25	0.28	0.44	0.61	0.14	0.02	0.61	0.84	0.66
9	0.08	0.24	0.40	0.46	0.26	0.16	0.07	0.19	0.62	0.12	0.25	0.62	0.80	0.78
10	0.27	0.09	0.05	0.38	0.15	0.21	0.08	0.42	0.24	0.13	0.30	0.85	0.88	0.80
11	0.04	0.16	0.18	0.25	0.14	0.14	0.45	0.30	0.48	0.22	0.05	1.02	0.61	0.66
12	0.18	0.30	0.00	0.24	0.04	0.09	0.30	1.14	0.32	0.17	0.17	1.10	0.68	0.62

SUM OF RV RESIDUALS : 0.000001010887046 MEAN RESIDUAL : 7.220621754E-9

POPULATION NUMBERS (000S) 28/ 5/92

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	304554	154562	161745	361416	322537	351979	439896	352458	172643	153345	213161	379772	516968	174189
4	277506	248150	125502	130115	293327	262531	285837	359448	287980	140596	123441	172007	309396	416297
5	215276	211317	191984	91872	100039	212338	202622	220567	280878	222008	106771	87808	124867	216015
6	65690	140778	139087	131111	63282	64711	135300	137155	147456	189999	152502	69153	52754	69287
7	20781	35561	88837	86715	84905	38784	35763	75826	81599	79222	111166	81501	33805	22656
8	8385	10037	19178	56431	51077	46499	20856	17967	36740	43260	39102	49641	31703	12847
9	4602	4080	5087	11331	35461	26500	24769	10519	8331	16759	17769	15177	14856	9723
10	4026	2383	2164	3064	6404	18249	13612	12217	5141	4012	8457	6381	4557	3678
11	1403	2316	1266	1301	1803	3503	9204	7320	5331	2400	2067	3000	1931	1139
12	1029	753	1390	827	768	1171	1947	5241	3365	2576	1353	992	922	600
13	521	644	451	930	500	502	734	1186	2770	1758	1319	726	295	323
3+1	903973	810582	738690	875114	960743	1026768	1170540	1199905	1032235	855936	777108	866158	1092054	927554

FISHING MORTALITY 28/ 5/92

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.005	0.008	0.018	0.007	0.006	0.008	0.002	0.005	0.017	0.015	0.005	0.017	0.013	
4	0.072	0.057	0.112	0.063	0.125	0.059	0.059	0.047	0.060	0.075	0.141	0.120	0.157	0.073
5	0.225	0.218	0.181	0.173	0.236	0.251	0.190	0.203	0.191	0.176	0.234	0.310	0.369	0.263
6	0.417	0.260	0.272	0.235	0.290	0.393	0.379	0.319	0.421	0.336	0.427	0.516	0.645	0.508
7	0.528	0.417	0.254	0.329	0.402	0.420	0.488	0.525	0.435	0.506	0.608	0.744	0.768	0.490
8	0.520	0.480	0.326	0.264	0.458	0.430	0.464	0.569	0.585	0.690	0.746	1.006	0.982	0.625
9	0.456	0.434	0.307	0.371	0.465	0.466	0.507	0.516	0.531	0.484	0.824	1.003	1.143	0.652
10	0.353	0.432	0.309	0.330	0.403	0.485	0.420	0.629	0.562	0.463	0.836	0.995	1.187	0.560
11	0.422	0.311	0.226	0.304	0.232	0.387	0.363	0.577	0.527	0.373	0.534	0.979	0.969	0.714
12	0.268	0.313	0.201	0.302	0.248	0.267	0.296	0.438	0.449	0.469	0.423	1.014	0.851	0.495
13	0.251	0.221	0.147	0.160	0.220	0.219	0.247	0.266	0.256	0.280	0.363	0.459	0.482	0.295

Table 46. Input parameters for projections for 2J3KL cod.

Age	Jan. 1 1992 Population Nos.(000)		Weight at age (kg)	Partial Recruitment	
	ADAPT	L/S		ADAPT	L/S
3	270,000	250,000	0.42	.017	.012
4	141,310	132,375	0.68	.14	.12
5	315,586	268,601	1.02	.40	.35
6	132,035	83,953	1.45	.70	.63
7	32,065	17,164	1.88	1.0	1.0
8	10,766	5,326	2.19	1.0	1.0
9	5,182	1,500	2.57	1.0	1.0
10	3,787	827	3.07	1.0	1.0
11	1,676	450	3.78	1.0	1.0
12	404	116	5.02	1.0	1.0
13	273	36	6.41	.50	.50
14	190	58	8.45	.50	.50
15	0	0	10.47	.50	.50

Table 47. Results of projections to 1992 for 2J3KL cod.

RESULTS FROM ADAPT STARTING VALUES			
1992 Catch (000t)	1992 F (Ages 7-9)	1993 Jan 1 3+ Biomass (000t)	1993 Jan 1 7+ Biomass (000t)
79	0.25	781	222
100	0.33	758	209
145	0.50	712	182

RESULTS FROM LAUREC/SHEPHERD STARTING VALUES			
1992 Catch (000t)	1992 F (Ages 7-9)	1993 Jan 1 3+ Biomass (000t)	1993 Jan 1 7+ Biomass (000t)
50	0.25	658	134
94	0.50	612	112
100	0.54	607	109
145	0.84	560	112

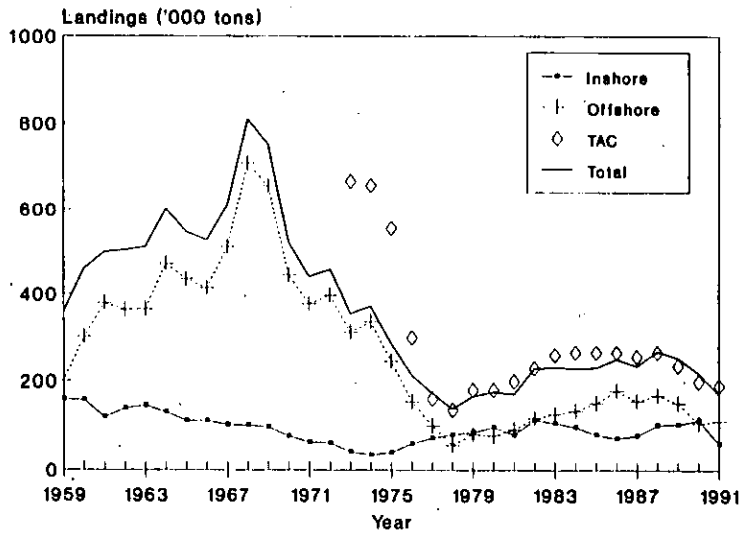


Figure 1. Cod in Divisions 2J3KL:
Inshore and offshore landings and TAC's.

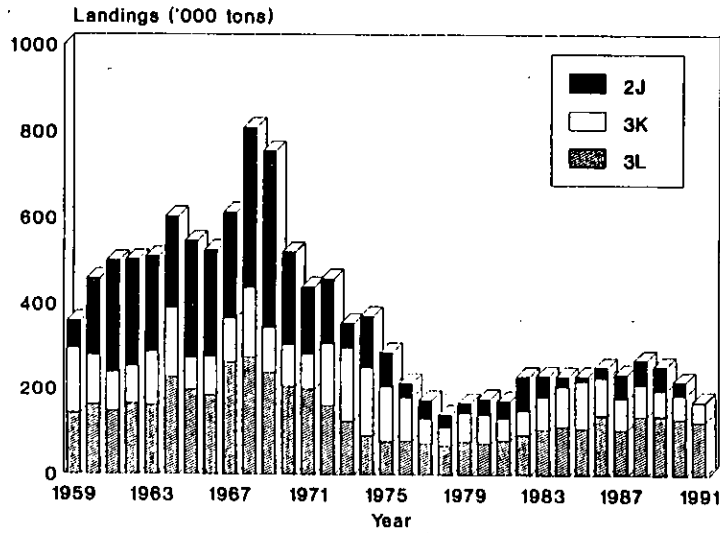


Figure 2. Cod in Divisions 2J3KL:
Landings by Division.

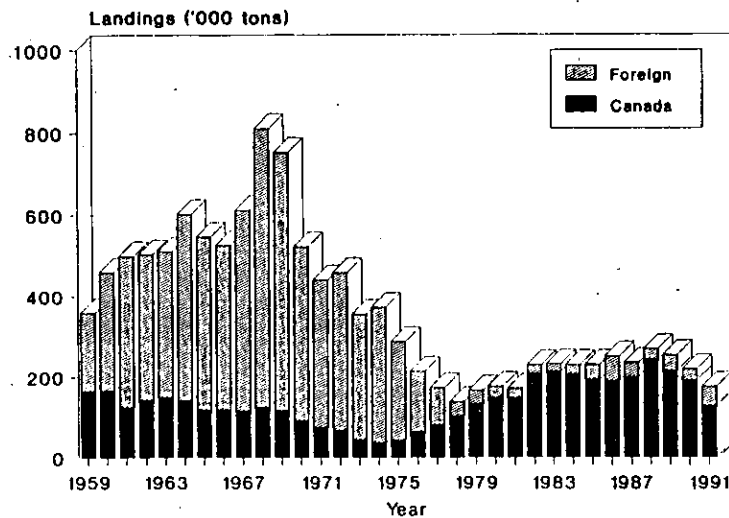


Fig. 3. Cod in Divisions 2J3KL: Landings
by Canada and other countries.

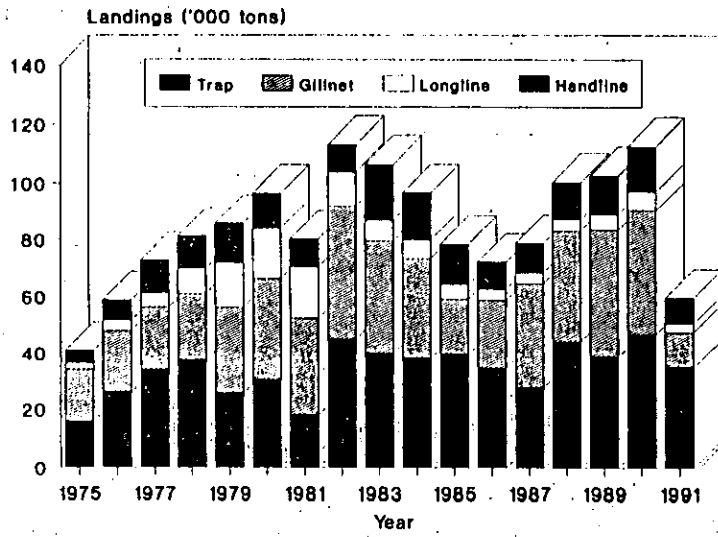


Fig. 4. Cod in Divisions 2J3KL: Landings by inshore gears.

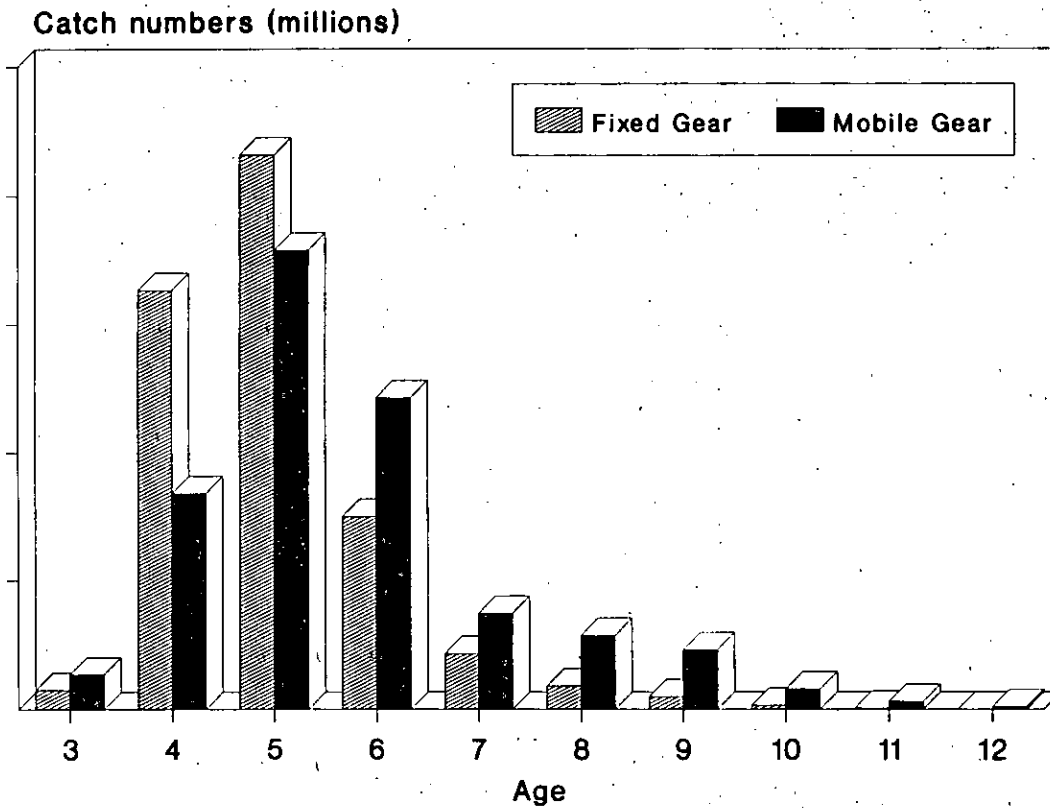


Fig 5. Age composition of the commercial cod catch for Div. 2J3KL during 1991.

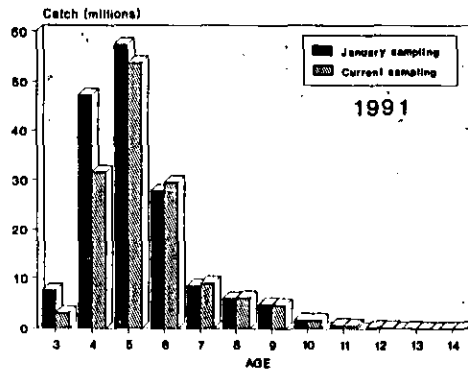
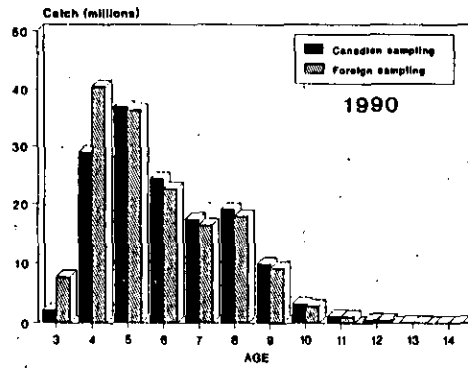


Figure 6. Revised catch at age for 1990 and 1991 compared to catch at age used in previous assessment.

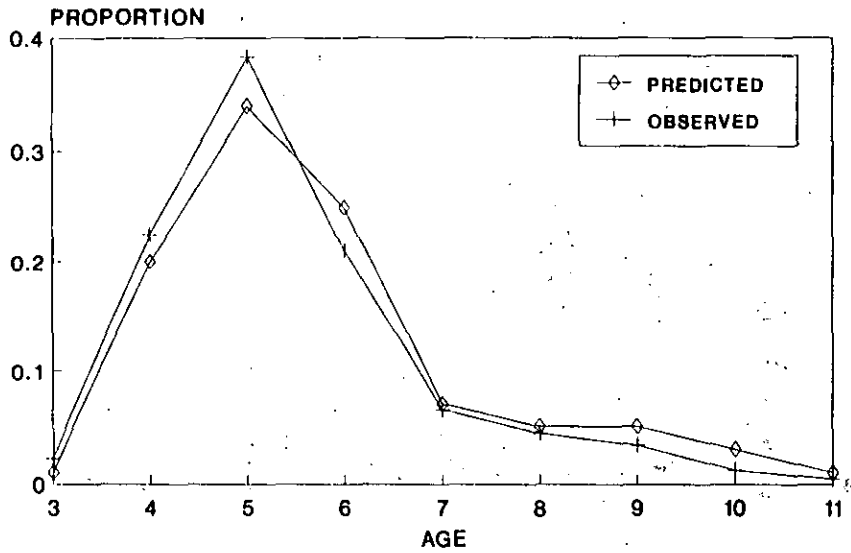


Fig. 7. Observed and predicted catch at age of 2J3KL cod for 1991.

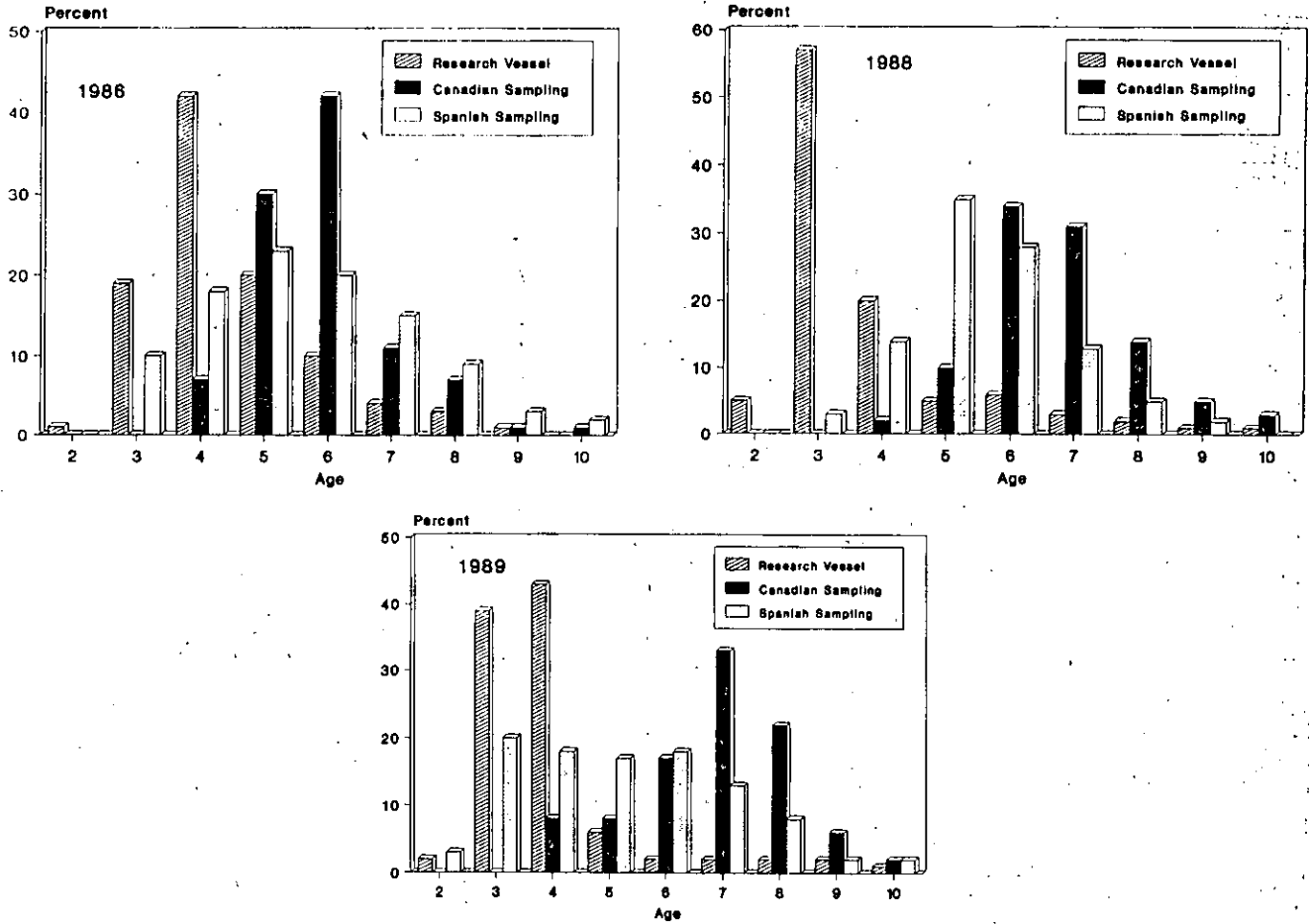


Fig. 8. Comparison of age compositions derived from Spanish, Canadian and RV sampling in Division 3L.

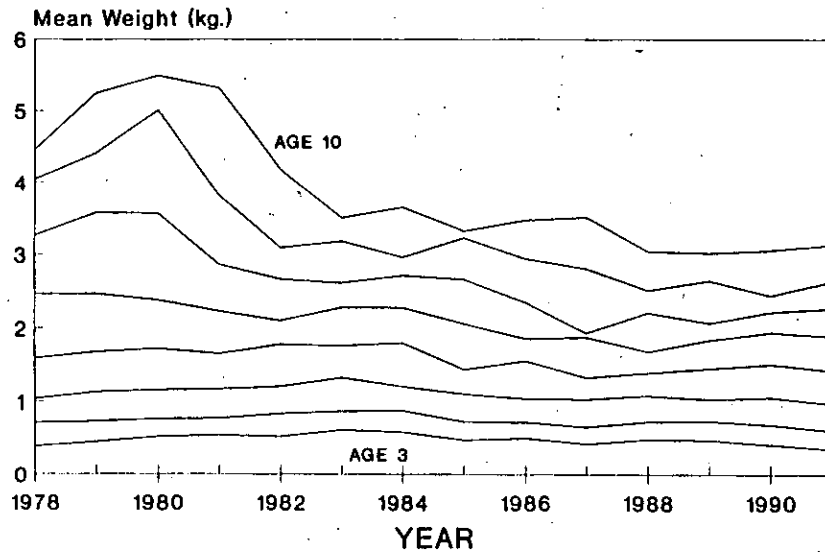


Fig. 9. Commercial fishery mean weights for 2J3KL cod.

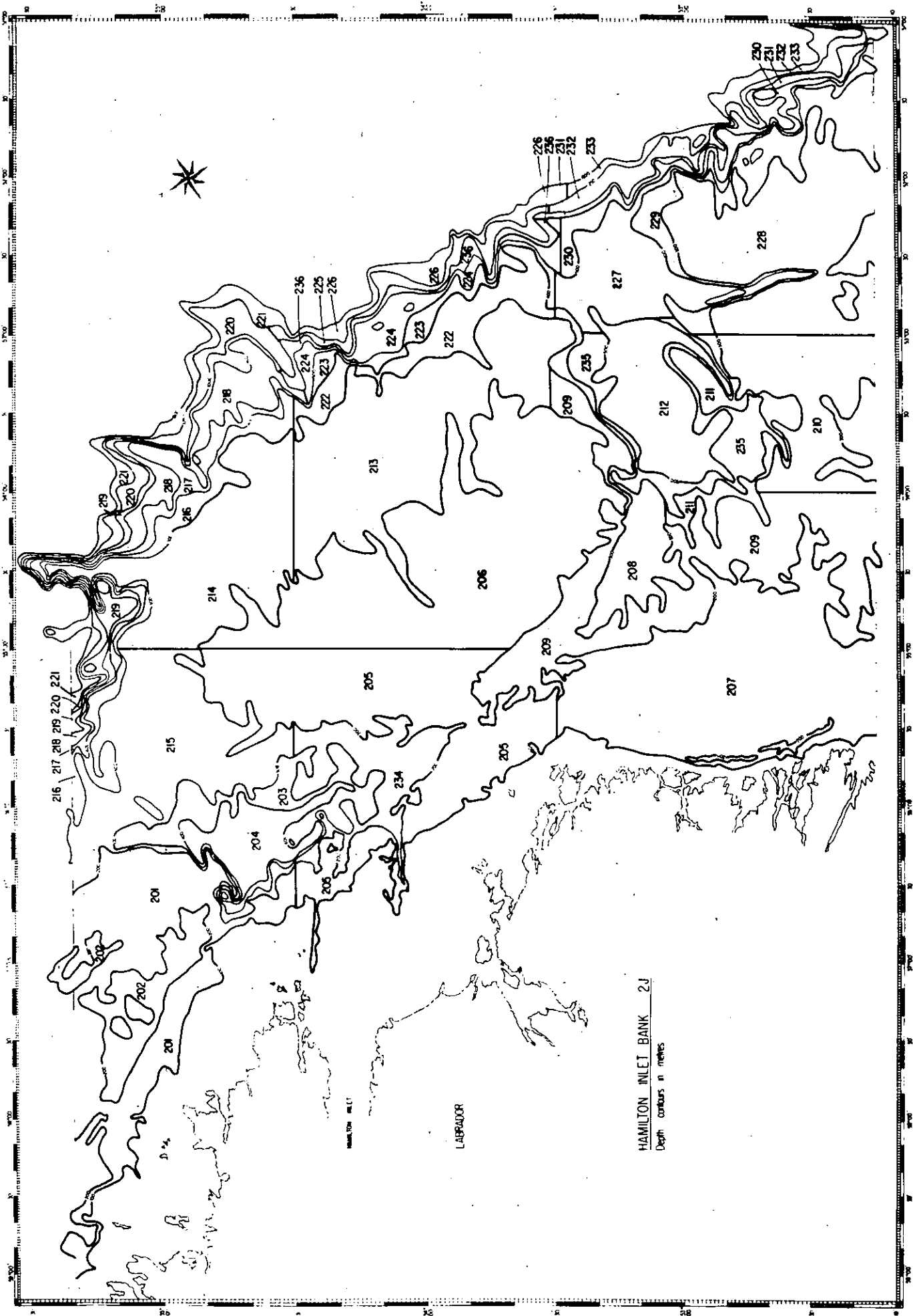


Figure 10. Area of stratification for RV surveys in Div. 2J.

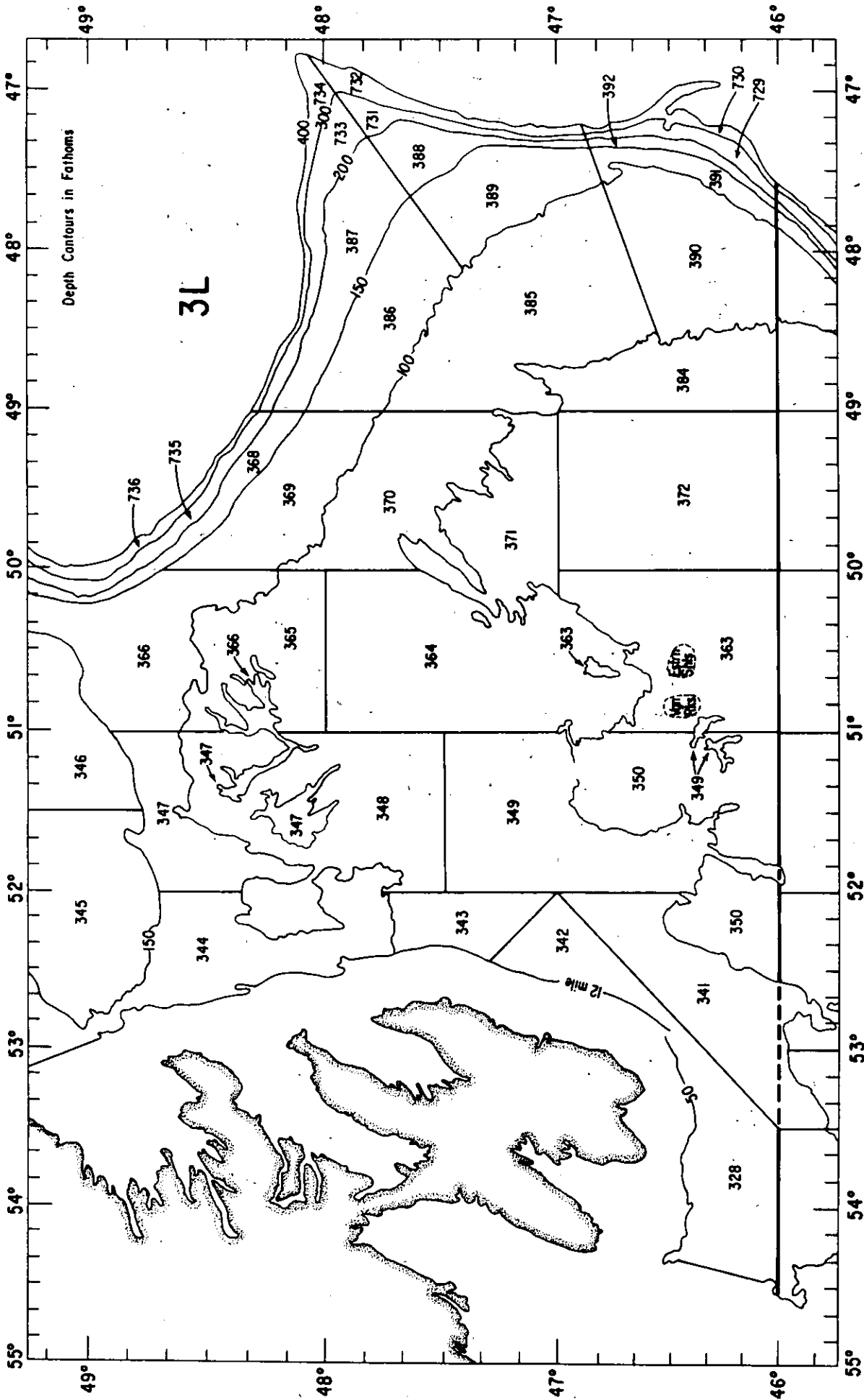


Figure 12. Area of stratification for RV surveys in Div. 3L.

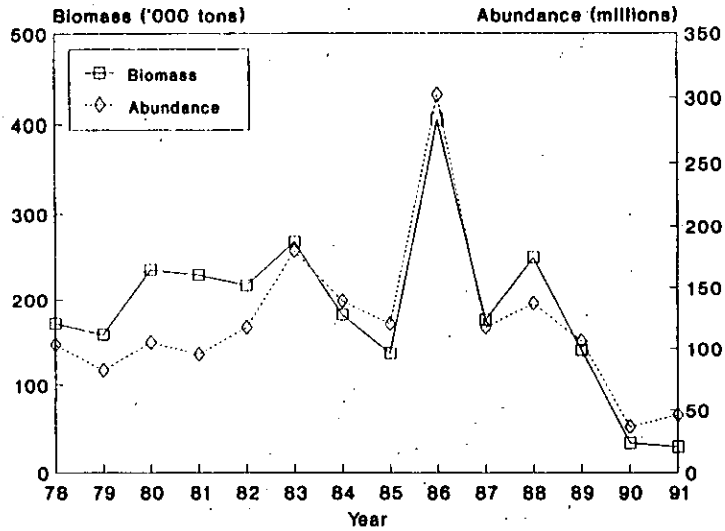


Figure 13. Biomass and abundance of cod from autumn RV surveys in Division 2J.

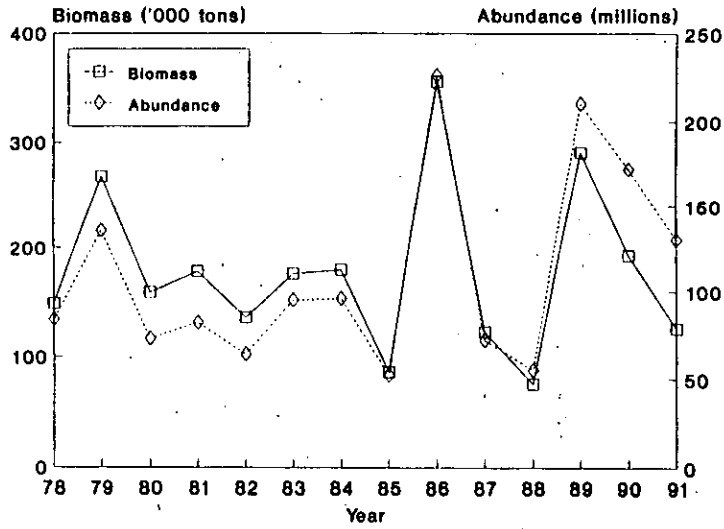


Figure 14. Biomass and abundance of cod from autumn RV surveys in Division 3K.

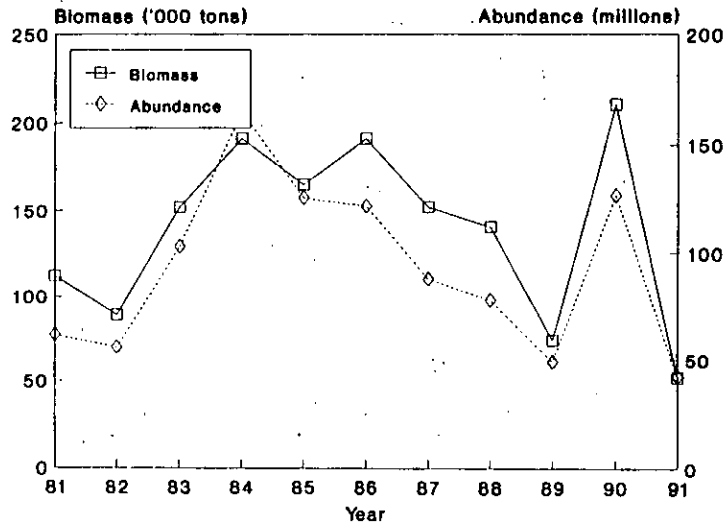


Figure 15. Biomass and abundance of cod from autumn RV surveys in Division 3L.

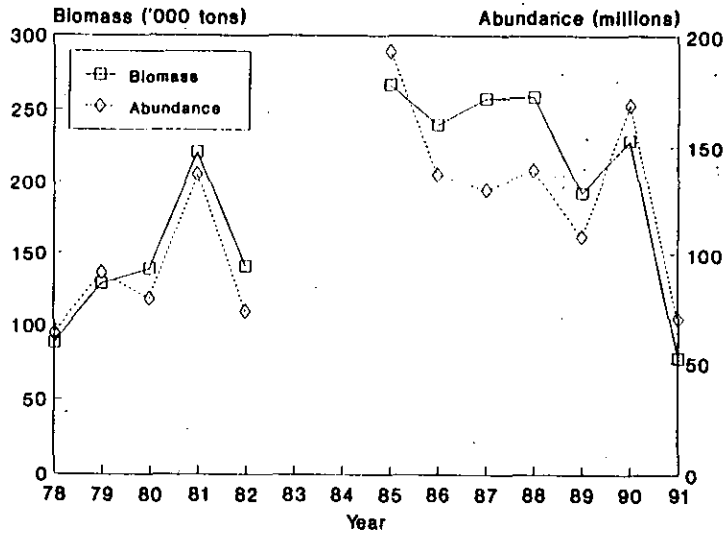


Figure 16. Biomass and abundance of cod from spring RV surveys in Division 3L.

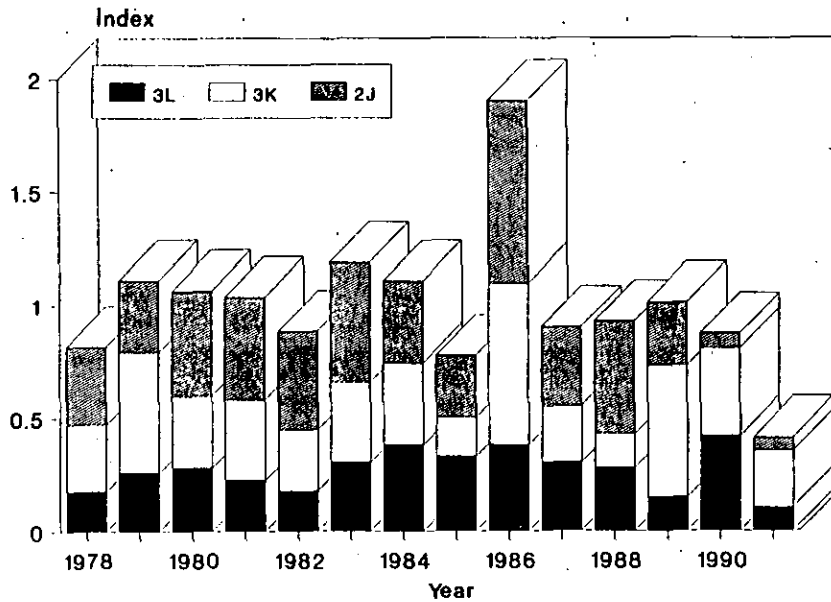


Fig. 17. Cod in Divisions 2J3KL: Index of research vessel biomass.

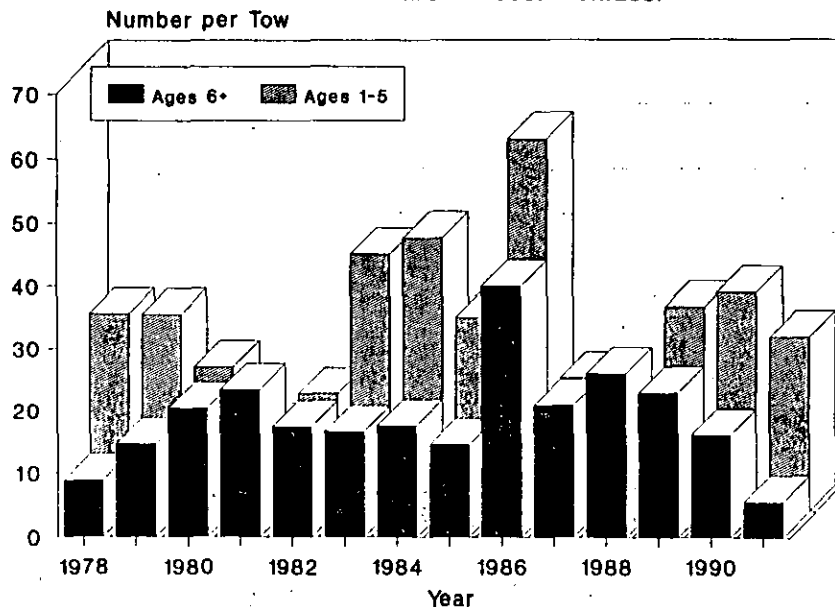


Fig. 18. Cod in Divisions 2J3KL: Research vessel survey numbers.

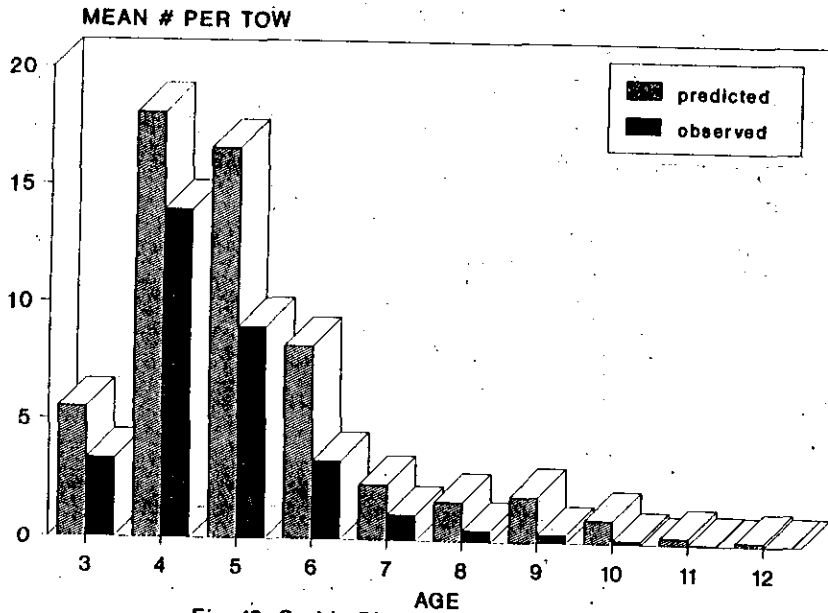


Fig. 19. Cod in Div. 2J3KL: Observed and predicted (1991 ADAPT) RV nos. per tow.

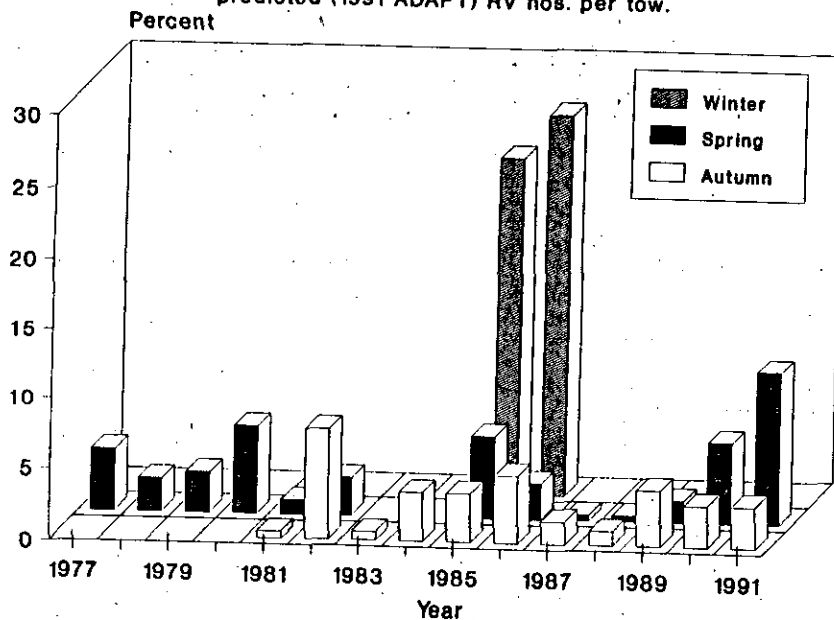


Fig. 20. Cod in Division 3L: Proportion of biomass outside 200 miles.

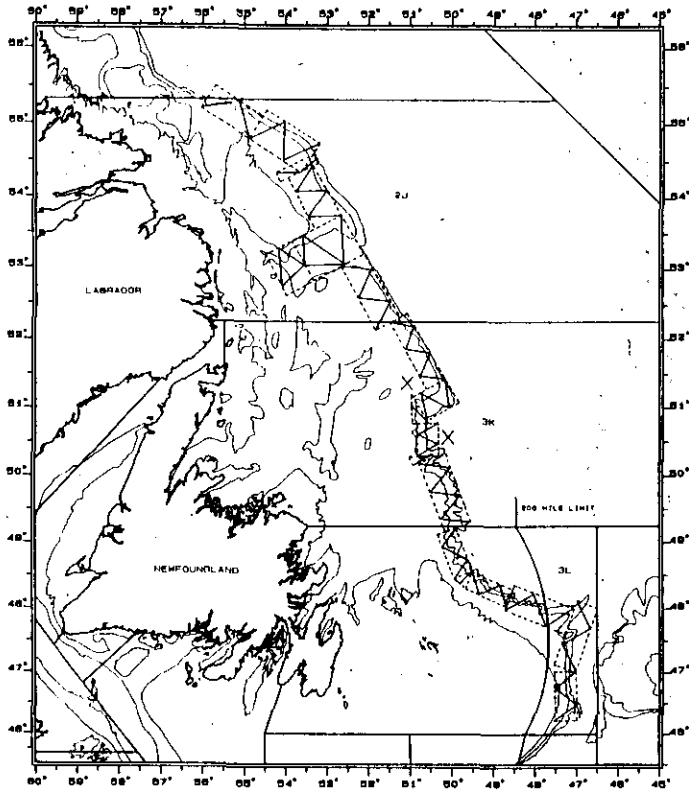


Figure 21. Intended survey area for Winter hydroacoustics and cod/seal scouting trip.

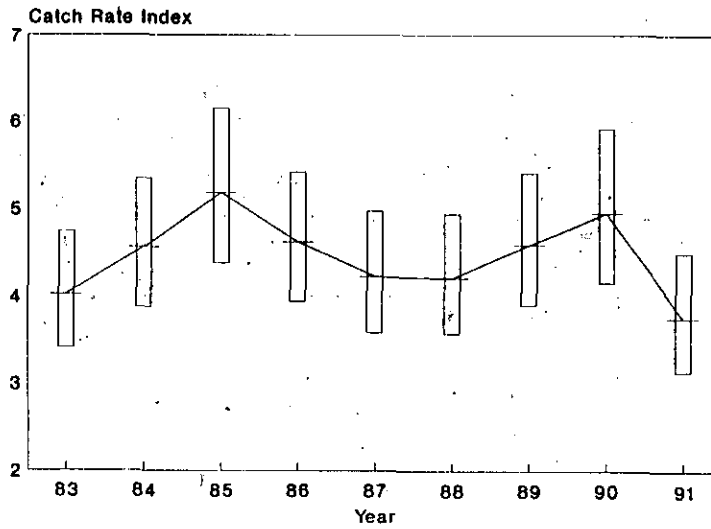


Figure 22. Catch rate index for 2J3KL cod with 90% C.I. for the years 1983-91.

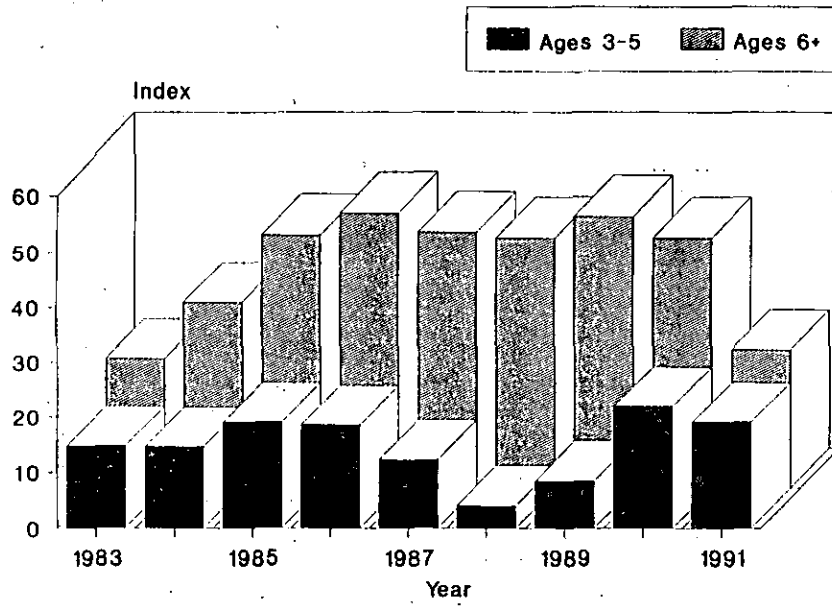


Figure 23. Commercial catch rate by age groups.

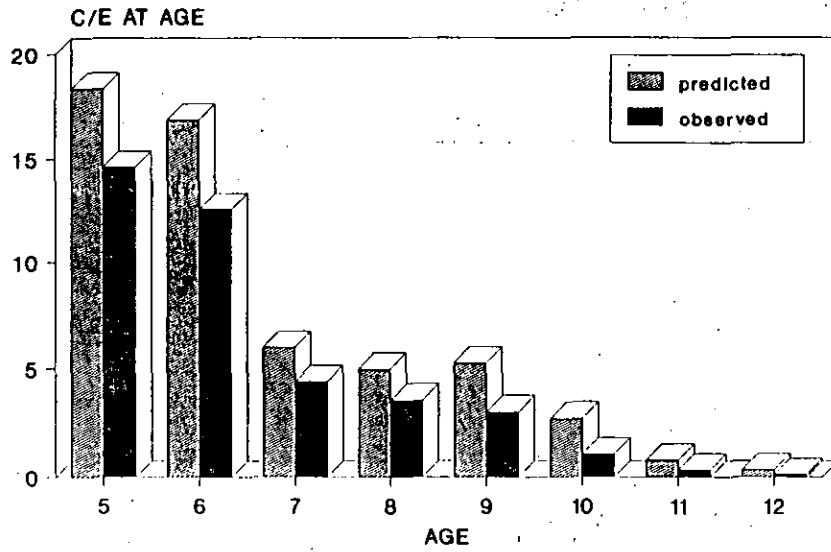


Fig. 24. Observed and predicted C/E at age of 2J3KL cod for 1991.

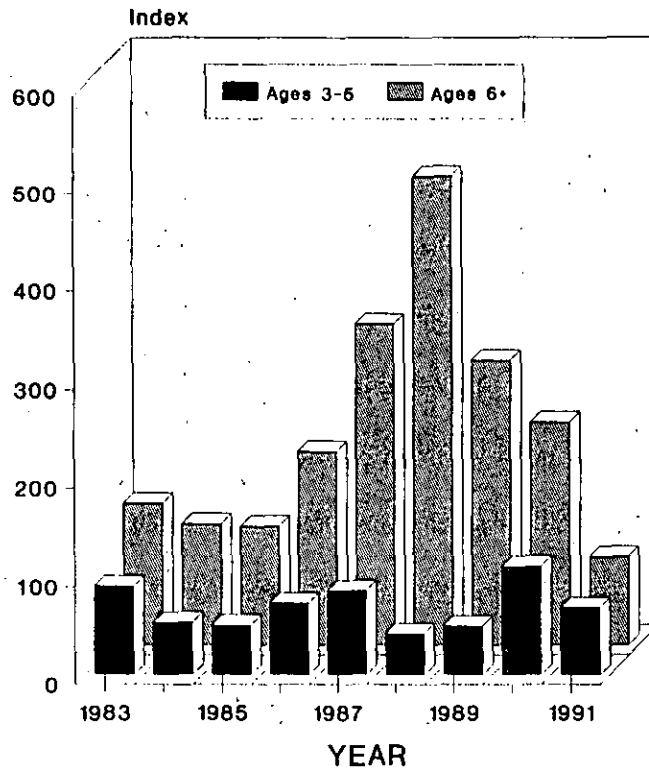


Fig. 25. Abundance index from spans.

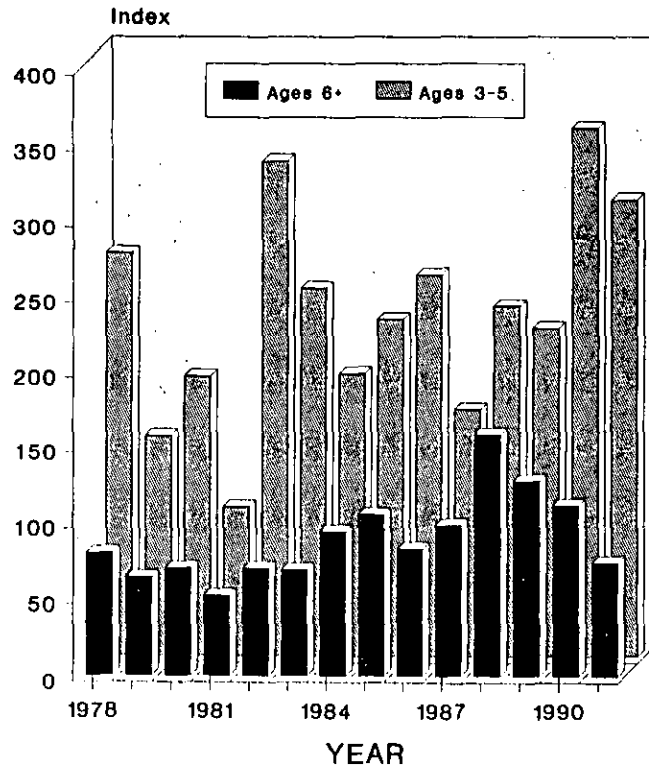


Fig. 26. Cod trap catch at age.

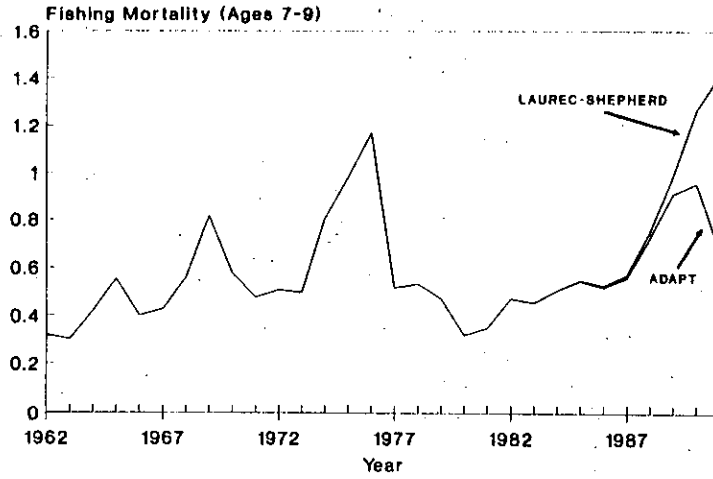


Fig. 27. Mean Fishing mortality for cod from ADAPT and Laurec-Shepherd analyses.

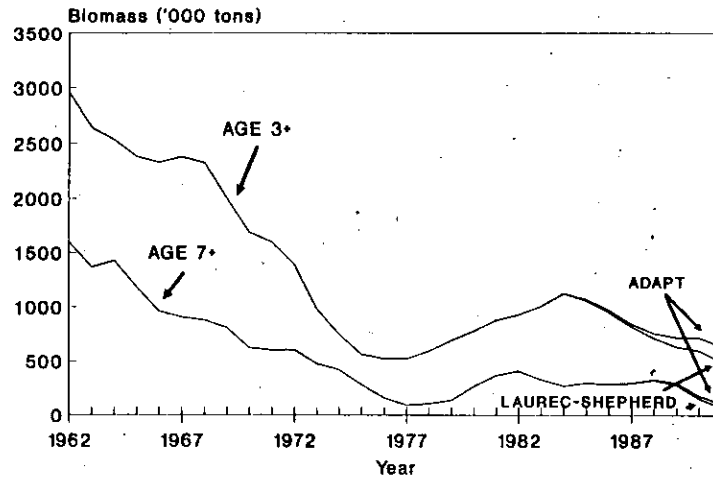


Fig 28. Jan 1 population biomass for cod from ADAPT and Laurec-Shepherd analyses.

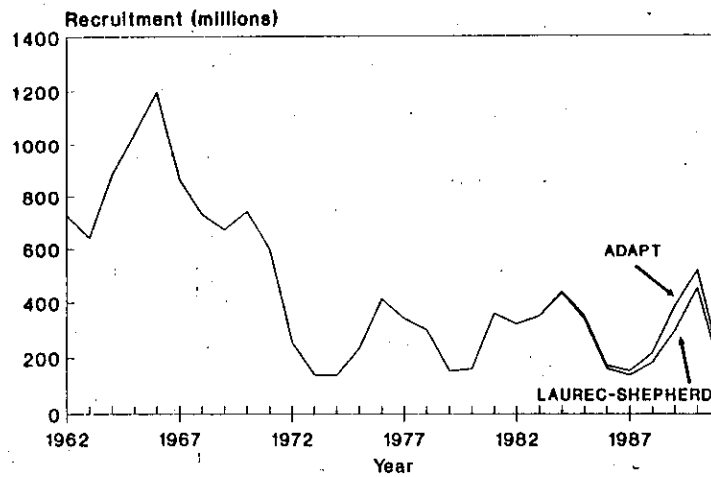


Fig. 29. Age 3+ population numbers from ADAPT and Laurec-Shepherd calibrations.

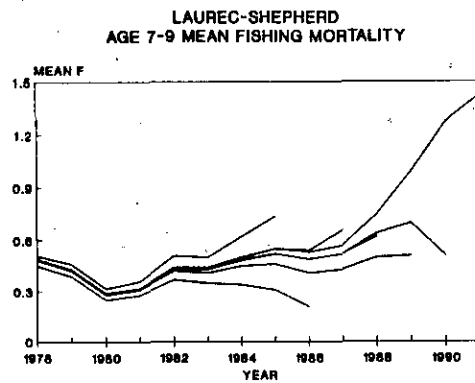
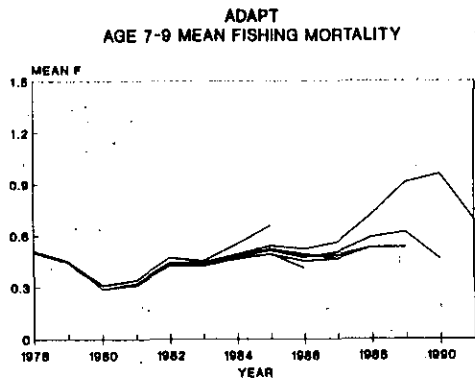


Fig.30. Retrospective analysis for 2J3KL cod showing age 7-9 mean fishing mortality.

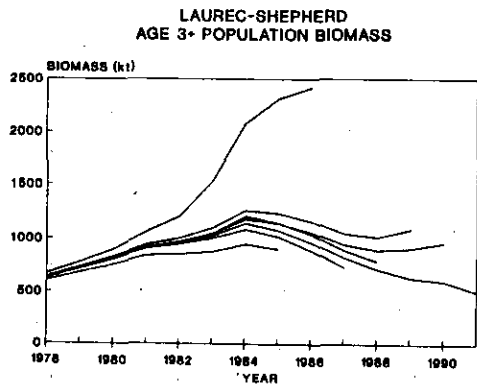
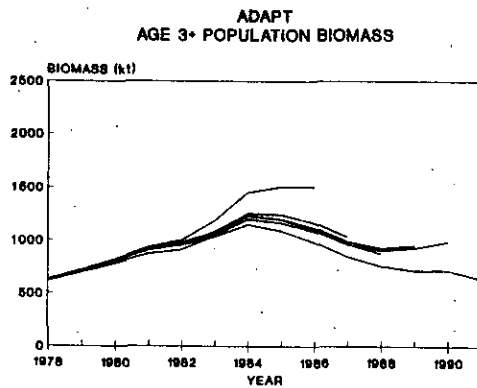


Fig.31. Retrospective analysis for 2J3KL cod showing age 3+ population biomass.

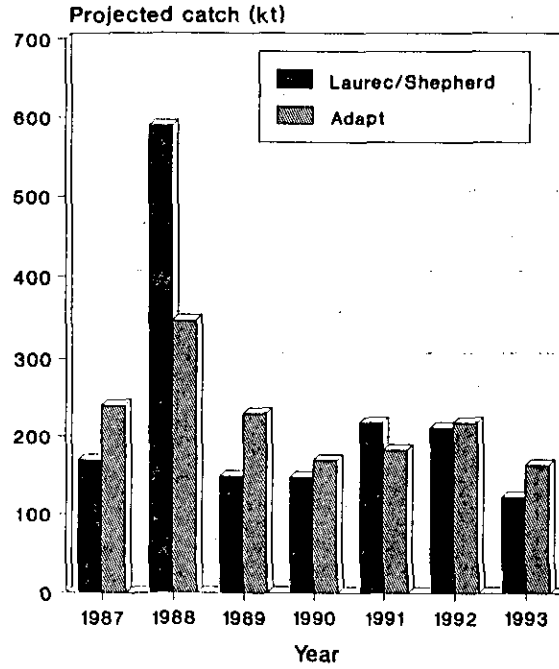


Fig.32. Retrospective analysis: projected catches at F=0.40.

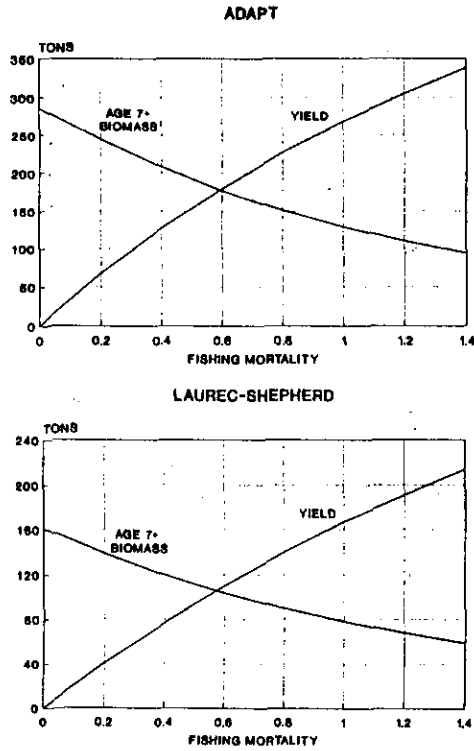


Fig.33. Projections of 1992 yield and Jan 1, 1993 age 7+ biomass from results of ADAPT and L/S.