Assessment of the cod stock in NAFO Divisions 2J and 3KL

by

J. W. Baird and C. A. Bishop
Science Branch
Department of Fisheries and Oceans
P. O. Box 5667
St. John's, Newfoundland A1C 5X1

Nominal Catch

Nominal catches for this stock declined from a high of about 800,000 t in 1968 to a low of about 139,000 t in 1978 (Table 1, Fig. 1.). Quota regulation for the entire stock has been in effect since 1973. The total catch has been relatively stable since 1982 at about 230-250,000 t. The inshore catch declined from 1982 to 1986 but increased in 1987 and again in 1988. The offshore catch has been relatively stable at approximately 155,000 t since 1984 with the exception of that reported for 1986. The catch of 179,000 t resulted mainly from an increase in the foreign catch in Div. 3L. Trends in the catch by inshore gears (Trap, gillnet, longline, and handline) since 1975 are shown in Table 2 and Figure 3. The predominant inshore gears for this time period have been traps and gillnets. The increase in inshore catch from 1987 to 1988 resulted mainly from a substantial increase in the trap catch. The trap catch in 1988 was the highest in the 1975-88 period.

During the 1960-71 period, landings were mainly from Div. 2J and 3L with those from Div. 2J predominating. Since 1971, landings have been mainly from Div. 3L and 3K (Fig. 2). Approximately 22% of the nominal catch in 1988 came from Div. 2J, 30% from Div. 3K, with the remaining 48% taken in Div. 3L (Table 1). The higher proportion of the catch taken in Div. 3L is due, in part, to fishing activity by Spain and Portugal on the Nose of the Grand Bank (Table 4).

Nominal catches in 1987 and 1988 by country, month, and division are shown in Tables 3 and 4. These were obtained from the Department of Fisheries and Oceans for Canadian-based vessels and from the FLASH database and the NAFO Secretariat for catches from countries other than Canada. The catch in 1988 by foreign fleets fishing outside the 200-mile zone in Div. 3L was estimated at 20,000 t based on NAFO circular letters which is consistent with Canadian surveillance estimates. Recent nominal catches, along with associated TACs, are as follows ('000 t):

Year	1981	1982	1983	1984	1985	1986	1987	1988
Catch	171	230	232	230	232	252	235	258
TAC	200	230	260	266	266	266	256	266

Catch and average weight at age

A summary of the sampling used to derive the catch at age in 1987 is given in Table 5. The following relationship was applied in deriving average weight at age: log weight = 3.0879 log length - 5.2106. The discrepancy between reported catch and catch calculated from these average weights for 1987 was about 3%. Catch numbers, average weight, and average length at age for 1987 are given in Table 6. The 1980-82 year classes were dominant in the commercial fishery as they had been in that for 1986. Catch at age by inshore and offshore components and by Division for 1987 is presented in Table 7.

A summary of the sampling used to derive the catch at age in 1988 is shown in Table 8. Sampling was considered adequate with respect to intensity by gear and spatial coverage. The length-weight relationship used in deriving average weight at age in 1988 is described above. The discrepancy between reported catch and catch calculated from these average weights for 1988 was about 1%. Catch numbers, average weight, and average length at age for 1988 are given in Table 9. The 1981, 1982, and

1983 year-classes were most abundant in the commercial catch. Average weights at age from the 1988 fishery were similar to those for the 1987 fishery. Catch at age by inshore and offshore components and Division in 1988 is presented in Table 10 and Fig. 4.

In previous assessments of this stock, the age range of catch and average weight matrices used for sequential population analyses included ages from 4 to 13. The current analysis includes data for ages 3 to 13 obtained from the matrices shown in Tables 11 and 12. Average weights for the period 1962-72 were estimates obtained using weight-at-age data from 1964-68 (2J) and 1965-70 (3K and 3L) periods which had been weighted by Divisional catch.

Research vessel surveys

Research vessel surveys were conducted in the fall by the GADUS ATLANTICA in Div. 2J and 3K since 1977 and 1978 respectively. Fall surveys in Div. 3L were conducted by the A. T. CAMERON during 1981-82 and by the WILFRED TEMPLEMAN in 1983-88. The 1984 fall survey was conducted earlier in the year than were the other surveys (August-September as opposed to October-November). Biomass and abundance estimates from all these surveys are shown in Tables 13-18. Spring surveys were conducted in Div. 3L from 1971-82 by the A. T. CAMERON and in 1985-88 by the WILFRED TEMPLEMAN. Tables 19 and 20 give abundance and biomass for the latter period (1977-88) of this survey. To account for incomplete coverage of strata in certain years, estimates of abundance for non-sampled strata were obtained using a multiplicative analysis. Stratification charts used for the surveys in the 3 NAFO Divisions are shown in Fig. 5-7. The results from the fall surveys indicate that biomass and abundance have shown large fluctuations for Div. 2J and 3K in recent years, relative stability in Div. 3L biomass since 1983, and declining abundance since 1984 (Fig. 8-10). Estimates from the spring surveys in Div. 3L suggest that abundance and biomass have been higher in the 1985-88 period than in the 1976-82 period (Fig. 11).

Percent biomass by division (Table 21) in 1988 showed a different pattern than that for 1981-87 (54% and 16% for Div. 2J and 3K in 1988 as opposed to the 1981-87 average of 41% and 31% respectively).

Tables 22-25 give mean numbers per tow at age for surveys in all divisions. The values shown include adjustments to account for strata omitted during the surveys. Dominant year classes in the surveys were: 2J - 1981, 1982; 3K - 1982, 1983; 3L (fall) - 1981, 1982, 1983; and 3L (spring) - 1981, 1982, 1983. An autumn survey index was calculated for 2J3KL by averaging (weighted by the surveyed area) the results from the three divisions. Since there were no autumn surveys in 3L for 1978 to 1980, an index for these years was estimated by averaging year class estimates in successive spring surveys in Div. 3L in 1977-81 (Table 25) to obtain values for the intervening fall periods. This gave a total autumn survey abundance index for ages 2-13 (Table 26) in Div. 2J, 3K, and 3L for the period 1978-88. The 1987-88 values were similar to those of the early 1980s. The abundance of ages 6 and older has shown a general increase in recent years.

Plots of the mean number per tow at age values by year class (1971-82) suggested full recruitment to the research gear at approximately age 5 and a subsequent steady decline in abundance with age (Fig. 12-14). Values from the 1986 survey were inconsistent with this pattern.

Commercial catch-effort

Offshore catch and effort data are available by Division, month, country, and gear and a multiplicative model (Gavaris 1980) was used to account for the country/gear, seasonal, and divisional differences.

For the 1962-79 period, catch and effort data were obtained from NAFO Statistical Bulletins and included that for Canadian (TC. 4 and 5), Portuguese (TC. 6 and 7), and Spanish (TC. 6) otter trawlers. For the 1978-88 period, data for Canadian (TC. 4, 5, and 6) and Portuguese (TC. 6 and 7) otter trawlers were used. Portuguese catch rates for the latter period were obtained from observer records.

As in previous assessments, the analysis was done separately for both these series. Plots of residuals showed 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 errors, data with less than 10 t catch or 10 h effort were excluded from the analysis. Results from the regression analyses on the two time series are given in Tables 27-30 with the resultant catch rates given in Tables 31-32 and Fig. 15-16.

The series from the two periods were combined into a catch rate index for the entire period by scaling each series to its respective mean of the 1978-79 indices. In only these two years was there sufficient overlap in country-gear components to adequately link the two periods. The resulting catch rate index is presented in Figure 17 and indicates an overall decline from 1962 to 1977 with a subsequent increase to 1985, declines in both 1986 and 1987, followed by an increase in 1988 to approximately the 1984-86 level.

Catch and effort data were also analyzed by Division for the 1978-88 time period only. The results of the divisional regressions are given in Tables 33-38 with the resultant catch rates in Tables 39-41 and Fig. 18-20. The analysis indicated a declining trend since 1983 in Div. 2J and an overall increasing trend in both Div. 3K and 3L from 1978-88.

Offshore catches since 1977 have been mainly by Canadian vessels. In 1987 and 1988, the Canadian groundfish management plan required that offshore catches be taken from the three divisions in equal proportions; in addition, in 1988 discards were counted against company allocations. The possible effect of this change on fishing activity and subsequent catch rate data could not be quantified. However, there was sufficient information to suggest that fishing pattern in Div. 2J during January and February of 1987 and 1988 would not be comparable with CPUE of previous years; consequently, data for these months were not included in multiplicative analyses.

As the fishery for cod in Div. 3L may be mostly a directed American plaice fishery, catch rates were analyzed using data from only 2J and 3K for the 1978-88 period. Results of the regression of ln catch rate are given in Tables 42 and 43. The resultant catch rate (Table 44, Fig. 21) show similar trends as the analysis using data from all 3 divisions.

Estimation of Stock Size

Research vessel survey and commercial catch rate indices were analyzed in separate formulations of the adaptive framework (Gavaris, 1988).

The formulation used in the adaptive framework with the research survey abundance index was as follows:

PARAMETERS:

- Year class estimates
  $N_{i,1988}$ i = 3 to 9
- Calibration coefficients for RV numbers
  Ki i = 3 to 9

STRUCTURE:

- Natural mortality assumed to be 0.20.
- Error in catch at age assumed negligible.
- F on oldest age group (13) was calculated as the total F for age groups 7-11.
- F for age groups 10-13 in 1988 set equal to the total F for ages 7-9 in 1988.
- Intercepts not fitted.

INPUT:

- $C_{i,t}$ i = 3 to 13, t = 1978-88
- $RV_{i,t}$ i = 3 to 9, t = 1978-88
- Fall RV survey related to the population at the same age fished to the time of the survey.

OBJECTIVE FUNCTION:

- Minimize
  $\Sigma\Sigma_{it} \{obs\ (\ln RV_{i,t}) - pred\ (\ln RV_{i,t})\}^2$

SUMMARY:

- Number of observations = 77.
- Number of parameters = 14.

It had previously been determined that intercepts were not significant and, hence, were unnecessary for these relationships. All parameters estimated by the model were significant with most CVs (11 of 14) less than .20 (Table 45). Examination of residuals for RV data for all ages (Table 45, Figs. 22-32) indicated some patterns in the residuals. For each age, the predicted value for 1986 is lower than the observed value, while the 1985 predicted values are all (except age 3) higher than observed. This may indicate that the 1986 survey estimate may be too high while the 1985 estimate may be too low. Analyses were also conducted with the 1985 and 1986 survey results alternately omitted. When 1986 is omitted, the estimated F_T is slightly higher (14%)

than the original analysis; and when 1985 is omitted, the F_T is about the same as the original. The analysis using survey data with all years included in the model resulted in an average fully-recruited fishing mortality (ages 7-10) of about 0.57 (Table 46). The age 3+ population numbers at the start of the year have declined since 1985 and are at its lowest level since 1980 (Table 46).

An adaptive framework using survey data aggregated for ages 6+, similar to the calibration for RV survey data in the most recent assessment of this stock (Baird and Bishop, 1987), gave an estimate of fully-recruited F in 1988 of about 0.75. The pattern of residuals for 1985 and 1986 were similar to that of the age disaggregated analysis. The population estimates (ages 6-9) were better estimated in the age disaggregated analysis (CVs ranging from .16-.18) than the total age 6+ population in the age-aggregated analysis (CV = .22).

The formulation used in the adaptive framework with the commercial catch rate index was as follows:

PARAMETERS:

- Population estimates
  $N_{8,1988}$
- Calibration coefficient for C/E
  K

STRUCTURE:

- Natural mortality assumed to be 0.20.
- Error in catch at age assumed negligible.
- F on oldest age group (13) was calculated as the total F for age groups 7-11.
- The following PR was assumed for 1988:

AGE	3	4	5	6	7	8-13
PR	.007	.08	.29	.59	.78	1.00

- Intercepts were not fitted.

INPUT:

- $C_{i,t}$ $i = 3$ to 13, $t = 1978$-88
- C/E_t $t = 1978$-88
- C/E_t related to exploitable biomass

OBJECTIVE FUNCTION:

- Minimize
  $\sum_i \{\text{obs } (\ln C/E_t) - \text{pred } (\ln C/E_t)\}^2$

SUMMARY:

- Number of observations = 11

- Number of parameters = 2

As was the case with the RV analysis, it had previously been determined that intercepts were not significant and were, hence, unnecessary.

An examination of offshore selectivities indicated a shift in offshore PR from full recruitment at ages 6-7 in 1978-81 to full recruitment at ages 8-10 in 1982-88. Average PR vectors for these two periods were used in calibration with the commercial catch rate index for the 1978-88 period. These average PRs are as follows:

Age	3	4	5	6	7	8	9	10	11	12	13
1978-81 Ave.	.001	.116	.569	.988	1.0	.836	.769	.801	.785	.695	.607
1982-88 Ave.	.001	.040	.259	.570	.773	.910	.947	1.0	.871	.875	.814

The estimate of $N_{8,1988}$ was significant (Table 47) with a CV = 0.25, but residuals (Table 47, Fig. 33-34) indicate patterns caused by lack of fit of the model. More complex models were not attempted due to the shortness of the time series. This calibration estimated a fully recruited fishing mortality in the terminal year of about 0.30 (Table 48). The age 3+ population numbers estimated from this analysis indicated a fairly regular increase over the 1978-88 period (Table 48).

Other formulations of adapt were attempted using commercial catch rate data but for various reasons were not used in the final analysis. A brief description of these formulations is as follows:

1) Because of the concern that the fishery for cod in Div. 3L is mostly a directed American plaice fishery, a formulation using only 2J3K catch rates versus 2J3K offshore exploitable biomass was examined. There is some uncertainty in using offshore PR for only two divisions. This analysis gave results similar to the 2J3KL analysis (F_T = 0.31).

2) An analysis using 1978-88 catch rates after adjustments for windows was also conducted. As the window adjustments were small (Myers et al. 1989) fishing mortality estimates were essentially unchanged from the analysis using unadjusted data.

3) An analysis using the long time series (1962-88) yielded a F_T in 1988 of 0.10 but residuals were serially correlated. This may have been due to a change in catchability around the time of extension of jurisdiction (1977-78) such that two relationships exist, one from 1962 to 1977 and another from 1978 to 1988 (Fig. 35).

The fishing mortalities in the terminal year derived from the ADAPT formulations using RV surveys at age and Div. 2J3KL catch rates from the 1978 to 1988 period were

averaged to provide estimates of terminal fishing mortalities for 1988. This resulted in an average fully recruited fishing mortality in 1988 of 0.436. Beginning of the year population numbers, average population biomass and fishing mortality for this cohort analysis are given in Tables 49-51. The age 3+ biomass increased from a low of about 450,000 t in 1976 to about 1.2 million tons in 1984 and has subsequently declined to the present level of 1 million tons (Fig. 36). This analysis also implies that fully recruited fishing mortalities since 1982 have been about .45 (Fig. 37). Recruitment levels in recent years have been below those observed in the 1960's (Table 49) with age 3 recruits since 1981 ranging from about 250 to 540 million fish.

Recruitment

Using the average fishing mortalities derived from the two ADAPT runs, the sizes of the 1984 and 1985 year-classes at age 3 in 1987 and 1988 was estimated to be 214 and 382 million fish respectively. The value of 214 million was the fifth lowest in the 27 year time series.

Nonparametric density estimation methods, (Evans and Rice 1988, Rice and Evans 1988) using the historic series of age 7+ beginning of the year biomass as a proxy for spawning stock biomass and numbers at age 3 lagged 3 years, were used to produce probability ogives of possible levels of recruitment for these two year-classes. The value of 214 million fish for the 1984 year-class at age 3 has a fairly low probability given the corresponding spawning biomass. The median recruitment for this year-class was about 350 million but a value of about 250 million (255 million exactly) was used because this value has a relatively low cumulative probability (around 0.30) which reflects the relatively low value of the original cohort estimate. The median recruitment for the 1985 year-class at age 3 was about 350 million so a value about this level (344 million exactly) was used as an estimate for this year-class.

Catch Projections

The parameters used for the projection of the 1989 catch are given in Table 52. The weights at age are averages of the values for 1986-88. The partial recruitment values used for 1989 were derived from the 1988 fishing mortalities with full recruitment at age 8 years. Natural mortality was assumed to be 0.2. The 1986 year-class at age 3 years in 1989 was assumed to be 300 million, the geometric mean at age 3 for the 1978-88 period. The 1984 and 1985 year-classes at age 3 in 1987 and 1988 were taken at 255 and 344 million fish respectively as discussed in the recruitment section.

The average population biomass for 1989 is projected to be about 1.1 million tons and the 1989 catch at the $F_{0.1}$ level (0.20) is projected to be 125,000 t (Table 53).

References

Baird, J. W., and C. A. Bishop. 1987. Assessment of the cod stock in NAFO Divisions 2J+3KL. CAFSAC Res. Doc. 87/42. 96 p.

Evans, G. T., and J. C. Rice. 1988. Predicting recruitment from stock size without the mediation of a functional relation. J. Cons. int. Explor. Mer, 44: 111-122.

Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci. 37: 2272-2275.

1988. An adaptive framework for the estimation of population size. CAFSAC Res. Doc. 88/29: 12 p.

Judge, C. C., W. E. Griffiths, R. C. Hills, and T. C. Lee. 1980. The theory and practice of econometrics. John Wiley and Sons, New York. 793 p.

Myers, R. A., R. Wells, J. Baird, and C. Bishop. 1989. Statistical models of the effect of trawl windows on the catch of Atlantic cod, Gadus morhua. CAFSAC Res. Doc. In preparation.

Rice, J. C., and G. T. Evans. 1988. Tools for embracing uncertainty in the management of the cod fishery in NAFO Divisions 2J+3KL. J. Cons. int. Explor. Mer, 45: 73-81.

Table 1. Historical catches of cod from NAFO Divisions 2J3KL for the period 1959-87.

	2J					3K				
	Offshore			Inshore		Offshore			Inshore	
Year	Can.	Other	Total		Total	Can.	Other	Total		Total
1959	-	46372	46372	17533	63905	-	97678	97678	56264	153942
1960	1	164036	164037	15418	179455	53	69855	69908	47676	117584
1961	1	243147	243148	17545	260693	-	60574	60574	31159	91733
1962	-	226841	226841	23424	250265	-	45554	45554	42816	88370
1963	1	197868	197869	23767	221636	-	79331	79331	47486	126817
1964	13	197359	197372	14787	212159	-	121423	121423	40735	162158
1965	-	246650	246650	25117	271767	21	50097	50118	26467	76585
1966	39	226244	226283	22645	248928	13	58907	58920	32208	91128
1967	28	217255	217283	27721	245004	114	78687	78801	24905	103706
1968	4650	355108	359758	12937	372695	1849	119778	121627	40768	162395
1969	30	405231	405261	4328	409589	56	80949	81005	24923	105928
1970	-	212961	212961	1963	214924	92	78274	78366	21512	99878
1971	-	154700	154700	3313	158013	31	61506	61537	21111	82648
1972	-	149435	149435	1725	151160	7	133369	133376	14054	147430
1973	1123	52985	54108	3619	57727	108	159653	159761	13190	172951
1974	-	119463	119463	1804	121267	19	149189	149208	10747	159955
1975	410	78578	78988	3000	81988	189	112678	112867	15518	128385
1976	94	30691	30785	3851	34636	771	79540	80311	20879	101190
1977	525	39584	40109	3523	43632	1051	26776	27827	28818	56645
1978	4682	17546	22228	6638	28866	7027	6373	13400	29623	43023
1979	9194	6537	15731	8445	24176	21579	16890	38469	27018	65487
1980	13592	7437	21029	17210	38239	21920	6830	28750	37015	65765
1981	22125	4760	26885	14215	41100	23112	3847	26959	23002	49961
1982	58384	8923	67307	14429	81736	8881	4074	12955	42141	55096
1983	37281	4158	41439	10743	52182	31623	2815	34438	40681	75119
1984	10754	1259	12013	13150	25163	48114	11059	59173	35143	94316
1985	1541	5	1546	10209	11755	72111	9714	81825	30368	112193
1986	4627	7373	12011	12567	24578	58239	2226	60465	28539	89004
1987	38216	3620	41836	16139	57975	39240	6119	45359	27141	72500
1988	41350	-	41350	15261	56611	41046	-	41046	35965	77011

Table 1 (Cont'd.)

	3L					2J3KL			
	Offshore			Inshore		Total	Total		
Year	Can.	Other	Total		Total	inshore	offshore	Total	TAC
1959	4515	51515	56030	85695	141725	159492	200080	359572	-
1960	7355	60213	67568	94192	161760	157286	301513	458799	-
1961	4675	70318	74993	70659	145652	119363	378715	498078	-
1962	4383	87463	91846	72271	164117	138511	364241	502752	-
1963	4446	83015	87461	73295	160756	144548	364661	509209	-
1964	10158	142370	152528	75806	228334	131328	471323	602651	-
1965	7353	130387	137740	58943	196683	110527	434508	545035	-
1966	8253	120206	128459	55990	184449	110843	413662	524505	-
1967	13478	200343	213821	49233	263054	101859	509905	611764	-
1968	15784	211808	227592	47332	274924	101037	708977	810014	-
1969	18255	151945	170200	67973	238173	97224	656466	753690	-
1970	14471	137840	152311	53113	205424	76588	443638	520226	-
1971	11976	148766	160742	38115	198857	62539	376979	439518	-
1972	4380	109052	113432	46273	159705	62052	396243	458295	-
1973	1258	97734	98992	24839	123831	41648	312861	354509	666000
1974	880	67918	68798	22630	91428	35181	337469	372650	657000
1975	670	53770	54440	22695	77135	41213	246295	287508	554000
1976	2187	40998	43185	35209	78394	59939	154281	214220	300000
1977	5362	26799	32161	40282	72443	72623	100097	172720	160000
1978	9213	12263	21476	45194	66670	81455	57104	138559	135000
1979	14184	12693	26877	50359	77236	85822	81077	166899	180000
1980	15523	13963	29486	42298	71784	96523	79265	175788	180000
1981	21760	15070	36830	42821	79651	80038	90674	170712	200000
1982	27192	9271	36463	56479	92942	113049	116725	229774	230000
1983	39125	10920	50044	54999	105043	106423	125922	232345	260000
1984	49620	13944	63564	49428	112992	97721	134750	232471	266000
1985	39112	28927	68039	39306	107345	79883	151410	231293	266000
1986	55117	51555	106672	31263	137935	72369	179137	251506	266000
1987	43185	25883	69068	35467	104535	78747	156263	235010	256000
1988	53257	20000	73257	50699	123956	101925	155653	257578	266000

Table 2. Inshore cod catches (000't) by division and gear in NAFO Divisions 2J, 3K, and 3L from 1975 to 1988.

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	6.6	6.6	0.3	1.8	18.2	12.5	0.9	4.4
	3L				Total			
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	25.6	14.8	2.3	8.0	50.4	33.9	3.4	14.2

Table 3. Cod landings (t) from Divisions 2J, 3K, and 3L by country during 1987.

Month	Can(N) Ins.	Can(N) Off.	Can(M)	FRG	France	GDR	Poland	Japan	UK	USSR	Total
					2J						
Jan		3516	601	3073							7190
Feb		2991	97								3088
Mar		12846	2342								15188
Apr		8955	5648								14603
May			160								160
Jun	179	9									188
Jul	2166										2166
Aug	7848	89	2			4					7943
Sep	4845	103						14		7	4969
Oct	757	116						1		10	884
Nov	38	22	39					1	453	17	570
Dec			707						40		1026
	15833	28926	9596	3073		4	-	16	493	34	57975
					3K						
Jan	2	8056	2441	4390	1554						16443
Feb		11540	4622				1				16163
Mar		1218	737								1955
Apr	3	499	336								838
May	76	5896	87					18			6077
Jun	1512	459	1061								3032
Jul	11060	90	34								11184
Aug	9231	413	16			2		4			9666
Sep	3942	110	6					8		21	4087
Oct	1138	36						34		14	1222
Nov	136	179	33					4		14	366
Dec	41	837	534			17		38			1467
	27141	29333	9907	4390	1554	19	1	106		49	72500

(cont'd)

Table 3 cont'd.

Month	Can(N) Ins.	Can(N) Off.	Can(M)	Port	Spain	GDR	France	Farees	UK	USSR	Total
					3L						
Jan	17	300	16		829						1162
Feb	6	194	71		590						861
Mar	4	243	49		2634						2930
Apr	45	1836	354		1111						3346
May	1515	5242	2899		203						9859
Jun	6681	4669	666		1114						13130
Jul	12420	5241	641		875						19177
Aug	7194	2521	717		135	9					10576
Sep	4027	3138	135		900						8200
Oct	2168	4453	639		464						7724
Nov	956	4496	196		905				329		6882
Dec	434	3855	614		1911						6814
NK				13620			231	19		4	13874
	35467	36188	6997	13620	11671	9	231	19	329	4	104535

Table 4. Cod landings (t) by Canada in 1988 from Divisions 2J, 3K, and 3L by month and gear (figures in brackets are estimates).

Month	OT		GN	Trap	LT	HL	Total
	Can N	Can M					
			2J				
J	4469	841					5310
F	205	70					275
M	8024	1380					9404
A	14692	4398					19090
M	5018	1529					6547
J	2		6	11		1	20
J			941	1315	95	65	2416
A	5		3882	4463	5	1047	9402
S	2		1659	808	121	599	3189
O			78	18	44	62	202
N		(37).	41				78
D		(678)					678
Total	32417	8933	6607	6615	265	1774	56611
			3K				
J	12520	1403	250				14173
F	13870	4758	206				18834
M	1974	1090	64				3128
A	495	152	1				648
M	250	1150	112	138		1	1651
J	213	6	428	521	1	83	1252
J	9		9282	10142	21	205	19659
A	839	232	1803	7069	391	2573	12907
S	169	233	196	298	332	1209	2437
O	163	2	79	21	87	339	691
N	(166)	(33)	67		20	26	312
D	(777)	(542)					1319
Total	31445	9601	12488	18189	852	4436	77011

Table 4 (Cont'd.).

Month	Can N OT	GN	Trap	LL	HL	Can M OT	DS	LT	Total
						3L			
J	261	18				187			466
F	4058	124				1446			5628
M	6424	271				2414		38	9147
A	2037	324	7	151		83	104	174	2880
M	3418	1989	629	120	11	640		371	7178
J	3505	2723	7846	28	694	820	129	293	16038
J	3265	5568	12823	72	1354	492		183	23757
A	1966	2676	3587	450	3099	384	5	258	12425
S	2359	877	604	832	2098	913		87	7770
O	5356	224	121	540	668	724			7633
N	(5250)	49		68	54	(267)			5688
D	(4501)					(838)		7	5346
Total	42400	14843	25617	2261	7978	9208	238	1411	103956

Total 2J3KL Canada = 237578
Total other countries (3L) = 20000
257578

Table 5. Commercial sampling for Divisions 2J+3KL cod in 1987.

Div.	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings(t) Country/month	Landings(t) Total
2J	OT	1	Can(N)	564	Jan	10635	3516	4117
			"		Feb	13811	2991	3088
			"		Mar	23940	12846	15188
			FRG	161	Jan	4416	3073	3073
				725		52802		25466
		2	Can(N)	474	Apr	14701	8955	8964
			Other					5808
				474		14701		14772
		3-4	Can(N)	-[a]	Nov	211	39	39
					Dec	265	986	986
			UK		Nov	1995	453	493
			Other					80
						2471		1598
	GN	3-4	Can(N)	466[b]	Aug	268	66	66
					Sep	535	103	103
					Oct	251	115	137
						1054		306
	Trap	3	Can(N)	466	Jul	5393	1243	5010
			"		Aug	4343	3506}	
	GN		"		Jul	3039	789	9219
			"		Aug	7425	4016}	
	HL		"		Jul	1425	67	1388
			"		Aug	260	386}	
	Other							216
				466		21885		15139
	Total			1665		92913		57975
3K	OT	1	Can(N)	543	Jan	19903	8056	8056
			"		Feb	14958	11540	11540
			"		Mar	553	1218	1955
			Can(M)		Jan	300	2441	2441
			"		Feb	300	4622	4622
			FRG	175	Jan	5440	4390	4390
			France	138	Jan	3074	1554	1554
				856		44528		34559

Table 5 (Cont'd.).

Div.	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings(t) Country/month	Landings(t) Total
3K	OT	2	Can(N)	575	Apr	1116	499	499
					May	14794	5896	5983
					Jun	265	459	1520
			Can(M)		APR	267	336	336
			Other					18
				575		16442		8356
		3-4	Can(N)	54[b]	Nov	1492	179	179
					Dec	1562	837	837
			Other					1428
						3054		2444
	GN	2	Can(N)	143	May	554	51	56
	Trap	3	Can(N)	769	Jul	4059	4790	4790
			"		Aug	6155	5029	5029
			"		Other			1439
	GN		"		Jun	949	1218	1218
			"		Jul	2681	6047	6047
			"		Aug	1169	1935	1935
	LL		"		Jul	416	9	87
			"		Aug	450	472	472
	HL		"		Aug	3870	1795	2145
	GN	4	Can(N)	430	Sep	1054	582	845
	LT		"		"	225	614	920
	HL		"		"	8541	1465	2158
				1342		30123		27141
	Total			2527		94147		72500
3L	OT	1-2	Can(N)	550	Jan	159	300	873
			"		Apr	4418	1836	2190
			"		May	4870	5242	8141
			"		Jun	4394	4669	5335
						13841		16539
		3	Can(N)	444	Jul	1280	5241	5882
			"		Aug	979	2521	3247
			"		Sep	3553	3138	3273
						5812		12402

Table 5 (Cont'd.).

Div.	Gear	Qtr.	Country	No. aged	Month	No. meas.	Landings(t) Country/month	Landings(t) Total
3L	OT	4	Can(N)	425	Oct	5866	4453	5092
			"		Nov	6407	4496	4692
			"		Dec	1339	3855	4469
			UK		Nov	493	310	329
						14105		14582
			Other					25545[c]
	Trap	2	Can(N)	499	May	242	173	177
	GN		"		"	2748	1256	1319
						2990		1496
	Trap	3	Can(N)	1282	Jun	5432	3878	3878
			"		Jul	8612	5643	5643
			"		Aug	1580	1547	1547
			"		Other			141
	GN		"		Jun	2561	2543	2543
			"		Jul	3932	6188	6188
			"		Aug	1469	3697	3697
	HL		"		Jun	341	204	214
			"		Jul	399	415	415
			"		Aug	4317	1419	1419
						28643		25685
	GN	4	Can(N)	638	Sep	627	1855	1855
			"		Oct	446	755	755
					Other			1089
	LL		Can(N)		Sep	807	559	2083
	HL		"		"	7846	1496	2504
						9726		8286
3L	Total			3838		75117		104535
2J3KL				8030		262177		

TABLE 6. ESTIMATED CATCH, AVERAGE WEIGHT, AND AVERAGE LENGTH AT AGE, ALONG WITH ASSOCIATED VARIANCES FOR THE COMMERCIAL COD FISHERY IN NAFO DIV. 2J3KL DURING 1987.

	AVERAGE		CATCH		
AGE	WEIGHT	LENGTH	MEAN	STD. ERR.	C. V.
2	0.325	33.554	42	12.74	0.31
3	0.431	36.814	2329	143.51	0.06
4	0.657	42.180	9217	303.54	0.03
5	1.034	48.699	32340	837.07	0.03
6	1.317	52.544	49061	1066.84	0.02
7	1.872	58.959	28469	878.90	0.03
8	1.932	59.441	19505	696.43	0.04
9	2.799	66.963	5818	296.15	0.05
10	3.511	71.737	1346	126.60	0.09
11	4.800	79.637	676	53.58	0.08
12	4.641	78.148	873	61.52	0.07
13	5.745	83.417	391	36.74	0.09
14	6.130	85.446	200	19.43	0.10
15	8.533	95.961	37	7.10	0.19
16	13.509	110.848	22	2.84	0.13
17	9.104	98.551	3	1.31	0.39
18	21.770	131.993	1	0.01	0.01
19	17.657	120.933	4	1.09	0.25
20					
21	13.097	112.000	1	0.98	1.09
22					
23	16.628	121.000		0.25	1.22

Table 7. Offshore and Inshore catch-at-age by NAFO Division for the commercial cod fishery in Divisions 2J3KL during 1987 (number x 10^{-3}).

Age	Offshore			Inshore			Total
	2J	3K	3L	2J	3K	3L	2J3KL
2			2		34	6	42
3		8	22	2	748	1498	2329
4	46	374	636	67	1842	6251	9217
5	4009	5104	10216	1553	5469	5988	32340
6	13320	11382	12419	2400	4936	4602	49061
7	5425	7037	7541	2216	3251	3000	28469
8	7609	5695	1648	1768	1644	1142	19505
9	903	1391	1081	764	1140	539	5818
10	238	345	239	172	211	142	1346
11	43	173	234	86	69	72	676
12	228	177	182	143	83	58	873
13	74	99	116	51	22	29	391
14	66	51	22	30	19	13	200
15		15	8	8	2	4	37
16		2	9	8	1	4	22
17	1			2			3
18			1				1
19			1	1		2	4
20							
>20				1			1
landings (000' t)	42142	45359	69068	15833	27141	35467	235010

Table 8. Commercial Sampling for Divisions 2J+3KL cod in 1988.

Div.	Gear	Qtr.	No. Aged	Mo.	No. Meas.	Landings (t) Mo.	Landings (t) Total
2J	OT	1	335	Jan	3614	5310	14989
				Mar	7753	9404	
			335		11367		14989
		2	337	Apr	7315	19090	25639
				May	903	6547	
			337		8218		
		1-4	**672**		**19585**		**41350**
	Trap	3	530	Jul	2793	1315	6615
	"			Aug	2284	4463	
	GN			Jul	3455	941	6607
	"			Aug	6767	3882	
	HL			Jul	292	65	1774
	"			Aug	205	1047	
	Other						265
	Total Ins.		530		15796		15261
	OT+Ins.		**1202**		**35381**		**56611**
3K	OT	1	418	Jan	8979	13923	35615
				Feb	6860	18628	
				Mar	298	3064	
		2	101	Apr	410	647	2266
				May	401	1400	
		3	48	Aug	396	839	1482
		1-4	567		**17344**		**41046**
	GN	1	201	Jan	377	250	521
				Feb	812	206	
			201		1189		521
	Trap	3	934	Jun	1895	521	18189
	"			Jul	10264	10142	
	"			Aug	3558	7069	
	GN			Jun	1312	540	11967
	"			Jul	2324	9282	
	"			Aug	1326	2145	
	HL			Jun	1412	84	2862
	"			Aug	4448	2573	
	LT			Aug	1755	391	413
			934		27294		33431

(cont'd)

Table 8 cont'd.

Div.	Gear	Qtr.	No. Aged	Mo.	No. Meas.	Landings (t) Mo.	Landings (t) Total
3K	LT	4	411	Sep	437	332	439
	HL			Sep	5187	1209	1574
			411		5624		2013
	Inshore	**1-4**	**1546**		**34107**		**35965**
	OT+Ins.	**1-4**	**2113**		**51451**		**77011**
3L	OT	1	379	Feb	2102	5504	5952
				Mar	1237	8838	8838
					3339		14790
		2	562	Apr	825	2224	2224
				May	2043	4058	4058
				Jun	871	4454	4454
					3739		10736
		3	431	Jul	942	3757	3757
				Aug	1139	2355	2355
				Sep	3559	3272	3272
					5640		9384
		4	444	Oct	5235	6080	6080
				Nov	2015	5517	5517
				Dec	3433	5339	5339
					10683		16936
		1-4	**1816**		**23401**		**51846**
	Other[a]						20000
	Offshore	**Total**					**71846**
	GN	2	826	Mar	462	271	2726
	"			May	2761	1989	
	Trap			May	945	629	636
					4168		3362
	Trap	3	1265	Jun	18835	7846	7846
	"			Jul	10710	12823	17135
	GN			Jun	2446	2723	2723
	"			Jul	2794	5568	5568
	"			Aug	827	2676	2676
	LT			Aug	677	708	2138
	HL			Jun	2508	694	705
	"			Jul	470	1354	1354
	"			Aug	5111	3099	3099
					44378		43244

(cont'd)

Table 8 cont'd.

Div.	Gear	Qtr.	No. Aged	Mo.	No. Meas.	Landings (t) Mo.	Total
3L	GN	4	771	Sep	1506	877	1150
	HL			Sep	7230	2098	2820
	LT			Sep	3723	919 }	1534
	"			Oct	1550	615 }	
					14009		5504
	Inshore	**1-4**	**2862**		**62555**		**52110**
	Ins.+Off.	**1-4**	**4678**		**85956**		**123956**
2J3KL		**1-4**	**7993**		**172788**		**257578**

[a]Estimate for other countries based on NAFO circular letters and surveillance data.

TABLE 9. ESTIMATED CATCH, AVERAGE WEIGHT AND LENGTH AT AGE, ALONG WITH ASSOCIATED VARIANCES FOR THE COMMERCIAL COD FISHERY IN NAFO DIVISIONS 2J3KL DURING 1988.

	AVERAGE		CATCH		
AGE	WEIGHT	LENGTH	MEAN	STD. ERR.	C. V.
2	0.295	32.353	25	3.18	0.13
3	0.489	38.283	3106	219.11	0.07
4	0.730	43.701	16482	470.93	0.03
5	1.069	49.352	21273	742.09	0.03
6	1.365	53.333	46761	1341.56	0.03
7	1.645	56.556	44072	1369.78	0.03
8	2.180	61.924	17461	853.58	0.05
9	2.472	64.266	8526	503.03	0.06
10	2.990	68.079	4099	327.31	0.08
11	4.329	76.752	693	62.78	0.09
12	5.409	82.070	376	37.82	0.10
13	6.432	86.714	325	29.23	0.09
14	8.372	94.236	194	20.15	0.10
15	9.635	98.338	86	13.06	0.15
16	9.455	99.037	26	5.77	0.22
17	12.263	107.361	5	2.23	0.43
18	16.260	119.538	9	3.80	0.41
19	17.012	121.118	4	1.11	0.28
20	11.439	103.918	4	2.14	0.48
21	10.112	103.000		0.24	1.06

Table 10. Offshore and inshore catch-at-age by NAFO Division for the commercial cod fishery in Divisions 2J3KL during 1988. (Numbers x 10^{-3}).

Age	Offshore			Inshore			Total
	2J	3K	3L	2J	3K	3L	2J3KL
2			4		8	14	26
3			118	13	416	2559	3106
4	68	195	501	255	3585	11878	16482
5	1215	1727	3152	653	5090	9436	21273
6	11799	7489	11354	2957	6825	6337	46761
7	10805	10376	10231	2988	5259	4413	44072
8	3912	3490	4539	1365	2078	2077	17461
9	2566	1727	1652	935	1051	595	8526
10	1147	831	921	270	566	365	4100
11	89	83	178	128	138	79	695
12	61	71	107	49	41	48	376
13	46	65	109	25	52	28	325
14	38	21	91	11	15	18	194
15	11	10	44	7	7	7	86
16	2	4	13	2	2	2	25
17		1	1	2			4
18			7	1			8
19			4				4
20			2	1		1	4
Landings	41350	41046	73257	15261	35965	50699	257578

TABLE 11 . CATCH NUMBERS AT AGE (X 1000) FROM THE COMMERCIAL COD FISHERY IN NAFO DIVISIONS 2J3KL FOR THE PERIOD 1962-88.

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	301	1446	2872	85	819	790	288	59	6819	33	236	0	473	420
3	8666	5746	19338	5177	14057	15262	6142	4330	18104	12876	6737	3963	3231	3968
4	26194	27577	27603	28709	65992	77873	94291	39626	60102	71557	79809	40785	13201	14101
5	64337	60234	57757	46800	93687	100339	205805	100858	82357	95384	116562	94844	34927	25370
6	58163	118112	60681	66946	62812	96759	150541	163228	101249	98111	76196	59503	74403	34426
7	47314	58996	100147	64360	59312	54996	83808	107509	85696	57865	55984	35464	60539	39105
8	27521	29349	50865	68176	30423	38691	39443	52661	29218	25055	29553	27351	35687	36485
9	20142	15520	20892	33819	23844	17146	23171	19651	10857	11732	11750	14153	18854	13421
10	18036	11612	12264	14913	8762	16084	10984	12370	3825	4470	6393	7566	10492	7514
11	10444	8248	8698	6945	4528	5949	5591	6389	2000	2223	2987	3815	5818	2315
12	9468	4204	6352	3729	2280	3367	5249	4479	1200	1287	1660	2153	2934	1179
13	7778	3942	4989	3948	1825	2108	1939	3004	507	1140	1388	1173	1078	808
14	5785	2933	4036	3730	1186	1529	1334	1557	224	720	725	450	652	372
15	4669	2928	2703	2722	967	685	818	622	214	355	748	278	249	165
16	3888	1737	1456	1859	806	424	610	567	244	474	606	309	338	82
17	3955	1263	1918	575	416	193	127	319	124	124	452	85	162	5
18	2161	1352	1154	971	279	107	89	100	32	128	136	27	113	8
19	232	328	501	183	486	72	83	46	10	148	195	38	45	22
20	403	182	312	226	178	211	26	99	34	78	36	8	20	1
2+	319457	355709	384538	353873	372659	432585	630339	517474	402816	383760	392153	291965	263216	179767
3+	319156	354263	381666	353788	371840	431795	630051	517415	395997	383727	391917	291965	262743	179347
4+	310490	348517	362328	348611	357783	416533	623909	513085	377893	370851	385180	288002	259512	175379
5+	284296	320940	334725	319902	291791	338660	529618	473459	317791	299294	305371	247217	246311	161278
6+	219959	260706	276968	273102	198104	238321	323813	372601	235434	203910	188809	152373	211384	135908
7+	161796	142594	216287	206156	135292	141562	173272	209373	134185	105799	112613	92870	136981	101482

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2	15	108	0	0	92	0	0	18	3	0	1	42	25
3	13767	7128	1323	1152	2554	2185	1702	2585	782	650	831	2329	3106
4	33727	65510	17556	12361	12025	7172	31286	13616	14871	14824	15219	9217	16482
5	28049	40462	39206	37493	28814	13191	19003	42602	31760	36614	44168	32340	21273
6	20898	12107	20319	29202	30016	24800	14397	19028	38624	33922	45869	49061	46761
7	16811	5397	7711	10982	18017	22014	25435	12044	12503	28006	26025	28469	44072
8	16022	3396	3078	3460	4830	11848	16930	14701	7246	7050	14722	19505	17461
9	10931	2730	1530	1300	1217	3175	11936	8934	8910	3836	3104	5818	8526
10	4637	1381	1083	757	520	779	1923	6341	4227	5162	2000	1346	4099
11	1462	532	437	560	232	309	338	1018	2536	2905	1977	676	603
12	631	296	219	183	229	195	156	248	451	1681	1101	873	376
13	292	149	105	116	56	125	90	90	146	254	574	391	325
14	251	75	62	51	65	48	153	41	48	107	116	200	194
15	100	42	40	43	37	14	40	29	41	39	29	37	86
16	50	21	21	38	13	28	12	11	30	20	18	22	26
17	40	20	7	7	10	20	13	9	7	17	11	3	5
18	64	14	8	7	14	5	4	6	7	1	9	1	9
19	30	2	2	4	4	5	0	2	4	3	2	4	4
20	20	6	7	9	10	5	0	3	3	5	2	0	4
2+	147797	139376	92714	97725	98755	85918	123418	121326	122199	135096	155778	150334	163437
3+	147782	139268	92714	97725	98663	85918	123418	121308	122196	135096	155777	150292	163412
4+	134015	132140	91391	96573	96109	83733	121716	118723	121414	134446	154946	147963	160306
5+	100288	66630	73835	84212	84084	76561	90430	105107	106543	119622	139727	138746	143824
6+	72239	26168	34629	46719	55270	63370	71427	62505	74783	83008	95559	106406	122551
7+	51341	14061	14310	17517	25254	38570	57030	43477	36159	49086	49690	57345	75790

TABLE 12 . AVERAGE WEIGHT-AT-AGE FROM THE COMMERCIAL COD FISHERY IN NAFO DIVISIONS 2J3KL FOR THE PERIOD 1962-88.

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
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
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
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
5	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.64	0.71	0.91	0.96	0.93
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2	0.09	0.00	0.00	0.41	0.00	0.00	0.31	0.34	0.00	0.21	0.32	0.30
3	0.45	0.40	0.46	0.53	0.55	0.53	0.62	0.59	0.48	0.51	0.43	0.49
4	0.60	0.72	0.74	0.77	0.78	0.84	0.87	0.88	0.73	0.72	0.66	0.73
5	0.97	1.04	1.13	1.16	1.17	1.20	1.32	1.20	1.10	1.04	1.03	1.07
6	1.66	1.58	1.67	1.71	1.64	1.77	1.75	1.79	1.43	1.54	1.32	1.36
7	2.33	2.46	2.46	2.38	2.23	2.10	2.28	2.28	2.06	1.85	1.87	1.64
8	2.82	3.26	3.57	3.56	2.86	2.66	2.61	2.71	2.66	2.35	1.93	2.18
9	3.46	4.05	4.41	5.01	3.81	3.09	3.18	2.96	3.23	2.94	2.80	2.47
10	3.88	4.46	5.25	5.49	5.32	4.18	3.50	3.65	3.32	3.47	3.51	2.99
11	4.78	5.02	5.80	6.72	6.29	6.16	4.79	4.28	4.06	3.80	4.80	4.33
12	6.13	6.72	7.03	7.87	7.06	7.19	7.76	6.19	4.55	4.54	4.64	5.41
13	7.31	8.10	8.96	8.38	7.32	8.00	9.07	8.39	7.03	5.34	5.74	6.43
14	8.40	7.42	8.54	10.03	10.01	8.36	9.14	10.26	9.67	7.12	6.13	8.37
15	8.81	8.20	9.46	11.31	8.99	7.86	10.62	11.44	11.37	11.77	8.53	9.64
16	11.75	11.26	10.70	13.87	11.54	7.91	10.57	11.61	11.27	11.24	13.51	9.46
17	10.63	11.61	13.12	10.68	10.48	9.58	13.13	17.47	12.68	14.15	9.10	12.26
18	12.27	8.92	13.49	16.09	11.15	12.95	15.97	12.94	12.42	16.14	21.77	16.26
19	7.62	10.57	15.51	12.04	9.82	0.00	9.73	15.21	14.38	12.30	17.66	17.01
20	17.46	16.00	14.77	11.37	12.59	0.00	15.88	12.81	19.49	15.72	0.00	11.44

NOTE - AVERAGE WEIGHTS OF 0.00 INDICATE NO CATCH.

Table 13. Cod abundance estimates (No. x 10^3) from research vessel surveys in NAFO Division 2J (Fall). Numbers in brackets are estimates for non-sampled strata.

Depth range (m)	Stratum number	Stratum area (mi^2)	Gadus 3 1977	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 1981	Gadus 71 1982	Gadus 86-88 1983	Gadus 101-102 1984	Gadus 116-115 1985	Gadus 131-132 1986	Gadus 145-147 1987	Gadus 159-160 1988
101-200	201	1427	13336	3071	1500	5749	8355	16692	16246	10533	15246	21638	6784	54
	205	1823	2894	8039	1574	787	4550	21765	13547	25230	8159	9481	7841	13707
	206	2582	6889	1634	1236	2104	6220	5868	8694	30077	12764	29985	4222	21638
	207	2246	9745	5100	2664	3406	5479	9094	13024	14210	27849	6310	9027	4504
Total		8078	32864	17844	6974	12046	24604	53419	51511	80050	64018	67414	27874	39903
201-300	202	440	2097	462	396	5681	2378	2378	1833	1866	760	7663	2626	(2679)
	209	1608	10174	3531	21485	3410	10099	7681	29567	3862	8599	28567	13594	6711
	210	774	6166	4154	2760	2982	445	4713	59785	4953	299	21187	145	2401
	213	1725	6944	19617	18516	19811	2158	5807	12806	6915	14028	23624	10316	12334
	214	1171	16716	10658	6527	10958	3956	5900	4659	25667	19030	43496	40024	31805
	215	1270	19281	34205	9986	25692	35768	27583	7233	8040	7424	85617	8593	32304
	228	1428	2948	(3402)	6780	8254	10701	2187	2269	1853	352	12702	1164	2272
	234	508	1258	553	267	1506	534	2250	4698	3005	2339	5415	1760	1125
Total		8924	65584	76582	66717	78294	66039	58499	122850	56161	52831	228271	78222	91631
301-400	203	480	883	(765)	(642)	3081	81	1117	462	703	156	1784	1405	2090
	208	448	1017	247	1480	202	303	1368	1749	224	1043	2051	3918	757
	211	330	632	5450	2737	4659	1746	2415	1325	297	776	1090	1709	1647
	216	384	0	(168)	202	3603	86	14	10	331	115	94	3127	476
	222	441	50	1479	149	1258	132	0	11	11	182	17	281	66
	229	567	415	234	2873	1319	447	298	670	71	936	539	85	440
Total		2650	2997	8343	8083	14122	2795	5212	4227	1637	3208	5575	10525	5476
401-500	204	354	199	(340)	(284)	(383)	1342	142	540	1422	0	518	425	1860
	217	268	0	(0)	(0)	(2)	0	0	0	(7)	0	0	50	0
	223	180	0	(0)	(0)	(0)	0	0	0	0	0	0	0	14
	227	686	51	(25)	(17)	(31)	0	21	26	0	0	51	77	86
	235	420	32	(93)	(76)	(107)	158	126	1135	63	32	0	268	173
Total		1908	282	458	377	523	1500	289	1701	1492	32	569	1101	2133
Total			101727	103226	82148	104985	94940	117420	180292	139339	120091	301831	117447	139141
Mean no. per tow			62.86	63.78	50.76	64.87	58.66	72.55	111.40	86.10	74.20	186.50	72.57	85.98
Unadjusted total			101786	98432	81130	104461	94988	117469	180290	139366	120103	302092	117569	136682
Upper limit			149969	131104	128646	139530	162744	151085	744785	184179	154186	468810	163856	183268
Lower limit			53602	65761	33613	69392	27234	83853	-384206	94552	86020	135374	71282	90096

Table 14. Cod biomass estimates (t) from research vessel surveys in NAFO Division 2J (Fall). Numbers in brackets are estimates for non-sampled strata.

Depth range (m)	Stratum number	Stratum area (mi²)	Gadus 3 1977	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 1981	Gadus 71 1982	Gadus 86-88 1983	Gadus 101-102 1984	Gadus 116-115 1985	Gadus 131-132 1986	Gadus 145-147 1987	Gadus 159-160 1988
101-200	201	1427	12377	4847	3256	11319	15998	18085	16764	12033	14952	24712	9158	84
	205	1823	2761	16200	2669	1676	10126	39216	17742	25093	7526	11016	9456	27403
	206	2582	5328	2074	2671	3849	13153	8533	11442	39133	13186	34327	5313	36617
	207	2246	16809	8209	4192	7738	12284	12612	12608	18136	27954	7864	11883	7613
Total		8078	37275	31330	12788	24582	51561	78446	58556	94395	63618	77919	35810	71717
201-300	202	440	3074	525	749	12964	6292	5681	3798	2948	850	10363	4533	(5194)
	209	1608	15336	5384	43569	12810	22275	18351	53925	7678	12245	37475	19297	11006
	210	774	10481	5572	5771	5810	823	10428	97578	9448	782	25147	360	4532
	213	1725	6525	31627	31100	34068	5622	8073	14748	9401	16121	27904	13172	20289
	214	1171	24370	20791	13231	25095	9669	10993	6944	33853	24715	61918	62937	52313
	215	1270	31757	55780	19546	64301	96161	60996	12584	10471	10732	131984	14279	65032
	228	1428	3930	(5362)	12374	16972	23904	4357	2215	3012	299	15820	1749	4845
	234	508	2857	1030	553	3699	1192	4614	5370	3657	2402	7178	2790	2521
Total		8924	98330	126071	126893	175719	165938	123493	197162	80468	68146	317789	119117	165732
301-400	203	480	1930	(1759)	(1829)	7467	230	3141	1369	2054	192	2982	2798	4396
	208	448	1962	438	3341	631	908	3750	3153	454	1454	2589	6120	1816
	211	330	1738	10285	5685	9384	4747	6490	3016	954	1400	1462	3573	3412
	216	384	0	(372)	484	10204	454	86	24	908	180	142	5462	937
	222	441	43	2029	653	2780	281	0	105	22	281	15	463	91
	229	567	1009	319	7394	3150	1144	467	516	106	1397	816	96	786
Total		2650	6682	15202	19386	33616	7764	13934	8183	4498	4904	8006	18512	11438
401-500	204	354	308	(650)	(676)	(1018)	3149	316	1506	2192	0	829	683	3514
	217	268	0	(2)	(2)	(9)	0	0	0	(7)	0	0	80	0
	223	180	0	(0)	(0)	(3)	0	0	0	0	0	0	0	19
	227	686	131	(53)	(56)	(97)	0	36	129	0	0	101	117	137
	235	420	75	(170)	(178)	(274)	347	315	1584	121	24	0	497	334
Total		1908	514	875	912	1401	3496	667	3219	2319	24	930	1377	4004
Total			142799	173476	159978	235318	228757	216539	267120	181678	136693	404642	174819	252893
Mean wt. per tow			88.24	107.19	98.85	145.40	141.35	133.80	165.05	112.26	84.46	250.03	108.02	156.26
Unadjusted total			142961	165109	157237	233916	228894	216679	267120	181731	136723	405184	175021	248085
Upper limit			199808	222301	253553	314419	424737	288880	1175017	241662	174398	667126	247909	336941
Lower limit			86113	107917	60921	153412	33051	144478	-640777	121800	99048	143243	102132	159229

Table 15. 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.

Depth range (m)	Stratum number	Stratum area (mi^2)	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58,59 1981	Gadus 71,72 1982	Gadus 86-88 1983	Gadus 101-102 1984	Gadus 116-115 1985	Gadus 131-132 1986	Gadus 145-147 1987	Gadus 160-161 1988
101-200	618	1455	(6259)	(8830)	(4937)	(5785)	(4801)	(6951)	4806	6458	12975	2652	1074
	619	1588	(963)	(1380)	(749)	(886)	(727)	(1075)	1243	221	930	671	460
Total		3043	7222	10210	5686	6671	5528	8026	6049	6679	13905	3323	1534
201-300	620	2709	17720	26203	15206	12689	4248	17610	22825	1728	31158	6449	4236
	621	2859	14563	25646	2739	7453	6471	4603	6070	1531	4654	930	2854
	624	668	13121	23166	627	3686	2470	1128	965	552	602	234	769
	632	447	727	2265	5078	3171	2494	8321	(3392)	1029	1158	1879	12516
	634	1618	4105	18157	13651	19455	11384	14186	6229	7112	99786	18660	4676
	635	1274	3825	1492	3706	4743	3175	1227	3275	874	3727	829	1033
	636	455	1820	2446	6051	3695	7001	2603	3413	928	3440	1482	2318
	637	1132	2528	5778	3909	4744	6409	8718	19062	3824	11939	3781	6936
Total		12162	58409	105153	50967	59636	43652	58396	65231	17578	156464	34244	35338
301-400	623	1027	6167	2981	7593	876	1557	5769	11764	1015	1060	3855	1172
	625	850	1340	2488	1515	1021	2169	1276	574	1723	808	2760	1340
	626	919	3191	759	1012	2235	911	1276	770	826	10451	1173	317
	628	1085	1433	2891	1008	1371	570	1955	1140	1826	672	375	2108
	629	495	718	446	144	50	412	562	459	272	1348	237	431
	630	544	(285)	388	315	225	(214)	306	414	82	65	177	191
	633	2179	4283	3044	2944	3106	3552	3748	5954	10059	26717	15375	3660
	638	2059	2720	8081	3246	9158	5699	13643	3323	9189	9080	7388	4637
	639	1463	1603	3075	741	1303	2921	4095	1304	2128	3423	1459	1977
Total		10621	21740	24153	18518	19345	18005	32630	25702	27120	53624	32799	15833
401-500	622	632	(258)	(373)	(199)	356	190	142	308	59	332	47	237
	627	1194	(363)	(529)	(278)	104	152	193	178	89	1262	341	284
	631	1202	(289)	(425)	(219)	162	0	523	18	103	68	752	1585
	640	198	(12)	(19)	(8)	0	0	(14)	7	10	7	7	59
	645	204	(16)	(26)	(11)	0	5	8	15	15	(28)	31	15
Total		3430	938	1372	715	622	347	880	526	276	1697	1178	2180
Total			88310	140889	75884	86275	67532	99931	97511	51651	225692	71544	54871
Mean no. per tow			40.21	64.16	34.55	39.29	30.75	45.50	44.40	23.52	102.77	32.58	24.99
Unadjusted total			79865	129306	69484	79602	61791	91907	94118	51653	225663	71587	54871
Upper limit			113311	218233	93324	104928	75262	119955	125225	65201	498301	101570	207965
Lower limit			46420	40380	45645	54276	48320	63859	63010	38104	-46976	41603	-98223

Table 16. Cod biomass estimates (t) from research vessel surveys in NAFO Division 3K (Fall). Numbers in brackets are estimates for non-sampled strata.

Depth range (m)	Stratum number	Stratum area (mi^2)	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58,59 1981	Gadus 71,72 1982	Gadus 86-88 1983	Gadus 101-102 1984	Gadus 116-115 1985	Gadus 131-132 1986	Gadus 145-147 1987	Gadus 160-161 1988
101-200	618	1455	(6449)	(11566)	(7445)	(8327)	(6613)	(9010)	9363	10318	18917	3979	97
	619	1588	(1608)	(2920)	(1863)	(2089)	(1650)	(2264)	3004	652	811	1164	469
Total		3043	8057	14486	9308	10416	(8263)	11274	12367	10970	19728	5143	566
201-300	620	2709	32708	55286	33699	33603	9851	33248	41781	4190	46251	11244	2721
	621	2859	25889	63106	5939	10935	11764	6750	14149	2229	7283	887	4361
	624	668	29936	40531	1742	7973	5365	1586	959	953	1153	232	1112
	632	447	873	3896	10165	7566	5721	13992	(6617)	1667	2072	2726	16458
	634	1618	6907	29309	29404	40573	23579	22967	11703	11161	163994	32997	7054
	635	1274	3702	2551	7902	10271	7249	3236	5457	1619	7900	1404	1423
	636	1455	2248	5040	11959	8428	14144	6335	7065	1884	4489	3011	4087
	637	1132	3540	10613	7871	9829	13256	17317	34548	6209	17860	7109	11429
Total		12162	105803	210332	108681	129178	90929	105431	122277	29912	251002	59610	48645
301-400	623	1027	11293	7522	15746	2175	4849	12071	20190	2303	2182	7108	1041
	625	850	1825	5538	4626	2640	4817	3499	1397	2935	1446	4490	2549
	626	919	6976	1940	3242	4781	2076	3932	1653	1735	12331	1914	327
	628	1085	2729	6206	2739	3848	1480	3841	2112	3000	1038	659	2329
	629	495	1136	1062	337	150	1255	1167	832	346	2066	322	270
	630	544	(622)	1019	1174	939	(638)	847	708	230	84	327	415
	633	2179	6947	6379	8073	8406	8482	6558	10861	16779	45140	26825	6307
	638	2059	4210	13362	7161	17706	10143	23310	5511	13854	13234	12674	6547
	639	1463	2204	5734	1949	3225	8335	9295	2684	3349	5372	2526	3185
Total		10621	38572	48762	45047	43870	42075	64520	45948	44351	82893	56845	19970
401-500	622	632	(438)	(802)	(509)	1297	561	289	646	79	451	47	353
	627	1194	(599)	(1105)	(697)	267	330	601	318	127	2121	350	446
	631	1202	(488)	(908)	(570)	451	0	1489	72	220	113	1200	2165
	640	198	(34)	(67)	(41)	0	0	(51)	119	59	11	45	216
	645	204	(61)	(114)	(71)	0	54	42	176	130	(93)	47	77
Total		3430	1620	2996	1888	2015	945	2472	1331	615	2789	1689	3257
Total			153421	276575	164922	185440	142201	183691	181921	86029	356414	123283	75437
Mean wt. per tow			69.86	125.94	75.10	84.44	64.75	83.64	82.84	39.17	162.29	56.14	34.35
Unadjusted total			143123	259093	153728	175023	133310	172458	175307	86029	356316	123358	75437
Upper limit			215048	421005	201839	237798	159091	216590	228070	107721	797048	180376	285967
Lower limit			71198	97181	105619	112247	107529	128325	122544	64338	-84415	66340	-135093

Table 17. Cod abundance (No. x 10^{-3}) from stratified random cruises in Division 3L (Fall). Numbers in brackets are estimates for non-sampled strata.

Depth range	Stratum No.	Stratum area	ATC 323-325 1981	ATC 333-334 1982	WT 7-9 1983	WT 16-18 1984	WT 37-39 1985	A. Needler 72 1986	WT 65 1987	WT 78 1988
31-50	350	2071	4923	2332	6335	15455	13698	15197	4785	3902
	363	1780	802	1960	13050	19374	40659	2439	6770	9193
	371	1121	105	1010	4679	8018	1058	151	1330	1963
	372	2460	14256	8679	37532	27415	21453	6039	21406	5128
	384	1120	(1059)	273	6025	20303	452	52	8589	336
Total		8552	21145	14254	67621	90565	77320	23878	42880	20522
51-100	328	1519	(546)	(652)	(927)	285	385	4598	257	928
	341	1574	1930	975	1359	1512	945	1287	144	966
	342	585	381	1039	274	439	205	219	176	132
	343	525	897	(415)	328	2089	263	617	131	210
	348	2120	1724	3310	1953	7002	1284	1999	1008	1194
	349	2114	2154	1492	1622	8059	3047	2739	681	2257
	364	2817	963	1113	1629	8162	1774	964	1012	2145
	365	1041	8693	2090	578	8400	684	1583	521	375
	370	1320	173	413	727	7799	561	248	380	255
	385	2356	44	309	318	1827	118	702	197	27
	390	1481	37	111	111	2483	48	241	764	125
Total		17452	17542	11919	9826	48057	9364	15197	5271	8614
101-150	344	1494	2075	5047	1103	3701	2978	2464	1654	977
	347	983	2706	2915	2041	2976	719	1290	553	2966
	366	1394	5197	8022	4473	6221	18207	23099	9433	23992
	369	961	2669	1371	2525	2803	1960	21671	5194	3203
	386	983	861	553	(1937)	1513	1269	5737	1107	1004
	389	821	(1074)	1756	(1773)	811	961	985	3374	1017
	391	282	(96)	95	635	32	635	95	169	32
Total		6918	14678	19759	14487	18057	26729	55341	21484	33191
151-200	345	1432	2015	3637	2929	2300	4658	5105	3386	4208
	346	865	5822	2337	4389	1731	3441	5089	11834	10259
	368	334	1316	1429	(2301)	602	2871	6168	1617	1580
	387	718	808	3000	(2419)	3072	1253	10618	880	377
	388	361	(223)	253	(373)	528	461	(363)	149	339
	392	145	(21)	147	33	103	60	16	5	38
Total		3855	10205	10803	12444	8336	12744	27359	17871	16801
Total			63571	56737	104378	165018	126083	121775	87506	78425
Mean no. per tow			23.03	20.55	37.81	59.78	45.67	44.11	31.70	28.41
Unadjusted total			60550	55688	94649	165427	125937	121410	87505	78427
Upper limit			83240	67092	123077	197373	175516	169896	109122	98525
Lower limit			37860	44285	66220	133481	76355	72925	65889	58329

Table 18. Cod biomass (t) from stratified random cruises in Division 3L (Fall). Numbers in brackets are estimates for non-sampled strata.

Depth range	Stratum No.	Stratum area	ATC 323-325 1981	ATC 333-334 1982	WT 7-9 1983	WT 16-18 1984	WT 37-39 1985	A. Needler 72 1986	WT 65 1987	WT 78 1988
31-50	350	2071	6244	3849	8463	16498	11218	21047	6486	8216
	363	1780	852	2009	17993	20017	40414	4605	11261	15379
	371	1121	137	1363	6126	11210	1304	89	2710	4404
	372	2460	20737	6882	44364	27045	29915	11255	40873	9964
	384	1120	(1858)	1090	5941	27463	583	53	13690	911
Total		8552	29828	15193	82887	102233	83434	37049	75020	38874
51-100	328	1519	(599)	(619)	(1120)	299	656	3128	131	1215
	341	1574	2146	901	1949	1760	957	1793	309	561
	342	585	834	951	263	736	205	233	167	237
	343	525	1419	(456)	661	2261	99	690	194	269
	348	2120	2651	4249	3125	11537	1995	2384	1512	1973
	349	2114	3604	3174	2266	8257	3856	3211	1067	3835
	364	2817	1932	1800	1946	4536	1419	1298	1521	3309
	365	1041	17904	3702	961	3624	977	1512	1087	1035
	370	1320	300	446	1184	7891	597	69	842	562
	385	2356	38	43	1019	1886	94	1095	951	326
	390	1481	9	58	852	1130	9	35	277	204
Total		17452	31436	16399	15346	43917	10864	15448	8058	13526
101-150	344	1494	3869	7701	1682	6121	4010	3623	2019	897
	347	983	4550	4805	3167	5731	1245	1833	701	3852
	366	1394	9313	11920	8999	7101	27549	34160	15868	39741
	369	961	7755	2290	5849	3962	4557	33585	12236	6341
	386	983	1414	1430	(5812)	2546	4162	13630	2869	4044
	389	821	(1794)	3428	(3243)	2737	2521	1723	1733	704
	391	282	(102)	487	159	79	325	370	70	6
Total		6918	28797	32061	28911	28277	44369	88924	35496	55585
151-200	345	1432	4703	7686	6443	3673	8104	9106	5375	7693
	346	865	12012	4212	7746	3003	5805	7670	19771	18031
	368	334	5948	3604	(7285)	1222	6011	12300	5353	4319
	387	718	1334	9216	(7586)	7465	4056	20225	2740	1289
	388	361	(369)	461	(674)	616	1951	(490)	115	366
	392	145	(30)	220	109	68	106	11	8	41
Total		3855	24396	25399	29843	16047	26033	49802	33362	31739
Total			114459	89052	156990	190480	164700	191222	151936	139727
Mean wt. per tow			41.46	32.26	56.87	69.00	59.66	69.27	55.04	50.61
Unadjusted total			109706	87997	131267	191701	164448	190731	151936	139726
Upper limit			153131	105967	175407	226108	212703	264591	191200	172522
Lower limit			66281	70027	87127	157294	116193	116872	112672	106929

Table 19. 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.

Depth range (fath)	Stratum number	Stratum area (mi^2)	ATC 262 1977	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
31-50	350	2,071	2,993	1,373	7,756	2,798	829	1,221	15,883	5,893	6,685	32,355
	363	1,780	4,783	2,352	7,616	1,817	3,296	1,924	7,182	7 429	11,194	14,621
	371	1,121	112	477	1,599	2,917	0	189	8,061	926	1,647	1,178
	372	2,460	2,247	8,969	6,135	3,293	5,032	1,477	27,099	12,451	9,290	13,346
	384	1,120	42	56	2,711	1,555	42	42	98	1,906	2,174	387
Total		8,552	10,177	13,227	25,817	12,380	9,199	4,853	58,323	28,605	30,990	61,887
51-100	328	1,519	72	(190)	296	(409)	0	342	257	443	794	285
	341	1,574	3,161	325	827	1,024	1,004	2,150	3,505	1,661	2,599	8,330
	342	585	768	747	132	417	(264)	278	586	454	307	176
	343	525	335	867	768	1,399	867	2,374	1,103	719	381	801
	348	2,120	875	2,361	3,687	3,456	887	2,467	4,986	5,450	10,702	8,391
	349	2,114	3,385	4,337	4,035	2,997	595	3,729	7,016	6,767	4,616	5,951
	364	2,817	967	599	4,705	2,996	952	1,304	5,821	3,483	8,064	5,286
	365	1,041	781	391	2,481	1,035	(1,683)	4,689	1,797	1,516	5,798	5,236
	370	1,320	66	330	817	1,486	0	248	7,394	805	4,742	2,715
	385	2,356	383	59	783	3,139	59	0	2,087	258	514	849
	390	1,481	1,223	1,056	2,223	1,223	389	139	358	97	79	0
Total		17,452	12,016	11,262	20,754	19,581	6,700	17,720	34,910	21,653	38,596	38,020
101-150	344	1,494	7,327	11,635	15,981	7,947	29,001	9,196	695	4,864	449	841
	347	983	861	6,254	5,737	10,212	3,247	10,773	1,668	5,519	2,410	5,003
	366	1,394	10,461	(17,208)	11,118	5,232	56,749	18,521	41,420	20,339	13,214	4,133
	369	961	761	577	2,813	6,757	7,286	1,876	10,950	9,534	6,810	10,929
	386	983	1,599	639	2,749	2,066	2,693	812	5,371	1,783	3,011	3,320
	389	821	2,178	1,130	1,464	5,259	1,140	2,712	8,677	1,380	1,150	1,335
	391	282	921	201	1,117	1,757	688	191	476	603	286	127
Total		6,918	24,108	37,644	40,979	39,230	100,804	44,081	69,257	44,022	27,330	25,688
151-200	345	1,432	5,505	5,321	1,800	6,385	15,264	2,714	2,107	13,160	21,498	7,820
	346	865	782	(2,070)	1,380	1,125	2,727	801	714	16,999	6,324	4,058
	368	334	319	(465)	56	113	1,880	639	1,492	4,250	5,382	238
	387	718	108	198	256	108	296	1,419	24,226	5,686	189	552
	388	361	881	257	190	41	393	989	488	2,520	14	244
	392	145	44	44	178	5	196	218	1,818	403	5	234
Total		3,855	7,639	8,355	3,860	7,777	20,756	6,780	30,845	43,018	33,412	13,146
Total			53,938	70,484	91,411	78,971	137,459	73,434	193,336	137,302	130,329	138,742
Mean no. per tow			19.54	25.53	33.11	28.61	49.79	26.60	70.03	49.74	47.21	50.26
Unadjusted total			53,938	50,554	91,410	78,560	135,716	73,433	193,335	137,299	130,328	138,741
Upper Limit			67,857	70,457	112,937	93,294	266,824	94,202	255,581	161,282	179,957	177,548
Lower Limit			40,018	30,651	69,883	63,827	4,608	52,665	131,090	113,317	80,699	99,933

Table 20. Cod biomass estimates (t) from research vessel surveys in NAFO Division 3L (Spring). Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Stratum number	Stratum area (mi²)	ATC 262 1977	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
31-50	350	2,071	5,187	2,106	13,637	7,124	2,539	4,775	31,785	16,344	19,008	56,567
	363	1,780	5,399	3,919	11,237	4,182	7,082	6,721	14,881	12,152	19,419	23,096
	371	1,121	535	1,490	2,439	8,148	0	789	15,647	3,184	4,122	4,005
	372	2,460	1,865	7,006	8,342	7,448	7,155	3,978	44,792	19,171	22,017	27,917
	384	1,120	10	19	3,521	2,480	462	231	284	3,667	3,681	844
Total		8,552	12,996	14,540	39,176	29,382	17,238	16,494	107,389	54,518	68,247	112,429
51-100	328	1,519	38	(191)	518	(644)	0	893	74	838	1,897	456
	341	1,574	3,916	1,006	2,468	3,291	2,038	8,495	4,735	8,022	12,076	16,947
	342	585	1,196	3,010	409	961	(599)	871	429	1,639	604	307
	343	525	438	1,789	1,190	2,936	946	4,768	795	1,502	1,064	1,346
	348	2,120	1,701	3,546	7,128	7,855	1,966	5,709	7,904	11,590	33,966	23,118
	349	2,114	10,746	8,879	8,800	7,282	1,321	10,182	16,005	27,730	14,008	17,951
	364	2,817	1,101	928	7,884	7,154	1,533	3,938	9,837	9,223	20,328	13,755
	365	1,041	1,112	532	2,953	2,442	(2,358)	6,056	2,160	3,324	9,791	8,361
	370	1,320	330	367	1,046	2,807	0	99	7,054	3,511	7,679	5,896
	385	2,356	422	80	1,118	6,278	413	0	2,084	424	1,066	2,133
	390	1,481	505	795	2,125	2,798	500	217	261	406	503	0
Total		17,452	21,505	21,123	35,639	44,448	11,674	41,228	51,338	68,214	102,982	90,270
101-150	344	1,494	7,784	20,366	19,398	10,172	50,712	19,583	648	8,032	1,023	1,121
	347	983	1,128	8,492	7,705	16,019	8,043	21,435	3,416	10,419	4,919	8,818
	366	1,394	6,211	(14,110)	11,509	5,912	81,497	21,817	45,178	30,705	19,201	7,551
	369	961	2,050	999	2,448	7,406	9,378	4,959	19,297	11,488	11,564	16,889
	386	983	1,228	251	2,881	2,361	4,593	1,279	3,877	1,906	4,368	3,274
	389	821	1,343	1,063	1,098	6,923	478	1,664	6,169	900	647	692
	391	282	634	356	1,048	2,064	1,212	95	429	826	201	41
Total		6,918	20,378	45,673	46,087	50,857	155,913	70,832	79,014	64,276	41,923	38,386
151-200	345	1,432	13,271	10,687	4,844	11,674	29,493	6,060	2,939	17,444	28,741	11,340
	346	865	990	(2,138)	2,137	2,154	4,307	1,223	341	20,427	8,298	5,203
	368	334	404	(708)	239	796	1,761	809	1,536	6,412	7,166	652
	387	718	122	184	459	256	243	2,353	21,491	6,555	195	520
	388	361	1,181	181	349	108	190	1,321	346	1,572	10	179
	392	145	30	66	189	0	128	256	2,237	435	3	98
Total		3,855	15,998	13,964	8,217	14,988	36,122	12,022	28,890	52,845	44,413	17,992
Total			70,877	95,356	129,111	139,673	220,944	140,579	266,632	239,859	257,566	259082
Mean wt. per tow			25.67	34.54	46.77	50.60	80.03	50.92	96.58	86.88	93.30	93.85
Total			70,877	78,118	129,117	139,030	218,214	140,578	266,628	239,857	257,565	259,080
Upper limit			93,640	100,261	154,966	166,965	405,205	171,826	337,779	278,797	321,059	325,467
Lower limit			48,114	55,974	103,267	111,094	31,224	109,329	195,476	200,916	194,071	192,693

Table 21. Biomass estimates (000't) of cod from autumn research vessel surveys in NAFO Div. 2J, 3K and 3L.

Div.	1981	1982	1983	1984	1985	1986	1987	1988	
2J	228.8	216.5	267.1	181.7	136.7	404.6	174.8	252.9	
3K	185.4	142.2	183.7	181.9	86.0	356.4	123.3	75.4	
3L	114.5	89.1	157.0	190.5	164.7	191.2	151.9	139.7	
Total	528.7	447.8	607.8	554.1	387.4	952.2	450.0	468.0	
Percentage									Ave.
2J	43	48	44	33	35	43	39	54	42
3K	35	32	30	33	22	37	27	16	29
3L	22	20	26	34	43	20	34	30	29
Total	100	100	100	100	100	100	100	100	100

TABLE 22 . MEAN NUMBER (ADJUSTED FOR MISSING STRATA) PER TOW OF COD AT AGE FROM RV SURVEYS IN DIV. 2J DURING AUTUMN.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0.00	0.00	0.00	0.36	0.00	1.06	1.99	0.52	0.06	0.03	0.08	0.76
2	3.34	0.51	0.31	1.54	4.16	3.09	14.10	5.30	1.51	2.28	0.41	2.58
3	9.66	7.47	1.37	1.32	3.06	18.26	16.83	16.75	9.06	8.49	1.93	2.67
4	29.13	13.78	11.53	4.49	2.29	6.42	25.91	16.55	22.06	31.24	4.43	4.68
5	13.33	27.87	16.91	20.38	4.22	4.47	16.46	26.70	13.64	70.31	24.93	7.85
6	2.93	9.54	16.28	20.81	17.00	4.28	8.85	10.19	16.54	41.29	25.16	25.64
7	1.36	2.12	2.32	12.35	15.22	13.24	4.54	2.46	7.32	21.61	7.37	29.75
8	1.23	0.77	0.73	1.79	9.62	11.65	12.34	1.55	1.26	8.71	5.29	5.57
9	0.96	0.61	0.50	0.52	2.00	7.91	5.61	3.50	0.86	0.72	2.21	3.96
10	0.53	0.44	0.29	0.38	0.51	1.33	3.56	1.50	1.18	0.66	0.38	1.95
11	0.20	0.24	0.29	0.24	0.08	0.36	0.74	0.66	0.43	0.60	0.05	0.31
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
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
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
1+	62.86	63.78	50.76	64.87	58.66	72.55	111.40	86.10	74.20	186.50	72.57	85.98
2+	62.86	63.78	50.76	64.51	58.66	71.49	109.41	85.58	74.14	186.47	72.49	85.22
3+	59.52	63.27	50.45	62.97	54.50	68.40	95.31	80.27	72.64	184.19	72.08	82.64
4+	49.86	55.81	49.07	61.65	51.45	50.14	78.49	63.52	63.58	175.70	70.16	79.97
5+	20.73	42.03	37.54	57.17	49.16	43.72	52.57	46.97	41.51	144.46	65.72	75.29
6+	7.41	14.16	20.64	36.79	44.93	39.25	36.12	20.26	27.87	74.15	40.80	67.43
7+	4.48	4.62	4.35	15.97	27.93	34.97	27.27	10.07	11.33	32.87	15.63	41.79

TABLE 23 . MEAN NUMBER (ADJUSTED FOR MISSING STRATA) PER TOW OF COD AT AGE FROM RV SURVEYS IN DIV. 3K DURING AUTUMN.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0.00	0.00	0.19	0.01	0.23	0.88	0.26	0.01	0.35	0.38	1.14
2	0.26	0.13	1.06	1.32	1.82	3.55	3.27	0.65	2.42	0.90	2.43
3	2.71	2.22	1.44	5.42	1.76	7.71	5.64	2.96	4.84	2.15	4.12
4	11.82	15.11	2.07	3.40	5.00	6.53	9.76	4.56	24.10	3.88	3.18
5	14.42	24.86	11.68	3.71	4.93	11.50	7.86	6.21	29.08	9.38	3.91
6	6.61	14.78	12.76	12.38	2.77	3.52	8.07	3.09	20.18	7.26	5.36
7	2.11	3.80	2.76	8.95	5.83	2.38	2.99	2.98	10.33	3.48	2.89
8	0.99	1.91	1.33	2.78	5.68	4.18	1.50	0.92	6.22	2.44	0.97
9	0.61	0.46	0.49	0.51	1.66	3.24	2.40	0.69	2.37	1.25	0.46
10	0.48	0.40	0.34	0.24	0.64	1.13	1.45	0.64	0.79	0.62	0.27
11	0.03	0.27	0.03	0.20	0.17	0.40	0.59	0.54	0.98	0.32	0.07
12	0.10	0.06	0.20	0.20	0.08	0.17	0.28	0.16	0.68	0.17	0.09
13	0.03	0.04	0.07	0.06	0.06	0.07	0.10	0.06	0.25	0.11	0.03
14	0.03	0.12	0.14	0.12	0.13	0.24	0.22	0.05	0.18	0.23	0.07
1+	40.21	64.16	34.55	39.29	30.75	45.50	44.40	23.52	102.77	32.58	24.99
2+	40.21	64.16	34.36	39.28	30.52	44.62	44.14	23.51	102.42	32.20	23.85
3+	39.95	64.03	33.31	37.96	28.70	41.07	40.87	22.87	100.01	31.30	21.41
4+	37.24	61.81	31.87	32.54	26.94	33.36	35.23	19.90	95.17	29.15	17.30
5+	25.42	46.70	29.80	29.14	21.94	26.84	25.47	15.34	71.07	25.27	14.12
6+	11.00	21.84	18.12	25.43	17.01	15.34	17.61	9.13	41.99	15.89	10.22
7+	4.39	7.06	5.36	13.06	14.24	11.82	9.54	6.04	21.81	8.63	4.86

TABLE 24. MEAN NUMBER (ADJUSTED FOR MISSING STRATA) PER TOW OF COD AT AGE FROM RV SURVEYS IN DIV. 3L DURING AUTUMN.

	1981	1982	1983	1984	1985	1986	1987	1988
1	0.37	0.42	0.65	0.36	0.01	0.04	0.16	0.05
2	0.37	2.76	3.56	7.58	1.22	1.15	2.77	1.68
3	6.43	1.99	13.59	11.43	9.66	2.53	2.02	4.54
4	2.68	6.64	5.24	18.89	12.85	11.80	3.91	2.38
5	2.55	2.82	7.58	5.18	10.92	10.17	9.43	4.96
6	3.81	2.08	1.41	10.52	5.18	10.43	7.13	6.09
7	5.36	1.73	1.35	1.69	3.43	3.27	3.33	4.62
8	1.00	1.57	2.35	1.18	0.71	2.47	1.31	2.16
9	0.20	0.29	1.26	1.03	0.81	0.95	1.00	1.03
10	0.07	0.09	0.45	1.08	0.40	0.38	0.10	0.54
11	0.04	0.05	0.13	0.43	0.29	0.48	0.13	0.13
12	0.03	0.06	0.06	0.25	0.11	0.26	0.22	0.10
13	0.12	0.06	0.18	0.18	0.07	0.18	0.18	0.13
1+	23.03	20.55	37.81	59.78	45.67	44.11	31.70	28.41
2+	22.66	20.13	37.16	59.42	45.66	44.07	31.54	28.36
3+	22.29	17.37	33.59	51.85	44.44	42.92	28.77	26.68
4+	15.86	15.39	20.01	40.42	34.78	40.39	26.75	22.15
5+	13.18	8.75	14.76	21.53	21.93	28.59	22.83	19.77
6+	10.63	5.93	7.19	16.35	11.01	18.42	13.41	14.81
7+	6.82	3.85	5.78	5.83	5.83	7.99	6.27	8.71

TABLE 25. MEAN NUMBER (ADJUSTED FOR MISSING STRATA) PER TOW OF COD AT AGE FROM RV SURVEYS IN DIV. 3L DURING SPRING.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0.00	0.00	0.06	0.09	0.18	0.03	0.00	0.00	0.00	0.00	0.01	0.00
2	0.89	0.09	0.08	1.90	0.50	1.72	0.00	0.00	1.39	0.25	0.42	0.28
3	4.04	4.26	0.84	0.88	9.02	1.56	0.00	0.00	12.15	3.43	2.39	5.13
4	5.81	7.96	9.15	3.42	7.22	9.26	0.00	0.00	18.20	12.60	5.23	4.48
5	4.51	6.33	13.88	10.45	6.43	2.34	0.00	0.00	16.41	12.71	13.41	7.45
6	2.11	4.09	6.48	8.43	11.01	2.96	0.00	0.00	8.23	9.26	12.60	16.61
7	0.63	1.84	1.53	2.13	11.23	4.15	0.00	0.00	8.14	4.38	6.67	8.00
8	0.65	0.59	0.46	0.77	2.99	3.08	0.00	0.00	1.72	3.48	2.34	4.08
9	0.43	0.50	0.12	0.15	0.77	0.93	0.00	0.00	0.76	0.77	1.83	1.46
10	0.15	0.30	0.19	0.07	0.25	0.20	0.00	0.00	1.07	0.65	0.67	1.21
11	0.10	0.22	0.08	0.12	0.08	0.07	0.00	0.00	1.19	1.11	0.48	0.34
12	0.06	0.15	0.04	0.07	0.08	0.05	0.00	0.00	0.40	0.70	0.61	0.40
13	0.16	0.22	0.18	0.14	0.08	0.26	0.00	0.00	0.32	0.41	0.56	0.83
1+	19.54	26.56	33.09	28.62	49.83	26.63	0.00	0.00	69.99	49.75	47.22	50.27
2+	19.54	26.56	33.03	28.53	49.65	26.60	0.00	0.00	69.99	49.75	47.21	50.27
3+	18.65	26.47	32.95	26.63	49.16	24.88	0.00	0.00	68.60	49.50	46.79	49.99
4+	14.61	22.21	32.11	25.75	40.14	23.32	0.00	0.00	56.45	46.07	44.40	44.86
5+	8.80	14.25	22.96	22.34	32.91	14.06	0.00	0.00	38.26	33.47	39.17	40.38
6+	4.28	7.92	9.07	11.89	26.48	11.71	0.00	0.00	21.85	20.76	25.76	32.93
7+	2.18	3.82	2.60	3.45	15.47	8.75	0.00	0.00	13.62	11.51	13.16	16.32

NOTE - SURVEYS NOT CONDUCTED DURING 1983 OR 1984.

TABLE 26. MEAN NUMBER OF COD PER TOW AVERAGED OVER THREE DIVISIONS (2J,3K,3L) FROM RV SURVEYS CONDUCTED DURING AUTUMN.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2	0.23	0.53	0.86	1.62	2.53	6.15	5.58	1.10	1.85	1.56	2.15
3	2.94	1.28	3.10	5.27	5.92	12.42	10.81	7.27	4.77	2.04	3.94
4	10.16	8.78	3.50	2.82	6.04	10.76	15.26	12.35	20.69	4.03	3.21
5	16.26	16.58	10.98	3.35	3.93	11.07	11.37	10.02	31.29	13.23	5.32
6	7.25	13.63	13.89	9.92	2.85	3.94	9.62	7.28	21.28	11.61	10.66
7	2.41	3.65	8.09	8.99	5.93	2.48	2.31	4.24	10.14	4.38	10.23
8	1.00	1.30	1.96	3.72	5.42	5.42	1.38	0.92	5.26	2.67	2.60
9	0.50	0.41	0.62	0.75	2.62	3.00	2.10	0.78	1.37	1.38	1.56
10	0.41	0.24	0.29	0.24	0.58	1.44	1.31	0.67	0.58	0.34	0.80
11	0.15	0.23	0.10	0.10	0.17	0.37	0.54	0.41	0.68	0.17	0.15
12	0.11	0.08	0.18	0.11	0.09	0.14	0.28	0.15	0.42	0.19	0.11
13	0.11	0.06	0.08	0.11	0.07	0.13	0.12	0.06	0.19	0.13	0.08
2+	41.53	46.76	43.64	36.98	36.14	57.32	60.68	45.25	98.52	41.74	40.82
3+	41.30	46.23	42.78	35.36	33.62	51.17	55.10	44.15	96.67	40.18	38.67
4+	38.36	44.95	39.68	30.10	27.70	38.75	44.29	36.87	91.91	38.14	34.73
5+	28.21	36.17	36.19	27.27	21.66	27.99	29.03	24.52	71.21	34.11	31.52
6+	11.95	19.59	25.20	23.93	17.73	16.92	17.66	14.51	39.92	20.88	26.20
7+	4.70	5.96	11.31	14.01	14.88	12.97	8.03	7.23	18.64	9.27	15.54

TABLE 27. ANALYSIS OF VARIANCE FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV. 2J3KL FOR THE YEARS 1962-79.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R,..... 0.773
MULTIPLE R SQUARED,..... 0.598

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	4.687E0	4.687E0	
REGRESSION	34	3.925E2	1.154E1	66.194
TYPE 1	4	6.528E1	1.632E1	93.587
TYPE 2	2	1.767E1	8.834E0	50.660
TYPE 3	11	1.182E2	1.075E1	61.639
TYPE 4	17	2.010E2	1.182E1	67.803
RESIDUALS	1515	2.642E2	1.744E-1	
TOTAL	1550	6.613E2		

TABLE 28. REGRESSION COEFFICIENTS FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV 2J3KL FOR THE YEARS 1962-79.

			REGRESSION COEFFICIENTS		
CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	3125	INTERCEPT	0.793	0.079	1550
2	23				
3	2				
4	62				
1	3124	1	-0.333	0.065	94
	17126	2	0.333	0.043	555
	17127	3	0.663	0.047	307
	19126	4	0.244	0.045	436
2	31	5	-0.161	0.029	471
	32	6	-0.275	0.027	674
3	1	7	-0.052	0.060	94
	3	8	-0.222	0.051	155
	4	9	-0.108	0.050	165
	5	10	-0.322	0.051	150
	6	11	-0.546	0.052	147
	7	12	-0.751	0.057	105
	8	13	-0.752	0.056	106
	9	14	-0.761	0.054	119
	10	15	-0.776	0.053	127
	11	16	-0.706	0.053	135
	12	17	-0.569	0.057	119
4	63	18	0.046	0.070	63
	64	19	-0.021	0.069	68
	65	20	-0.184	0.069	75
	66	21	-0.128	0.066	98
	67	22	-0.037	0.065	112
	68	23	-0.089	0.065	113
	69	24	-0.289	0.065	111
	70	25	-0.435	0.067	99
	71	26	-0.613	0.067	109
	72	27	-0.731	0.068	108
	73	28	-0.740	0.071	85
	74	29	-0.629	0.074	73
	75	30	-0.583	0.071	92
	76	31	-0.804	0.081	52
	77	32	-1.329	0.073	92
	78	33	-1.310	0.079	70
	79	34	-0.653	0.077	76

TABLE 29. ANALYSIS OF VARIANCE FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV. 2J3KL FOR THE YEARS 1978-88.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.829
MULTIPLE R SQUARED..... 0.687

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.835E2	1.835E2	
REGRESSION	30	3.983E2	1.328E1	52.659
TYPE 1	7	4.500E1	6.428E0	25.494
TYPE 2	2	4.991E1	2.496E1	98.982
TYPE 3	11	1.200E2	1.091E1	43.262
TYPE 4	10	5.489E1	5.489E0	21.769
RESIDUALS	720	1.815E2	2.521E-1	
TOTAL	751	7.634E2		

TABLE 30. REGRESSION COEFFICIENTS FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV 2J3KL FOR THE YEARS 1978-88.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	27124	INTERCEPT	0.666	0.159	751
2	23				
3	1				
4	78				
1	3124	1	-0.149	0.120	118
	3125	2	-0.004	0.110	266
	3126	3	0.903	0.198	10
	17126	4	-0.227	0.124	86
	17127	5	-0.451	0.188	16
	27125	6	0.376	0.113	166
	27126	7	0.596	0.130	55
2	31	8	-0.315	0.054	259
	32	9	-0.727	0.054	350
3	2	10	0.035	0.084	79
	3	11	-0.352	0.084	79
	4	12	-0.370	0.081	92
	5	13	-0.813	0.081	99
	6	14	-1.030	0.087	75
	7	15	-1.213	0.105	36
	8	16	-1.237	0.123	25
	9	17	-1.208	0.116	29
	10	18	-1.100	0.105	41
	11	19	-0.982	0.100	49
	12	20	-0.773	0.087	81
4	79	21	0.330	0.113	60
	80	22	0.522	0.116	50
	81	23	0.717	0.112	61
	82	24	0.659	0.108	80
	83	25	0.849	0.106	84
	84	26	0.985	0.105	85
	85	27	1.142	0.108	80
	86	28	1.060	0.108	70
	87	29	0.871	0.109	74
	88	30	1.022	0.109	73

TABLE 31 . COMMERCIAL CATCH RATE INDEX FOR COD IN DIV. 2J3KL FOR THE PERIOD 1962-79.

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED			
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT
1962	0.7408	0.0067	2.281	0.187	502572	220324
1963	0.7867	0.0064	2.389	0.190	509209	213168
1964	0.7194	0.0062	2.233	0.176	602651	269827
1965	0.5564	0.0060	1.898	0.147	545035	287192
1966	0.6129	0.0056	2.008	0.150	524505	261144
1967	0.7033	0.0052	2.199	0.159	611764	278218
1968	0.6518	0.0048	2.089	0.145	810014	387786
1969	0.4517	0.0050	1.710	0.120	753690	440762
1970	0.3057	0.0052	1.477	0.106	520226	352114
1971	0.1279	0.0052	1.237	0.089	439518	355374
1972	0.0093	0.0054	1.098	0.081	458295	417252
1973	0.0007	0.0060	1.089	0.085	354509	325645
1974	0.1114	0.0065	1.216	0.098	372650	306519
1975	0.1578	0.0059	1.274	0.098	287508	225693
1976	-0.0629	0.0076	1.021	0.089	214220	209868
1977	-0.5887	0.0056	0.604	0.045	172720	285973
1978	-0.5693	0.0063	0.616	0.049	138559	225085
1979	0.0876	0.0058	1.188	0.091	166899	140529

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.076

TABLE 32 . COMMERCIAL CATCH RATE INDEX FOR COD IN DIV. 2J3KL FOR THE PERIOD 1978-88.

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED			
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT
1978	0.3470	0.0127	1.595	0.179	138559	86872
1979	0.6770	0.0095	2.222	0.216	166899	75108
1980	0.8690	0.0107	2.691	0.278	175788	65323
1981	1.0639	0.0084	3.274	0.300	170712	52145
1982	1.0062	0.0081	3.091	0.278	229774	74344
1983	1.1958	0.0075	3.737	0.323	232345	62172
1984	1.3323	0.0074	4.284	0.367	232471	54266
1985	1.4885	0.0080	5.007	0.447	231293	46197
1986	1.4072	0.0075	4.616	0.400	251506	54481
1987	1.2179	0.0085	3.818	0.352	235010	61547
1988	1.3689	0.0086	4.441	0.411	257578	58002

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.093

TABLE 33. ANALYSIS OF VARIANCE FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV. 2J FOR THE YEARS 1978-88.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.893
MULTIPLE R SQUARED..... 0.797

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.718E2	1.718E2	
REGRESSION	28	7.493E1	2.676E0	15.944
TYPE 1	7	1.133E1	1.618E0	9.643
TYPE 2	11	2.854E1	2.595E0	15.460
TYPE 3	10	2.081E1	2.081E0	12.402
RESIDUALS	114	1.913E1	1.678E-1	
TOTAL	143	2.659E2		

TABLE 34. REGRESSION COEFFICIENTS FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV 2J FOR THE YEARS 1978-88.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	27124	INTERCEPT	-0.578	0.371	143
3	1				
4	78				
1	3124	1	0.845	0.340	12
	3125	2	0.847	0.309	49
	3126	3	1.626	0.443	3
	17126	4	0.084	0.328	22
	17127	5	0.311	0.386	5
	27125	6	1.128	0.311	35
	27126	7	1.107	0.339	14
3	2	8	-0.106	0.157	19
	3	9	-0.303	0.162	23
	4	10	-0.133	0.165	27
	5	11	-0.668	0.184	17
	6	12	-1.035	0.176	15
	7	13	-1.479	0.255	5
	8	14	-2.322	0.540	1
	9	15	-2.138	0.540	1
	10	16	-2.932	0.536	1
	11	17	-1.553	0.257	7
	12	18	-0.993	0.198	14
4	79	19	0.753	0.222	11
	80	20	0.827	0.209	13
	81	21	1.477	0.222	11
	82	22	1.348	0.196	26
	83	23	1.831	0.198	23
	84	24	1.604	0.220	16
	85	25	1.425	0.263	7
	86	26	1.581	0.261	8
	87	27	1.186	0.215	11
	88	28	1.214	0.223	12

TABLE 35 . ANALYSIS OF VARIANCE FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV. 3K FOR THE YEARS 1978-88.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.870
MULTIPLE R SQUARED..... 0.757

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.677E2	1.677E2	
REGRESSION	28	1.381E2	4.933E0	25.548
TYPE 1	7	8.795E0	1.256E0	6.507
TYPE 2	11	5.559E1	5.054E0	26.175
TYPE 3	10	4.483E1	4.483E0	23.216
RESIDUALS	230	4.441E1	1.931E-1	
TOTAL	259	3.502E2		

TABLE 36 . REGRESSION COEFFICIENTS FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV 3K FOR THE YEARS 1978-88.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	27124	INTERCEPT	0.042	0.262	259
3	1				
4	78				
1	3124	1	0.066	0.228	32
	3125	2	0.097	0.211	97
	3126	3	0.659	0.307	4
	17126	4	-0.081	0.232	29
	17127	5	-0.462	0.302	7
	27125	6	0.337	0.214	53
	27126	7	0.558	0.227	29
3	2	8	-0.044	0.108	37
	3	9	-0.513	0.114	30
	4	10	-0.489	0.113	36
	5	11	-0.782	0.107	41
	6	12	-0.893	0.126	24
	7	13	-1.283	0.221	5
	8	14	-1.743	0.243	5
	9	15	-1.842	0.235	7
	10	16	-1.650	0.182	13
	11	17	-1.340	0.194	10
	12	18	-1.163	0.134	24
4	79	19	0.591	0.158	25
	80	20	0.747	0.174	14
	81	21	1.054	0.169	20
	82	22	0.865	0.170	19
	83	23	0.997	0.160	24
	84	24	1.575	0.151	31
	85	25	1.639	0.149	36
	86	26	1.289	0.152	26
	87	27	1.452	0.157	27
	88	28	1.638	0.167	23

TABLE 37 . ANALTSIS OF VARIANCE FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV. 3L FOR THE YEARS 1978-88.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.810
MULTIPLE R SQUARED..... 0.656

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.318E⁻1	3.318E⁻1	
REGRESSION	28	8.881E1	3.172E0	21.858
TYPE 1	7	2.110E1	3.014E0	20.770
TYPE 2	11	4.908E1	4.461E0	30.744
TYPE 3	10	9.561E0	9.561E⁻1	6.589
RESIDUALS	321	4.658E1	1.451E⁻1	
TOTAL	350	1.357E2		

TABLE 38. REGRESSION COEFFICIENTS FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV 3L FOR THE YEARS 1978-88.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	27124	INTERCEPT	0.275	0.182	350
3	1				
4	78				
1	3124	1	-0.357	0.132	74
	3125	2	-0.143	0.119	121
	3126	3	-0.850	0.341	3
	17126	4	-0.117	0.142	35
	17127	5	-0.510	0.301	4
	27125	6	0.390	0.126	78
	27126	7	0.688	0.184	12
3	2	8	0.510	0.128	23
	3	9	-0.028	0.115	27
	4	10	-0.161	0.110	29
	5	11	-0.663	0.104	41
	6	12	-0.949	0.105	36
	7	13	-0.880	0.116	26
	8	14	-0.787	0.123	19
	9	15	-0.796	0.119	21
	10	16	-0.753	0.112	27
	11	17	-0.576	0.106	32
	12	18	-0.283	0.102	43
4	79	19	-0.050	0.144	24
	80	20	0.121	0.146	23
	81	21	0.195	0.138	30
	82	22	0.130	0.135	35
	83	23	0.267	0.134	37
	84	24	0.271	0.134	38
	85	25	0.474	0.135	37
	86	26	0.583	0.132	36
	87	27	0.292	0.135	37
	88	28	0.384	0.134	38

TABLE 39 . COMMERCIAL CATCH RATE INDEX FOR COD IN DIV. 2J FOR THE PERIOD 1978-88.

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1978	0.2681	0.0502	1.387	0.308	28866	20805
1979	1.0213	0.0365	2.967	0.564	24176	8148
1980	1.0948	0.0350	3.196	0.595	38239	11966
1981	1.7454	0.0238	6.160	0.948	41100	6672
1982	1.6163	0.0270	5.405	0.885	81736	15122
1983	2.0989	0.0226	8.777	1.317	52182	5945
1984	1.8725	0.0369	6.949	1.328	25163	3621
1985	1.6931	0.0551	5.754	1.338	11755	2043
1986	1.8490	0.0324	6.802	1.220	24578	3613
1987	1.4542	0.0372	4.573	0.878	57975	12678
1988	1.4821	0.0409	4.693	0.943	56611	12062

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.187

TABLE 40 . COMMERCIAL CATCH RATE INDEX FOR COD IN DIV. 3K FOR THE PERIOD 1978-88.

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1978	0.1388	0.0242	1.251	0.194	43023	34402
1979	0.7297	0.0171	2.266	0.296	65487	28898
1980	0.8862	0.0224	2.643	0.394	65765	24881
1981	1.1926	0.0185	3.598	0.488	49961	13887
1982	1.0042	0.0196	2.978	0.416	55096	18499
1983	1.1360	0.0164	3.403	0.435	75119	22074
1984	1.7134	0.0132	6.072	0.698	94316	15533
1985	1.7779	0.0131	6.477	0.740	112193	17321
1986	1.4279	0.0131	4.564	0.522	89004	19500
1987	1.5903	0.0149	5.364	0.655	72500	13515
1988	1.7773	0.0168	6.461	0.836	77011	11919

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.130

TABLE 41 . COMMERCIAL CATCH RATE INDEX FOR COD IN DIV. 3L FOR THE PERIOD 1978-88.

PREDICTED CATCH RATE

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1978	0.1319	0.0210	1.214	0.175	66670	54904
1979	0.0820	0.0143	1.159	0.138	77236	66637
1980	0.2533	0.0151	1.375	0.169	71784	52206
1981	0.3270	0.0116	1.483	0.159	79651	53711
1982	0.2617	0.0104	1.390	0.141	92942	66864
1983	0.3990	0.0103	1.595	0.162	105043	65873
1984	0.4024	0.0103	1.600	0.162	112992	70616
1985	0.6057	0.0119	1.959	0.213	107345	54789
1986	0.7152	0.0106	2.187	0.225	137935	63063
1987	0.4243	0.0120	1.634	0.179	104535	63970
1988	0.5162	0.0115	1.792	0.192	103956	58021

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.112

TABLE 42. ANALYSIS OF VARIANCE FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV. 2J3K FOR THE YEARS 1978-88.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.845
MULTIPLE R SQUARED..... 0.715

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.100E2	3.100E2	
REGRESSION	29	2.103E2	7.253E0	32.161
TYPE 1	7	1.888E1	2.697E0	11.958
TYPE 2	1	7.356E0	7.356E0	32.617
TYPE 3	11	8.879E1	8.072E0	35.792
TYPE 4	10	5.716E1	5.716E0	25.343
RESIDUALS	372	8.390E1	2.255E-1	
TOTAL	402	6.043E2		

TABLE 43. REGRESSION COEFFICIENTS FROM THE REGRESSION OF LN CATCH RATE FOR COD IN DIV. 2J3K FOR THE YEARS 1978-88.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	27124	INTERCEPT	0.160	0.229	402
2	23				
3	1				
4	78				
1	3124	1	0.277	0.196	44
	3125	2	0.290	0.181	146
	3126	3	0.969	0.262	7
	17126	4	-0.073	0.195	51
	17127	5	-0.194	0.244	12
	27125	6	0.578	0.183	88
	27126	7	0.705	0.196	43
2	31	8	-0.304	0.053	259
3	2	9	-0.149	0.098	56
	3	10	-0.547	0.099	53
	4	11	-0.497	0.097	63
	5	12	-0.893	0.098	58
	6	13	-0.997	0.111	39
	7	14	-1.530	0.170	10
	8	15	-1.802	0.233	6
	9	16	-1.892	0.220	8
	10	17	-1.750	0.174	14
	11	18	-1.602	0.162	17
	12	19	-1.213	0.118	38
4	79	20	0.651	0.140	36
	80	21	0.827	0.146	27
	81	22	1.177	0.147	31
	82	23	1.092	0.136	45
	83	24	1.368	0.134	47
	84	25	1.598	0.134	47
	85	26	1.664	0.137	43
	86	27	1.348	0.140	34
	87	28	1.408	0.139	38
	88	29	1.519	0.143	35

TABLE 44. COMMERCIAL CATCH RATE INDEX FOR COD IN DIV. 2J3K FOR THE PERIOD 1978-88.

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED			
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT
1978	0.1464	0.0194	1.284	0.178	71889	56005
1979	0.7969	0.0138	2.467	0.290	89663	36345
1980	0.9737	0.0161	2.941	0.372	104004	35366
1981	1.3237	0.0136	4.179	0.486	91061	21792
1982	1.2385	0.0128	3.839	0.434	136832	35647
1983	1.5147	0.0113	5.064	0.539	127301	25140
1984	1.7446	0.0114	6.372	0.679	119479	18750
1985	1.8103	0.0117	6.804	0.736	123948	18217
1986	1.4948	0.0111	4.965	0.522	113582	22878
1987	1.5544	0.0128	5.265	0.595	130475	24781
1988	1.6653	0.0138	5.879	0.689	133622	22728

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.115

TABLE 45. Results from ADAPT using RV survey data showing final parameter estimates for ages 3-9 numbers with corresponding slopes, correlations between the estimated parameters, and residuals between log-transformed observed and predicted rv.

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET,..... 0.001544
MEAN SQUARE RESIDUALS 0.133238

PAR, EST,	STD, ERR,	T-STATISTIC
2.27594E5	8.63136E4	2.63683E0
1.01732E5	2.48745E4	4.08982E0
1.12220E5	2.32562E4	4.82539E0
1.83955E5	3.40155E4	5.40797E0
1.23181E5	2.02731E4	6.07608E0
3.89811E4	6.34163E3	6.14686E0
1.80155E4	2.88398E3	6.24675E0
2.14962E-5	2.64156E-6	8.13770E0
4.47887E-5	5.29570E-6	8.45757E0
8.42665E-5	9.79029E-6	8.60715E0
1.28597E-4	1.48940E-5	8.63413E0
1.58422E-4	1.85871E-5	8.52320E0
1.87691E-4	2.22444E-5	8.43765E0
2.06934E-4	2.46091E-5	8.40886E0

CORRELATION MATRIX

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.000	0.074	0.063	0.053	0.046	0.025	0.018	-0.319	-0.040	-0.029	-0.022	-0.018	-0.015	-0.016
2	0.074	1.000	0.088	0.074	0.063	0.036	0.026	-0.231	-0.262	-0.040	-0.030	-0.025	-0.021	-0.022
3	0.063	0.088	1.000	0.091	0.080	0.045	0.033	-0.197	-0.203	-0.233	-0.038	-0.032	-0.027	-0.027
4	0.053	0.074	0.091	1.000	0.100	0.058	0.041	-0.167	-0.169	-0.182	-0.228	-0.040	-0.034	-0.035
5	0.046	0.063	0.080	0.100	1.000	0.076	0.099	-0.143	-0.146	-0.162	-0.203	-0.297	-0.147	-0.213
6	0.025	0.036	0.045	0.058	0.076	1.000	0.095	-0.080	-0.082	-0.093	-0.124	-0.183	-0.317	-0.116
7	0.018	0.026	0.033	0.041	0.099	0.095	1.000	-0.058	-0.060	-0.068	-0.086	-0.120	-0.189	-0.324
8	-0.319	-0.231	-0.197	-0.167	-0.143	-0.080	-0.058	1.000	0.125	0.090	0.069	0.057	0.048	0.049
9	-0.040	-0.262	-0.203	-0.169	-0.146	-0.082	-0.060	0.125	1.000	0.092	0.070	0.058	0.049	0.050
10	-0.029	-0.040	-0.233	-0.182	-0.162	-0.093	-0.068	0.090	0.092	1.000	0.077	0.065	0.055	0.056
11	-0.022	-0.030	-0.038	-0.228	-0.203	-0.124	-0.086	0.069	0.070	0.077	1.000	0.082	0.072	0.071
12	-0.018	-0.025	-0.032	-0.040	-0.297	-0.183	-0.120	0.057	0.058	0.065	0.082	1.000	0.105	0.102
13	-0.015	-0.021	-0.027	-0.034	-0.147	-0.317	-0.189	0.048	0.049	0.055	0.072	0.105	1.000	0.106
14	-0.016	-0.022	-0.027	-0.035	-0.213	-0.116	-0.324	0.049	0.050	0.056	0.071	0.102	0.106	1.000

STANDARDIZED RESIDUALS

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	-0.584	-0.729	0.112	-0.204	0.047	0.709	0.282	0.016	0.415	-0.064	0.000
4	0.088	0.033	-0.145	-0.451	-0.479	0.170	0.440	-0.074	0.580	-0.216	0.053
5	0.348	0.369	0.010	-0.444	-0.314	-0.060	-0.016	-0.209	0.603	-0.152	-0.135
6	0.511	0.220	0.249	-0.076	-0.531	-0.134	-0.058	-0.366	0.746	-0.300	-0.260
7	0.509	0.260	-0.044	0.146	-0.187	-0.244	-0.175	-0.392	0.392	-0.332	0.067
8	0.409	0.466	0.027	-0.510	0.152	0.199	-0.286	-0.477	0.383	-0.224	-0.137
9	0.214	0.130	0.192	-0.413	-0.245	0.167	-0.110	-0.182	0.602	-0.440	0.085

TABLE 46. Beginning of the year population numbers and fishing mortality derived from ADAPT using RV survey data for cod in Div. 2J3KL.

POPULATION NUMBERS (000S)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	300880	152130	160188	369169	322533	350289	463910	407384	179843	126217	227157
4	272966	245143	123511	128840	300273	262528	284454	379110	332950	146491	101230
5	209665	207601	189521	90242	98996	217534	202619	219435	296976	258825	111597
6	63760	136184	136044	129095	61948	63856	139554	137153	146529	203178	182646
7	19677	33817	85075	84224	83254	37692	35064	79308	81598	78463	121956
8	7731	9133	17750	53351	49037	45148	19962	17395	39591	43258	38481
9	4091	3545	4347	10162	32960	24830	23662	9787	7862	19094	17768
10	3225	1965	1726	2458	5447	16185	12245	11311	4542	3629	10368
11	1096	1660	924	943	1307	2720	7513	6201	4590	1909	1753
12	654	502	853	546	492	765	1306	3857	2448	1969	951
13	269	337	246	491	271	262	402	661	1637	1008	822
	884014	792017	720184	869519	956518	1021808	1190690	1271601	1098564	884041	814729

FISHING MORTALITY

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	0.005	0.008	0.018	0.007	0.006	0.008	0.002	0.002	0.005	0.021	0.015
4	0.074	0.057	0.114	0.063	0.122	0.059	0.060	0.044	0.052	0.072	0.197
5	0.232	0.223	0.184	0.176	0.238	0.244	0.190	0.204	0.180	0.149	0.235
6	0.434	0.270	0.280	0.239	0.297	0.399	0.365	0.319	0.425	0.310	0.330
7	0.568	0.445	0.267	0.341	0.412	0.436	0.501	0.495	0.435	0.512	0.503
8	0.580	0.542	0.358	0.282	0.481	0.446	0.513	0.594	0.529	0.690	0.683
9	0.533	0.520	0.370	0.424	0.511	0.507	0.538	0.568	0.573	0.411	0.740
10	0.464	0.555	0.405	0.431	0.495	0.567	0.480	0.702	0.667	0.528	0.566
11	0.581	0.466	0.325	0.450	0.336	0.534	0.467	0.729	0.646	0.497	0.566
12	0.462	0.515	0.352	0.502	0.431	0.444	0.481	0.657	0.687	0.673	0.566
13	0.558	0.473	0.288	0.328	0.453	0.472	0.507	0.545	0.484	0.552	0.566

TABLE 47. Results from ADAPT using commercial catch rate data showing final parameter estimates and correlation between age 8 fishable biomass with it's slope and residuals between logged observed and predicted cpue.

ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.000592
MEAN SQUARE RESIDUALS 0.103301

PAR. EST.	STD. ERR.	T-STATISTIC
7.34267E4	1.85604E4	3.95610E0
7.35796E-6	9.57720E-7	7.68279E0

CORRELATION MATRIX

	1	2
1	1.000	-0.668
2	-0.668	1.000

STANDARDIZED RESIDUALS

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
0	-0.212	-0.313	-0.373	-0.161	0.114	0.316	0.379	0.485	0.193	-0.194	-0.234

TABLE 48. Beginning of the year population numbers and fishing mortality derived from ADAPT using commercial cpue data for cod in Div. 2J3KL.

POPULATION NUMBERS (000S)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	304837	155878	165843	396554	381781	443944	701753	643853	426503	923914	1607248
4	275424	248382	126579	133470	322694	311036	361132	573839	526554	348439	754330
5	210602	209613	192173	92754	102786	235891	242334	282214	456406	417335	276938
6	63734	136951	137691	131266	64005	66960	154583	169669	197927	333709	312423
7	19746	33795	85703	85573	85032	39376	37605	91614	108219	120545	228826
8	7735	9190	17732	53865	50142	46604	21340	19475	49666	65054	72934
9	4063	3547	4393	10148	33381	25734	24854	10915	9566	27342	35613
10	3274	1942	1728	2496	5435	16530	12985	12286	5466	5023	17121
11	1032	1700	905	944	1338	2710	7796	6807	5389	2665	2895
12	622	450	885	531	494	790	1298	4088	2944	2623	1571
13	274	311	203	518	258	263	422	654	1826	1414	1358
	891343	801760	733837	908119	1047346	1189836	1566102	1815414	1790467	2248065	3311256

FISHING MORTALITY

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	0.005	0.008	0.017	0.006	0.005	0.006	0.001	0.001	0.002	0.003	0.002
4	0.073	0.057	0.111	0.061	0.113	0.050	0.047	0.029	0.032	0.030	0.024
5	0.230	0.220	0.181	0.171	0.229	0.223	0.156	0.155	0.113	0.090	0.088
6	0.434	0.269	0.276	0.234	0.286	0.377	0.323	0.250	0.296	0.177	0.180
7	0.565	0.445	0.264	0.335	0.401	0.413	0.458	0.412	0.309	0.302	0.238
8	0.579	0.538	0.358	0.279	0.467	0.429	0.470	0.511	0.397	0.403	0.305
9	0.538	0.519	0.365	0.424	0.503	0.484	0.505	0.492	0.444	0.268	0.305
10	0.455	0.563	0.404	0.423	0.496	0.552	0.446	0.624	0.518	0.351	0.305
11	0.631	0.453	0.333	0.449	0.327	0.536	0.446	0.638	0.520	0.329	0.305
12	0.493	0.597	0.337	0.520	0.430	0.426	0.485	0.606	0.533	0.459	0.305
13	0.543	0.525	0.361	0.308	0.480	0.470	0.475	0.552	0.422	0.361	0.305

TABLE 49. Beginning of the year population numbers (000's) for cod in Divisions 2J3KL for the 1962-88 period using terminal F=.436.

POPULATION NUMBERS

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
3	726625	638837	880533	1038056	1194871	864145	728326	667958	738858	595613
4	561209	587069	517836	703422	845204	965558	693693	590745	542960	588544
5	686397	435778	455699	398992	549936	632283	720070	482630	447806	390156
6	378139	503760	302283	320834	284321	365478	426879	403323	303884	292113
7	193457	256966	305572	192582	202101	175948	211677	213284	182518	157185
8	108031	115578	157004	159564	99437	111799	94291	97474	77344	71892
9	73214	63546	68071	82520	68952	53885	56524	41510	32155	36886
10	60067	41717	37984	36828	36961	34878	28603	25312	16204	16503
11	40004	32859	23648	20002	16659	22333	14002	13479	9531	9806
12	30269	23303	19440	11491	10092	9542	12902	6405	5255	5994
13	29741	16215	15275	10168	6034	6200	4766	5813	1191	3216
3+	2887155	2715629	2783345	2974460	3314568	3242048	2991732	2547933	2357706	2167908
4+	2160530	2076792	1902812	1936404	2119697	2377902	2263406	1879975	1618848	1572295
5+	1599321	1489723	1384976	1232981	1274493	1412344	1569713	1289230	1075888	983751
6+	912923	1053945	929277	833989	724557	780061	849643	806600	628082	593595
7+	534784	550185	626994	513155	440236	414583	422764	403277	324199	301482

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	254561	140438	137060	233109	417650	342479	302597	153427	160764	378648	339570
4	475996	202321	111395	109292	187263	329486	273949	246548	124573	129311	308034
5	417112	317499	128743	79258	76721	122801	210485	208405	190672	91111	99382
6	233125	236033	174128	73802	41935	37434	63929	136855	136702	130037	62660
7	150388	121922	139407	75241	29274	15424	19694	33955	85624	84763	84025
8	76334	72470	67732	59359	26218	8757	7745	9147	17863	53801	49479
9	36190	35756	34586	23163	15586	6969	4096	3556	4358	10255	33328
10	19584	18998	16468	11256	6821	2870	3235	1969	1735	2467	5523
11	9467	10250	8708	3990	2417	1389	1100	1669	927	950	1315
12	6017	5048	4940	1865	1172	656	656	505	860	549	498
13	3743	3424	2185	1390	460	388	269	339	248	497	273
3+	1682516	1164159	825351	671725	805518	868653	887754	796375	724327	882389	984087
4+	1427955	1023720	688291	438616	387868	526174	585158	642948	563563	503741	644517
5+	951959	821399	576896	329324	200605	196687	311209	396400	438990	374430	336483
6+	534847	503901	448153	250066	123884	73887	100724	187995	248318	283318	237102
7+	301721	267868	274025	176264	81948	36452	36795	51140	111616	153282	174442

AGE	1983	1984	1985	1986	1987	1988
3	378935	539494	490475	246851	254891	344354
4	276477	307907	440992	400979	201353	206580
5	223888	214040	238637	347641	314523	156514
6	64172	144756	146503	162249	244659	228247
7	38275	35322	83568	89253	91335	155918
8	45779	20439	17606	43079	49526	49019
9	25191	24179	10177	8036	21949	22899
10	16486	12541	11734	4862	3771	12706
11	2782	7760	6443	4936	2171	1869
12	771	1357	4059	2646	2253	1165
13	267	407	703	1802	1170	1054
3+	1073022	1308201	1450898	1312334	1187599	1180325
4+	694088	768707	960422	1065483	932708	835971
5+	417611	460800	519430	664504	731356	629392
6+	193723	246761	280793	316863	416833	472878
7+	129551	102005	134290	154614	172173	244631

TABLE 50. Average population biomass (tons) for cod in Divisions 2J3KL for the 1962-88 period using terminal F=.436.

POPULATION BIOMASS (AVERAGE)

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
3	222485	195915	268146	319032	365889	263772	223427	205123	224690	181415
4	272719	285238	250709	342944	403481	460252	319987	283789	254296	273856
5	519533	321174	338211	297814	397271	460129	480904	340023	320702	268339
6	385803	487626	299289	316001	277754	346383	378629	342533	273716	262563
7	250974	336810	373031	233920	253184	217297	244465	222465	197105	185811
8	177721	190246	245489	228951	157621	171813	136383	124864	115839	110271
9	147832	131139	134271	149749	131986	105384	102565	71021	61948	72147
10	143430	101227	89163	80847	92332	72740	63923	51379	40508	40260
11	116203	96125	63336	54469	48020	64627	36523	32827	28674	29169
12	93441	78879	59374	35157	33152	28550	36900	12864	17233	19837
13	139377	76961	68285	43303	27464	27434	19982	22024	4916	14074
3+	2469518	2301340	2189305	2102188	2188154	2218381	2043688	1708913	1539628	1457744
4+	2247033	2105425	1921158	1783156	1822264	1954609	1820262	1503790	1314937	1276329
5+	1974314	1820187	1670449	1440212	1418784	1494357	1500275	1220001	1060641	1002474
6+	1454782	1499013	1332238	1142398	1021513	1034228	1019371	879977	739939	734134
7+	1068978	1011388	1032948	826398	743759	687845	640742	537445	466224	471571

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	100074	40114	42928	94208	167322	138123	109446	63710	76568	188170	162680
4	207449	76502	64204	57990	93191	159334	172573	160887	82368	88679	221531
5	203537	169462	89852	56285	50916	87479	177878	192147	183773	88920	96597
6	185283	176159	130813	56823	34988	45851	74848	182439	185829	172793	87561
7	162230	119844	119069	64636	29750	25973	33832	61633	162994	146167	132255
8	113965	92185	64798	56957	30072	17299	17544	23059	48804	122266	95704
9	76296	54733	42606	29541	16833	16834	11762	11191	16649	29134	73936
10	47431	37198	24205	14997	10204	7161	10553	7264	7156	9740	16708
11	27758	23206	13900	7682	4956	4668	3837	7075	4852	4403	6274
12	18950	12957	9545	3675	3235	2663	3224	2541	5206	2792	2664
13	13337	11305	6877	3872	1554	2003	1531	2210	1647	2830	1610
3+	1156310	813664	608796	446665	443023	507388	617028	714156	775846	855894	897521
4+	1056236	773550	565868	352457	275700	369265	507582	650446	699278	667724	734841
5+	848787	697048	501664	294467	182509	209931	335009	489559	616910	579045	513310
6+	645250	527586	411813	238182	131593	122451	157131	297412	433137	490125	416713
7+	459967	351427	281000	181359	96605	76601	82282	114973	247308	317332	329152

AGE	1983	1984	1985	1986	1987	1988
3	212160	288268	213228	113898	98853	152194
4	212217	239186	286502	256322	117475	130781
5	239521	213772	217793	304867	277157	140507
6	84561	199360	165198	190059	259998	249392
7	64821	58014	125873	124784	127153	194820
8	88317	39882	32457	73638	66619	77055
9	57674	50951	23240	16572	47343	40266
10	40532	33419	26064	11580	9511	28110
11	9507	24444	17323	12999	7758	5989
12	4418	6153	12647	8214	7324	4666
13	1771	2454	3547	7143	4928	5016
3+	1015498	1155902	1123872	1120075	1024118	1028795
4+	803338	867634	910644	1006177	925265	876601
5+	591121	628448	624143	749855	807790	745820
6+	351600	414677	406350	444988	530634	605313
7+	267039	215316	241151	254929	270636	355921

TABLE 51. Fishing mortality matrix for cod in Div. 2J3KL with terminal F=.436.

FISHING MORTALITY

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
3	0.013	0.010	0.025	0.006	0.013	0.020	0.009	0.007	0.027	0.024	0.030	0.032	0.026	0.019	0.037
4	0.053	0.053	0.061	0.046	0.090	0.093	0.163	0.077	0.130	0.144	0.205	0.252	0.140	0.154	0.222
5	0.109	0.166	0.151	0.139	0.209	0.193	0.380	0.263	0.227	0.315	0.369	0.401	0.356	0.437	0.518
6	0.186	0.300	0.251	0.262	0.280	0.346	0.494	0.593	0.459	0.464	0.448	0.327	0.639	0.725	0.800
7	0.315	0.293	0.450	0.461	0.392	0.424	0.575	0.814	0.732	0.522	0.530	0.388	0.654	0.854	1.007
8	0.331	0.329	0.443	0.639	0.413	0.482	0.620	0.909	0.540	0.486	0.558	0.540	0.873	1.137	1.125
9	0.362	0.315	0.414	0.603	0.482	0.433	0.603	0.741	0.467	0.433	0.444	0.575	0.922	1.023	1.492
10	0.403	0.368	0.441	0.593	0.304	0.713	0.552	0.777	0.302	0.356	0.447	0.580	1.218	1.338	1.392
11	0.340	0.325	0.522	0.484	0.357	0.349	0.582	0.742	0.264	0.288	0.429	0.530	1.341	1.025	1.104
12	0.424	0.222	0.448	0.444	0.287	0.494	0.597	1.482	0.291	0.271	0.364	0.637	1.068	1.199	0.904
13	0.338	0.310	0.443	0.552	0.403	0.466	0.588	0.827	0.625	0.491	0.520	0.470	0.771	0.998	1.161

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	0.023	0.005	0.008	0.018	0.006	0.006	0.008	0.002	0.001	0.004	0.010	0.010
4	0.248	0.073	0.057	0.113	0.063	0.119	0.056	0.055	0.038	0.043	0.052	0.092
5	0.453	0.230	0.222	0.183	0.174	0.237	0.236	0.179	0.186	0.151	0.121	0.162
6	0.442	0.433	0.269	0.278	0.237	0.293	0.397	0.349	0.296	0.375	0.251	0.255
7	0.489	0.567	0.442	0.265	0.338	0.407	0.427	0.496	0.463	0.389	0.422	0.371
8	0.560	0.578	0.541	0.355	0.279	0.475	0.438	0.497	0.584	0.474	0.571	0.494
9	0.567	0.532	0.518	0.369	0.419	0.504	0.497	0.523	0.539	0.557	0.347	0.523
10	0.759	0.462	0.553	0.402	0.429	0.486	0.554	0.466	0.666	0.606	0.502	0.436
11	0.551	0.578	0.463	0.324	0.445	0.334	0.518	0.448	0.690	0.585	0.422	0.436
12	0.690	0.461	0.511	0.349	0.498	0.425	0.440	0.458	0.612	0.616	0.559	0.436
13	0.544	0.556	0.470	0.285	0.323	0.447	0.461	0.499	0.503	0.429	0.455	0.436

Table 52. Parameters used as input for catch projections of NAFO Div. 2J3KL cod.

Age	January 1989 Population numbers (000)	Weight at age (kg)	Partial recruitment
3	300000	.48	.02
4	279128	.70	.21
5	154267	1.05	.37
6	108978	1.41	.58
7	144811	1.79	.85
8	88087	2.15	1.00
9	24488	2.74	1.00
10	11113	3.32	1.00
11	6727	4.31	1.00
12	990	4.86	1.00
13	617	5.84	1.00

Table 53. Results of catch projections for cod in Division 2J3KL showing average population biomass, fishing mortality at age, and catch biomass assuming $F_{0.1}$ in 1989.

Age	Average population biomass (t)	Fishing mortality	Catch biomass (t) at $F_{0.1}$
3	129357	.004	521
4	174371	.042	7289
5	141234	.074	10485
6	131436	.116	15283
7	216260	.170	36833
8	156336	.200	31219
9	55235	.200	11060
10	30439	.200	6082
11	23895	.200	4779
12	3966	.200	793
13	2968	.200	594
3+	1065498	.079	124937

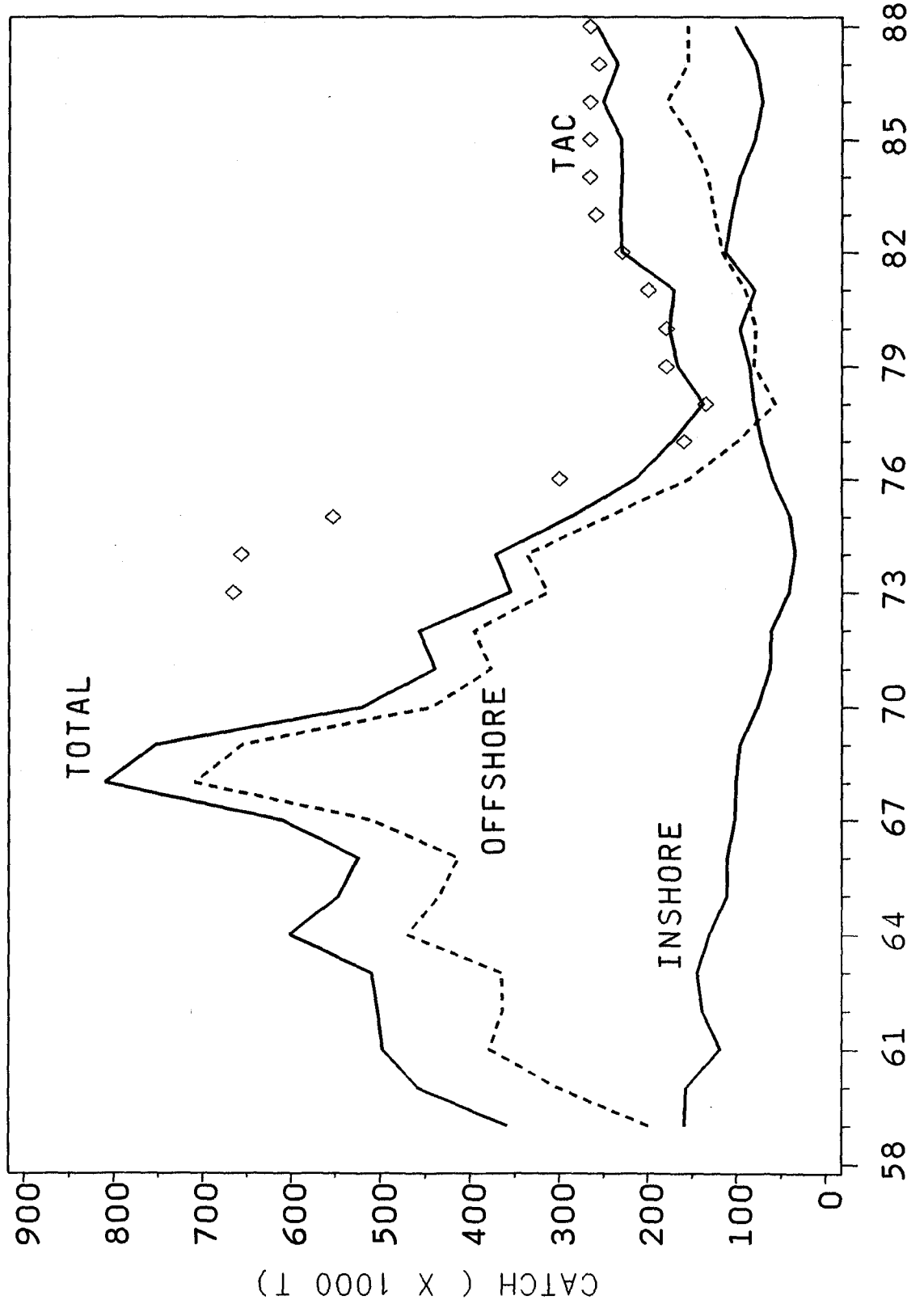


FIG. 1. CATCHES OF COD WITH ASSOCIATED TACS FROM DIVISIONS 2J3KL FOR THE 1959-88 PERIOD.

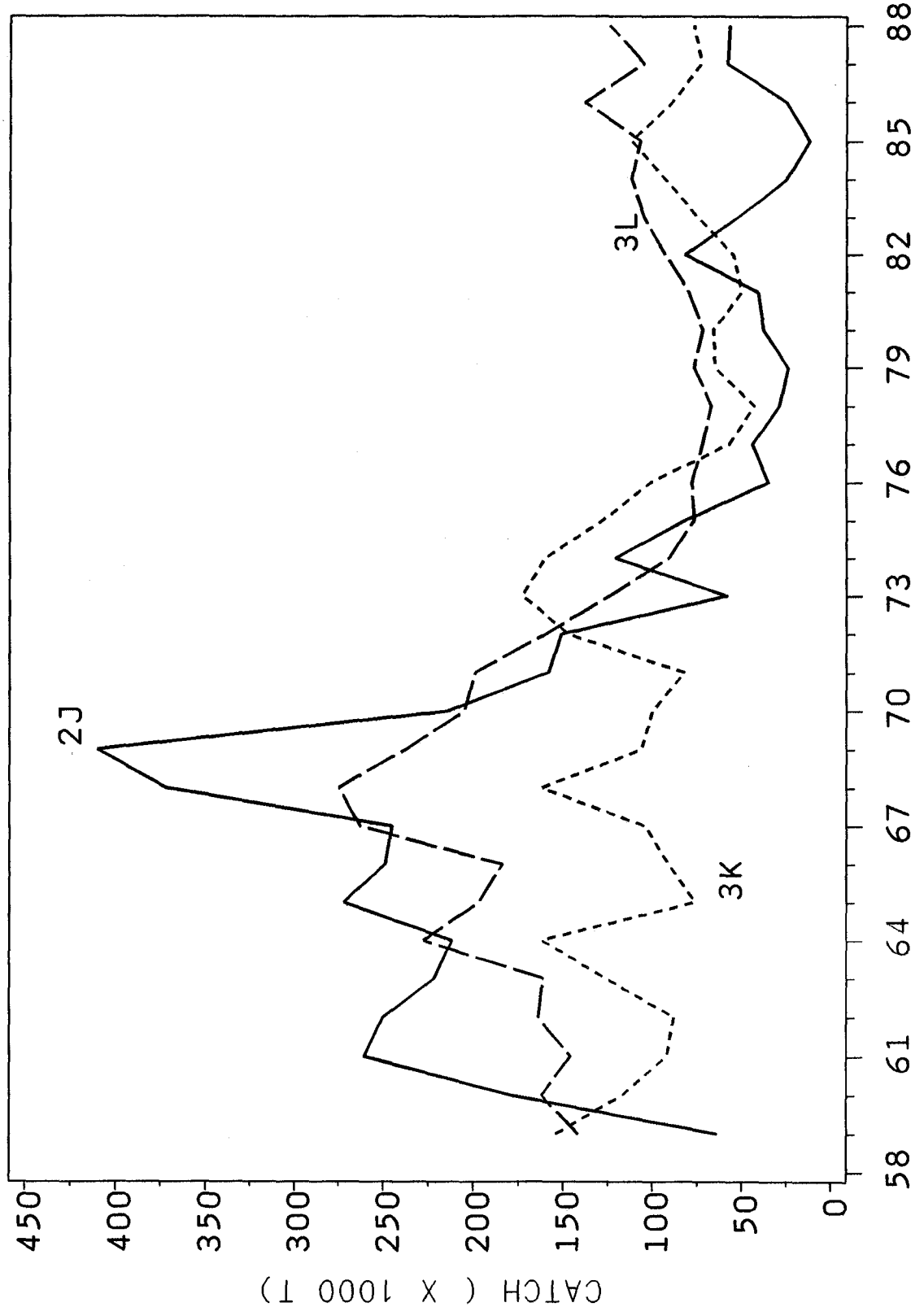


FIG. 2. CATCHES OF COD BY NAFO DIVISION (2J,3K,3L)
FOR THE 1959-88 PERIOD.

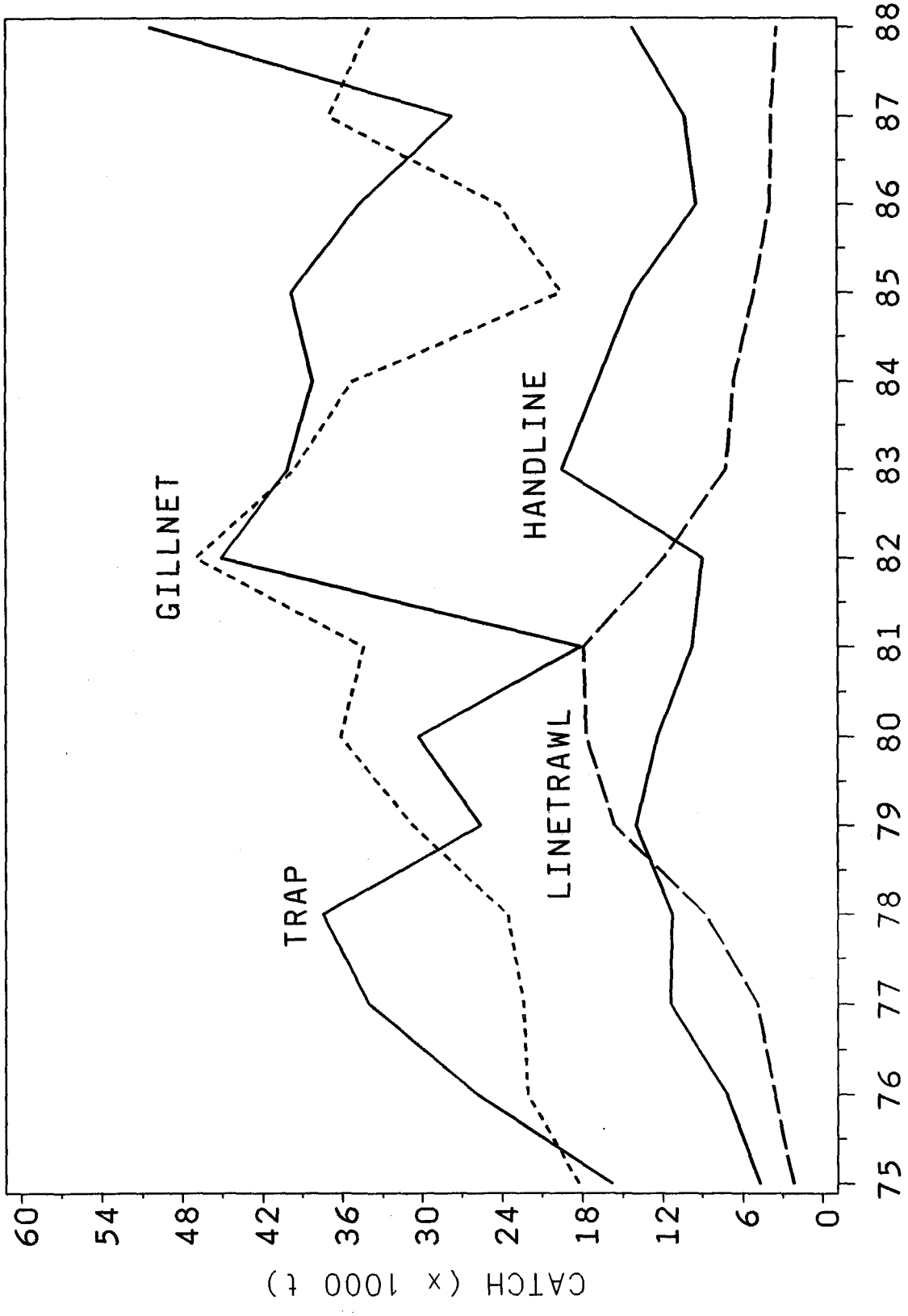


FIG. 3. INSHORE COD CATCHES BY GEAR TAKEN IN NAFO DIV. 2J3KL FOR THE PERIOD 1975-88.

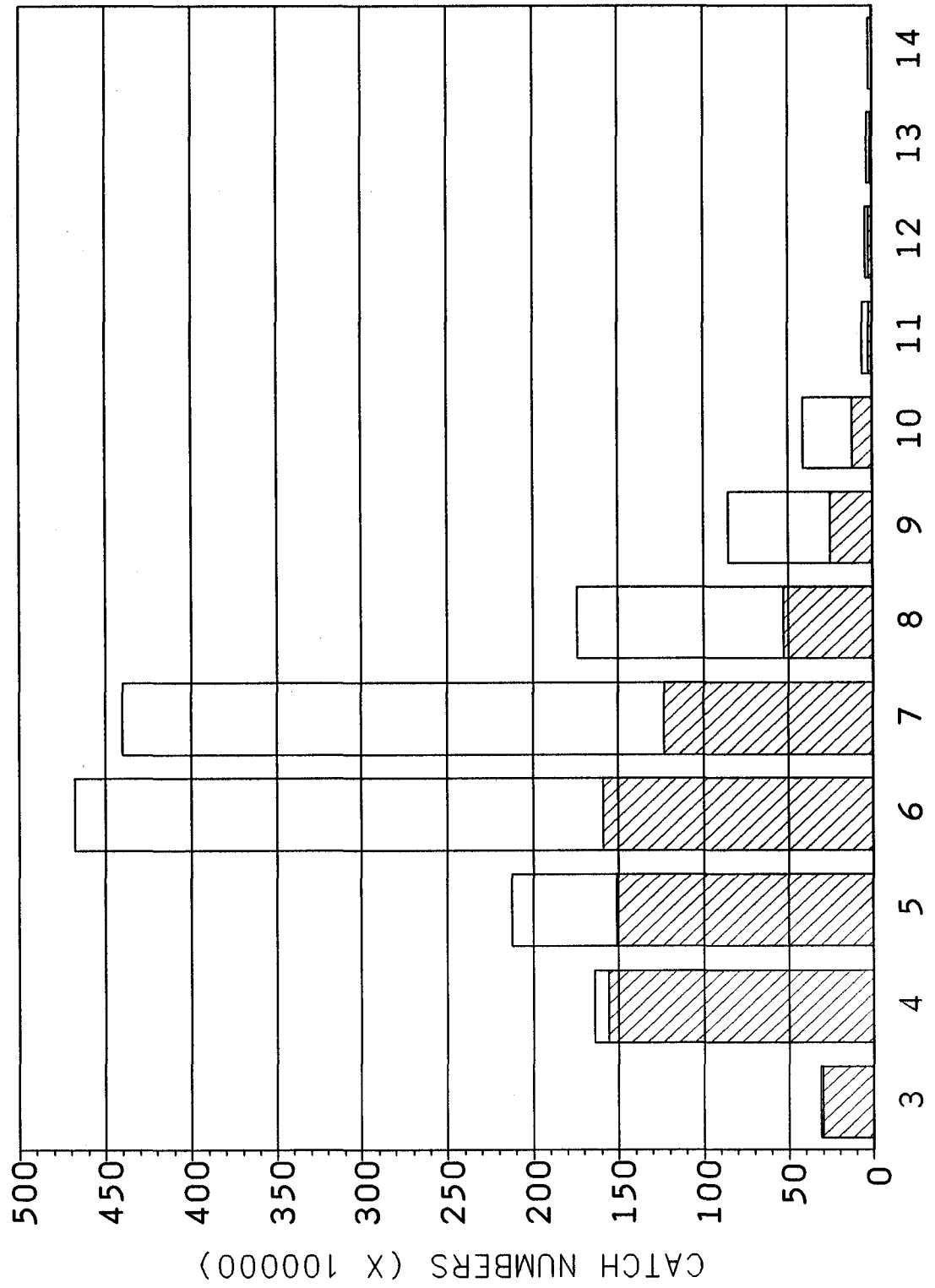


FIG. 4. AGE COMPOSITION OF THE COMMERCIAL CATCH FOR DIV. 2J3KL COD DURING 1988.

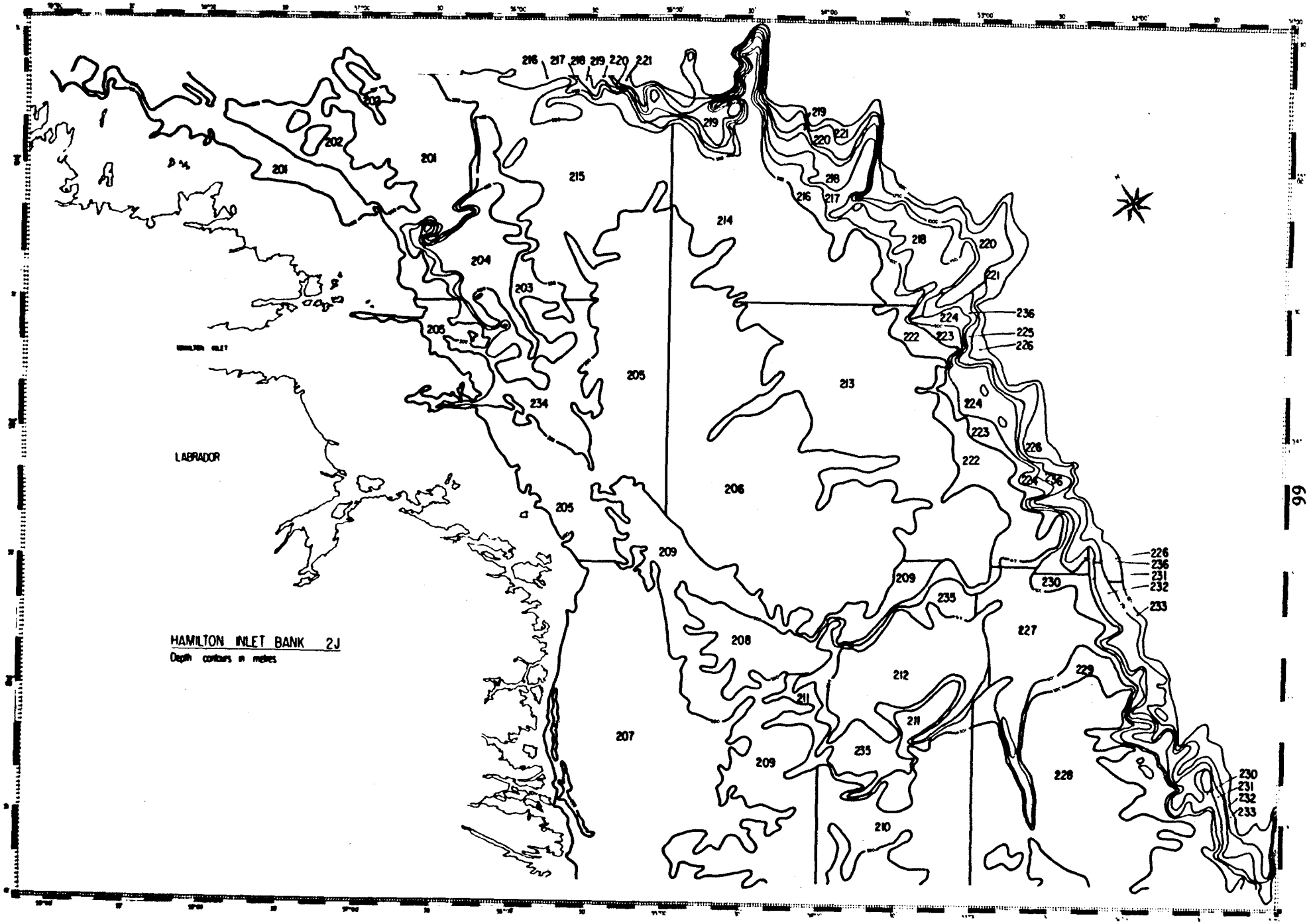


FIG 5. AREA OF STRATIFICATION FOR SURVEYS IN DIV. 2J.

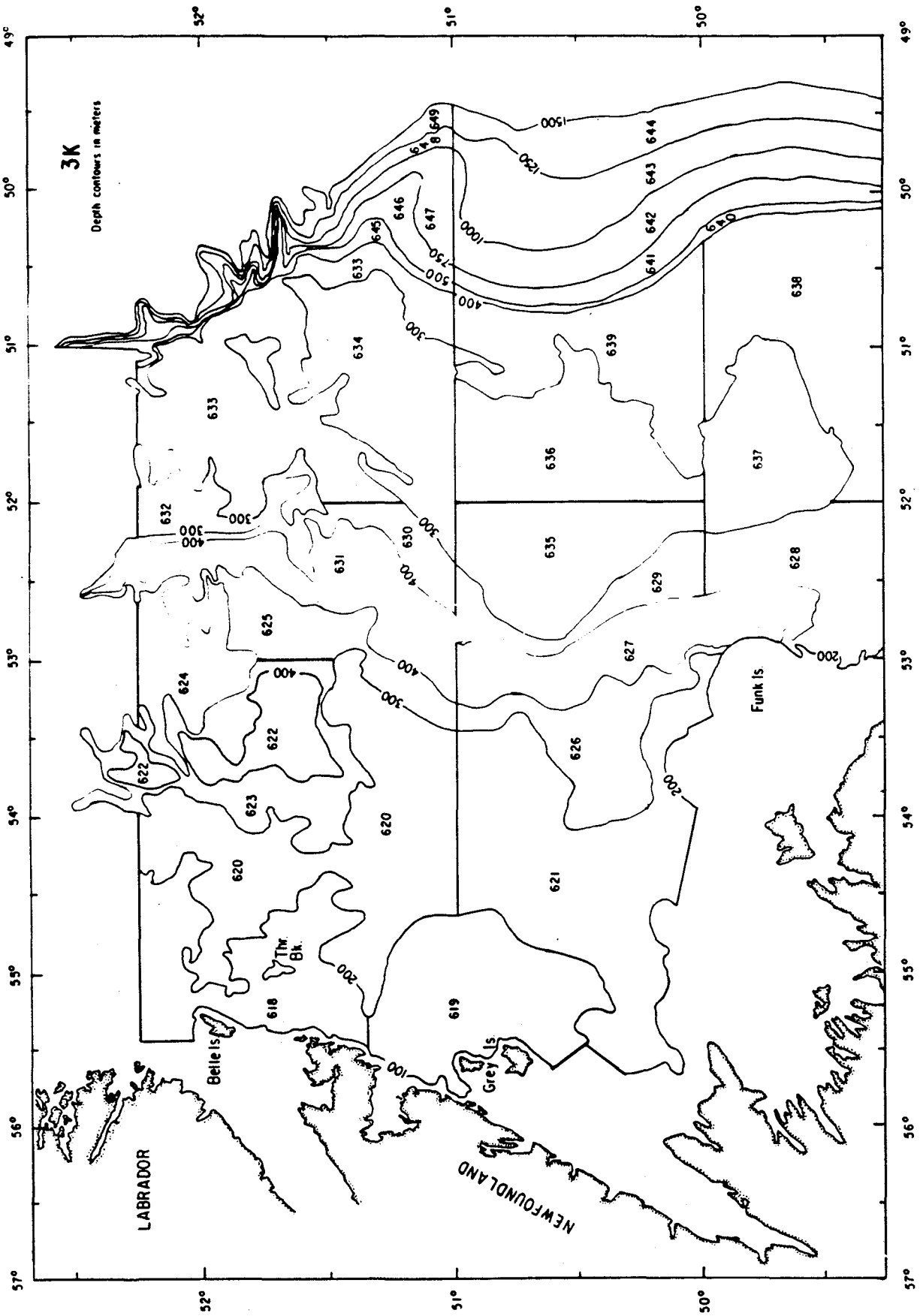


FIG 6. AREA OF STRATIFICATION FOR SURVEYS IN DIV. 3K.

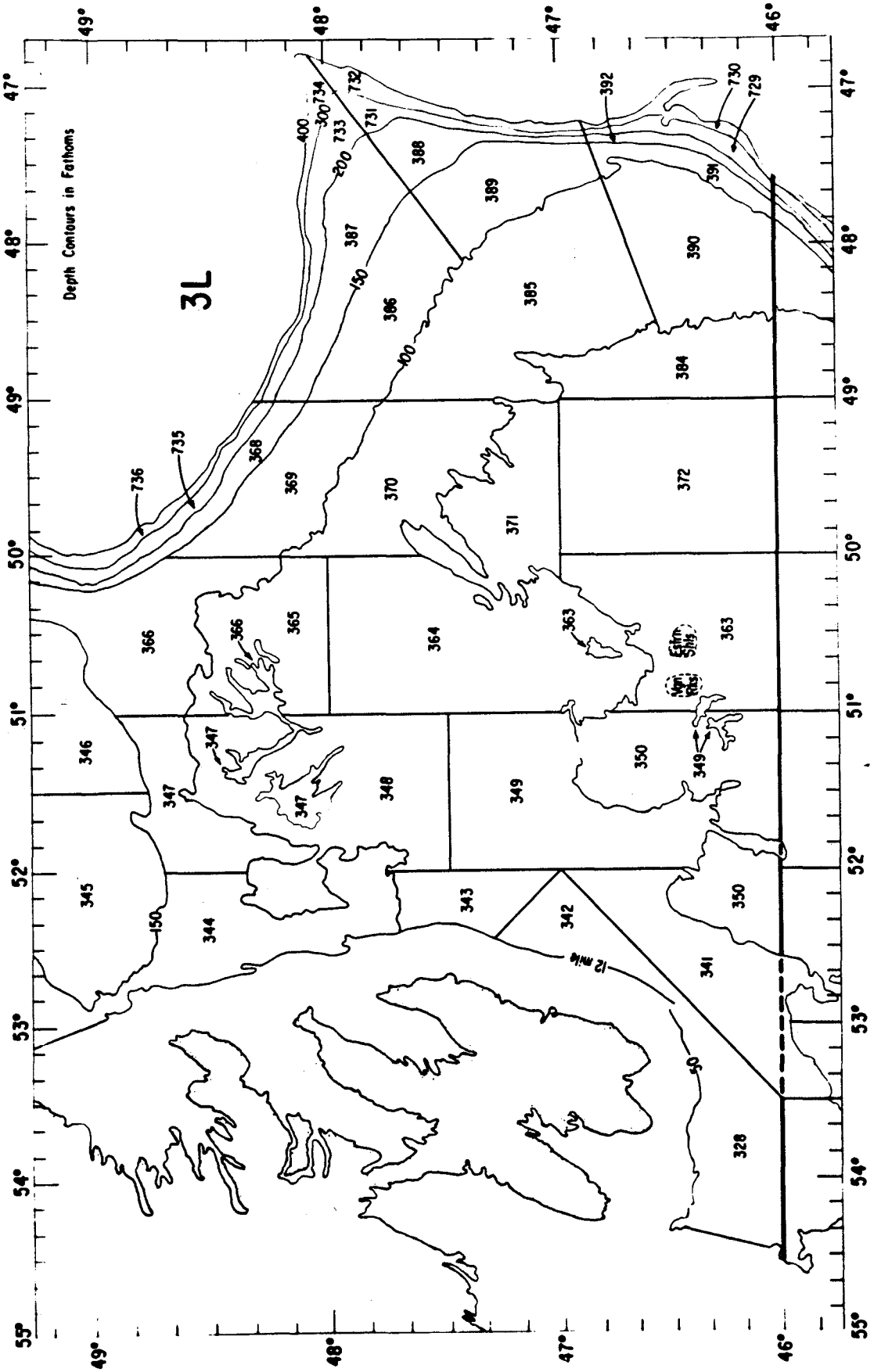


FIG 7. AREA OF STRATIFICATION FOR SURVEYS IN DIV. 3L.

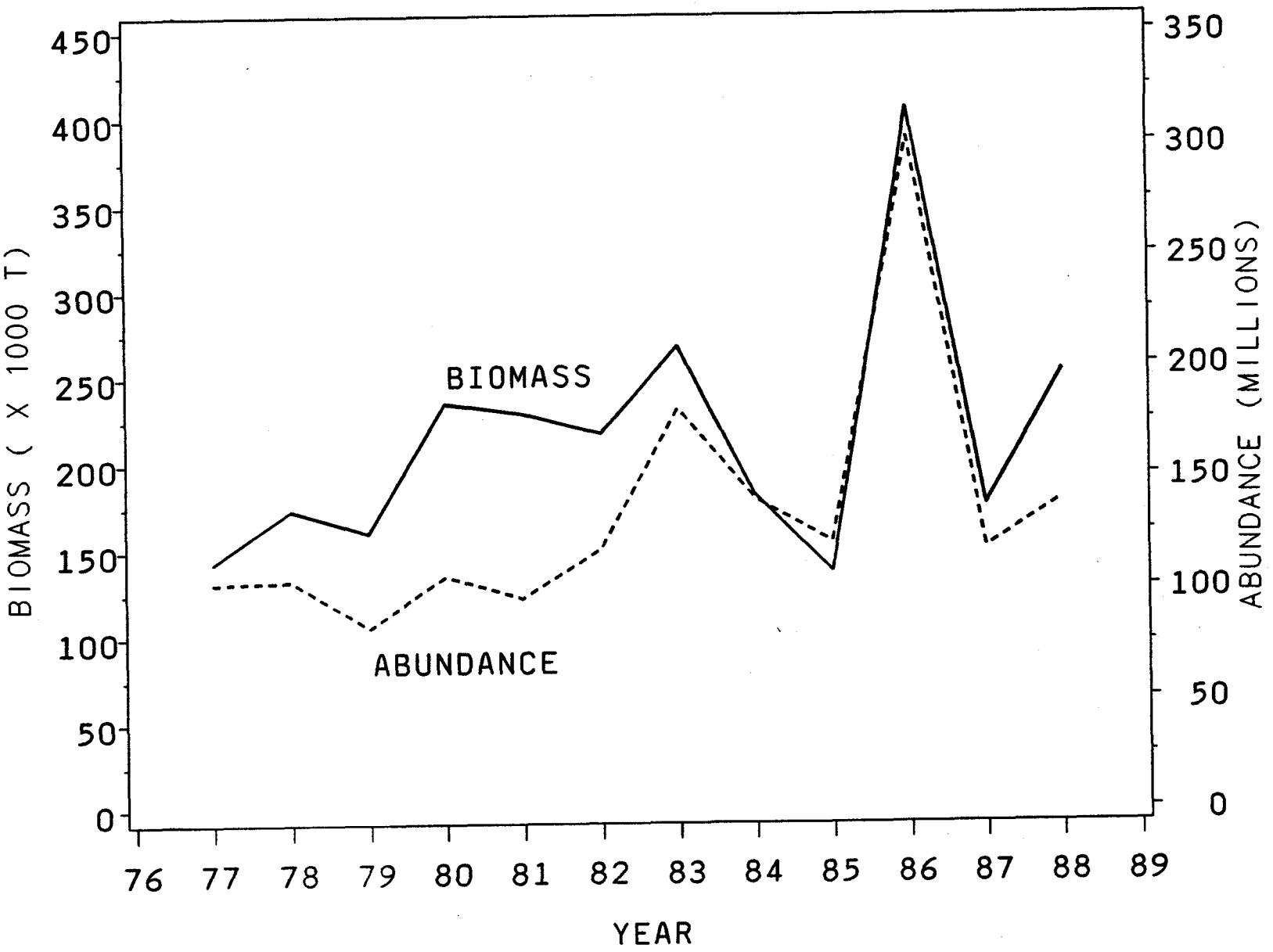


FIG. 8 . COD BIOMASS AND ABUNDANCE IN DIVISION 2J OBTAINED FROM AUTUMN RV SURVEYS.

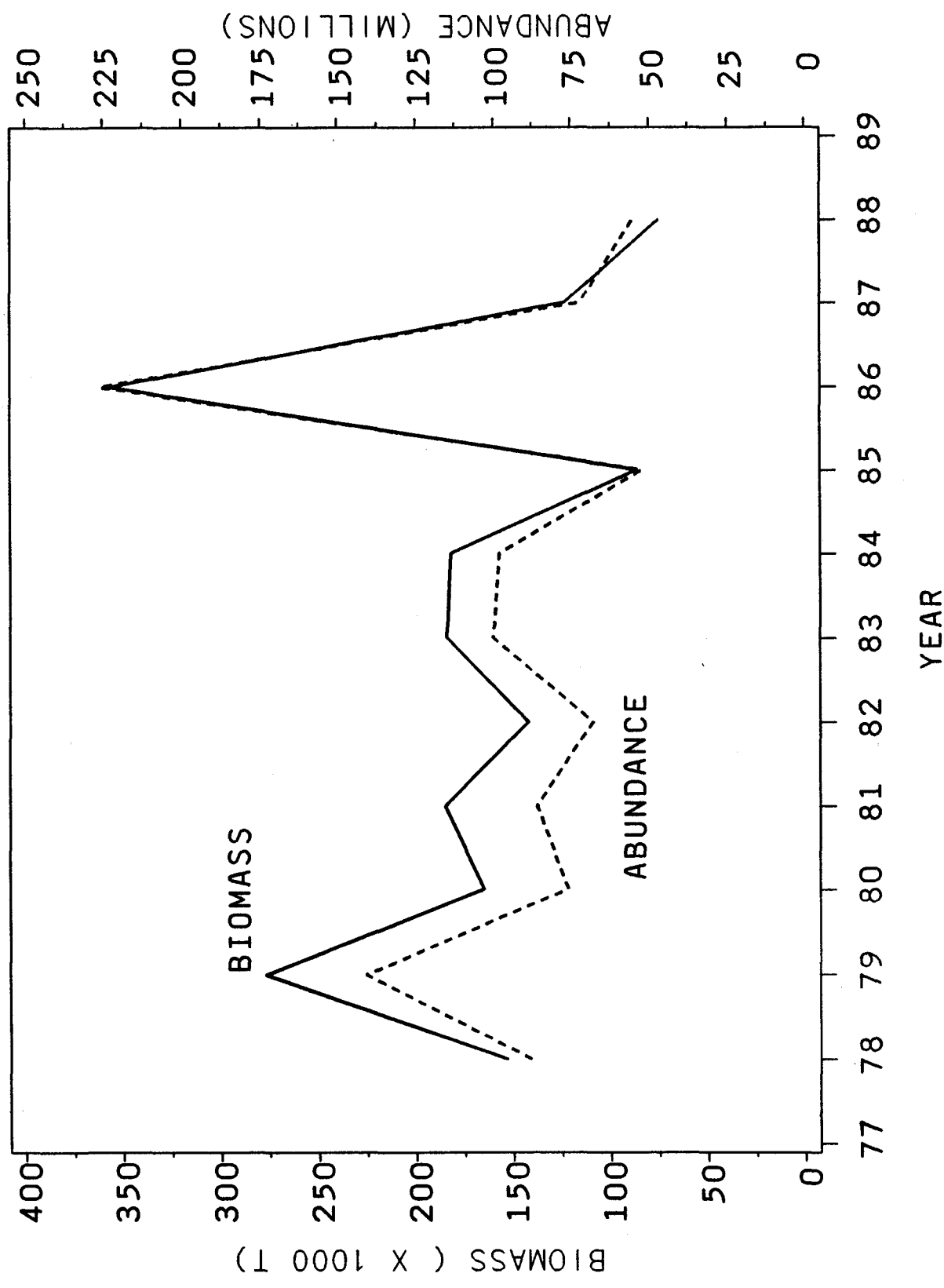


FIG. 9 . COD BIOMASS AND ABUNDANCE IN DIVISION 3K OBTAINED FROM AUTUMN RV SURVEYS.

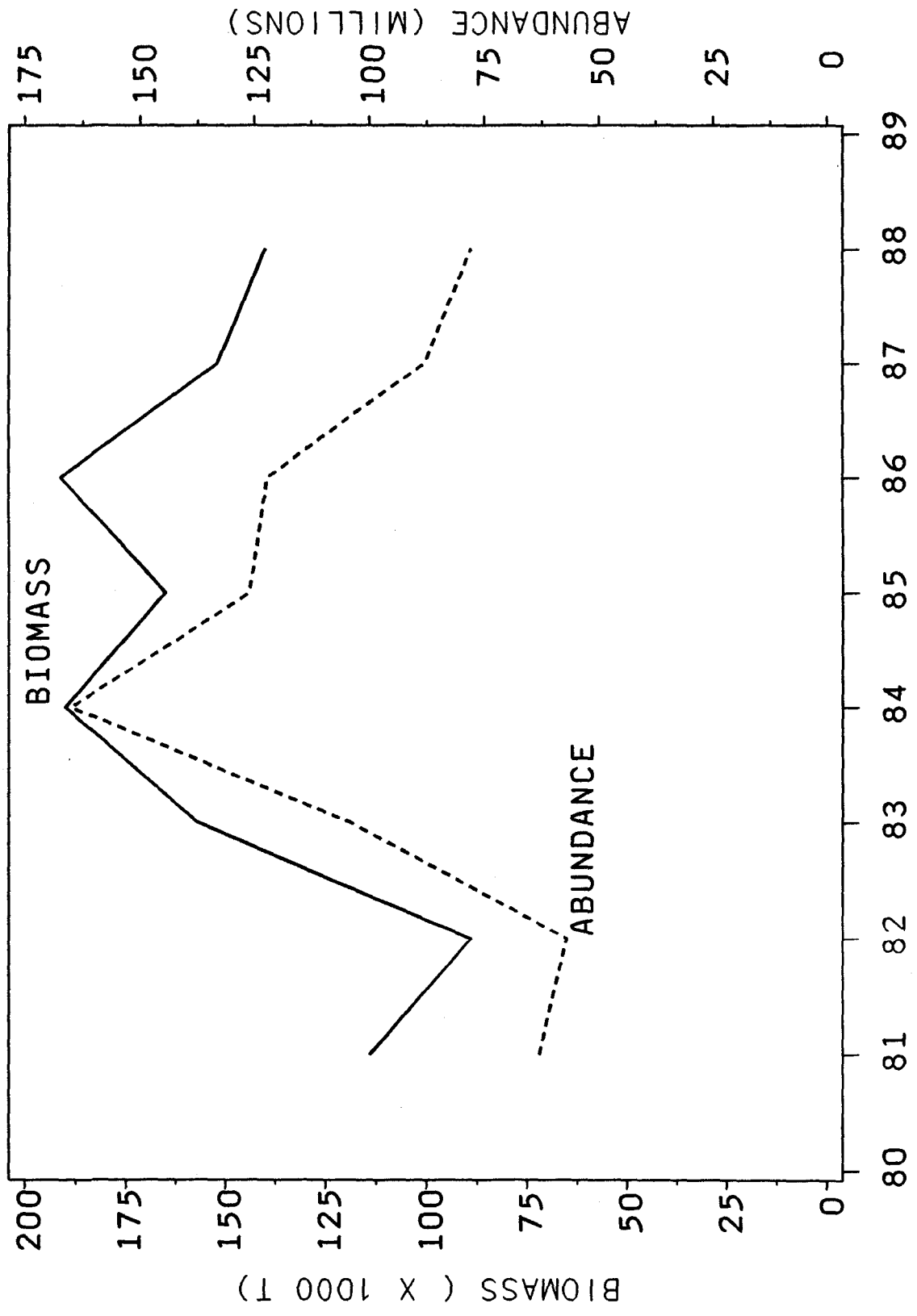


FIG. 10 . COD BIOMASS AND ABUNDANCE IN DIVISION 3L OBTAINED FROM AUTUMN RV SURVEYS.

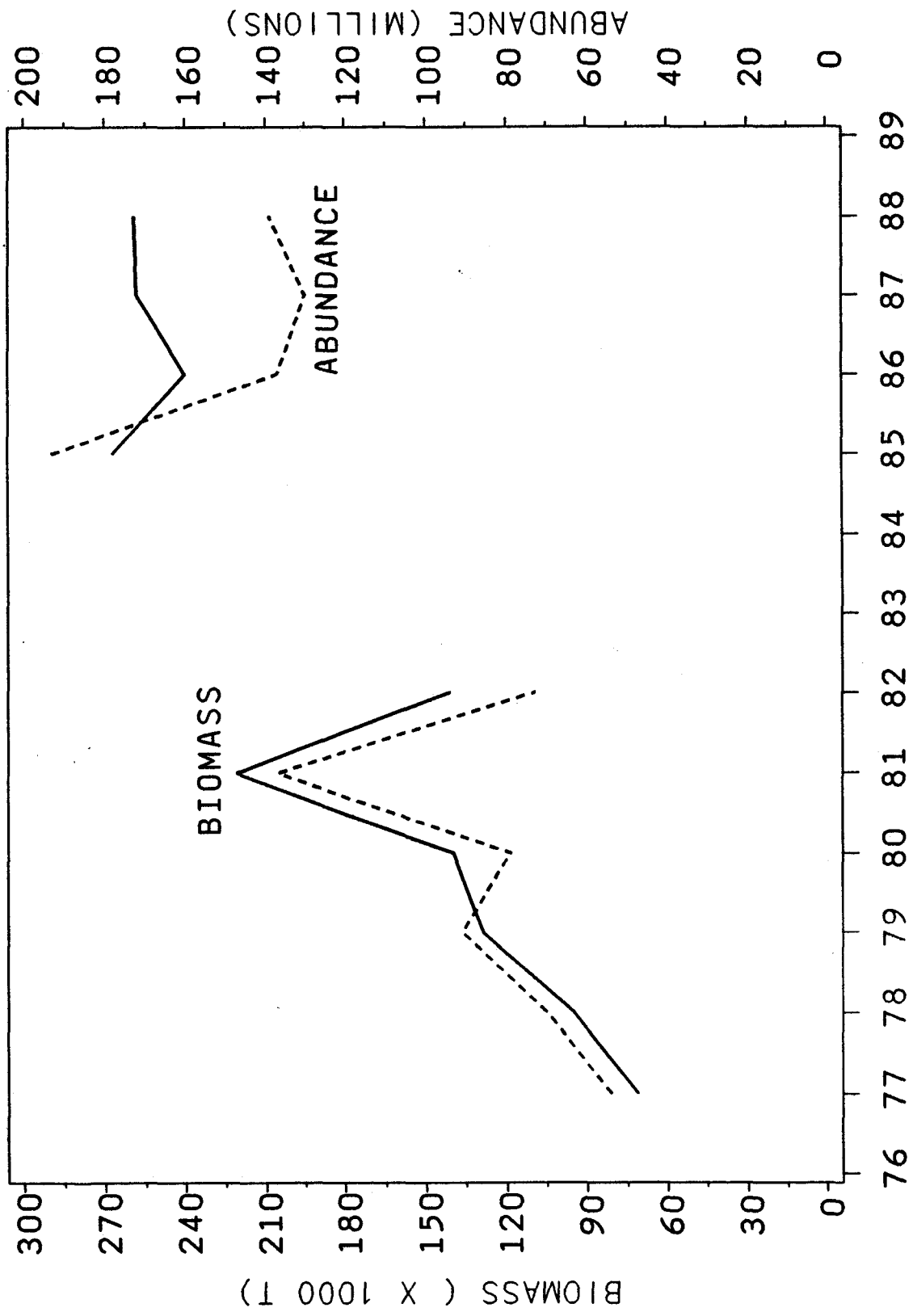


FIG. 11 . COD BIOMASS AND ABUNDANCE IN DIVISION 3L OBTAINED FROM SPRING RV SURVEYS.

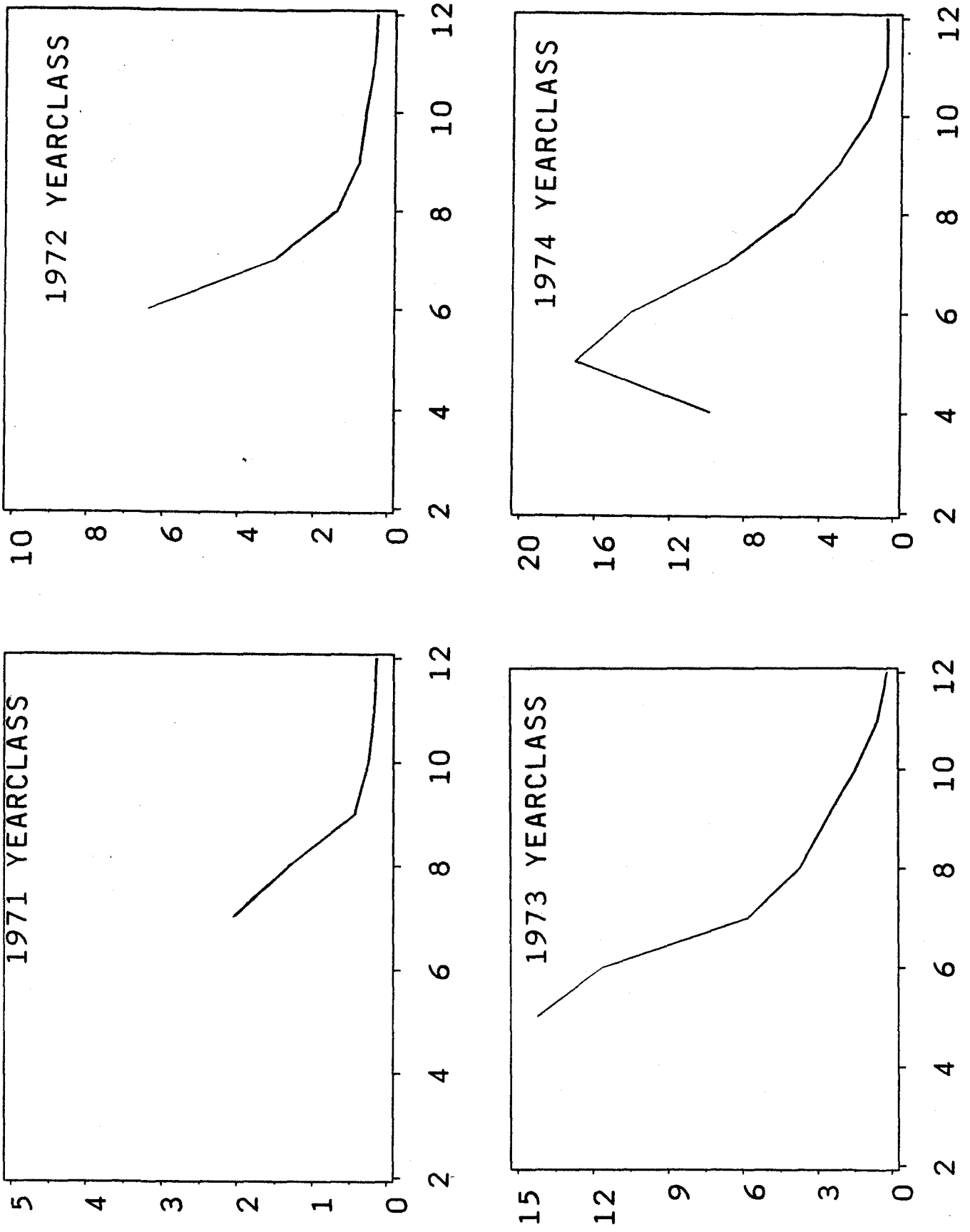


FIG. 12. MEAN NUMBER OF COD PER TOW BY YEARCLASS FROM FALL SURVEYS AVERAGED FOR DIVISIONS 2J,3K,3L (1971-74 YEARCLASSES).

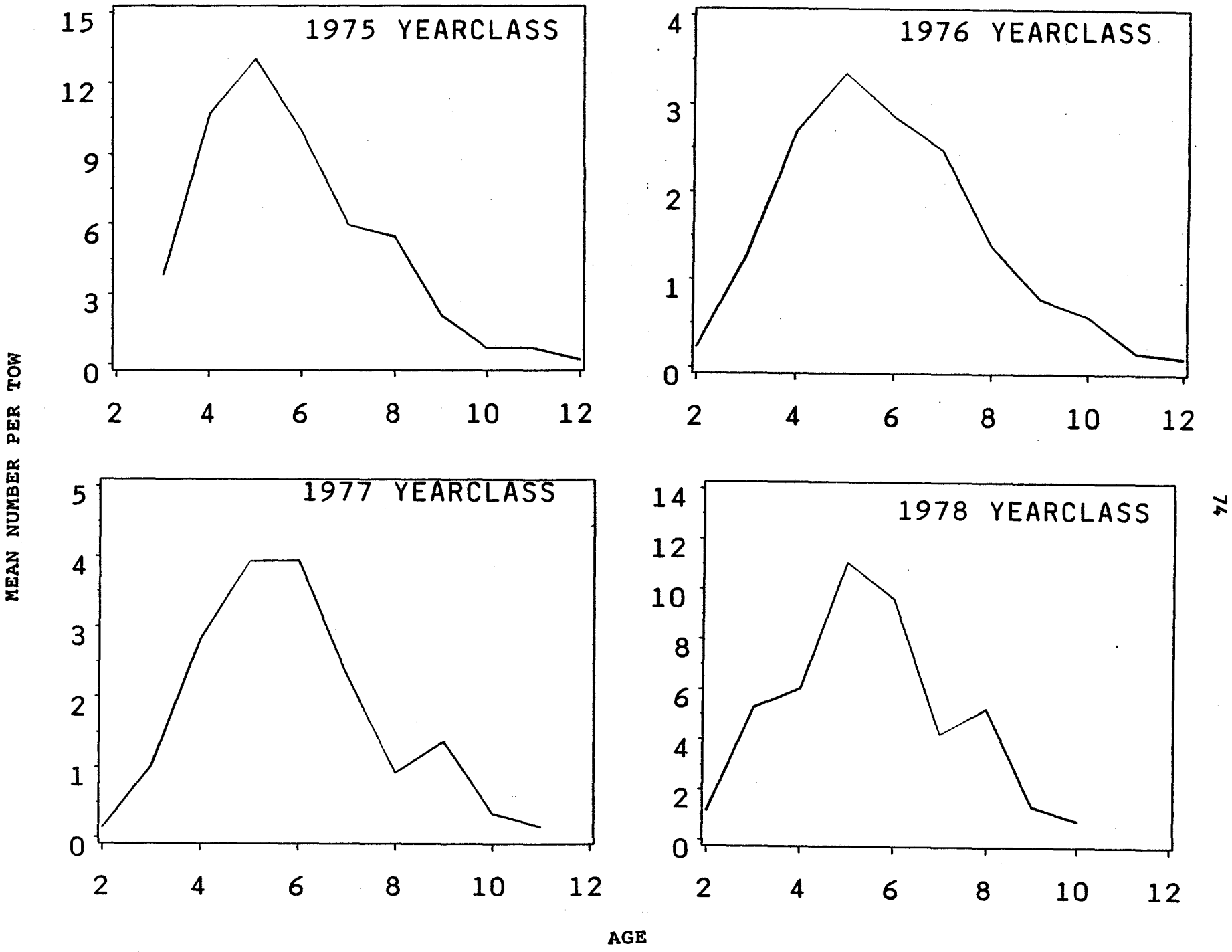


FIG. 13. MEAN NUMBER OF COD PER TOW BY YEARCLASS FROM FALL SURVEYS AVERAGED FOR DIVISIONS 2J.3K.3L (1975-78 YEARCLASSES).

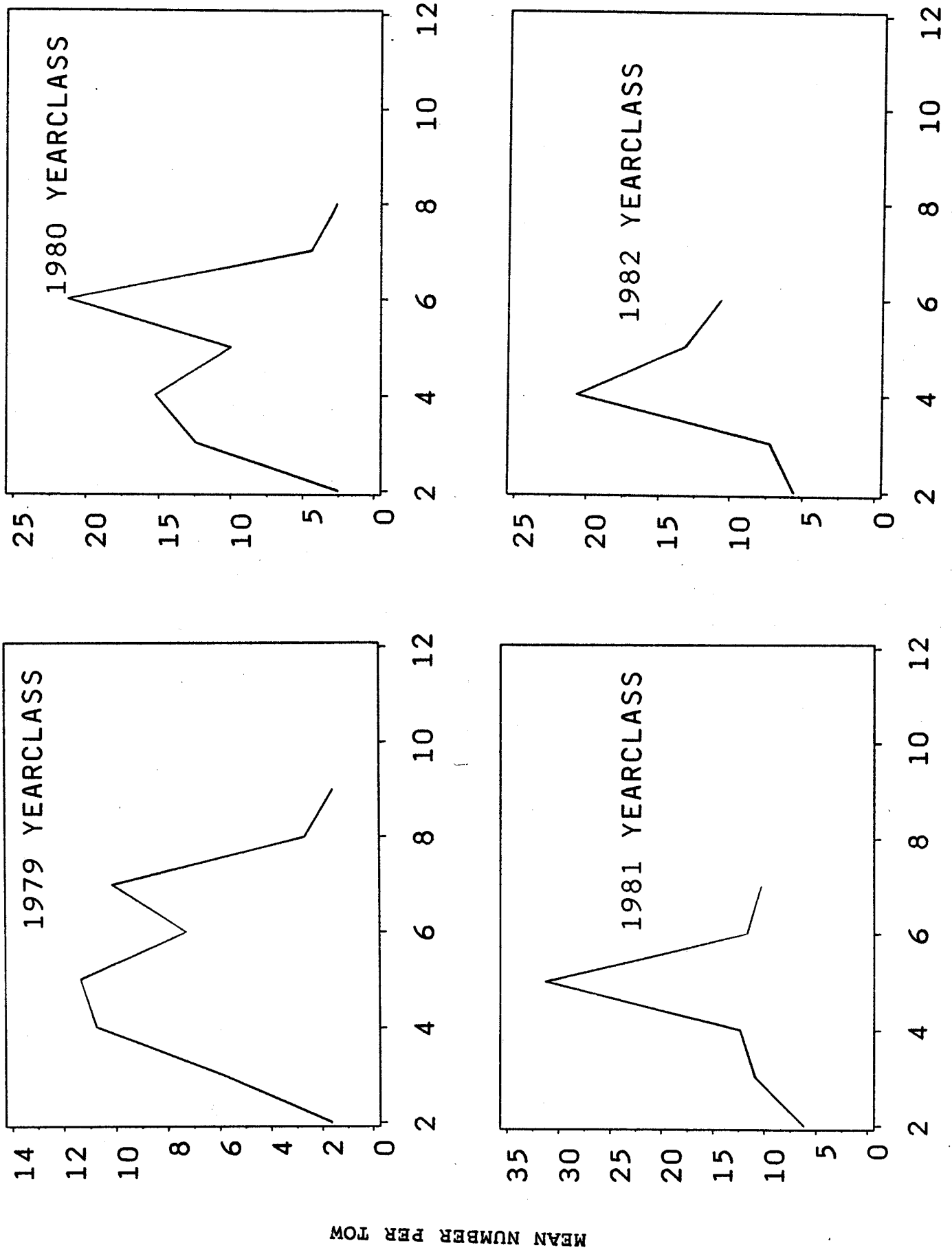


FIG. 14. MEAN NUMBER OF COD PER TOW BY YEARCLASS FROM FALL SURVEYS AVERAGED FOR DIVISIONS 2J,3K,3L (1979-82 YEARCLASSES).

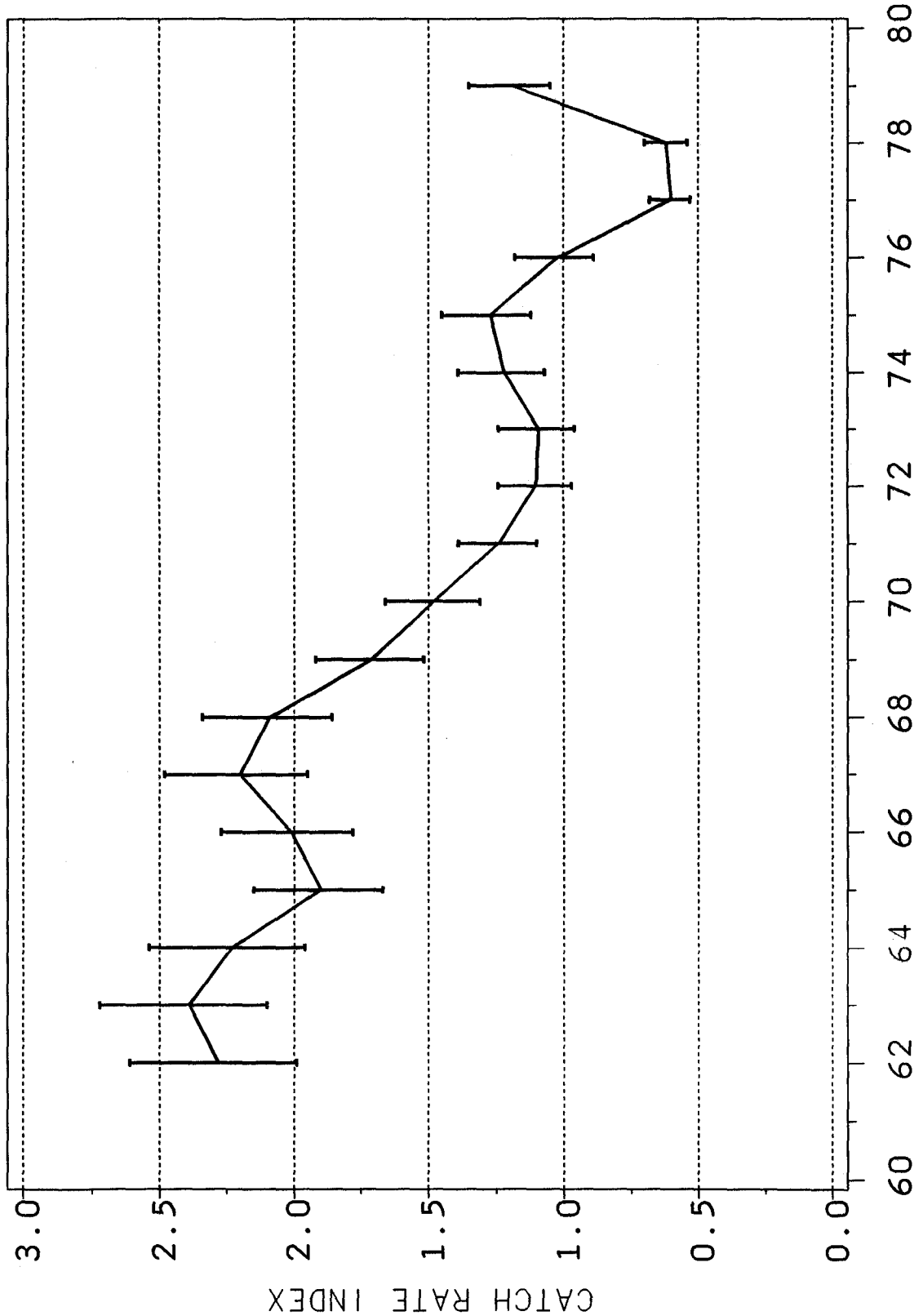


FIG 15. CATCH RATE INDEX WITH APPROXIMATE 90% C. I. FOR DIV. 2J3KL COD (1962-79).

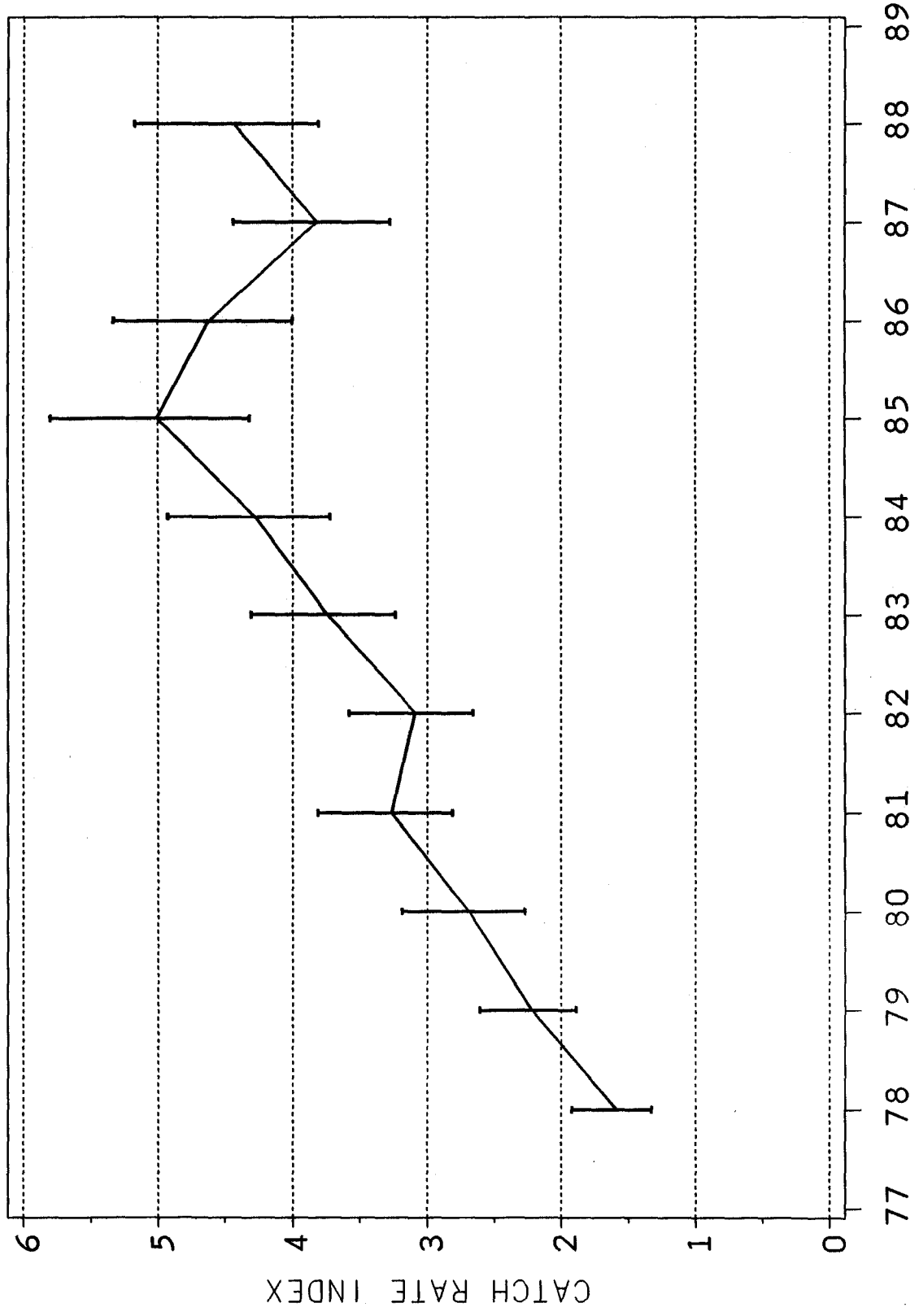


FIG 16. CATCH RATE INDEX WITH APPROXIMATE 90% C.I.
FOR DIVISION 2J3KL COD (1978-88).

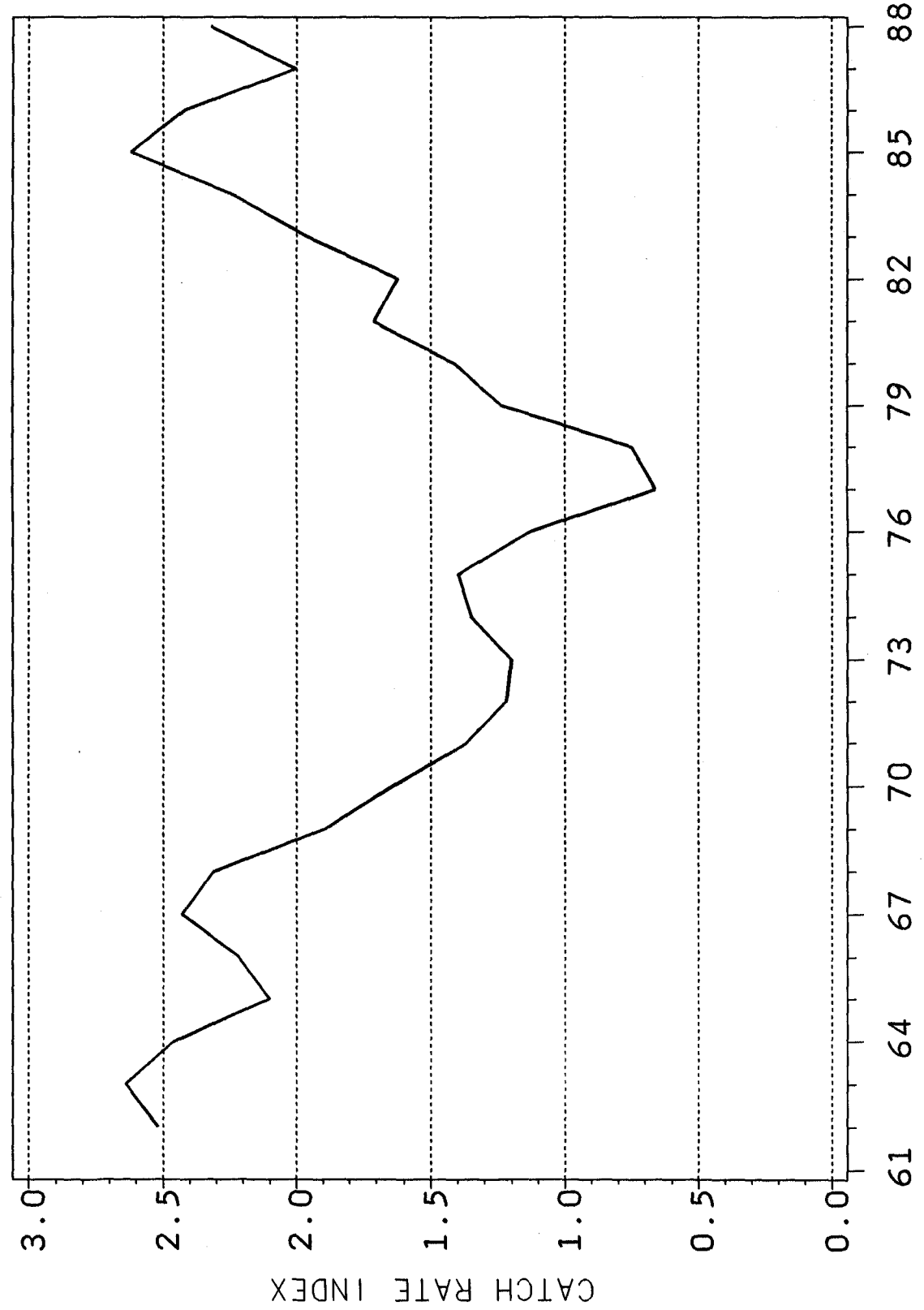


FIGURE 17. STANDARDIZED CATCH RATE INDICES FOR 2J3KL COD FOR THE PERIOD 1962-88.

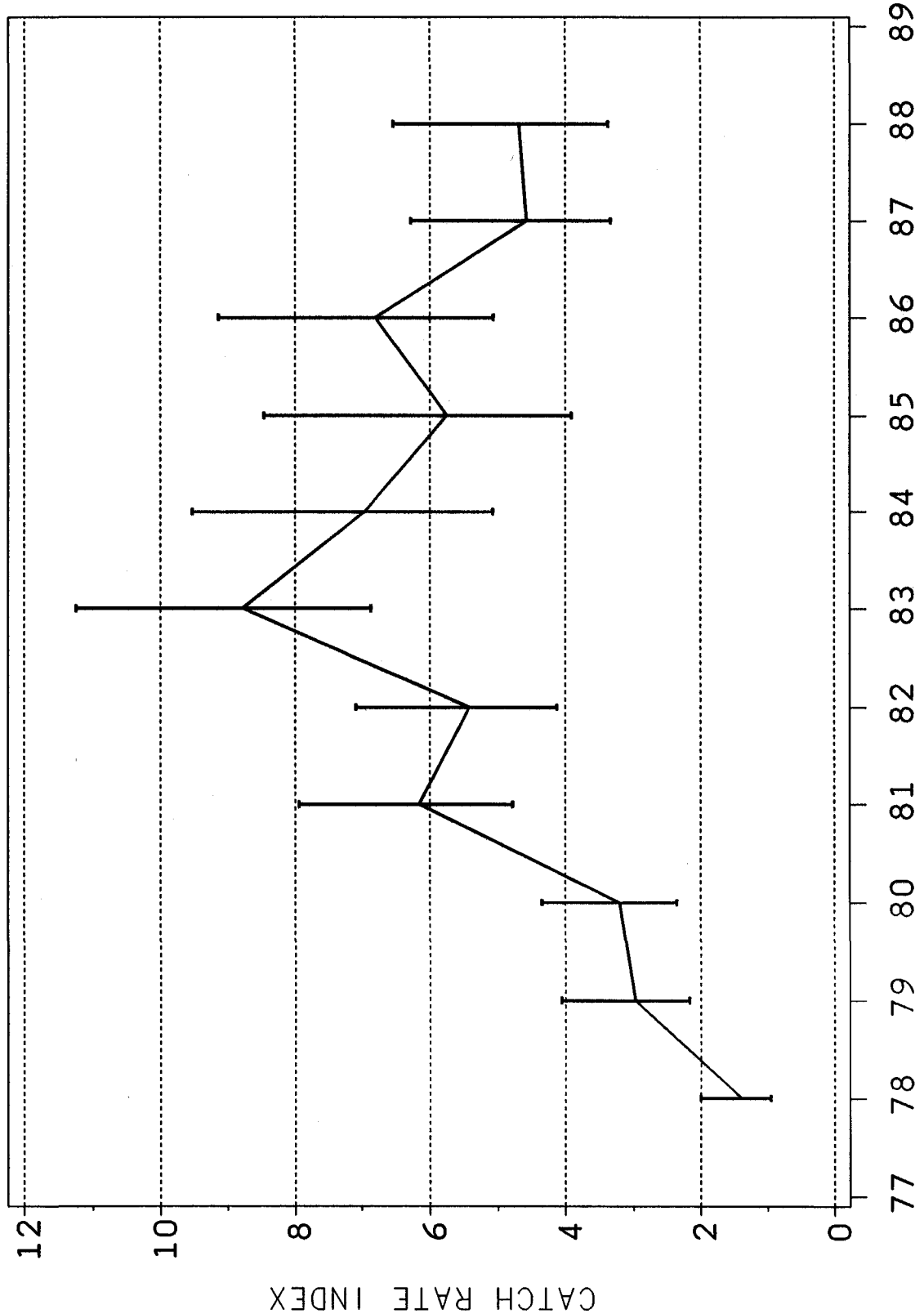


FIG 18 CATCH RATE INDEX WITH APPROXIMATE 90% C. I.
FOR DIV. 2J COD (1978-88).

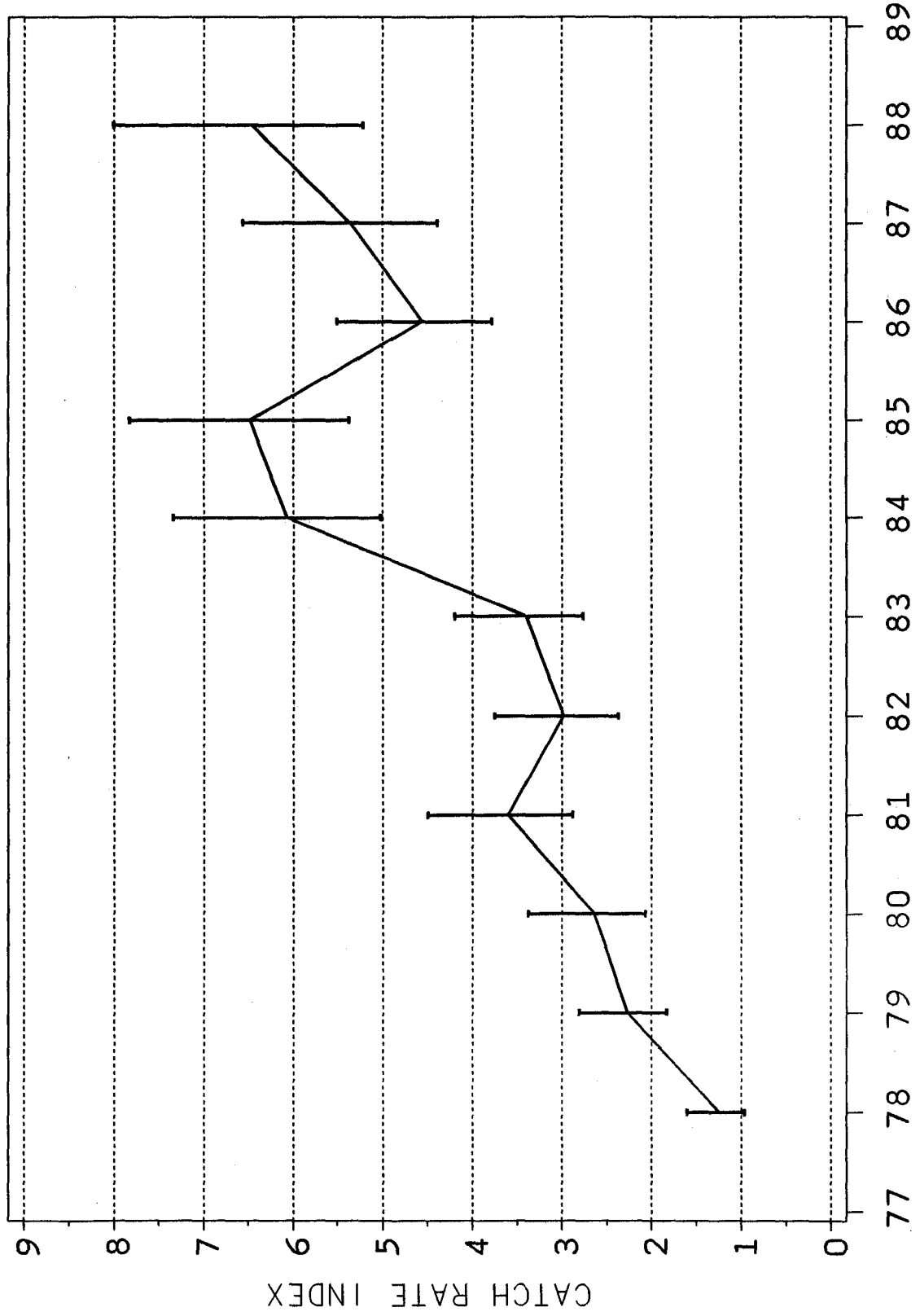


FIG 19. CATCH RATE INDEX WITH APPROXIMATE 90% C. I.
FOR DIV. 3K COD (1978-87).

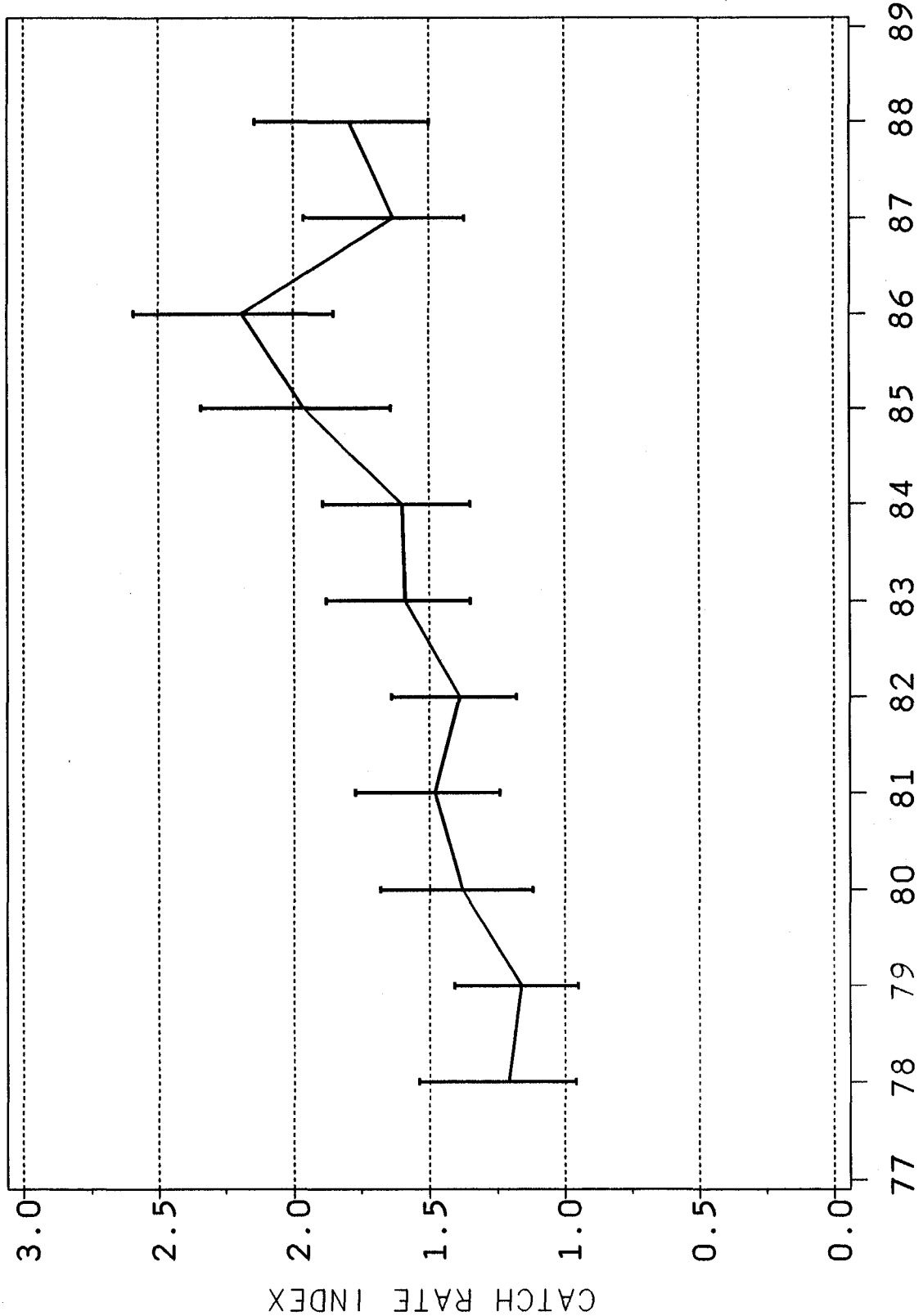


FIG 20. CATCH RATE INDEX WITH APPROXIMATE 90% C. I.
FOR DIV. 3L COD (1978-87).

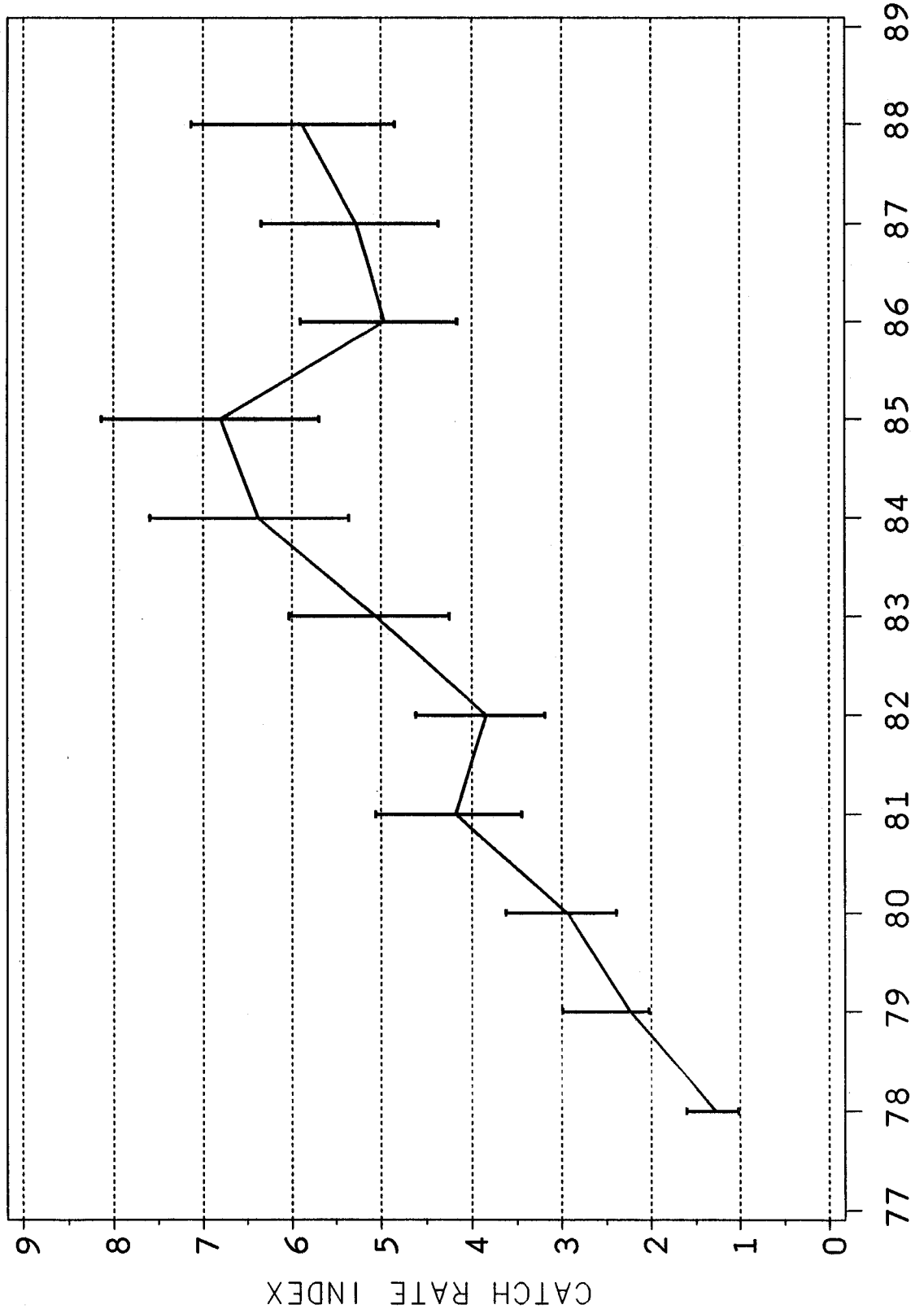


FIG 21. CATCH RATE INDEX WITH APPROXIMATE 90% C.I.
FOR DIVISION 2J3K COD (1978-88).

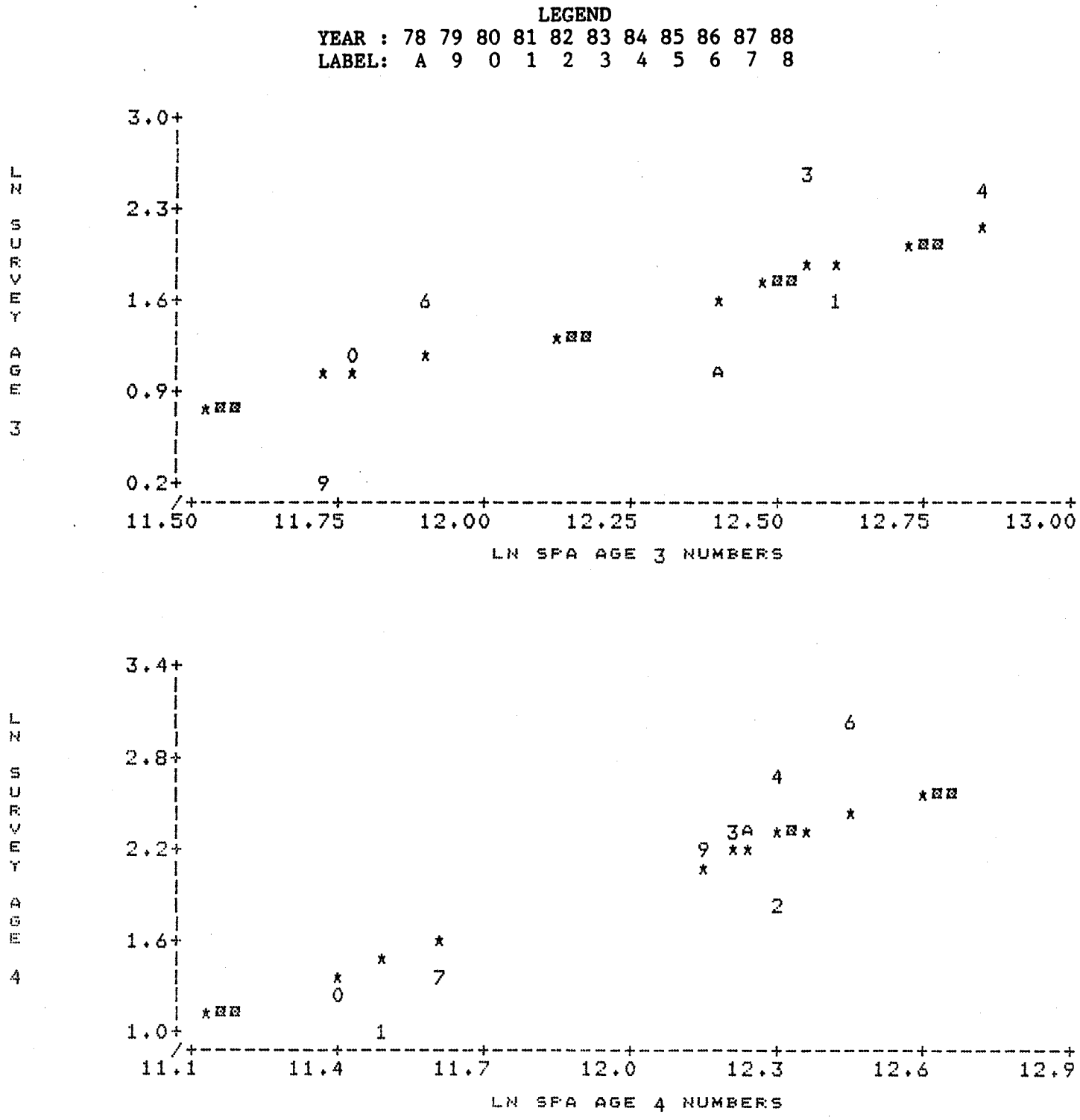


FIGURE 22. LN SPA NUMBERS VERSUS LN RV SURVEY NUMBERS FOR AGES 3 AND 4 FOR COD IN DIV. 2J3KL FOR THE PERIOD 1978-88.

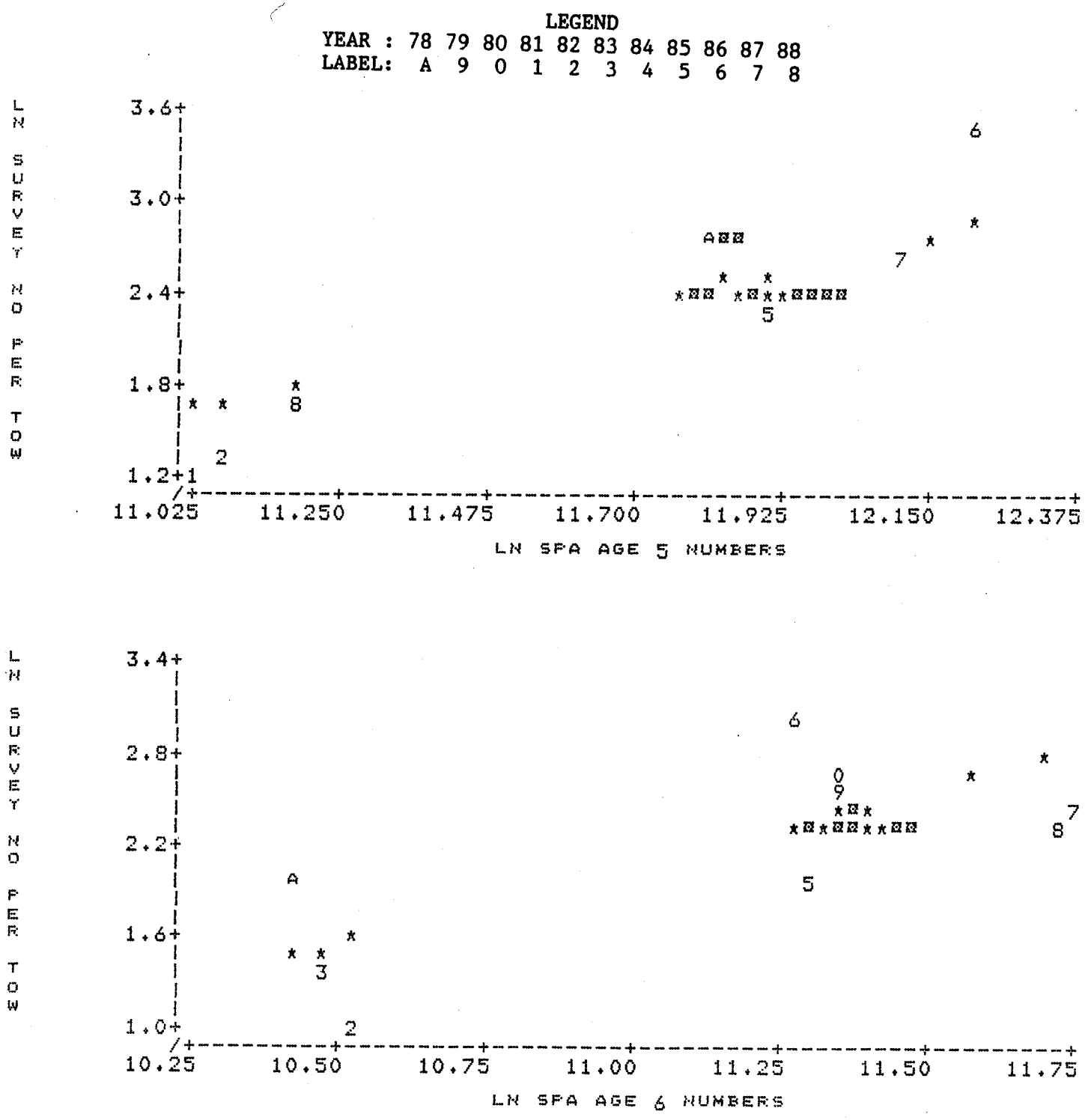


FIGURE 23. LN SPA NUMBERS VERSUS LN RV SURVEY NUMBERS FOR AGES 5 AND 6 FOR COD IN DIV. 2J3KL FOR THE PERIOD 1978-88.

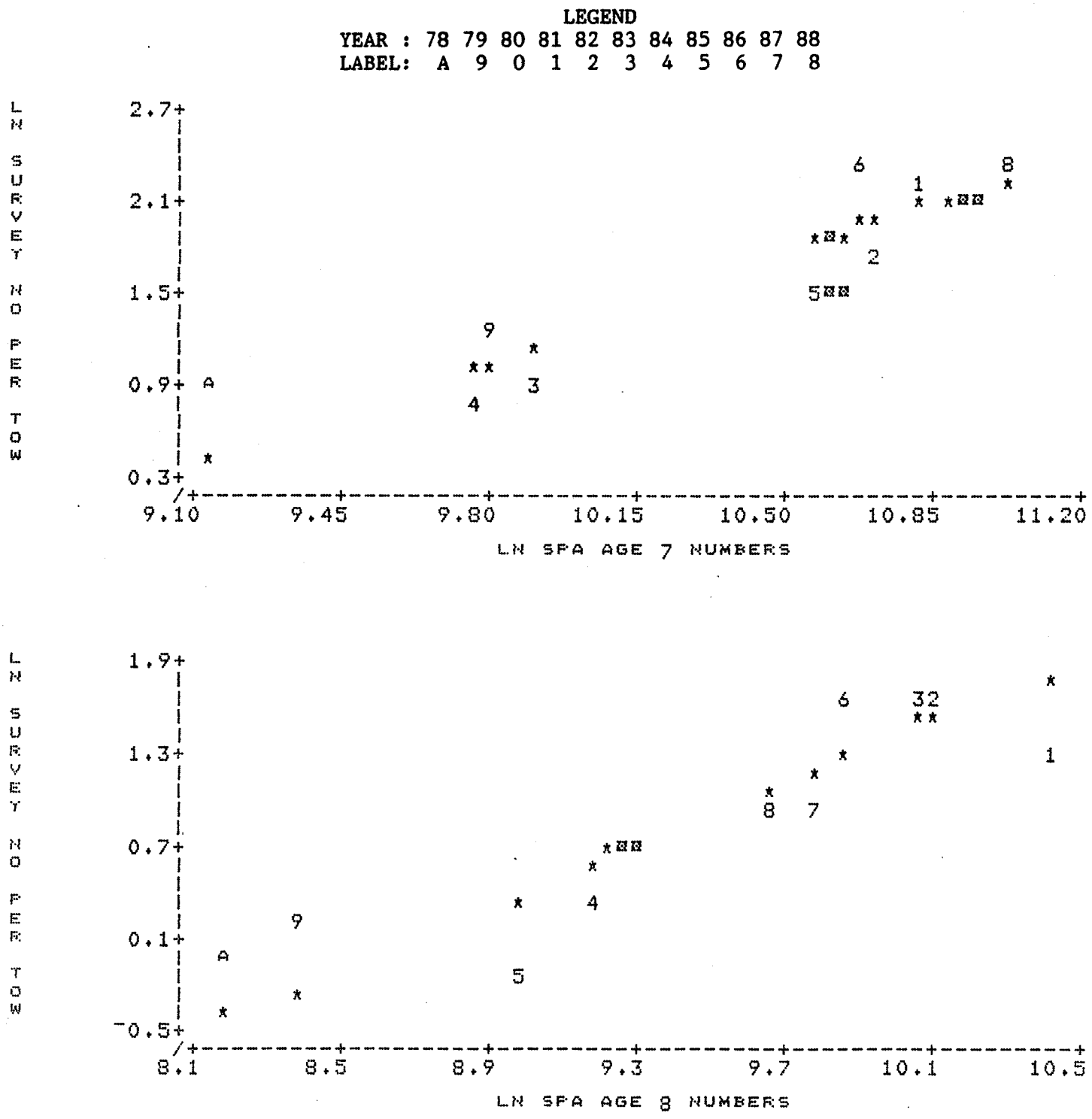


FIGURE 24. LN SPA NUMBERS VERSUS LN RV SURVEY NUMBERS FOR AGES 7 AND 8 FOR COD IN DIV. 2J3KL FOR THE PERIOD 1978-88.

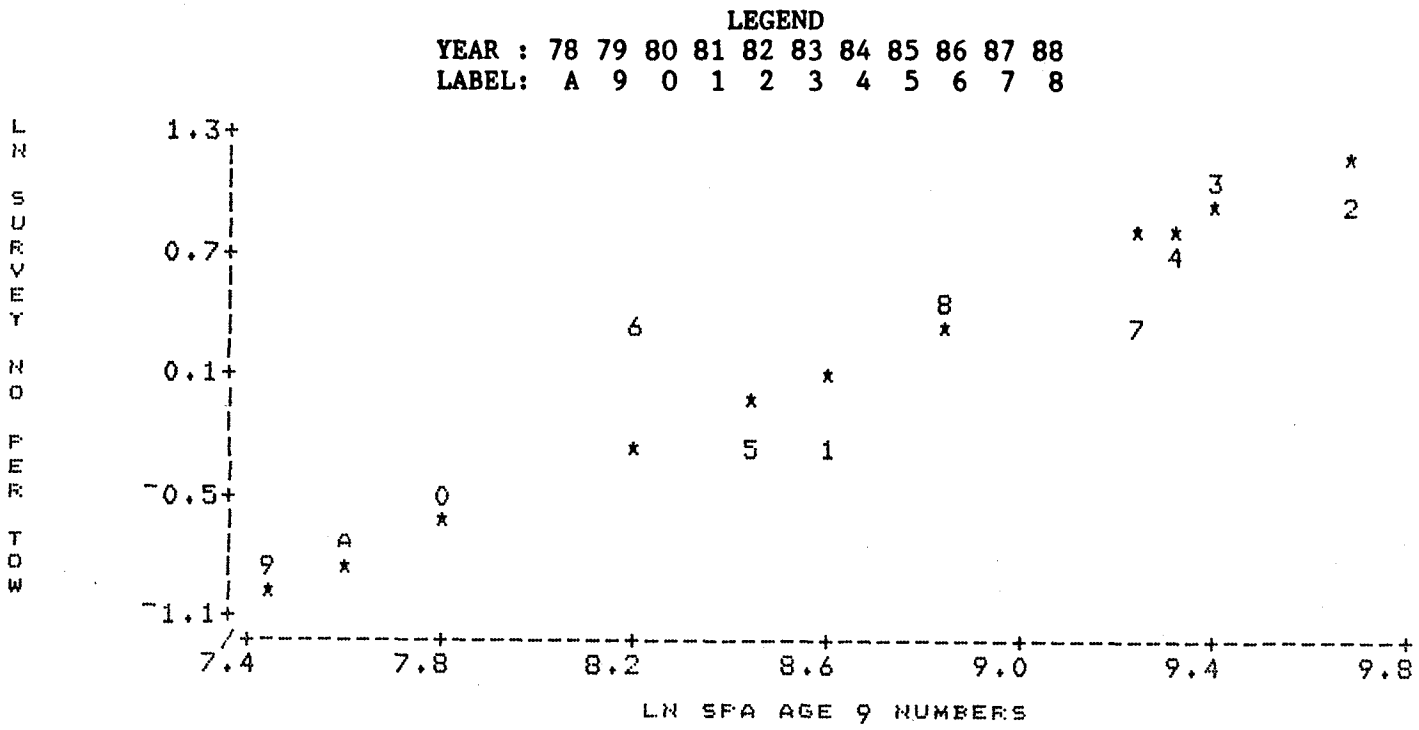


FIGURE 25. LN SPA NUMBERS VERSUS LN RV SURVEY NUMBERS FOR AGE 9 FOR COD IN DIV. 2J3KL FOR THE PERIOD 1978-88.

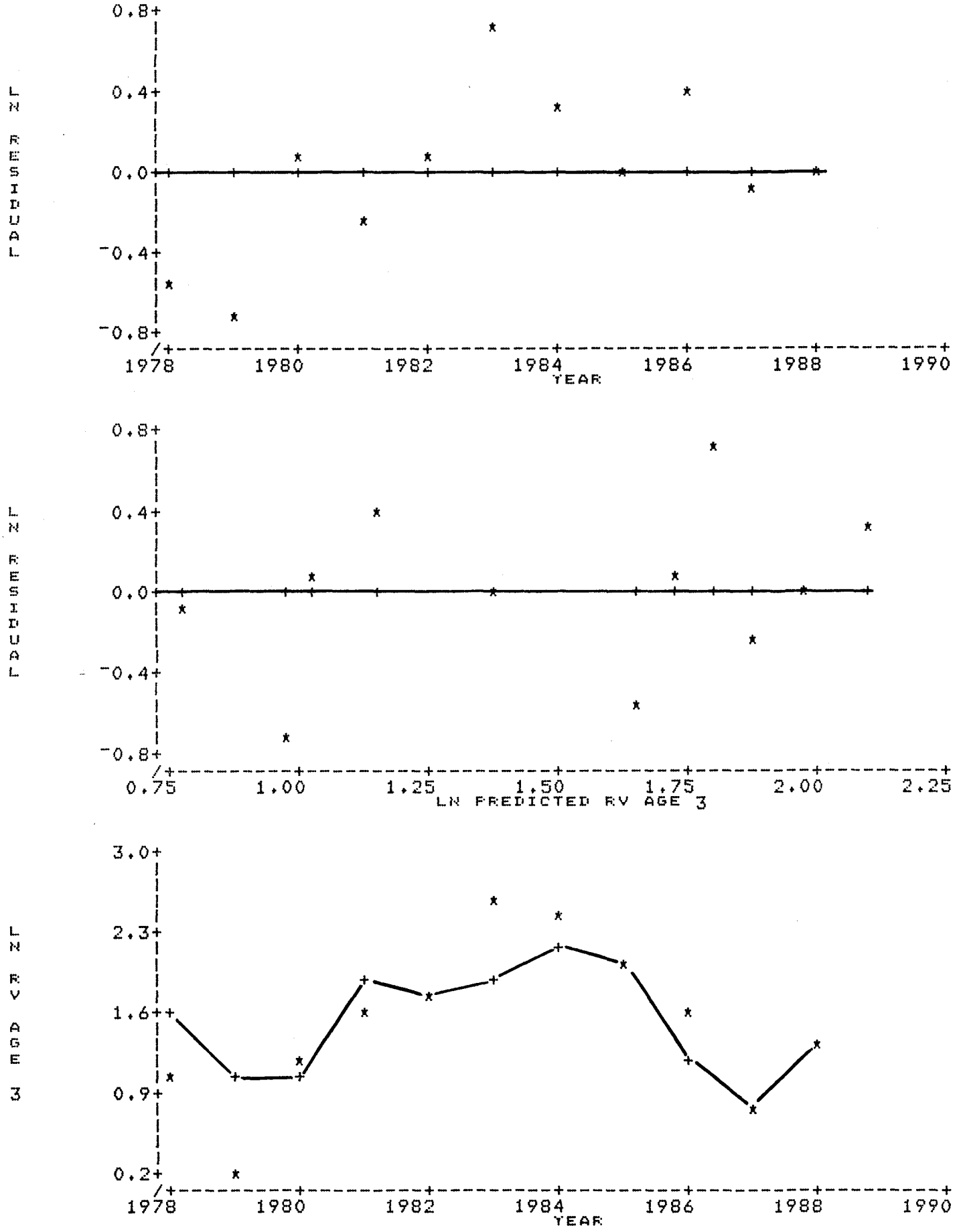


FIGURE 26. RESIDUAL PLOTS AND TIME SERIES PLOT OF THE OBSERVED (*) AND PREDICTED (+) LN ABUNDANCE INDEX FOR AGE 3 COD IN DIVISIONS 2J3KL.

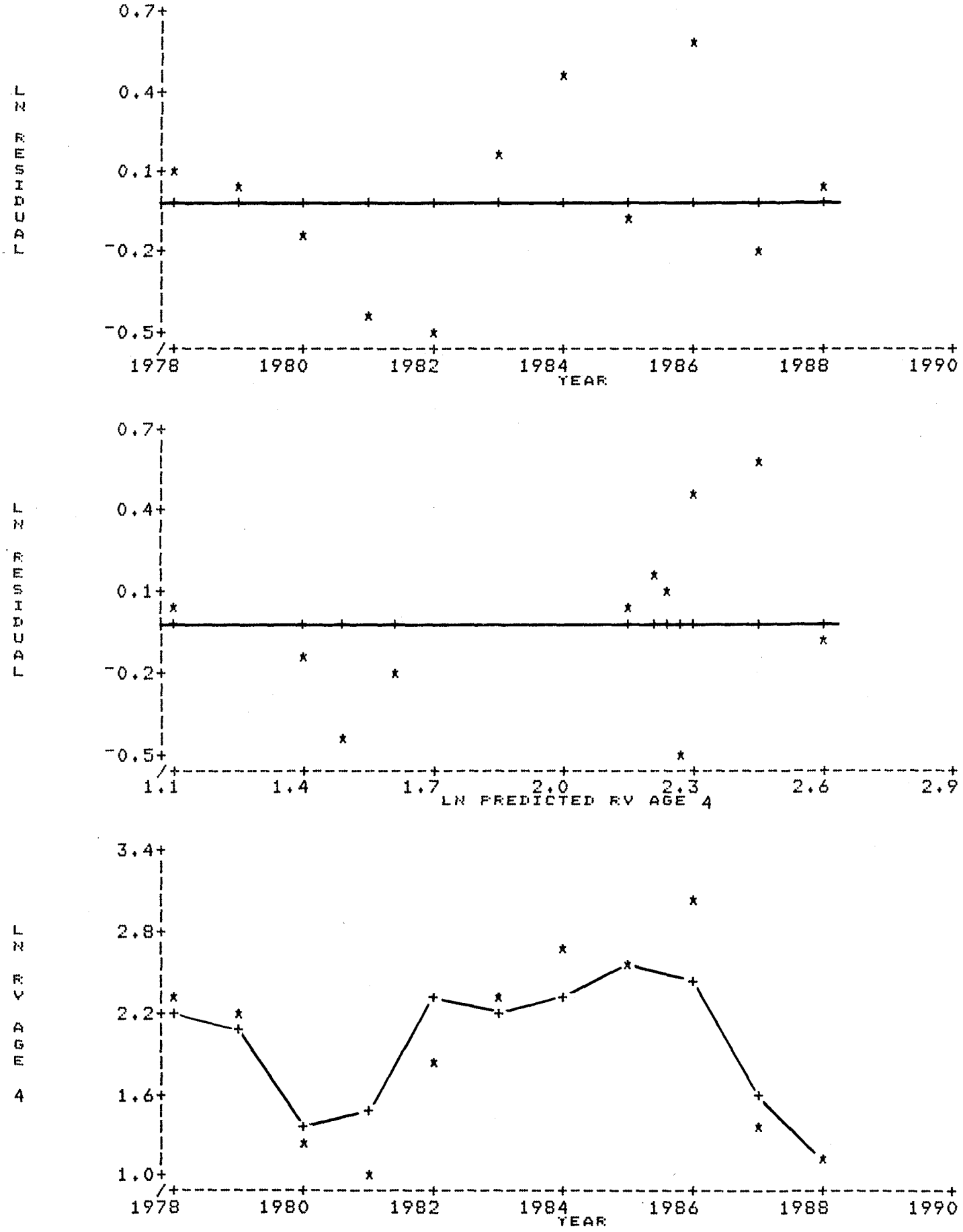


FIGURE 27. RESIDUAL PLOTS AND TIME SERIES PLOT OF THE OBSERVED (*) AND PREDICTED (+) LN ABUNDANCE INDEX FOR AGE 4 COD IN DIVISIONS 2J3KL.

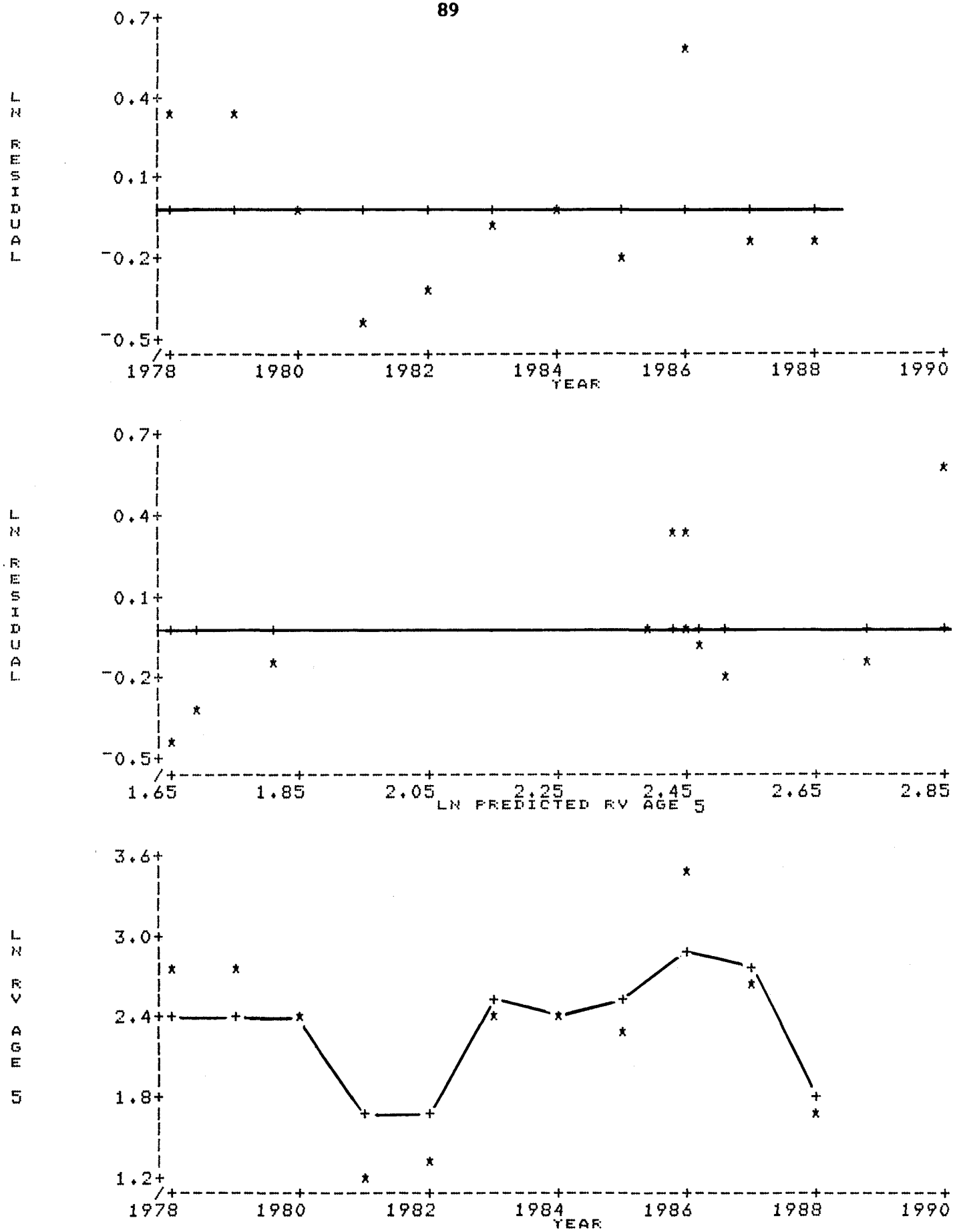


FIGURE 28. RESIDUAL PLOTS AND TIME SERIES PLOT OF THE OBSERVED (*) AND PREDICTED (+) LN ABUNDANCE INDEX FOR AGE 5 COD IN DIVISIONS 2J3KL.

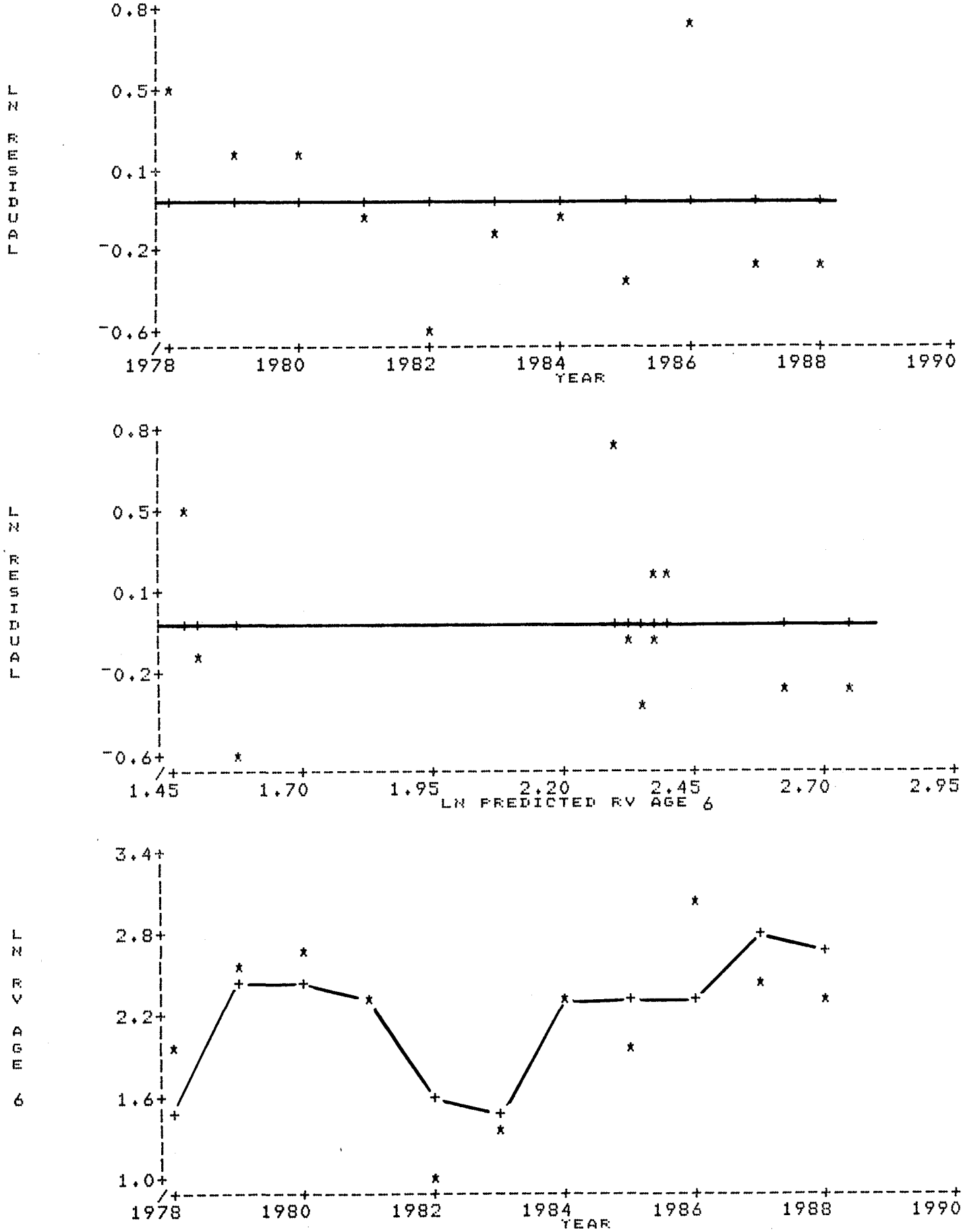


FIGURE 29. RESIDUAL PLOTS AND TIME SERIES PLOT OF THE OBSERVED (*) AND PREDICTED (+) LN ABUNDANCE INDEX FOR AGE 6 COD IN DIVISIONS 2J3KL.

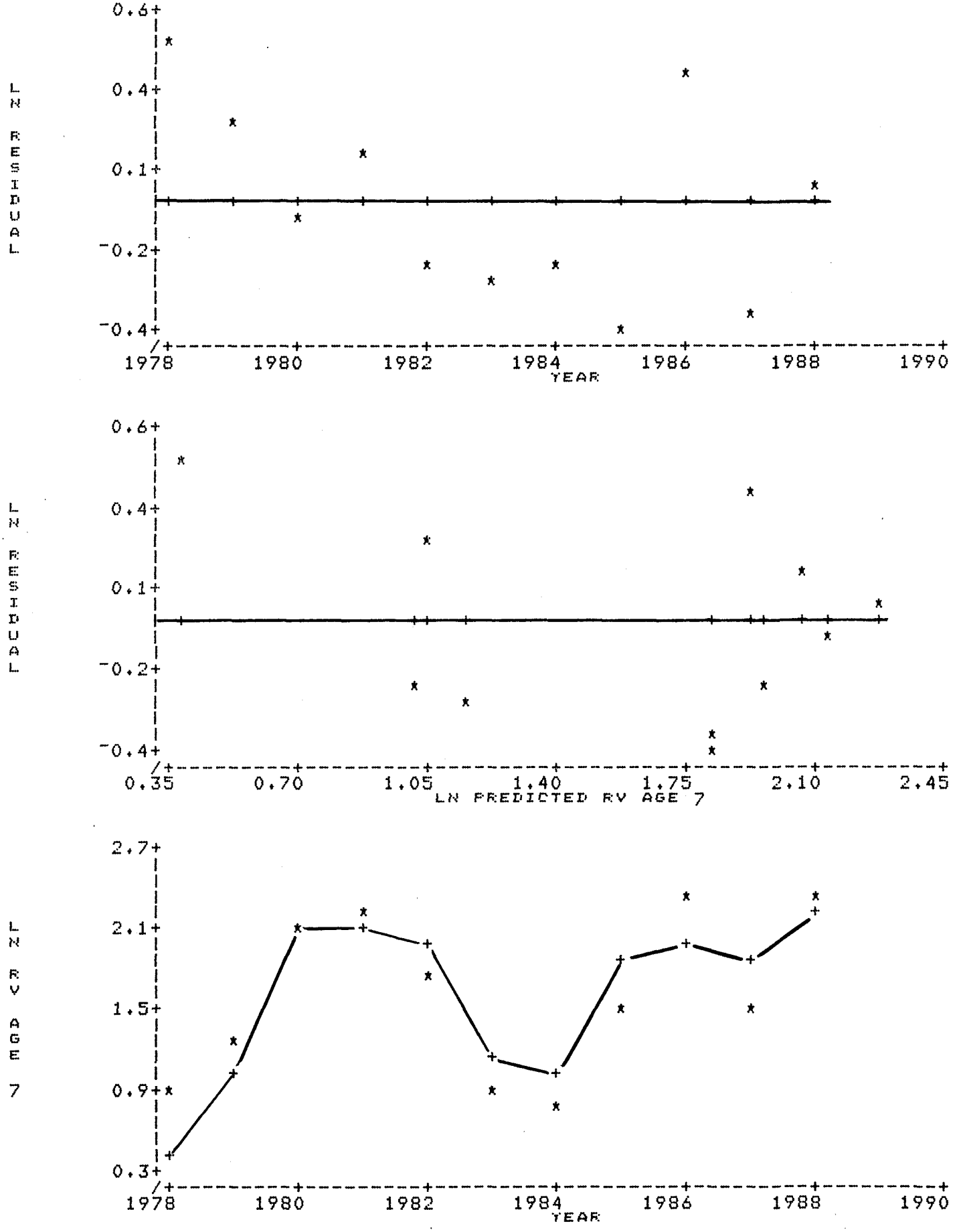


FIGURE 30. RESIDUAL PLOTS AND TIME SERIES PLOT OF THE OBSERVED (*) AND PREDICTED (+) LN ABUNDANCE INDEX FOR AGE 7 COD IN DIVISIONS 2J3KL.

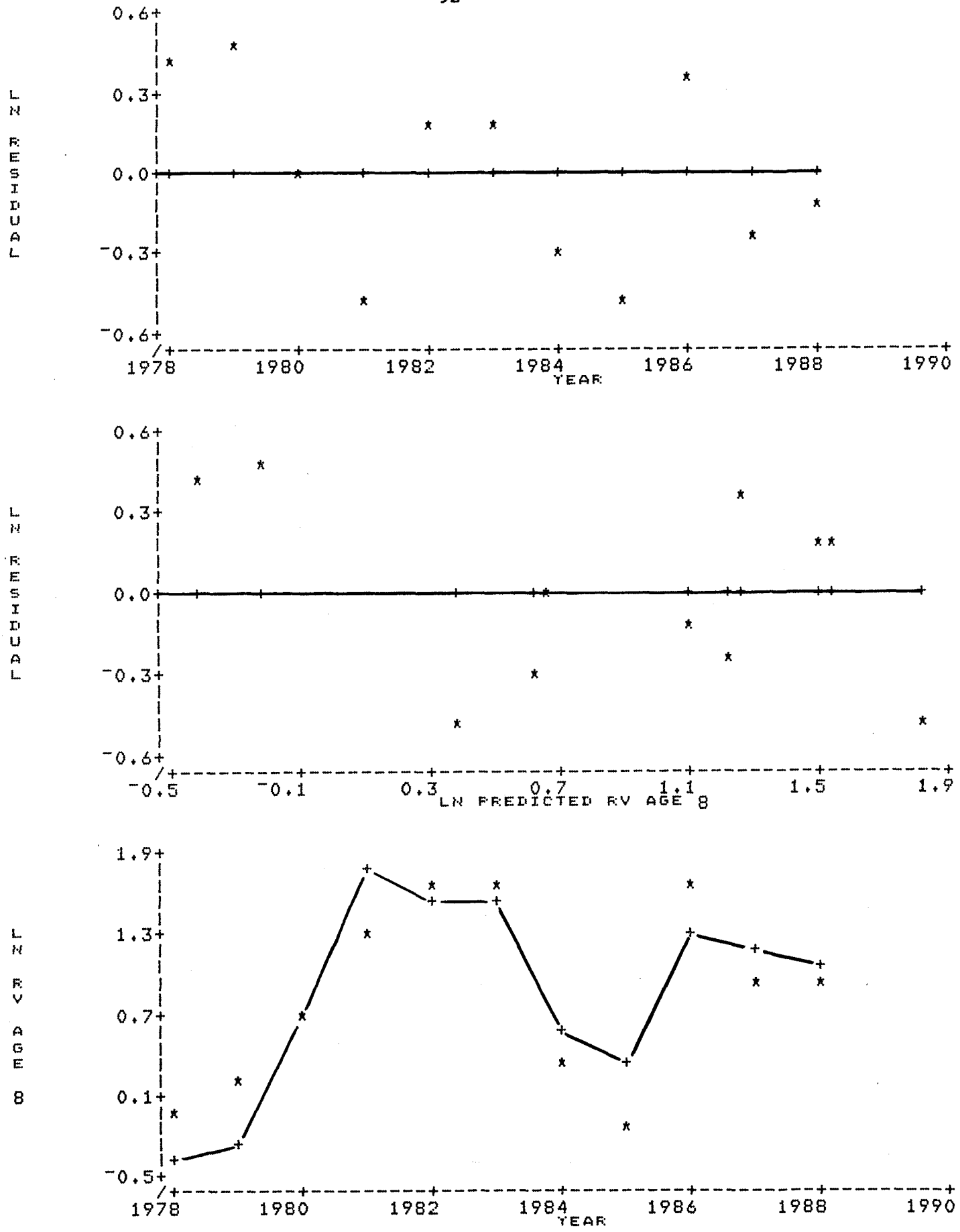
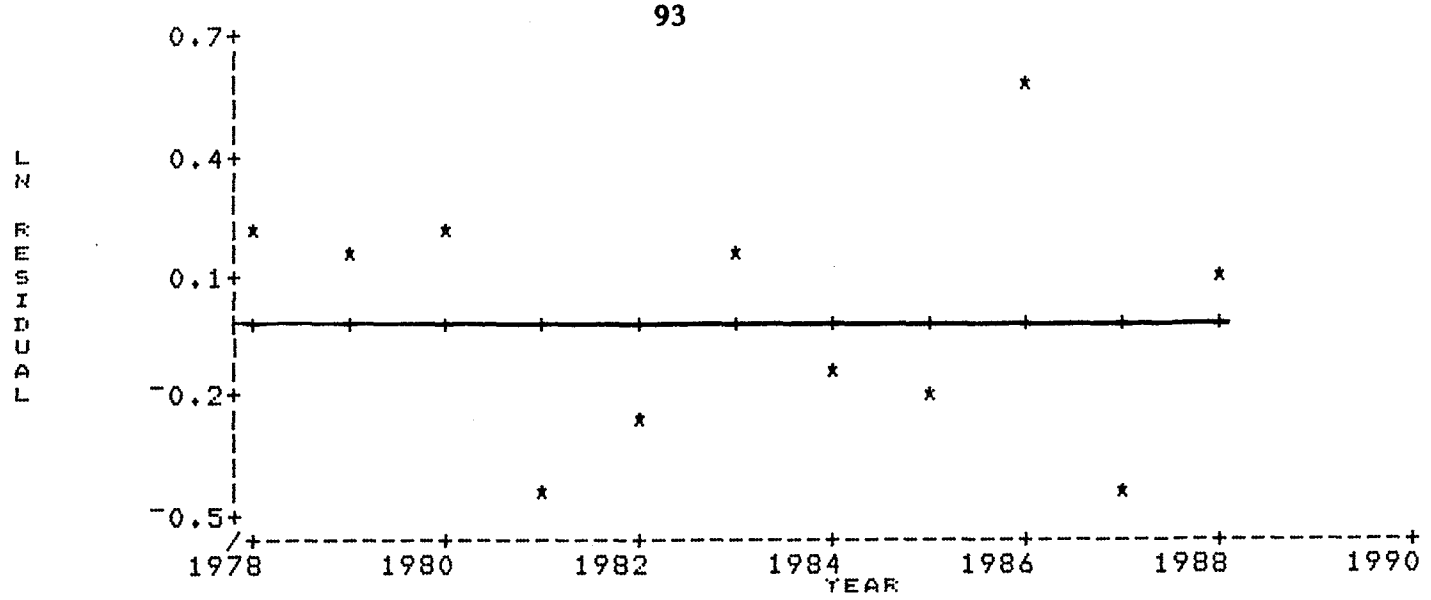
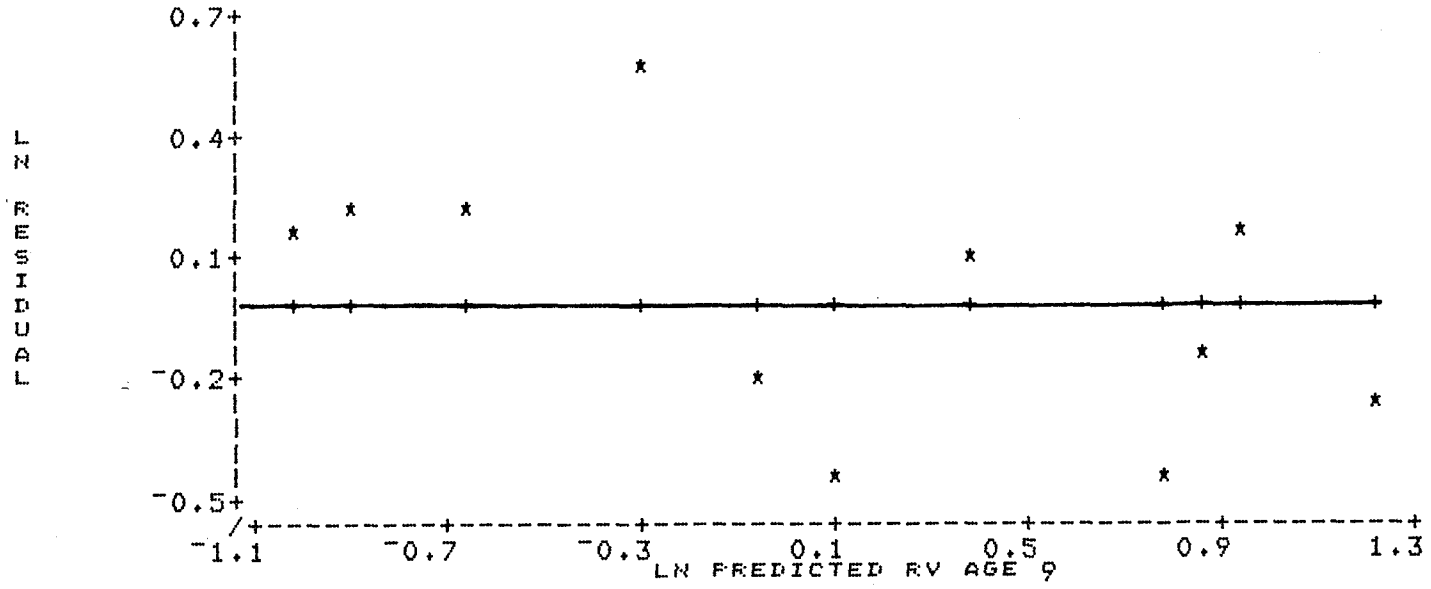


FIGURE 31. RESIDUAL PLOTS AND TIME SERIES PLOT OF THE OBSERVED (*) AND PREDICTED (+) LN ABUNDANCE INDEX FOR AGE 8 COD IN DIVISIONS 2J3KL.





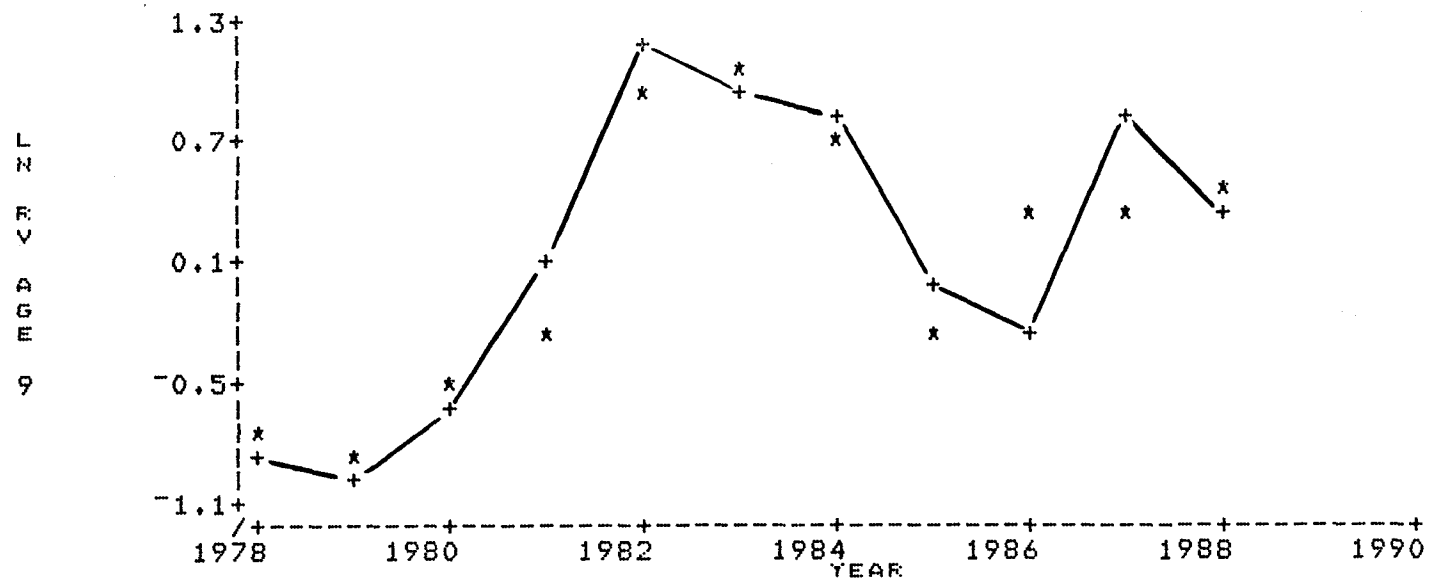


FIGURE 32. RESIDUAL PLOTS AND TIME SERIES PLOT OF THE OBSERVED (*) AND PREDICTED (+) LN ABUNDANCE INDEX FOR AGE 9 COD IN DIVISIONS 2J3KL.

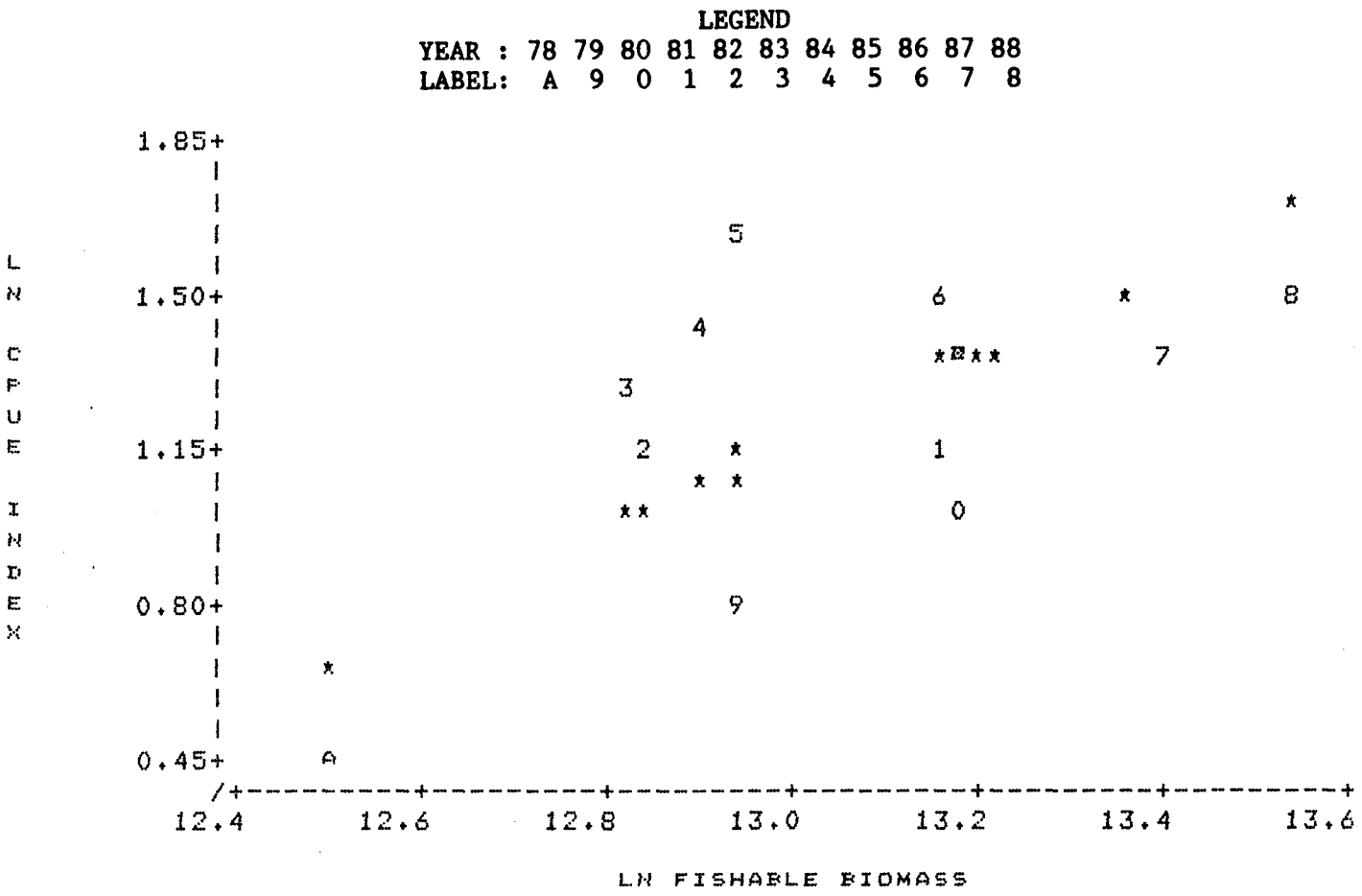


FIGURE 33. LN FISHABLE BIOMASS VERSUS LN CPUE INDEX FOR COD IN DIVISIONS 2J3KL FOR THE PERIOD 1978-88.

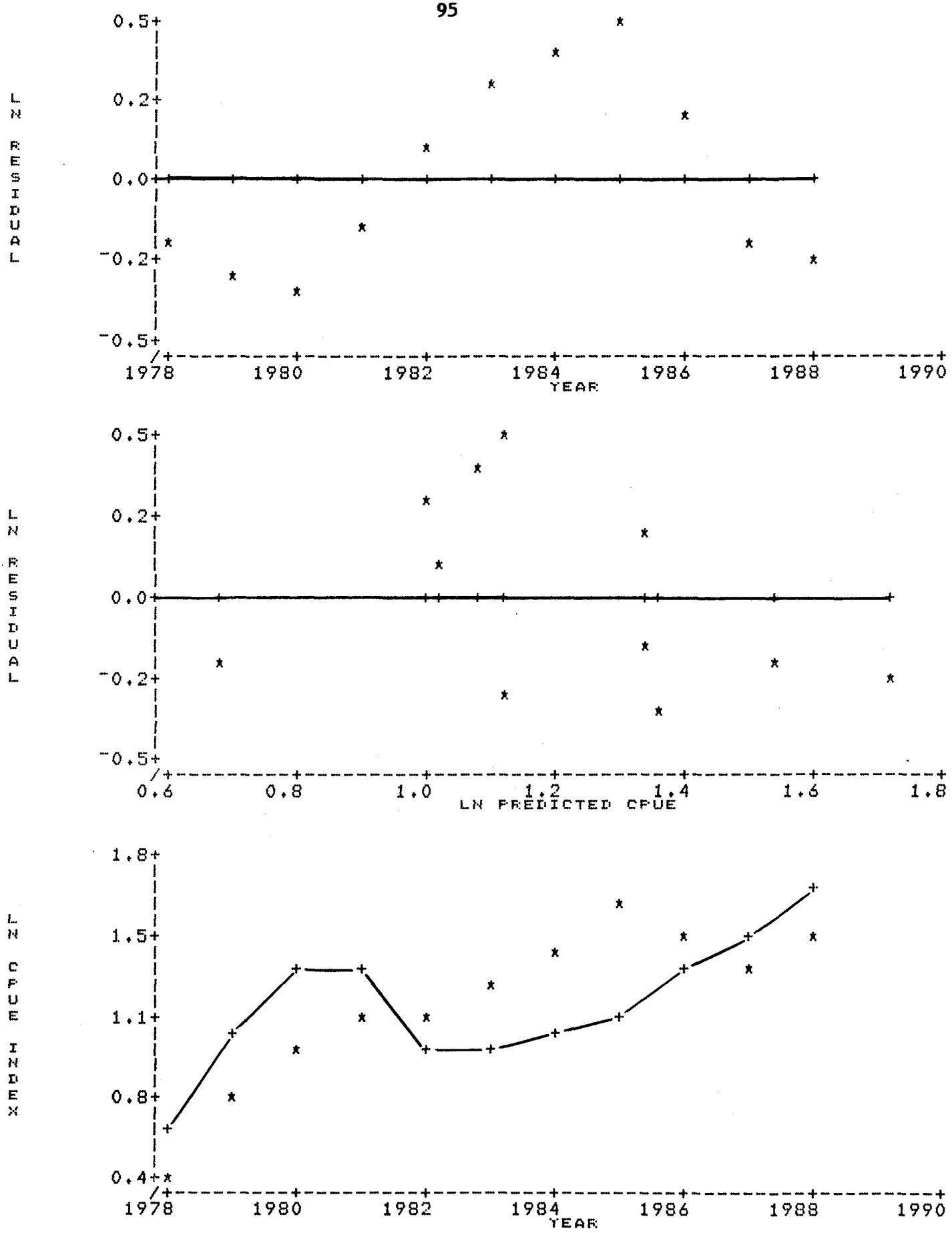


FIGURE 34. RESIDUAL PLOTS AND TIME SERIES PLOT OF THE OBSERVED (*) AND PREDICTED (+) LN CPUE INDEX FOR COD IN DIVISIONS 2J3KL.

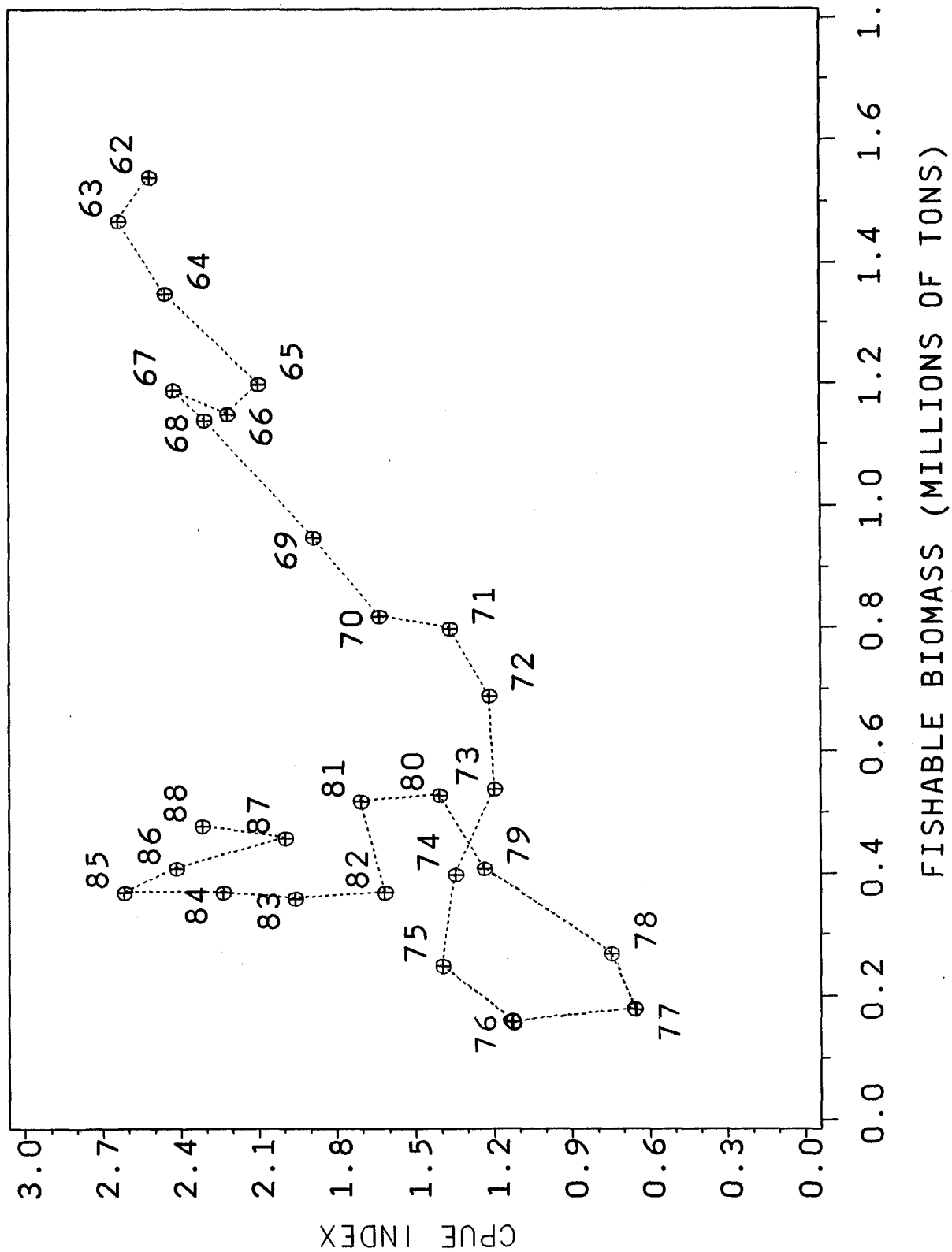


FIGURE 35 . CATCH RATE INDEX AND FISHABLE BIOMASS FOR COD IN DIV. 2J3KL FOR THE PERIOD 1962-88.

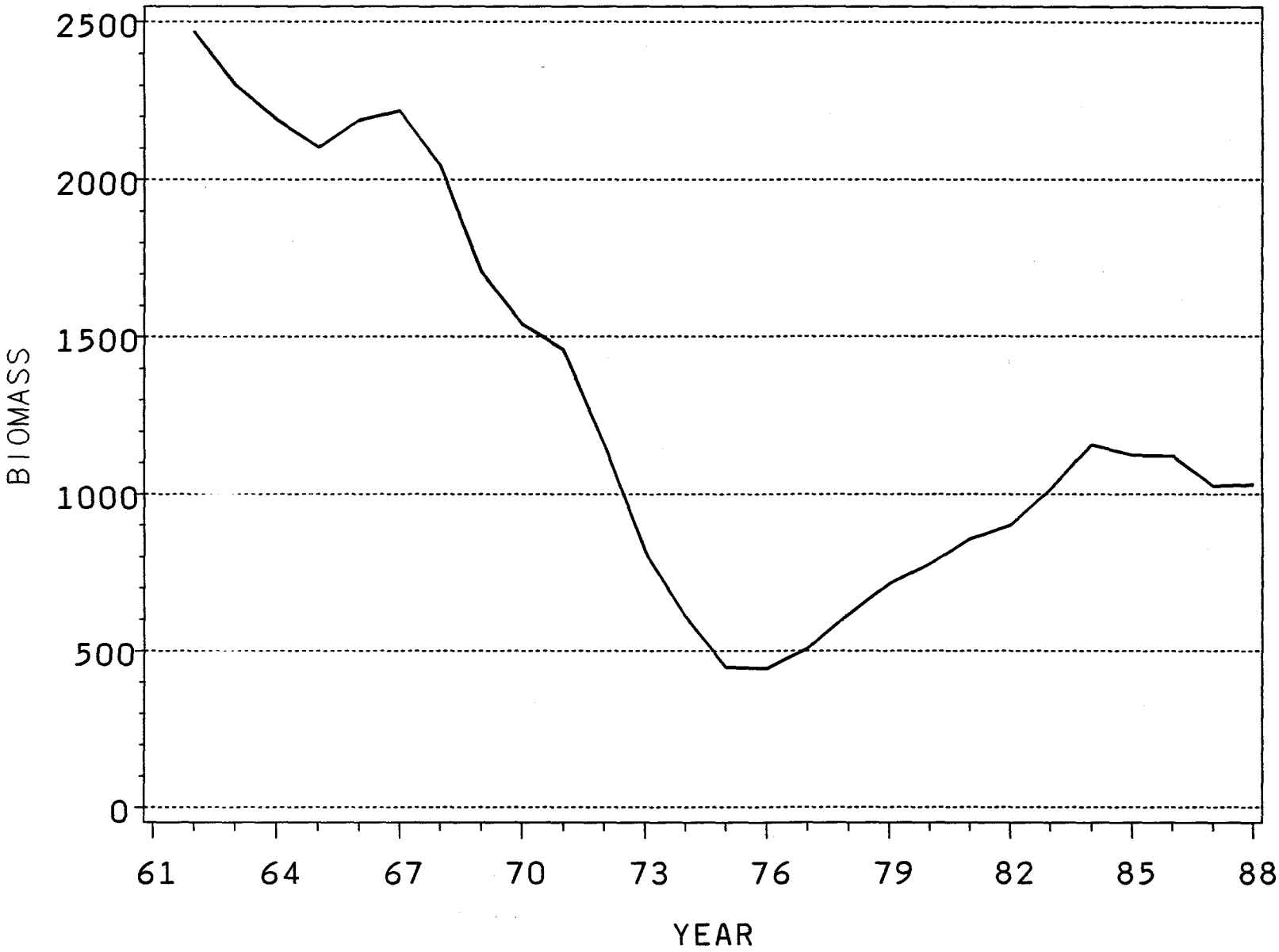


FIGURE 36. AVERAGE POPULATION BIOMASS (THOUSANDS OF TONS) FOR COD IN DIV. 2J3KL FOR THE PERIOD 1962-88 (F IN 1988 =.436).

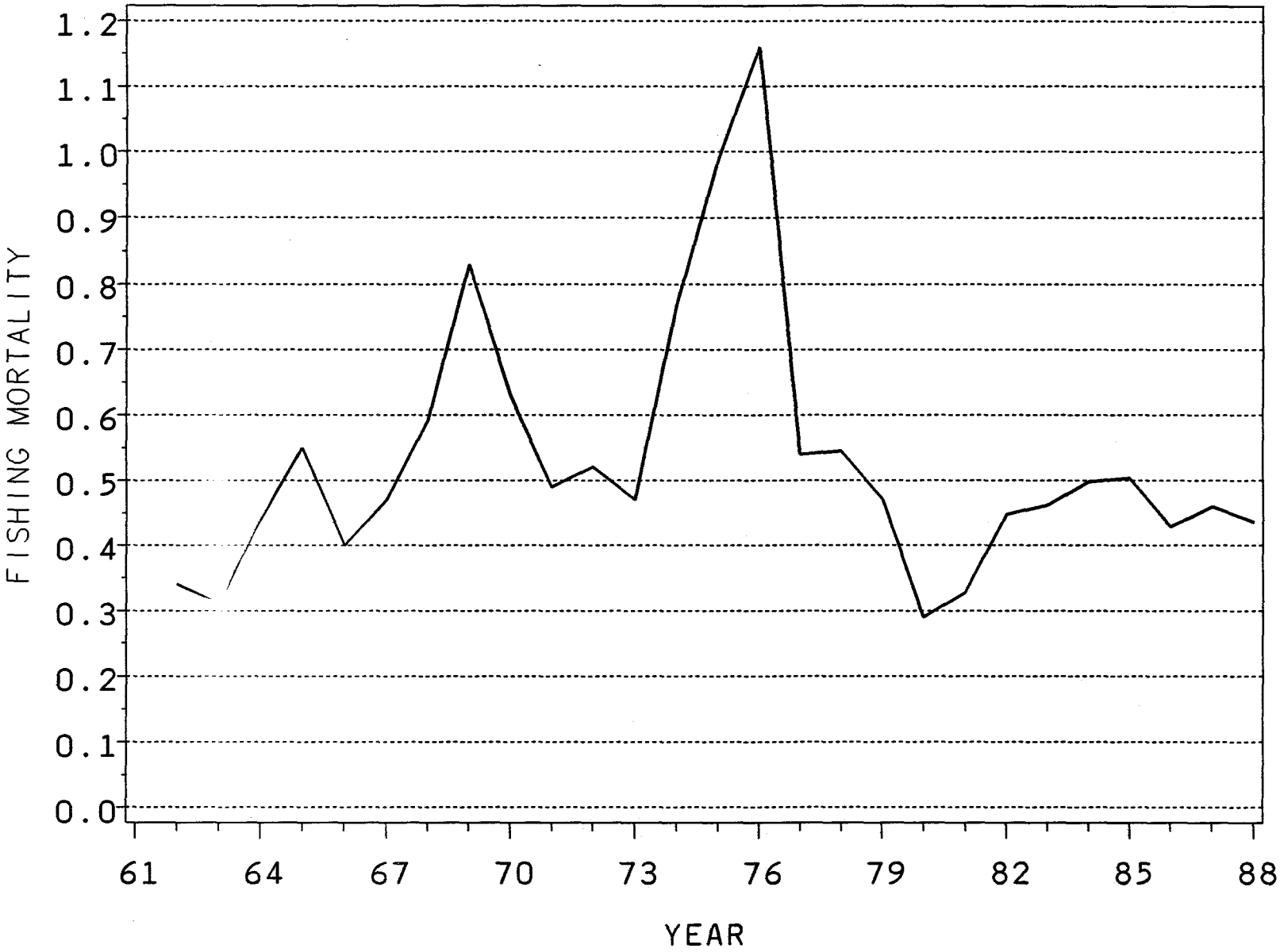


FIGURE 37. FISHING MORTALITY FOR AGES 7-11 FOR 2J3KL COD FROM A COHORT ANALYSIS WITH F IN 1988 = .436.

APPENDIX 1 — SOFTWARE FOR ADAPT

THIS SOFTWARE WAS ORIGINALLY SUPPLIED BY SCIENTIFIC STAFF FROM THE SCOTIA-FUNDY REGION AND WAS MODIFIED FOR THIS ASSESSMENT BY P. FANNING (SCOTIA-FUNDY) AND J. BAIRD.

```
     ∇INPUT[⎕]∇
[0]   INPUT;ANS
[1]   C←⎕EX 'K'
[2]   →(0=⎕NC 'STOCKΔNAME')/'''STOCK NAME?''◊STOCKΔNAME←⍞'
[3]   'CATCH MATRIX FOR ',STOCKΔNAME  ◊ C←⎕
[4]   'FIRST YEAR AND YOUNGEST AGE IN CATCH MATRIX ? ' ◊ ANS←⎕
[5]   YR←((1↑ANS)-1)+⍳¯1↑⍴C
[6]   AG←((¯1↑ANS)-1)+⍳1↑⍴C
[7]   'ENTER PARTIAL RECRUITMENT VECTOR FOR ALL AGES'   ◊ PR←⎕
[8]   PR←⎕
[9]   'ASSUMED AGES OF FULL RECRUITMENT (START WITH FIRST FULLY RECRUITED AGE) ? '  ◊ AGE←AG⍳⎕
[10]  'PRESENCE OR ABSENCE OF PLUS GROUP (P/A) ? ' ◊ NUM←'P'=⍞
[11]  'NATURAL MORTALITY ? '  ◊ M←⎕
[12]  'ENTER STARTING ESTIMATES OF AGE-SPECIFIC FS (TO BE ESTIMATED) FOR LAST YEAR '
[13]  ' EXCLUDE VALUE FOR PLUS ( IF ANY) GROUP '  ◊ FLY←⎕
[14]  'AGES IN CALIBRATION INDEX ? '  ◊ ROWS←AG⍳AGES←⎕
[15]  FRST←1↑ROWS ◊ LAST←¯1↑ROWS
[16]  'STARTING ESTIMATES OF YEAR-SPECIFIC FS FOR OLDEST'
[17]  ' NON-PLUS GROUP AGE (ENTER 0 IF NOT DESIRED)'  ◊ FAG←⎕
[18]  FVECT←FLY[¯1+FRST+⍳1+LAST-FRST],1↓0⍴FAG
[19]  CVECT←,C[(¯1+FRST+⍳1+LAST-FRST);¯1↑⍴C]
[20]  →(FAG=0)/S1
[21]  CVECT←CVECT,1↓0,C[LAST;]
[22] S1:NVECT←(CVECT×(FVECT+M))÷(FVECT×(1-*-FVECT+M))
[23]  LBND←CVECT  ◊ UBND←(⍴NVECT)⍴1000000
[24]  'RV INDEX OF ABUNDANCE - SAME YEARS AS CATCH AT AGE, SAME AGES AS CALIBRATION BLOCK'
[25]  'ENTER 0 IF NO RV INDEX'
[26]  INDEXΔTYPE← 0 0 ⍴ INDICATOR OF INDICES AVAILABLE (RV,CPUE)
[27]  IΔRV←⎕
[28]  →(0=+/+/IΔRV)/CPUE ⍝ NO RV INDEX SO GO TO CPUE INPUT
[29]  INDEXΔTYPE[1]←1
[30]  'ESTIMATES OF STANDARD ERROR OF INDEX  (ENTER 1 IF LOG MODEL)? '
[31]  ISEΔRV←⎕
[32]  'INDEX FOR WHAT MONTH ( NO, FROM 1 TO 12 ) ? ' ◊ MNTH←⎕÷12
[33]  'STARTING AGE - SPECIFIC COEFFICIENTS FOR RV INDEX'
[34]  ' MATRIX OF AGE BY AGE COEFFICIENTS (1 OR 2 COLUMNS)'
[35]  (1≠+/+/ISEΔRV)/' MODEL IS      I = [B0] + B1 X POP '
[36]  (1=+/+/ISEΔRV)/' LOG MODEL IS    LN(I) = LN( [B0] + B1 X POP ) '
[37]  K←⎕
[38]  LBND←LBND,(⍴,K)⍴(-¯1↑⍴K)↑ ¯9000 0 ⍝ MIN SLOPE =0, MIN INTER.=¯9000
[39]  UBND←UBND,(⍴,K)⍴9000 ⍝ MAX SLOPE AND INTER, = 9000
[40] CPUE:'CPUE INDEX OF ABUNDANCE - SAME YEARS AS CATCH AT AGE'
[41]  'ENTER 0 IF NO CPUE INDEX' ◊ IΔCPUE←⎕
[42]  →(0=+/+/IΔCPUE)/EXIT ⍝ NO CPUE INDEX SO GO TO EXIT
[43]  INDEXΔTYPE[2]←1
[44] L1:'ESTIMATES OF STANDARD ERROR OF CPUE?  (ENTER 1 FOR LOG MODEL) '
[45]  ISEΔCPUE←⎕
[46]  'ENTER MEAN WEIGHTS AT AGE - SAME YEARS AND AGES AS CATCH' ◊ MWT←⎕
[47]  'STARTING COEFFICIENTS FOR CPUE INDEX (AGE AGGREGATED)'
[48]  →(0=⎕NC 'K')/NORV
[49]  'ENTER ',(⍕¯1↑⍴K),' VALUE(S) FOR COEFFICIENT(S)'
[50]  K←K⍪⎕
[51]  →EXIT1
[52] NORV:
[53]  'ENTER 1 (SLOPE) OR 2 (INTERCEPT AND SLOPE) COEFFICIENTS'
[54]  K←(1,⍴,K)⍴K,⎕
[55] EXIT1:LBND←LBND,(((|1-¯1↑⍴K)↑¯9000),0
[56]  UBND←UBND,(((|1-¯1↑⍴K)↑9000),9000
[57] EXIT:INITIAL←NVECT,,K
[58]  ALPHA←1E¯3×NVECT ◊ LIMIT←100
[59]  'PENALTY CONSTRAINTS ON INITIALLY (Y/N)? DEFAULT IS OFF'
[60]  USEΔCONSTRAINTS←0
[61]  →(('Y'=ANS)∨'Y'=ANS←⎕INKEY)/'USEΔCONSTRAINTS←1'
[62]  'PENALTY FUNCTIONS TURNED ',(2 3 ⍴'OFFON ')[1+USEΔCONSTRAINTS;]
[63]  'READY TO RUN MINIPOP'
```

```
     ∇MINIPOP[□]∇
[0]   MINIPOP;BOOL;J;DIAG;G;LAMBDA;HESS;N;P;PAR;RSS;DE;CAUSE;I;V;NPHI;PHI;PNLTY;DPNLTY;SHESS;NORM;I;ΔTS;ANS
[1]  ⍝ NON-LINEAR LEAST SQUARES USING MARQUARDT ALGORITHM
[2]   TIMEFMT
[3]   'DO YOU WISH TO DOCUMENT YOUR INPUT ?'
[4]   ⍞←(('Y'=ANS)∨'Y'=ANS←□INKEY)/'MINIDOC'
[5]   PAGE ΔTS
[6]   RSSVEC←⍳0
[7]   P←⍴PAR←PAR+.INITIAL
[8]   RSS←E+.×E←OBJΔFN PAR ⍝ RESIDUAL SUM OF SQUARES
[9]   N←⍴E
[10]  PNLTY←ALPHA PNLTYΔFN PAR ⍝ PENALTY FOR CONSTRAINTS
[11]  NPHI←PHI←RSS+PNLTY
[12]  LAMBDA←0.01
[13]  BOOL←(P×P)⍴1,P⍴0 ⍝ USED TO CREATE DIAG MATRIX
[14]  CON←10
[15]  J←1
[16]  PRNT
[17]  RSSVEC←RSSVEC,RSS
[18] L3:→(LIMIT<J←J+1)/L6 ⍝MAIN LOOP
[19]  PAR←PAR
[20]  PHI←NPHI
[21]  DE←DIFFΔOBJ
[22]  G←2×E+.×DE ⍝ GRADIENT
[23]  HESS←2×(⍉DE)+.×DE ⍝ HESSIAN
[24]  DPNLTY←DIFFΔPNLTY ⍝ DIFFERENCE FOR PENALTY
[25]  G←G+DPNLTY[1;]
[26]  DIAG← 1 1 ⍉HESS←HESS+(2⍴P)⍴BOOL\DPNLTY[2;]
[27]  LAMBDA←9.9999999999999E⁻7⌈LAMBDA×0.01
[28]  I←1
[29]  SHESS←HESS+(2⍴P)⍴BOOL\DIAG×LAMBDA←LAMBDA×10 ⍝ MARQUARDT METHOD
[30]  NORM←(+⌿SHESS*2)*0.5 ⍝ COLUMN NORMS
[31]  SHESS←SHESS÷(⍴SHESS)⍴NORM ⍝ SCALE HESSIAN
[32]  PAR←PAR+V←(⌹SHESS)÷NORM ⍝ STEP DIRECTION; STEP SIZE=1
[33]  →(∼FRGHΔFN PAR)/L4
[34]  RSS←E+.×E←OBJΔFN PAR
[35]  PNLTY←ALPHA PNLTYΔFN PAR
[36]  →(PHI)NPHI←RSS+PNLTY)/L6
[37] L4:LAMBDA←LAMBDA×100
[38] L5:PAR←PAR+V←V×0.1*I ⍝INNER LOOP  REDUCE STEP SIZE
[39]  →(10<I←I+1)/L6
[40]  →(∼FRGHΔFN PAR)/L5
[41]  RSS←E+.×E←OBJΔFN PAR
[42]  PNLTY←ALPHA PNLTYΔFN PAR
[43]  →(PHI)NPHI←RSS+PNLTY)/L6
[44]  →L5
[45] L6:PRNT
[46]  RSSVEC←RSSVEC,RSS
[47]  MSR←RSS÷N-P
[48]  T1←NPHI-PHI
[49]  P1←PAR-PAR
[50]  →(1=∧/CAUSE←(10)>I),(LIMIT)>J),(1E⁻3<CON←(((N-P)×G+.×V)÷P×RSS)*0.5),(1E⁻4<|T1÷PHI),(9.9999999999999E⁻6∨.<|P1÷1E⁻20+|PAR))/L3
[51]  (∼CAUSE)/[1]EXIT
[52]  ⍞←(USEΔCONSTRAINTS)/''USEΔCONSTRAINTS←0 ⋄ ''TURNING CONSTRAINTS OFF''⋄→L3'
[53]  PAGE ΔTS
[54]  OUTPUT
[55]
```

```
     ∇ITERCOHORT[⎕]∇
[0]   ITERCOHORT;CATCH;J;MORT;FI;FC;ITER;I;Y;X;FCNEW;DIFF1
[1]   CATCH←C
[2]   J←¯1↑⍴CATCH
[3]   MORT←(⍴CATCH)⍴M
[4]   F←(⍴CATCH)⍴0
[5]   FI←FLY
[6]   →(NUM=0)/S3
[7]   FI←FI,¯1↑FI
[8]  S3:→(FAG=0)/S2
[9]   FC←FAG
[10]  →S1
[11] S2:FC←(¯1↑⍴CATCH)⍴(¯1↑FI)
[12] S1:ITER←0
[13] OK9:I←⍴FI
[14]  F[(⍳I);J]←I⍴FI
[15]  F[I;]←J⍴FC
[16]  ITER←ITER+1
[17]  →(ITER≥20)/0
[18]  POP←(⍴CATCH)⍴0
[19]  POP[(⍳I);J]←((,CATCH[(⍳I);J])×FI+(,MORT[(⍳I);J]))÷FI×1-⍟-FI+(,MORT[(⍳I);J])
[20]  POP[I;]←((,CATCH[I;])×FC+(,MORT[I;]))÷FC×1-⍟-FC+(,MORT[I;])
[21]  →(NUM=0)/SK1
[22]  I←I-1
[23]  POP[I;]←((,CATCH[I;])×FC+(,MORT[I;]))÷FC×1-⍟-FC+(,MORT[I;])
[24]  F[I;]←J⍴FC
[25] SK1:Y←J-1
[26] AA:X←MORT[⍳I-1;Y]
[27]  POP[⍳I-1;Y]←(CATCH[⍳I-1;Y]×X×X÷2)+(POP[1↓⍳I;Y+1]×X*2)
[28]  →(1≤Y←Y-1)/AA
[29]  F[⍳I-1;⍳J-1]←(⍟(¯1 ¯1 ↓POP[⍳((1↑⍴POP)-NUM);])÷ 1 1 ↓POP[⍳((1↑⍴POP)-NUM);])÷ ¯1 ¯1 ↓MORT[⍳((1↑⍴POP)-NUM);]
[30]  →(FAG≠0)/0
[31]  FCNEW←(+/[1]POP[AGE;]×F[AGE;])÷+/[1]POP[AGE;]
[32]  DIFF1←|(FCNEW-FC)÷FCNEW
[33]  FC←(¯1↓FCNEW),¯1↑FC
[34]  →((⌈/¯1↓DIFF1)>0.01)/OK9
```

```
     ∇INTERFACE[⎕]∇
[0]   INTERFACE POPN;PR;FRF;FOFF
[1]  ⍝ PRODUCES 1 OR 2 GLOBAL VARIABLES POPIND AND FBIOM
[2]   →(0=INDEXΔTYPE[1])/CPUE
[3]   POPIND←POPN×⍟-(F+M)×MNTH ⍝ ADJUSTS SPA POPULATION TO THE SURVEY MONTH
[4]   POPIND←POPIND[ROWS;] ⍝ SELECTS CALIBRATION BLOCK
[5]  CPUE:→(0=INDEXΔTYPE[2])/EXIT
[6]   PR←PRMAT  ⍝ PRMAT PREVIOUSLY DEFINED
[7]   POPNΔMID←POPN×(1-⍟-F+M)÷F+M
[8]   FBIOM←+/POPNΔMID×PR×MWT
[9]  EXIT:
```

```
     ∇OBJΔFN[⎕]∇
[0]   R←OBJΔFN A
[1]   S←(⍴NVECT)⍴A ⍝ SURVIVORS AT DESIGNATED AGE
[2]   FVECT←(⍟S÷(S-CVECT×M÷2)×⍟-M)-M
[3]   →(∧/PR=1)/NOPR ⍝ SKIPS PR IF NO PR WAS IMPOSED
[4]   FLY←PR×FRF←FVECT  ⍝ FULLY RECRUITED F FOR CPUE DATA
[5]  ⍝ THESE NEXT TWO LINES SHOULD BE USED FOR RV DATA
[6]  ⍝FRF←(+/((1↑AGE)-FRST)↓FVECT×S)÷+/((1↑AGE)-FRST)↓S ⍝ FULLY RECRUITED F
[7]  ⍝ FLY←PR×FRF
[8]  NOPR:FLY[¯1+FRST+⍳1+LAST-FRST]←FVECT
[9]   →(FAG=0)/S1
[10]  FAG←(⍬⍴⍴FAG)↑⍬⍴FVECT)
[11] S1:X←((INDEXΔTYPE[2]+⍴ROWS),(¯1↑⍴K))⍴(-(INDEXΔTYPE[2]+⍴ROWS)×¯1↑⍴K)↑A
[12] ⍝ K IS THE CURRENT CALIBRATION COEFFICIENTS
[13]  ITERCOHORT
[14]  INTERFACE POP
[15]  R←,RESI K ⍝ CALCULATE INDEX RESIDUALS
```

```
      ∇DIFF∆PNLTY[□]∇
[0]   R←DIFF∆PNLTY;I;R1;DELTA;TPAR;FPNLTY;BPNLTY
[1]   ⍝ CALCULATES FIRST AND SECOND DIFFERENCES OF PENALTY FUNCTION
[2]    I←1
[3]    R← 2 0 ⍴0
[4]    DELTA←(0.01×PAR)+0.01×PAR=0
[5]   L1:TPAR←((I-1)↑PAR),(PAR[I]+DELTA[I]),I↓PAR
[6]    R1←(PNLTY-FPNLTY←ALPHA PNLTY∆FN TPAR)÷DELTA[I]
[7]    TPAR←((I-1)↑PAR),(PAR[I]-DELTA[I]),I↓PAR
[8]    BPNLTY←ALPHA PNLTY∆FN TPAR
[9]    R←R,,R1,(FPNLTY+BPNLTY-2×PNLTY)÷DELTA[I]
[10]   →L1×⍳I←I+1

      ∇FRGN∆FN[□]∇
[0]   R←FRGN∆FN A
[1]   R←∧/(A)≥LBND),A≤UBND
[2]   ⍝ THIS FUNCTION SHOULD RETURN A 1 IF THE PARAMETERS
[3]   ⍝ ARE IN THE FEASIBLE REGION AND 0 OTHERWISE
[4]   ⍝ R←1 DEFAULT RETURNS 1

      ∇PNLTY∆FN[□]∇
[0]   R←ALPHA PNLTY∆FN A
[1]   R←USE∆CONSTRAINTS×+/ALPHA÷(⍴NVECT)↑A
[2]   ⍝ STATE VARIABLE 'USE∆CONSTRAINTS' CONTROLS PENALTY FUNCTION
[3]   ⍝ 1 → CONSTRAINTS ON; 0 → CONSTRAINTS OFF

      ∇RESI[□]∇
[0]   R←RESI K
[1]   R←⍳0
[2]   →(0=INDEX∆TYPE[1])/CPUE ⍝ NO RV SURVEY
[3]   R←R,,POPIND RESI∆RV((-INDEX∆TYPE[2]),0)↓K
[4]   →(0=INDEX∆TYPE[2])/RES ⍝ NO CATCH RATE SERIES
[5]   CPUE:K←(⊖K)[1;] ⍝ GET BOTTOM ROW OF K
[6]    R←R,,FBIOM RESI∆CPUE K
[7]   RES:


      ∇RESI∆RV[□]∇
[0]   R←POPIND RESI∆RV K
[1]   →(1=¯1↑⍴K)/NOINT
[2]   K← 3 2 1 ⍉(⍳2,⍴POPIND)⍴,K
[3]   IHAT∆RV←(K[1;;]+K[2;;]×POPIND) ⍝ WITH INTERCEPT
[4]   →RES
[5]   NOINT:K←⍉(⍳⍴POPIND)⍴,K
[6]    IHAT∆RV←K×POPIND ⍝ WITHOUT INTERCEPT
[7]   RES:→(1=⍴,ISE∆RV)/LOG
[8]    R←(I∆RV-IHAT∆RV)÷ISE∆RV
[9]    →0
[10]  LOG:R←(⍟I∆RV)-⍟IHAT∆RV


      ∇RESI∆CPUE[□]∇
[0]   R←FBIOM RESI∆CPUE K
[1]   →(1=⍴,K)/NOINT
[2]   IHAT∆CPUE←(K[1]+K[2]×FBIOM) ⍝ WITH INTERCEPT
[3]   →RES
[4]   NOINT:IHAT∆CPUE←K×FBIOM ⍝ WITHOUT INTERCEPT
[5]   RES:→(1=⍴,ISE∆CPUE)/LOG
[6]    R←(I∆CPUE-IHAT∆CPUE)÷ISE∆CPUE
[7]    →0
[8]   LOG:R←(⍟I∆CPUE)-⍟IHAT∆CPUE
```