Northwest Atlantic Fisheries Organization

Serial No. N2239

NAFO SCR Doc. 93/56
(Corrigendum)

SCIENTIFIC COUNCIL MEETING - JUNE 1993

Spatial and Temporal Variability in Condition Factors of 2J3KL Cod

by

C. A. Bishop and J. W. Baird

The following changes (underlined) are to be made:

Fig. 1. Annual mean condition factor (Kf) by age and year for cod in Division 3K.

SHOULD READ

Fig. 1. Annual mean condition factor (Kf) by age and year for cod in Division 2J.

Fig. 2. Annual mean condition factor (Kf) by age and year for cod in Division 2J.

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Spacial and Temporal Variability in Condition Factors of 2J3KL Cod.

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Introduction

Assessment results have indicated that the Division 2J3KL cod stock may have declined abruptly in recent years and that no single factor could be identified as the main cause. Research surveys suggest that declines in biomass and abundance have been more pronounced in the northern part of the stock area, particularly in Div.2J. Information is presented in this paper relative to annual condition factors for cod from Divisions 2J3KL along with their relationship with temperature and capelin abundance.

Data and Methods

Condition factors to be described are defined as follows: Kf = Gutted weight(grams)/length^3 and Kl =liver weight/length^3. Gutted weights were used to avoid variation resulting from different feeding intensities. Observations on these lengths and weights cover the period 1947 to 1992 although coverage was incomplete during the early period. Most observations were made during the fall in the 1977-92 period and the analyses presented in this paper will include data mainly from the 4th quarter of these years. In the early part of this period observations on livers were volumetric while in subsequent years weights were obtained. A regression analysis of liver weights and volumes indicated a close correspondence (Wt. liver = 1.000770*vol.liver). For the analyses weight values were used, if present, or were calculated from the regression equation.

Condition factors (Kf and Kl) are presented by NAFO Division, year and by age for ages 3 to 11. The relationship of Kf and Kl to temperature and/or Div.2J+3K capelin biomass were also determined from linear regressions. The temperature data used were the the fourth quarter temperature anomalies from Station 27 at a depth of 175m. Capelin biomass estimates were obtained from Miller,1992. The fall 1992 estimate was provided by D.Miller.

Mean condition factors by month were obtained for the 2J3KL database and analysed for seasonal variability.

Results

The relationship of gutted weight to length^3 was examined using all length-weight data and was found to be consistent with an assumed linear relationship.

Mean condition factors (Kf and Kl) at age for Div. 2J,3K and 3L for the fall surveys over the period 1977-92 are shown in Figs. 1-6. Kf estimates for Div.2J and 3K (Figs.1-3) have shown a declining trend in recent years commencing in 1989 for most ages. Values observed in Div.3L did not indicate a trend although most ages showed an increase from 1991 to 92.

Div.2J cod Kl estimates have similarly declined since 1989 (Figs.4-6) with those for ages 6-8 being substantial from 1990 to 1991. A persistent decline was not evident for Div.3K. Those for ages 5 and older generally increased in 1992.

In Div. 2J current levels for both condition factors are the lowest in the time series. This is not the case for most ages in Div. 3K.

Kl values for Div.3L have shown an increasing trend since 1987 for ages 3-8 and since 1988 for ages 9-11. The pattern in Div. 3L is generally opposed to those in 2J and 3K.

Condition factor data at age were analysed to determine possible changes with year class for the 1972-90 y/c's. Data (Kf) for Division 2J only are presented in Figures 7-10. Y/c's from 1972-81 did not indicate major trends other than a slight increase with age (Fig.7-8). The data would suggest that the declines observed (Fig.9-10) are year rather than y/c effects.

Regression analyses were conducted comparing mean annual Divisional condition factors by age with Station 27 temperature data and/or capelin biomass (Fig.11-12). The model with capelin biomass and Kf indicated significant relationships for ages 2-8 in Div.2J, ages 3-9 in 3K, but only for age 4 in 3L (Table 1). Relationships were not as good using temperature as the independent variable, with the exception of an increase in the number of significant relationships in Div. 3L. Inclusion of both temperature and capelin biomass in the model did not improve the relationships.

Similar analyses using Kl produced very few significant relationships at age.

Monthly Kf values for Div. 3L were examined for seasonal trends and for annual changes. Data was not available for all months in each year and for most years only a few months were represented. In general it appeared that Kf's were lowest in the 2nd quarter and highest at the beginning and end of the year.

Discussion

The condition factors presented suggest that there are different trends by Division. There has been a decline in recent years in Divs. 2J and 3K but the effect was more pronounced in Div.2J. Div.3L has shown an increasing trend in Kl values. Some of the decline in Kf in Div. 2J may be related to capelin biomass, which is a main food species for cod. Studies on the North-east arctic cod stock (Jorgensen, 1992) suggested that reduced growth and condition factor(Kf) in the late 1980's was a direct result of a sharp decline in the capelin stock.

References

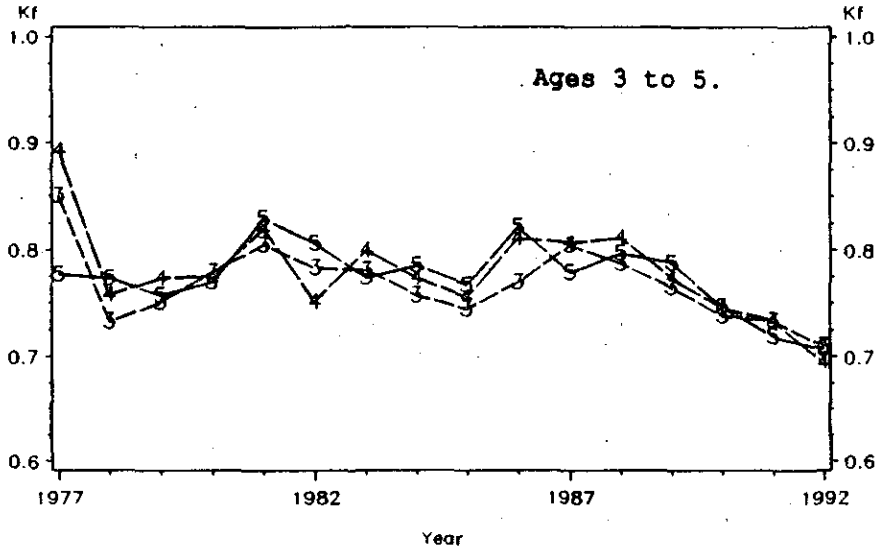
Jorgensen,Terje. 1992. Long-term changes in growth of North-east Arctic cod (Gadus Morhua) and some environmental influences. ICES J.mar.Sci.,49:262-277.

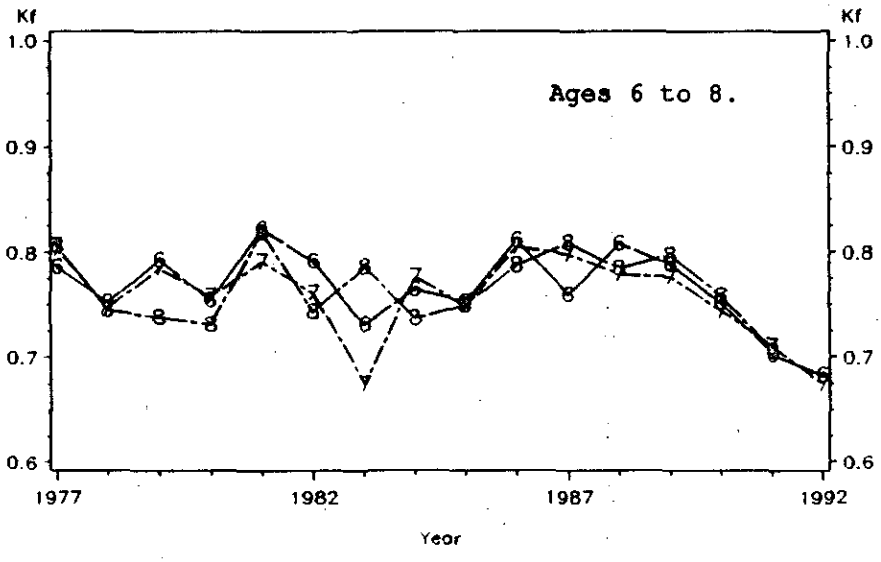
Miller, D.S 1992. Observations and Studies on SA2+3K Capelin in 1991. CAFSAC Res.Doc. 92/15.

Table 1. Results of regression analyses of mean annual condition factor (Kf) at age with Div. 2J3K capelin biomass. (Model: mean Kf=B0 +B1xcapelin biomass + e).

DIV	AGE	DF	B0	B1	PVALUE	R2
DIV=2J	AGE=1	7	0.67390	-0.00087	0.9657	0.0003
DIV=2J	AGE=2	10	0.71134	0.01698	0.0240	0.4495
DIV=2J	AGE=3	10	0.73333	0.02238	0.0193	0.4730
DIV=2J	AGE=4	10	0.73795	0.02524	0.0423	0.3831
DIV=2J	AGE=5	10	0.73121	0.04404	0.0074	0.5680
DIV=2J	AGE=6	10	0.72912	0.03700	0.0112	0.5286
DIV=2J	AGE=7	10	0.73625	0.02370	0.0353	0.4048
DIV=2J	AGE=8	9	0.75173	0.02266	0.0348	0.4459
DIV=2J	AGE=9	9	0.76112	0.01774	0.1853	0.2079
DIV=2J	AGE=10	9	0.75958	0.03163	0.0703	0.3526
DIV=2J	AGE=11	9	0.81517	0.00031	0.9870	0.0000
DIV=2J	AGE=12	9	0.80916	0.00078	0.9625	0.0003
DIV=2J	AGE=13	9	0.84196	0.01640	0.5112	0.0558
DIV=2J	AGE=14	4	0.79617	0.03320	0.4662	0.1877
DIV=2J	AGE=15	4	0.85618	0.01566	0.6543	0.0756
DIV=2J	AGE=16	3	0.76548	0.09897	0.3049	0.4831
DIV=2J	AGE=17	3	0.94111	-0.07145	0.2100	0.6241
DIV=2J	AGE=18	1	0.39941	0.32504	.	1.0000
DIV=3K	AGE=0	1	1.48363	-0.25965	.	1.0000
DIV=3K	AGE=1	8	0.72809	-0.01718	0.6798	0.0258
DIV=3K	AGE=2	10	0.72637	-0.00575	0.4913	0.0541
DIV=3K	AGE=3	10	0.71129	0.02630	0.0041	0.6184
DIV=3K	AGE=4	10	0.72977	0.01814	0.0409	0.3872
DIV=3K	AGE=5	10	0.73014	0.02378	0.0077	0.5646
DIV=3K	AGE=6	10	0.74026	0.02775	0.0007	0.7408
DIV=3K	AGE=7	10	0.74465	0.01588	0.0731	0.3137
DIV=3K	AGE=8	9	0.75456	0.01519	0.0432	0.4187
DIV=3K	AGE=9	10	0.76501	0.02013	0.0575	0.3447
DIV=3K	AGE=10	9	0.77546	0.01591	0.1643	0.2266
DIV=3K	AGE=11	9	0.81674	-0.00084	0.9525	0.0005
DIV=3K	AGE=12	9	0.79982	0.01928	0.1610	0.2297
DIV=3K	AGE=13	8	0.82190	-0.00016	0.9931	0.0000
DIV=3K	AGE=14	8	0.84997	0.00489	0.8127	0.0086
DIV=3K	AGE=15	8	0.85594	-0.07153	0.0946	0.3479
DIV=3K	AGE=16	7	0.82085	0.02393	0.3823	0.1290
DIV=3K	AGE=17	3	0.78545	0.14534	0.1254	0.7649
DIV=3K	AGE=18	2	0.82477	0.03752	0.6914	0.2172
DIV=3K	AGE=19	1	0.95452	-0.10305	.	1.0000
DIV=3K	AGE=20	1	1.00859	-0.21718	.	1.0000
DIV=3L	AGE=1	5	0.63739	0.00132	0.7225	0.0350
DIV=3L	AGE=2	10	0.72448	-0.00293	0.4576	0.0627
DIV=3L	AGE=3	10	0.75837	-0.00309	0.2007	0.1748
DIV=3L	AGE=4	10	0.76587	-0.00523	0.0296	0.4253
DIV=3L	AGE=5	10	0.77453	-0.00285	0.1444	0.2211
DIV=3L	AGE=6	10	0.77302	-0.00421	0.2236	0.1595
DIV=3L	AGE=7	10	0.77594	-0.00159	0.5398	0.0432
DIV=3L	AGE=8	10	0.75759	0.00332	0.1010	0.2705
DIV=3L	AGE=9	10	0.77352	0.00184	0.5035	0.0512
DIV=3L	AGE=10	10	0.76308	0.00614	0.0279	0.4324
DIV=3L	AGE=11	10	0.812388	-0.00299	0.3648	0.0919
DIV=3L	AGE=12	9	0.801500	0.00434	0.3551	0.1075
DIV=3L	AGE=13	9	0.839550	-0.00284	0.5109	0.0559
DIV=3L	AGE=14	6	0.845248	-0.00216	0.7489	0.0224
DIV=3L	AGE=15	6	0.773501	0.00743	0.2860	0.2219
DIV=3L	AGE=16	6	0.779060	0.01883	0.0498	0.5700
DIV=3L	AGE=17	4	0.878129	-0.03706	0.0994	0.6499
DIV=3L	AGE=18	1	0.802294	0.02104	.	1.0000
DIV=3L	AGE=20	1	0.972780	-0.56030	.	1.0000

Figure 1. Annual mean condition factor (Kf) by age and year for cod in Division 3K.





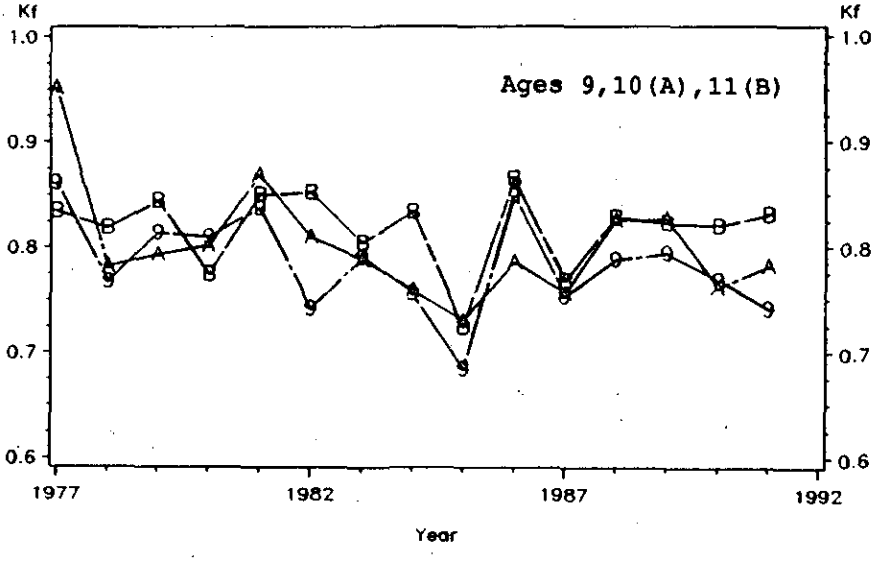
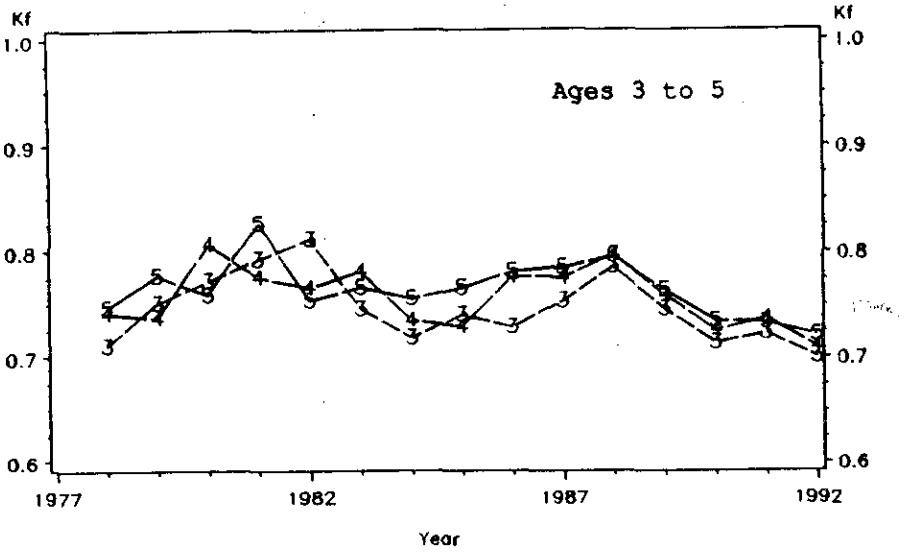
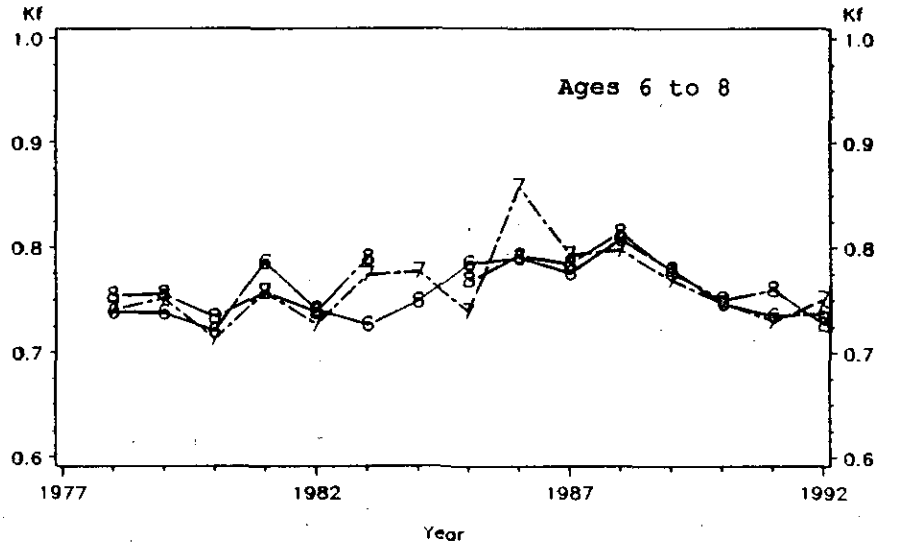


Figure 2. Annual mean condition factor (Kf) by age and year for cod in Division 2J.





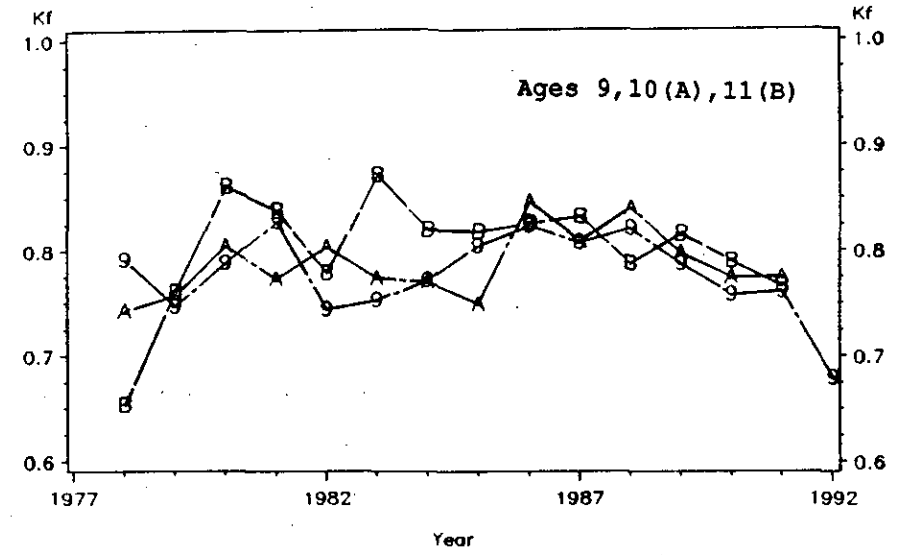
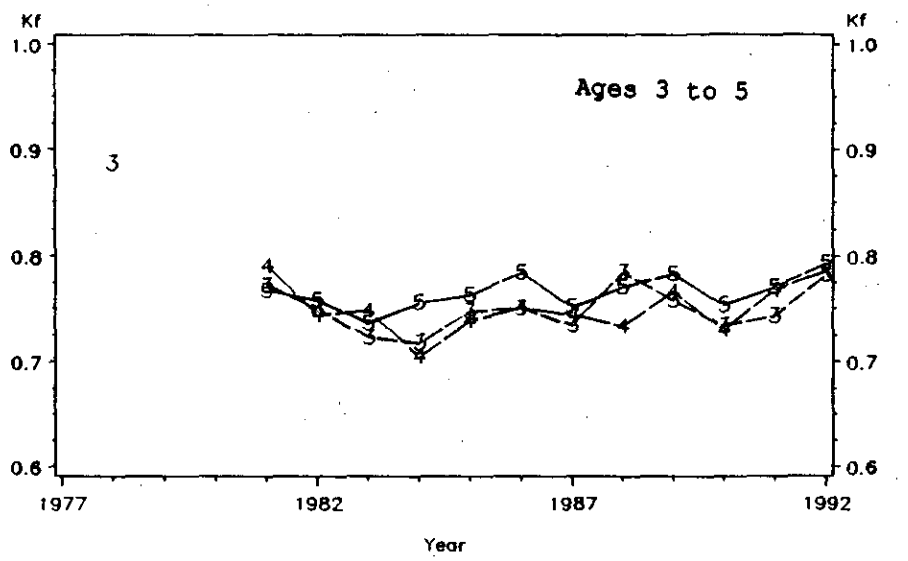
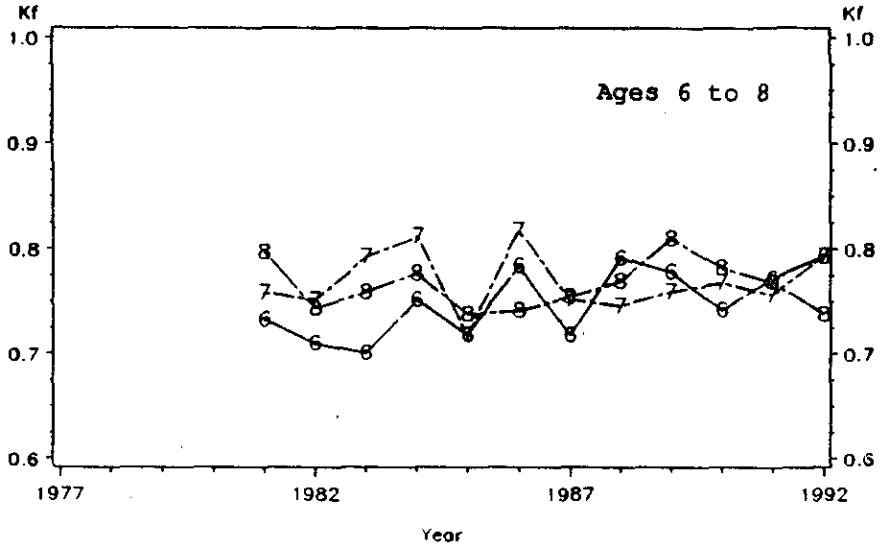


Figure 3. Annual mean condition factor (Kf) by age and year for cod in Division 3L.





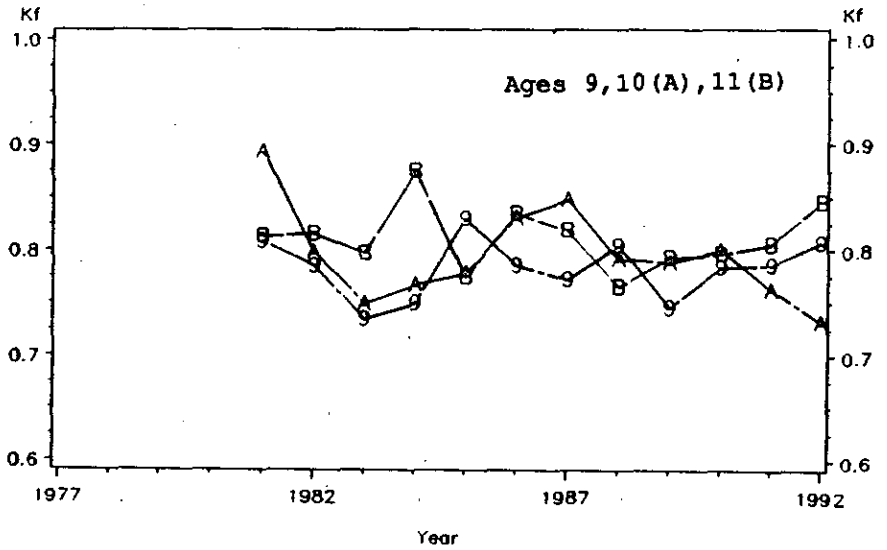
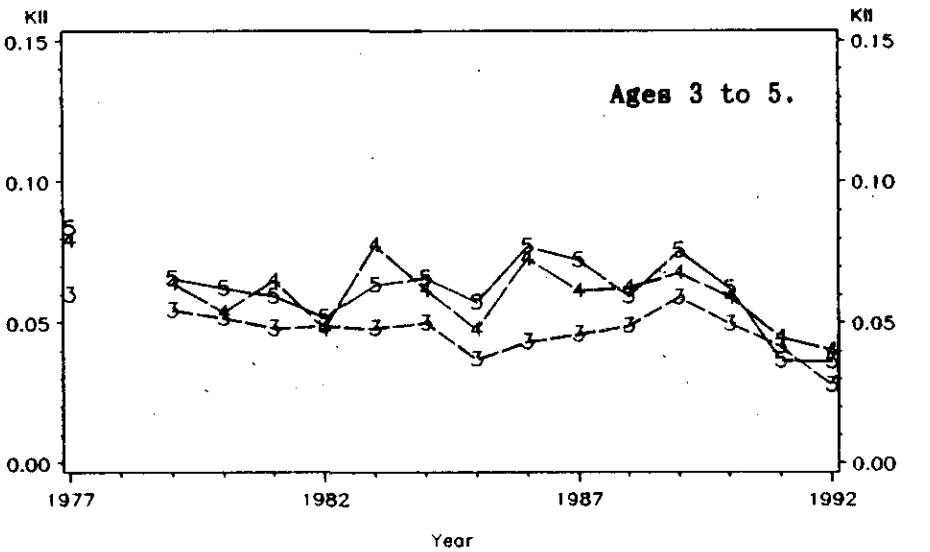
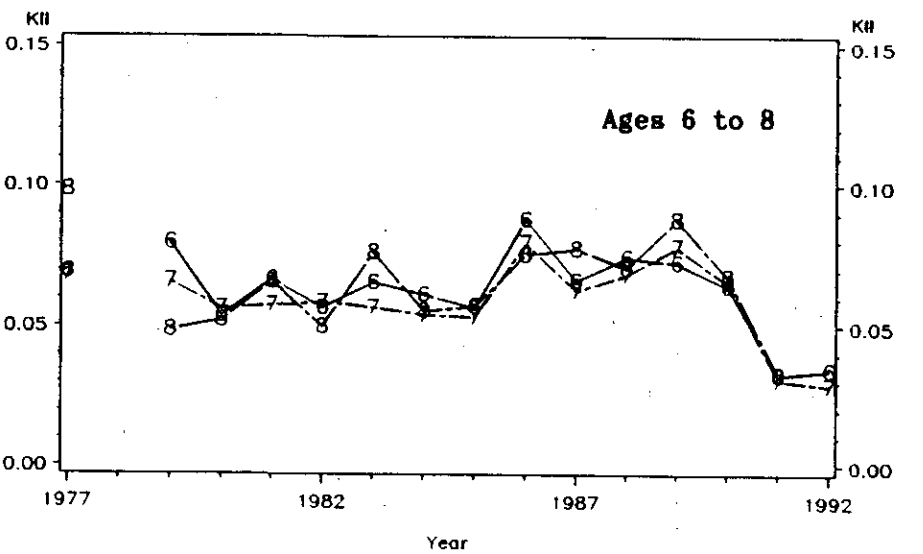


Figure 4. Annual mean liver condition factor (K1) by age and year for cod in Division 2J.





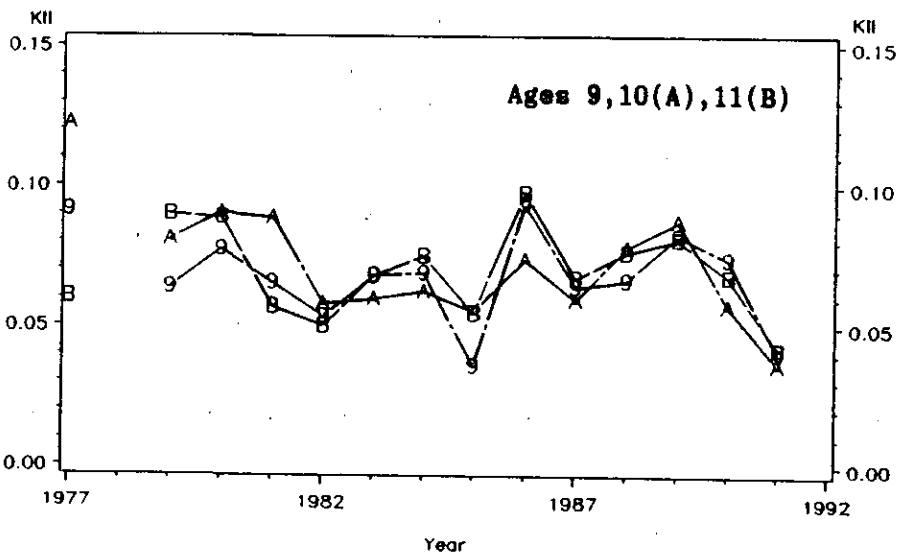
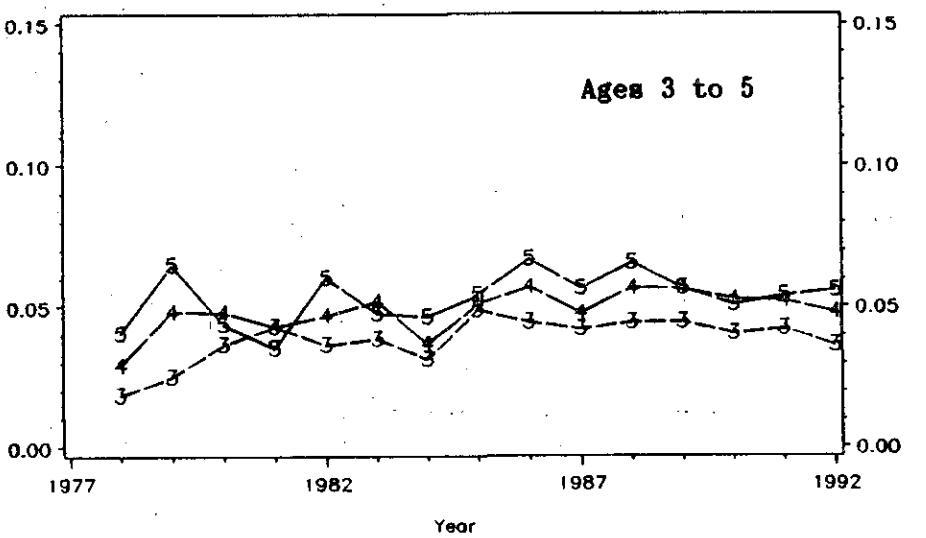
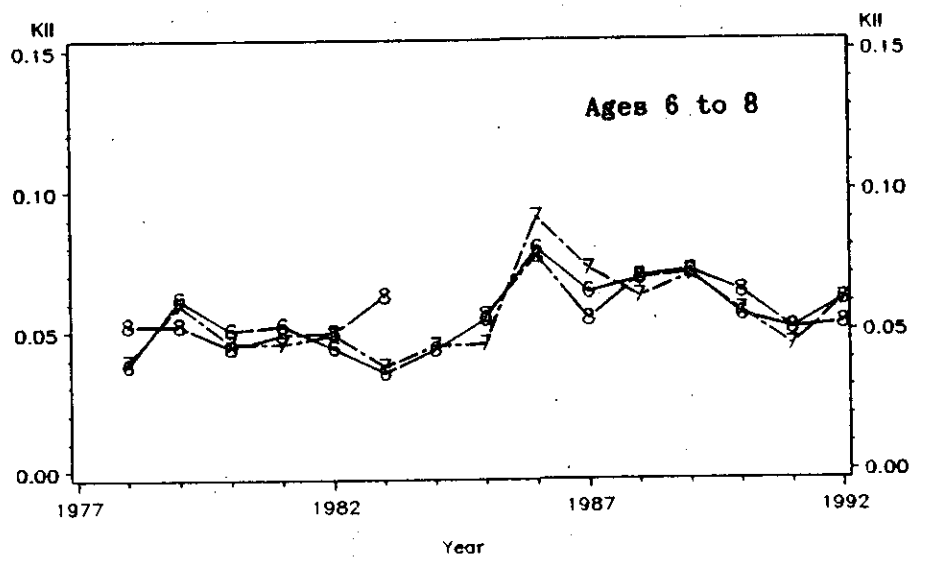


Figure 5. Annual mean liver condition factor (Kl) by age and year for cod in Division 3K.





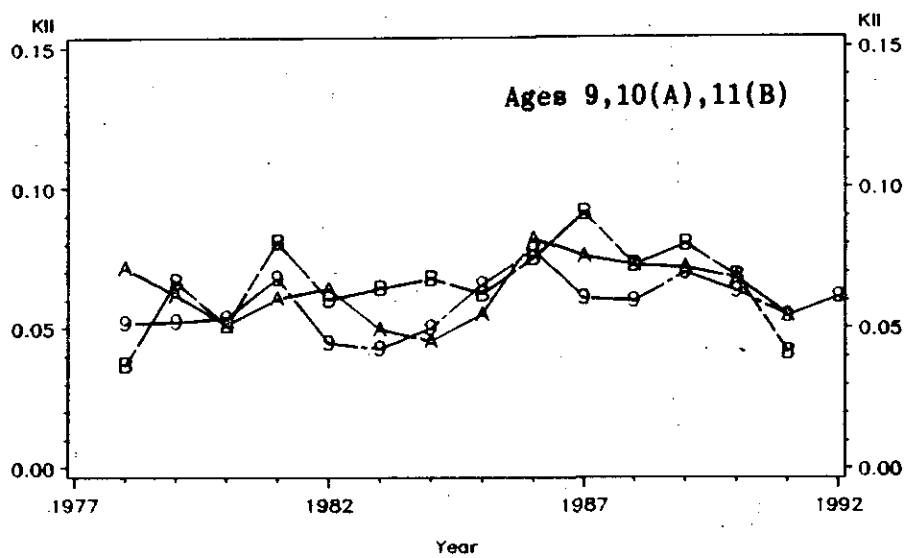
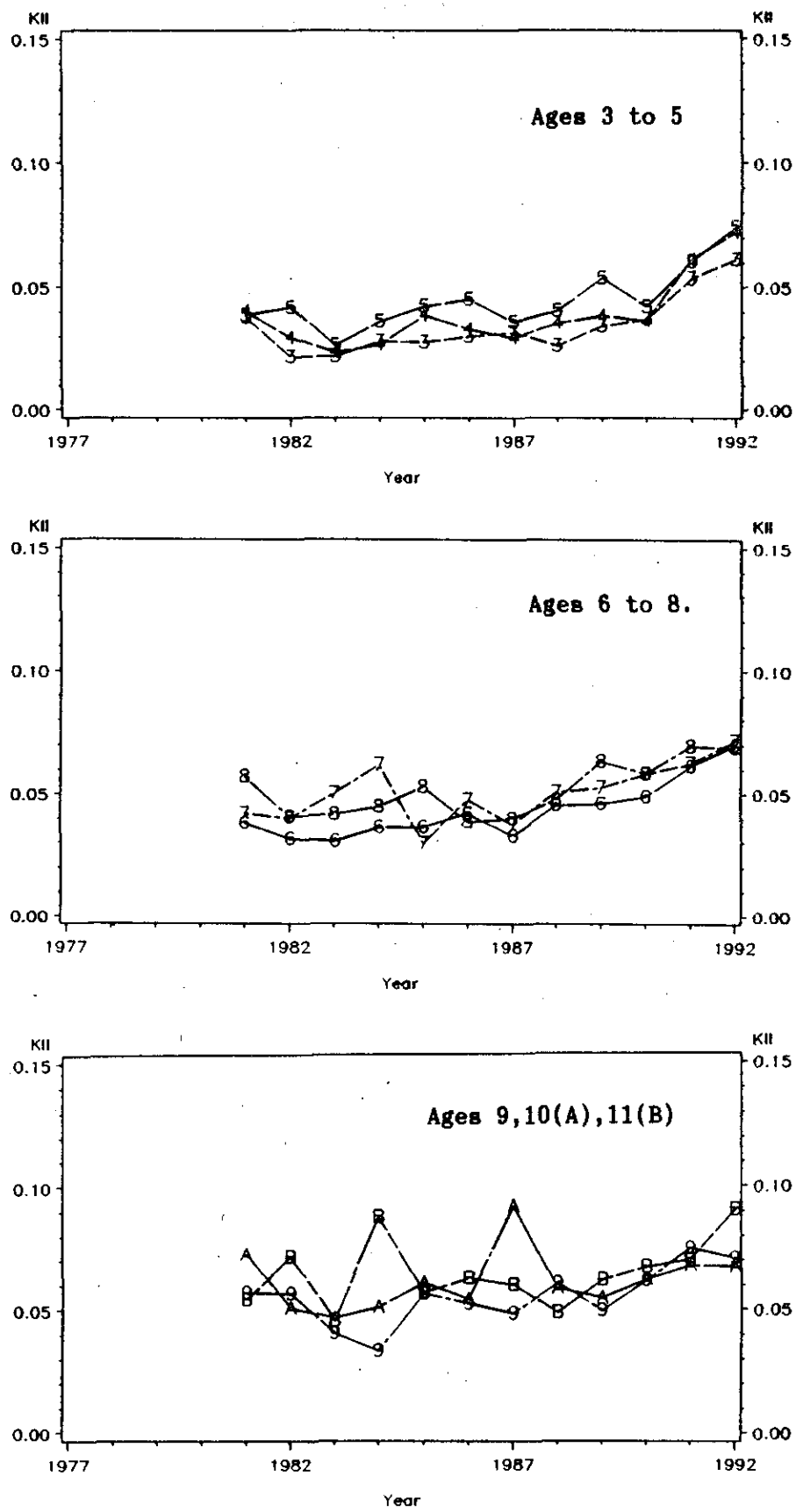


Figure 6. Annual mean liver condition factor (K1) by age and year for cod in Division 3L.



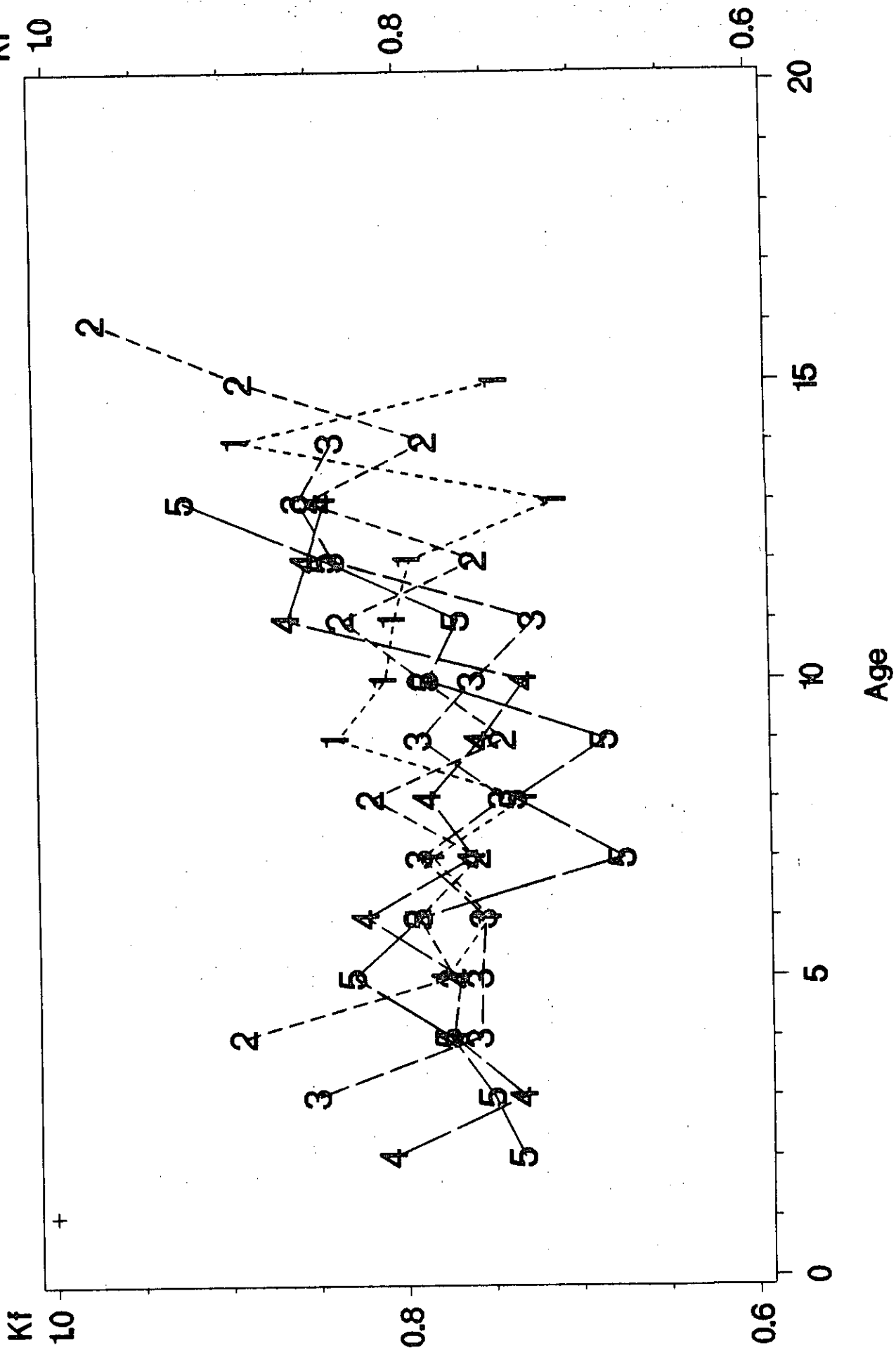


Figure 7. Annual mean condition factor (Kf) at age and by year class for Div.2J cod. Year classes 1972(1) to 76(5).

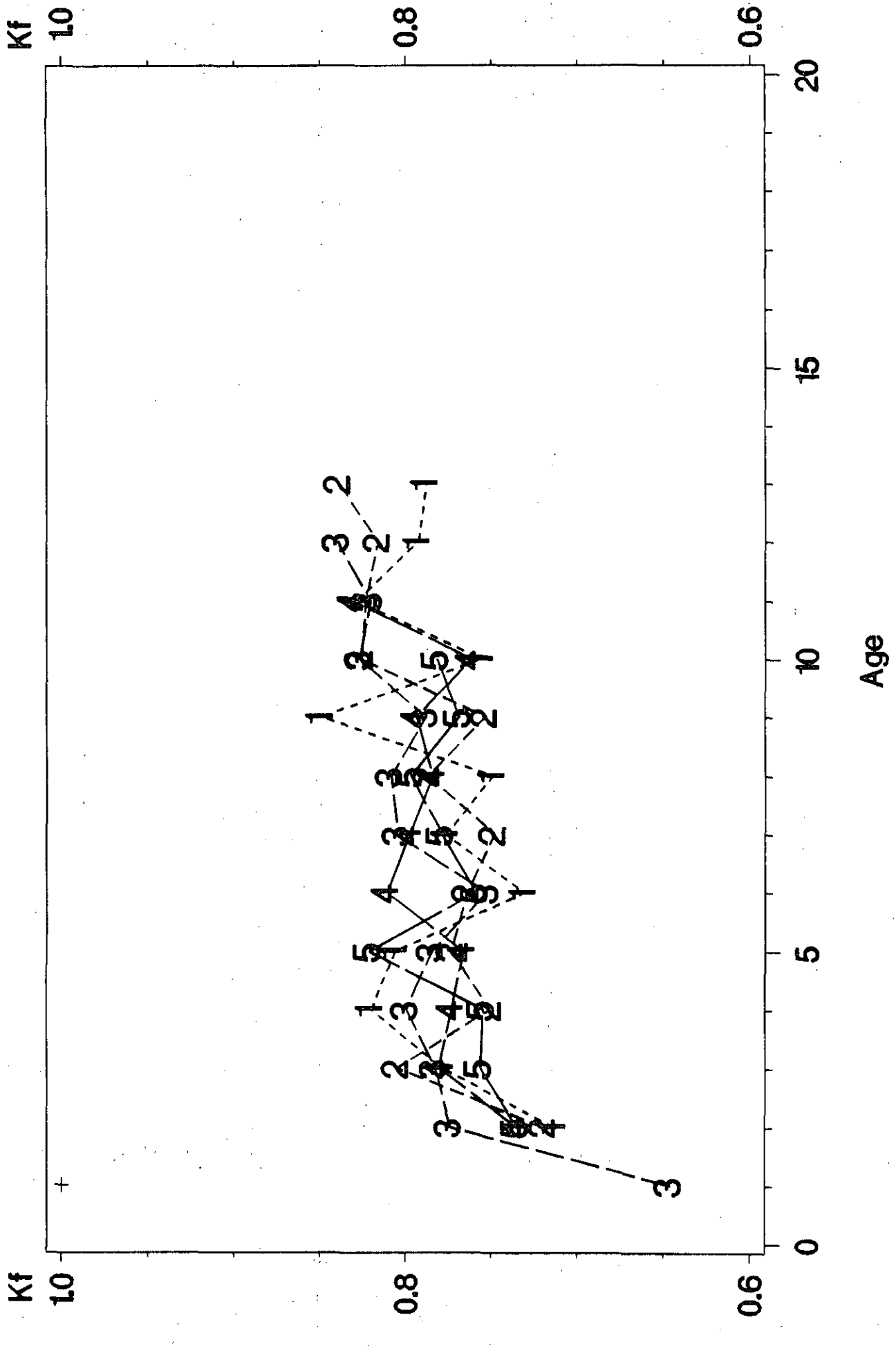


Figure 8. Annual mean condition factors (Kf) at age and by year class for Div. 2J cod. Year classes 1977(1) to 1981(5).

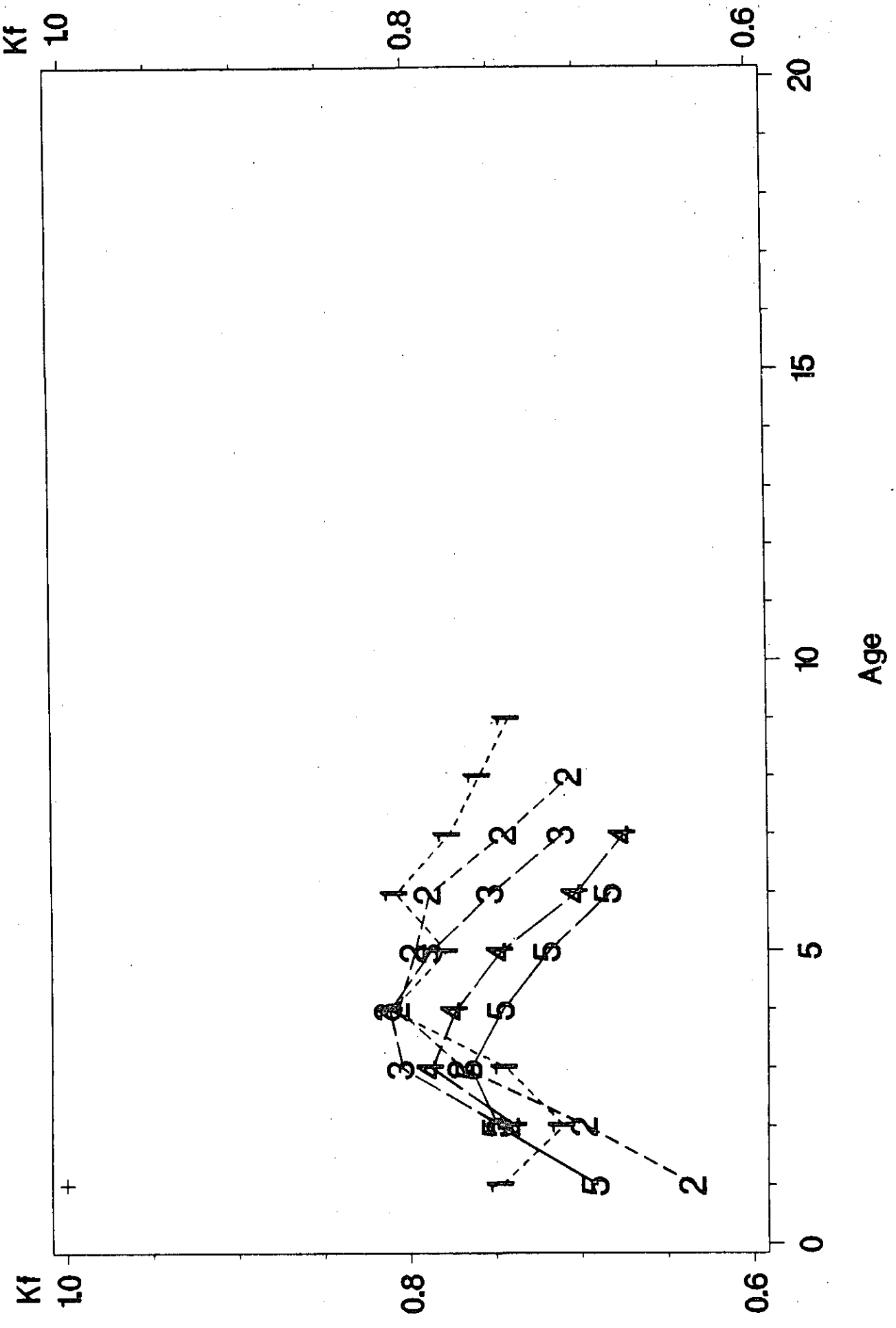
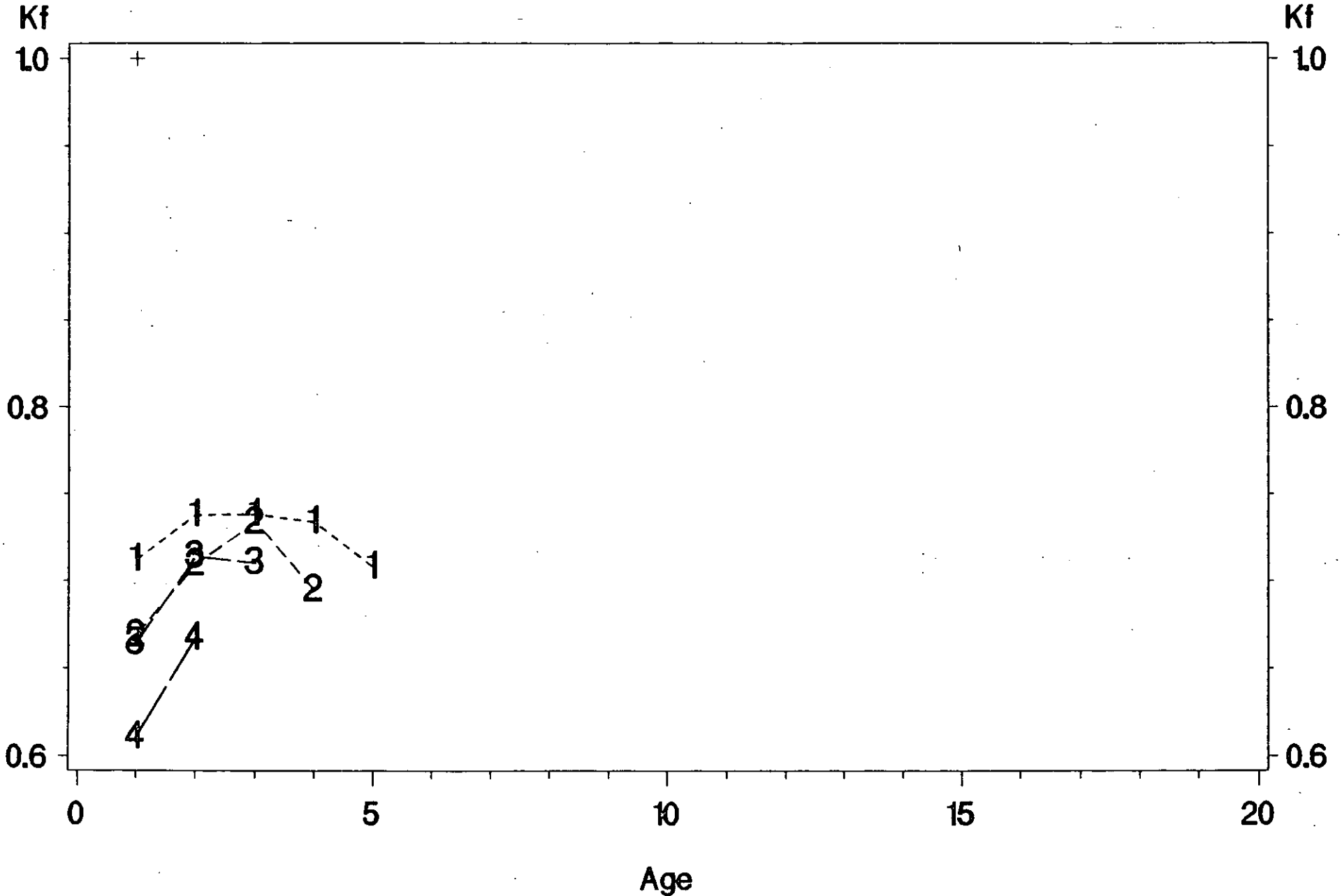


Figure 9. Annual mean condition factors (Kf) at age and by year class for Div.2J cod. Year classes 1982(1) to 1986(5).

Figure 10. Annual mean condition factors (Kf) at age and by year class for Div. 2J cod. Year classes 1987(1) to 1991(5).



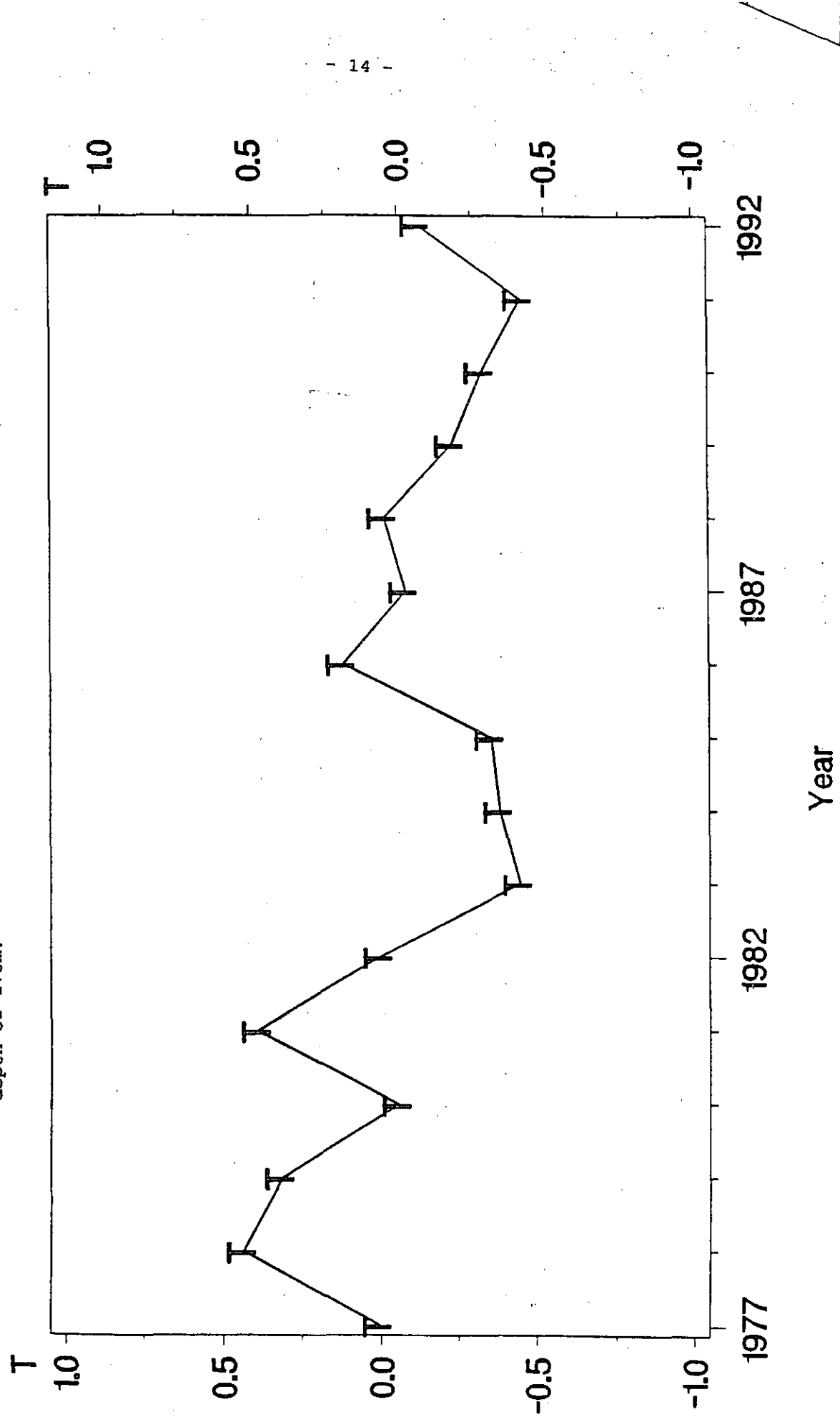


Figure 11. Station 27 fall temperature anomaly (T - deg C) for Quarter 4 at a depth of 175m.

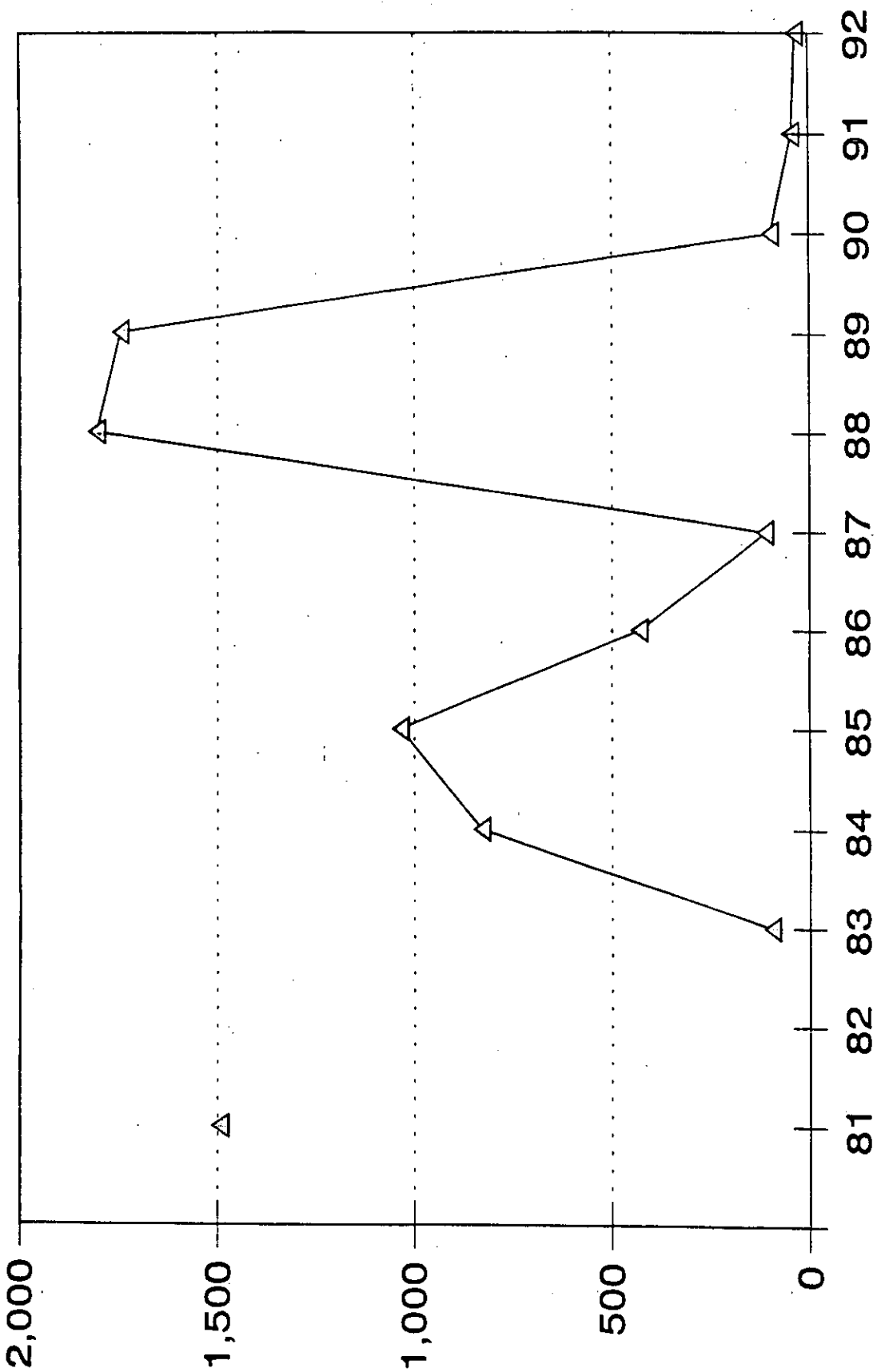


Figure 12. Total capelin biomass (thousands of tons) (ages 1-5) from fall acoustic surveys in Div. 2J+3K.