The Offshore Fishery for Capelin in SA2 + Div. 3K

by

J. E. Carscadden, D. B. Atkinson and D. S. Miller
Fisheries Research Branch
Department of Fisheries and Oceans
P. O. Box 5667
St. John's, Newfoundland   A1C 5X1

Abstract

Catch trends for the offshore and inshore capelin fisheries are presented. Three catch rate series are compared to trends in abundance from acoustic surveys and a sequential capelin abundance model. Where long-term abundance indices were available, trends in abundance were similar and exhibited a decline during the late 1970's and an increase in the early 1980's. Catch rate estimates in recent years may not be comparable to earlier years because of changes in magnitude and geographical distribution of the fishery. Age-compositions from the commercial fishery indicate that in most years since 1979, two-year-olds have dominated.

Résumé

On présente les tendances des prises pour la pêche côtière et hauturière du capelan. Trois séries de taux de capture sont comparées aux tendances de l'abondance constatées à partir des levés acoustiques et d'un modèle séquentiel d'abondance du capelan. Lorsque des indices d'abondance à long terme étaient disponibles, les tendances de l'abondance étaient semblables et montraient une baisse à la fin des années 1970 et une augmentation au début des années 1980. Il se peut que les estimations des taux de capture des dernières années ne soient pas comparables à ceux des années antérieures en raison des changements d'ampleur et de répartition géographique de la pêche. Les compositions par âge tirées de la pêche commerciale indiquent que, pour la plupart des années écoulées depuis 1979, les poissons âgés de deux ans ont dominé.

Catch Trends

The capelin fishery in NAFO SA2 and Division 3K was, until 1972, a small inshore domestic fishery occurring during the spawning season. In 1972, substantial offshore catches were reported. These catches peaked in 1976 at 212,000 t and declined during the late 1970's to 11,000 t in 1979. During 1980-82, the only directed offshore catches were taken in an experimental USSR fishery. In most years, the offshore fishery occurred during August-December with peak catches occurring in September-November (Fig. 1). During 1972-78, catches occurred in both Div. 2J and 3K but since 1979, most of the catches have been taken in Div. 2J. In recent years, a small directed inshore roe fishery during June and July has occurred.

The offshore fishery first came under quota regulation in 1974 and the inshore fishery in 1982. Catches and TAC's ('000 t) since 1974 are shown below.

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Offshore											
TAC	110*	160*	160*	212*	212	75	5	10	10	10	17
Nominal catch	126	198	214	150	53	11	5	10	10	10**	16**
Inshore											
TAC									3	11	8
Nominal catch	1	1	2	2	2	1	1	2	4	4**	7**

 * countries without specific allocations could each take up to 10,000 t
   beyond the allocated TAC
** preliminary

Abundance Indices

Abundance indices for this capelin stock include commercial catch per unit effort indices, acoustic estimates from Canadian and Soviet surveys and until 1979, estimates from a sequential capelin abundance model (Table 1).

Commercial catch rates have been calculated from a number of different sources. One series (USSR/FCR in Table 1) consists of estimates from Seliverstov and Serebrov (1979) for the years 1972-1978 inclusive and for 1979 to 1984 estimates are from the Canadian Observer Program (Foreign Cooperative Research Section, D. Kulka, pers. comm.). The estimates for 1972-78 are from BMRT-A class trawlers whereas the estimates for 1979-84 are from USSR Tonnage Class 7 trawlers but it is not known whether these trawlers are BMRT-A class. Nevertheless this series has been taken as indicative of

trends in capelin abundance in Div. 2J3K (see CAFSAC 1984 (Advisory Document. 84/17)). A catch rate series (1972-82) was also calculated using data from NAFO Statistical Bulletins for USSR trawlers Tonnage Class 7 (TC 7) in which capelin comprised > 50% of the catch (TC 7 in Table 1).

Another catch rate series (Table 1 and Fig. 2) was generated using data from NAFO Statistical Bulletins and a multiplicative model (Gavaris 1980) which accounted for country-gear, seasonal and divisional differences. Details of the results from the multiplicative model are given in Tables 2 and 3. The catch rate indices indicate a decline in capelin abundance from 1972 to 1979, an increase in 1980 and a decline to 1982. This pattern is somewhat different than that shown for the catch rate series (USSR/FCR) used in the past and the USSR acoustic series (Fig. 3). However, the catch rate series using the multiplicative model and TC 7 trawlers were highly correlated (Fig. 4) for the years 1974-82. Since the values for 1979-82 from the TC 7 series and from the USSR/FCR series (collected by the Foreign Cooperative Research Section) were similar, we used the FCR values as indicative of TC 7 values in the multiplicative model - TC 7 regression (Fig. 3) to predict values for 1983 and 1984. Effort values were then derived for 1983 and 1984. Catch rate at age indices were calculated (Table 4) using catch numbers from the offshore fishery and the effort values (Table 5). Because of annual differences in maturation rates, emphasis on catch rates at age 2 only as an indicator of capelin abundance may be misleading. However, most capelin have matured by ages 3 and 4, therefore, an examination of a year-class at ages 2 and 3 in Table 4 should yield a historical perspective of relative year-class strength. This would indicate that the following year-classes have been relatively strong: 1980, 1973, 1981, 1979. This analysis does not take into account the changing pattern of the fishery in recent years (see below) and the effects of this change on catch rates in the overall fishery and as a result, catch rates by year-class.

The changes in the offshore fishery may be affecting catch/effort estimates. There has been a substantial decline in catches and geographical distribution of this fishery (Fig. 1). In most of the earlier years of the fishery, catches in Div. 3K were somewhat lower than in Div. 2J, and since 1979, catches in Div. 3K have formed only a small proportion of the total catch. This change in the fishing pattern must raise some concern as to the comparability of catch/effort data before and after 1979. In fact it was the decision of STACFIS (Anon. 1981) that the catch rate in 1980 was not a reliable indicator of stock abundance because the fishery was concentrated in a small area with fewer vessels for a shorter time period and was able to sustain a relatively high catch rate. Although this problem has not been identified since 1980, the distribution of the fishery was not changed although the catches have increased (because of increased quotas) and have occurred over a longer period.

Age Compositions

Age compositions from the offshore commercial fishery have been available since 1972 (Fig. 5). The trends in abundance noted previously can be explained by variations in recruitment. The 1973 year-class was large accounting for the peak in abundance during the mid 1970's. The age composition data indicate that the 1969 year-class was also relatively large and should have resulted in large biomasses in the early 1970's. This is not obvious from the C/E figures although these estimates may be biased down in the early years because this was a new fishery. Abundance estimates from acoustic surveys (Miller and Carscadden 1985) and inshore sampling data (Carscadden 1983) indicate that the 1979 year-class was strong; this would account for the increase in the biomass during the early 1980's. The relative strength of the 1979 year-class is not obvious from the age composition data in Figure 5 which show that age 2 fish have dominated in the catch in most years since 1979. The changed pattern of the fishery after 1979 probably results in age compositions in the catch that are not representative of the population.

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Table 1. Summary of abundance estimates and abundance indices for Div. 2J3K capelin stock. Underlined values are predicted - see text for details.

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Catch/effort													
USSR/FCR (t/hr)	2.81	3.29	4.56	6.47	5.27	4.14	2.29	1.34	4.57*	3.68	3.19	5.31	4.24
TC 7 (t/hr)	2.65	2.75	3.62	4.51	3.62	4.00	2.34	1.35	4.92	3.72	3.36		
Multiplicative model (standardized to 1972)	1.000	1.079	0.883	1.000	0.826	0.878	0.497	0.380	1.105	0.825	0.740	1.175	0.949
Acoustic													
USSR ('000's t)	-	-	1334	982	749	506	59	14	20	-	611	852	-
Canadian ('000's t)									**	1794	-***	223	860
Sequential capelin abundance model	1987	2251	1848	4025	2843	1474	434	428					

*   considered to be an overestimate
** some capelin found but too few to estimate biomass
*** capelin detected but equipment problems precluded an estimate

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Table 2. Analysis of variance and regression coefficients for capelin in Div. 2J3K, 1972-82.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R...............0.801
MULTIPLE R SQUARED......0.641

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.671E2	1.671E2	
REGRESSION	22	2.868E1	1.304E0	11.032
TYPE 1	7	1.717E1	2.452E0	20.753
TYPE 2	5	2.846E0	5.692E-1	4.817
TYPE 3	10	1.124E1	1.124E0	9.513
RESIDUALS	136	1.607E1	1.182E-1	
TOTAL	159	2.119E2		

TYPE 1 IS COUNTRY-GEAR-TC

TYPE 2 IS MONTH

TYPE 3 IS YEAR

REGRESSION COEFFICIENTS

VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
INTERCEPT	1.400	0.363	159
1	-0.879	0.230	4
2	-1.352	0.399	6
3	-0.514	0.343	12
4	-0.943	0.196	6
5	-0.693	0.143	11
6	-1.054	0.207	5
7	-0.312	0.081	40
8	-0.336	0.230	4
9	0.151	0.145	8
10	0.183	0.085	37
11	0.119	0.087	31
12	0.071	0.078	44
13	0.029	0.158	12
14	-0.113	0.377	15
15	0.011	0.374	20
16	-0.180	0.373	21
17	-0.120	0.371	34
18	-0.688	0.375	26
19	-0.952	0.383	14
20	0.157	0.482	2
21	-0.187	0.359	6
22	-0.296	0.360	5

Table 3. Catch rate index series for capelin in Div. 2J3K, 1972-82.

PREDICTED RELATIVE POWER

YEAR	TOTAL CATCH	PROP.	RELATIVE POWER MEAN	S.E.	EFFORT
1972	46000	0.967	1.000	0.000	46000
1973	136000	0.988	1.079	0.170	126020
1974	126000	0.983	0.883	0.322	142722
1975	198000	0.944	1.000	0.362	198029
1976	214000	0.968	0.826	0.299	259007
1977	150000	1.000	0.878	0.316	170757
1978	53000	0.984	0.497	0.181	106668
1979	10000	1.081	0.380	0.141	26290
1980	5000	0.959	1.105	0.505	4526
1981	10000	1.017	0.825	0.288	12114
1982	10000	0.965	0.740	0.259	13516

AVERAGE C.V. FOR THE MEAN:0.318

Table 4. Catch rate at age indices for capelin in Div. 2J3K fishery, 1972-82.

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
2	50	104	71	280	31	9	23	134	225	330	369	344	340
3	270	122	173	126	286	92	79	18	201	73	88	415	100
4	88	165	62	37	23	186	54	4	53	20	7	65	50
5	12	21	43	12	3	19	49	5	7	11	2	5	7
6	2	1	3	2	1	3	3	5	4	1	-	-	-

Table 5. Numbers of capelin in catch ($\times 10^{-3}$) in Div. 2J3K offshore fishery, 1972-84 and effort (hr) from the multiplicative model 1972-82, and predicted for 1983 and 1984.

| Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
2	228	1306	1015	5554	790	157	247	351	102	400	499	293	574
3	1240	1539	2464	2487	7409	1578	843	47	91	89	119	353	169
4	406	2085	888	733	606	3170	575	11	24	24	9	55	84
5	55	262	616	165	77	329	518	14	3	13	3	4	11
6	7	14	49	43	16	45	28	13	2	1	1	1	1
Effort (hr)	46000	126020	142722	198029	259007	170757	106668	26290	4526	12114	13516	8511	16860

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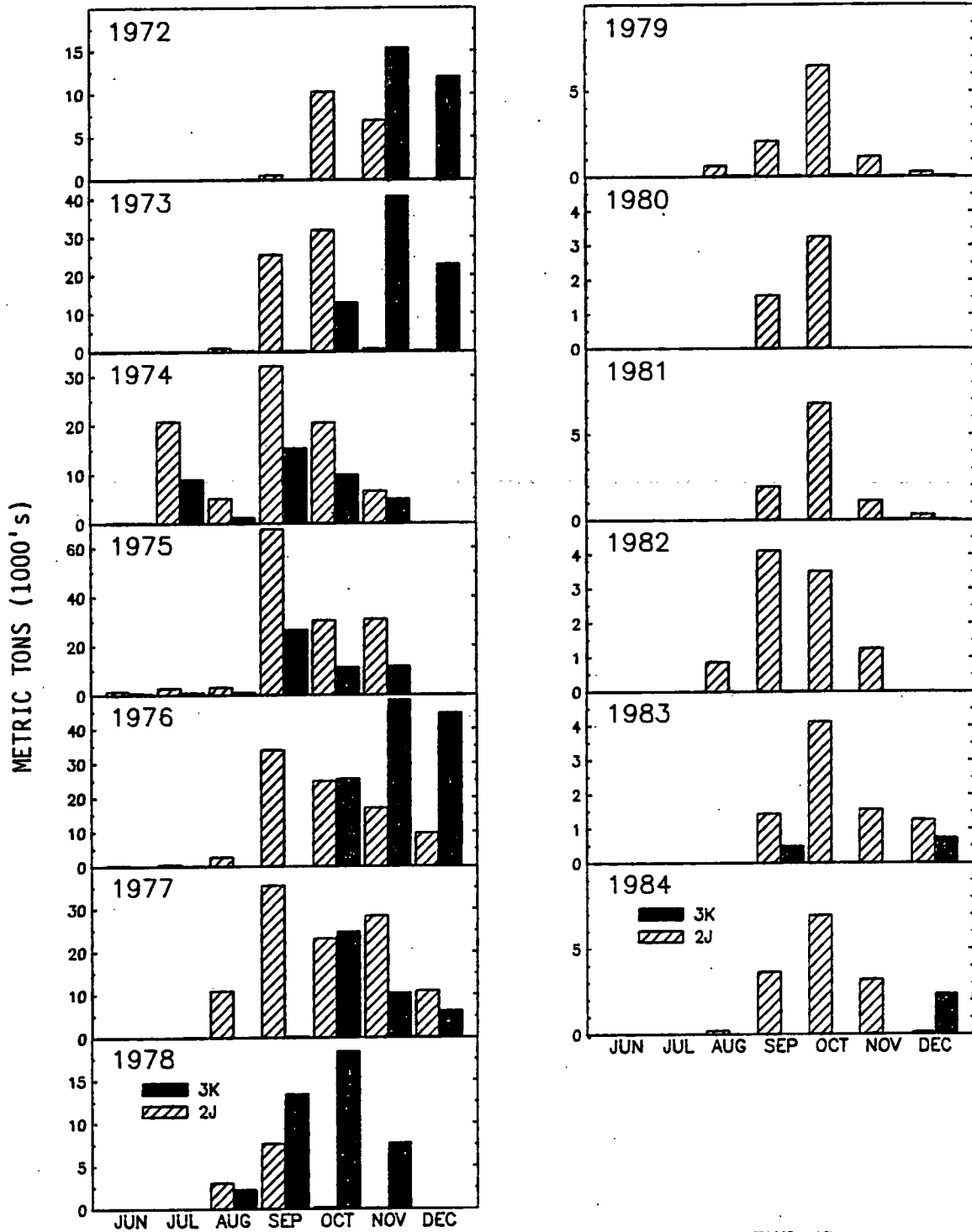
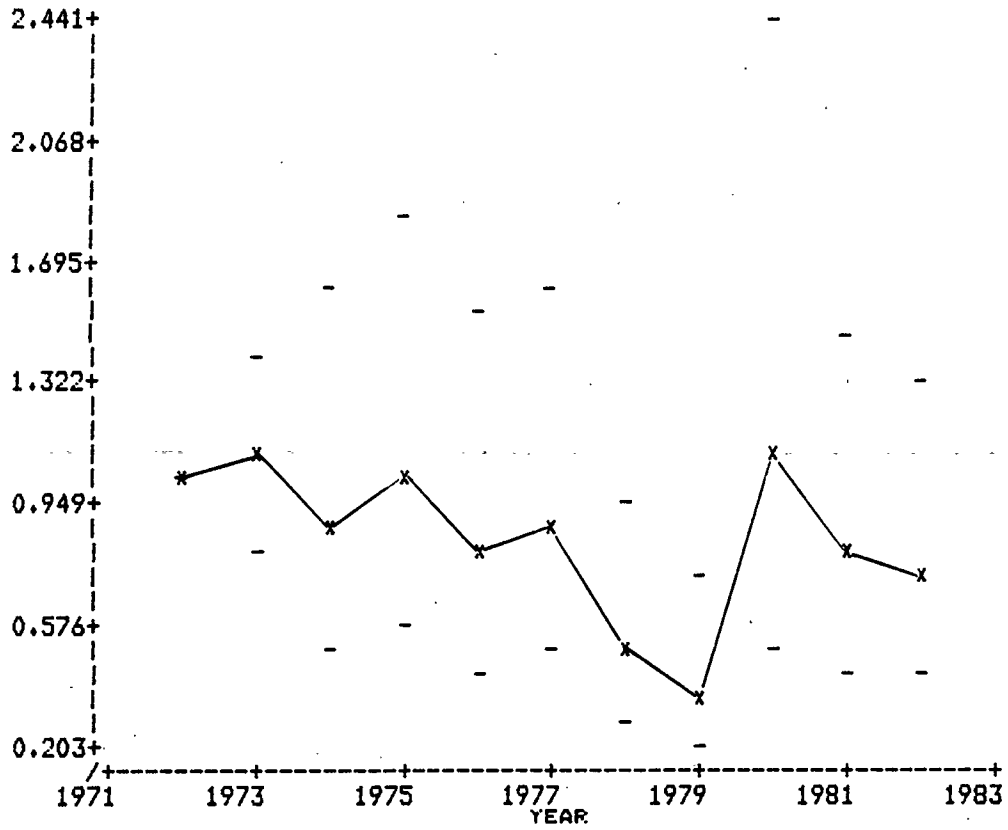Fig. 1. Offshore commercial capelin catches in Div. 2J3K, 1972-84.

Fig. 2. Catch rate index with approximate 90% confidence interval for capelin in Div. 2J3K.
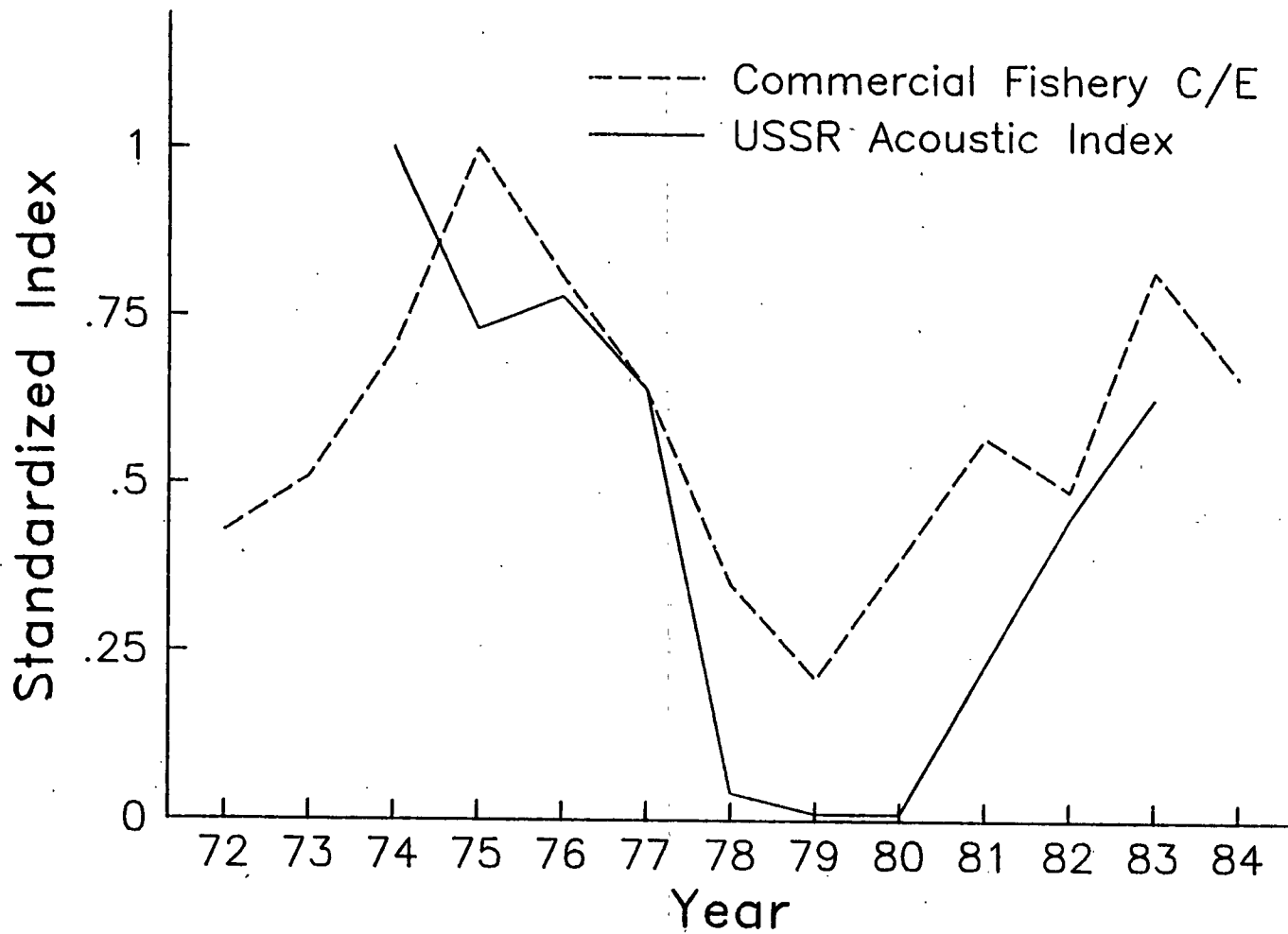
Fig. 3. Standardized indices of capelin abundance for the Div. 2J3K capelin stock derived from commercial catch rates (USSR/FRC - Table 1) and USSR acoustic estimates.
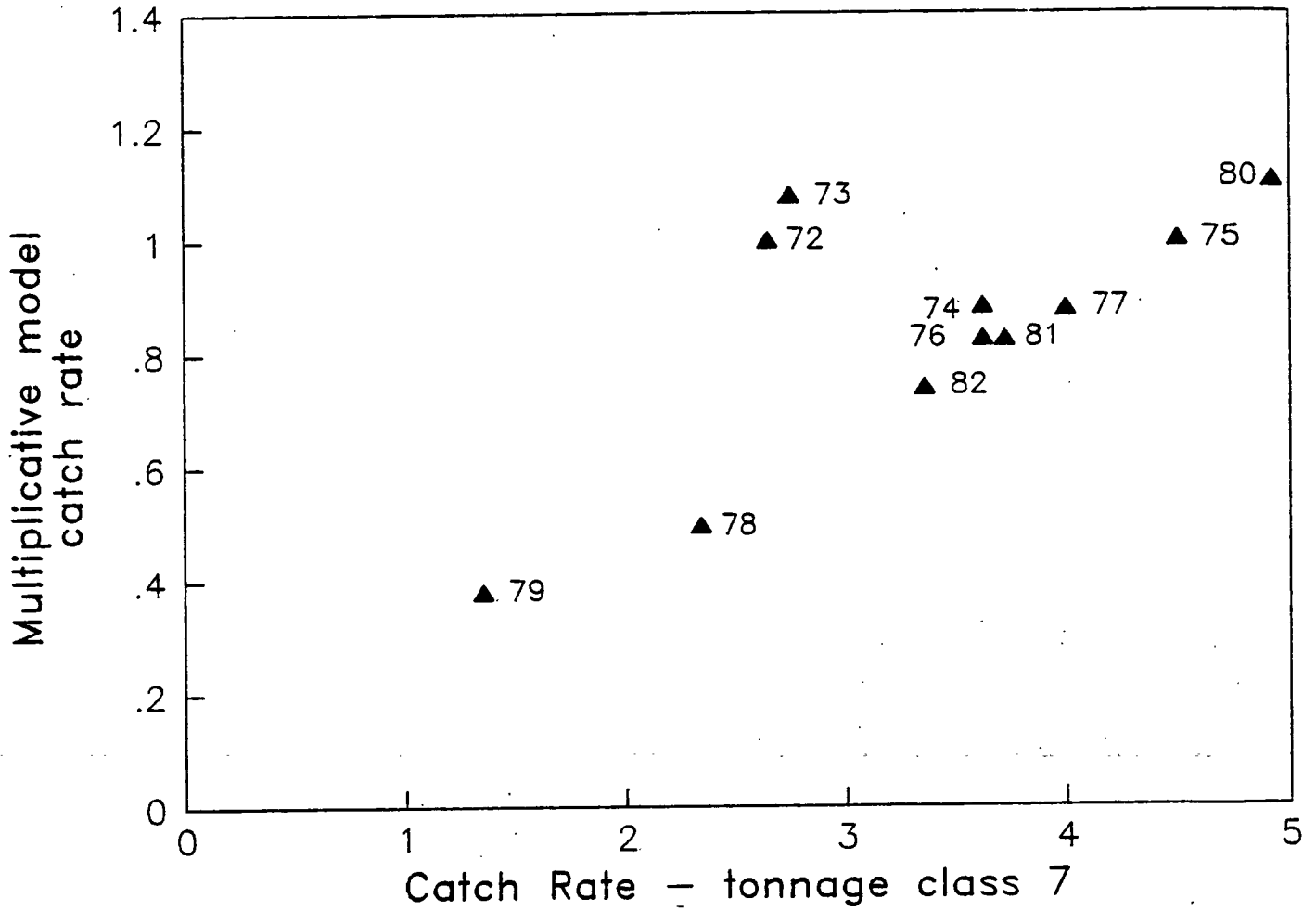
Fig. 4. Relationship between commercial catch rate indices from multiplicative model and TC 7 trawlers (from Table 1). The regression equation is Y = 0.0623 + 0.2091 X, r = .9882 for the years 1974-82.
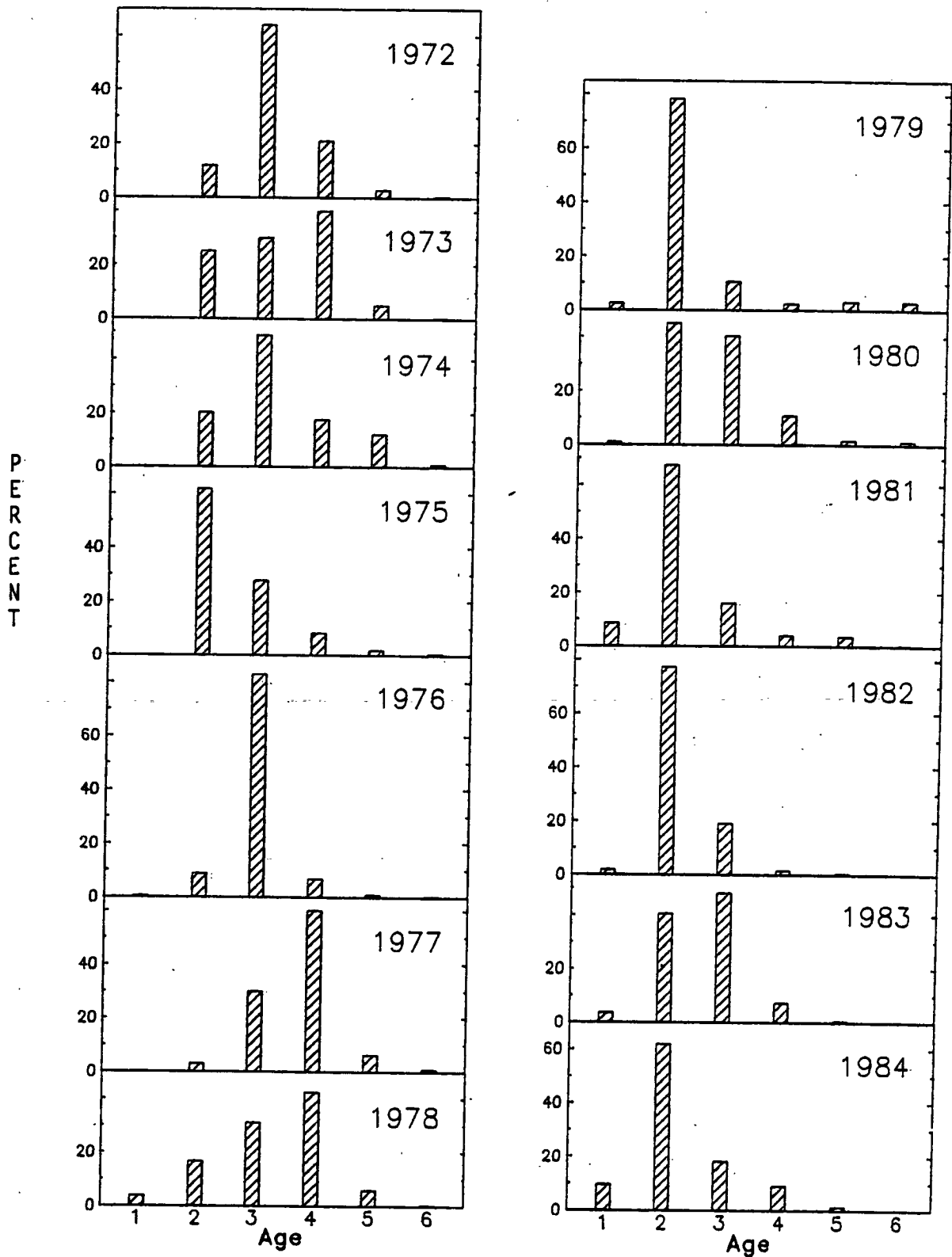
Fig. 5. Age-compositions of capelin from the offshore commercial capelin fishery in Div. 2J3K, 1972-84.