Observations and Studies on SA2 + Div. 3K Capelin in 1991

by

D. S. Miller
Science Branch
Department of Fisheries and Oceans
P. O. Box 5667
St. John's, Newfoundland A1C 5X1

Abstract

This paper documents recent information relevant to capelin in SA2 + Division 3K.

Part A contains results of the Canadian acoustic survey conducted during October 4-28, 1991 in Divisions 2J3K and northern Division 3L. Total biomass for the survey was estimated at 54,515 tons, a further decrease from the 1990 survey estimate.

Part B contains information on commercial catch rates and age compositions from the offshore fall fishery. The 1991 catch rate of 1.27 tons per hour was significantly lower than the 1990 rate of 5.87 tons per hour.

Résumé

Le présent document expose certaines données récentes sur le capelan de SA2 et de la division 3K.

La partie A contient les résultats de relevés acoustiques effectués du 4 au 28 octobre 1991 dans les divisions 2J3K et dans le nord de la division 3L. On a estimé la biomasse totale à 54 515 tonnes, ce qui représente encore une diminution par rapport aux estimations de 1990.

La partie B contient des renseignements sur les taux de prises commerciales dans la pêche hauturière d'automne ainsi que sur la composition de ces prises selon l'âge. Le taux de prises de 1991, soit 1,27 tonne à l'heure, était bien inférieur à celui de l'année précédente (5,87 tonnes).

Introduction

An acoustic survey of capelin in NAFO Divisions 2J3K and 3L was conducted during the period October 4-28, 1991. Capelin detected acoustically in Divisions 2J3K had an estimated biomass of 43,133 tons and in Division 3L had an estimated biomass of 11,382 tons. This paper provides data pertaining to the distribution and age composition of the acoustic biomass estimate.

The capelin fishery in NAFO Subarea 2 and Div. 3K was, until 1972, limited to inshore catches during the spawning season. In 1972, substantial catches were taken offshore by vessels from several countries, and these peaked in 1976 at 212,000 t before declining during the late 1970's to 11,000 t in 1979. Since then, 1980-91, the USSR has conducted the only directed fishery offshore. Throughout its history, the offshore fishery has generally been conducted during August-December with peak catches occurring in September-November. During 1979-82 and again in 1985 and 1988, the catches were taken in Div. 2J only, but in other years catches have also been made in Div. 3K. In 1991 the commercial catch was greatly reduced and the only capelin caught were taken in Division 3K.

In recent years, an inshore directed roe fishery during June and July has developed, primarily in Div. 3K.

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

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Offshore TAC	10	10	17	17	17	31	17	20	71	57a
Nominal catch	10	10	17	17	17	31	17	22b	59b	0.5b
Inshore										
TAC	3	11	8	8	19	9	22	24	29	29
Nominal Catch	4	4	7	7	12	11	27	27b	35b	20b

a) Comprised of 12,000 TAC and 45,000 SeaFreeze allocation.
b) All 1989, 1990 and 1991 catches are preliminary data.

This paper provides data pertaining to distribution of the fishery, age composition of the catch, and catch rates for the 1991 USSR offshore fishery.

Part A: Acoustic survey

Methodology

The survey was conducted from the research vessel Gadus Atlantica during the period October 4-28, 1991. The configuration of the acoustic data acquisition system was the same as in 1990. The calibration parameters of the system were as follows:

Combined source level/receive sensitivity	54.71 dB
Fixed receiver gain	11.32 dB
TVG gain	20 log R
Attenuation coefficient	.012 dB/m
Pulse length	600 ósecs
Bandwidth	3.3 kHz
Average beam pattern	-28.79 dB
Target strength	-34 dB/kg

The survey design was random parallel transects with a minimum allowable spacing of 1 nautical mile as recommended by the CAFSAC Pelagic Subcommittee (O'Boyle and Atkinson, 1989). Stratum outlines and transect locations and fishing set locations are shown in Figure 1.

The survey was initially planned to cover the same strata as were covered in the 1990 survey (Miller and Lilly, 1991). The six northernmost strata (D-I) in Division 2J were surveyed during the first part of the survey (Oct 4-19) but almost no capelin were detected in these strata. During the first part of the survey, reports were received from a DFO observer on a Canadian groundfish trawler operating in northern Division 3L of significant capelin concentrations in this area. Because of these reports and the extremely low capelin abundance observed in the north during the first part of the acoustic survey, it was decided to concentrate the second part of the survey (Oct 21-28) in southern Division 3K and northern 3L. Strata B and C from the 1990 survey were deleted, stratum A was expanded to the south, and two additional strata, J and K were added in Division 3L. Exploratory acoustic transects between strata D and A were covered but data from these strata were not included in the acoustic estimate. Estimates of mean biomass and backscatter and their standard error were calculated the same as for the 1989 and 1990 surveys. As noted for previous surveys, this variance accounts only for the sampling design and does not include any variance due to error in the target strength value used or the measurement of the calibration parameters of the acoustic data acquisition system.

Fishing sets were made on an opportunistic basis throughout the survey. It was attempted to have at least one set for each twelve hour watch and at least one set for each transect. For those midwater trawl sets that contained capelin, a random sample of 200 capelin was obtained for length, sex, and maturity observations and a stratified age sample was selected from each length/sex/maturity sample. Length composition and an age/length key was constructed for each stratum from the samples obtained in that stratum. As insufficient capelin were obtained from fishing sets in strata D-I to estimate the age composition of the acoustic biomass, the age and length composition from stratum A was used to apportion the acoustic biomass estimate for these strata.

Results and Conclusions

Table 1. gives estimates of acoustic backscatter and biomass for each stratum and for the total survey. Total biomass was estimated at 54,515 tons with a coefficient of variation of 0.515. This can be apportioned as 2,983 tons for Division 2J, 40,150 tons for 3K and 11,382 tons for 3L. Table 2. provides estimates of backscatter and biomass for each acoustic transect and shows the distibution of the biological sampling amongst the acoustic transects. Tables 3 and 4 give the total age composition by numbers and biomass for the historical

period of Canadian acoustic biomass estimates. Table 5. provides for each stratum, the percent at age by number, the mean length at age, total numbers and mean length and the number of samples used. The 1989 yearclass was predominant in Divisions 2J3K and the 1990 yearclass was predominant in Division 3L.

Figure 2 illustrates the historical acoustic biomass estimates for both Canada and the USSR. The biomass estimate of 54,515 tons is the lowest on record in the Canadian historical series. Preliminary results from the USSR acoustic survey carried out during October-November, 1991 indicate a biomass estimate of only 19,200 tons (R.V. Vilnyus trip report). The USSR 1991 acoustic estimate is comparable to the low estimates of stock abundance from the 1979 and 1980 USSR acoustic surveys.

Part B: Offshore Capelin Fishery

Discussion

The TAC allocated to the USSR fleet in 1991 was 12,000 tons with a further allocation of 45,000 tons resulting from a transfer of allocation from the Canadian company, Sea Freeze. This was similar to the arrangement made in 1990 (Miller and Lilly, 1991). The USSR offshore fishery was unable to find any commercial concentrations of capelin in Division 2J and only 457.1 tons were taken in Division 3K.

Tables 6,7,8 give historical catches (inshore and offshore) since 1972. Figures 3a,b show the distribution of the offshore commercial fishery catch over time for each NAFO division. Figure 4 shows the geographical distribution of samples obtained from the USSR commercial fishery in 1991.

Offshore Catch Rates

As in past years, catch rates are available from two sources, NAFO statistics and a combination of USSR/observers (Table 9). The NAFO data are available only up to 1990. The second series is a combination of USSR estimates (Seliverstov and Serebrov 1979) for 1971-78 and observers (Foreign Cooperative Research Section, D. Kulka, pers. comm.) Monthly catch rate estimates from observers are given in Table 10.

With the addition of the 1989 NAFO data, the discrepancy between the catch rate series continues (Figure 5). In theory, there should be no difference in the trends between the FCR series and the NAFO series since the FCR series is essentially a subset of the NAFO series. The observers have usually observed a significant portion of the catch, especially in recent years when efforts have been made to place an observer on each vessel (Table 11).

Age-compositions from the Offshore Fishery

Age-compositions from the offshore fishery are given in Table 12. The age composition is almost identical to that obtained for stratum A in the acoustic survey which was in the same geographic area (Figure 4).

References

Miller, D. S. and G. R. Lilly. 1991 Observations and studies on SA2 + Div. 3K capelin in 1990. CAFSAC Res. Doc. 91/11 30 p.

O'Boyle, R. N., and D. B. Atkinson. 1989. Hydroacoustic survey methodologies for pelagic fish as recommended by CAFSAC. CAFSAC Res. Doc. 89/72. 12 p.

Seliverstov, A. S., and L. I. Serebrov. 1979. Status of capelin stocks in Divisions 2J and 3K in 1978. ICNAF Res. Doc. 79/17, Ser. No. 3435. 11 p.

Table 1. Statistics for each stratum and total survey

Strata	Transects sampled	Number of possible transects	Transect area (km^2)	Transect area scattering coefficient (sr^{-1}) Mean	S.E.	Strata total backscatter (m^2/sr)	Biomass per transect (tons) Mean	S.E.	Total biomass (tons)
I	5	25	237.0	2.	0.2	48.	4.9	0.6	121.
F	5	25	309.7	3.	1.7	81.	8.2	4.3	205.
E	5	30	189.7	3.	1.4	103.	8.6	3.5	258.
D	5	45	432.5	21.	3.9	955.	53.3	9.8	2399.
A	4	90	534.4	178.	126.3	15984.	446.1	317.3	40150.
J	4	40	574.8	41.	9.2	1642.	103.1	23.1	4124.
K	4	40	217.4	72.	31.8	2890.	181.5	80.0	7258.
Total	32	295		74.	6.7	21703. .515	184.8	16.8	54515. .515

Table 2. Backscatter, biomass, and biological sampling for each transect.

Strata	Transect Number	Transect length (km)	Transect area (km^2)	Area scattering (sr^{-1})	Total backscattering (m^2/sr)	Density (g/m^2)	Transect biomass (tons)	# of sets	Lsms	Ages
I	1	128.0	237.0	0.	2.	.02	5.	1	0	0
	2	128.0	237.0	0.	3.	.03	7.	0	0	0
	3	128.0	237.0	0.	2.	.02	4.	0	0	0
	4	128.0	237.0	0.	2.	.02	5.	1	0	0
	5	128.0	237.0	0.	1.	.01	3.	1	0	0
F	1	167.2	309.7	0.	0.	.00	1.	2	0	0
	2	167.2	309.7	0.	1.	.01	2.	1	0	0
	3	167.2	309.7	0.	4.	.03	10.	1	0	0
	4	167.2	309.7	0.	10.	.08	24.	2	0	0
	5	167.2	309.7	0.	1.	.01	3.	1	0	0
E	1	102.4	189.7	0.	9.	.12	22.	1	0	0
	2	102.4	189.7	0.	2.	.03	6.	1	0	0
	3	102.4	189.7	0.	3.	.04	8.	1	0	0
	4	102.4	189.7	0.	2.	.03	5.	1	0	0
	5	102.4	189.7	0.	1.	.01	2.	0	0	0
D	1	233.5	432.5	0.	26.	.15	67.	1	0	0
	2	233.5	432.5	0.	18.	.11	46.	1	0	0
	3	233.5	432.5	0.	17.	.10	42.	1	0	0
	4	233.5	432.5	0.	11.	.06	28.	1	0	0
	5	233.5	432.5	0.	33.	.19	84.	1	0	0
A	1	143.5	265.8	2.	554.	5.24	1393.	1	200	42
	2	143.5	265.8	0.	40.	.38	101.	1	200	39
	3	143.5	265.8	0.	27.	.26	68.	0	0	0
	4	143.5	265.8	0.	88.	.84	222.	1	200	44
J	1	110.0	203.7	0.	27.	.34	69.	0	0	0
	2	110.0	203.7	0.	37.	.46	93.	1	200	34
	3	110.0	203.7	0.	32.	.39	80.	2	200	46
	4	110.0	203.7	0.	68.	.84	171.	1	200	33
K	1	128.9	238.7	0.	21.	.22	53.	1	200	44
	2	128.9	238.7	1.	136.	1.43	342.	0	0	0
	3	128.9	238.7	0.	14.	.15	35.	1	0	0
	4	128.9	238.7	0.	118.	1.24	296.	1	200	26

Table 3. Numbers (billions) at age of capelin from NAFO Division 2J3K hydroacoustic surveys.

Year	Cruise	Date/Age	1	2	3	4	5+	Total
1991	207	Oct 4-28	4.7	2.5	0.4	0.1	<0.1	7.7
	(2J3K)		0.1	2.2	0.4	0.1	<0.1	2.8
	(3L)		4.6	0.3	<0.0	0.0	0.0	4.9
1990	189	Oct 6-28	1.4	2.6	1.6	0.6	<0.1	6.2
1989	173	Oct 13-29	1.9	59.0	35.3	2.5	0.5	99.2
1988	158	Oct 7-24	15.8	96.0	13.6	2.0	3.9	131.3
1987	144	Oct 10-25	0.7	4.4	0.5	0.6	0.1	6.3
1986	130	Oct 18-29	0.1	6.6	12.1	1.1	0.2	20.1
1985	115	Sept 26-Oct 19	1.5	54.0	13.5	1.5	0.6	71.1
1984	100	Sept 29-Oct 22	6.2	34.7	7.1	4.1	0.4	52.5
1983	85	Oct 2-24	2.6	2.5	1.3	0.2	0.0	6.6
1981	56	Oct 1-19	67.8	59.3	7.4	2.8	0.7	138.0

Table 4. Biomass (thousands of tons) at age of capelin from NAFO Division 2J3K hydroacoustic surveys.

Year	Cruise	Date/Age	1	2	3	4	5+	Total
1991	207	Oct-4-28	10.7	32.6	8.8	2.1	0.4	54.6
	(2J3K)		1.0	31.0	8.7	2.1	0.4	43.2
	(3L)		9.7	1.6	0.1	0.0	0.0	11.4
1990	189	Oct 6-28	1.8	43.8	36.2	14.1	0.5	96.4
1989	173	Oct 13-29	15.4	850.1	791.2	68.9	18.5	1744.1
1988	158	Oct 7-24	76.2	1208.7	336.9	55.1	127.0	1803.9
1987	144	Oct 10-25	3.9	77.8	12.0	15.1	3.0	111.8
1986	130	Oct 18-29	0.7	109.9	284.1	30.2	6.0	430.9
1985	115	Sept 26-Oct19	8.4	686.6	286.3	36.7	17.8	1035.4
1984	100	Sep 29-Oct 22	25.5	497.9	181.9	109.8	11.3	826.4
1983	85	Oct 2-24	17.6	41.1	31.2	4.3	0.0	94.2
1981	56	Oct 1-19	337.8	891.2	172.4	71.9	20.8	1494.1

Table 5. Age composition and mean length at age ,total number in billions, total mean length, and number of samples by survey stratum.

Strata	Age	1	2	3	4	5+	Total N/L	Number of samples
A,D,E	%	5.0	77.3	14.1	3.1	0.5	2.8	4
F,I	L	119	144	163	171	179	147	
J	%	88.6	11.4	0.0	0.0	0.0	1.4	3
	L	95	117	-	-	-	97	
K	%	96.0	3.8	0.2	0.0	0.0	3.4	2
	L	90	110	133	-	-	91	

Table 6. Capelin catches for Subarea 2.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1972									586	10297	6955		17838
1973								930	25577	32055	904	372	59838
1974					84	172	20816	5079	32110	20568	6560		85389
1975			200	2713		1402	2818	3152	70798	31969	30932	875	144859
1976						201	504	3761	37148	26299	17021	9665	94599
1977								10890	35498	23144	28431	10879	108842
1978								3046	7636	195	37		10914
1979								645	2078	6444	1155	265	10587
1980									1547	3248			4795
1981									1947	6793	1117	292	10149
1982						4	3	1287	4435	3357	599		9685
1983						1	2	299	2326	3898	1786	1561	9873
1984							1	481	3948	7366	3385		15181
1985							1	333	2763	8129	5341	272	16839
1986						2	1		3352	6885			10240
1987							3	237	10908	14117	3246		28511
1988						1	2		3161	11982	1682		16828
1989									5787	13637	2520		21944
1990									12747	21790	7045	8	41590
1991													

Table 7. Capelin catches for Division 3K.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1972						226	230	5		39	15319	11966	27785
1973						103	338	130	86	12703	40565	22659	76584
1974					36	320	9880	1274	15317	9874	4849		41550
1975			85	1214		757	1440	1009	26484	11144	11479	30	53642
1976	112				1386	1206	506			25501	48463	44553	121727
1977	19				12	1781	354		234	24666	10318	6183	43567
1978				15	6	1386	1014	2220	13395	18338	7660		44034
1979						581	90	56	43	85	5	41	901
1980						208	1146						1354
1981					18	1584	201				31	15	1849
1982						3029	825	5		1			3860
1983						2673	1091			55		573	4392
1984						2693	4420	3	1			2186	9303
1985						102	7302	7					7411
1986						8134	3666			1027	4764	729	18320
1987						8818	133	41		11	1851	721	11575
1988					12	19237	7568						26817
1989						26853			39	333	158		27383
1990						9367	25773				11096	6826	53062
1991										9.5	343.1	104.5	457.1

Table 8. Total capelin catch for Subarea 2 and Division 3K

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1972						226	230	5	586	10336	22274	11966	45623
1973						103	338	1060	25663	44758	41469	23031	136422
1974					120	492	30696	6353	47427	30442	11409		126939
1975			285	3927		2159	4258	4161	97282	43113	42411	905	198501
1976	112				1386	1407	1010	3761	37148	51800	65484	54218	216326
1977	19				12	1781	354	10890	35732	47810	38749	17062	152409
1978				15	6	1386	1014	5266	21031	18533	7697		54948
1979						581	90	701	2121	6529	1160	306	11488
1980						208	1146		1547	3248			6149
1981					18	1584	201		1947	6793	1148	307	11998
1982						3033	828	1292	4435	3358	599		13545
1983						2674	1093	299	2326	3953	1786	2134	14265
1984						2693	4421	484	3949	7366	3385	2186	24484
1985						102	7303	340	2763	8129	5341	272	24250
1986						8136	3667		3352	7912	4764	729	28560
1987						8818	136	278	10908	14128	5097	721	40086
1988					12	19238	7570		3161	11982	1682		43645
1989						26853			5826	13970	2678		49327
1990						9367	25773		12747	21790	18141	6834	94652
1991										9.5	343.1	104.5	457.1

Table 9. Commercial catch rate series (tons/hour) for Div. 2J3K capelin, 1972-98.

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
USSR/FCR	2.81	3.29	4.56	6.47	5.27	4.14	2.29	1.34	4.57	3.68
TC7 (NAFO)	2.65	2.75	3.62	4.51	3.62	4.00	2.34	1.35	4.92	3.72

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
USSR/FCR	3.19	5.31	4.24	6.96	6.05	7.70	5.97	6.12	5.87	1.27
TC7 (NAFO)	3.36	4.51	3.86	4.16	4.38	4.71	4.47	4.70	5.45	

Table 10. Monthly catch rates (t/hr) of tonnage class 7, USSR trawlers from observer data.

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Div. 2J													
Aug.				2.42					8.46				
Sept.	0.98	5.26	2.26	3.26	3.34	6.73	5.09	4.83	8.04	4.81	4.51	8.90	
Oct.	1.58	4.25	4.20	2.81	7.41	7.43	7.50	6.72	7.67	6.43	8.02	6.59	
Nov.	0.96		4.38	12.16	6.16	3.22	6.67	9.02	9.38	6.28	5.95	6.08	
Dec.	1.20				7.96								
Div. 3K													
Aug.													
Sept.													
Oct.								7.43					
Nov.	0.26					3.14		6.08	7.56		6.96	4.77	1.74
Dec.						2.96		5.90	2.92		1.91	1.58	1.67

Table 11. Number of samples by month, proportion of catch observed by FRC personnel, and monthly catch for commercial USSR fishery in Div. 2J3K.

	1983	1984	1985	1986	1987	1988	1989	1990	1991
Aug.	0/0/253	0/0/481	0/0/333	12/49/3352	4/208/236			15/90/12747	
Sept.	11/56/2326	10/49/3948	2/17/2763	18/46/6885	17/83/10908	10/102/361	22/90/6453	19/89/21790	
Oct.	11/48/3898	6/22/7366	12/42/8129		32/70/14117	32/81/11982	27/85/13342	7/91/7045	
Nov.	6/47/1731	17/66/3385	10/29/5341		5/79/3246	11/82/1665	10/91/2020		
Dec.	2/23/1561		0/0/272						
Aug.					0/0/41				
Sept.							0/0/7		
Oct.	0/0/55			4/42/1027	0/0/11				0/100/10
Nov.		3/100/0*		12/43/4764	2/81/1851		0/94/563	7/93/11096	4/93/343
Dec.	0/0/573	9/53/2186		1/21/729	0/70/721		4/83/341	4/88/6826	1/100/106

* no catch in NAFO stats but 570.5 t observed

Table 12. Commercial age compositions for Div. 2J3K, 1972-89.

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0.1	3.8	2.5	1.0	8.6	1.8	3.6	9.6	0.1	0.3	0.6	0.8	0.3	0.0	3.6
2	3.0	16.6	78.3	45.1	67.4	77.3	40.5	61.9	66.7	21.1	44.1	72.0	40.5	35.5	81.5
3	29.9	31.1	10.6	40.4	16.1	19.1	48.2	18.2	28.7	69.3	19.5	18.7	54.2	47.8	14.4
4	60.0	42.3	2.4	10.8	4.0	1.5	7.3	9.1	2.8	8.3	32.2	2.3	4.3	16.1	0.3
5	6.2	5.9	3.2	1.6	3.6	0.4	0.5	1.2	1.5	0.7	3.5	5.6	0.3	0.5	0.2
6	0.9	0.3	3.0	1.1	0.2	0.1	0.1	0.0	0.1	0.3	0.1	0.5	0.4	0.0	0.0

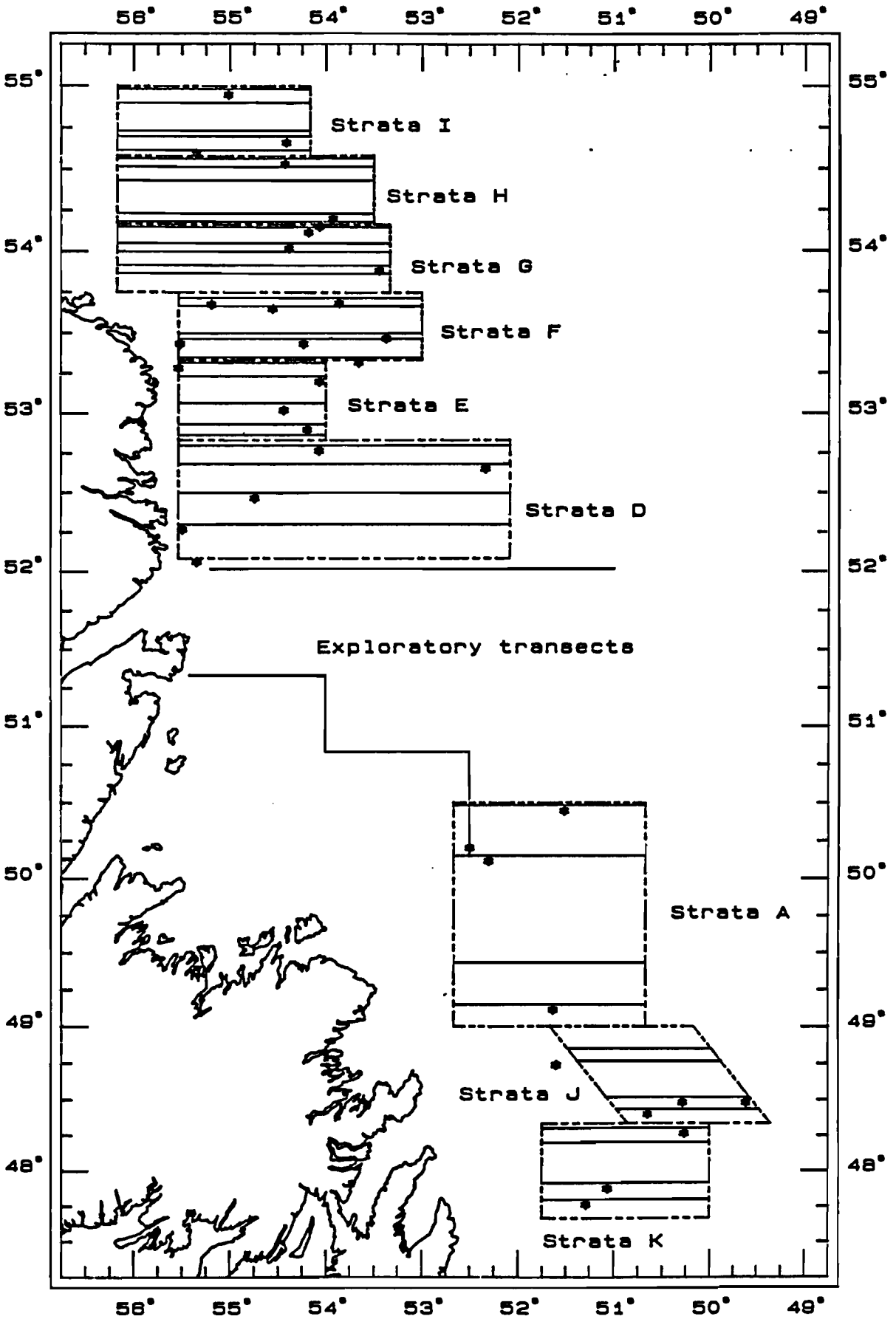

Fig. 1. Survey transects and fishing set locations for Div. 2J3KL capelin survey, October 1991.

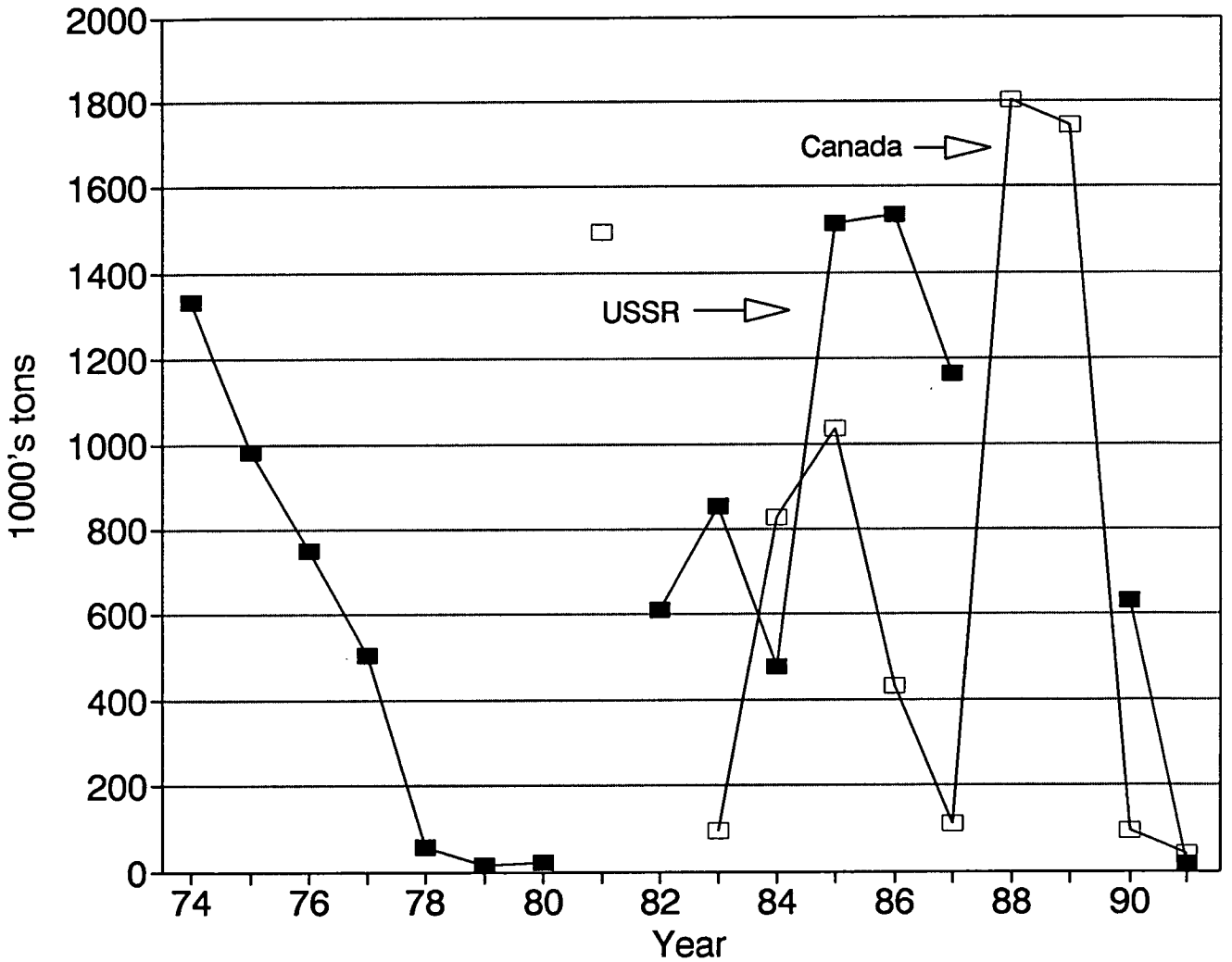

Figure 2. Canadian and USSR capelin acoustic survey biomass estimates

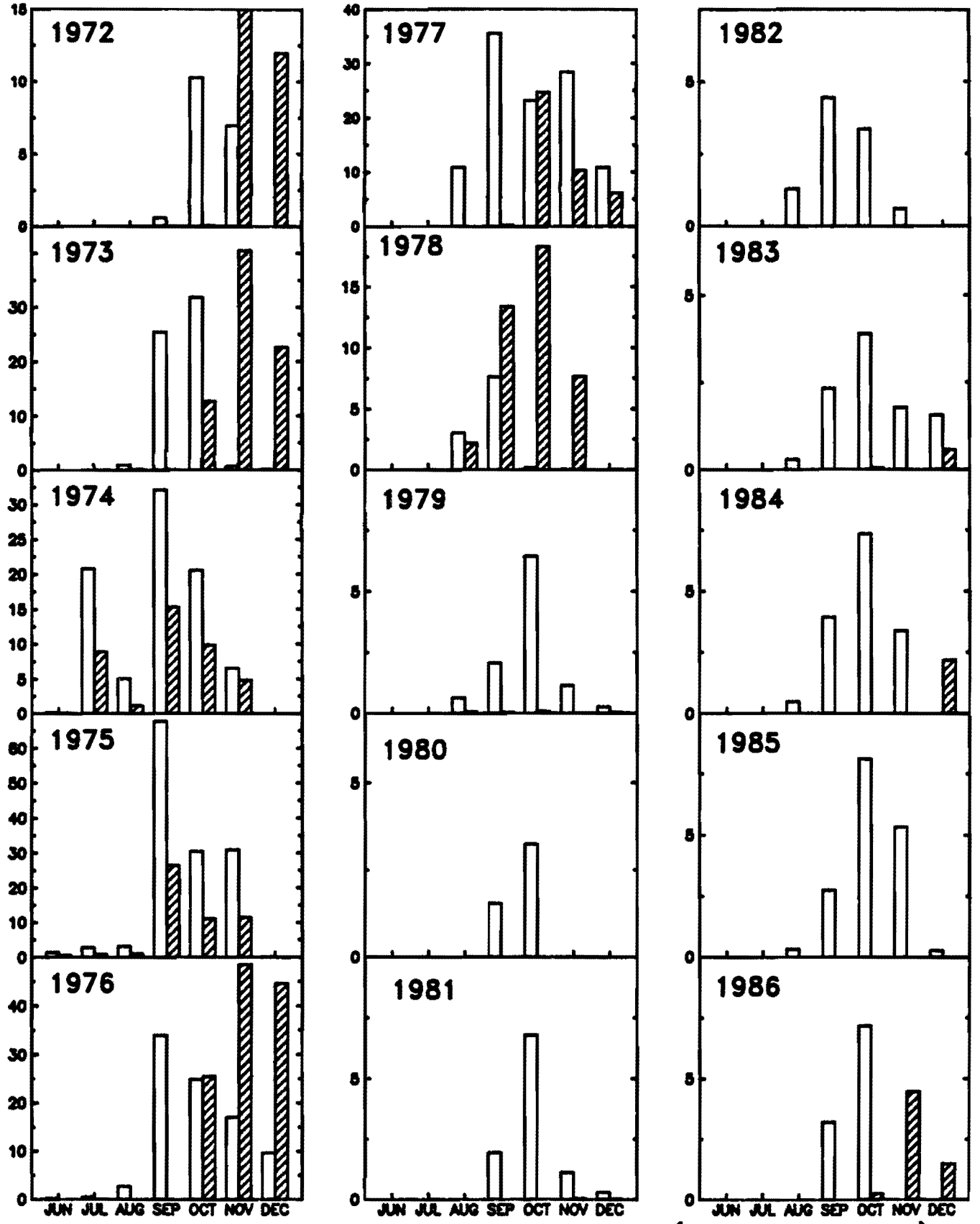

Figure 3a. Commercial fishery catches (1000's of tons)

(Open bars – Division 2J, Hatched bars – Division 3K)

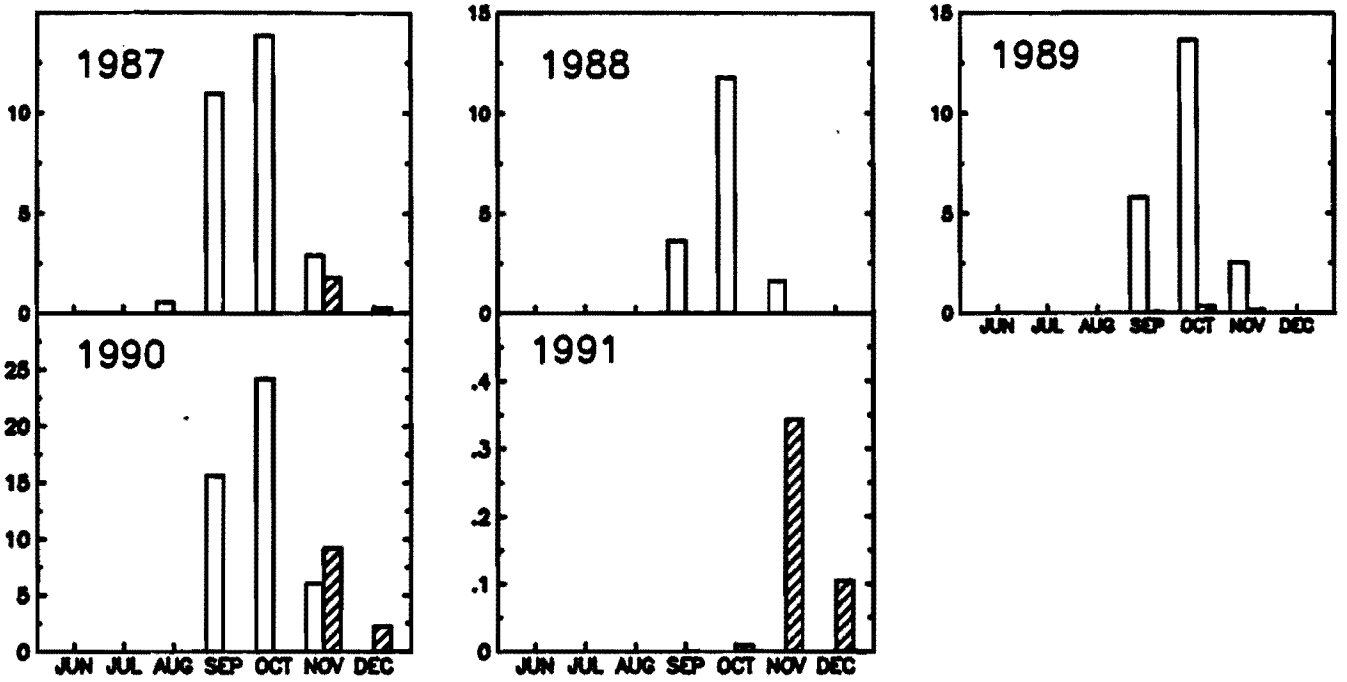

Figure 3b. Commercial fishery catches (1000's of tons)
(Open bars – Division 2J, closed bars – Division 3K)

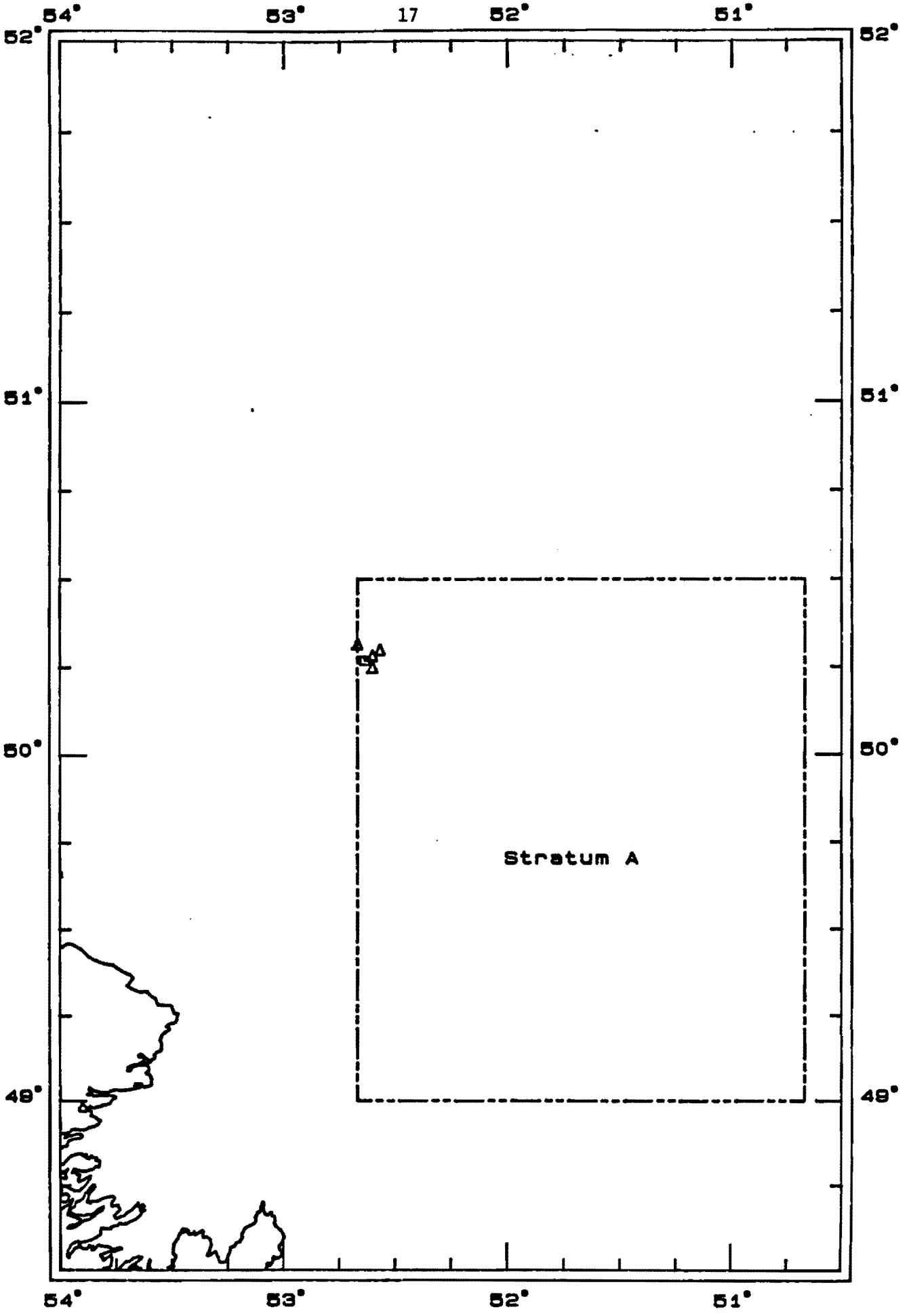

Fig. 4. USSR capelin fishery sample distribution.

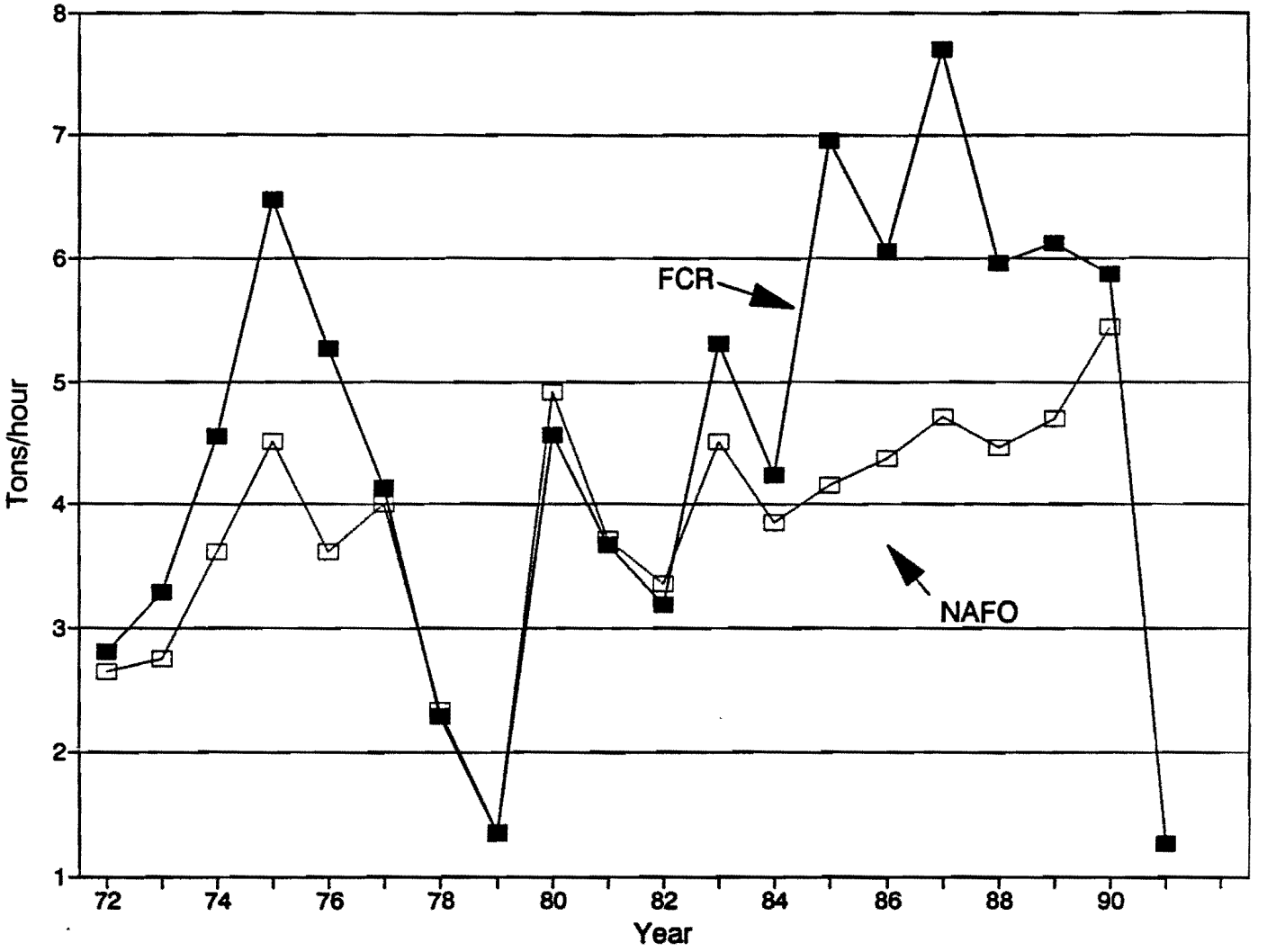

Figure 5. FCR and NAFO catch rates (tons/hour) for tonnage class 7 vessels.