Canadian Atlantic Fisheries
Scientific Advisory Committee

Comité scientifique consultatif des
pêches canadiennes dans l'Atlantique

CAFSAC Research Document 91/68

CSCPCA Document de recherche 91/68

Capelin in NAFO Div. 2J3K and Div. 3L

by

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Abstract

This paper presents the results of the examination of data from three sources: inshore catch rate data from Div. 3L and 3K and aerial survey indices from Div. 3L in relation to projections from offshore acoustic surveys, minimum trawlable biomass estimates of capelin from groundfish surveys and capelin bycatch in the shrimp fishery.

The acoustic biomass projections from Div. 3L were significantly correlated with aerial survey indices and catch rate indices from Div. 3L. Trap and purse seine catch rates from Div. 3L were significantly correlated with catch rates from the same gear in Div. 3K. There were no significant relationships between biomass projections from Canadian acoustic surveys in Div. 2J3K and Div. 3K inshore trap and purse seine catches. When USSR acoustic surveys were used as a basis for projections, there was a significant relationship with trap catch rates but not purse seine catch rates. When projections from Canadian acoustic surveys in Div. 3L were compared to inshore catch rates in Div. 3K, only the trap catch rate - acoustic projection relationship was significant ($P \leq 0.10$).

Minimum biomass estimates for capelin from groundfish surveys were low. The highest estimate in Div. 2J3K was 11,000 t and for Div. 3L, 1700 t. There were no significant relationships between the minimum biomass estimates and other indicators of capelin abundance.

The shrimp fishery in Div. 2J and 3K is relatively new. Capelin occur as a bycatch in a high proportion of shrimp catches but the proportion of total catch weight is small.

Résumé

Le présent document contient les résultats de l'analyse de données provenant de trois sources, soit : les données sur le taux de prises de la pêche côtière dans les divisions 3L et 3 K et les indices établis dans le cadre d'un relevé aérien de la Division 3L par rapport aux projections découlant d'études acoustiques de la pêche hauturière; les estimations de la biomasse minimale exploitable de capelan établies d'après les évaluations du poisson de fond; et les prises accidentelles dans la pêche de la crevette.

Il existe une nette corrélation entre les projections de biomasse obtenues par étude acoustique dans la division 3L et les indices des relevés aériens ainsi que ceux des taux de prises dans cette division. Une importante corrélation se dégage également entre les taux de prises au parc en filet et à la senne coulissante dans la division 3L et dans la division 3K. Il n'existe pas de relation notable entre les projections de biomasse obtenues dans le cadre de l'étude acoustique canadienne dans les divisions 2J3K et les prises de la pêche côtière au parc en filet et à la senne coulissante dans la division 3 K. Les projections fondées sur les études acoustiques réalisées par l'U.R.S.S. sont en étroite corrélation avec les taux de prises au parc en filet, mais non avec les taux de prises à la senne coulissante. Lorsqu'on compare les projections fondées sur l'étude acoustique canadienne dans la division 3 L et les taux de prises de la pêche côtière dans la division 3 K, seul le taux de prises au parc en filet est en étroite corrélation avec les projections ($P \leq 0.10$).

Les estimations de la biomasse minimale de capelan provenant des évaluations du poisson de fond sont faibles, les plus élevées étant de 11 000 t pour les divisions 2J3K et de 1 700 t pour la division 3L. Il n'y pas de relation marquée entre les estimations de la biomasse minimale et d'autres indicateurs de l'abondance du capelan.

La pêche de la crevette dans les divisions 2J et 3K est relativement nouvelle. Le capelan est présent sous forme de prises accidentelles dans une bonne proportion des prises de crevettes, mais il ne représente qu'un faible pourcentage du poids total de ces prises.

Introduction

During the February 1991 assessment of the capelin stock in NAFO Div. SA2 + Div. 3K, the usual sources of data (acoustic biomass estimate, fishery catch rates and fishery sampling data) along with new data on stock structure were available to assess the stock. The primary data source used for projections was the 1990 Canadian acoustic survey. The biomass estimate from this survey was very low resulting in a projected low spawning biomass for 1991. There was some concern that this estimate may have underestimated the true stock size and as a result, personnel from the Newfoundland Region were asked to examine other data sources to further evaluate the status of this stock.

This paper presents the results of the examination of data from three sources: inshore catch rate data from Div. 3L and 3K and aerial survey indices from Div. 3L in relation to projections from offshore acoustic surveys, minimum trawlable biomass estimates of capelin from groundfish surveys and capelin bycatch in the shrimp fishery.

1) Inshore Catch Rates and Projections from Acoustic Surveys

We have examined the relationships between mature capelin biomass projected from acoustic surveys in Div. 3L and Div. 2J3K and the inshore indices of abundance as well as the relationships between the inshore indices between Div. 3K and Div. 3L.

a) First, the relationship between the mature biomass projected from acoustic surveys in Div. 3L and the indices of abundance from the inshore fishery for mature fish was examined.

The projections for mature biomass were performed during STACFIS meetings of NAFO (see for example, NAFO Sci. Coun. Rept. 1989, p. 101) and have used standard projection parameters (mean weight at age, natural mortality, spawning mortality and maturity-at-age). Up to and including 1985, a combination of acoustic estimates by USSR and Canada was used. During this time period, acoustic surveys were performed in year x, reported during year x+1 and projected forward to year x+2. Beginning in 1986, the Canadian survey time was changed by about one month later and analytical procedures were streamlined. As a result, the survey results for a given year were available for the NAFO meeting of the same year so that essentially one year was eliminated from the sequence between data collection and the fishery. USSR survey results have not been available on this basis and have not entered into the projections since 1985.

Inshore indices of abundance are available from trap net and purse seine catch rates and aerial surveys (Carscadden et al. 1990, Nakashima 1990, Nakashima and Harnum 1990). The trap net and purse seine catch rate data are collected through the research logbook program; with the same procedures used in Div. 3L and 3K. During the aerial surveys, schools of capelin are photographed near the spawning beaches along two transects in each of Conception and Trinity Bays. Several coverages of each transect are usually possible each year, the exact numbers being dependent on

weather conditions. School surface areas are measured from the photographs and summed for each transect. The highest estimates of school surface area for each transect are summed and these values become an annual index of abundance. The results of the aerial survey are reported annually to NAFO.

The acoustic biomass projections are significantly correlated with all of the inshore indices (Table 1). While the trap catch rates and aerial survey indices are correlated, the purse seine catch rates are not correlated with the trap catch rates or aerial survey index (Table 1). The trends in the acoustic projections, aerial survey index and trap catch rates are shown in Figure 1 and the relationships between all indices are shown in Figure 2. Thus, we have two independent indicators of stock status inshore, one of which is fishery-independent (aerial survey), which are showing the same trends during the 1980's. Further, they are showing the same trends predicted from acoustic surveys of immature fish detected offshore, at least one year prior to entering the fishery. Thus, we conclude that the acoustic surveys in Div. 3L are providing reliable estimates of relative year-class strength to predict patterns in mature abundance inshore.

b) We then examined the relationship of trap and purse seine catch rates collected from the research logbook surveys in Div. 3L and Div. 3K. These were significantly correlated (trap $r^2 = 0.88$, purse seine $r^2 = 0.72$, $P \leq 0.05$) (Fig. 3).

c) We examined the relationship between mature biomass projected from Canadian fall offshore acoustic surveys in Div. 2J3K (Carscadden et al. 1989) and the inshore catch rates from the logbook program in Div. 3K. The mature biomass on 1 July was estimated from the previous year's acoustic survey using $M = 0.30$ (between spawning periods) and the parameters given in Table 2. Unlike the situation in Div. 3L, there was no significant relationship between the projected mature biomass from acoustic surveys and the inshore indices of abundance of mature fish, nor were the trap and purse seine catch rates in Div. 3K correlated (Table 3, Fig. 4).

d) USSR offshore acoustic surveys (Bakanev and Mamylov 1988) were also used as a basis for projections using the same projection parameters and procedures as outlined above for the Canadian surveys. The relationship between the projected biomass and 3K trap catch rates was significant but the relationship with 3K purse seine catch rates was not (Table 4, Fig. 5).

e) We then examined the relationship between projections from the Div. 3L acoustic surveys (from part a) above) and inshore catch rates in Div. 3K. Only the relationship between the acoustic projection and 3K trap catch rate was significant ($P \leq 0.10$) (Table, 5, Fig. 6).

2) Minimum Biomass Estimates from Bycatch in Groundfish Surveys

Stratified random groundfish surveys using bottom trawls have been conducted by Canada in Div. 2J3K mainly during November and December since 1979. The GADUS ATLANTICA has been used in all years. Timing of the surveys, until 1988, is shown in Figure 7. Surveys in 1989 and 1990 have continued during the November-December period. Trips 27 and 42 were not included in the analysis.

Fall surveys are also conducted during October-November in Div. 3L usually using the WILFRED TEMPLEMAN. The A. T. CAMERON was used during 1981 and 1982 and the ALFRED NEEDLER in 1986. We made no attempt to correct for any vessel differences in gear efficiency.

Minimum biomass estimates were calculated using the stratified analysis program (Tables 6 and 8). In all cases, capelin biomass estimates are low. For Div. 2J3K combined, the highest was 11,152 t in 1980 and the lowest was 399 t in 1985. The 1990 estimate was 531 t. The estimate for Div. 3L ranged from a low of 255 t in 1986 to a high of 1668 t in 1988. The 1990 estimate was 672 t.

There were no statistically significant relationships (Fig. 8) in the following combinations tested.

2J biomass versus 3K biomass
2J biomass versus 3L biomass
3K biomass versus 3L biomass
2J3K biomass versus 3L biomass
Canadian acoustic survey biomass versus 2J3K biomass
USSR acoustic survey biomass versus 2J3K biomass
2J3K biomass (year + 1) versus 3K trap catch rate
2J3K biomass (year + 1) versus 3K purse seine catch rates

Age-compositions from the catches in the groundfish surveys are shown in Table 9. There is a trend towards a greater incidence of younger capelin towards the south, especially in Div. 3L. The bottom trawls used by the TEMPLEMAN and GADUS ATLANTICA differ in only minor ways so the differences in age composition between Div. 2J3K and Div. 3L probably reflect biological differences. The midwater trawl samples taken during the Canadian acoustic surveys show a trend towards smaller fish from Div. 2J to Div. 3K.

3) Bycatch in the Shrimp Fishery

The shrimp fishery in Div. 2J and 3K is relatively new. Significant catches in Div. 2J have been recorded since 1986 and in Div. 3K since 1987 (Table 10). The catch breakdown by NAFO Div. is approximate because the catches are reported according to "stock areas" (e.g. Cartwright, St. Anthony Basin, Funk Island Deep) some of which overlap the two NAFO Divisions. In addition, catches are tabulated in CAFSAC shrimp documents on a fishing season. However, the catch data indicate that the shrimp fishery is recent.

A monthly summary of observations made by fisheries observers (D. Kulka, pers. comm.) is given in Table 11. It is obvious that capelin occur in a fairly high proportion of shrimp sets (% of observed sets with capelin), especially in 1989. However, the % of total catch weight is fairly small (usually less than 5%). There are several instances where the monthly catch is small (<50 t).

The annual summary (Table 12) indicates that observer coverage has been increasing. In Div. 2J, observer coverage was good during 1986-89 but shrimp bycatch was less than 1% except in 1989. In Div. 3K, coverage was good in 1988 and 1989 and shrimp bycatch was highest in 1989.

References

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Table 1. Projected biomass for acoustic surveys in Div. 3L, trap and purse seine catch rates in Div. 3L and aerial survey indices in Div. 3L. Bottom of the table shows correlation coefficients (upper right) and probability levels (lower left).

Year	Projected biomass (1000's t)	Trap catch rate (t/day)	Purse seine catch rate (t/day)	Aerial survey index
1981		2.9	9.4	
1982	346	3.1	16.4	223.2
1983	648	3.4	18.8	367.3
1984	384	2.9	14.3	216.5
1985	596	4.6	16.4	357.3
1986	1300	4.6	19.0	283.3
1987	2830	8.8	18.1	763.0
1988	900	6.2	20.7	447.9
1989	3345	6.7	24.3	635.9

	Projected	Trap catch	Purse seine	Aerial
Proj. biomass	-	.833	.707	.886
Trap	.010	-	.544	.944
Purse seine	.050	.164	-	.593
Aerial	.003	.0004	.122	-

Table 2. Values of proportion mature and mean weight (g) by age used in projections.

Age	Proportion mature	Mean wt. (g) inshore mean (1979, 1982-89)
3	.22	29.9
4	.64	37.3
5	.77	35.1
6	.89	36.7

Table 3. Projected biomass from Canadian acoustic surveys in Div. 2J3K, trap and purse seine catch rates in Div. 3K. Bottom portion of table shows correlation coefficients (upper right) and probability levels (lower left).

Year	Projected biomass (1000's t)	Trap catch rate (t/day)	Purse seine catch rate (t/day)
1981			9.2
1982			15.5
1983		3.3	12.0
1984	43.3	4.1	14.1
1985	427.1	3.2	16.5
1986	603.9	5.8	18.0
1987	301.7	10.5	15.3
1988	49.4	5.9	18.5
1989	931.4	5.8	16.7
1990	1076.4	10.7	21.8

	Projected	Trap	Purse seine
Proj. biomass	-	.402	.623
Trap	.371	-	.465
Purse seine	.135	.293	-

Table 4. Projected biomass from USSR acoustic surveys in Div. 2J3K, trap and purse seine catch rates in Div. 3K. Bottom of table shows correlation coefficients (upper right) and probability levels (lower left).

Year	Projected biomass (1000's t)	Trap catch rate (t/day)	Purse seine catch rate (t/day)
1983	461.2	3.2	12.0
1984	489.0	4.1	14.1
1985	214.5	3.2	16.5
1986	852.9	5.8	18.0
1987	1059.0	10.5	15.3
1988	535.3	5.9	18.5

	Projected	Trap	Purse seine
Proj. biomass	-	.892	.161
Trap	.017	-	.249
Purse seine	.761	.634	-

Table 5. Correlation coefficients (upper right) and probabilities (lower left) between projected biomass from acoustic surveys in Div. 3L and inshore catch rates in Div. 3K.

	Projected biomass 3L	Trap 3K	Purse seine 3K
Projected biomass 3L	-	.704	.216
Trap 3K	.078	-	.254
Purse seine 3K	.641	.583	-

Table 6. Biomass estimates (kg) of capelin by strata from fall stratified random groundfish surveys in NAFO Div. 2J.

Stratum	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
201	0	0	0	0	4070	3749	1785	0	0	0	0	0	803	179
202	0	0	0	0	2147	49542	0	1651	0	0	330	–	330	198
203	0	–	–	0	0	0	1201	0	961	0	0	0	4204	180
204	0	–	–	0	0	0	0	0	0	0	266	0	2657	0
205	7389	0	428316	290789	5953484	236281	2224	1711	26855	0	411	159649	23674	342
206	881	0	4853147	2574981	135671	20028	12598	28368	19243	1762	0	64375	24600	176
207	0	0	10790	0	34655	14429	0	4817	9102	0	307	956170	0	0
208	0	0	1513	0	0	1233	0	0	7286	0	0	504	1681	1513
209	0	0	47316	8056941	6035	3621	1626	56041	2146	2586	302	483	45716	0
210	484	0	0	0	5810	1077	0	4793	16496	495784	2457617	42606	34030	5084
211	1115	0	619	33028	0	248	74314	1239	826	0	12386	0	661	2824
212	0	–	–	–	0	299	166	0	0	0	2492	0	748	3489
213	0	0	0	0	242786	16883	0	1295	8345	0	0	16186	16757	0
214	0	0	0	0	0	4395	110	440	14650	0	0	0	1055	0
215	0	0	0	0	0	1059	834	0	0	0	0	272	52273	1059
216	0	–	0	0	144	0	0	0	0	0	0	0	0	0
217	0	–	–	–	0	0	0	–	0	0	0	0	0	0
218	0	–	–	–	0	0	0	–	0	0	0	0	0	0
219	–	–	–	–	0	–	0	–	0	0	0	0	0	0
222	0	0	0	0	0	0	0	0	0	0	0	828	0	0
223	0	–	–	–	0	0	0	0	0	0	0	0	0	0
224	0	–	–	–	0	0	0	0	0	0	0	0	0	0
225	–	–	–	–	–	–	–	–	–	–	–	–	–	–
227	0	–	–	–	0	0	0	172	0	0	644	0	6952	2626
228	0	–	0	0	0	0	0	24501	18376	44663	503801	0	1206	0
229	0	0	0	0	0	0	0	0	0	6100	0	0	1986	0
230	0	–	–	–	0	0	0	0	0	0	178	0	0	0
231	0	–	–	–	–	0	0	0	0	342	0	0	–	0
232	0	–	–	–	–	–	–	–	–	–	–	–	–	–
234	1716	0	3432	0	763	3813	0	2288	0	1907	0	0	953	0
235	1103	–	–	–	0	525	0	0	0	0	2365	0	0	631
236	0	–	–	–	0	0	0	0	0	137	0	0	–	0
Total	12689	0	5345133	10955739	6385566	357133	94858	127314	124285	553282	2981097	1241073	220286	18301
Upper Limit	37547	–	15879835	26566156	20327410	751486	1050144	217134	178038	2492163	7947510	3512506	343394	27014
Lower Limit	-12170	–	-5189570	-4654677	-7556280	-37220	-860429	37494	70533	-1385600	-1985317	-1030360	97178	9588

Table 7. Biomass estimates of capelin (kg) by strata from fall stratified random groundfish surveys in NAFO Div. 3K.

Stratum	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
618	–	–	–	–	–	–	8260	0	123417	0	168378	15154	0
619	–	–	–	–	–	–	7493	10558	2384	45297	271951	894	477
620	0	46480	0	1353287	6778	528707	223684	123574	3841	259996	117434	580358	12156
621	0	6438	0	3902	301985	18599	36627	68981	496114	706956	30474	40144	26729
622	–	–	–	474	0	35580	3677	3558	0	6325	2688	7590	2372
623	0	0	9636	28909	1542	6424	160606	15418	3855	339200	4625	26853	174052
624	0	0	0	0	0	0	7647	11909	15043	0	0	167	5140
625	0	4892	0	0	0	0	2552	1404	14888	5264	21215	957	6540
626	862	1150	0	138	0	6209	5588	11497	0	22765	34492	12969	23799
627	–	–	–	148	1904	4888	13331	0	4444	13035	17064	7999	19553
628	0	2036	20361	0	27012	9230	32849	582	3054	73463	4235	7941	6353
629	0	5057	3746	0	0	15607	8428	936	0	31339	4869	8365	4682
630	–	0	0	2246	–	5104	30881	0	6125	65336	20417	3539	2450
631	–	–	–	3609	22557	4511	6445	16241	5414	39098	7820	18948	8872
632	0	0	0	0	0	0	0	–	0	0	0	0	9395
633	0	1363	0	4089	0	0	0	0	73604	36430	1227	22665	141688
634	0	1822	4858	13880	38644	0	4048	1735	6074	11152	202	5010	25505
635	0	18170	19126	574	21039	28690	4508	5977	2527	9244	0	6011	2710
636	0	0	58978	5461	10922	0	1092	683	0	1872	1274	437	468
637	212	2974	25492	4957	48799	31950	7405	2124	2127	2974	2124	1869	8157
638	0	3091	51519	5023	87582	3653	113108	0	12365	13292	386	703	183380
639	0	0	2745	7321	45026	0	35005	0	183	6275	0	0	10511
640	–	–	–	0	0	0	0	0	0	0	74	0	0
641	–	–	–	0	0	0	0	0	–	0	–	–	0
642	–	–	–	0	0	–	0	0	–	00	–	–	2795
645	–	–	–	0	0	0	0	0	–	0	0	306	0
646	–	–	–	0	0	0	0	0	–	0	–	–	375
647	–	–	–	0	0	–	0	–	–	–	–	–	0
Total	1075	93472	196462	1434019	613791	699154	713233	275177	775454	1689315	710953	768881	513159
Upper Limit	3901	156419	320490	2915080	1219172	1777584	1089734	412923	1513594	2733245	1234495	1696286	979227
Lower Limit	–1751	30526	72434	–47042	8410	–379276	336732	137431	37314	645386	187410	–158525	47091

Table 8. Biomass estimates by strata (kg) of capelin from fall stratified random groundfish surveys in NAFO Div. 3L.

Stratum	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
328	–	–	–	88367	998	380	19954	0	16289	7982
341	19692	0	0	42534	3038	169	12734	443	5908	2363
342	0	0	2196	0	0	9399	4391	1464	0	0
343	0	–	2627	37931	0	0	657	18128	0	91954
344	0	0	6729	188779	221177	131053	11495	57835	11535	1308
345	9137	19886	4972	68078	8035	107492	44532	33783	10749	
346	0	16720	2337	33764	3896	0	5194	11131	0	
347	122980	222287	9838	9838	147576	3848	0	113634	22432	5165
348	31827	13367	4195	68201	2022	3536	53470	17859	253460	
349	0	6347	882	37971	0	992	11267	353	2380	0
350	0	0	583	12955	0	0	0	1865	155	0
363	0	0	0	0	0	954	0	0	0	0
364	1410	0	1922	12687	8811	0	302	15406	6728	352
365	0	21880	31257	123073	100217	0	391	115962	145735	108226
366	3488	17440	52320	7610	82549	0	18686	375955	468024	28078
368	125357	3761	–	0	3761	0	0	2507	5265	0
369	108205	66005	148602	145304	20799	0	24346	101424	89450	3968
370	0	6936	165	708	18166	4954	495	17694	24771	0
371	0	0	0	0	0	0	0	0	0	0
372	0	0	0	1420	0	0	142	0	0	0
384	0	0	0	0	2207	0	280	0	1681	0
385	0	66319	176851	38907	34633	36264	2948	22447	15274	1516
386	0	27671	–	48423	12544	29515	5534	698036	5903	0
387	2695	109589	–	0	8084	0	39524	1078	3593	0
388	–	9484	–	4200	6775	–	0	2710	0	0
389	–	83197	–	74980	13558	13356	1541	2311	616	6574
390	0	55585	5585	0	156432	3706	12507	13062	24616	150635
391	–	5292	0	15876	8891	4234	39161	2646	2117	0
392	–	14694	544	0	3265	2177	0	0	0	0
729	–	–	–	0	0	0	–	–	–	140
730	–	–	–	1595	0	–	–	–	–	–
731	–	–	–	0	0	–	–	–	–	0
732	–	–	–	0	0	–	–	–	–	0
733	–	–	–	0	1171	–	–	–	–	0
734	–	–	–	0	0	–	–	–	–	0
735	–	0	–	0	0	0	–	–	–	–
736	–	–	854	–	2627	0	–	–	–	0
Total	424791	766460	502459	1240657	1027322	254953	317382	1668157	915244	672471
Upper limit	1089671	1457571	920574	1979991	1585853	470458	513214	2528514	1604090	1315619
Lower limit	-240089	75348	84344	501324	468792	39449	121550	807799	226399	29323

Table 9. Age compositions of capelin taken in fall stratified-random groundfish surveys. Number of samples in parenthesis.

			Age					
			1	2	3	4	5	6
Div. 2J								
Oct./Nov.	1981	(5)	.6	59.0	33.0	5.0	2.2	
Nov.	1982	(1)		39.9	55.0	5.0		
Nov.	1987	(1)		.5	8.3	72.3	18.9	
Nov.	1988	(2)		57.5	31.5	4.3	6.7	
Div. 3K								
Nov./Dec.	1982	(2)		11.8	87.9	.3		
Nov.	1987	(2)		53.8	21.1	20.1	5.1	
Dec.	1988	(3)	9.8	71.5	17.3	.7	.6	
Div. 3L								
Nov.	1981	(2)	.8	9.6	59.8	28.5	1.3	
Nov./Dec.	1982	(2)	6.2	46.5	43.6	3.7		
Oct.	1983	(3)	36.6	28.2	12.7	21.7	.8	
Oct./Nov.	1985	(9)	15.1	75.0	9.6	0.1		
Oct./Nov.	1988	(3)	14.2	83.8	1.5	.2	.3	
Oct.	1987	(3)	37.0	38.7	23.9	.4		

Table 10. Approximate (see text) shrimp catches for NAFO Div. 2J and 3K, 1984-90.

Area	1984	1985	1986	1987-88*	1988-89*	1989-90
Div. 2J	290	2	2317	4123	2934	3825
Div. 3K	0	0	48	4113	4704	3715

* Fishing season changed from calendar year to May 1-April 30 from 1987 onward.

Table 11. Capelin bycatch in NAFO Div. 2J3K shrimp fishery. Numerator is % of observed sets with capelin and denominator is capelin as % of total observed catch weight. * denotes total monthly observed catch is less than 50 t while ** denotes total monthly observed catch is less than 10 t.

	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Div. 2J												
1984											**14/0.0	
1986											*0/0	1/0
1987	20/0					0/0	*0/0		**0/0	38/0.3	21/0.1	0/0
1988	*11/0.1	47/0	43/0.6	32/1.5	3/0	**0/0	**50/1.4	**0/0		**100/0.8		**0/0
1989	89/2.5	88/1.9	95/14.4	90/4.5	31/0.1	*0/0	**0/0	*8/0	35/0	*36/0		76/0.3
Div. 3K												
1987	59/0								**100/0.1	**100/13.1	66/1.0	
1988	**100/9.8	92/3.3	44/0.5	45/0.9			**33/1.4	**50/4.5		76/0.3	**0/0	*69/0.8
1989	55/2.1	73/5.3	80/6.3	63/3.1	30/0.2		**0/0	**100/0.1	**0/0	**0/0		

Table 12. Capelin bycatch in NAFO Div. 2J3K shrimp fishery.

Area	Total shrimp catch (t) observed	Total capelin catch (t) observed	Capelin % of of shrimp catch	Capelin % of total catch (all species)	Total sets observed	Total sets of capelin
Div. 2J						
1984	2.7	0.001	0	0	8	1
1986	988.1	0.035	0	0	391	5
1987	1521.5	0.70	0	0	729	75
1988	3392.2	26.45	0.8	0.7	1194	320
1989	4693.7	162.84	3.5	3.0	1988	1172
Div. 3K						
1987	108.5	1.98	1.8	0.9	127	83
1988	1804.8	22.11	1.2	0.8	1087	540
1989	3009.9	200.27	6.7	4.6	2858	2020

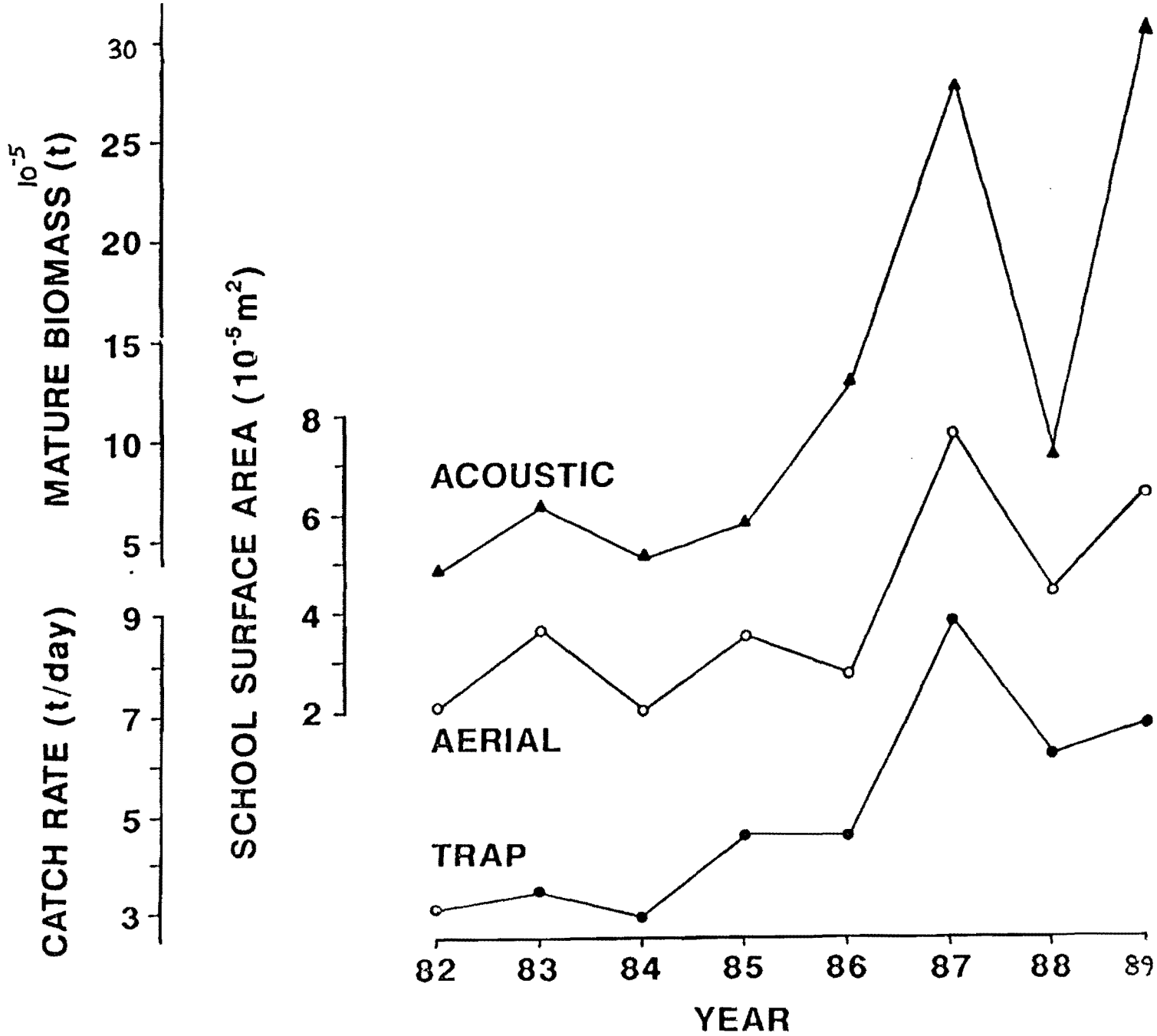


Fig. 1. Trends in biomass projected from Div. 3L acoustic surveys, Div. 3L trap catch rates and aerial surveys in Div. 3L.

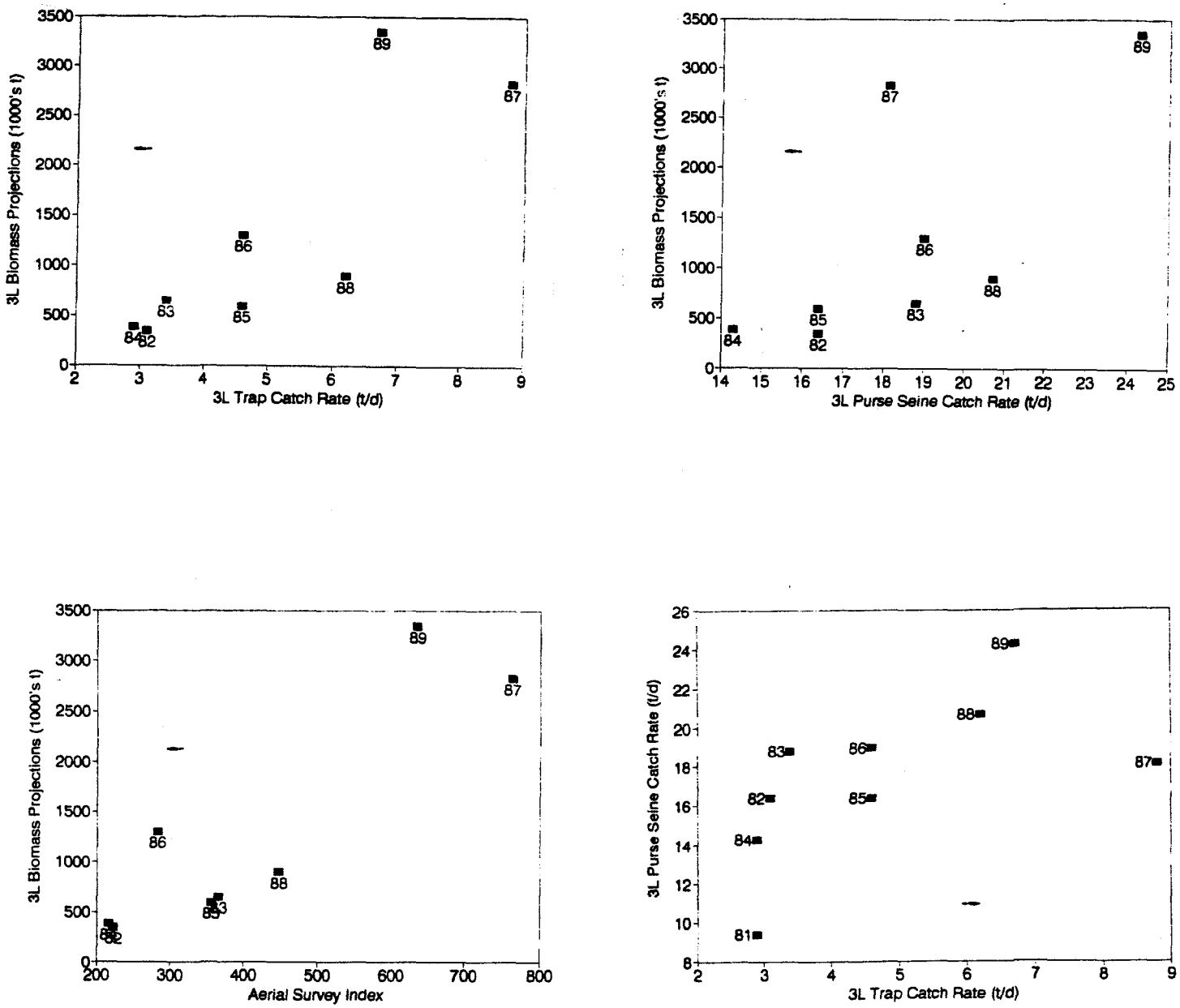


Fig. 2. Relationships between biomass projected from Div. 3L acoustic surveys and inshore indices in Div. 3L.

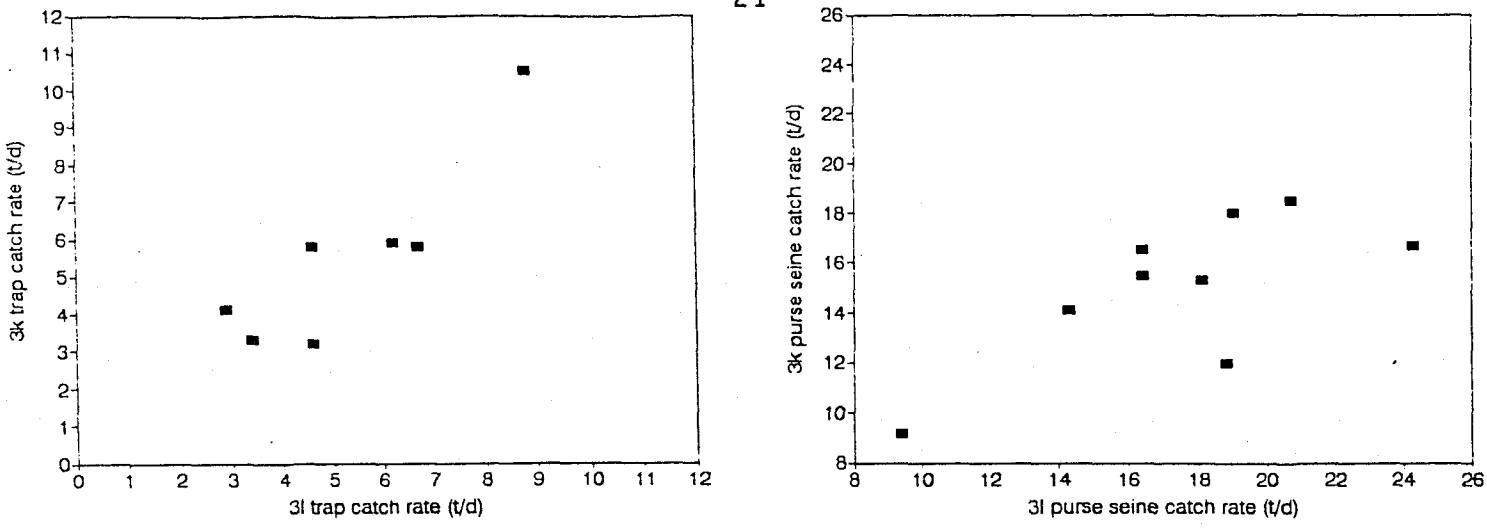


Fig. 3. Relationships between trap and purse seine catch rates in Div. 3L and 3K.

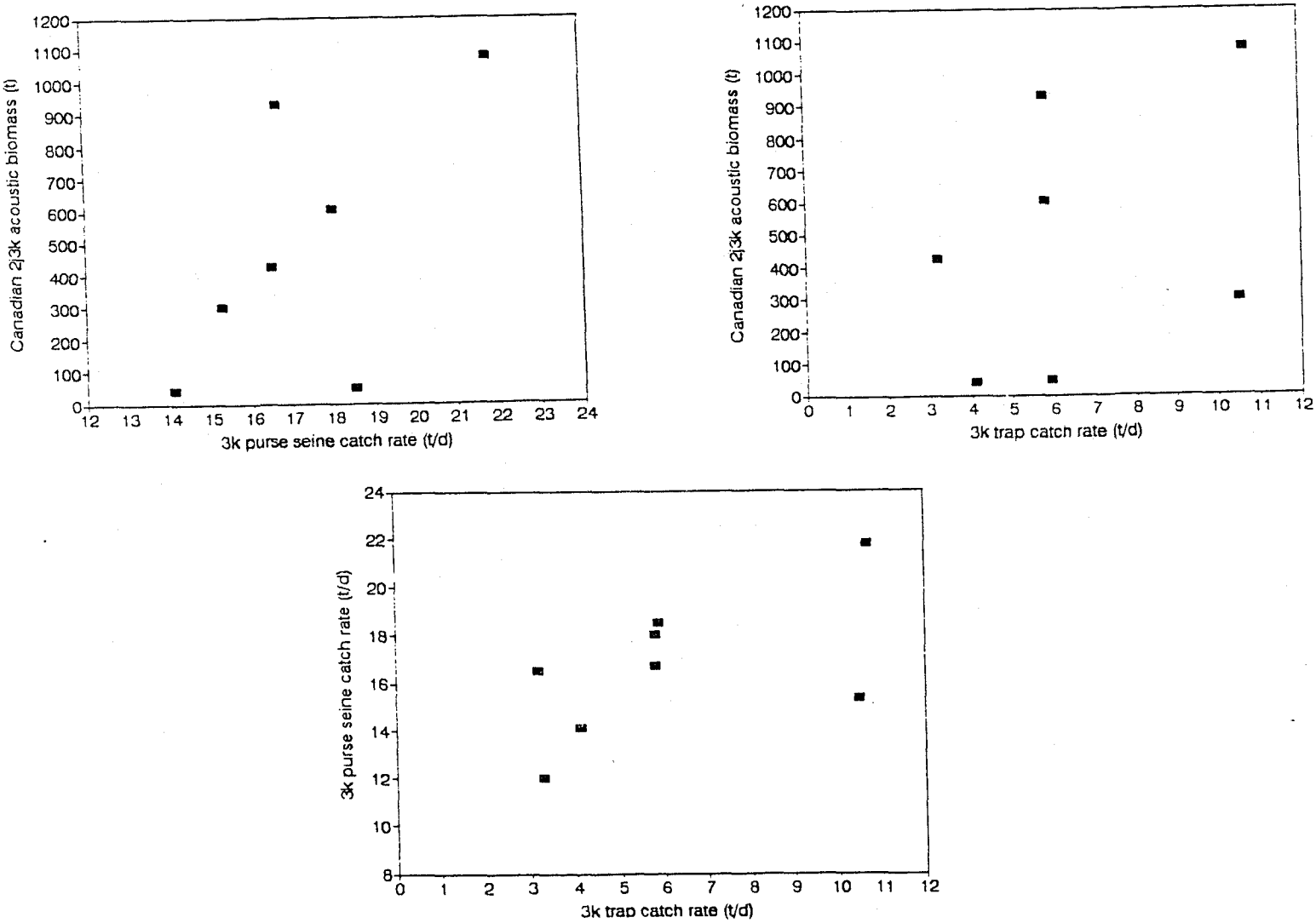


Fig. 4. Relationships between biomass projected from Canadian acoustic surveys in Div. 2J3K and inshore catch rates in Div. 3K.

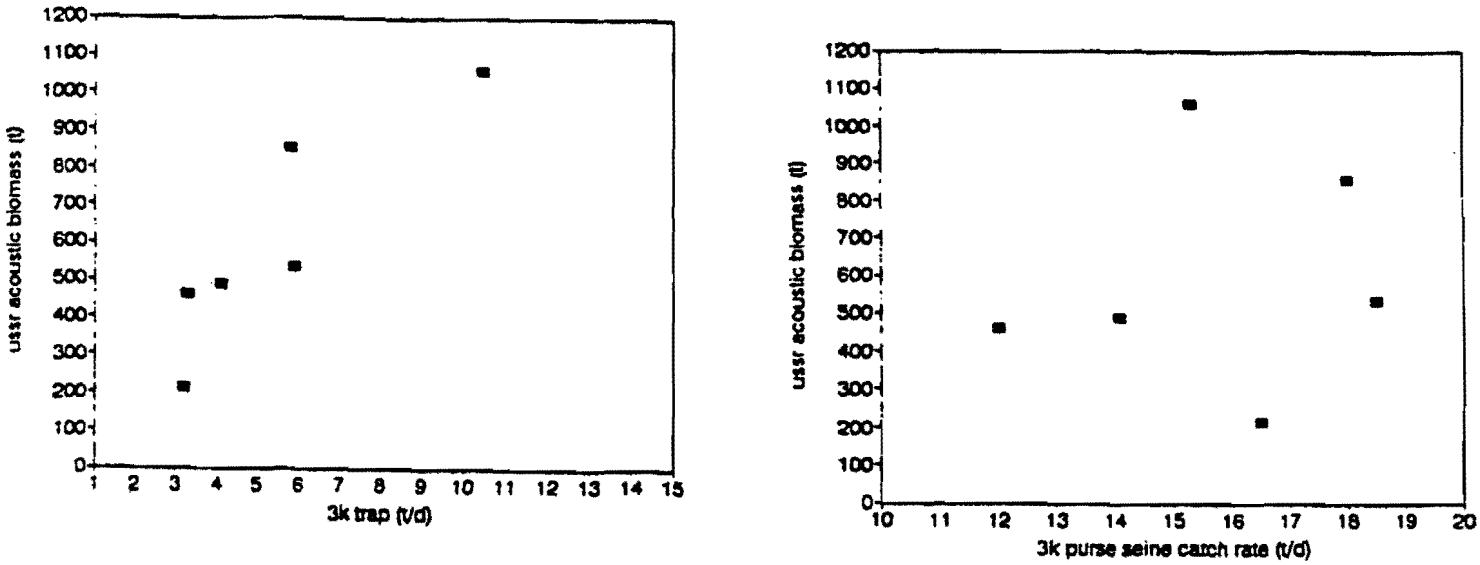


Fig. 5. Relationships between biomass projected from USSR acoustic surveys in Div. 2J3K and inshore catch rates in Div. 3K.

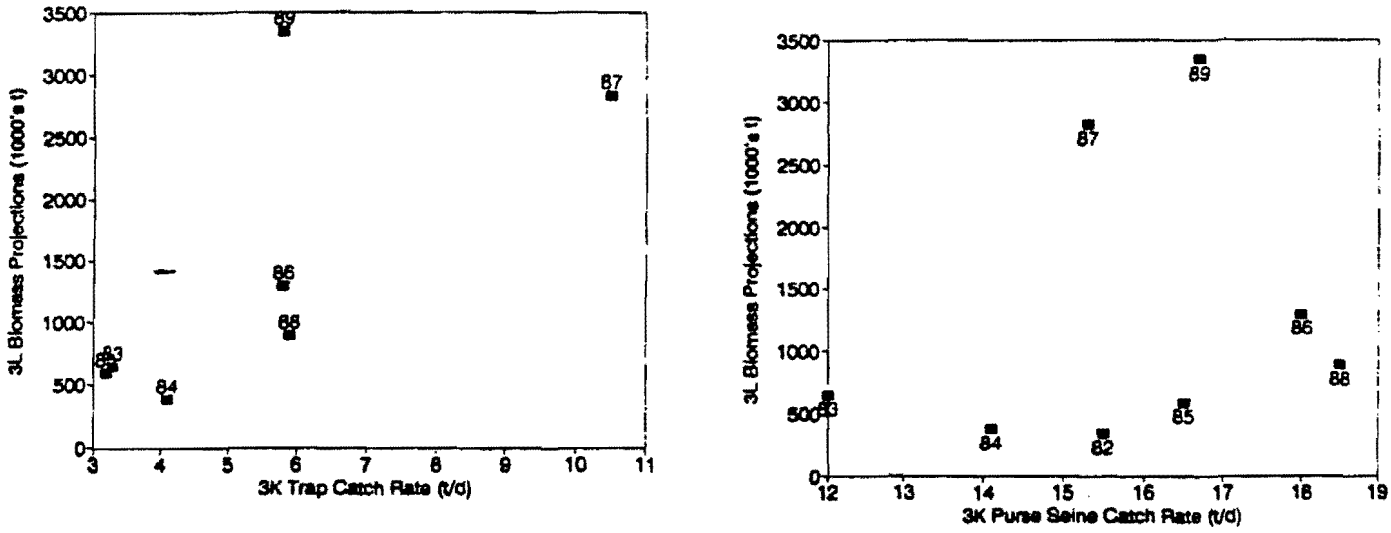


Fig. 6. Relationships between biomass projected from Div. 3L acoustic surveys and inshore catch rates in Div. 3K.

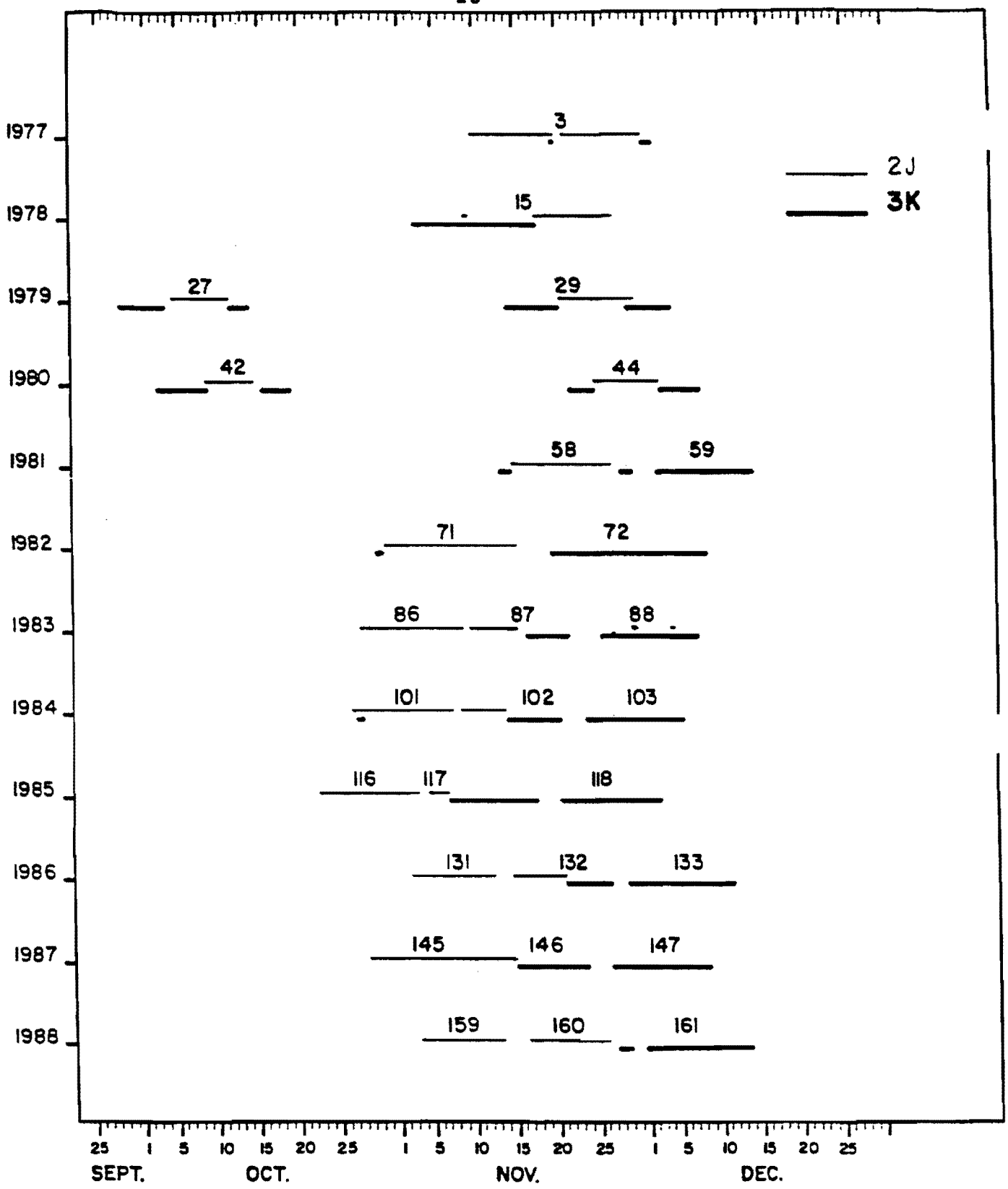


Fig. 7. Timing of random depth-stratified bottom-trawl surveys in NAFO Division 2J3K during the autumns of 1977-88. GADUS ATLANTICA trip numbers are shown above each survey period.

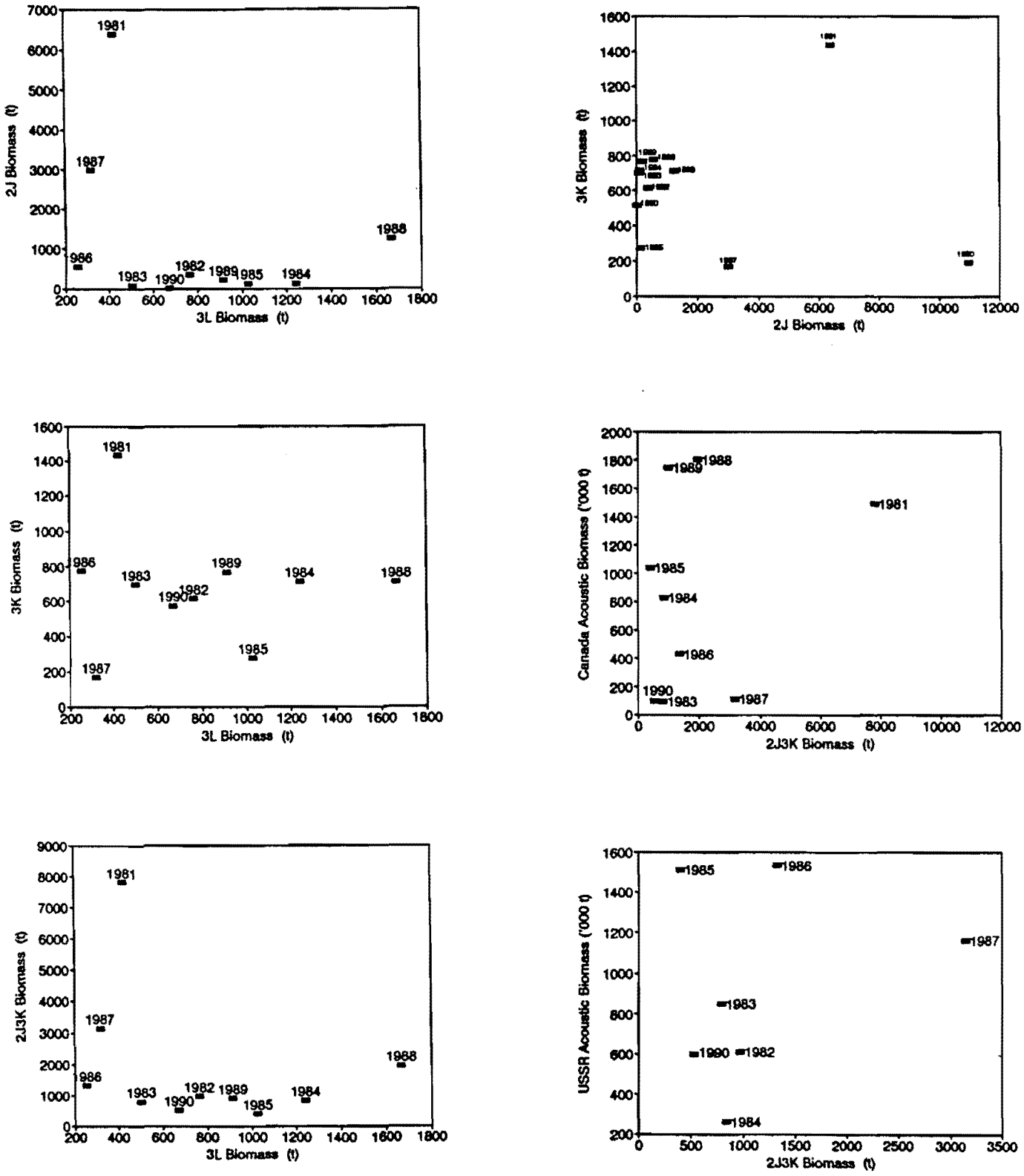
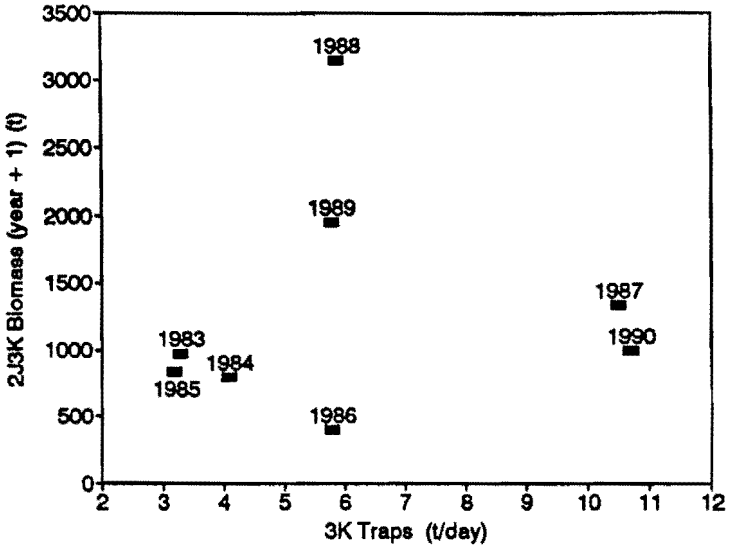


Fig. 8. Relationships between minimum trawlable biomass of capelin from stratified random groundfish surveys and acoustic surveys and inshore catch rates.


2J3K Biomass (year + 1) (t)
3K Traps (t/day)
1988
1989
1987
1990
1983
1984
1985
1986

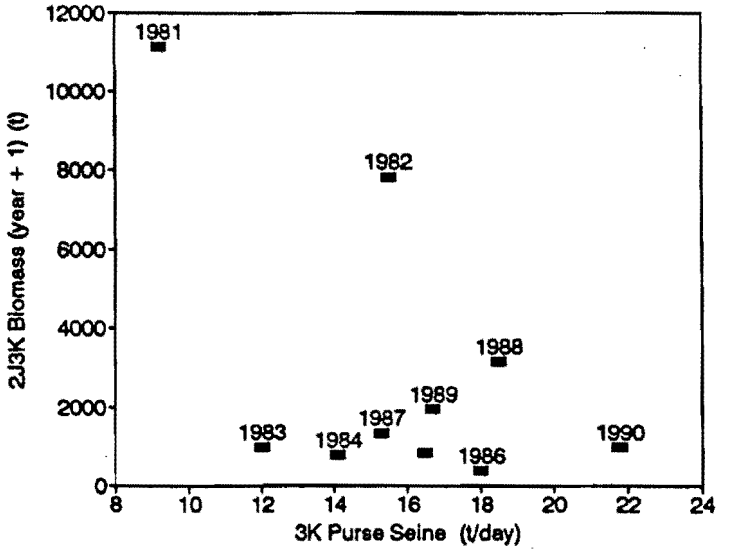

2J3K Biomass (year + 1) (t)
3K Purse Seine (t/day)
1981
1982
1988
1989
1987
1983
1984
1986
1990

Fig. 8.