Not to be cited without
permission of the authors[1]

Canadian Atlantic Fisheries
Scientific Advisory Committee

CAFSAC Research Document 86/90

Ne pas citer sans
autorisation des auteurs[1]

Comité scientifique consultatif des
pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 86/90

Capelin in NAFO SA2 + Div. 3K

by

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

[1] This series documents the scientific basis for fisheries management advice in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the Research Documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research Documents are produced in the official language in which they are provided to the Secretariat by the author.

[1] Cette série documente les bases scientifiques des conseils de gestion des pêches sur la côte atlantique du Canada. Comme telle, elle couvre les problèmes actuels selon les échéanciers voulus et les Documents de recherche qu'elle contient ne doivent pas être considérés comme des énoncés finals sur les sujets traités mais plutôt comme des rapports d'étape sur les études en cours.

Les Documents de recherche sont publiés dans la langue officielle utilisée par les auteurs dans le manuscrit envoyé au secrétariat.

Abstract

This paper summarizes data from offshore research activities and from the commercial offshore fishery for capelin in NAFO SA2 + Div. 3K. A comparison of distribution and timing of the commercial capelin fishery and the Canadian acoustic surveys for capelin indicated that the surveys are conducted at a time appropriate to estimate capelin abundance. Capelin age compositions from the Canadian surveys generally exhibit higher proportions of younger fish than age compositions from the commercial fishery probably because of the fine-mesh liner in the survey gear. In most years, Soviet fishery samples and Canadian research samples agreed in the identification of the relative strengths of year-classes. A comparison between the Canadian acoustic surveys for capelin and distribution of capelin taken during groundfish surveys indicated that the acoustic coverage of strata containing capelin during the groundfish survey was generally good in Div. 2J but not so complete in Div. 3K.

Commercial catch rates from different sources showed a similar pattern since 1977 when the dominant gear has been TC7 USSR midwater trawlers. There was a decline through the late 1970's and then a general increase since then. Concern has been expressed about the comparability of commercial catch rates between recent years and earlier years in the series.

Catch rates of capelin from groundfish sets exhibited different trends depending on the treatment of the data. Because the groundfish surveys are not designed to sample pelagic, schooling fish that exhibit diel migrations these catch rates may not be suitable as abundance indices but may be useful to describe the distribution of capelin.

USSR acoustic estimates were available from 1974-84 (except for 1981) and the trends of this series and commercial catch rates were similar. Canadian acoustic estimates were available only for 1981-85 (except for 1982). The trend of this series was different from the commercial catch rate series but more similar to the catch rates of capelin from the groundfish surveys.

RESUME

Le présent document résume les données sur les activités de recherche et de pêche hauturières pour le capelan dans la sous-zone 2 et la division 3K de l'OPANO. Une comparaison entre, d'une part, la distribution et la période de pêche commerciale du capelan et, d'autre part, les relevés acoustiques canadiens du capelan a révélé que ceux-ci sont menés à un moment approprié pour l'estimation de l'abondance de l'espèce. Les compositions selon l'âge tirées de relevés canadiens montrent en général des proportions plus élevées de jeunes poissons que les compositions selon l'âge obtenues de la pêche commerciale; ceci est probablement dû à l'utilisation d'un maillage fin dans les engins de relevé. Pour la plupart des années, les échantillons prélevés dans les captures russes et les échantillons canadiens expérimentaux concordaient pour ce qui est de l'établissement des tailles relatives des classes d'âge. Une comparaison entre les relevés acoustiques canadiens du capelan et la distribution de l'espèce observée au cours de relevés du poisson de fond a révélé que la couverture acoustique des couches habitées par le capelan au cours de ces derniers relevés étaient généralement bonne dans la division 2J, mais pas aussi complète dans la division 3K.

Les taux de capture commerciale obtenus de diverses sources montrent une tendance semblable depuis 1977 dans les cas où le principal engin utilisé était le chalut méso-pélagique russe (CJ7). Le déclin observé vers la fin des années 1970 a été suivi d'un accroissement général. On s'est intéressé à la comparabilité des taux de capture commerciale observés ces dernières années et de ceux obtenus les années précédentes.

Les taux de capture du capelan dans les coups de filet pour le poisson de fond ont montré différentes tendances selon le traitement des données. Etant donné que les relevés du poisson de fond ne sont pas conçus pour l'échantillonnage des poissons pélagiques en bancs qui effectuent des migrations nycthémérales, ces taux peuvent ne pas être adéquats comme indices d'abondance mais peuvent servir à la description de la répartition du capelan.

Des données acoustiques recueillies par l'URSS étaient disponibles pour la périod 1974-1984 (sauf 1981); les tendances de cette série et des taux de capture commerciale étaient semblables. Les estimations acoustiques canadiennes ne couvraient que la période 1981-1985 (sauf 1982). La tendance de cette série était différente de celle de la série des taux de capture commerciale, mais elle se rapprochait de celle de la série des taux de capture du capelan obtenus au cours des relevés de poisson de fond.

Introduction

Since the inception of the offshore capelin fishery in SA2 + Div. 3K in 1972, substantial research effort has been generated to assess the status of this capelin stock. Annual acoustic surveys have been conducted by the USSR since 1974 and by Canada since 1977. Incidental data on capelin have also been collected during Canadian groundfish trawl surveys in Div. 2J3K since 1977. There is also a large body of commercial fishery data and these data were used in sequential capelin abundance models (SCAM) during the late 1970's. Although the SCAMs have not been used in recent years, commercial catch rate data have been used during the 1980's in an attempt to assess the status of the stock. In recent years, a directed inshore fishery to supply ripe females for the Japanese market has developed and research and commercial fishery data are now routinely collected during the spawning season.

It is the purpose of this paper to summarize pertinent data from the various offshore research activities and from the commercial offshore fishery to aid in assessment of this capelin stock. Besides comparing trends in abundance from various sources, timing and distribution of acoustic surveys are compared to other indicators of distribution to determine the efficacy of these acoustic surveys.

Catch trends

The capelin fishery in NAFO SA2 and Div. 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 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 TACs ('000 t) since 1975 are shown below.

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Offshore											
TAC	160*	160*	212*	212	75	5	10	10	10	17	17
Nominal catch	198	214	150	53	11	5	10	10	11**	16**	17**
Inshore											
TAC								3	11	8	8
Nominal catch	1	2	2	2	1	1	2	4	4	7**	7**

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

A. Canadian Acoustic Surveys and Commercial Fishery Distribution and Timing

Canadian acoustic surveys in Div. 2J3K have been conducted since 1977 but because of technical reasons, the estimates of capelin biomass prior to 1981 are considered very unreliable (see Stevens et al. 1985 for a more detailed discussion) and are not used in comparing status of the stock. In recent years, the survey design has become more rigorous by a) adopting a zig-zag survey design with equal transects thereby permitting calculation of variance estimates (Nakashima 1981), b) covering approximately the same area each year, and c) conducting the survey at about the same time each year.

The offshore capelin fishery in Div. 2J3K has in most years occurred during August-December (Fig. 1). During 1972-78 catches were taken in both Div. 2J and 3K, but since 1979 catches have been taken mostly in Div. 2J.

To determine whether the Canadian acoustic surveys are covering the capelin distribution, the area covered by the acoustic surveys was compared to the area fished by the USSR commercial fleet. This assumes that the commercial fleet fishes all areas in which capelin occur in quantities great enough to satisfy the needs of the fleet. This assumption may be violated; the quotas in this area have been relatively low in recent years, and therefore the fleet may be concentrating in areas where experience has shown that catch rates will be highest. Samples from the USSR fleet are collected by the Fisheries Cooperative Research Section in St. John's and the distribution of the fishery is therefore representative of the samples collected by observers and processed by the

Pelagic Section in St. John's. In collecting and processing samples, the aim is to collect and process two samples per week from each area (roughly 30 n mi x 60 n mi) of the fishery. The actual number of samples collected and processed and the proportion of observed catch to total catch is given in Table 1. In months where over 1000 t of capelin were caught, 77% had over 25% of the catch observed and 41% had over 50% of the catch observed. There were no months in which catches exceeded 1000 t that samples were not collected. It seems reasonable then that the distribution of samples from the commercial fishery provides an adequate representation of the distribution of the commercial fishery itself.

Plots of the distribution of commercial catches, by month, and the areas surveyed by the GADUS are shown in Figures 2-8. It is obvious that the GADUS acoustic surveys cover a wider area than that fished by the commercial fleet.

The commercial fishery since 1979 has operated from August to December in some years but in all years operates during September and October (Fig. 1, Table 1). In Div. 2J, where most of the catch has occurred since 1979, catch rates are usually good during September and October (Table 2). Monthly catch rates for large Soviet refrigerator trawlers (Bakanev 1981) indicate that in the early years of the fishery, catch rates were highest in the first months of the season (Table 3). In recent years, capelin have not been fished extensively during August. It is not known whether the changes in monthly catch rate trends reflect changes in capelin distribution and/or schooling or changes in fleet deployment. Given that the fleet has become much smaller since quotas were lowered and licencing has become more rigorous since extension of jurisdiction, the latter is a likely possibility.

Prior to 1981, GADUS acoustic trips were in late October and early November but since 1981, these surveys have been of 3-4 weeks duration during late September and early October. Thus, based on the data from the commercial fishery, it would appear that these surveys are conducted at a time appropriate to estimate capelin abundance.

Age Compositions

Because recruitment is important in determining the mature spawning biomass of capelin, the age compositions from the commercial fishery and acoustic surveys provide valuable information on relative year-class strengths. To compare the age compositions from the two sources, the samples from the USSR fishery have been grouped to correspond to the survey blocks. Because the commercial samples are often collected over several months from any one survey area while catches are collected on a monthly basis, catches were weighted by the number of samples. For example, during 1985, all commercial samples were from NAFO Div. 2J and those from within

the survey area were from Blocks C and D. All September and October samples were from Block C thus the total catch by USSR trawlers for these months was included in the analysis. For November, six samples were from Block C and four from Block D; therefore 60% of the November catch was entered for Block C samples and 40% of the catch for the Block D samples. The results of the comparisons for years 1979-85 are given in Tables 4-10.

The age compositions in these tables indicate that the Canadian fishing gear catches a higher proportion of one-year-olds, perhaps because of the fine-mesh liner in the survey gear. Age compositions for age 2 and older only were calculated for each data set and these age compositions are given on the second line of each cell in Tables 4-10. There are differences in labelling of survey blocks from year to year but in all tables the blocks are arranged from south to north.

Sampling was not extensive during the early years of the Canadian surveys. The low sampling rates for 1979 and 1980 were the result of relatively low biomasses of capelin during these two years and fishable concentrations were not detected often during the surveys. The sampling rate has increased since 1982 and age compositions derived for recent years are probably more representative of the population surveyed. For the last three years there is a higher proportion of one-year-olds in the southern part of the survey area. In fact, there is a dramatic drop in the proportion of one-year-olds in the most northerly block, north of approximately 54°N.

In the last four years, 1982-85, the Soviet fishery samples and Canadian research samples agree when identifying the relative strengths of year-classes, with the exception of 1983. In that year, three-year-olds were slightly more prominent in Soviet samples in Block C while in the same area, Canadian samples identified two-year-olds as dominant. In some years and blocks (eg. 1982 Blocks F and G and 1985 Block D), agreement is very good. In years and blocks when agreement is not as good, the proportion of two-year-olds is usually higher in Canadian surveys with the proportion of three-year-olds higher in the Soviet fishery data.

While the Soviet commercial fishery generally operates over a smaller area than the Canadian research vessel surveys, the commercial fishery extends over a longer time period. Monthly age compositions were calculated from the Soviet fishery and are shown in Table 11. Two-year-olds dominate in most years. In 1979, 1980, 1983 and 1984 the proportions of two-year-olds in the catches increase during the fishing season. In 1982, this trend occurs during August through October but in November the proportion of two-year-olds declined. There was no trend in 1985 and the trend is opposite in 1980. Fishing occurred in only two months in 1980 and the dominance of age groups in the samples changed over those months. In September, three-year-olds dominated while in October two-year-olds dominated. The fishery occurred in a very restricted area in 1980 compared to other years. The catch rate estimates for 1980 were considered to be overestimated (Anon. 1981).

During 1984, there was a dramatic increase in one- and two-year-olds in the November age compositions and during that month fishing occurred more to the south of Div. 2J. During December, fishing occurred in Div. 3K and the age compositions of one- and two-year-olds, while declining somewhat from the November 2J estimates, remained higher than those from September and October in 2J.

Age compositions from the commercial offshore fishery in Div. 2J3K, from the USSR fleet, are given in Figure 9.

B. Canadian Groundfish and Acoustic Surveys

Stratified-random groundfish surveys in Div. 2J3K have been conducted by GADUS ATLANTICA in most years immediately after the capelin acoustic survey. A preliminary examination of the catch information indicated that capelin were rarely taken deeper than 500 m and the following analyses concentrate on strata 500 m and less. Catches of capelin were also very low in 1977 and 1978 and these years were not included in most of the subsequent analyses.

Catch rates (average no./set) of capelin in these surveys are given in Tables 12 and 13. Survey blocks were plotted on strata charts and visually examined and divided in three categories; no coverage by the acoustic survey, less than 50% of an individual stratum covered by the acoustic survey (marked with *), and more than 50% of an individual stratum covered by the acoustic survey (marked with **). The results are given in Tables 12 and 13. In some years and in some strata, very large individual catches were recorded. Most catches of capelin consisted of a few individuals although a few catches of hundreds or thousands of individuals occurred. To illustrate the effect of large catches on the catch rate, the largest catch, if it exceeded 3000 fish, was replaced by the next largest catch.

Using this visual comparison, the acoustic coverage of strata containing capelin during the groundfish survey is generally good in Div. 2J but not so complete in Div. 3K. The strata in Div. 3K were further divided into those strata covered by the acoustic surveys (Strata 620-627) and those strata not usually covered by the acoustics survey (Strata 628-640) (Table 14). In all years except one (1980) the catch rates are higher in those strata covered by the acoustic survey although the ratio of catch rates between the areas is quite variable.

Some insight into capelin distribution can be obtained from cod feeding (Lilly 1984). Lilly examined cod feeding data from 1977-82 and used data from 1981 to illustrate spatial variability of cod predation on capelin. Predation of capelin was most intense on Hamilton Bank but also

occurred in other areas, including Funk Island Bank (i.e. the area not covered by acoustic surveys). The variation in total stomach fullness was largely a reflection of capelin distribution. He noted that similar patterns in total fullness index and partial fullness index for capelin were observed in 1980 and 1982. A similar geographic pattern in Greenland halibut predation on capelin was reported for the years 1981 and 1982 (Bowering and Lilly 1985), with some predation on capelin on Funk Island Bank but with most intense predation on Hamilton Bank and on or near the coastal shelf off southern Labrador and northern Newfoundland.

Because of increasing acoustic noise over greater depths, the distribution of capelin by depth is important in acoustically surveying capelin. There is a general decrease in catch rates of capelin with greater depth (Table 15) and in most years, catch rates are much greater in depths less than 300 m. There is a similar trend for Div. 2J when the proportion of sets with capelin is examined (Table 16).

Capelin are known to undergo dynamic vertical migrations, usually dispersing and moving into the surface layers at night and schooling at greater depths during the daytime. Thus, the groundfish survey data were divided into day (0730-1630 NST) and night sets. In five years out of seven, there was a higher proportion of sets with capelin during the day (Table 17) for each division and the divisions combined. However, this did not always happen in the same year eg. 1981. Nevertheless, catch rates by division were calculated for day sets (Table 18).

Trends in catch rates are quite different when comparing catch rates from all data and from daytime sets only. When considering all catches, the catch rates since 1982 have been relatively low with higher catch rates in 1980 and 1981. With only daytime catches, catch rates are relatively low in 1983-85 with higher catch rates in 1981 and 1982.

Samples were available for only a few groundfish catches (Table 19). The age compositions were not strikingly different from age compositions from the Canadian acoustic surveys or the commercial fishery although there appeared to be a higher proportion of older ages in the catches.

C. Abundance Indices

a) Commercial Catch Rates:

Commercial catch rates have been calculated from a number of different sources. One series (USSR/FRC in Table 20) consists of estimates from Seliverstov and Serebrov (1979) for the years 1972-78 inclusive and for 1979-84 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. This series has been taken as indicative of trends in capelin abundance in Div. 2J3K (see CAFSAC Advisory Document 84/17)).

A catch rate series (1972-84) was also calculated using data from NAFO Statistical Bulletins for USSR trawlers Tonnage Class 7 (TC7) in which capelin comprised >50% of the catch (TC7 in Table 20).

Another catch rate series (Table 20) was generated using data from NAFO Statistical Bulletins, most recent NAFO information from 1983 and 1984, preliminary catch data from 1985, and 1985 catch/hour data from FCR in a multiplicative model (Gavaris 1980). The analysis was slightly different from that presented previously (Carscadden et al. 1985) in that data were not included when there were less than two data points (compared to five last year) and the catch rates calculated this year are actual rates rather than relative rates. Details of the analysis are given in Tables 21 and 22 and the results are depicted in Figure 10. Significant differences occur between gears, months and years but not between NAFO Divisions.

Catch numbers (Table 23) and effort values (Table 21) from the multiplicative model were used to calculate catch rate-at-age indices (Table 24). 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 would probably be more appropriate in assessing year-class strength. This has the disadvantge of yielding less information on the 1983 year-class which will be an important year-class in the 1986 fishery.

b) Acoustic Surveys:

i) USSR Acoustic Surveys

USSR acoustic surveys have been conducted annually (except for 1981) since 1974 and the results have been published in the NAFO Research Document series. Since the authors normally produce a biomass estimate in tons as well as the total numbers of capelin estimated and the age composition, it is possible to estimate the numbers of fish by age. Unfortunately in many cases, the estimates must be considered approximate since the age compositions are often provided only as histograms and reading them with any accuracy is difficult. Bakanev (1980) provided a document summarizing age compositions in tabular form but the sample sizes and the age compositions are sometimes very different from those in the original papers even taking into account the difficulty in reading the histograms in the originals. The estimates of numbers at age from the Soviet surveys are given in Table 25 using both the original age compositions and those from Bakanev (1980). Relative year-class strengths are given in Table 26 and biomass estimates are given in Table 27.

The estimates of abundance of year-classes in 1982-84 surveys indicate that at age 2, the 1981 year-class was strongest followed by the 1980 and 1982 year-class (no estimates are available for 1979 year-class). At age 3, the 1981 year-class was very weak compared to the 1979 and 1980 year-classes. Based on the entire time-series, the 1973 year-class was the strongest at ages 2 and 3 with the 1981, 1980 and 1982 next in strength at age 2 and the 1971, 1979 and 1980 next in strength at age 3.

Generally the USSR surveys cover approximately the same area as the Canadian surveys. A common comment in their reports is that their estimates are underestimates because they cannot survey inside the Canadian territorial zone where there believe capelin occur. Their surveys occur usually in October or November, a notable exception being the 1984 survey when the survey occurred in December. They attribute the low estimates in 1984 to the lateness of the survey and the occurrence of fish within the Canadian territorial zone (Bakanev and Gorchinsky 1985).

ii) Canadian Acoustic Surveys

Biomass estimates and numbers at age from the Canadian acoustic surveys are given in Tables 27 and 28, respectively.

From the Canadian surveys, the 1979 year-class was most abundant at age 2 followed by the 1982 and 1983 year-classes. At age 3, the 1978 year-class appeared strongest followed by the 1981, 1982 and 1980. Unfortunately, there was no estimate available from the 1982 survey, a critical year in evaluating the strengths of the 1979 and 1980 year-classes.

c) Summary of Abundance Indices:

i) The commercial catch rates (Fig. 11) show a similar pattern especially since 1977 when the dominant gear has been TC7 USSR midwater trawlers. These estimates show a decline through the late 1970's and then a general increase since then (ignoring the 1980 value - see also the confidence intervals around the 1980 point in Fig. 10). There is a dramatic increase in catch rate between 1984 and 1985 and the 1985 catch rate is the highest on record.

Concern about the comparability of catch rate estimates between the period 1972-78 and 1979 to the present has been expressed before (see eg. Carscadden et al. 1985). Since 1979, most of the catches have occurred only in Div. 2J although the results of the multiplicative model indicate that differences between divisions are not significant. However, the size of the catch and presumably the fishing fleet is much smaller than during the mid 1970's. Thus, it is possible that a smaller fleet could operate and sustain relatively good catch rates even if the stock was lower than in the 1970's.

ii) Groundfish Surveys:

Catch rates (no./tow) from groundfish surveys differ primarily in which year from 1979 to 1985 had the highest catch rate. Depending on how the data are treated, 1980, 1981 or 1982 exhibited the highest catch rates. Information from other sources indicates that the 1979 and 1980 year-classes were more abundant than year-classes immediately prior and this observation, when taken with the age compositions of capelin caught in the groundfish survey, would be consistent with high catch rates in 1981 and 1982. If this were the case, then the catch rates from daytime catches would probably be considered more reliable. In this case, catch rates in 1983, 1984 and 1985 for 2J3K combined have shown a slight increase but they are well below the 1981 and 1982 catch rates.

All 2J3K combined catch rates show an increase from 1984 to 1985. The increase in catch rate between 1984 and 1985 is more dramatic for Div. 3K than Div. 2J.

Because of the known diel migrations of capelin, catch rates of capelin in bottom trawls are probably of limited use as abundance indicators and the incidence of capelin in bottom trawl catches is probably more indicative of capelin distribution. Capelin are reported to move from Div. 2J to Div. 3K in November and December (eg. Bakanev and Gorchinsky 1985). What effect such a migration would have on the catch rates is unknown; the groundfish surveys generally cover Div. 2J in November and Div. 3K in December.

iii) Acoustic Estimates:

The USSR time series is fairly long and generally follows the trend of the commercial catch rate series. Unfortunately there is no 1985 value available and there is no estimate for 1981.

The Canadian estimates are available only from 1981 and a key year, 1982, is missing. The annual trends are different from the commercial catch rate series. The estimates from 1983, 1984 and 1985 are much lower than the 1981 estimate, a pattern more consistent with the groundfish catch rate pattern. However, the 1985 Canadian acoustic estimate is lower than the 1984 estimate and this decline is the opposite from all of the other abundance indices. The timing and rate of migration of capelin from Div. 2J to Div. 3K is unknown. The catch rates of capelin in Div. 2J during groundfish surveys have not changed between 1983 and 1985 while the proportion of groundfish sets with capelin increased. In Div. 3K the proportion of sets with capelin and catch rates increased between 1984 and 1985. It is possible that a greater proportion of capelin had already moved to Div. 3K outside the area surveyed acoustically and were not detected during the 1985 Canadian survey (see Table 14).

References

Anon. 1981. Report of Scientific Council Special Meeting. NAFO, February 1981.

Bakanev, V. S. 1980. Results of USSR investigations on capelin in Divisions 2J and 2K, Autumn 1979. NAFO Res. Doc. 80/II/43, Ser. No. N075. 6 p.

1981. Results of Soviet investigations on capelin in Northwest Atlantic in 1980. NAFO SCR Doc. 81/II/10, Ser. No. N274. 10 p.

1983. Results of instrumental assessment of capelin abundance in Divisions 2J and 3K in October 1982. NAFO SCR Doc. 83/VI/11, Ser. No. N659. 7 p.

Bakanev, V. S. and A. S. Seliverstov. 1978. Capelin investigations in the waters off southern Labrador (Division 2J) and on the north Newfoundland Bank (Division 3K) in the autumn of 1977. ICNAF Res. Doc. 78/30, Ser. No. 5191. 11 p.

Bakanev, V. S., A. S. Seliverstov , and L. I. Serebrov. 1976. Preliminary instrument estimate of abundance and biomass of capelin off South Labrador and the North Newfoundland Bank (Divisions 2J and 3K). ICNAF Res. Doc. 76/54, Ser. No. 3840. 16 p.

Bakanev, V. S. and K. V. Gorchinsky. 1985. Hydroacoustic survey of capelin stocks in Divisions 2J + 3K and trawl survey of capelin prerecruits in Divisions 3KLNO in November 1984 - January 1985. NAFO SCR Doc. 85/52, Ser. No. N1001. 11 p.

Bowering, W. R. and G. R. Lilly. 1985. Diet of Greenland halibut off southern Labrador and northeastern Newfoundland (Div. 2J + 3K) in autumn of 1981-82, emphasizing predation on capelin. NAFO SCR Doc. 85/109, Ser. No. N1085. 16 p.

Carscadden, J. E., D. B. Atkinson, and D. S. Miller. 1985. The Offshore Fishery for Capelin in SA2 + Div. 3K. CAFSAC Res. Doc. 85/52. 15 p.

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.

Klochkov, D. N., A. S. Seliverstov, and L. I. Serebrov. 1977. Estimate of capelin stocks in the South Labrador and Northern Newfoundland Bank areas in the autumn of 1976 (Divisions 2J and 3K). ICNAF Res. Doc. 77/33, Ser. No. 5058. 11 p.

Lilly, G. R. 1984. Annual variability in the diet of Atlantic cod (Gadus morhua L.) off southern Labrador and northeast Newfoundland (Div. 2J+3K) in autumn, 1977-82. NAFO SCR Doc. 84/79, Ser. No. N868. 12 p.

Mamylov, V. S. and V. S. Bakanev. 1984. An acoustic assessment of capelin stocks in NAFO Div. 3LNO and 2J + 3K in 1983. NAFO SCR Doc. 84/39, Ser. No. N824. 8 p.

Miller, D. S. and J. E. Carscadden. 1983. Capelin acoustic surveys in NAFO Divisions 2J3K and 3LNO, 1982. NAFO SCR Doc. 83/50, Ser. No. N708. 10 p.

1984. Capelin acoustic biomass survey for NAFO Division 2J3K, October 1983. CAFSAC Res. Doc. 84/79. 10 p.

1985. Capelin acoustic biomass survey of NAFO Divisions 2J3K, September 29-October 22, 1984. CAFSAC Res. Doc. 85/60.

1986. Results of a hydroacoustic survey of NAFO Div. 2J3K capelin in September-October 1985. CAFSAC Res. Doc. 86/29.

Miller, D. S., B. S. Nakashima, and J. E. Carscadden. 1982. Capelin acoustic surveys in NAFO Divisions 2J + 3KL, 3LNO and 3L, 1981-82. NAFO SCR Doc. 82/54, Ser. No. N547. 12 p.

Nakashima, B. S. 1981. Sampling variation and survey design for capelin (Mallotus villosus) densities from an acoustic survey in Divisions 3LNO, 1980. NAFO SCR Doc. 81/14, Ser. No. N278. 8 p.

Seliverstov, A. S. and L. I. Serebrov. 1979. Status of capelin stocks in Divisions 2J and 3K in 1978. ICNAF Res. Doc. 79/30, Ser. No. 5366. 12 p.

Serebrov, L. I., V. S. Bakanev, and S. M. Kovalev. 1975. The state of Newfoundland capelin stock. ICNAF Res. Doc. 75/7, Ser. No. 3435. 11 p.

Stevens, C. R., J. E. Carscadden, D. B. Atkinson, W. H. Lear, D. S. Miller, and B. S. Nakashima. 1985. A Summary of Hydroacoustic Research in the Newfoundland Region. CAFSAC Res. Doc. 85/ 35. 32 p.

Table 1. Number of samples by month, monthly catch and proportion of catch observed by FCR personnel for commercial USSR fishery in Div. 2J3K. Number of samples/proportion of catch observed/total catch.

	1979	1980	1981	1982	1983	1984	1985
Div. 2J							
August	0/0/645			4/25/1286	0/0/253	0/0/481	0/0/185
September	14/12/1616	12/100/1547	9/50/1947	16/55/4435	11/56/2326	10/49/3948	2/17/2819
October	37/38/5676	17/92/3248	29/67/6793	7/21/3357	11/48/3898	6/22/7366	12/52/6621
November	10/67/1155		3/43/1117	3/50/599	6/47/1731	17/66/3385	10/27/5777
December	1/49/265		0/0/292		2/23/1561		0/0/616
Div. 3K							
August	0/0/56						
September	0/0/43						
October	0/0/85				0/0/55		0/0/2
November	0/100/5					3/100/0*	0/0/14
December					0/0/573	9/53/2186	0/0/12

* no catch in NAFO Stats but 570.5 t observed

Table 2. Monthly catch rates (catch/hour) of OTM7 USSR trawlers from observer data.

	1979	1980	1981	1982	1983	1984	1985
2J							
Aug.				2.42			
Sept.	.980	5.26		3.26	3.3	6.7	5.1
Oct.	1.58	4.25	4.20	2.81	7.4	7.4	7.5
Nov.	0.96		4.38	12.16	6.2	3.2	6.7
Dec.					8.0		
3K							
Aug.							
Sept.							
Oct.							
Nov.	0.26					3.1	
Dec.						3.0	

Table 3. Catch per hour of Soviet vessels (of a large refrigerator trawler type) from Bakanev (1981).

	1974	1975	1976	1977	1978	1979	1980
August	7.57	5.91	3.07	4.16	2.71	1.43	
September	6.70	6.7	3.40	4.74	2.37	0.32	6.16
October	3.64	3.82	3.14	3.58	3.26	1.38	4.57
November	3.74	3.84	3.79	4.22	1.57		2.37
December		1.77	3.93	3.54			
Weighted Average	3.74	5.07	3.59	4.00	2.45	1.15	4.92

Table 4. Age compositions of capelin in Div. 2J3K during 1979 from Canadian acoustic survey and Soviet commercial fishery by month and NAFO Division. Overall Canadian age compositions weighted by number of samples.

	Soviet commercial							Canadian acoustic survey						
Age	1	2	3	4	5	6	N	1	2	3	4	5	6	N
Oct. 3K								52.0	45.8 95.5	1.6 3.3	.1 .2	.1 .3	.3 .7	2
Nov. 3K								17.0	81.2 97.8	0 0	.9 1.1	0 0	.9 1.1	1
Sept. 2J	4.6	75.1 78.7	11.2 11.8	2.3 2.4	3.7 3.9	3.0 3.1	14							
Oct. 2J	2.3	77.1 78.9	10.2 10.5	2.8 2.9	3.9 4.0	3.6 3.7	37	31.2	61.7 89.7	3.7 5.4	1.3 1.9	1.3 1.9	.9 1.3	2
Nov. 2J	2.1	83.2 85.0	8.1 8.3	1.5 1.6	2.4 2.5	2.7 2.7	10	96.5	3.5 100.0					1
Dec. 2J	1.3	82.4 83.5	11.9 12.0	2.6 2.6	1.3 1.3	.6 .6	1							
Overall 2J	2.8	77.6 79.8	10.2 10.5	2.5 2.6	3.6 3.7	3.3 3.4	62	72.8	24.6 90.5	1.3 4.9	.5 1.7	.5 1.7	.3 1.2	
Overall								65.5	32.0 92.7	1.4 4.0	.4 1.2	.3 1.0	.4 1.1	

Table 5. Age compositions of capelin in Div. 2J3K during 1980 from Canadian acoustic survey and Soviet commercial fishery, analyzed by month and NAFO Division.

	Soviet commercial							Canadian acoustic survey						
Age	1	2	3	4	5	6	N	1	2	3	4	5	6	N
Oct. 3K								1.2	57.5 58.2	33.5 33.9	6.0 6.1	1.7 1.8		2
Nov. 3K								1.7	33.9 34.5	60.5 61.6	3.3 3.3	.6 .6		2
Sept. 2J	.4	32.1 32.2	46.2 46.4	18.0 18.1	2.0 2.1	1.2 1.2	12							
Oct. 2J	1.3	51.8 52.5	37.6 38.1	7.0 7.1	1.2 1.3	1.0 1.0	17							
Nov. 2J								17.6	62.9 76.4	15.6 18.9	3.1 3.8	.8 .9		
Overall	1.0	45.2 45.6	40.5 41.0	10.7 10.8	1.5 1.5	1.1 1.1	29	8.2	53.2 58.0	33.5 36.5	4.1 4.4	1.0 1.1		

Table 6. Age compositions of capelin in Div. 2J3K during 1981 from Canadian acoustic survey and Soviet commercial fishery, analyzed by survey blocks.

	Soviet commercial							Canadian acoustic survey						
Age	1	2	3	4	5	6	N	1	2	3	4	5	6	N
Block F								90.2	3.8 100.0					1
Block E								79.5	18.9 92.1	1.5 7.1	.2 .8			1
Block D								59.6	36.7 90.7	3.2 8.0	.4 1.1	.1 .2		3
Block C	20.5	56.6 71.3	18.2 22.9	3.1 4.0	1.2 1.5	.3 .4	2	76.8	20.6 89.0	2.3 9.9	.2 1.0	.1		1
Block B	7.5	69.4 75.1	16.2 17.5	4.2 4.6	2.4 2.6	.2 .2	23	39.9	54.4 90.5	4.8 7.9	.8 1.3	.2 .3		1
Block A	6.9	74.7 80.3	12.4 13.3	3.8 4.1	2.0 2.2	.1 .1	14	5.8	79.8 84.8	10.8 11.4	2.4 2.5	1.2 1.2		2
Overall	7.9	71.0 77.0	14.9 16.2	4.0 4.3	2.2 2.3	.2 .2	39	49.2	44.1 86.7	5.3 10.4	1.1 2.1	.5 .9		9

Table 7. Age composition of capelin in Div. 2J3K during 1982 from Canadian acoustic survey and Soviet commercial fishery, analyzed by survey blocks. No biomass estimate from Canadian survey and samples were given equal weight for overall age compositions.

	Soviet commercial							Canadian acoustic survey						
Age	1	2	3	4	5	6	N	1	2	3	4	5	6	N
Block C								51.7	44.5 92.1	3.5 7.3	.3 .6			3
Block D								36.6	49.0 77.3	13.1 20.6	1.3 2.0	.1		1
Block E	6.4	74.7 79.8	16.9 18.0	1.4 1.5	.6 .7		5	42.4	56.0 97.3	1.5 2.7				1
Block F	1.3	80.6 81.6	16.4 16.6	1.4 1.4	.3 .3		16	6.2	80.7 86.1	12.0 12.8	1.0 1.0	.1 .1		8
Block G	.2	74.4 74.5	23.4 23.4	1.6 1.6	.4 .4		8	3.3	71.7 74.1	22.3 23.1	2.4 2.5	.3 .3		5
Overall	2.0	77.9 79.6	18.2 18.5	1.4 1.5	.4 .4		29	16.9	68.8 82.8	12.9 15.5	1.2 1.5	.1 .2		18

Table 8. Age compositions of capelin in Div. 2J3K during 1983 from Canadian acoustic survey and Soviet commercial fishery analyzed by survey blocks.

	Soviet commercial							Canadian acoustic survey						
Age	1	2	3	4	5	6	N	1	2	3	4	5	6	N
Block A								61.4	31.8 82.2	5.5 14.2	1.4 3.6			2
Block B								87.8	11.0 89.8	1.2 10.2				1
Block C	4.0	41.1 42.8	47.6 49.6	6.8 7.1	.4 .4		20	36.8	37.6 59.5	22.4 35.5	3.0 4.8	.2 .3		8
Block D								10.8	52.6 60.0	32.5 36.5	3.9 4.4	.1 .1		13
Overall								60.2	26.8 67.3	11.4 28.7	1.5 3.8	.1 .2		23

Table 9. Age compositions of capelin in Div. 2J3K during 1984 from Canadian acoustic survey and Soviet commercial fishery, analyzed by survey blocks.

	Soviet commercial							Canadian acoustic survey						
Age	1	2	3	4	5	6	N	1	2	3	4	5	6	N
Block A	10.5	62.5 69.9	17.0 19.0	8.5 9.5	1.5 1.6		12	28.8	60.2 84.6	7.3 10.3	3.4 4.8			7
Block B	9.2	80.6 88.9	6.0 6.6	3.4 3.8	.7 0.7	.1 <.1	6	31.6	65.9 96.4	2.0 3.0	.5 .6			6
Block C	1.0	52.7 53.2	29.7 30.0	14.8 15.0	1.8 1.8	<.1	28	29.4	55.0 77.9	9.5 13.4	5.4 7.7	.5 .7		13
Block D								2.0	71.6 73.1	16.5 16.8	9.0 9.2	.9 .9		23
Overall	3.1	56.6 61.0	25.8 26.6	12.9 13.3	1.7 1.7		46	12.4	65.9 75.3	13.5 15.4	7.4 8.4	.7 .8		49

Table 10. Age compositions of capelin in Div. 2J3K during 1985 from Canadian acoustic survey and Soviet commercial fishery, analyzed by acoustic survey block.

	Soviet commercial							Canadian acoustic survey						
Age	1	2	3	4	5	6	N	1	2	3	4	5	6	N
Block A								13.9	81.4	4.7				
Block B								2.7	86.7	9.9	.6	.2		
Block C	.1	64.6 64.6	30.0 30.1	3.3 3.3	1.9 1.9	.1 .1	17	19.0	64.3	14.7	1.5	.5		
Block D	0	67.0	28.3	2.6	1.8	.3	4	.1	64.3	30.2	3.6	1.6	.1	
Overall	.1	64.9 65.0	29.8 29.8	3.2 3.2	1.6 1.6	.2 .2		12.4	67.8	17.3	1.8	.7		

Table 11. Monthly age compositions of Soviet catches in Div. 2J (1981-85) and Div. 3K (1984).

Month/age		1	2	3	4	5	6	N	Catch
Div. 2J									
1979	September	4.6	75.1	11.2	2.3	3.7	3.0	14	1616
			78.7	11.8	2.4	3.9	3.1		
	October	2.3	77.1	10.2	2.8	3.9	3.6	37	5676
			78.9	10.5	2.9	4.0	3.7		
	November	2.1	83.2	8.1	1.5	2.4	1.7	10	1155
			85.0	8.3	1.6	2.5	2.7		
	December	1.3	82.4	11.9	2.6	1.3	.6	1	265
			83.5	12.0	2.6	1.3	.6		
1980	September	.4	32.1	46.2	18.0	2.0	1.2	12	1547
			32.2	46.4	18.1	2.1			
	October	1.3	51.8	37.6	7.0	1.2	1.0	17	3248
			52.5	38.1	7.1	1.3	1.0		
1981	September	5.5	77.8	9.8	4.3	2.2	.2	9	1947
			82.4	10.4	4.5	2.4	.3		
	October	7.9	69.4	16.1	4.1	2.3	.2	28	6793
			75.4	17.5	4.4	2.5	.2		
	November	14.7	59.1	20.3	3.9	1.6	.3	3	1117
			69.4	23.9	4.6	1.9	.3		
1982	August	7.0	74.7	16.4	1.1	.8		8	1286
				80.3	17.6	1.2	.9		
	September	.3	78.7	19.3	1.3	.3	.1	16	4435
			78.9	19.4	1.3	.3	.1		
	October	2.1	79.3	16.4	1.9	.3		7	3357
			81.0	16.8	1.9	.3			
	November	2.5	67.7	28.5	1.0	.3		3	599
			69.5	29.2	1.1	.3			
1983	September	.8	34.3	50.7	12.8	1.3	.1	11	2326
			34.6	51.1	12.9	1.3	.1		
	October	2.7	39.8	50.7	6.5	.3		11	3898
			40.9	52.1	6.7	.3			
	November	8.1	42.2	43.7	5.4	.7		6	1731
			45.9	47.5	5.9	.7			
	December	5.0	45.6	44.6	4.8			2	1561
			48.0	46.9	5.1				

...2

Table 11. Continued...

Month/age		1	2	3	4	5	6	N	Catch
1984	September	.1	50.3	32.8	14.8	2.0		10	3948
			50.3	32.8	14.9	2.0			
	October	.3	46.1	34.0	17.7	1.9		6	7366
			46.3	34.1	17.7	1.9			
	November	5.5	73.8	12.6	12.6	6.8	.1	17	3385
			78.1	13.3	7.2	1.3	.1		
1985	September	0	68.4	25.9	4.1	1.5		2	2819
	October	.1	65.3	30.2	2.8	1.4	.2	12	6621
			65.3	30.2	2.9	1.4	.2		
	November	.1	68.8	26.7	2.3	1.9	.2	9	5777
			68.9	26.7	2.3	1.9	.2		
Div. 3K									
1984	December	9.3	61.9	17.8	9.0	1.9		9	
			68.3	19.6	10.0	2.1			2186

Table 12. Capelin in 2J from groundfish surveys (average number/set). * = less than 50% of strata covered by Canadian acoustic survey, ** = greater than 50% of strata covered by Canadian acoustic survey.

Stratum	1977	1978	1979	1980	1981	1982	1983	1984	1985
201	0	-	0	0	1.30*	0.83*	0.17	0 **	0
202	0	0	0	1.50	4.00	24.50	0	0.50**	0
203	0	0	0.67*	2.00*	0 **	0 **	0.33**	0 **	2.00**
204	0	0	0 *	- *	0 **	0 **	0 *	0 *	0 *
205	1.20	-	86.0 **	75.00**	1566.62**	103.50**	1.25**	0.25**	7.13**
206	0.09	-	699.50**	458.29**	23.73**	3.72**	3.14**	3.64**	4.29**
207	0	-	1.80**	0 **	6.89**	3.09**	0 **	0.43**	1.59**
208	0	0	1.00**	0 **	0 **	2.33**	0 **	0 **	10.33**
209	0	0	7.31**	1378.83**	1.00**	1.18**	0.51**	19.79**	1.00**
210	0.17	0	0 **	0 **	2.00**	1.52**	0 *	4.25*	8.89*
211	1.00	0	0.25	22.00**	0 *	1.00**	108.00*	1.50*	1.00*
213	0	0	0 *	0 **	314.00**	4.90**	0 *	0.60*	1.67*
214	0	0	0	0 *	0 **	1.75**	0.13**	0.25**	5.83**
215	0	0	0	0.25*	0 *	0.78*	0.38*	0 *	0 *
216	0	0	0	0 *	0.50*	0 *	0 *	0 *	0 *
217	0	0	0	0 *	0 *	0 *	0 *	- *	0 *
222	0	0	0	0 *	0 *	0 *	0	0	0
223	0	0	0	0 *	0	0	0	0	0
227	0	0	0	0	0	0	0	0.33	0
228	0	0	0	0	0	0	0	5.43	3.14
229	0	0	0	0	0	0	0	0	0
234	0.50	0	1.25**	0 **	1.50**	4.00**	0 **	0.60**	0 **
235	0.75	0	0.50**	0 *	0 *	0.33*	0 *	0 *	0 *
Av. no/set	0.15	0	62.14	128.02	164.12	10.73	2.45	2.83	2.51
Adjusted av. no/set			12.46	104.82	36.7				

Table 13. Capelin in 3K and combined 2J3K from groundfish surveys (average number/set). * = less than 50% of strata covered by Canadian acoustic survey, ** = greater than 50% of strata covered by Canadian acoustic survey.

Stratum	1977	1978	1979	1980	1981	1982	1983	1984	1985
620	0.25	0	5.40**	0.08**	247.9 **	0.89**	96.10**	31.62**	46.50**
621	-	0.20	1.09**	0 **	0.45**	48.36**	2.75**	10.43**	7.00**
622	0	0	0 **	0 **	1.00**	0 **	23.50	2.75	3.00
623	0	0	0 **	5.83**	10.00**	0.40**	2.67*	5.00*	80.17*
624		0	0 *	0 **	0 *	0 *	0.0	8.00	4.75
625		0	1.20*	0	0	0	0	0.80	0.60
626		0	1.20**	1.80**	0.20**	0 **	3.75*	4.17*	2.92*
627		0.50	0 *	2.50	0.17*	0.43*	1.50	0	1.71
628		0	0.20	7.83	0	10.17	4.50	0.14	17.58
629		0	6.50	7.80	0	0	12.33	0.50	7.75
630		0	0.25	0.25	5.50	-	4.00	0	39.41
631		0	0	0.33	1.20	9.00	1.40	3.40	1.57
632		0	0	0	0	0	0	-	0
633		0	0.10	0	0.75	0	0	0	0
634		0	0.25	0.43	1.43	10.18	0	0.14	0.44
635		0	5.88	6.17	0.60	5.40	11.33	1.38	2.71
636		0	0.0	16.43	1.17	4.40	0	0.13	0.25
637		0.20	0.57	4.67	1.33	21.71	15.00	0.50	3.43
638		0	0.33	2.33	1.50	15.73	0.82	0	18.27
639		0	0	0.83	0.67	14.70	0	0	6.88
640		0	-	0	0	0	-	0	0
Av. no/set	0.13	0.05	1.28	2.60	26.94	10.67	13.14	5.46	13.11
Combined 2J3K			28.53	56.21	86.83	11.07	6.86	4.17	8.32
Combined 2J3K with adjusted 2J values			6.29	46.3	29.5	11.07	6.86	4.17	8.32

Table 14. Catch rate (no/set) of capelin in groundfish surveys in Div. 3K, separated by strata covered by acoustic surveys and not covered by acoustic surveys.

Strata	Year						
	1979	1980	1981	1982	1983	1984	1985
620-627 (covered by acoustics)	1.73	1.00	57.45	14.08	23.0	11.08	21.63
628-640 (not covered by acoustics)	1.01	3.96	1.02	9.96	3.25	0.46	6.86
Ratio $\frac{620\text{-}627}{628\text{-}640}$	1.71	0.25	56.32	1.41	7.08	24.09	3.15

Table 15. Catch rates (no/set) of capelin from groundfish surveys by depth, Div. 2J3K, 1979-85. Values in parentheses include adjusted large sets.

	Year						
Depth (m)	1979	1980	1981	1982	1983	1984	1985
Div. 2J							
101-200	339.82	184.63 (34.74)	389.78 (19.95)	26.67	1.45	1.55	3.36
201-300	1.28	201.95 (145.8)	54.49	2.60	0.16	5.84	2.53
301-400	0.30	4.72	.08	.53	12.76	0.20	2.50
401-500	.10	0	0	.07	0	0.10	0
Weighted Average	62.1	128.0	164.1	10.7	2.5	2.8	2.5
Div. 3K							
201-300	2.02	3.12	51.27	16.19	22.29	10.08	12.30
301-400	0.65	2.75	1.61	8.58	2.07	.98	17.19
401-500	0	0.67	0.60	1.50	4.84	1.47	1.69
Weighted Average	1.28	2.60	26.94	10.67	13.14	5.46	13.11

Table 16. Proportion (%) of groundfish sets with capelin Div. 2J3K, by depth.

Depth (m)	Year						
	1979	1980	1981	1982	1983	1984	1985
Div. 2J							
101-200	59	21	45	63	16	17	39
201-300	18	12	31	31	11	44	37
301-400	17	8	8	18	12	7	25
401-500	10	0	0	7	0	10	0
Weighted Average	24	12	30	38	11	25	32
Div. 3K							
201-300	29	20	27	33	37	38	51
301-400	1	23	17	33	31	17	54
401-500	0	29	20	21	46	26	62
Weighted Average	23	22	22	32	36	28	54
TOTAL 2J3K	24	18	26	35	24	27	44

Table 17. Proportion (%) day and night groundfish sets with capelin, Div. 2J3K, 1979-85.

	Year						
	1979	1980	1981	1982	1983	1984	1985
Day							
2J	27	8	16	50	17	31	33
3K	82	13	30	35	36	30	53
2J3K	46	10	24	42	27	30	45
Night							
2J	7	15	40	37	8	21	31
3K	19	27	16	29	35	6	54
2J3K	16	22	27	34	22	11	44

Table 18. Catch rate (no/set) of capelin from groundfish surveys from daytime sets (0730-1630 NST). Catch rates in parentheses are adjusted by replacing catch of highest set with catch of next highest set.

	Year						
Division	1979	1980	1981	1982	1983	1984	1985
2J	16.7	7.4	343.8 (14.0)	26.8	1.4	3.2	2.5
3K	.5	1.1	4.2	8.9	2.0	1.8	6.9
2J3K	7.2	4.2	153.8 (8.5)	17.9	1.7	2.4	5.0

Table 19. Age composition from samples from groundfish sets.

		Age						
		1	2	3	4	5	6	N
1980								
Dec.	2J	.3	34.7	50.0	12.9	1.3	.8	3
Nov.	3K	8.3	55.0	36.4	.3			1
1981								
Nov.	2J	.1	56.9	33.6	5.9	3.4	.1	1
Nov.	2J	1.4	57.9	36.1	3.9	.5		3
Dec.	3K		97.8	1.1	1.1			1

Table 20. Commercial catch rate series for Div. 2J3K capelin, 1972-85.

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
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	6.96
TC7 (t/hr)	2.65	2.75	3.62	4.51	3.62	4.00	2.34	1.35	4.92	3.72	3.36	4.51	3.86	
Multiplicative model	5.03	4.37	3.90	5.06	4.76	4.32	2.07	1.90	5.44	3.94	3.53	4.52	4.01	7.25

* considered to be an overestimate

Table 21. Parameter estimates from the analysis of catch rates for 2J+3K capelin using a multiplicative model.

country-gear-TC	estimate	month	estimate
USSR-OTM7	0.000	APR	
BULGARIA-OTM7		MAY	-0.403
		JUN	
POL-OTM7	-0.325	JUL	
ROM-OTM7		AUG	0.129
		SEP	
USSR-OTB7		OCT	0.000
CUBA-OTM7	-0.610	NOV	
POL-OTM6		DEC	
JAP-OTB6	-0.887	Division	
GDR-OTM7			
JAP-OTB7		2J	0.000
POL-OTB7	-1.125	3K	
USSR-OTM5			
JAP-OTB5	-1.798		
NORWAY-OTM6	-2.713		

predicted catch rate

year	total catch	catch rate mean	s.e.	effort
1972	45107	5.030	1.124	8967
1973	134920	4.366	0.661	30906
1974	125596	3.902	0.429	32190
1975	197803	5.061	0.487	39086
1976	214642	4.762	0.494	45079
1977	150273	4.324	0.370	34752
1978	52528	2.069	0.195	25382
1979	10817	1.896	0.208	5704
1980	4795	5.436	1.523	882
1981	10195	3.941	0.650	2587
1982	9677	3.530	0.640	2741
1983	10442	4.521	0.621	2310
1984	17366	4.010	0.722	4331
1985	16636	7.252	0.973	2294

average c.v. for the mean:0.147

Table 22. Analysis of variance and regression coefficients for capelin in Div. 2J3K, 1972-1985.

regression of multiplicative model

multiple r.....0.839
multiple r squared.....0.705

analysis of variance

source of variation	df	sums of squares	mean squares	f_value
intercept	1	1.690e2	1.690e2	
regression	21	6.676e1	3.179e0	19.546
Gear type 1	6	3.308e1	5.513e0	33.900
Month type 2	2	1.999e0	9.997e-1	6.147
Years type 3	13	2.428e1	1.868e0	11.486
residuals	172	2.797e1	1.626e-1	
total	194	2.637e2		

regression coefficients

variable	coefficient	std. error	no. obs.
intercept	1.559	0.226	194
1	-1.798	0.249	3
2	-0.887	0.158	8
3	-1.125	0.134	16
4	-0.610	0.101	32
5	-2.713	0.305	2
6	-0.335	0.088	33
7	-0.403	0.142	10
8	0.129	0.083	35
9	-0.156	0.243	12
10	-0.274	0.248	16
11	-0.015	0.242	25
12	-0.075	0.239	24
13	-0.173	0.223	36
14	-0.909	0.228	27
15	-0.995	0.246	14
16	0.093	0.364	2
17	-0.256	0.274	6
18	-0.363	0.283	5
19	-0.123	0.255	9
20	-0.236	0.289	5
21	0.349	0.263	9

Table 23. Number of capelin in catch ($x10^{-3}$) in Div. 2J3K offshore fishery, 1972-85 and effort (hr) from the multiplicative model 1972-85.

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
2	228	1306	1015	5554	790	157	247	351	102	400	499	293	439	606
3	1240	1539	2464	2487	7409	1578	843	47	91	89	119	353	216	249
4	406	2085	888	733	606	3170	575	11	24	24	9	55	107	26
5	55	262	616	165	77	329	518	14	3	13	3	4	13	14
6	7	14	49	43	16	45	28	13	2	1	1	1	.3	1
Effort (hr)	8967	30906	32190	39086	45079	34752	25382	5704	882	2587	2741	2310	4331	2294

Table 24. Catch rate at age indices for capelin in Div. 2J3K offshore fishery, 1972-85.

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
2	25.43	42.26	31.53	142.10	17.52	4.52	9.73	61.54	115.65	154.62	182.05	126.84	101.36	264.17
3	138.28	49.80	76.55	63.63	164.36	45.41	33.21	8.24	103.17	34.40	43.41	152.81	49.87	108.54
4	45.28	67.46	27.59	18.75	13.44	91.22	22.65	1.93	27.21	9.28	3.28	23.81	24.71	11.33
5	6.13	8.48	19.14	4.22	1.71	9.47	20.41	2.45	3.40	5.03	1.09	1.73	3.00	6.10
6	.78	.45	1.52	1.10	.35	1.29	1.10	2.28	2.27	.39	.36	.43	.07	.44

Standardized by year-class

Age	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
2		.10	.16	.12	.54	.07	.02	.04	.23	.44	.59	.69	.48	.38	1.0
3	.84	.30	.47	.39	1.0	.28	.20	.05	.63	.21	.26	.93	.30	.66	
2+3		.23	.36	.29	.92	.19	.11	.05	.49	.45	.59	1.0	.53	.63	
2+3+4		.26	.35	.27	1.0	.22	.10	.11	.44	.39	.56	.90	.47		

Table 25. Numbers at age ($x10^9$) from Soviet surveys (O = from original paper and B = from Bakanev 1980).

	1974		1975		1976		1977		1978	1979	1980	1981	1982	1983	1984
Age	B	O	B	O	B	O	B	O	O	O			O	O	O
1						.5			.1				.2	2.5	5.2
2	3.5	6.1	18.2	27.4	3.7	6.7	.9	*	1.0	.03	.1		17.7	19.9	9.8
3	17.7	26.6	14.5	13.2	35.3	35.6	8.8		.8	.2	.4		17.7	15.8	3.2
4	11.8	10.3	10.3	3.2	5.2	2.1	18.4		.4	.3	.2		.9	3.3	1.6
5	10.0	4.4	.9	1.4	.8	.4	1.8		.1	.1	.04				.2
6	.7	.4	1.7	.5	.2		.2		.05	.05	.003				

* histogram provided but could not be read

Sources: Bakanev 1980, 1981, 1983; Bakanev and Gorchinsky 1985; Bakenev and Seliverstov 1978; Bakanev et al. 1976; Klochkov et al. 1977; Mamylov and Bakanev 1984; Seliverstov and Serebrov 1979; Serebrov et al. 1975

Table 26. Relative year-class strengths of capelin based on Soviet acoustic surveys. Values from original Soviet documents used.

	Year-class											
Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
2		.22	1.0	.24	.03	.04	.001	.004	-	.65	.73	.36
3	.75	.37	1.0	.25	.02	.01	.01	-	.50	.44	.09	

Table 27. Biomass estimates from Soviet and Canadian acoustic surveys for Div. 2J3K capelin.

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
USSR ('000 t)	1334	982	1047	860	59	14	20	-	611	852	268	
Canadian ('000 t)								1794	*	223	860	485

* capelin detected but equipment problems precluded an estimate

Table 28. Numbers at age from Canadian acoustic surveys ($x10^9$).

Age	1981	1982*	1983	1984	1985
1	84	71.0	12.4	6.8	4.6
2	71	21.1	5.5	36.1	25.0
3	10	3.3	2.4	7.4	6.3
4	2	3.7	.3	4.0	.7
5	1		.1	.3	.3

* no biomass estimates from Canadian surveys. Numbers derived using Soviet biomass estimates and Canadian age composition by STACFIS.

Sources: Miller and Carscadden 1983, 1984, 1985, 1986;
Miller et al. 1982

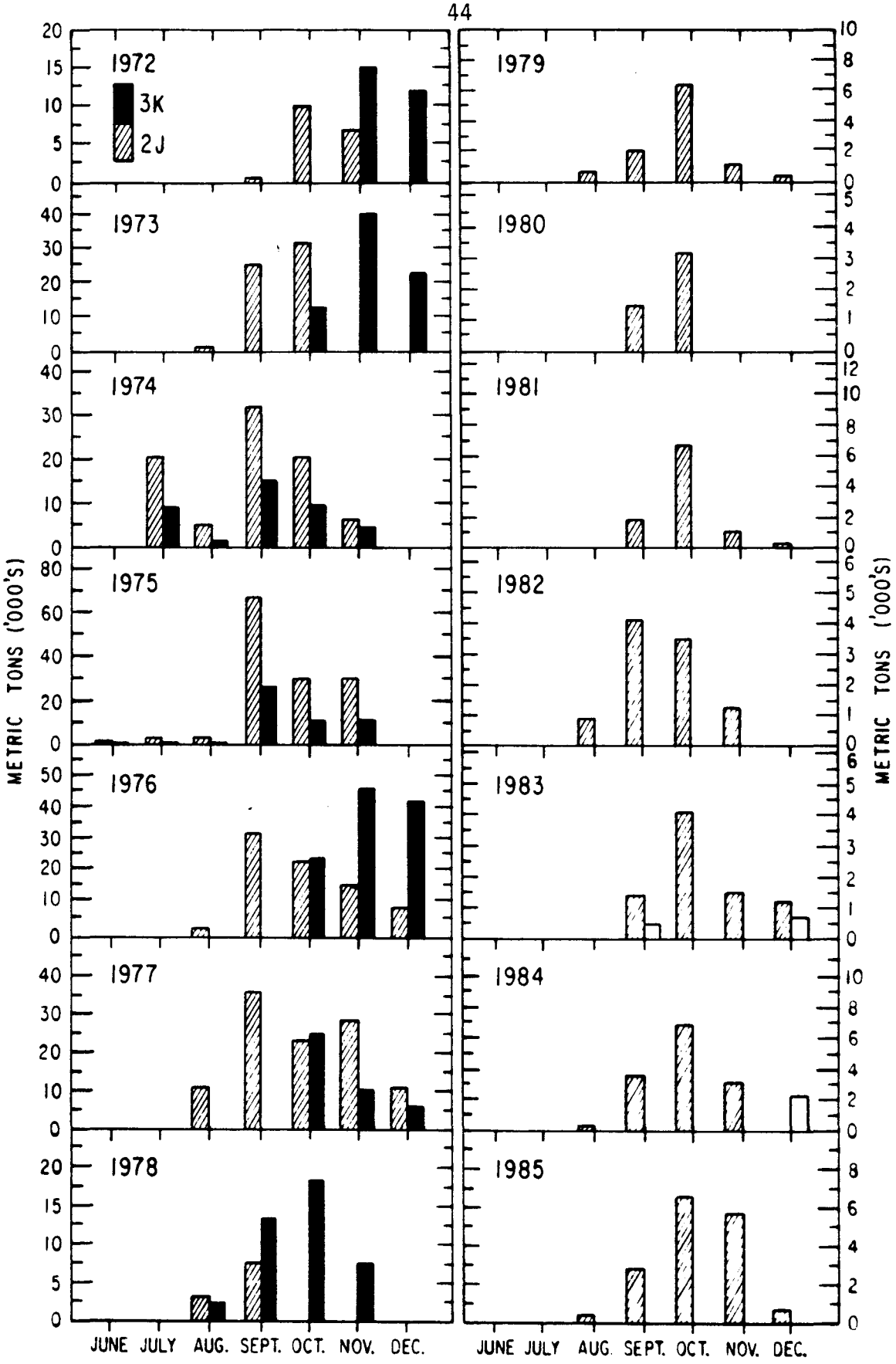

Fig. 1. Offshore commercial capelin catches in Div. 2J3K, 1972-85.

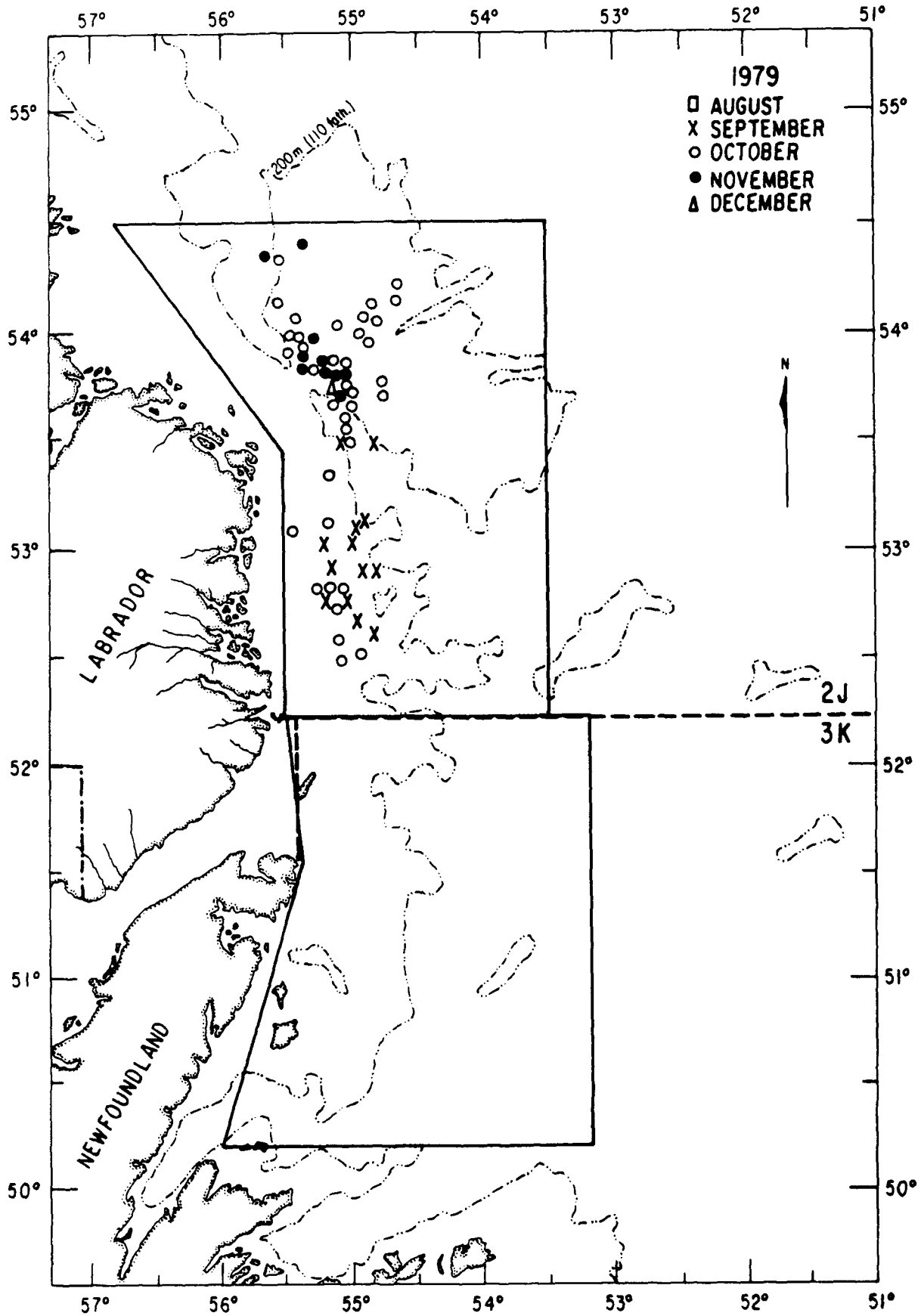

Fig. 2. Locations of USSR commercial fishing sets and boundaries of Canadian acoustic survey in Div. 2J3K, 1979.

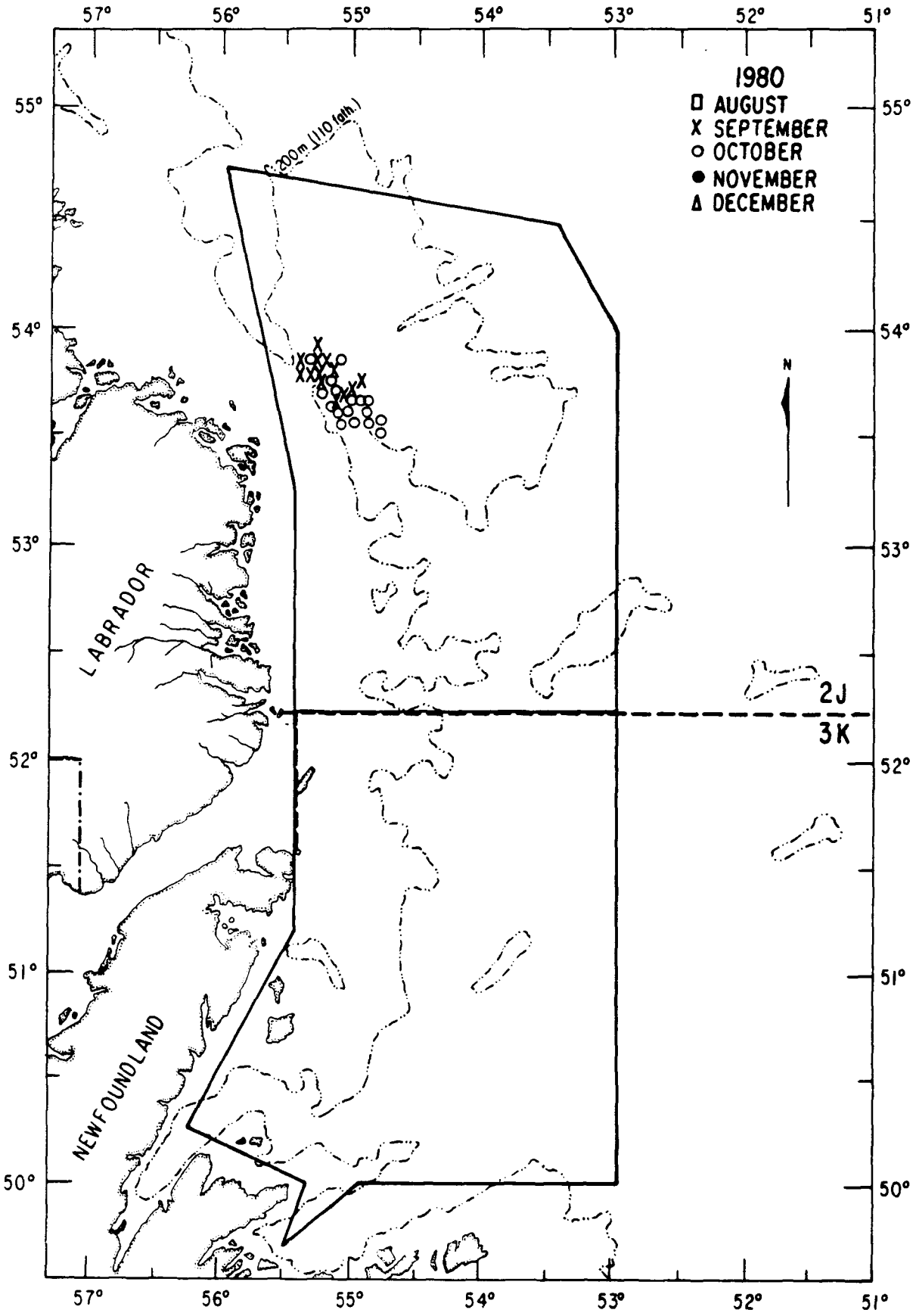

Fig. 3. Locations of USSR commercial fishing sets and boundaries of Canadian acoustic survey in Div. 2J3K, 1980.

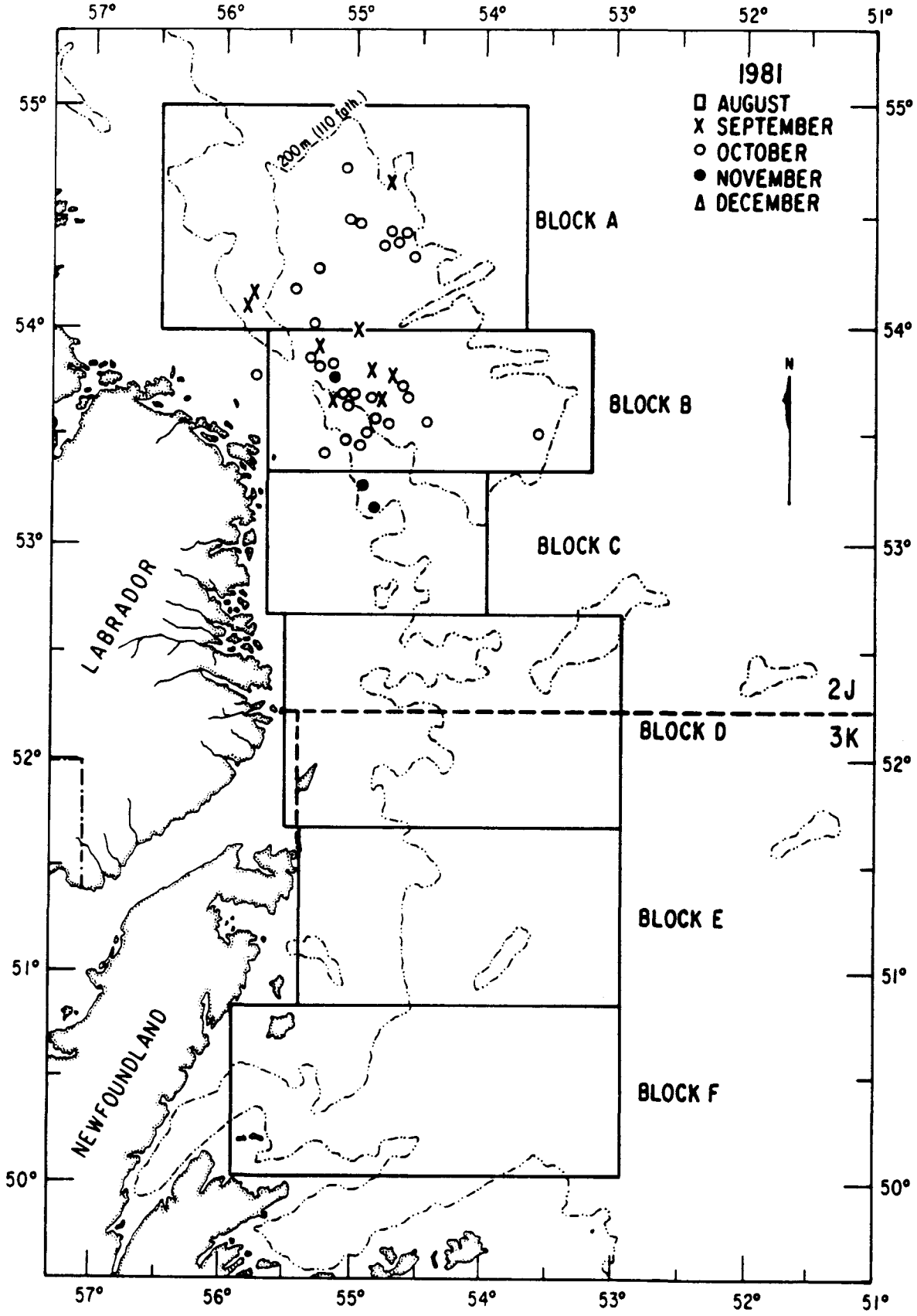

Fig. 4. Locations of USSR commercial fishing sets and Canadian acoustic survey blocks in Div. 2J3K, 1981.

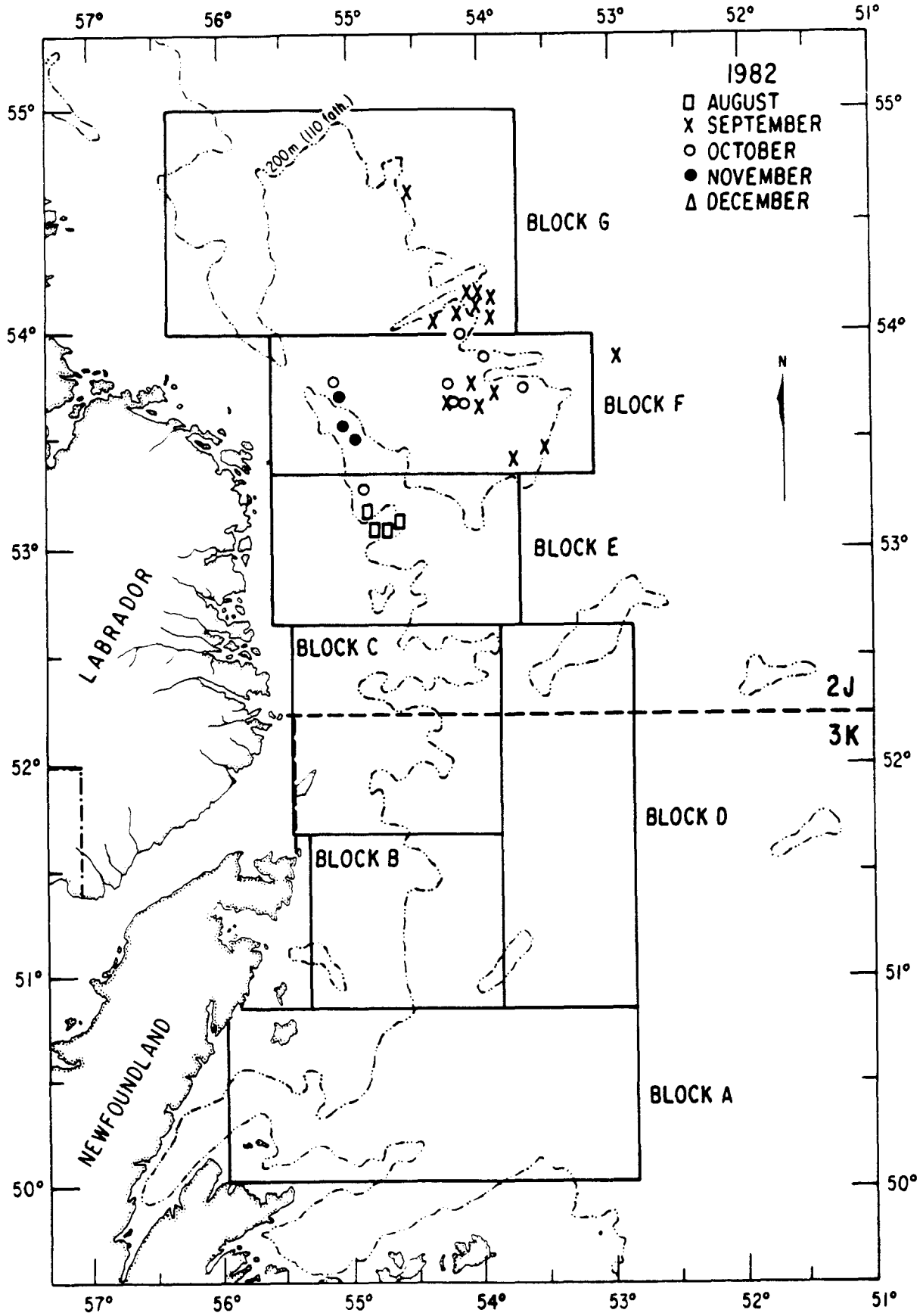

Fig. 5. Locations of USSR commercial fishing sets and Canadian acoustic survey blocks in Div. 2J3K, 1982.

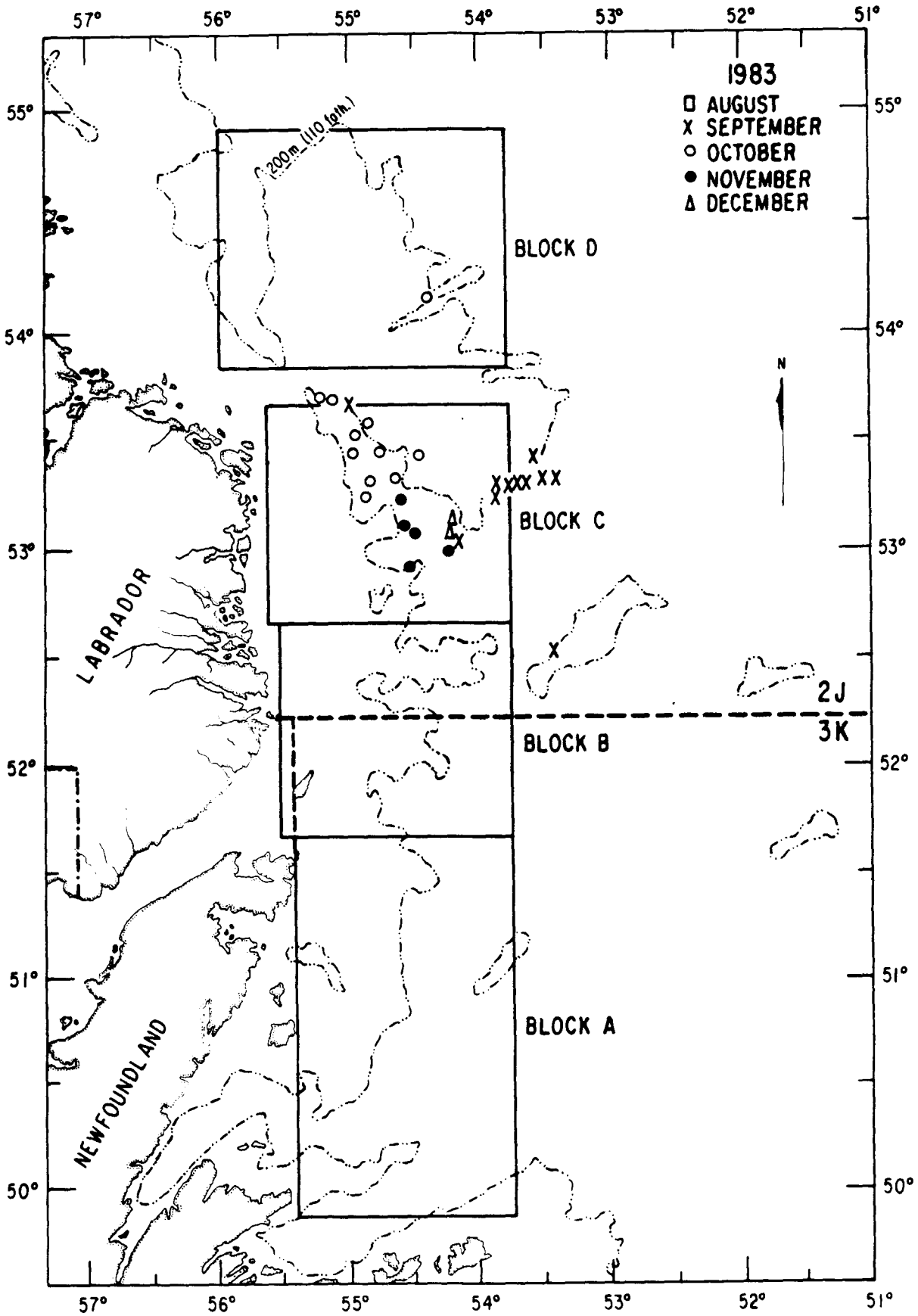

Fig. 6. Locations of USSR commercial fishing sets and Canadian acoustic survey blocks in Div. 2J3K, 1983.

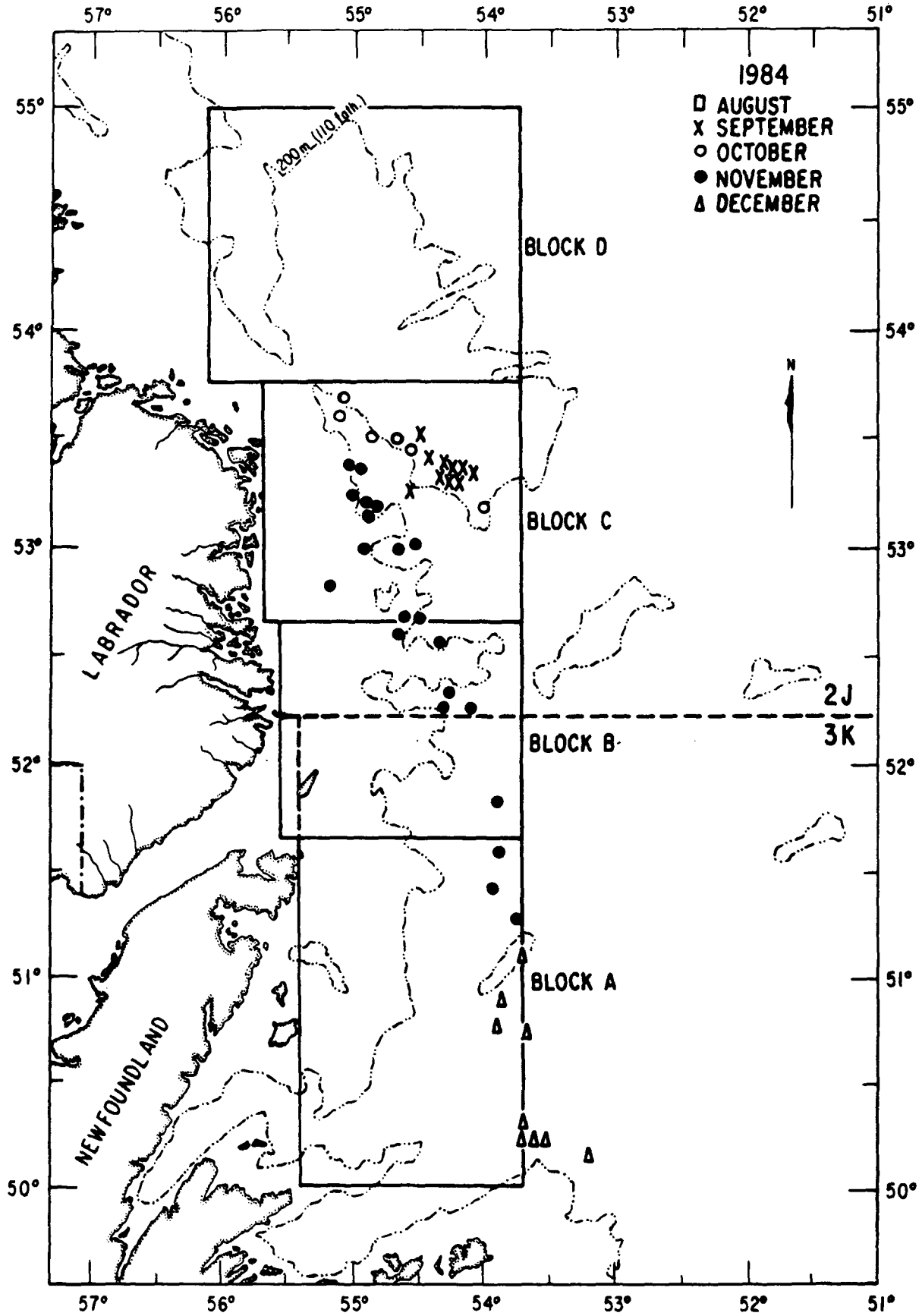

Fig. 7. Locations of USSR commercial fishing sets and Canadian acoustic survey blocks in Div. 2J3K, 1984.

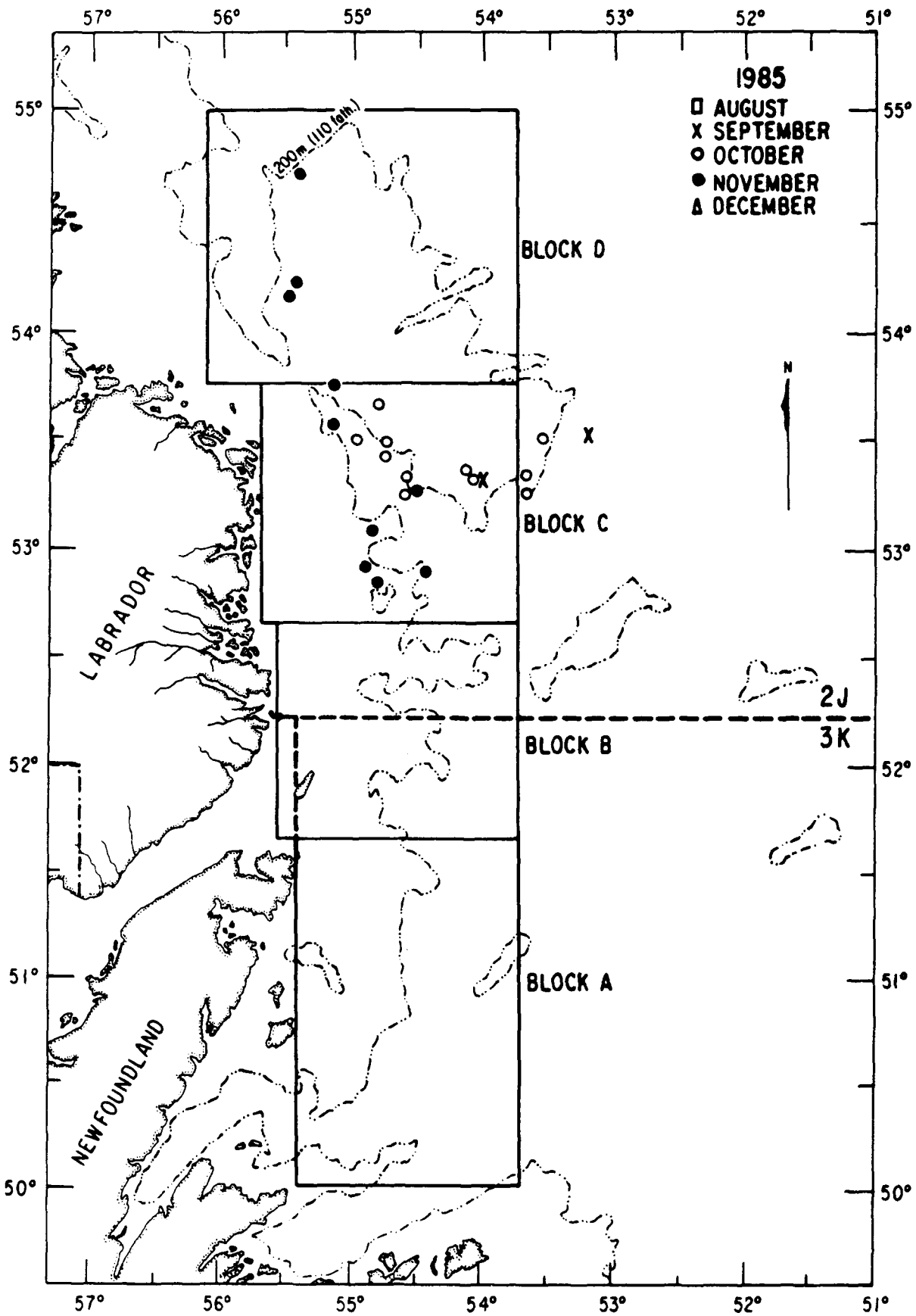

Fig. 8. Locations of USSR commercial fishing sets and Canadian acoustic survey blocks in Div. 2J3K, 1985.

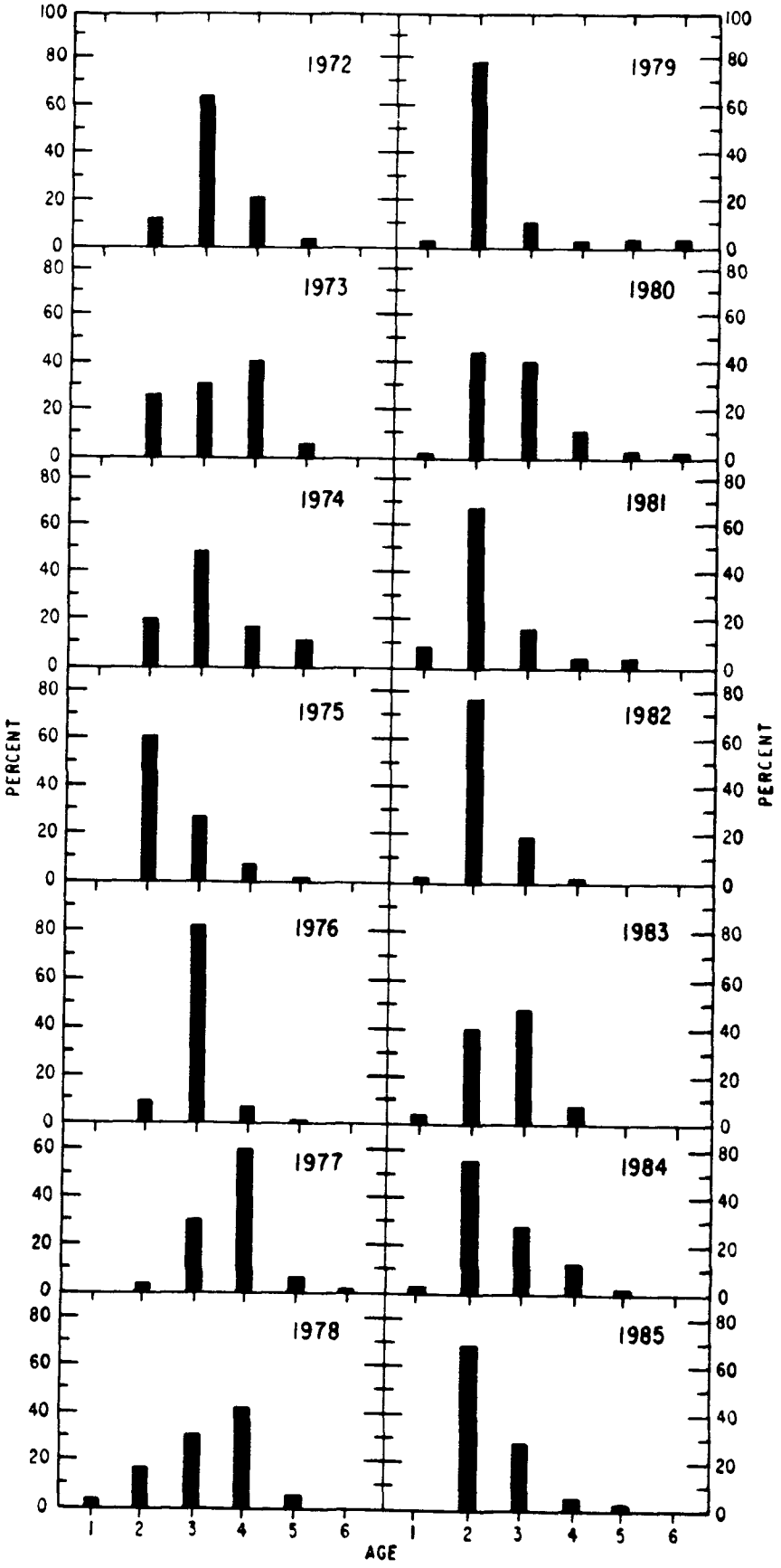

Fig. 9. Age-compositions of capelin from the offshore commercial fishery in Div. 2J3K, 1972-85.

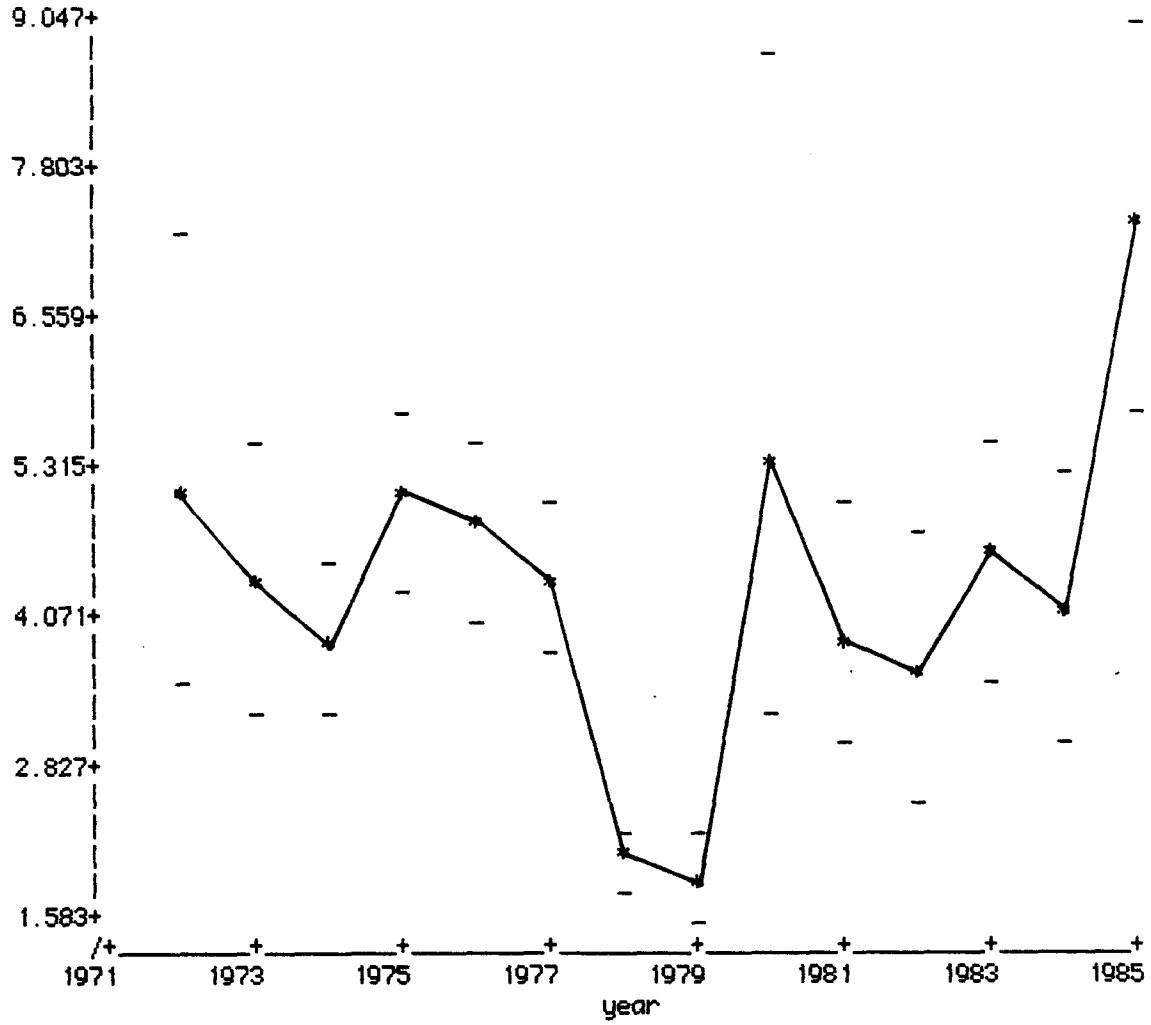

Fig. 10. Trends in catch rates for Div. 2J3K capelin, 1972-85, as determined using a multiplicative model.

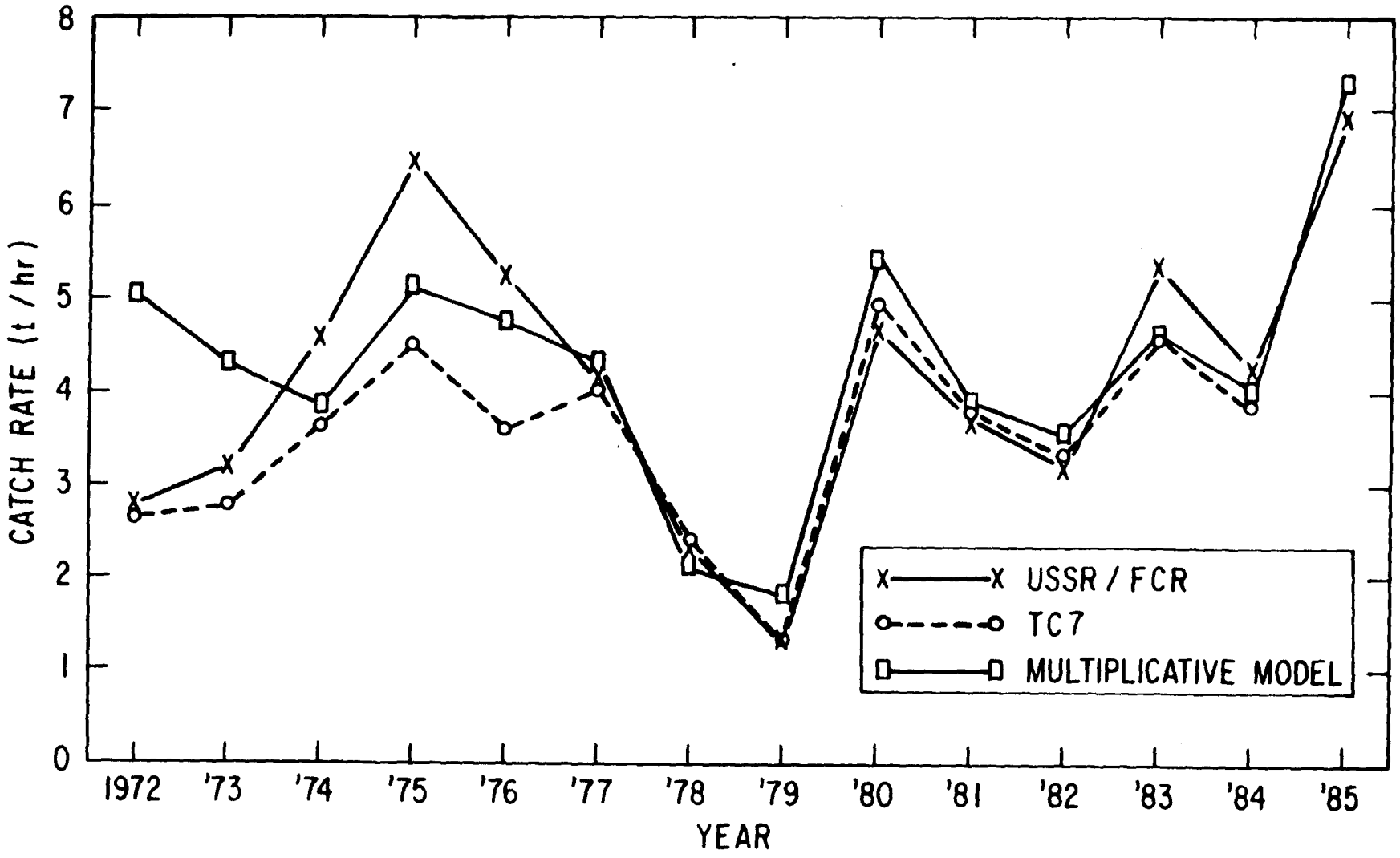

Fig. 11. Commercial catch rates for Div. 2J3K capelin, 1972-85.