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Capelin in NAFO SA2 + Div. 3K

by

J. Carscadden, B. S. Nakashima, D. S. Miller, R. Harnum and D. B. Atkinson
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+Div. 3K. Part A provides information on catch trends and TAC's in both the inshore and offshore areas from 1977-87.

Part B presents data on the offshore fishery and groundfish surveys. The geographical and seasonal pattern of the offshore catch in 1987 is similar to that in 1986 and during 1972-78 although the 1987 catch is much lower. The 1987 catch rate was the highest on record. Commercial catch rates during 1986 and 1987 from observer data were higher than those from NAFO data. The offshore commercial catch was dominated by the 1985 year-class (44%) followed by the 1983 year-class (32%) and the 1984 year-class (19%). The distribution of capelin catches during groundfish surveys compared to the Canadian acoustic survey indicated that the acoustic survey coverage was better in Div. 2J and Div. 3K.

Part C presents information on the concept of parallelism in year-class strengths of capelin by examination of age-composition and biomass estimates. This analysis indicates that the 1973 and 1983 year-classes were strong, the 1979, 1980 and 1982 year-classes were above average and the 1974-78 year-classes were weak in the Div. 3NO, Div. 3L and Div. 2J3K capelin stocks.

Part D contains data on the 1987 inshore fishery in Div. 3K. The 1987 catch was strongly dominated by the strong 1983 year-class, representing 82.5% of the total catch in numbers. Reported discards for all gear types increased substantially from 1986 levels and were the highest, proportionally to logbook landings since the research programme began operations. Catch rates of purse seines declined from 1986 but for traps, catch rates were highest in the series. However, the 1987 catch rates must be interpreted with caution because the conduct of the fishery was abnormal because of a labour dispute.

Part E describes the 1987 hydroacoustic survey of capelin in NAFO Div. 2J3K. Total capelin biomass was estimated at 134,000 t and two year-old capelin dominated.

Résumé

Cet article fait état des derniers renseignements recueillis sur le capelan dans la SA2 + Div. 3K. La partie A porte sur les tendances pour ce qui est des captures et sur le TPA dans les secteurs côtier et hauturier de 1977 à 1987.

Dans la partie B on présente des données sur la pêche hauturière et les relevés de poissons de fond. Aux points de vue géographique et saisonnier, les prises de pêche hauturière de 1987 sont comparables à celles de 1986 et de 1972 à 1978, bien

que les prises de 1987 soient beaucoup plus faibles. Le taux de capture de 1987 était le plus élevé jamais observé. En 1986 et 1987, les taux de capture de pêche commerciale étaient plus élevés d'après les données des observateurs que d'après celles de l'OPANO. Dans la prise de pêche hauturière commerciale, la classe de 1985 était prédominante (44 %); venait ensuite la classe de 1983 (32 %), puis celle de 1984 (19 %). En comparant la distribution des prises de capelans dans les relevés de poissons de fond à celle des relevés acoustiques canadiens, on a constaté que le relevé acoustique a été plus complet dans les Div. 2J et 3K.

Dans la partie C, on traite du parallélisme des effectifs de classe d'âge des capelans en examinant la distribution des âges et la biomasse estimée. L'analyse révèle que l'effectif des classes de 1973 et 1983 était élevé, que celui des classes de 1979, 1980 et 1982 était supérieur à la moyenne et que celui des classes de 1974 à 1978 était faible dans le stock de capelans des Div. 3NO, 3L et 2J3K.

Dans la partie D, on présente des données sur la pêche côtière de 1987 dans la Div. 3K. La classe de 1983, dont l'effectif était élevé, était nettement prédominante dans la prise de 1987, représentant en nombre 82,5 % des prises totales. Les rejets signalés pour l'ensemble des techniques de pêche avaient considérablement augmenté par rapport à 1986 et étaient les plus élevés, proportionnellement aux débarquements consignés aux journaux de bord, à être enregistrés depuis l'ouverture du programme de recherche. Les taux de capture à la senne coulissante ont baissé par rapport à 1986, mais les taux de la pêche au casier étaient les plus élevés de la série. Néanmoins, il faut interpréter ces données avec prudence, car un conflit de travail a perturbé la pêche en 1987.

Dans la partie E, on donne les résultats du relevé hydro-acoustique des capelans effectué en 1987 par l'OPANO dans la Div. 2J3K. La biomasse totale de capelans est estimée à 134 000 t; les capelans de deux ans prédominent.

Introduction

This document provides information pertinent to the capelin stock occurring in NAFO SA2 + Div. 3K. Catch information is found in Part A. Part B* includes catch rates and age compositions from the offshore fishery, a comparison of the areal coverage of the commercial fishery and the Canadian acoustic survey and distribution of capelin catches from the Canadian groundfish research surveys. Part C* provides historical documentation and discussion of parallelism in year-class strength of capelin in three stocks (Div. 2J3K, Div. 3L, and 3NO). Part D* summarizes the events of the 1987 inshore fishery, presents age-composition data derived from commercial samples and analyzes research logbook data submitted by commercial fishermen. Part E* presents the results of an acoustic survey conducted by Canada during the fall of 1987.

A. Catch trends

The capelin fishery in NAFO SA2 + 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. These offshore catches were taken mostly by USSR midwater trawlers. During 1980-82, the only directed offshore catches were taken in an experimental USSR midwater trawl fishery.

Since 1983, all offshore catches have been taken by USSR midwater trawlers. In most years, the offshore fishery occurred during August-December with peak catches occurring in September-November (Fig. 1). During 1972-82 and 1985, catches occurred in Div. 2J only while in other years catches occurred in both Div. 2J and Div. 3K.

In recent years, a small directed inshore fishery for roe has been conducted during June and July. In 1987, inshore capelin landings in NAFO SA2 + Div. 3K were the second highest in the series (Table 1) with all the fishing effort occurring in a single week in June.

The inshore capelin fishery has been regulated by quota management since 1982 (Table 2). White Bay and Notre Dame Bay are the principal bays in Div. 3K where the fishery operates.

In 1987, the 'normal' pattern of fishing activity was disrupted by a labour dispute. The fishery opened officially on June 1 in all areas of the Newfoundland Region, however, fishing did not begin until June 19 when a settlement was reached. Also on June 19 the capelin quota for SA2 + Div. 3K was revised downward from 15,500 t to 8600 t due to more recent information on a lower than expected market demand for frozen females in Japan. The fishery

*Part B-J. Carscadden, D. B. Atkinson, Part C-J. Carscadden, Part C-B. Nakashima, R. Harnum, Part E - D. S. Miller

was closed to all gear types 6 days later on June 25 in Notre Dame Bay and 7 days later in White Bay and Labrador on June 26.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Offshore											
TAC	212*	212	75	5	10	10	10	17	17	17	31
Nominal catch	150	53	11	5	10	10	10	17	17	17	30**
Inshore											
TAC	-	-	-	-	-	3	11	8	8	19	9
Nominal	2	2	1	1	2	4	4	7	7	12**	11**

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

B. Offshore fishery and Groundfish surveys

Offshore Fishery:

Catches in 1987 were taken in both Div. 2J and Div. 3K with the Div. 2J catches occurring earlier in the season. This pattern is similar to that of 1986 and reminiscent of the pattern of the fishery during 1972-78 although current catches are generally much lower.

The distribution of samples collected by the Foreign Cooperative Research Section, St. John's in relation to the 1987 Canadian acoustic survey is shown in Figure 2. As in 1986 (Carscadden et al. 1987), there is a general southward seasonal movement of the commercial fleet. During the survey conducted in October 1987, an extra block was added to the east of the "normal" survey area. It would appear that a significant portion of the fishery occurred in the same area covered by this additional block.

Catch Rates:

Commercial catch rates have been calculated from a number of different sources. One series (USSR/FCR in Table 6) consists of estimates from Seliverstov and Serebrov (1979) for the years 1971-78 inclusive and for 1979-87 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.

Data for the USSR OTM 7 fleet collected by the Canadian Observer Program for the years 1979-87 were analyzed using a multiplicative model (Gavaris 1980). All records with catches or effort less than 10 units were removed prior to analysis since it has been shown that rounding errors associated with these small values can introduce bias. An initial unweighted regression was

carried out, and the residuals examined (Fig. 3a, 3b). Based on these it was decided to include all of the data points. Boxplots of the residuals (expressed as percentiles) were done (Fig. 4). These indicated no trends with time but the catch rate in 1980 was much higher than predicted by the model. Further examination of these data (Fig. 5) indicated that catch rates in September were the cause for this so these data were deleted. The regression results after making the above modification (Tables 3a, 3b) indicate that the regression is very highly significant. An examination of the residuals (Fig. 6a, 6b) did not reveal any obvious outliers. A plot of the residuals versus the effort values (Fig. 7) indicates that some heteroscedasticity exists in the data so the regression was re-run weighted step-wise by effort (3 steps: 11-75, 76-225, and 226-362 units). The results (Table 4a, 4b) again indicate a high degree of significance. Boxplots of the residuals (Fig. 8) do not reveal any trends with time. Predicted catch rates, catch and effort are given in Table 5.

Figure 9 shows the differences in catch rates from 1979 through 1987 determined from different data sources and applying different techniques. Generally, the FCR data suggest a gradual increase over the time period for which data are available while the NAFO data show an increase only between 1985 and 1986. The two treatments of the FCR data show differences, since about 1980 in scaling only but the trends are the same. This would suggest that a straight average catch rate derived from these data is adequate and standardization using a multiplicative model is not necessary.

Last year, Carscadden et al. (1987) noted that during 1985 there was a large difference between catch rates derived from the Canadian Observer Program and NAFO Statistics. This also occurred for the 1986 data (Table 6). These large differences in catch rates in these two years are unexpected since the fleet has been well covered by the Observer Program and therefore the data collected should be in agreement with the data eventually reported to NAFO by the Soviets.

Age Compositions:

The offshore commercial catch was dominated by the 1985 year-class (44%) followed by the 1983 year-class (32%) and the 1984 year-class (19%) (Fig. 10). The contribution by 4-year-olds is the strongest since 1978 (42%). The greatest contribution by 4-year-olds occurred in 1977 when the strong 1973 year-class accounted for 60% of the catch.

During 1972-77, age compositions in the fall offshore commercial fishery agreed reasonably well with the age compositions of the spawning population inshore the following year indicating that the commercial fishery was taking predominantly maturing fish (Carscadden et al. 1985). An examination of data from 1981-87 shows while the agreement is not perfect, the trend is continuing into the 1980's (Table 7).

Canadian Groundfish Surveys:

Stratified-random groundfish surveys in Div. 2J3K have been conducted by GADUS ATLANTICA in most years immediately after the capelin acoustic survey. Tables 8 and 9 are updated from those presented previously (Carscadden and Atkinson 1986; Carscadden et al. 1987). The acoustic coverage of strata in

which capelin were caught during the groundfish survey was generally good in Div. 2J but not so complete in Div. 3K. It is probable that the catch rates from groundfish surveys are more useful as indicators of distribution of capelin rather than as indices of abundance.

C. Parallelism in Year-class Strengths of Capelin

The concept of parallelism in the three major stocks of capelin in the Newfoundland area (Div. 2J3K, Div. 3L, and Div. 3NO) has been cited in the scientific literature (see eg. Leggett et al. 1984) but there have been no analyses conducted to support the statement. It should be understood that this concept does not necessarily imply a direct linear relationship between year-class strengths in adjacent stocks but simply that very strong and/or very weak year-classes will often occur simultaneously.

Since the large offshore fishery developed in the early 1970's, a number of year-classes have been cited as being strong, namely the 1969, 1973, 1979, 1980 and 1983 year-classes while year-classes 1974-78 inclusive have been weak. In this section, we examine two types of data to determine if these observations are supported. The two types of data examined are: 1) age compositions and absolute abundances of year-class strength and 2) trends in biomass. In this case, we assume that since a capelin population contains only 4-6 age-classes (ages 1-7) or in a mature population only 2 age-classes (ages 3 and 4) predominate the presence of an exceptionally strong year-class will result in a large increase in biomass. Thus, a large increase (or decrease) in biomass in all stocks would indicate the presence of a strong (or weak) year-class in all stocks.

Age Compositions:

The data in Table 10 are from Carscadden (1978) and give age compositions of capelin from Div. 3N, 3L and 3P during the late 1960's and early 1970's. During this time period, the 1969 and 1973 year-classes were considered to be strong. In Div. 3N, the 1969 year-class does not show up strong as 3-year-olds but does appear strong as 4-year-olds. The 1973 year-class makes up a significant proportion of the population as 3-year-olds.

In Div. 3P, 3-year-olds dominated every year.

In Div. 3L, 4-year-olds dominated except in 1976, when 3-year-olds (1973 year-class) were dominant.

Age composition data for the 1980's for Div. 3N acoustic surveys and from Div. 3L and 3K inshore fisheries are shown in Table 11. During this time period, the 1983 year-class was considered very abundant with the 1979 and/or the 1980 year-class considered to be above average. In Div. 3N both the 1979 and 1983 year-classes appeared relatively large (Table 11). This is also true for the abundance data (Table 12).

In Div. 3L, both the 1979 and 1980 year-classes appeared relatively strong (Table 11). The 1983 year-class appeared relatively abundant as 3-year-olds but the relative strength of this year-class in this area cannot be fully assessed until the 1987 age-composition data are available.

In Div. 3K, the 1979, 1980 and 1983 year-classes appeared strong (Table 11). The 1983 year-class appeared very strong as 4-year-olds although this value may be biased up due to an anomalous fishery in 1987. The 1980 year-class appeared relatively strong even as 5-year-olds.

Age-composition data are available for the offshore fishery in Div. 2J3K since 1972 (Table 13). Both the 1969 and 1973 year-classes appeared in the fishery in some strength over a number of years, the former as 3-, 4-, and 5-year-olds and the latter as 2-, 3-, 4-, and 5-year-olds. During the late 1970's other year-classes appear relatively strong but probably weren't because at that time the biomass was very low (see below). The 1979 and 1980 year-classes may be average or above average. The 1983 year-class is strong; it has appeared in the fishery in some strength at ages 2-5 and most indicators show the stock biomass is increasing.

Relative strengths of year-classes from acoustic surveys and inshore catch rate data from Div. 3L during the late 1970's and 1980's are shown in Figure 11 and 13 (Carscadden et al. 1987). From standardized density and abundances at age 2 from offshore spring and summer acoustic surveys, the 1983 year-class appeared very strong (Fig. 11). From trap catch rate data (Fig. 12), the 1978 and 1981 year-classes appeared weak while the 1979 and 1982 year-classes appeared relatively strong. The 1983 year-class was fairly strong as 3-year-olds; confirmation on whether the 1983 year-class is strong will await the analysis of 1987 data. A similar pattern was apparent from purse seine catch rates (Fig. 13) with the 1978 and 1981 year-classes relatively weak compared to other year-classes.

During the late 1970's and early 1980's, sequential capelin abundance models were used to assess the Div. 3L and 2J3K capelin stocks. The relationship between 2-year-olds from both stocks as derived from these models is shown in Figure 14 (Carscadden and Miller 1979). The 1973 year-class was very strong and makes a significant contribution to the regression but the relationship would probably still be significant with only the other points included.

With the exception of only a few years, the Soviets have been conducting fall acoustic surveys in Div. 2J3K since 1974 and the numbers-at-age and standardized numbers-at-age from these surveys are given in Tables 14 and 15, respectively. The 1983 year-class was strongest at age 2 and 3 followed by the 1973 class. The 1979, 1980 and 1982 year-classes were also strong or at least above average.

Biomass Estimates:

All biomass estimates for the Div. 3NO capelin stock have been produced by USSR and Canada with the exception of one estimate in 1972 by Norway (Fig. 15). USSR surveys do not cover the same area at the same time of year and in recent years it is not possible to separate the biomass estimates in Div. 3L and Div. 3NO. Canadian estimates are available only since 1981.

Biomass was high in the mid-1970's, declined during the late 1970's, and early 1980's, and has increased since, although biomass levels in the 1980's are not as high as in the mid-1970's. The trends in biomass are consistent

with the presence of a strong 1973 year-class, then a series of weak year-classes in the late 1970's and fairly good year-classes during the 1980's.

There is not a good time series of biomass estimates for Div. 3L (Fig. 16). However, from the limited data, it would appear that biomass was low in the late 1970's and early 1980's and then increased dramatically in the mid-1980's, consistent with the presence of a strong 1983 year-class.

Biomass estimates for the Div. 2J3K stock from USSR acoustic surveys from 1972-86 show a trend of high biomass in the 1970's, low biomass in the late 1970's and early 1980's, and an increase in the mid-1980's (Fig. 17). This trend is consistent with the presence of a strong 1973 year-class, poor year-classes between 1974 and 1978, a strong 1979 and 1980 year-class and a much stronger 1983 year-class.

Estimates from a sequential capelin abundance model are available from 1972 to 1980 and show the same trend as the acoustic estimates (Fig. 17). The 1973 year-class was the strongest in the series.

Biomass estimates from Canadian acoustic surveys are available only from 1983 to 1987 and show a peak in 1985 (Fig. 17).

Catch rate data from the offshore fishery (Table 6) show a pattern similar to the USSR acoustic surveys with high biomas in the mid-1970's, a decline in the late 1970's, and an increase in the 1980's.

Summary:

While the data are occasionally fragmentary, the age composition and biomass trends considered together would indicate that parallelism in year-class strengths of capelin between the three major stocks (Div. 3NO, Div. 3L, and Div. 2J3K) occurs. The strong 1973 and 1983 year-classes, above average year-classes in 1979, 1980, and 1982 and weak 1974-78 year-classes resulted in high biomasses during the mid-1970's and mid-1980's and low biomasses in the late 1970's and early 1980's. These trends occurred in the three stocks considered here.

D. The 1987 Inshore Fishery in Div. 3K

Sampling Program:

Commercial samples were collected by fishermen and at fish plants at the rate of two samples per gear type per week per statistical section (Fig. 18) in Div. 3K (Table 16). Only 39 samples were collected and analyzed from the commercial catch because landings were down from 1986 (Table 1) and the fishery was closed 7 days after fishing had begun.

Age Composition of the Catch:

The 1987 catch was dominated strongly by the strong 1983 year-class as 4-year-olds representing 82.5% of the total catch in numbers (Table 17). Three-year-olds from the 1984 year-class constituted 10.8% which was the smallest proportion since 1982. The 1982 year-class as 5-year-olds was 6.3% of the catch.

The catch in 1987 was predominantly older and larger fish because the 1983 year-class made up such a high percentage. However, there was a potential bias in relating the age composition of the catch to the age composition of the mature population. In 1987, the entire fishery was conducted in 8 days and in all likelihood the fishery in Div. 3K operated during the part of the spawning season when the older, larger fish were more likely to be caught. In previous years the fishery was longer, extending into July when smaller, younger fish would have been caught. Consequently, the relative difference among ages in the inshore commerical catch in 1987 should be interpreted with caution. Even if the fishery had been longer, the 1983 year-class would have dominated the catch in 1987 because the 1983 year-class was observed to be strong and the 1984 year-class to be weak in surveys in 1986 (Carscadden et al. 1987).

The age composition of the 1986 catch reported in Carscadden et al. (1987) was updated in this report (Table 17) with more recent landing data for 1986.

Research Logbook Survey:

In 1987, research logbooks were distributed to 14 purse seine, 11 beach seine, and 16 trap fishermen who live in Div. 3K. Of these six purse seine, five beach seine, and 13 trap logbooks were returned in 1987. All six purse seiners fished exclusively in Div. 3K. Two trap fishermen each fished two capelin traps in 1987. Six fishermen did not fish capelin in 1987 and 11 logbooks were not submitted.

In 1987, 78% of the discards by purse seiners was due to the redfeed content (Table 18). In the miscellaneous category, capelin were let go because the amount caught was in excess of vessel capacity. Similarly for beach seiners, 80% of their discards was related to redfeed problems and the remaining 20% was attributed to males sorted from their catches (Table 19). For capelin traps there was a wider variety of reasons for discarding part of the catch (Table 19). The main reason which represented 37% of all trap discards was due to market-related problems such as boat quotas, blocked plants, and the quota being taken. Redfeed content was involved in 27% of the discards and low percentage of females made up 11%. Similar to purse seiners, the miscellaneous reason for traps was predominantly in excess of vessel capacity. For all gear types no discarding was reported to be due to over ripe, spawned out, or small females. This supports the notion of the short fishery which failed to prosecute the latter part of the spawning period when smaller, younger females would have been available. Thus, redfeed content for all three gear types and market-related problems for traps were the chief reasons reported for discarding capelin in 1987.

Reported discards for all gear types increased substantially from 1986 levels and were the highest, proportionally to logbook landings since the research logbook programme began operations. In our analysis of logbook records, discards constituted 87% of purse seine landings (Table 20), 120% of beach seine landings (Table 21), and 106% of trap landings (Table 22). In the majority of reports, capelin were reported released alive at sea. Discarding referred to capelin which were caught and not landed by the individual who

caught them. No distinction was made between fish released alive or let down dead.

Catch/effort data were available from 1981 to 1987 for purse seines and from 1983 to 1987 for beach seines and traps. Catch/effort (CPUE) estimates of purse seines decreased from 1986 to 1987 (Table 20) with CPUE estimates derived from logbook landings (L) following a steeper decline than those based on logbook catches (C) which included discards. Landings/set in 1987 were the lowest in the series and catch/set was the second lowest. For beach seines, CPUE indices gave mixed signals (Table 21). The 1987 indices based on landings only were the lowest in the series, whereas the catch/day in 1987 was the highest estimate since 1983 and the catch/set was average. For capelin traps, all four CPUE indices were the highest in their respective series (Table 22).

The 1987 CPUE estimates must be interpreted with caution when compared to CPUE values in earlier years because of the short length of the 1987 inshore fishery. The total fishing effort per gear type was considerably lower in 1987 than in previous years (Table 20, 21, and 22). Beach seine landings and fishing effort continued to decline in 1987 as industry relied more on capelin obtained from traps and purse seines (Table 1). Purse seine catches reported in 1987 had high redfeed levels which are indicative purse seine sets early in the spawning period when mature females are still feeding. As spawning progresses, the redfeed levels usually decline and later catches include spent and over-ripe females. In 1987, purse seine activity was curtailed earlier than in other years which may present difficulties in interpreting year to year trends. In 1987, purse seiners fished 5.2 days per vessel compared to 8-10 days in 1981-86. Capelin traps recorded high catches from the opening until the closing date of the fishery which was reflected in their catch/day rate of 10.5 t per day, almost double the 1986 estimate of 5.8 t. In other years traps were out fishing prior to the spawning peak when catches were low and infrequent and remained fishing beyond the spawning peak when spent females were present. Accordingly, the CPUE for traps may reflect higher catch rates than would have been experienced had the fishery not been interrupted by the labour dispute. At this point it is difficult to recast the CPUE's to reflect past fishing patterns. We did observe that all trap indices were the highest in its series, and fishermen reported that capelin were abundant where they were fishing during and after the fishery was closed. Thus the catch rates sustained by the trap fishery in 1987 were probably indicative of high capelin abundance during the fishery, however, the magnitude of the increase from 1986 to 1987 observed in Table 22 may be exaggerated.

E. Hydroacoustic Survey of Capelin in NAFO Div. 2J3K

A hydroacoustic survey for capelin was carried out in NAFO Div. 2J3K during the period October 10-25, 1987. This cruise is part of a series of annual acoustic surveys conducted on the Div. 2J3K capelin stock since 1981 (Carscadden et al. 1987, Miller and Carscadden 1984, 1985, 1986).

The configuration of the data acquisition system was the same as used for previous capelin surveys of this stock (Miller and Carscadden 1984) with the following exceptions: 1) the pulse length used was 1.2 milliseconds; 2) the attenuation coefficient (α) used was 0.0122 dB/meter; and 3) a new model of

transducer was used, i.e. Ametek-Straza SP303LT. Survey coverage was expanded in 1987 to include an area (Fig. 19, Block E) to the east of the area surveyed in previous years. Fishing sets were conducted using the same strategy as in earlier surveys to obtain samples for determining the age and length composition of the capelin stock.

Figure 19 shows the survey track and fishing set locations during the survey. Figure 20 shows the length and age distribution for each survey block and mean distribution for the entire survey area.

Table 23 is a summary of the results of the acoustic survey. Total capelin biomass is estimated at 133,639 tons. Table 24 presents numbers and biomass at age for all Div. 2J3K acoustic surveys since 1981.

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Table 1. Inshore capelin landings (t) by gear, 1975-88.

Year	NAFO Div.	Purse seine	Ring net	Beach seine	Trap	Misc.	Total
1975	2J	-	-	-	-	-	-
	3K	-	-	613	86	-	699
	2+3K	-	-	613	86	-	699
1976	2J	-	-	1	-	-	1
	3K	-	-	1519	162	4	1685
	2+3K	-	-	1520	162	4	1686
1977	2J	-	-	-	-	-	-
	3K	-	-	1891	24	-	1915
	2+3K	-	-	1891	24	-	1915
1978	2J	-	-	-	-	-	-
	3K	-	25	1948	447	-	2420
	2+3K	-	25	1948	447	-	2420
1979	2J	-	-	-	-	-	-
	3K	-	168	461	42	-	671
	2+3K	-	168	461	42	-	671
1980	2J	-	-	-	-	-	-
	3K	-	560	655	139	-	1354
	2+3K	-	560	655	139	-	1354
1981	2J	-	-	-	-	-	-
	3K	-	1000	520	283	-	1803
	2+3K	-	1000	520	283	-	1803
1982	2J	-	4	4	-	-	8
	3K	-	1935	1544	381	-	3760
	2+3K	-	1939	1548	381	-	3768
1983	2J	-	-	4	-	-	4
	3K	2359	-	1062	344	-	3765
	2+3K	2359	-	1066	344	-	3769
1984	2J	-	-	1	-	-	1
	3K	3661	-	2338	1119	-	7118
	2+3K	3661	-	2339	1119	-	7119
1985	2J	-	-	1	-	-	1
	3K	3948	-	835	2584	-	7367
	2+3K	3948	-	836	2584	-	7368
1986	2J	-	-	3	-	-	3
	3K	4222	-	2534	5143	-	11889
	2+3K	4222	-	2537	5143	-	11892
1987*	2J	-	-	4	-	-	4
	3K	3038	-	2141	5625	-	10804
	2+3K	3038	-	2145	5625	-	10808

* provisional

Table 2.

Allocation of quotas (t) and opening dates for the inshore commercial fishery in SA2 + Div. 3K.

Year	Area	Fixed gear	Purse seine	Reserve	Total	Product use	Opening date
1982	2J3K	1000	1000	1000	3000	Frozen females	June 1
1983	Notre Dame Bay	1500	1500		3000	Frozen females	June 15
	White Bay	1500	1500		3000	Frozen females	June 15
	2J3K	1000	1000		2000	Roe extraction	June 15
1984	Notre Dame Bay	2500	2500		5000	Frozen females	June 15
	White Bay & Labrador	1500	1500		3000	Frozen females	June 15
1985	Notre Dame Bay	2500	2500		5000	Frozen females	June 28
	White Bay & Labrador	1500	1500		3000	Frozen females	June 28
1986	Notre Dame Bay	5500	5500		11000	Frozen females	June 1
	White Bay & Labrador	4000	4000		8000	Frozen females	June 1
1987	Notre Dame Bay	3300	1700		5000	Frozen females	June 1*
	White Bay & Labrador	2600	1000		3600	Frozen females	June 1*

* fishery began June 19 after agreement on price structure and quotas

Table 3a. Statistics for initial run of multiplicative model.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.857
MULTIPLE R SQUARED..... 0.735

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.428E2	3.428E2	
REGRESSION	13	5.705E1	4.388E0	28.328
TYPE 2	4	1.845E0	4.612E-1	2.977
TYPE 3	1	2.569E-1	2.569E-1	1.658
TYPE 4	8	5.437E1	6.796E0	43.872
RESIDUALS	133	2.060E1	1.549E-1	
TOTAL	147	4.204E2		

Table 3b. Regression coefficients for initial run of multiplicative model.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
2	10	INTERCEPT	0.273	0.099	147
3	23				
4	79				
2	8	1	-0.238	0.240	3
	9	2	-0.286	0.085	38
	11	3	-0.117	0.095	34
	12	4	-0.175	0.153	11
3	31	5	-0.165	0.128	19
4	80	6	1.133	0.202	5
	81	7	1.068	0.133	19
	82	8	1.212	0.161	10
	83	9	1.586	0.151	11
	84	10	1.408	0.136	17
	85	11	1.725	0.161	9
	86	12	1.698	0.150	14
	87	13	2.004	0.113	43

Table 4a. Statistics for run of multiplicative model when Sept. 1980 data excluded.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.860
MULTIPLE R SQUARED..... 0.739

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.318E2	3.318E2	
REGRESSION	13	5.699E1	4.384E0	29.037
TYPE 2	4	1.809E0	4.523E-1	2.996
TYPE 3	1	2.397E-1	2.397E-1	1.588
TYPE 4	8	5.415E1	6.769E0	44.837
RESIDUALS	133	2.008E1	1.510E-1	
TOTAL	147	4.089E2		

Table 4b. Regression coefficients for run of multiplicative model when Sept. 1980 data excluded.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
2	10	INTERCEPT	0.269	0.097	147
3	23				
4	79				
2	8	1	-0.244	0.245	3
	9	2	-0.279	0.094	38
	11	3	-0.124	0.094	34
	12	4	-0.209	0.155	11
3	31	5	-0.164	0.130	19
4	80	6	1.137	0.188	5
	81	7	1.064	0.130	19
	82	8	1.171	0.156	10
	83	9	1.583	0.148	11
	84	10	1.409	0.134	17
	85	11	1.736	0.158	9
	86	12	1.698	0.149	14
	87	13	1.989	0.112	43

Table 5. Predicted catch rate for final run of multiplicative model.

STANDARDS USED VARIABLE NUMBERS: 10 23

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1979	0.2688	0.0094	1.405	0.137	10817	7698
1980	1.4057	0.0260	4.343	0.699	4795	1104
1981	1.3328	0.0092	4.072	0.392	10195	2504
1982	1.4403	0.0175	4.516	0.598	9677	2143
1983	1.8514	0.0168	6.814	0.882	10442	1532
1984	1.6780	0.0122	5.743	0.634	17366	3024
1985	2.0041	0.0179	7.934	1.061	16838	2122
1986	1.9671	0.0140	7.661	0.908	16757	2187
1987	2.2579	0.0059	10.288	0.790	28227	2744

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.117

Table 6. Commercial catch rate series for Div. 2J3K capelin, 1972-87.

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
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	6.05	7.70
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	4.16	4.38	

Table 7. Percentage age compositions of capelin from the autumn fishery (A) in Div. 2J3K and the subsequent summer spawning population (S) in Div. 3K during 1972-77, 1981-87 with the autumn frequencies incremented by 1 year. Data for 1972-77 from Carscadden et al. 1985. J. Northw. Atl. Fish. Sci. 6: 135-140.

Age (yr)	1972-73		1973-74		1974-75		1975-76		1976-77		1981-82		1982-83		1983-84		1984-85		1985-86		1986-87	
	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S
3	12	2	25	31	20	40	62	61	9	2	67	84	77	62	41	33	62	57	67	61	19	11
4	64	90	30	46	49	53	28	38	83	92	16	10	19	37	48	63	18	30	28	36	71	83
5	21	8	40	20	18	5	8	1	7	5	4	4	2	<1	7	3	9	12	3	2	9	6
6	3	1	5	3	13	2	2	1	1	1	4	1	.5	0	<1	<1	1	<1	2	1	1	<1

Table 8.

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	1986	1987
201	0	-	0	0	1.30*	0.83*	0.17	0 **	0	0	0
202	0	0	0	1.50	4.00	24.50	0	0.50**	0	0	0
203	0	0	0.67*	2.00*	0 **	0 **	0.33**	0 **	2.00**	0*	0**
204	0	0	0 *	- *	0 **	0 **	0 *	0 *	0 *	0*	1.0*
205	1.20	-	86.0 **	75.00**	1566.62**	103.50**	1.25**	0.25**	7.13**	0**	3.50**
206	0.09	-	699.50**	458.29**	23.73**	3.72**	3.14**	3.64**	4.29**	0.09**	0**
207	0	-	1.80**	0 **	6.89**	3.09**	0 **	0.43**	1.59**	0**	0.18**
208	0	0	1.00**	0 **	0 **	2.33**	0 **	0 **	10.33**	-**	0**
209	0	0	7.31**	1378.83**	1.00**	1.18**	0.51**	19.79**	1.00**	0.14**	0.13**
210	0.17	0	0 **	0 **	2.00**	1.52**	0 *	4.25*	8.89*	278.33*	1136.0**
211	1.00	0	0.25	22.00**	0 *	1.00**	108.00*	1.50*	1.00*	0*	14.0**
213	0	0	0 *	0 **	314.00**	4.90**	0 *	0.60*	1.67*	0*	0**
214	0	0	0	0 *	0 **	1.75**	0.13**	0.25**	5.83**	0	0**
215	0	0	0	0.25*	0 *	0.78*	0.38*	0 *	0 *	0	0*
216	0	0	0	0 *	0.50*	0 *	0 *	0 *	0 *	0	0
217	0	0	0	0 *	0 *	0 *	0 *	- *	0 *	0	0
222	0	0	0	0 *	0 *	0 *	0	0	0	0	0*
223	0	0	0	0 *	0	0	0	0	0	0	0
227	0	0	0	0	0	0	0	0.33	0	0	0.25
228	0	0	0	0	0	0	0	5.43	3.14	13.20	120.43
229	0	0	0	0	0	0	0	0	0	4.33	0
234	0.50	0	1.25**	0 **	1.50**	4.00**	0 **	0.60**	0 **	0.50**	0**
235	0.75	0	0.50**	0 *	0 *	0.33*	0 *	0 *	0 *	0*	1.0**
Av. no/set	0.15	0	62.14	128.02	164.12	10.73	2.45	2.83	2.51	10.42	48.12
Adjusted av. no/set			12.46	104.82	36.7						

Table 9.

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	1986	1987
620	0.25	0	5.40**	0.08**	247.9 **	0.89**	96.10**	31.62**	46.50**	0.33**	36.0**
621	-	0.20	1.09**	0 **	0.45**	48.36**	2.75**	10.43**	7.00**	86.67**	127.83**
622	0	0	0 **	0 **	1.00**	0 **	23.50	2.75	3.00	0	4.67**
623	0	0	0 **	5.83**	10.00**	0.40**	2.67*	5.00*	80.17*	1.0*	118.2**
624		0	0 *	0 **	0 *	0 *	0.0	8.00	4.75	13.00	0*
625		0	1.20*	0	0	0	0	0.80	0.60	15.00	2.75*
626		0	1.20**	1.80**	0.20**	0 **	3.75*	4.17*	2.92*	0*	13.6**
627		0.50	0 *	2.50	0.17*	0.43*	1.50	0	1.71	2.00	5.50
628		0	0.20	7.83	0	10.17	4.50	0.14	17.58	1.75	31.60
629		0	6.50	7.80	0	0	12.33	0.50	7.75	0	29.33
630		0	0.25	0.25	5.50	-	4.00	0	39.41	-	65.67
631		0	0	0.33	1.20	9.00	1.40	3.40	1.57	2.00	12.67
632		0	0	0	0	0	0	-	0	0	0
633		0	0.10	0	0.75	0	0	0	0	14.75	6.73
634		0	0.25	0.43	1.43	10.18	0	0.14	0.44	1.60	1.55
635		0	5.88	6.17	0.60	5.40	11.33	1.38	2.71	0.93	5.67
636		0	0.0	16.43	1.17	4.40	0	0.13	0.25	0	1.14
637		0.20	0.57	4.67	1.33	21.71	15.00	0.50	3.43	0.25	1.67
638		0	0.33	2.33	1.50	15.73	0.82	0	18.27	5.25	2.10
639		0	0	0.83	0.67	14.70	0	0	6.88	0.17	2.71
640		0	-	0	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	15.80	26.39
Combined 2J3K			28.53	56.21	86.83	11.07	6.86	4.17	8.32	13.17	36.45
Combined 2J3K with adjusted 2J values			6.29	46.3	29.5	11.07	6.86	4.17	8.32		

Table 10. Tables of age-composition of mature capelin from Division 3N, 3P and 3L (from Carscadden 1978).

Percentage age composition and mean length-at-age (mm) of mature capelin in samples from Div. 3N in June, 1967-76.

Sex	Year	Age-groups 2	3	4	5	6	Number of fish
Male	1967	—	66 (184)	30 (191)	4 (198)	—	307
	1969	6 (164)	23 (182)	68 (193)	4 (193)	—	811
	1970	4 (166)	52 (184)	40 (189)	4 (198)	—	25
	1972	—	36 (178)	63 (185)	1 (190)	—	106
	1973	—	5 (175)	86 (179)	9 (182)	—	44
	1974	—	29 (187)	41 (193)	29 (194)	2 (192)	350
	1975	5 (168)	51 (181)	42 (194)	2 (197)	—	539
	1976	—	59 (174)	37 (176)	4 (180)	1 (181)	295
	Mean[1]	4 (165)	37 (182)	52 (192)	7 (194)	2 (192)	
Female	1967	—	49 (166)	31 (173)	18 (179)	2 (189)	323
	1969	16 (146)	47 (159)	32 (170)	5 (184)	1 (194)	1000
	1970	—	52 (165)	28 (176)	20 (182)	—	25
	1972	—	43 (158)	52 (169)	5 (183)	1 (186)	244
	1973	1 (148)	10 (158)	82 (165)	7 (173)	—	256
	1974	1 (146)	28 (166)	27 (176)	42 (179)	3 (185)	400
	1975	7 (148)	39 (163)	30 (177)	12 (185)	11 (189)	1126
	1976	—	72 (155)	23 (162)	4 (175)	1 (182)	1119
	Mean[1]	7 (146)	39 (161)	36 (172)	13 (185)	5 (189)	

[1] Excluding 1976 data.

Percentage age composition and mean length-at-age (mm) of mature capelin in samples from Div. 3P in June, 1973-76.

Sex	Year	Age-group 2	3	4	5	6	Number of fish
Male	1973	1 (170)	48 (174)	42 (182)	8 (186)	—	577
	1974	15 (173)	55 (185)	21 (191)	8 (195)	—	978
	1975	3 (162)	71 (187)	24 (192)	1 (190)	1 (194)	563
	1976	—	73 (184)	25 (187)	2 (192)	—	890
Female	1973	3 (144)	49 (160)	34 (170)	14 (173)	—	95
	1974	21 (160)	50 (171)	22 (178)	7 (179)	1 (187)	219
	1975	6 (139)	54 (170)	29 (180)	8 (184)	2 (197)	187
	1976	—	72 (167)	22 (177)	5 (191)	2 (191)	60

Percentage age composition and mean length-at-age (mm) of mature capelin in samples from Div. 3L in June, 1967-76.

Sex	Year	Age-group 3	4	5	6	7	Number of fish
Male	1967	21 (188)	63 (198)	15 (201)	1 (206)	—	920
	1969	20 (192)	76 (194)	4 (185)	—	—	50
	1970	—	—	—	—	—	—
	1972	5 (179)	95 (188)	—	—	—	100
	1973	3 (178)	79 (185)	18 (187)	—	—	767
	1974	24 (187)	47 (193)	29 (196)	<1 (195)	—	904
	1975	26 (187)	69 (198)	4 (200)	<1 (206)	—	1241
	1976	51 (185)	48 (194)	1 (196)	—	—	1189
Female	1967	16 (166)	19 (176)	62 (182)	3 (186)	—	613
	1969	—	—	—	—	—	—
	1970	—	—	—	—	—	—
	1972	18 (157)	75 (168)	7 (176)	—	—	100
	1973	7 (171)	67 (171)	19 (176)	2 (193)	—	81
	1974	17 (166)	29 (177)	51 (181)	4 (184)	—	342
	1975	15 (164)	51 (179)	23 (186)	24 (187)	7 (189)	156
	1976	45 (164)	28 (175)	20 (182)	—	5 (200)	60

Table 11. Age compositions of capelin from Div. 3N Canadian acoustic surveys Div. 3L and Div. 3K inshore fisheries. Values in brackets are recalculated not including the one-year-olds.

Division	Year	Age 1	2	3	4	5	6
3N	1981	<0.1	5.7	78.3	13.2	2.8	<0.1
	1982	0	0.6	94.9	4.0	0.6	<0.1
	1983	0	2.5	44.4	46.9	6.2	<0.1
	1984	27.6	5.2	48.3	15.5	3.4	<0.1
			(7.1)	(66.7)	(21.4)	(4.8)	(<0.1)
	1985	1.5	45.0	49.6	3.8	<0.1	
	1986	4.9	2.2	67.5	25.2	0.4	
	1987*	20.9	6.8	23.5	44.6	3.9	
3L	1981	7.4	3.2	42.7	28.7	17.2	0.9
(inshore)	1982	0.1	1.4	83.1	11.4	3.2	0.7
	1983	-	4.6	60.7	32.9	1.7	0.1
	1984	-	1.7	39.6	53.7	4.8	0.2
	1985	-	12.6	61.0	20.2	5.8	0.4
	1986		.3	62.2	34.4	2.5	0.7
3K	1982	0	0.9	84.1	9.7	4.3	1.0
(inshore)	1983	0	0.1	62.4	37.1	0.4	0
	1984	0	0.6	33.4	62.6	3.1	0.1
	1985	0	1.4	57.2	29.3	11.5	0.4
	1986	0	0	61.0	35.8	2.4	0.7
	1987		0.1	10.8	82.5	6.3	0.3

* preliminary

Table 12. Estimates of year-class abundance (No. x 10^9) of capelin in Div. 3NO from Carscadden acoustic surveys.

Year	Age					
	1	2	3	4	5	6
1981	<0.1	0.6	8.3	1.4	0.3	<0.1
1982	0	0.1	16.6	0.7	0.1	<0.1
1983	0	0.2	3.6	3.8	0.5	<0.1
1984	1.6	0.3	2.8	0.9	0.2	<0.1
1985	0.2	5.9	6.5	0.5	<0.1	0
1986	1.1	0.5	15.2	5.7	0.1	<0.1
1987	2.1	0.7	2.4	4.5	0.4	

Table 13. Div. 2J3K commerical age compositions, 1972-87.

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1	0.0	0.0	0.1	0.0	1.5	0.1	3.8	2.5	1.0	8.6	1.8	3.6	9.6	0.1	0.3	0.6
2	11.8	25.1	20.2	61.8	8.8	3.0	16.6	78.3	45.1	67.4	77.3	40.5	61.9	67.3	19.1	43.8
3	64.0	30.0	48.9	27.7	82.9	29.9	31.1	10.6	40.4	16.1	19.1	48.2	18.2	28.3	70.8	19.4
4	21.0	40.0	17.6	8.2	6.8	60.0	42.3	2.4	10.8	4.0	1.5	7.3	9.1	2.5	8.9	32.3
5	2.8	5.0	12.2	1.8	0.9	6.2	5.9	3.2	1.6	3.6	0.4	0.5	1.2	1.6	.7	3.6
6	0.4	0.3	1.0	0.5	0.2	0.9	0.3	3.0	1.1	0.2	0.1	0.1	0.0	.1	.3	0.1

Table 14. Numbers of age ($x10^9$) from Soviet surveys for Division 2J+3K.

Age	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1			.5		.1				.2	2.5	41.3	2.7	0.5
2	6.1	27.4	6.7	*	1.0	.03	.1		17.7	19.9	19.3	83.8	19.0
3	26.6	13.2	35.6		.8	.2	.4		17.7	15.8	3.8	18.1	44.6
4	10.3	3.2	2.1		.4	.3	.2		.9	3.3	1.4	2.6	3.6
5	4.4	1.4	.4		.1	.1	.04					0.2	0.1
6	.4	.5			.05	.05	.003						

* histogram provided but could not be read

Table 15. Standardized numbers-at-age by year-class from Soviet surveys in Division 2J+3K.

Age	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
2				0.07	.33	.08	-	.01	.0004	.001	-	.21	.24	.23	1.0	.23
3			.60	.30	.80	-	.02	.005	.009	-	.40	.35	.09	.41	1.0	
4		1.0	.31	.21	-	.04	.03	.02	-	.09	.09	.14	.25	.35		
5	1.0	.32	.09	-	.02	.02	.009	0	0	0	0	.05	.02			

Table 16. Summary of the commercial samples collected and aged from the 1987 inshore capelin fishery in Div. 3K.

Gear type	No. of LSM/strat samples	No. otoliths aged (N)	Mean no. otoliths ± SD per sample
Purse seine	8	230	28.8 ± 1.2
Beach seine	10	310	31.0 ± 3.1
Capelin trap	21	639	30.4 ± 3.2
TOTAL	39	1179	

Table 17. Age-compositions (%) of capelin from the inshore commercial capelin fishery, Div. 3K, 1982-87.

	Age				
	2	3	4	5	6
Males					
1982	1.1	90.2	8.5	0.2	0.1
1983	0.2	65.0	34.8	0	0
1984	0	30.6	68.0	1.1	0
1985	0.6	61.7	34.7	3.0	0
1986	0	59.1	40.4	0.5	0
1987	0	8.7	89.9	1.4	0
Females					
1982	0.8	79.4	10.7	7.4	1.7
1983	0	44.0	52.6	3.4	0
1984	1.5	38.0	54.1	6.2	0.3
1985	0.8	55.5	27.1	16.0	0.5
1986	0	62.6	32.1	3.9	1.3
1987	0.2	12.5	76.3	10.4	0.6
Sexes combined					
1982	0.9	84.1	9.7	4.3	1.0
1983	0.1	62.4	37.1	0.4	0
1984	0.6	33.4	62.6	3.1	0.1
1985	1.5	57.2	29.5	11.5	0.4
1986	0	61.0	35.8	2.4	0.7
1987	0.1	10.8	82.5	6.3	0.3

Table 18. Reasons (expressed as % by weight) reported in logbooks for discarding capelin in purse seines in Div. 3K, 1981-87. This analysis excludes capelin given away to other fishermen.

Year	Low % females	Redfeed	Not mature enough	Small females	Females spawned out	No market	Over ripe	Misc.	Unknown
1981	90	6	4	0	0	0	0	0	0
1982	32	52	0	10	6	0	0	0	0
1983	5	48	0	4	0	42	0	0	1
1984	81	4	0	2	8	3	2	0	0
1985	6	52	0	0	5	2	0	33	3
1986	31	36	0	0	4	3	0	26	0
1987	6	78	0	0	0	0	0	10	6

Table 19. Reasons (expressed as % by weight) reported in logbooks for discarding capelin from beach seines and traps in Div. 3K in 1983-87. This analysis excludes capelin given away to other fishermen.

	Redfeed	Females over ripe	No market	Low % females	Males picked out	Females spawned out	Misc.	Unknown
Beach seine								
1983	47	3	37	6	7	0	0	0
1984	12	0	0	70	11	0	7	0
1985	13	0	64	23	0	0	0	0
1986	6	29	27	9	28	0	0	1
1987	80	0	0	0	20	0	0	0
Trap								
1983	81	0	0	4	1	15	0	0
1984	1	0	17	51	19	4	8	0
1985	19	0	27	28	19	+	2	4
1986	10	16	27	30	7	3	6	0
1987	27	0	37	11	5	0	14	6

Table 20. Capelin landings (t), discards (t), and catch/effort for purse seines in Div. 3K, 1981-87.

Year	No. fishermen	Landings		Discards logbook	No. days fished (D)	No. sets made (S)	L = Landings		C = Landings + discards	
		Statistics	Logbook				L/D	L/S	C/D	C/S
1981	10	533.9	725.0	92.9	89	118	8.2	6.1	9.2	6.9
1982	8	713.1	849.9	188.0	67	109	12.7	7.8	15.5	9.5
1983	14	808.2	1097.0	253.2	113	161	9.7	6.8	12.0	8.4
1984	10	854.1	928.0	297.1	87	127	10.7	7.3	14.1	9.7
1985	9	766.1	1067.2	551.5	98	129	10.9	8.3	16.5	12.6
1986	8		1053.9	310.0	76	110	13.9	9.6	18.0	12.4
1987	6		253.2	219.7	31	61	8.2	4.2	15.3	7.8

Table 21. Capelin landings (t), discards (t), and catch/effort for beach seines in Div. 3K, 1983-87.

Year	No. fishermen	Landings		Discards logbook	No. days fished (D)	No. sets made (S)	L = Landings		C = Landings + discards	
		Statistics	Logbook				L/D	L/S	C/D	C/S
1983	6	118.6	139.4	39.5	44	79	3.2	1.8	4.1	2.3
1984	10	409.6	408.6	59.2	74	126	5.5	3.2	6.3	3.7
1985	4	59.5	61.6	47.7	17	19	3.6	3.2	6.4	5.8
1986	10		383.6	259.1	110	221	3.5	1.7	5.8	2.9
1987	5		52.3	63.0	17	33	3.1	1.6	6.8	3.5

Table 22. Capelin landings (t), discards (t), and catch/effort for capelin traps in Div. 3K, 1983-87.

Year	No. fishermen	No. traps	Landings		Discards logbook	Bycatch		No. days fished (D)	No. times hauled (H)	L = Landings		C = Landings + discards	
			Statistics	Logbook		Cod	Herring			L/D	L/H	C/D	C/H
1983	3	3	87.3	85.8	51.3	6.0	24.9	41	48	2.1	1.8	3.3	2.9
1984	6	6	156.0	217.0	111.3	2.6	0.1	80	101	2.7	2.1	4.1	3.3
1985	9	9	172.6	212.0	209.9	2.8	0	132	123	1.6	1.7	3.2	3.4
1986	14	14		757.6	575.9	3.4	+	229	278	3.3	2.7	5.8	4.8
1987	13	15		355.8	378.4	0.1	0	70	125	5.1	2.8	10.5	5.9

Table 23. Acoustic survey results from Gadus 144, NAFO Division 2J+3K capelin survey, October 1987.

	Block A	Block B	Block C	Block D	Block E
Mean density	1.5	.0	5.7	.1	.8
Area (sq.km.)	20562.	13263.	14692.	20978.	19396.
Total biomass	30835.	620.	84353.	1420.	16410.
# of transects	16	6	13	7	5
# of estimates	556	228	514	355	197
Delta	.96	.96	.97	.98	.95
Lw limit delta	-.03	-.03	-.03	-.02	-.03
C of variation	28.5	34.1	29.9	63.0	27.3
Min density	.0	.0	.5	.0	.2
Max density	4.9	.1	20.0	.3	1.5

Block A			Block B			Block C			Block D			Block E		
T#	#Ds	Mean D	T#	#Ds	Mean D	T#	#Ds	Mean D	T#	#Ds	Mean D	T#	#Ds	Mean D
1	34	1.1	1	38	.0	1	39	.7	1	51	.0	1	39	.2
2	35	1.1	2	38	.0	2	40	.8	2	50	.0	2	40	.3
3	34	1.5	3	38	.0	3	39	1.5	3	51	.0	3	40	1.5
4	35	4.9	4	38	.1	4	40	1.2	5	51	.0	4	39	.9
5	34	3.8	5	38	.1	5	40	4.0	6	51	.0	5	39	1.3
6	35	1.9	7	38	.0	6	39	11.4	7	50	.1			
7	35	3.5				7	39	13.4	8	51	.3			
8	35	4.8				8	39	11.8						
9	35	1.3				9	40	20.0						
10	34	.0				10	39	8.4						
11	35	.0				11	40	.7						
12	35	.0				12	40	.6						
13	35	.0				13	40	.5						
14	35	.0												
15	35	.0												
16	35	.0												

Combined total biomass is 133639.

Table 24. Numbers (billions) and biomass (thousands of tons) at age of capelin from NAFO Division 2J3K hydroacoustic surveys.

Year	Cruise No.	Age	1	2	3	4	5+	Total
1987	144	#'s	0.8	5.3	0.5	0.7	0.1	7.4
		Biomass	4.7	92.9	14.3	18.0	3.6	133.5
1986	130	#'s	0.1	6.9	11.8	1.3	0.1	20.2
		Biomass	0.6	113.2	278.9	33.5	4.7	430.9
1985	115	#'s	9.8	53.3	13.6	1.4	0.5	78.6
		Biomass	9.5	682.9	289.8	36.4	16.0	1034.6
1984	100	#'s	6.5	34.5	7.2	3.8	0.4	52.4
		Biomass	27.9	498.0	184.9	104.6	11.1	826.5
1983	85	#'s	2.6	2.5	1.4	0.2	0.1	6.7
		Biomass	17.1	40.3	32.2	4.5	0.2	94.3
1981	56	#'s	68.1	58.7	8.5	1.7	0.8	137.8
		Biomass	340.2	890.6	189.6	47.8	25.5	1494.0

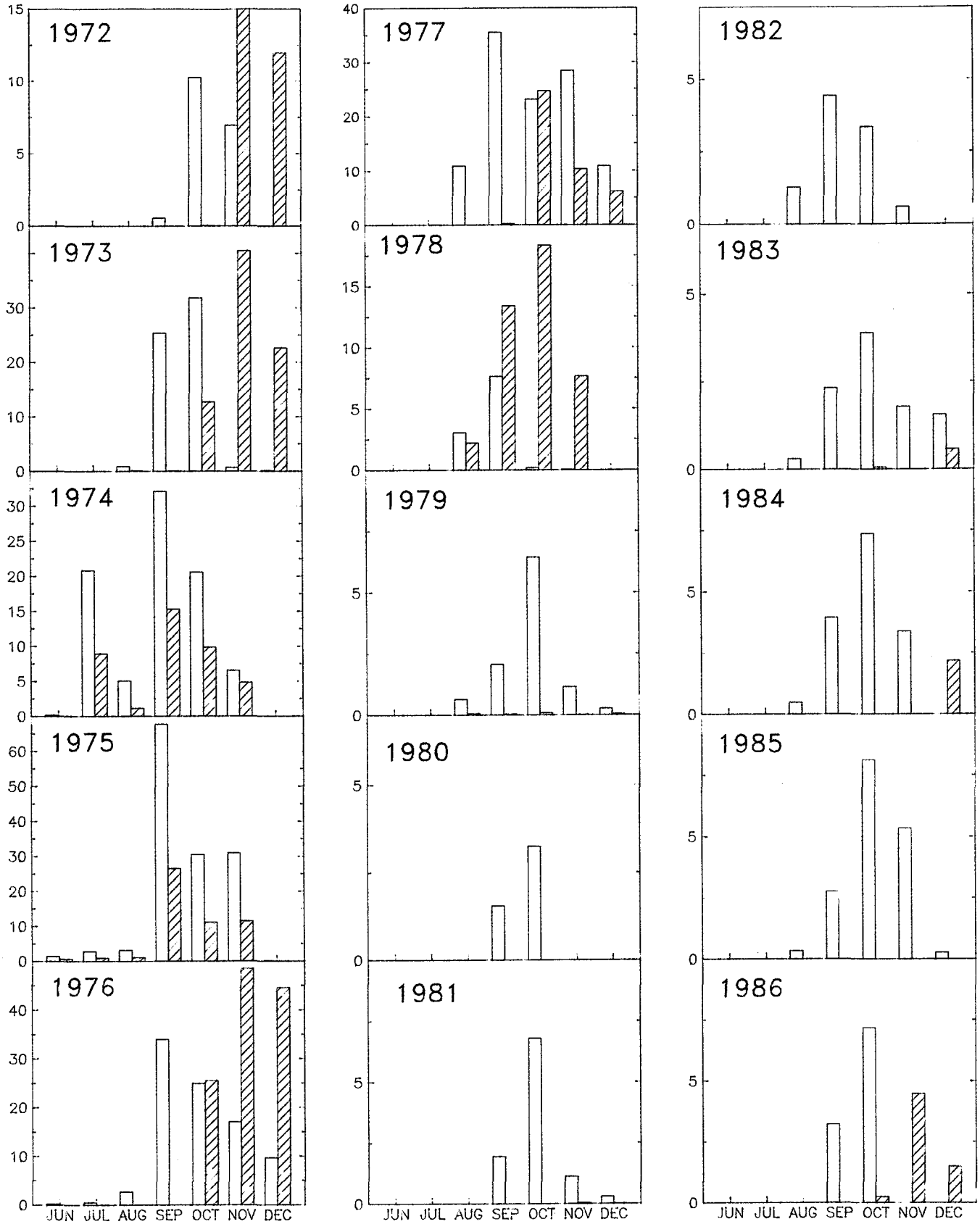


Figure 1a. Commercial fishery catches (1000's of tons)

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

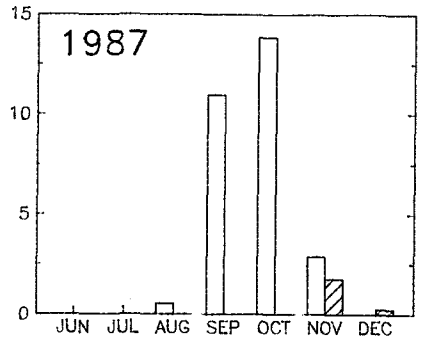


Figure 1b. Commercial fishery catches (1000's of tons)
(Open bars – Division 2J, hatched bars – Division 3K)

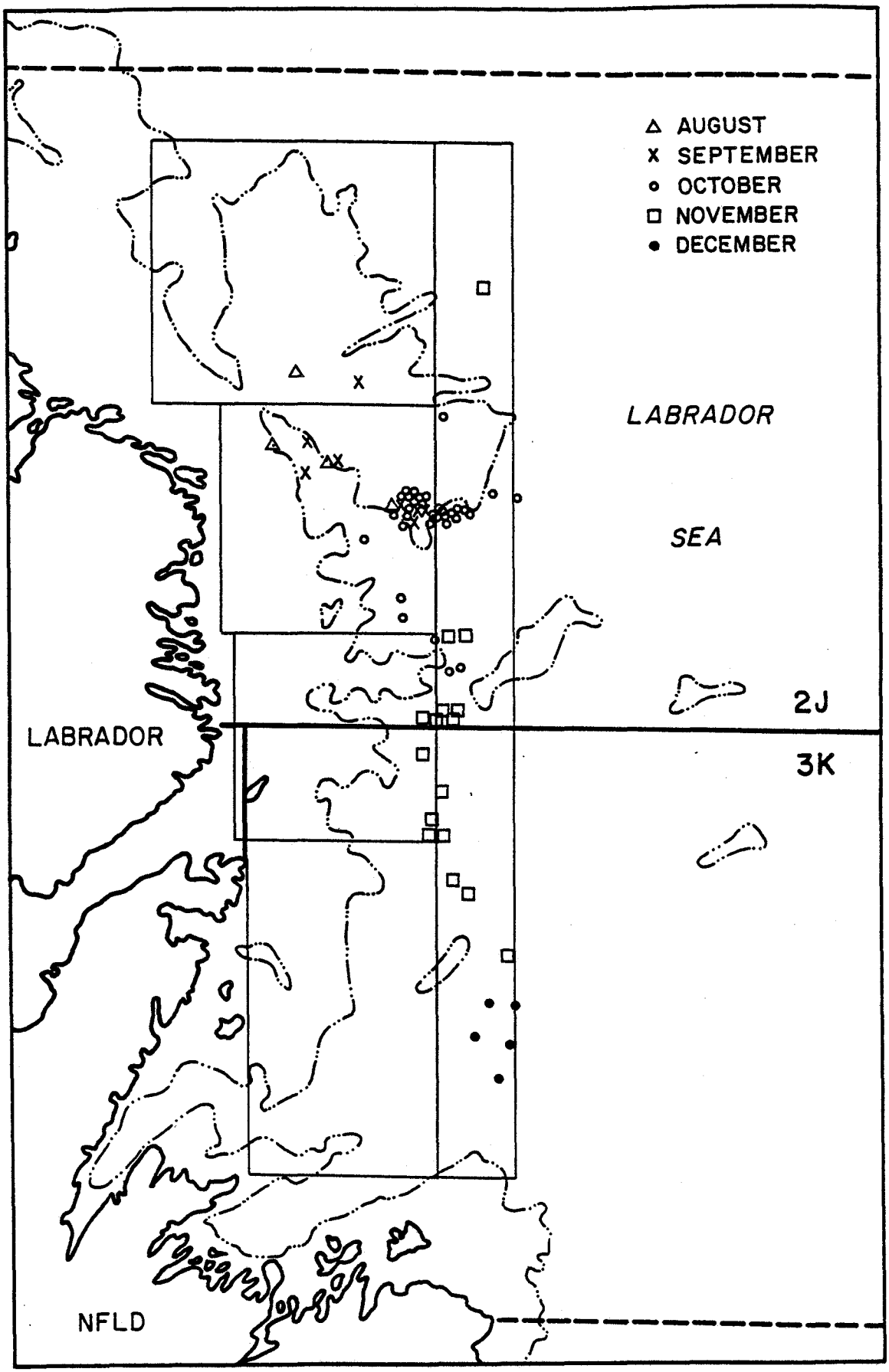


Fig. 2. Distribution of the 1987 offshore commercial capelin fishery by month and the limits of the CAnadian acoustic survey.

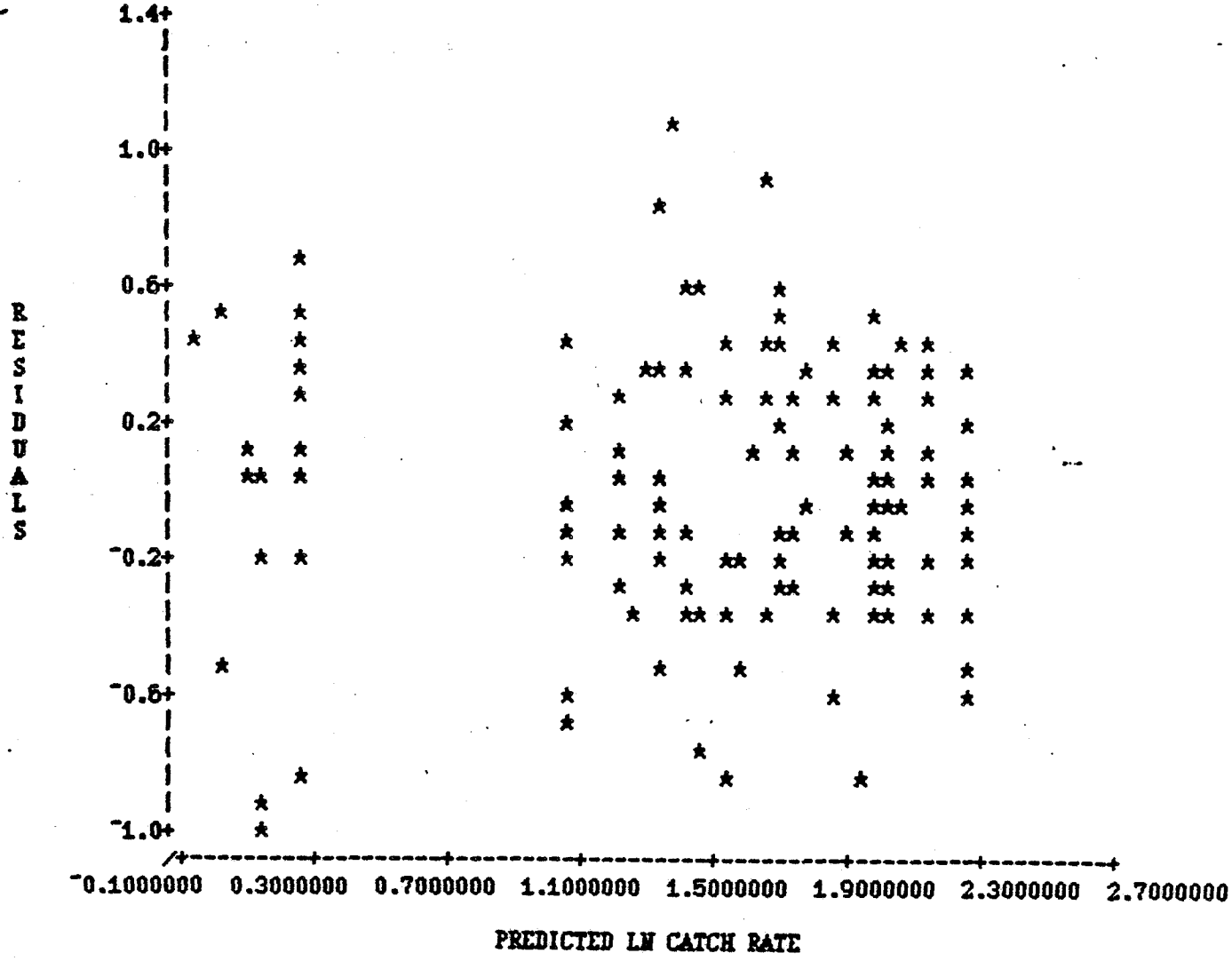


Fig. 3a. Residuals versus predicted catch rate for multiplicative model.

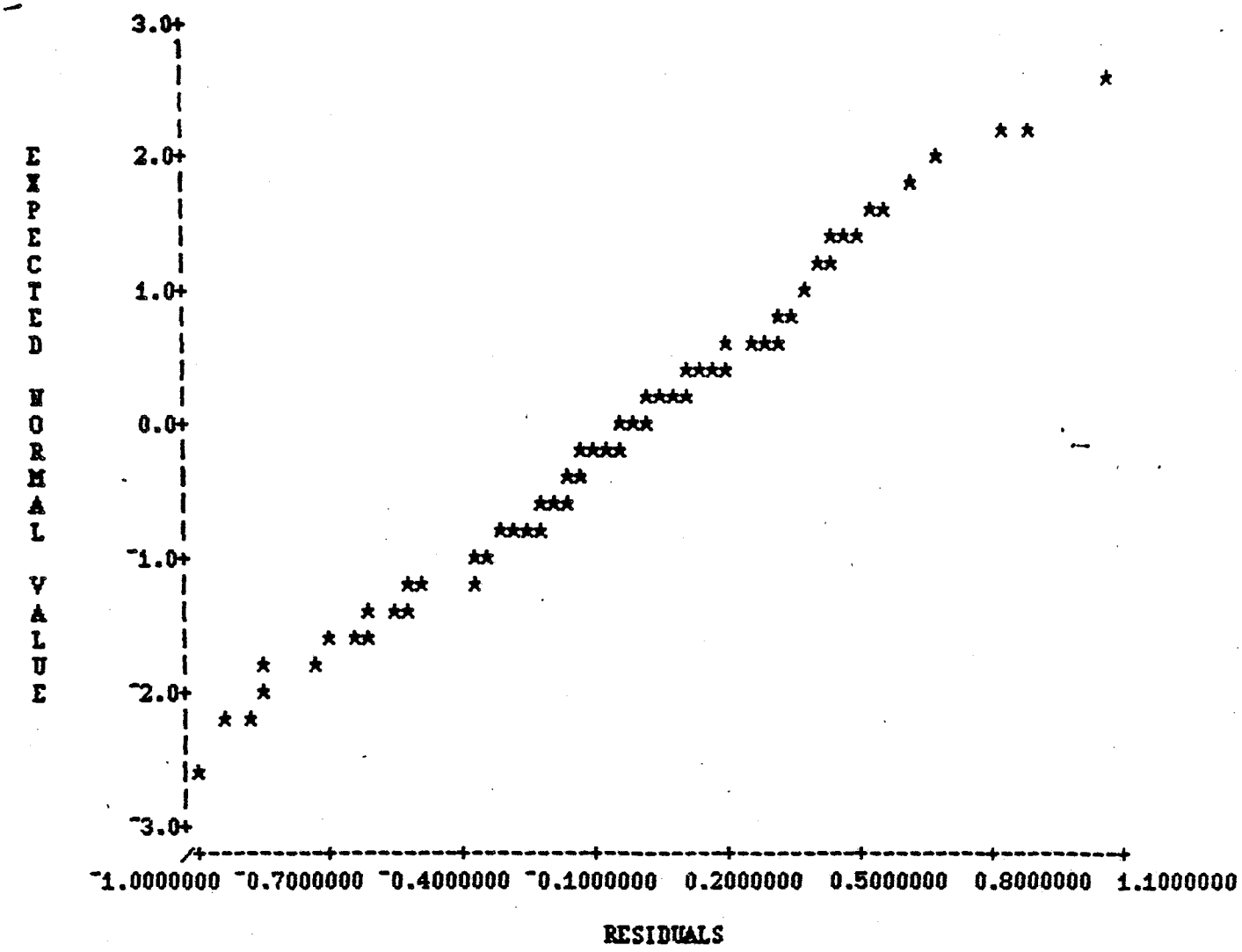


Fig. 3b. Expected normal values versus residuals for multiplicative model.

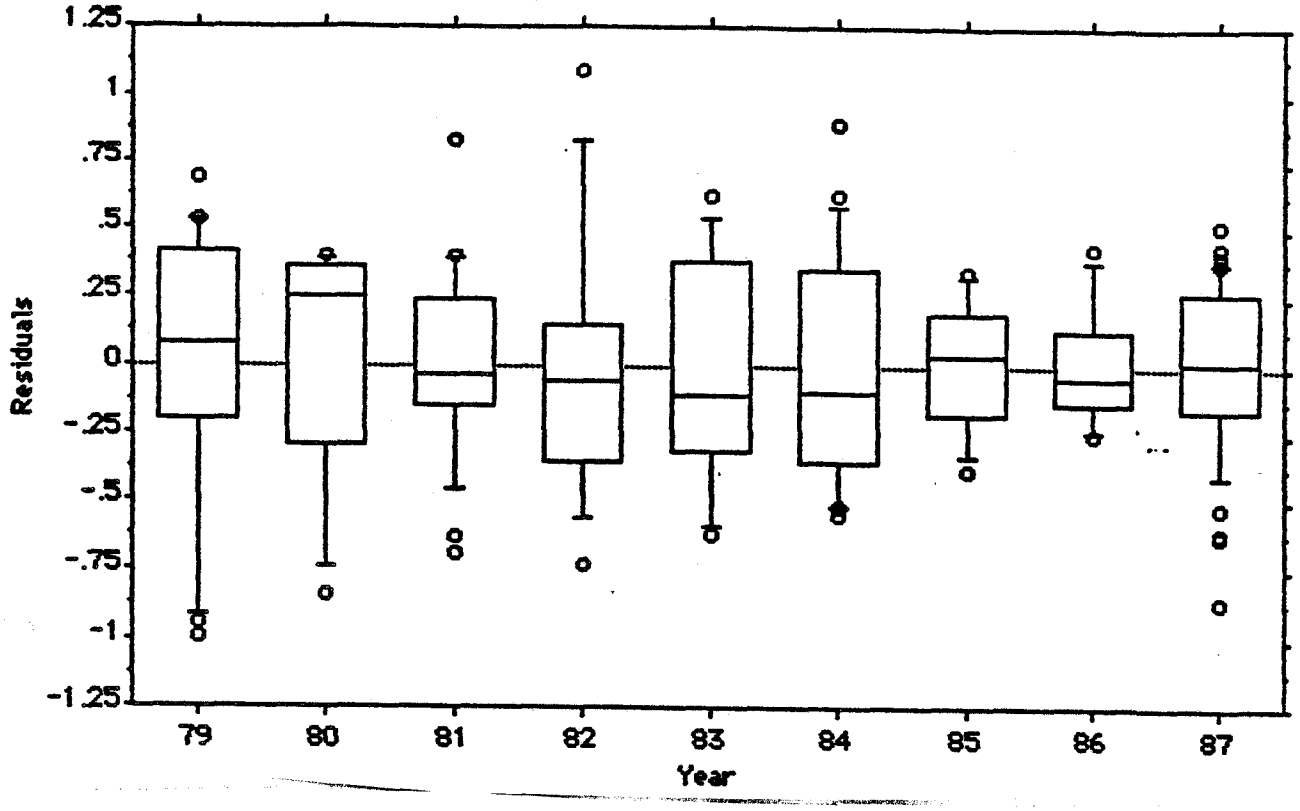


Fig. 4. Boxplots of residuals (percentiles-10, 25, 50, 75 and 90) from an initial multiplicative analysis of capelin catch/effort data for NAFO Division 2J+3K from the Canadian Oberver Program.

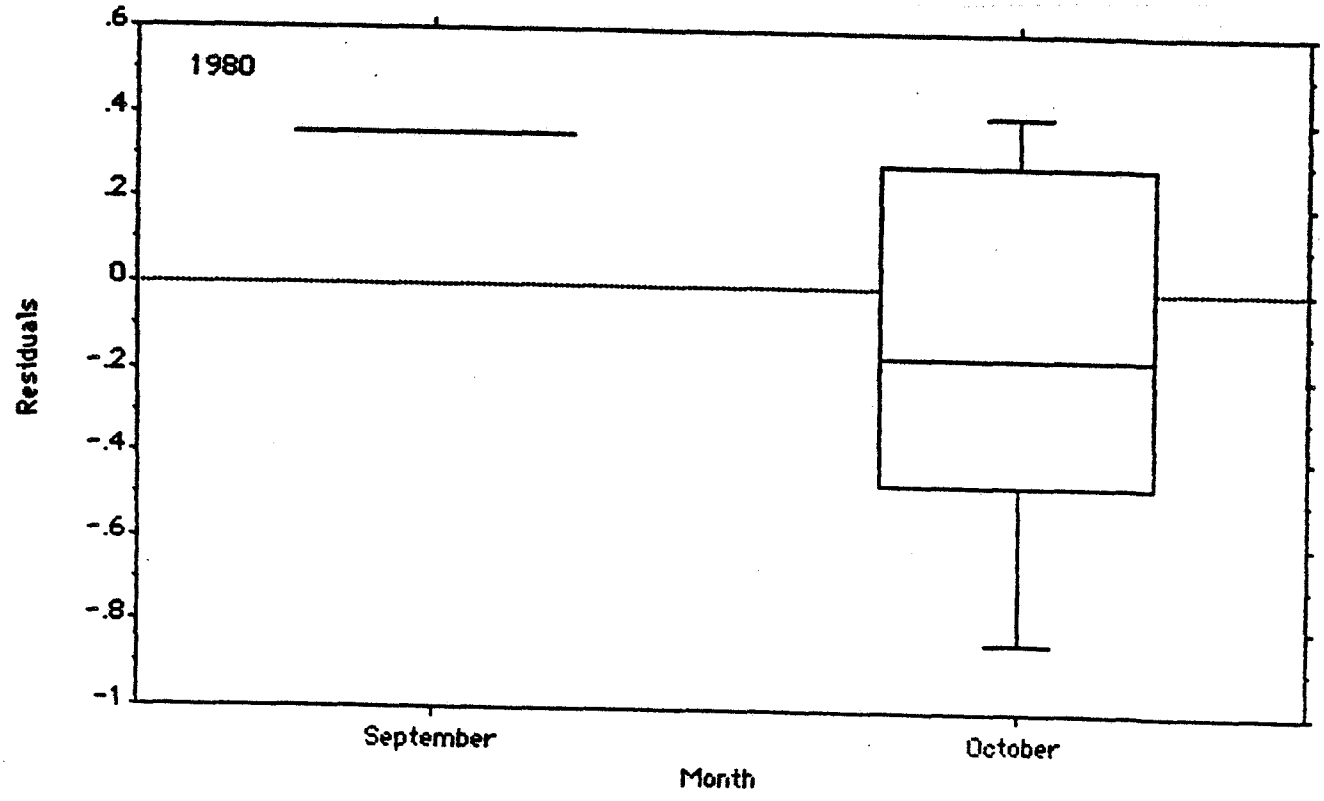


Fig. 5. Boxplots of residuals (percentiles-10, 25, 50, 75 and 90) for the different months in 1980 of capelin catch and effort data from the Canadian Oberver Program.

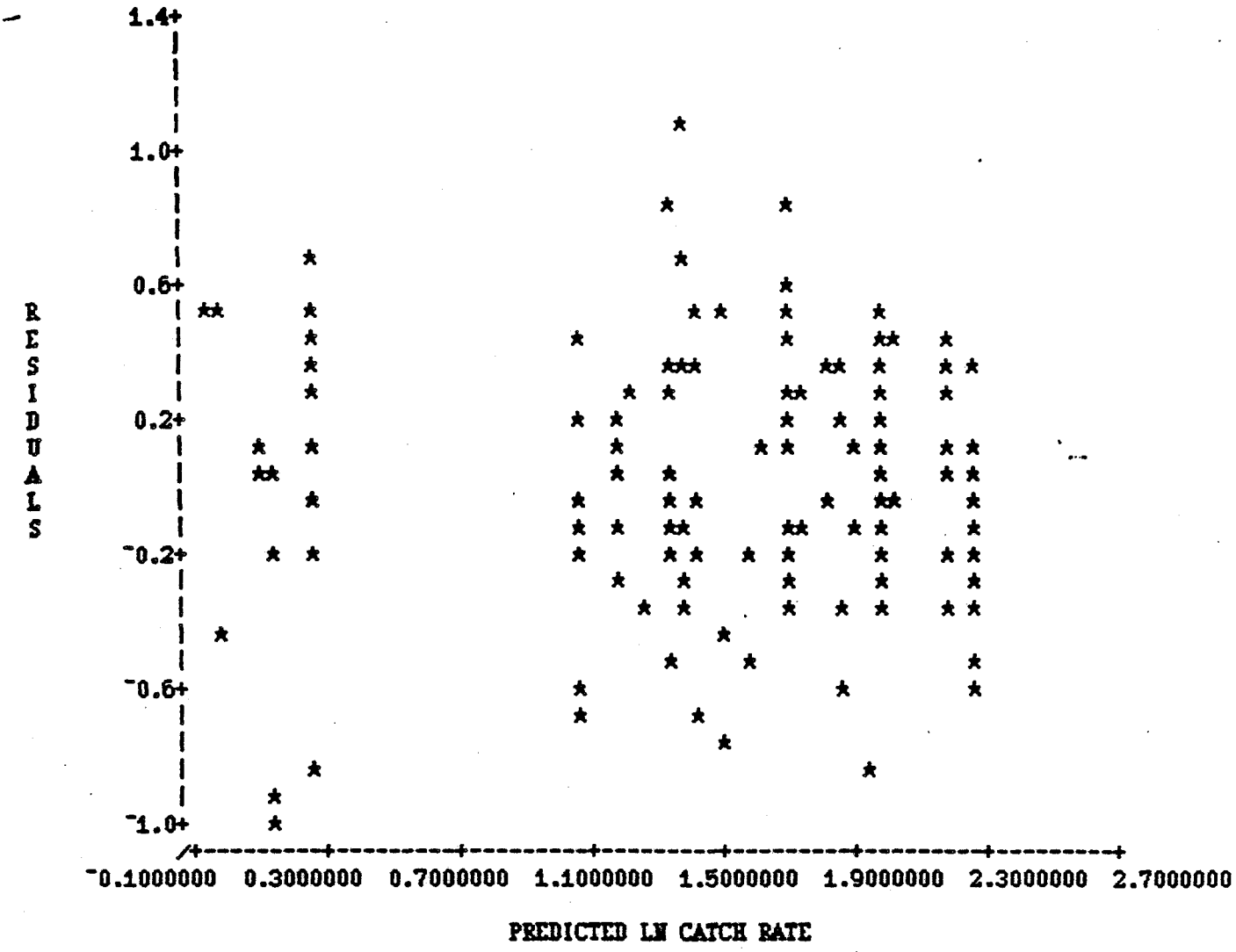


Fig. 6a. Residuals versus predicted catch rates from the multiplicative model after the September 1980 data were excluded.

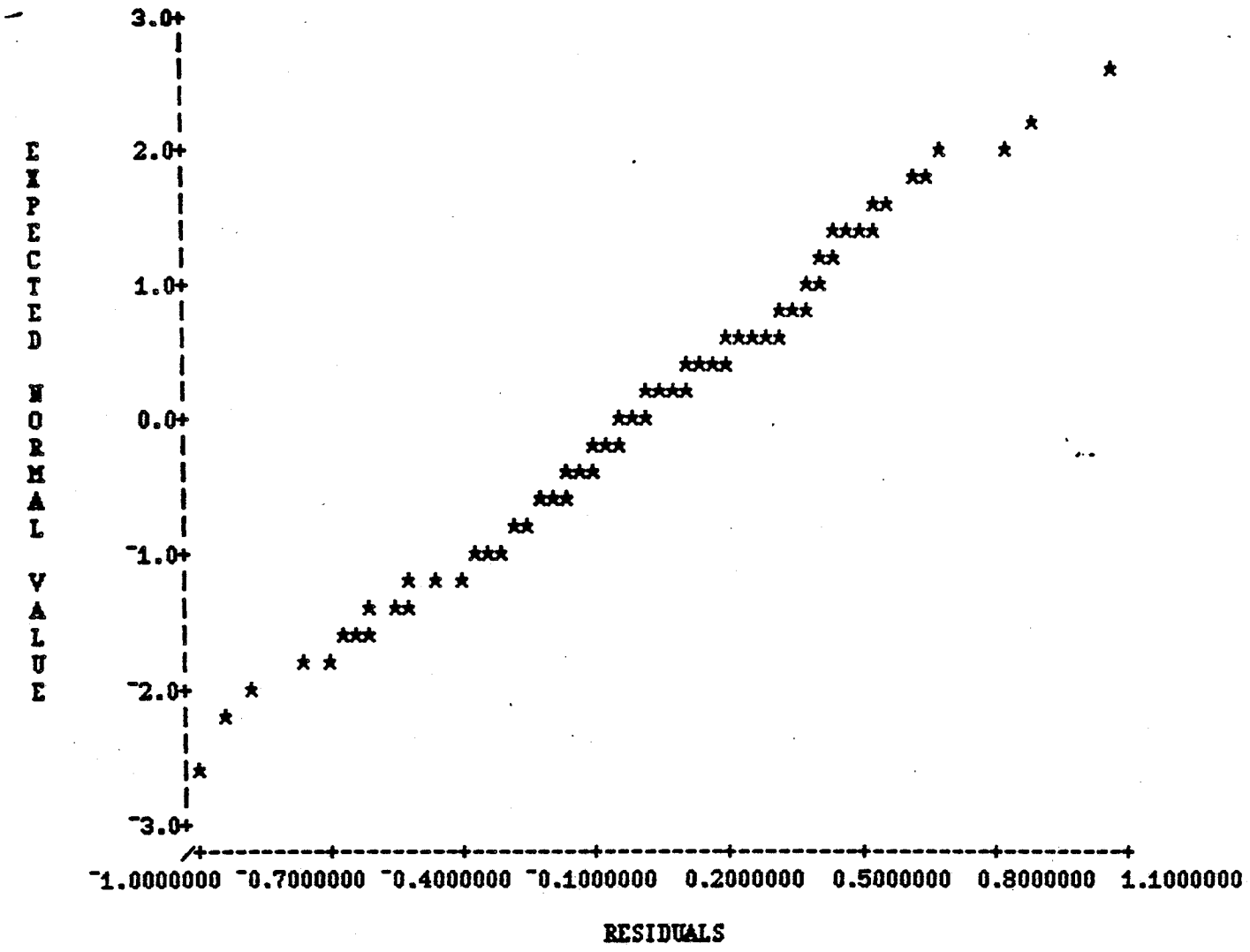


Fig. 6b. Expected normal values versus residuals for multiplicative model.

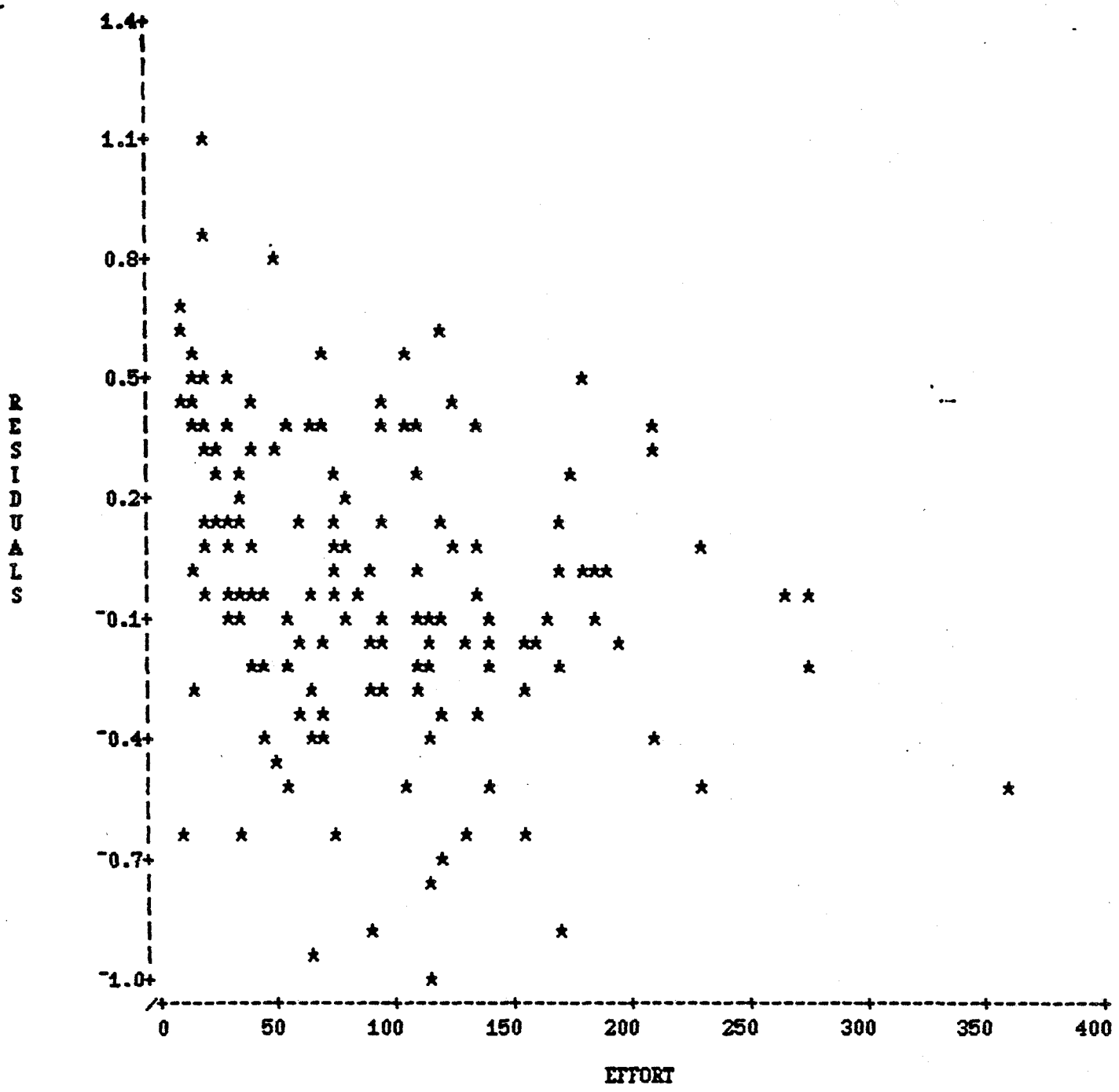


Fig. 7. Residuals from multiplicative model (excluding Sept. 1980 data) versus effort.

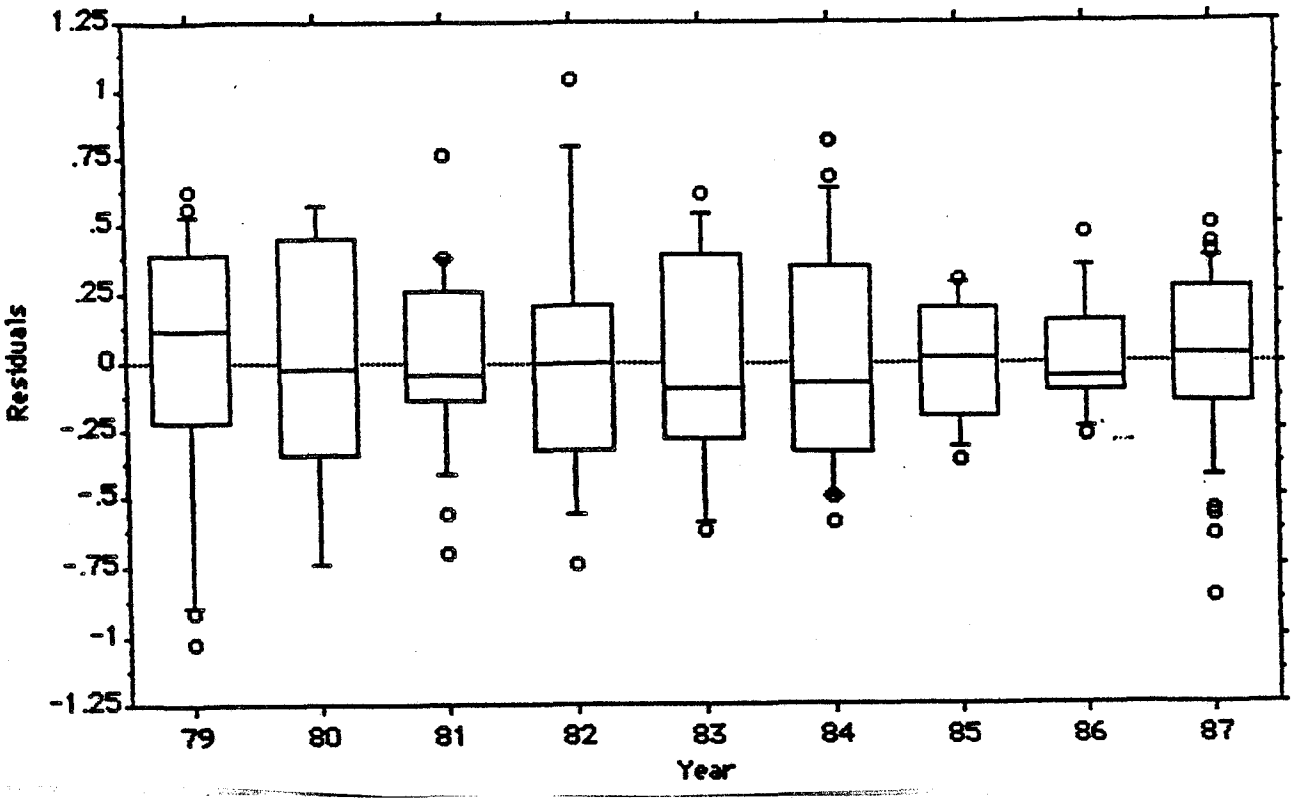


Fig. 8. Boxplots of residuals (percentiles-10, 25, 50, 75 and 90) from the final multiplicative analysis of capelin catch/effort data for NAFO Division 2J+3K from the Canadian Observer Program.

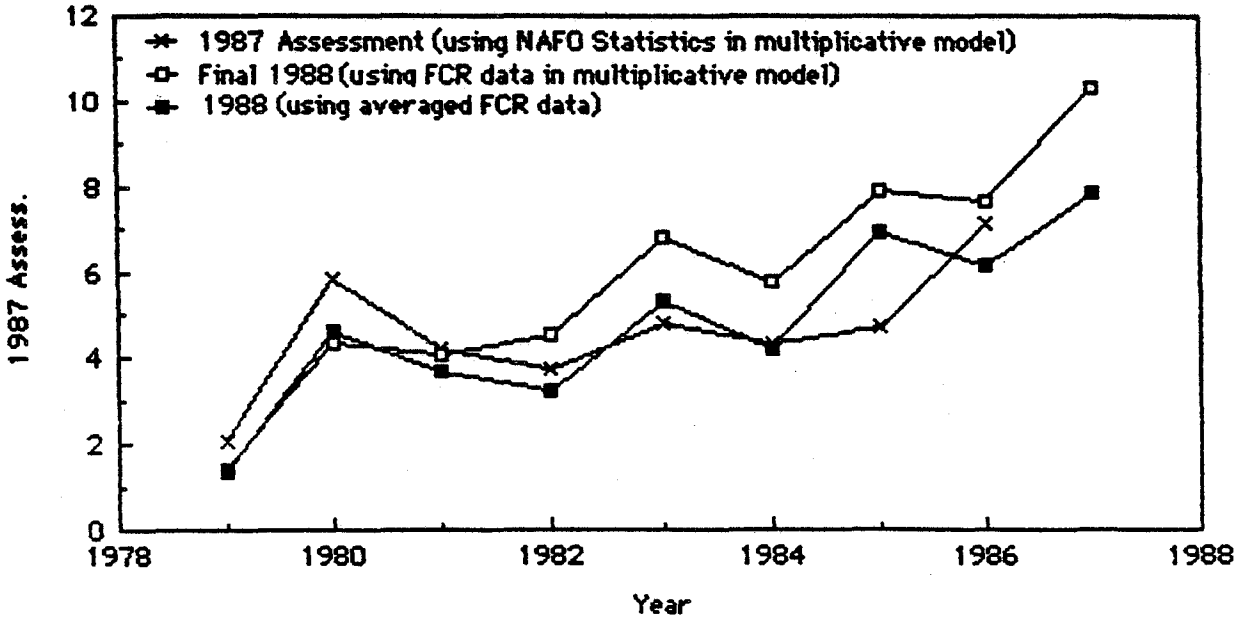


Fig. 9. Catch rates of capelin in NAFO Division 2J+3K as derived by different methods.

Figure 10a. Commercial age composition 1972 – 1986

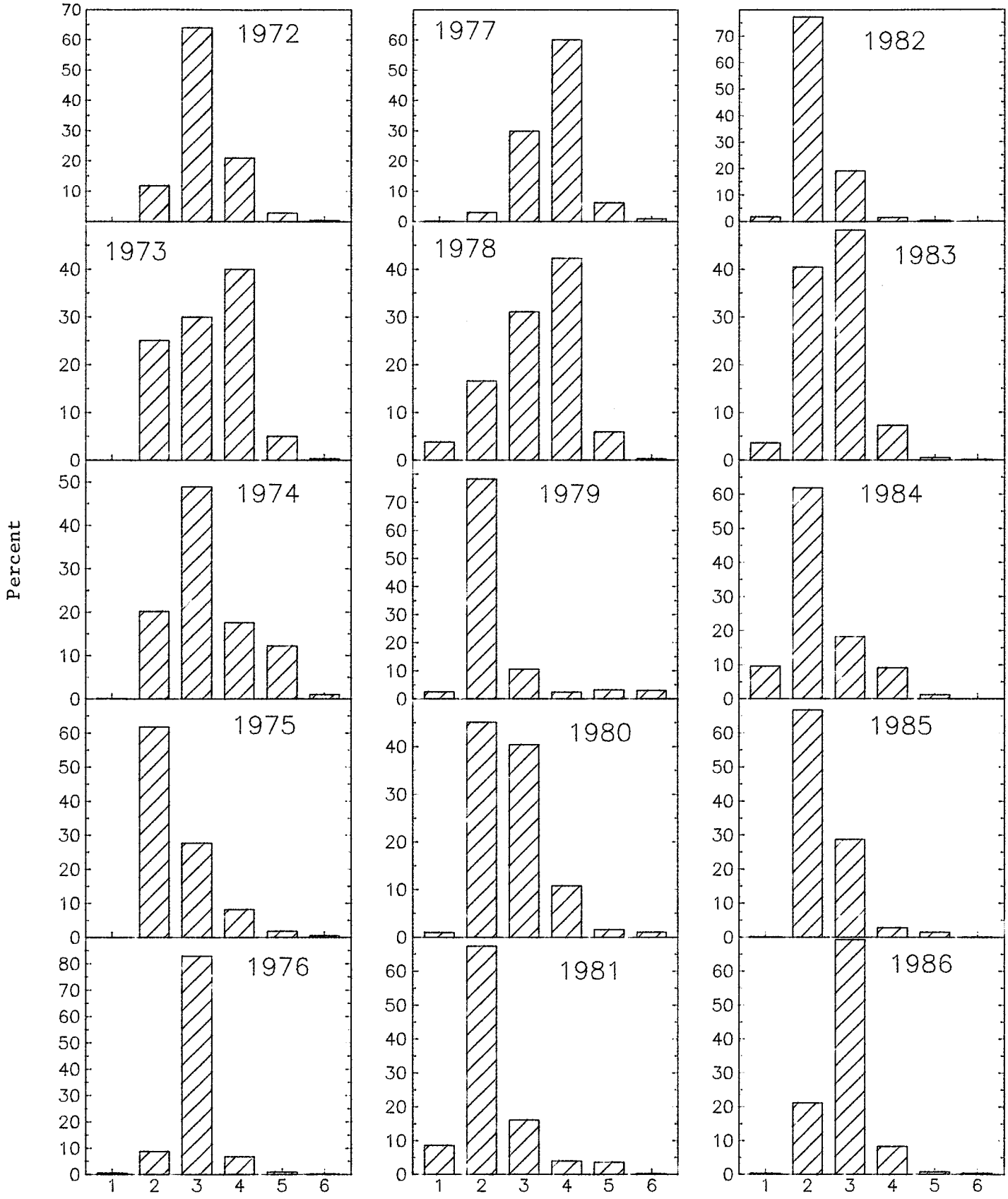
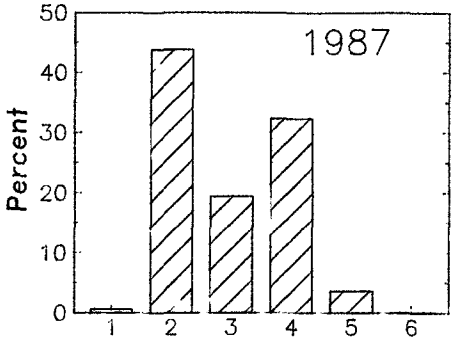
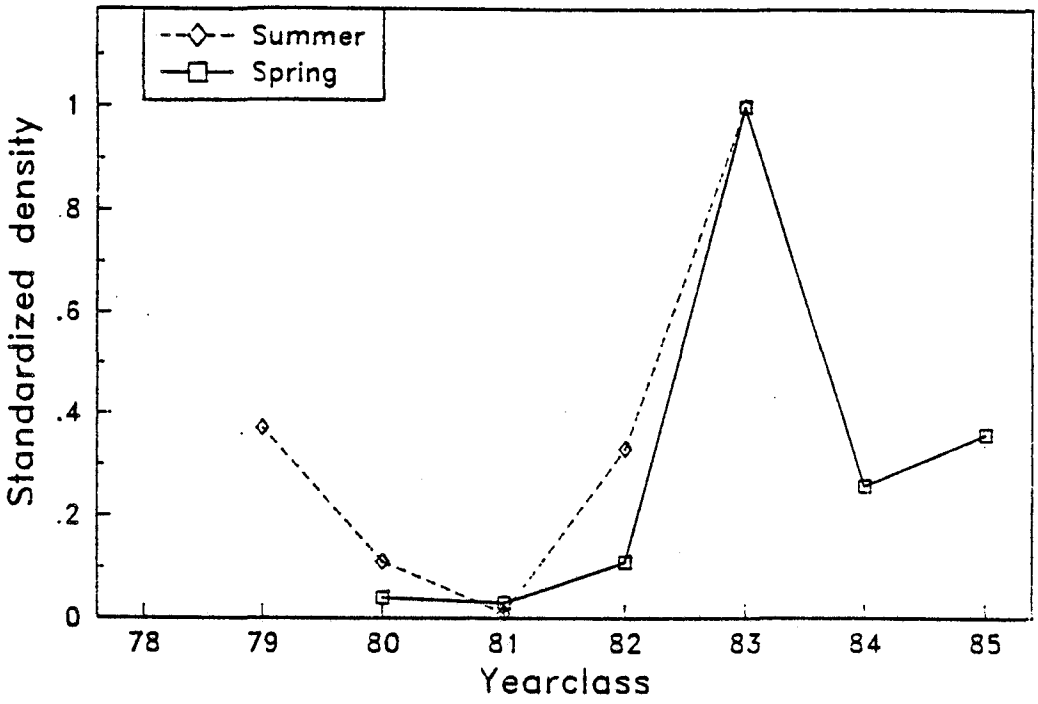


Figure 10b. Commercial age composition 1987





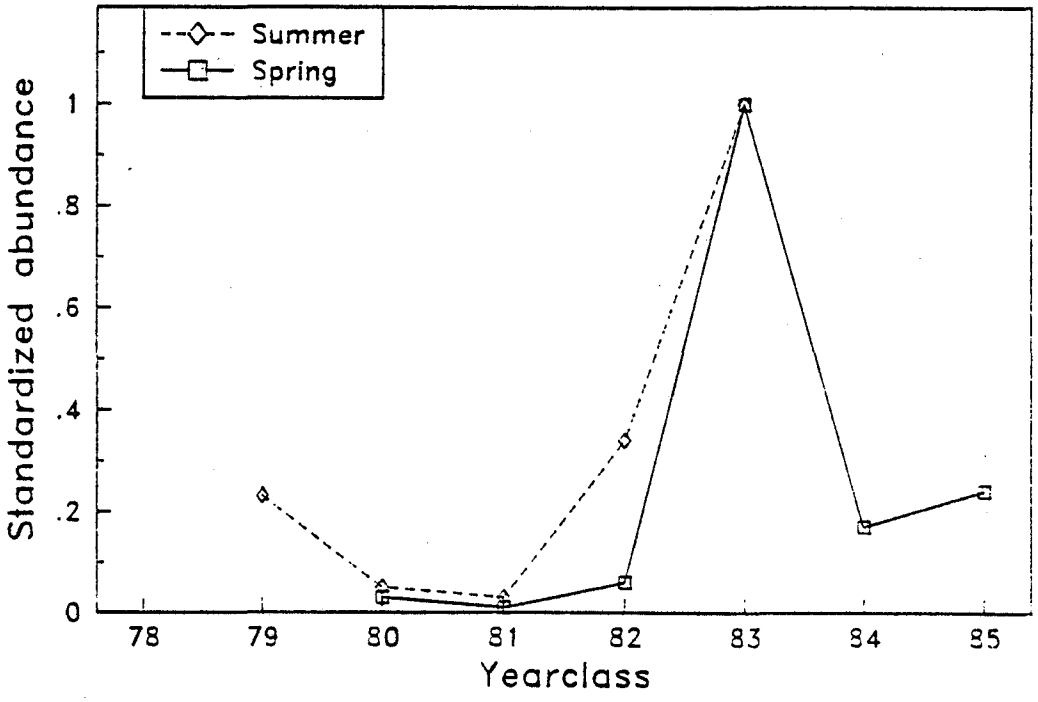


Fig. 11. Standardized density and abundance at age 2. for 1979–85 yearclasses of capelin from spring and summer acoustic cruises in NAFO division 3L

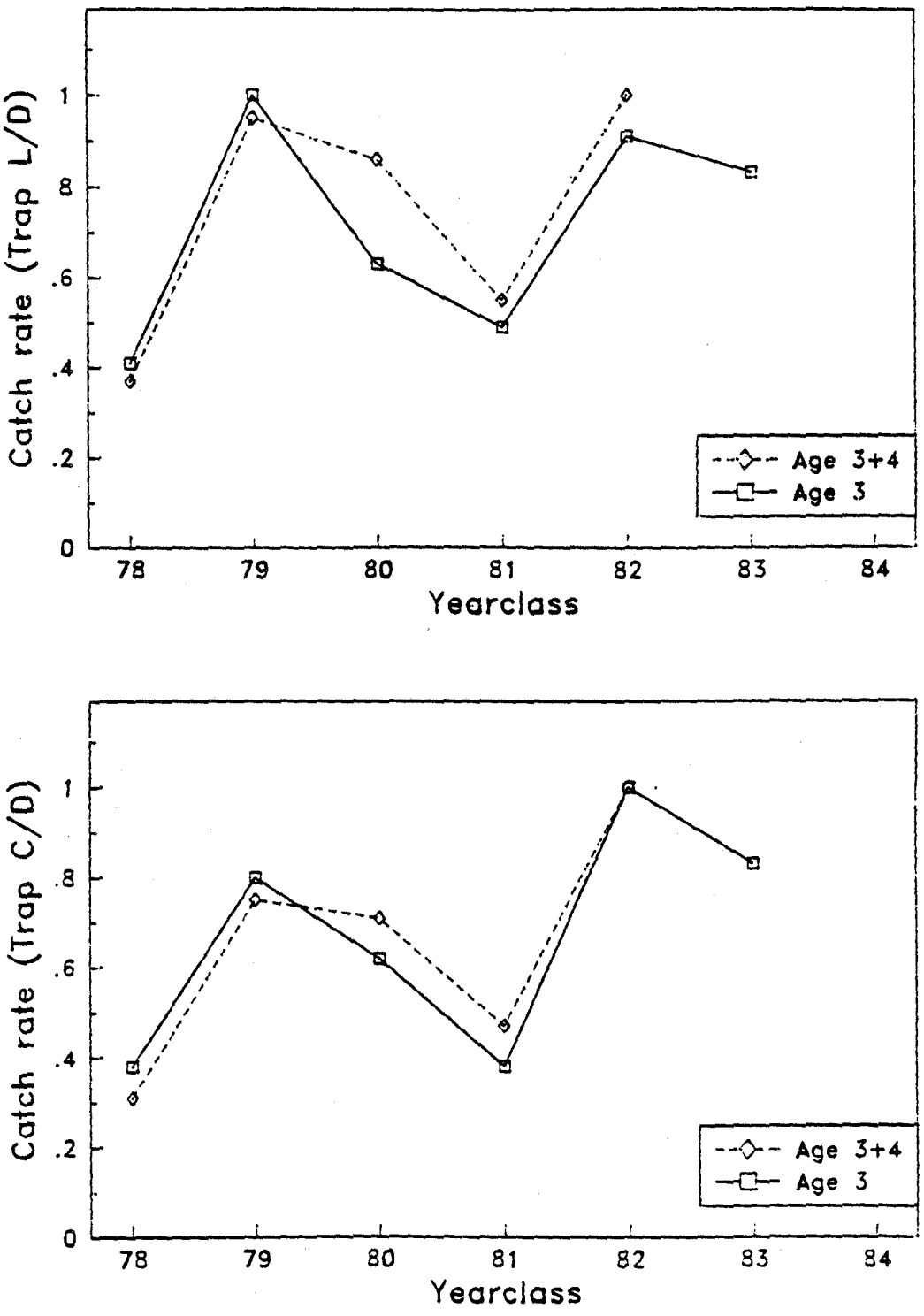


Fig. 12. Standardized catch rates at age from trap nets for, NAFO division 3L capelin, 1978-83 yearclasses

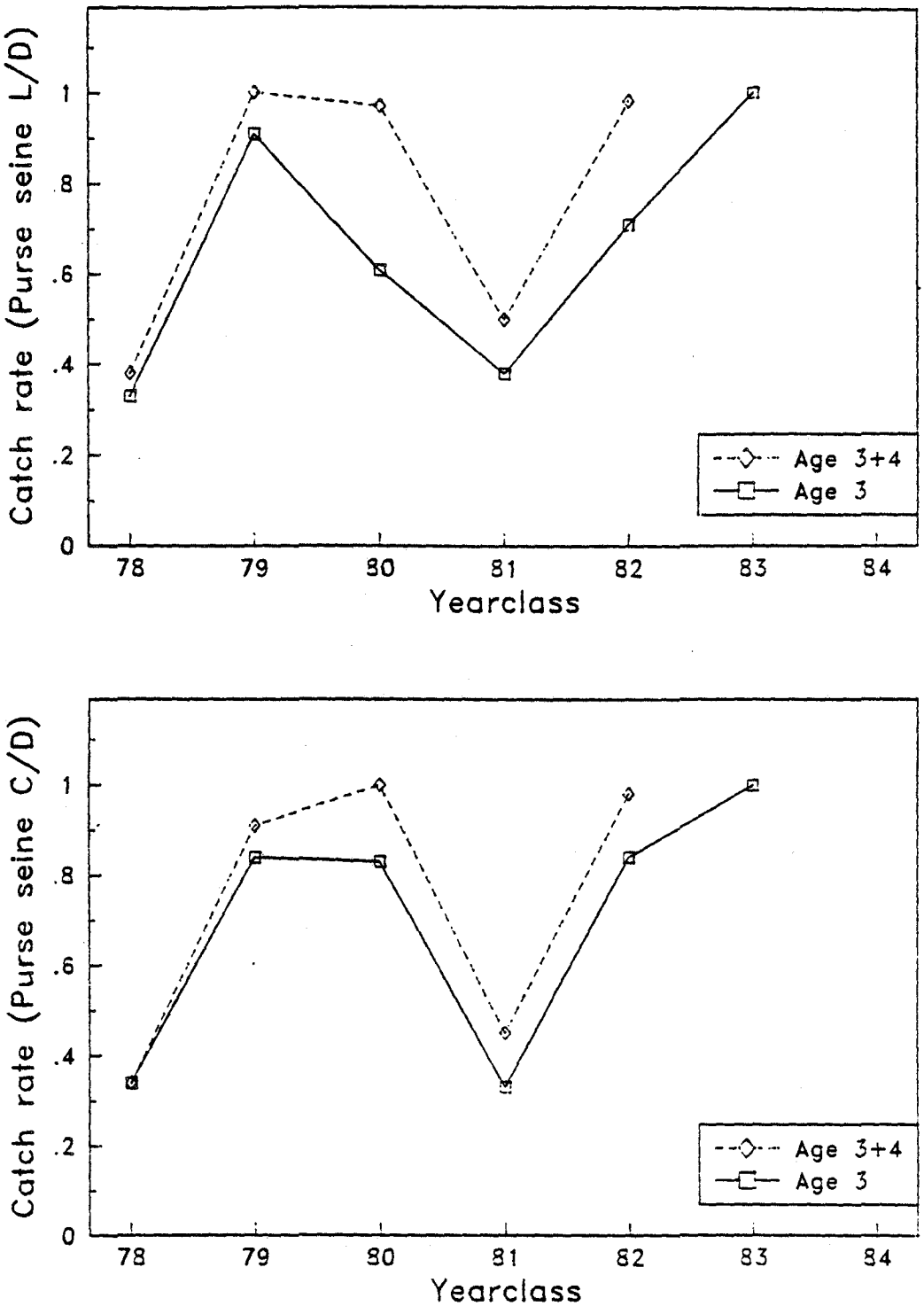


Fig. 13. Standardized catch rates at age from purse seines, for NAFO division 3L capelin, 1978-83 yearclasses

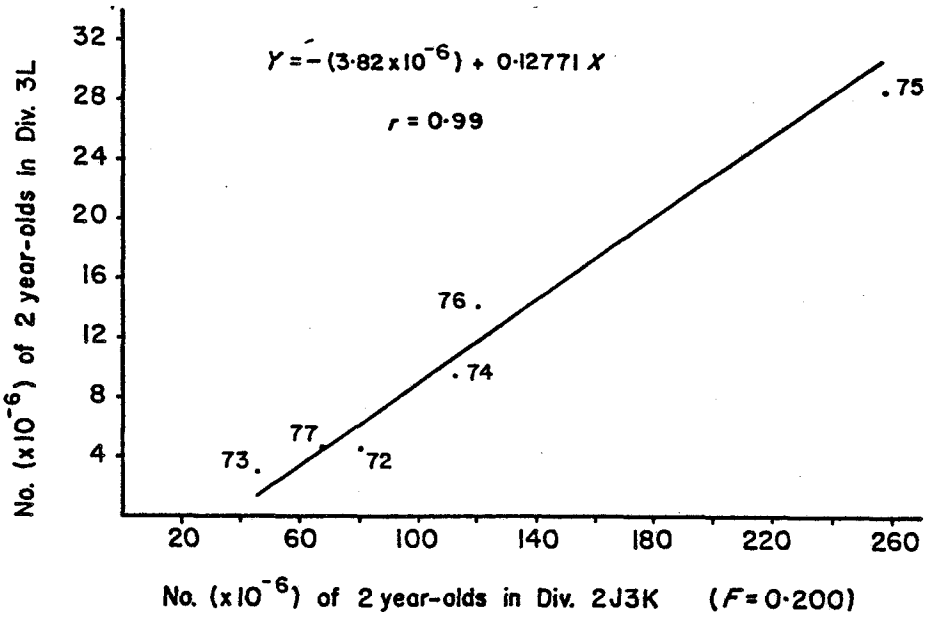


Fig. 14. Functional regression of number of 2-year-olds estimated from SCAM 3L against number of 2-year-olds estimated from SCAM 2J3K (F=0.200). Points are labelled by years (from Carscadden and Miller 1979).

Figure 15. Estimates of capelin biomass in Division 3NO 1972–87

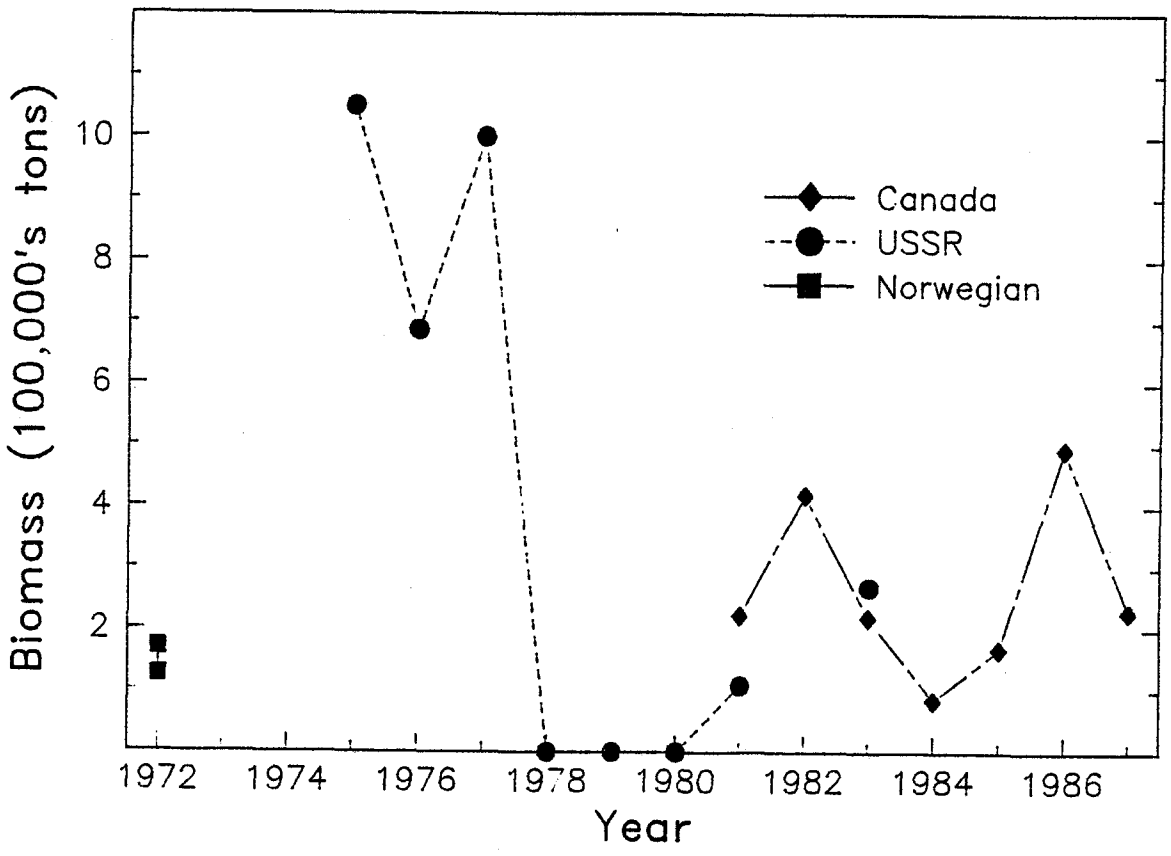


Figure 16. Estimates of capelin biomass in Division 3L 1978–87

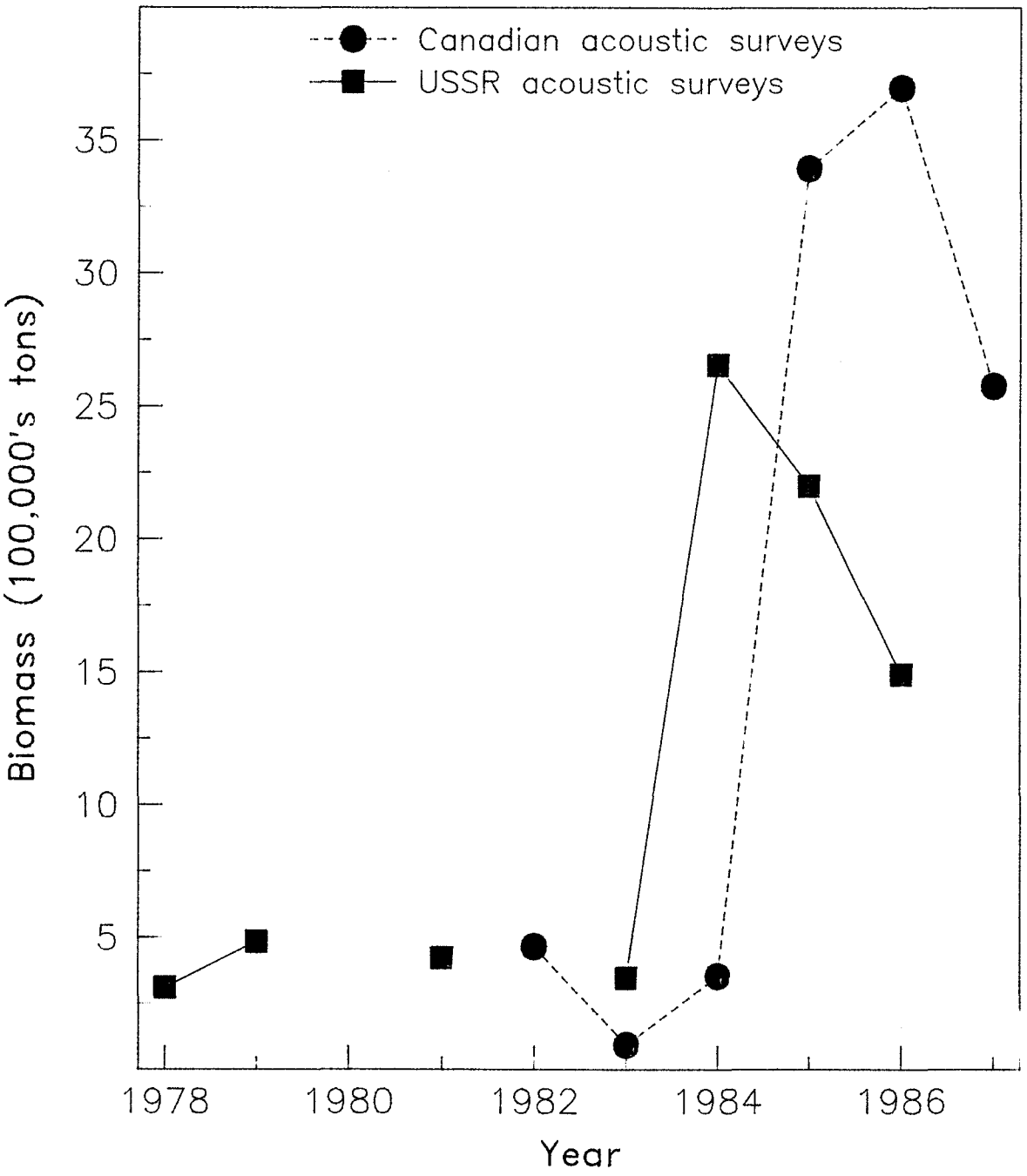
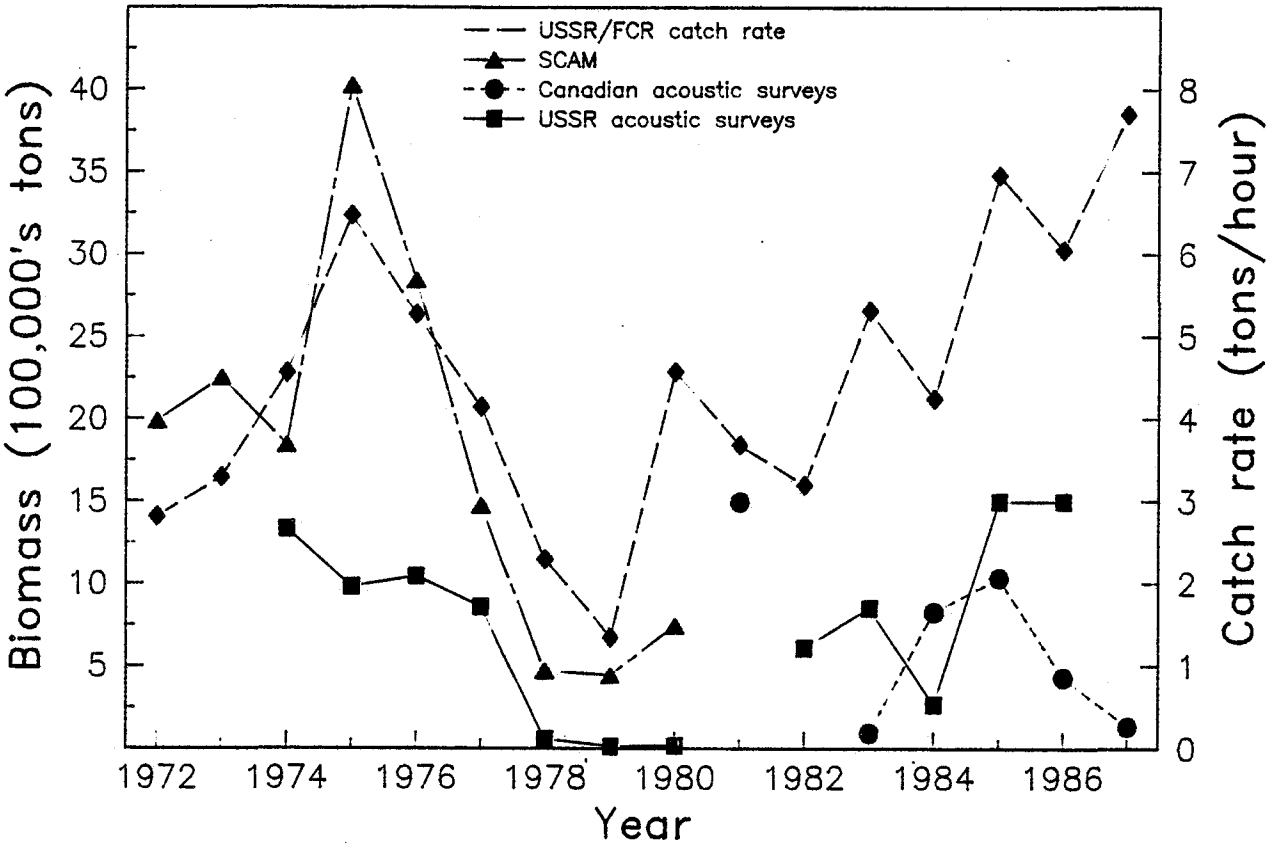


Figure 17. Abundance indices for capelin in Div. 2J3K, 1972–87



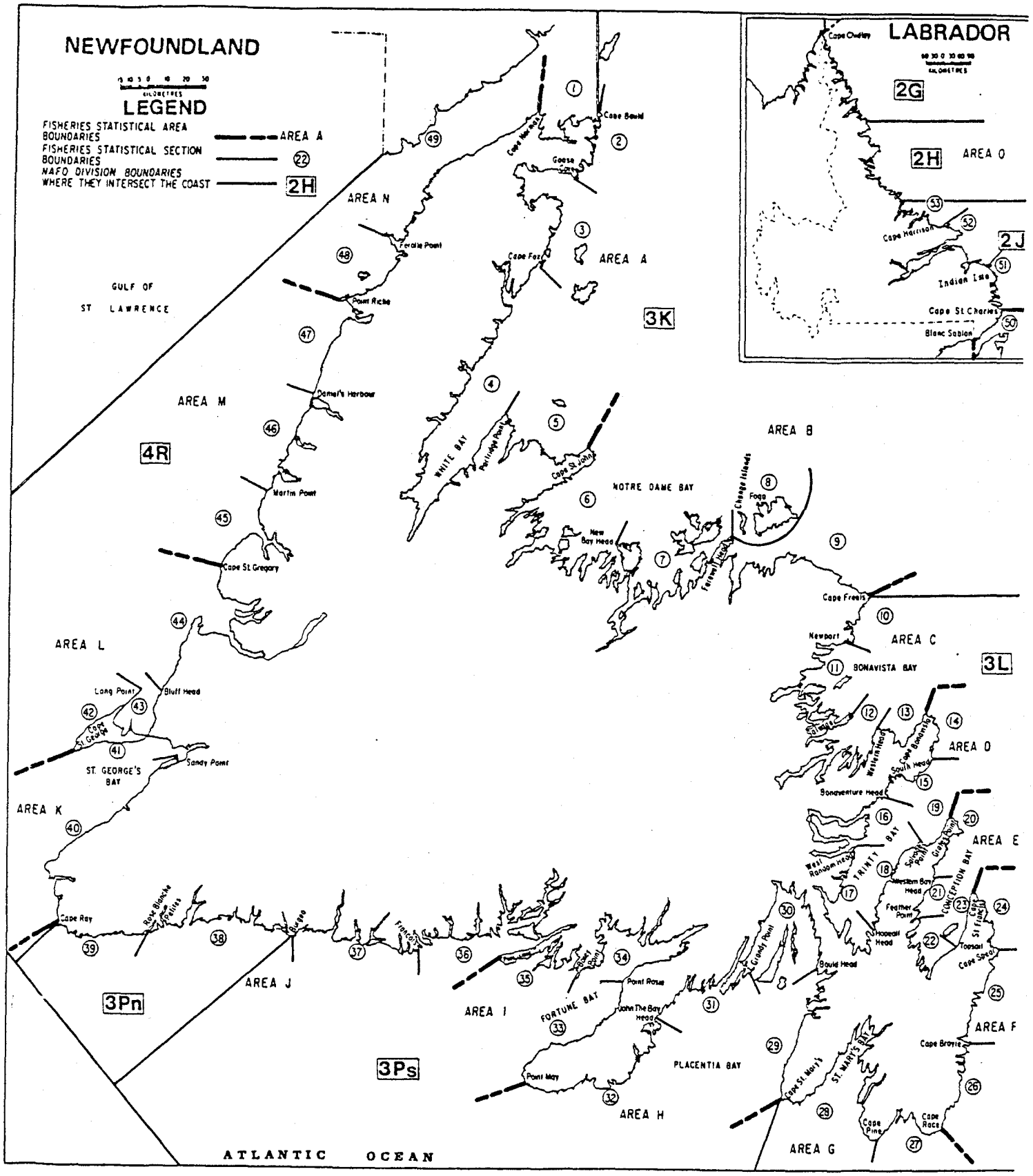


Fig. 18. Statistical area (alphabetic) and sections (numeric) in the Newfoundland Region.

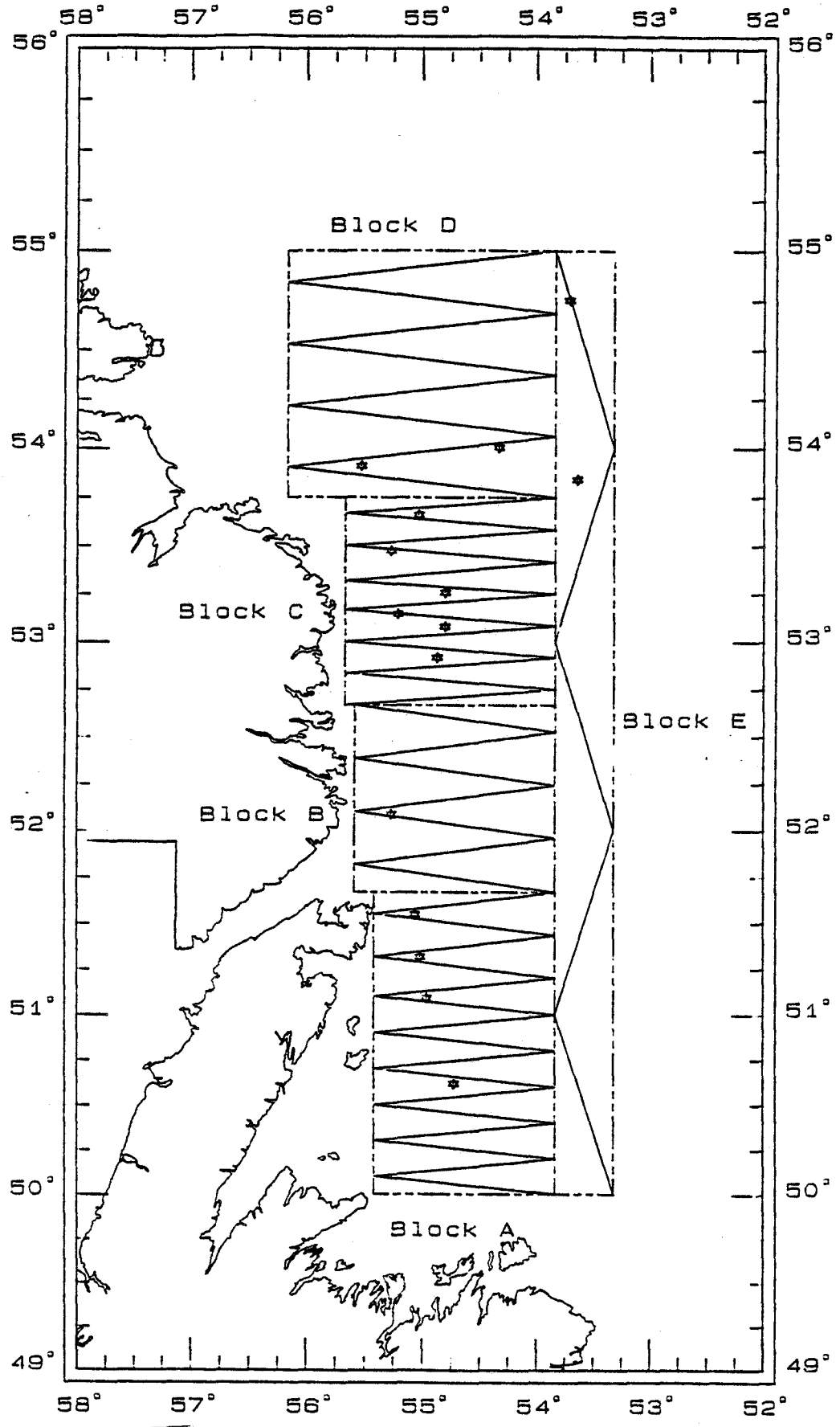


Fig. 19. Gadus 144 survey track

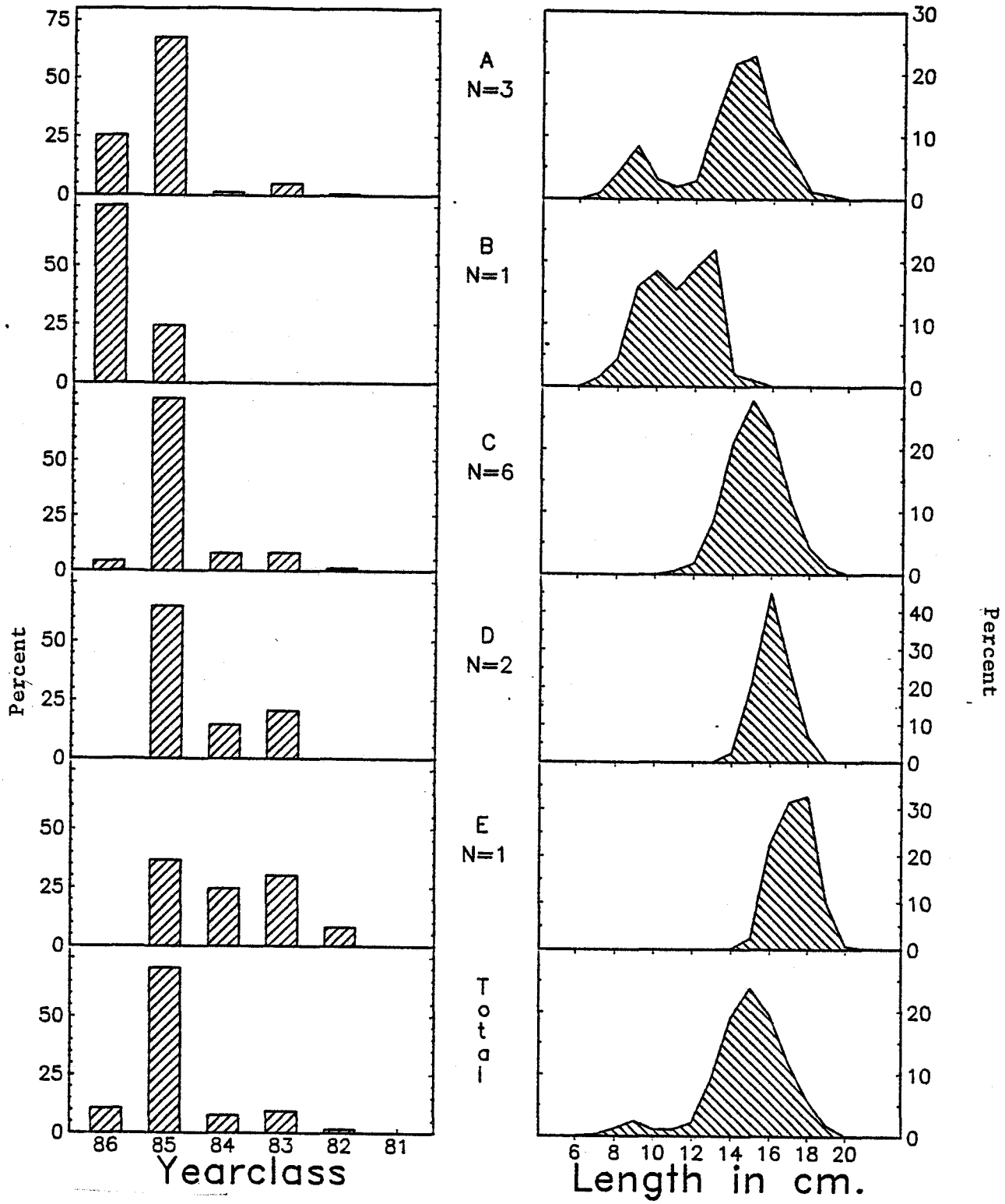


Fig. 20. Age and length compositions from Gadus Atlantica Cruise 144