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Capelin Acoustic Surveys
NAFO Divisions 2J3K and 3LNO, 1982

by

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

ABSTRACT

Acoustic surveys of capelin stocks were conducted in Divisions 3LNO during the period June 17 to July 4, 1982 and in Divisions 2J3K during the period October 1 to October 25, 1982 from the research vessel, Gadus Atlantica. Age and length distributions of capelin sampled during each of the surveys are provided. A biomass estimate from the 3LNO survey is provided.

INTRODUCTION

These surveys are a continuation of an annual acoustic survey program for capelin started in 1977. The U.S.S.R. conducts a similar acoustic survey program over the same areas. Biomass estimates from the surveys of both countries are used as a basis to provide advice on quota levels for the capelin stock complexes in Divisions 2J3K, 3L, and 3NO.

During 1982, acoustic surveys were conducted during April in Div. 3L (Miller et al. 1982), during 17 June-4July in Div. 3LNO and during 1-25 October in Div. 2J3K. This paper presents results of the June survey in Div. 3LNO and the October survey in Div. 2J3KL.

MATERIALS AND METHODS

Acoustic data were collected using a Simrad EK50 echo sounder operating at 49.5 kHz with a pulse length of 0.4 milliseconds. A time-varied-gain of 20 log R was used. Returned echo signals were demodulated and fed to a custom designed microprocessor controlled data acquisition system. This system sampled the signal at a 15 kHz sampling rate corresponding to one sample every 5 cm of water depth. Any samples exceeding a predefined threshold voltage were digitized and written to 9 track computer tape for subsequent echo integration analysis on another computer system.

The transducer used was an Ametek-Straza SP187LT with a half power beam angle of 6 degrees. The transducer was housed in a remote towed body that was kept at a depth of 10 to 20 meters below the surface at a distance of 100 to 150 meters behind the ship to minimize any effects of vessel noise. Vessel speed was maintained at 10 knots except during bad weather when it was reduced accordingly.

The geographic area to be covered for each survey was subdivided into discrete blocks based on the expected distribution of capelin determined from earlier surveys (Fig. 1 and 2). Within each block, a systematic zigzag survey design was used.

Midwater trawl fishing sets were conducted throughout the survey to provide length and age distributions of capelin and to determine the extent of mixing with other species. Capelin target strengths were calculated for each survey block using sampling data from that block and a weight/target strength regression: T.S.(dB) = 11.56 log W (gms) - 65.95. This regression was calculated using data from in situ target strength measurements using live capelin specimens (Buerkle, pers. comm.).

Subsequent analysis of the digitized acoustic data was carried out by squaring the sample voltage (rms) levels and averaging over one meter depth intervals. Data were accumulated over 10-minute intervals corresponding to a survey track distance of 3.1 kilometers and averaged. The density (λ) per cubic meter for depth R is then calculated from

$$\lambda = V_R^2 \times \frac{1}{Rx^2\, Po^2\, \bar{b}^2\, \frac{\sigma}{4\Pi}\, c\Pi\, \tau\, Go^2}$$

where V_R^2 is the average rms voltage squared at depth R, Rx is the receiving sensitivity of the transducer, Po is the rms transmitted pressure level, b is the average beam pattern factor, $\frac{\sigma}{4\Pi}$ is the target strength, c is the speed of sound in seawater, τ is the pulse length of the transmitted pressure level, and Go is the fixed gain of the echo sounder. The density per square meter of surface area is then calculated by summing the individual densities per cubic meter over the depth range. If sampling within the survey block indicated the presence of other species in the acoustic sample, the density estimate was adjusted proportionally to the percentage of weight of capelin in the midwater trawl samples. An average density estimate was then calculated from these individual estimates for the entire survey block. Total biomass for the block is calculated by applying the mean block density to the total surface area of the block.

Coefficients of variation due to sampling were calculated using a cluster sampling model (Nakashima 1981).

No biomass estimate is provided for the 2J3K capelin stock as equipment problems during the survey invalidated the collected data.

RESULTS AND DISCUSSION

Fig. 1 and 2 show the areas covered and the cruise track for each of the two surveys. Fig. 3-6 show age and length compositions of capelin sampled for each survey block. Fishable concentrations of capelin were not found in Block A and B of the 2J3K survey so no representative sampling data are provided for these blocks. Small 1981 yearclass capelin predominated in southern 3L with spawning aggregations of the 1979 yearclass predominating in northern 3L and on the Southeast Shoal of the Grand Bank (Divisions 3NO). The total age and length distributions for 3LNO are means weighted by the biomass estimate for each survey block. The 1980 and 1981 year-class capelin were predominant in the autumn survey in Division 2J3K.

Results of the acoustic survey in Divisions 3LNO are summarized in Tables 1, 2 and 3. The major portion of the 3LNO biomass estimate was contributed by the spawning component from the Southeast Shoal of the Grand Bank (Div. 3NO). The 3NO biomass estimate of 445,690 metric tons represents a significant increase over the 1981 survey estimate of 185,000 tons (Miller et al. 1982).

The 3L biomass estimate of 216,600 metric tons is lower than both the June 1981 estimate of 1,680,000 tons and the April 1982 estimate of 525,600 tons (Miller et al. 1982). The 1979 year-class is now predominent in Division 3L and as more of the year-class becomes mature and congregates in the near shore area prior to spawning, it becomes less available for acoustic biomass estimation. This may explain the large decline in the acoustic biomass estimate for Division 3L between June 1981 and June 1982.

REFERENCES

Miller, D.S., B.S. Nakashima, and J.E. Carscadden. 1982. Capelin acoustic surveys in NAFO Divisions 2J3KL, 3LNO, and 3L 1981-1982. NAFO SCR Doc. 82/VI/54.

Nakashima, B.S. 1981. Sampling variations and survey design for capelin (Mallotus villosus) densities from an acoustic survey in Divisions 3LNO, 1980. NAFO SCR Doc. 81/II/14.

Table 1. Summary of acoustic survey results for Gadus Atlantica, Cruise #66, NAFO Division 3LNO.

Block	NAFO Div.	Area (km^2)	Mean wgt. (gms)	T.S. (dB)	Biomass/m^2 (gms)	$V_{\bar{x}}$	δ	Lower limit of δ	Total biomass (m tons)
A	3L	864	18.8	-51.2	2.07	0.27	.90	-.10	1788
B	3L	13745	20.6	-50.9	5.02	0.19	.95	-.03	69000
C	3L	16741	4.8	-58.0	8.71	0.34	.97	-.03	145814
D	3NO	12833	23.8	-49.6	34.73	0.17	.95	-.03	445690
TOTAL		44183			14.99	0.14			662292

Table 2. Number of transects (t), total transect length, the range of mean densities $\bar{x}_i$ and the range of intervals (n_i) per transect for each survey block.

Block	t	Length (km)	Range of $\bar{x}_i$'s	Range of n_i's
A	26	37.0	0.2-13.6	10-15
B	8[a]	96.3	2.1-10.1	29-33
C	8	114.8	1.9-29.0	33-36
D	12	100.0	10.8-75.6	26-33

[a]:9 transects are shown in Block B, Fig. 1. In fact, one transect could not be completed and was not used in the analysis.

Table 3. Numbers and biomass-at-age from June 1982, acoustic survey in Div. 3LNO.

	Age 1	2	3	4	5	6
Div. 3L						
Numbers (billions)	27.6	4.9	5.3	0.2	<0.1	<0.1
Biomass (000't)	42.0	50.3	117.2	6.0	0.8	<0.1
Div. 3NO						
Numbers (billions)	0	0.1	17.6	0.8	0.1	<0.1
Biomass (000't)	0	1.1	414.7	23.5	5.3	1.2

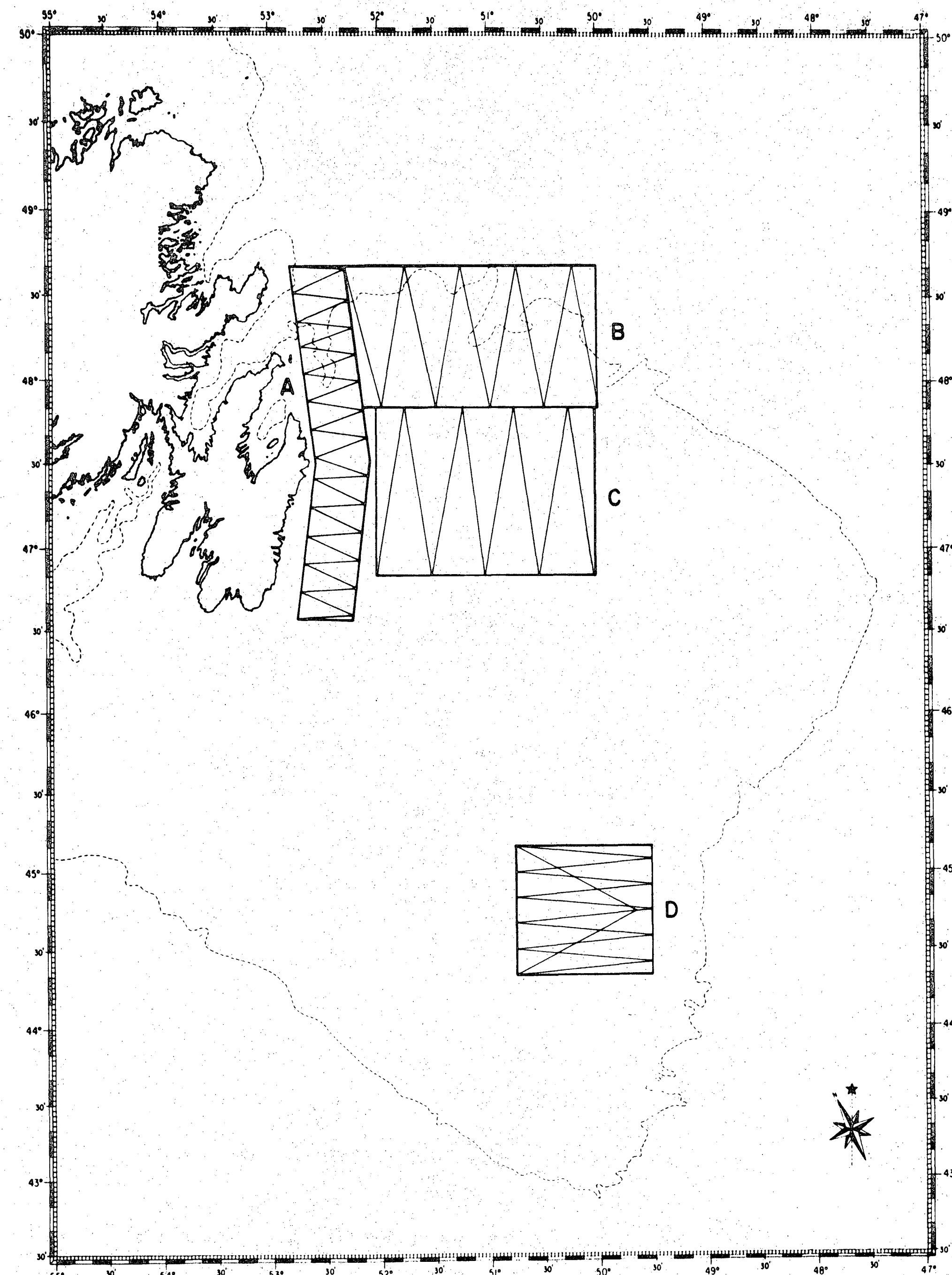

Fig. 1. Survey coverage for Gadus Atlantica, Cruise #66, NAFO Division 3LNO, June 1982.

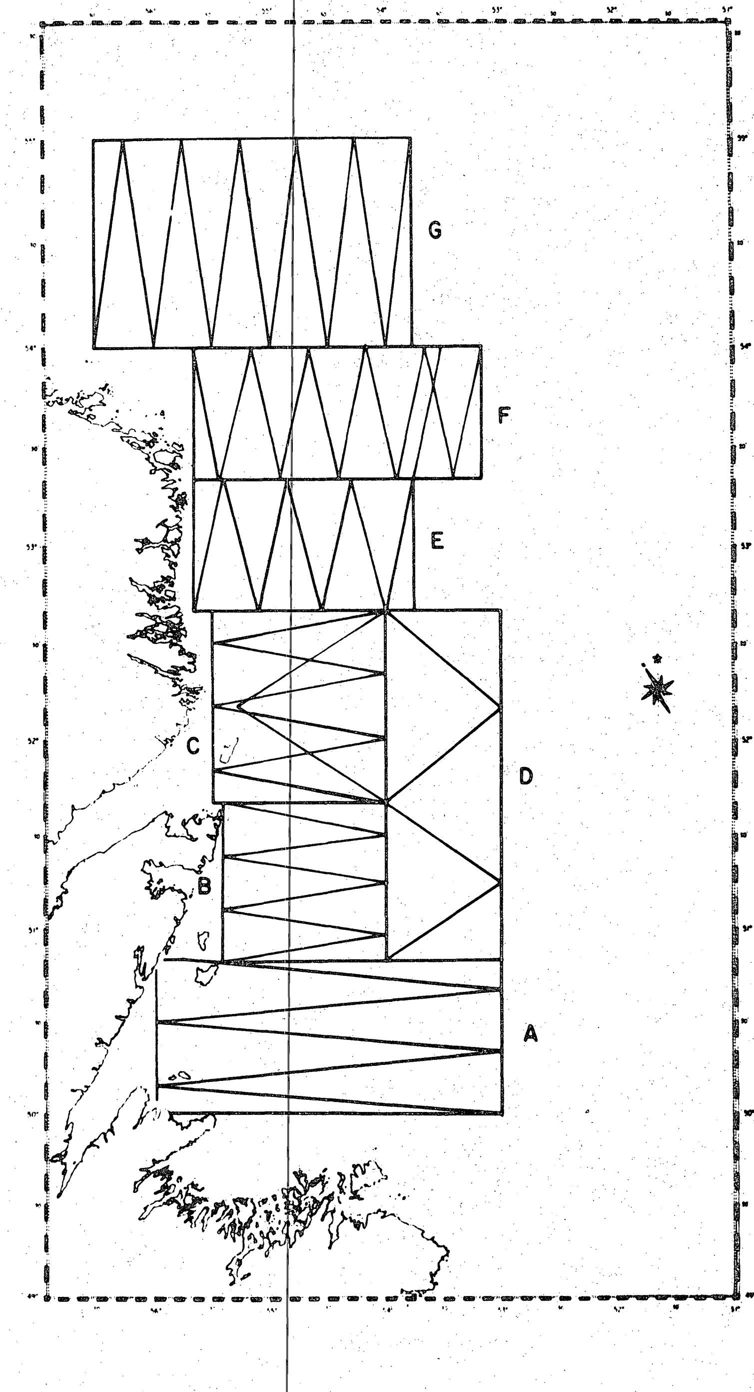

Fig. 2. Survey coverage for Gadus Atlantica, Cruise #70, NAFO Division 2J3K, October 1982.

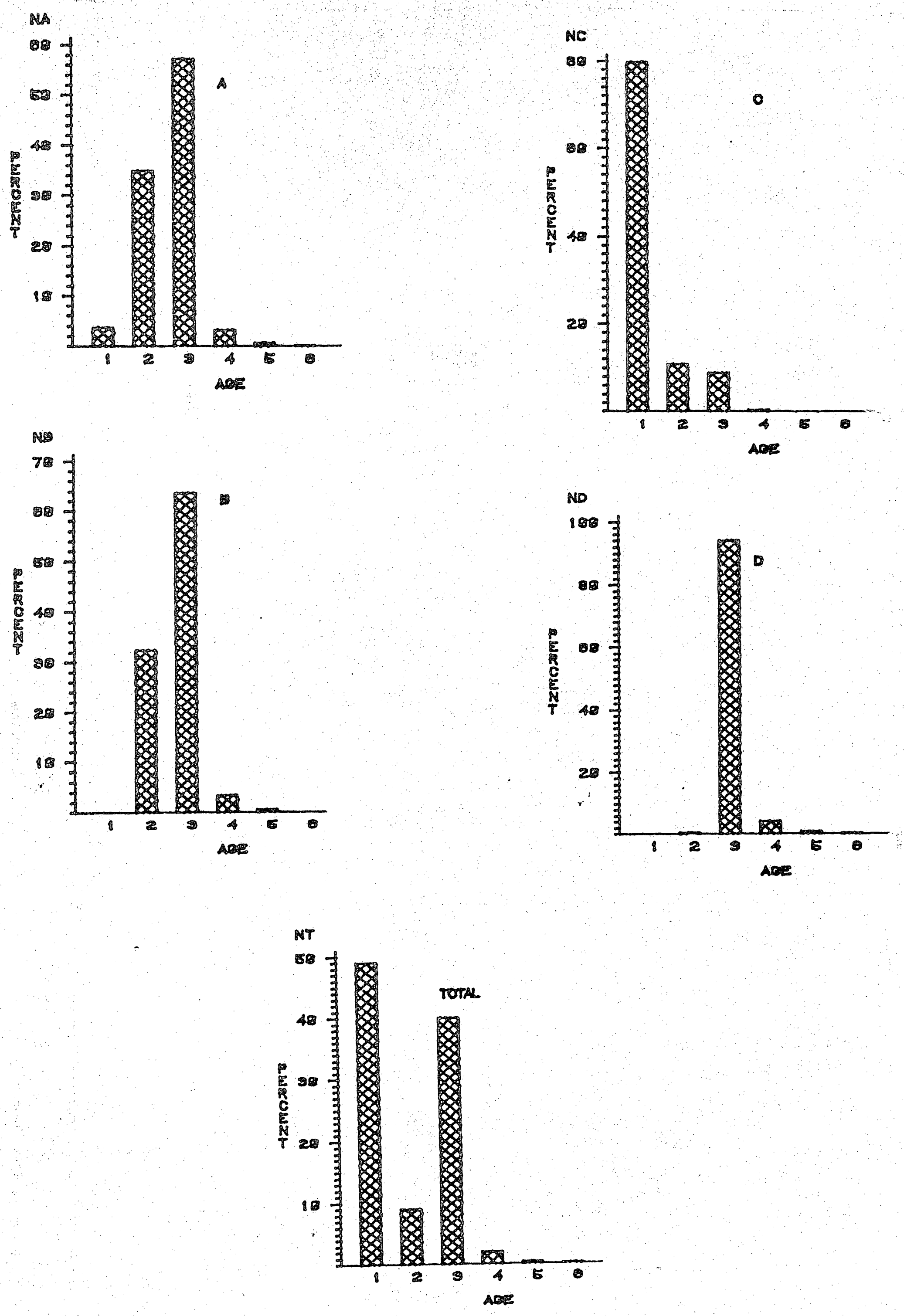

Fig. 3. Age composition of Division 3LNO capelin, Gadus Atlantica, Cruise #66.

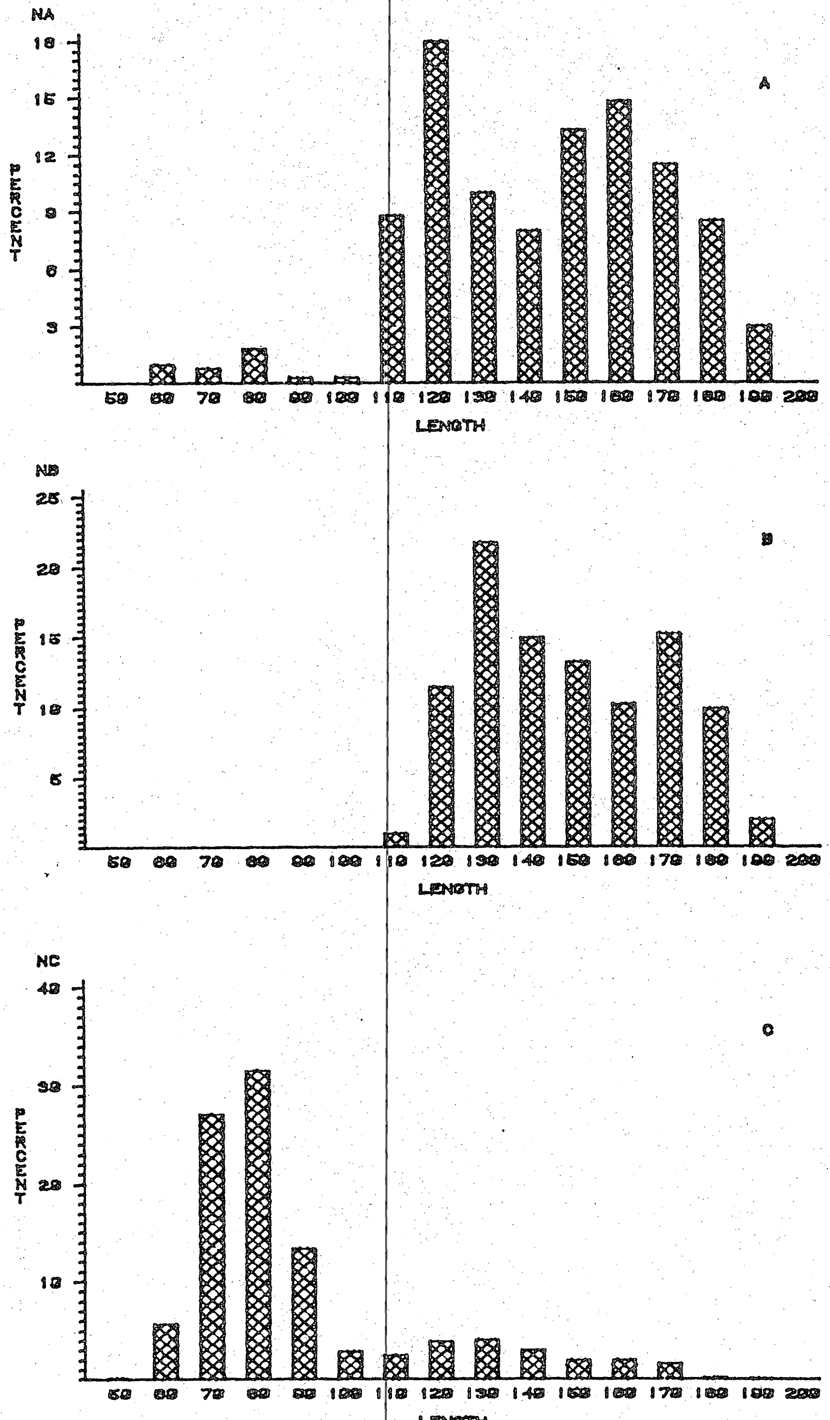

Fig. 4. Length composition of Division 3LNO capelin, Gadus Atlantica, Cruise #66.

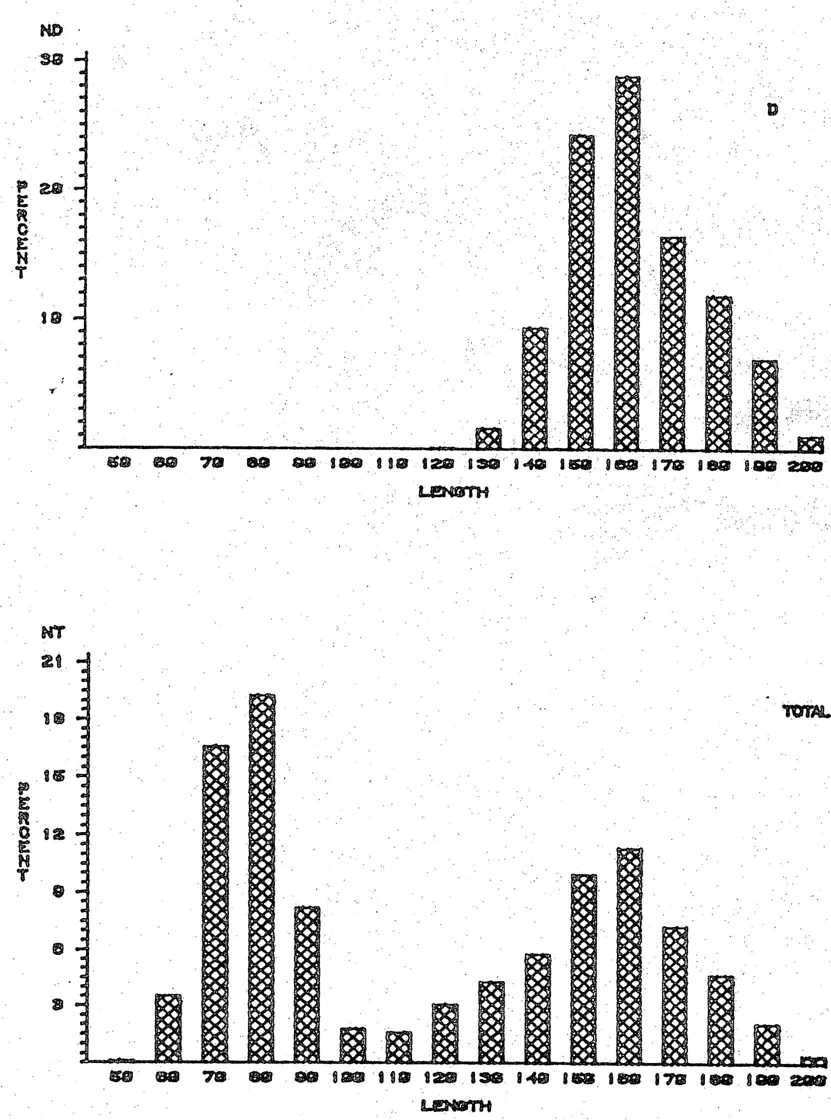

Fig. 4. Length composition of Division 3LNO capelin, Gadus Atlantica, Cruise #66.

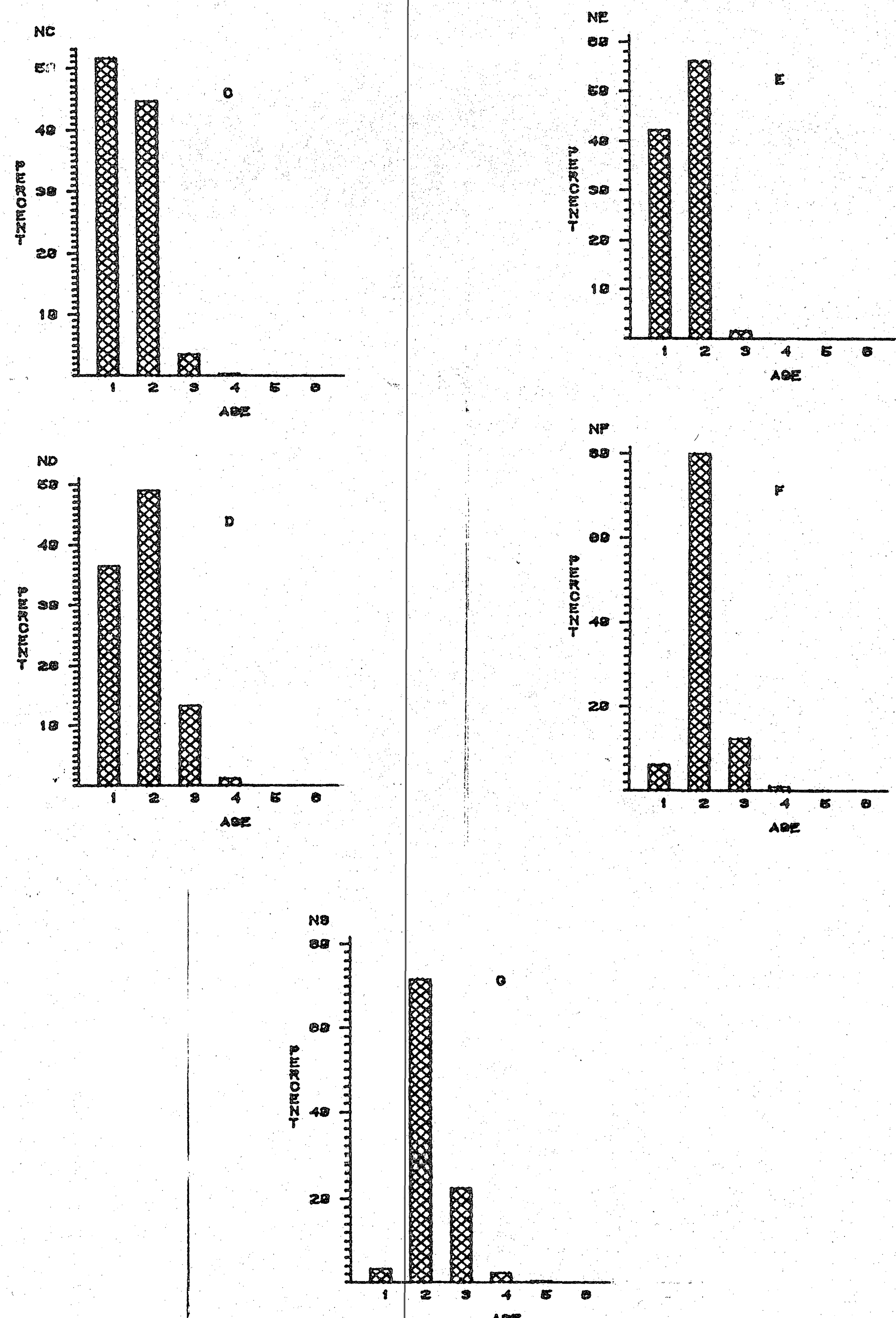

Fig. 5. Age composition of Division 2J capelin, Gadus Atlantica, Cruise #70.

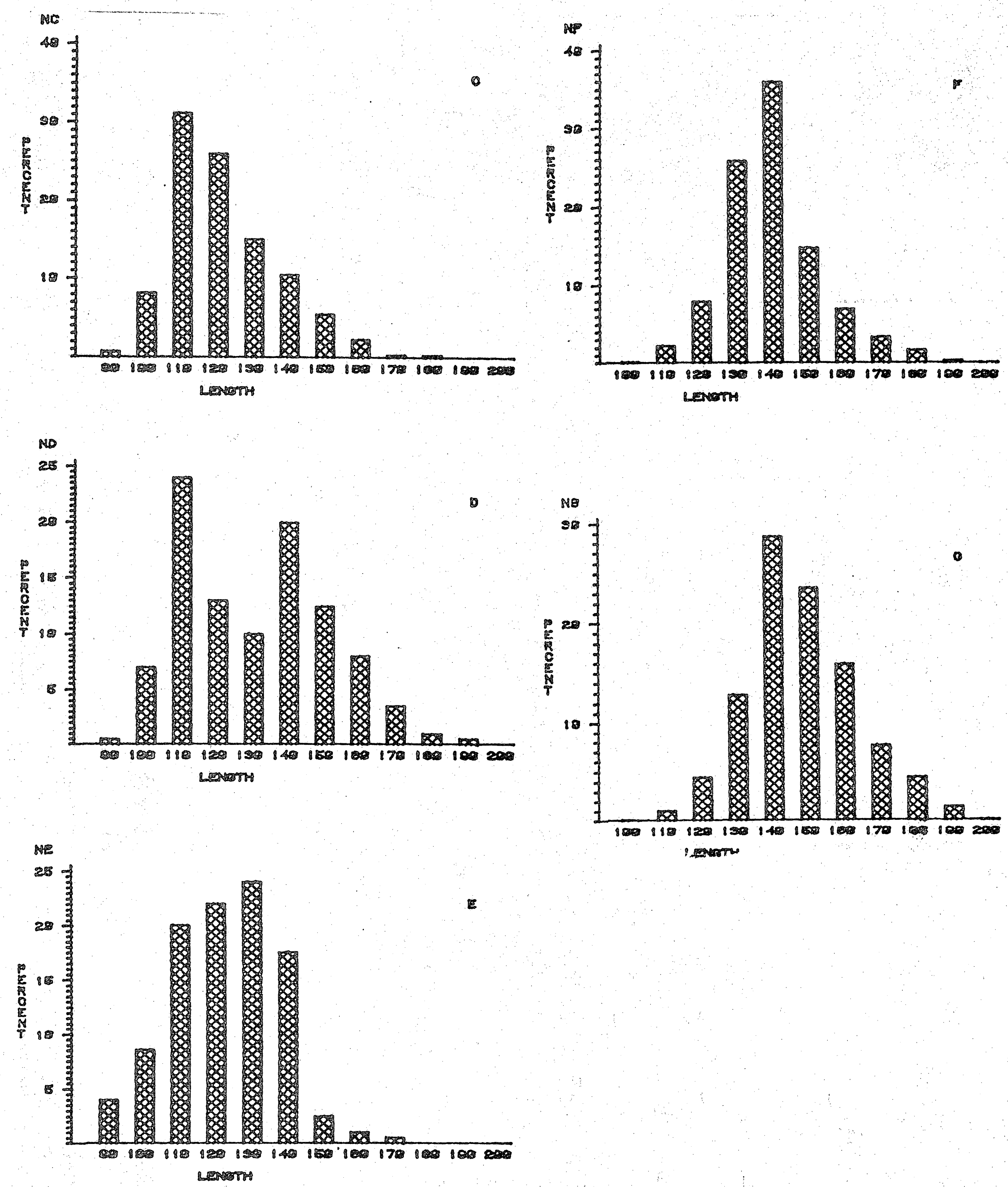

Fig. 6. Length composition of Division 2J capelin, Gadus Atlantica, Cruise #70.