



Serial No. 3837  
(D.c.3)

ICNAF Res.Doc. 76/VI/51

ANNUAL MEETING - JUNE 1976

Size of the capelin spawning stock on the Grand Newfoundland Bank

by

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**Abstract**

The paper contains the data on distribution, migrations, size-age structure of the capelin stock in the area of the Grand Newfoundland Bank as well as the estimates of the size of the capelin spawning stock in division 3N obtained by a combined echo-photo survey in June 1975.

**Introduction**

Capelin abundance survey in div. 3K ( North Newfoundland Bank ) and in div. 2J ( South Labrador ) was carried out in the fall 1974. The most cautious abundance estimate was found to be equal to 1.33 million tons ( Serebrov, Bakanev, Kovalev 1975). In these 2 divisions a northward feeding migration of capelin terminates, the capelin form up slowly moving winter concentrations and recruitment to these concentrations takes place. At the end of the year, often under the ice, starts a pre-spawning southward migration of capelin.

The capelin spawn mainly in the coastal waters of Newfoundland ( 3L, 3Ps ) and on the Southeast Shoal ( 3N ). Usually the spawning starts in June and ends at the beginning of August in div. 3N ( Kovalev, 1975, Templeman, 1948 ).

The first attempt to estimate capelin abundance in div. 3L, N, O, Ps made from May 17 to June 29, 1972 by Norwegian researchers gave the total biomass 0.8 million tons ( Dragesund, Monstad, 1973 ).

In accordance with recommendations of Standing Committee on Research and Statistics ( STACRES ) of the International Commission for the Northwest Atlantic Fisheries ( ICNAF, Ser. No. 3437, Proc. No. 1, B.d. Jan. 75)

the Polar Research Institute apart from comprehensive investigations of distribution, migrations and size-age structure of the capelin stock in sub-area 3 carried out in June 1975 a combined echo-photo survey to determine the size of the spawning capelin stock in div. 3N.

#### Material and method

The investigations on capelin in the first half 1975 were carried out from the end of March to the beginning of July by a scouting stern trawler "Suloy".

The expedition was set the following tasks:

- 1) to investigate the prespawning capelin migrations
- 2) to investigate the distribution of the immature and mature capelin and determine the mature to immature ratio in the catches of capelin taken by a standard commercial trawl.
- 3) to investigate the size-age structure of the capelin stock in the area of the Grand Bank ( 3L,N,O,Ps ).
- 4) to investigate the predator press on the capelin stock
- 5) to estimate abundance of the spawning stock

To investigate migrations and distribution we used hydroacoustic equipment, control trawlings and summed up information from scouting and commercial vessels.

The mature to immature ratio was determined by cutting open the abdomen after which operation the capelin were measured and sorted by size-groups into males, females and immature fish.

To investigate the size-age structure of the capelin stock, to collect and process the data on the feeding of predators the standard method was used ( Turuk, 1968 ). The method used to estimate the abundance of the spawning stock was that to determine the capelin abundance in the fall 1974 ( Serebrov, Bakanev, Kovalev, 1975 ).

In the course of the survey 392 pelagic and bottom trawlings and 122 biological analyses were made, 1250 otoliths for age identification of capelin and bottom fishes were taken and 34,388 fish were measured. The underwater camera "Triton" was used 24 times.

### Discussion of results and conclusion

On March 22 near the ice limit in the Avalon Channel were distributed large concentrations of the immature capelin. Just at that date from under the ice appeared the first schools of mature capelin which were migrating southwards through the area where the immature capelin were distributed ( Fig.1a ). At the beginning of April the concentrations of immature and mature capelin separated ( Fig.1b) It must be pointed out that being distributed in the same area the immature and mature capelin do not form up mixed schools. The schools of mature capelin are of a considerably greater density and produce echo recordings which are more sharp than those of the scattered immature capelin concentrations.

The analysis of the catches taken by a standard trawl showed that , as a rule, the by-catch of the immature capelin did not exceed 5% ( Fig.2 ).

In the period March- the first half of May the immature capelin kept in the Avalon Channel ( 3L ) and did not make distant migrations ( Fig.1a-f ). It is not every year that at the end of March the areas of the distribution of the immature and mature capelin coincide. In 1974, for example, the immature capelin concentrations kept at a far greater distance from the shore and the mature capelin migrated southwards just along the boundaries of the Canadian territorial waters ( Table 1 ).

In March-April the mature capelin migrated southwards and south-westwards (3L,0 ). In the end of May and in the beginning of June the capelin migrated quickly eastwards to the spawning area ( Fig.1g-j) The spawning in div.3N began in the second decade of June. We obtained somewhat surprising results on the feeding of predators on capelin ( Table 2 ). In div.2J and 3K, in the part free from ice, no capelin was found in the stomachs of cod, Greenland halibut, witch flounder, golden redfish and beaked redfish. This can be attributed to two reasons:

- a) a greater part of predators is distributed along a mainland slope where practically no capelin occur
- b) in March capelin concentrations migrate under the ice southwards along the coast of Newfoundland and therefore the areas where the capelin and predators are distributed are separated.

In div. 3L, N, O, P, the predator press existed only in the Avalon Channel. In the end of March the capelin accounted for nearly 100% of the cod diet ( Table 2 ).

Some capelin concentrations migrate to the coast of the Avalon Peninsula in the zone closed for international fishing ( Fig. 1a, ICHAF, Proc. No. 2, Ser. No. 3438, 1975 ).

Apparently in the end of March practically all the cod migrated in pursuit of the capelin in the fishing zone of Canada. No cod was found on the capelin migration routes to the spawning grounds in the international waters and on the Banks in div. 3N.

The areas where other predators and capelin are distributed in April-June do not coincide. Only on the Green Bank for a short period of some days the capelin occurred in the stomachs of the American plaice. But brittle star and sand eel dominated in the food found in their stomachs.

A preliminary echo-hydrological survey gave a general picture of the capelin distribution in the spawning area ( Fig. 3 ). East of the spawning grounds, in div. 3O, in the beginning of June no commercial capelin concentrations were found but later control trawlings gave up to several thousand specimens of capelin. The investigations we carried out allow us to assume that the approach to the spawning grounds ( 3N ) was in the beginning of June.

The first survey with a view to make more precise the capelin distribution on the spawning Banks, check cooperation between a research vessel and commercial data-collecting vessels and work out the most efficient route was carried out June 9-12 ( Fig. 4 ). The principal survey was made in the period June 12-14 ( Fig. 5 ).

In the spawning period the number of fish per unit volume of water in the daytime and at night was almost the same ( Table 3 ).

The preliminary survey during which we did not succeed in investigating all of the concentrations found by scouting and commercial vessels showed the capelin abundance in the investigated area to be equal to  $8335,3 \times 10^6$  specimens and the biomass-401,000 tons ( Table 4 ). During the principal survey ( Fig.5 ) the capelin biomass in the spawning area was 1,05 million tons ( Table 4 ). This figure compares rather well with that of the Norwegian researchers ( 0,8 million tons ) who conducted their investigations in the same period in 1972 but who employed another method ( Dragesund, Monstad, 1973 ).

However, the biomass of capelin in div. 3N ( 1.05 ) can not be regarded as the biomass of the spawning offshore stock for the prespawning capelin are entering div 3N during the whole of June and a greater part of July. Proceeding from the fact that the quota recommended by STACRES ( 0,2 million tons, ICNAF, Summ. Doc. 75/5 ) has been nearly filled by the middle of June we can think that the total spawning capelin stock ( south-eastern stock of the Newfoundland Bank ) was not less than 1,2 million tons and that the recommended quota amounted to not more than 17% of the stock. If we accept the hypothesis of G.H. Winters ( 1975 ) to identify the local capelin stocks on the basis of seasonal distributions the international capelin fisheries are based, especially in March - the first half of April, on the mixed concentrations of the following stocks: North Grand Bank - Avalon stock, South-Western inshore stock, St. Pierre - Green Bank stock and South-Eastern offshore stock. Thus, the effect of fishing mortality is suffered by several separate stocks which probably have different abundance dynamics with the result that the fishing mortality is quite insignificant and this in turn to a great extent decreases the probability of overfishing.

References

1. Dragesund, D and Monstad, T, 1973. Observation on capelin ( *Mallotus villosus* ) in Newfoundland waters. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 73/33:1-14.
2. Intern. Comm. Northw. Atlant., 1975. Ser. No. 3437, Proc. No. 1, B. d. Jan. 75
3. Intern. Comm. Northw. Atlant., 1975. Ser. No. 3438, Proc. No. 2, B. d. Jan 75
4. Kovalev, S. M., 1975. Biology and fishing of capelin in the Grand Bank area ( In Russian ). Мурм. эк. нах-во: I-32.
5. Serebrov, L. I., Bakanev, V. S. and Kovalev, S. M., 1975. The state of Newfoundland capelin stock. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 75/74:1-11
6. Templeman, W., 1948. The life history on the capelin ( *Mallotus villosus* Muller ) in Newfoundland. Bull. Nfld. Govt. Lab. No. 17:1-151
7. Turuk, T. N., 1968. Seasonal changes of cod feeding in the Labrador and Newfoundland area in 1964/1966 ( In Russian ). Труды ИИХРО, ВМР. 23:370-382
8. Winters, G. H., 1975. Review of capelin ecology and estimation of surplus yield from predator dynamics. Intern. Comm. Northw. Atlant. Fish. Res. Doc. 75/2:1-25.

Table 1

Capelin age composition in March-June 1973-1975  
( standard trawl, research vessels )

Year	Month division	A g e							n
		1	2	3	4	5	6	7	
1973	April ( 3LOPs )	-	1,3	12,3	57,0	28,5	1,3	-	398
	May ( 3LOPs )	-	1,5	8,0	76,4	14,0	0,1	-	738
	June ( 3M )	-	-	4,4	79,9	15,7	-	-	550
	March ( 3L )	-	-	42,0	26,0	32,0	-	-	100
1974	April ( 3L )	-	3,1	37,4	30,8	25,6	3,1	-	195
	May ( 3LO )	-	0,7	27,8	36,2	33,6	1,7	-	679
	June ( 3M )	-	-	31,0	35,6	31,3	2,1	-	491
1975	March ( 3L )	-	34,0	20,6	32,0	7,4	4,0	2,0	150
	April ( 3LO )	-	22,4	28,0	35,6	7,2	6,8	-	250
	May ( 3O )	-	5,0	47,0	37,0	5,0	6,0	-	100
	June ( 3NO )	-	2,5	32,5	42,0	13,0	10,0	-	200

Table 2

Proportion of capelin in the diet of predators  
( in percent )

Species	div	Month	% in diet	n
Greenland halibut	2I	March	0,0	173
Cod	2I	March	0,0	10
Cod	3K	March	0,0	41
Cod	3K	March	96,0	113
Golden redfish	2I	March	0,0	47
Beaked redfish	3K	March	0,0	25
Witch flounder	3K	March	0,0	72

Table 3

Average density of capelin concentrations

Time	Total number of photos	Number of photos with fish	Total number of fish on photos (n)	Volume of ocean on photos, m <sup>3</sup>	Number of fish in m <sup>3</sup>
Day	410	11	54	129,8	0,41
Night	195	11	31	80,3	0,38
Total	605	22	85	210,1	0,40



Table 4

Abundance and biomass of capelin offshore concentrations (  $\bar{N}$  )

Number of Fig. and type of survey	Density gradations Spec./mi <sup>2</sup> x10 <sup>6</sup>	Average abundance Spec./mi <sup>2</sup> x10 <sup>6</sup>	Area of concentrations in mi <sup>2</sup>	Total abundance Spec.x10 <sup>6</sup>	Average weight of 1 Spec.in gramms	Total biomass in tons
Fig.4	1	0.41	1093.6	448.4		15784
Preliminary survey	1.1-10.0	6.72	389.7	2618.8	35.2	92181
	10.1-100.0	24.80	336.1	8335.3		293402
Total			1819.4	11402.5		401367
Fig.5	1	0.50	549.6	274.80		9673
Principal survey	1.1-10.0	5.85	1158.2	6775.5	35.2	238496
	10.1-100.0	28.52	798.7	22778.9		801818
Total			2506.5	29829.2		1049987

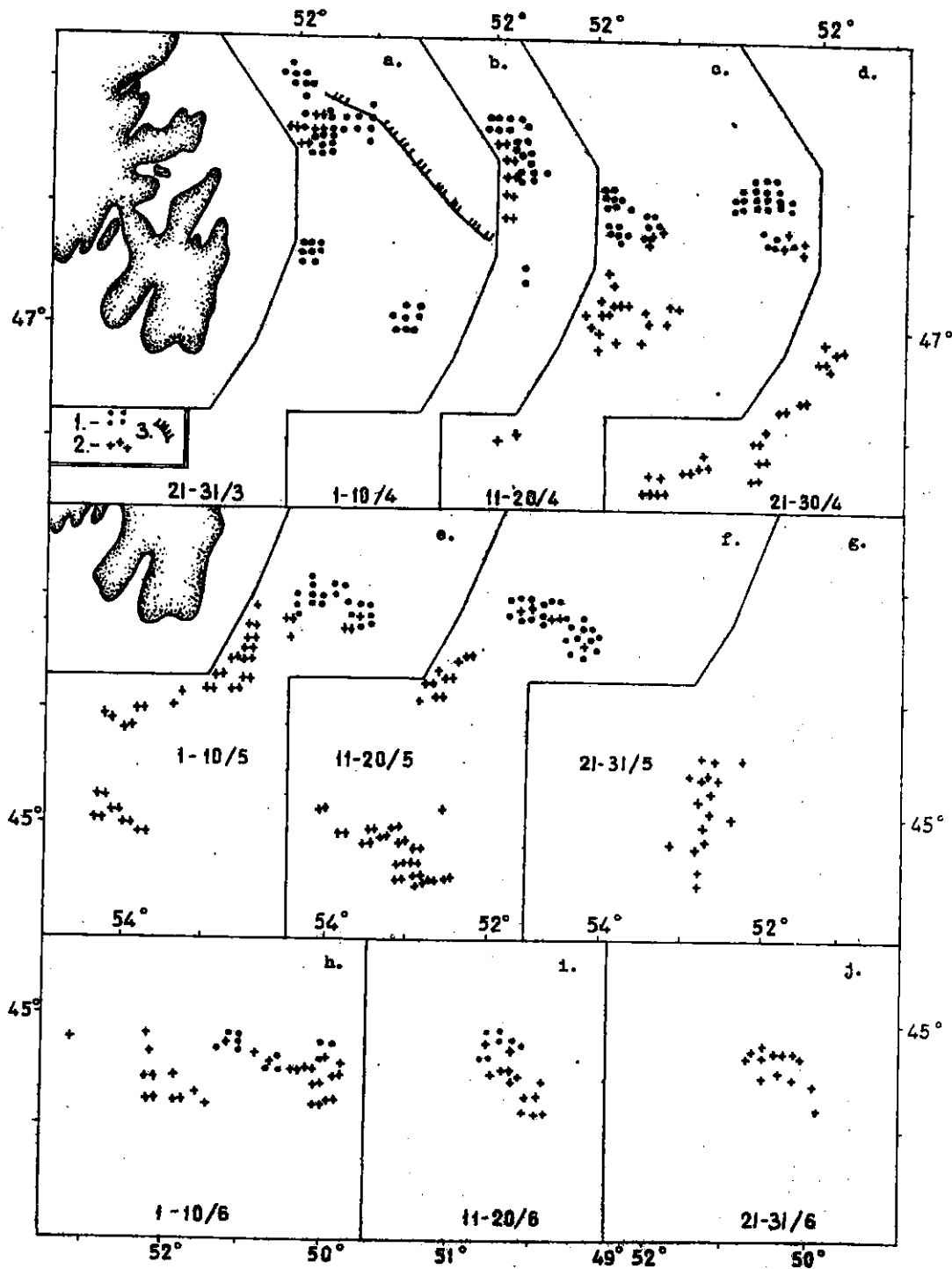


Fig.1 Distribution of the adult and immature capelin at the end of March-June of 1975 according to decades

- 1. immature
- 2. adult
- 3. ice-crumb

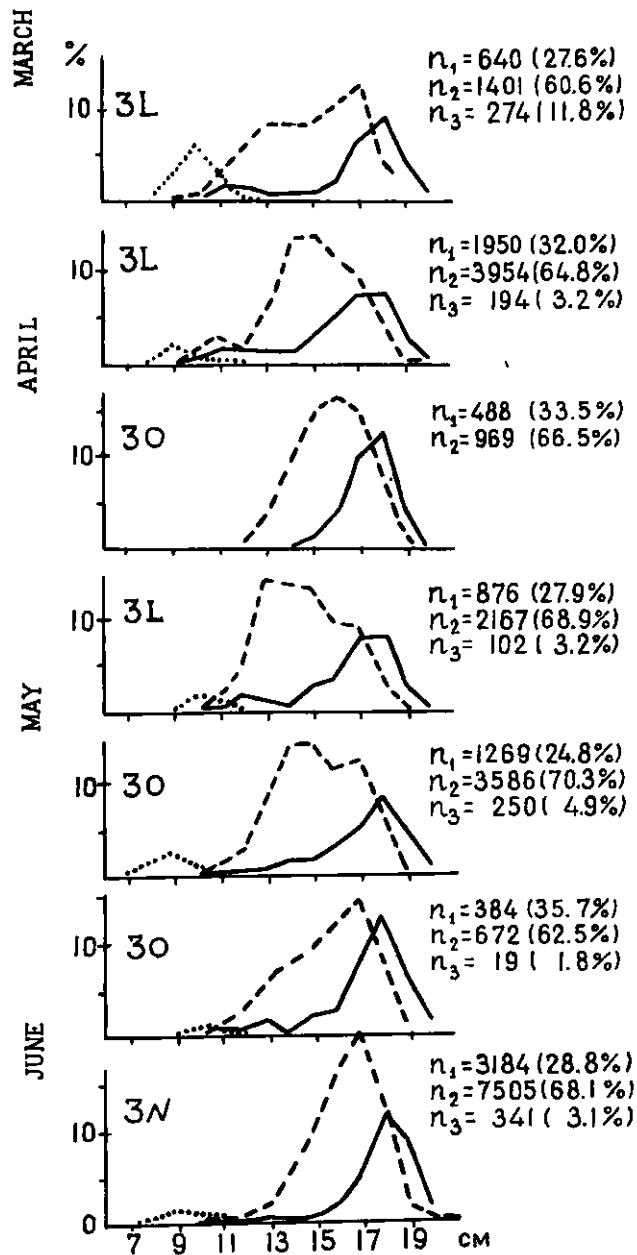


Fig.2. Size composition and males:females:immature capelin ratio ( in percent ) at the end of March- June 1975.

- $n_1$  - males ( - )
- $n_2$  - females ( - - - )
- $n_3$  - immature capelin ( . . . . )

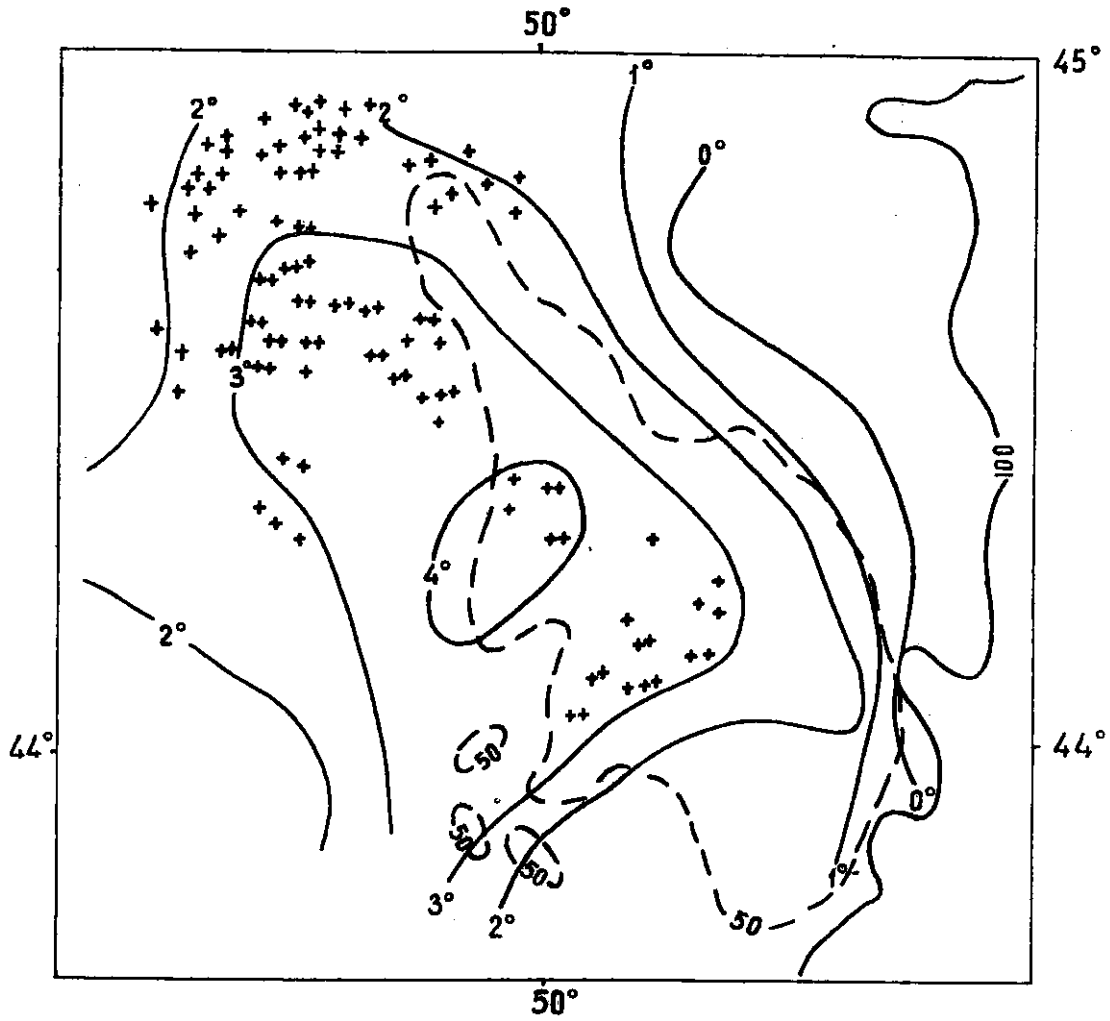


Fig.3 Distribution of capelin before the beginning of the survey of abundance (shoals are designated by crosses)

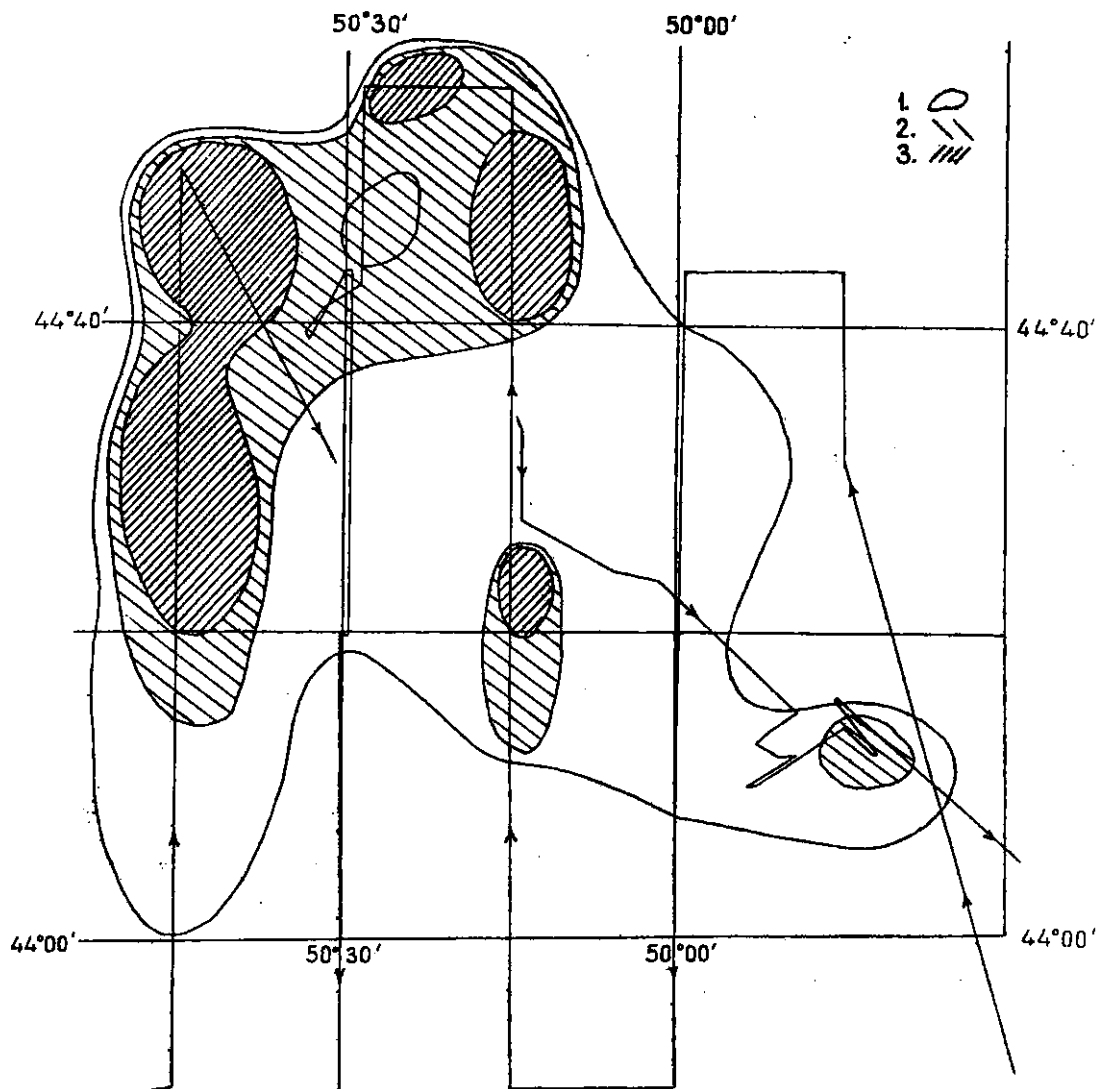


Fig.4 Preliminary echo and photo survey of the Newfoundland capelin abundance on 9-12 June of 1975

conventional signs:

1. less than  $1 \cdot 10^6$  spec/mile<sup>2</sup>
2. from  $1-10 \cdot 10^6$  spec/mile<sup>2</sup>
3.  $10-100 \cdot 10^6$  spec/mile<sup>2</sup>

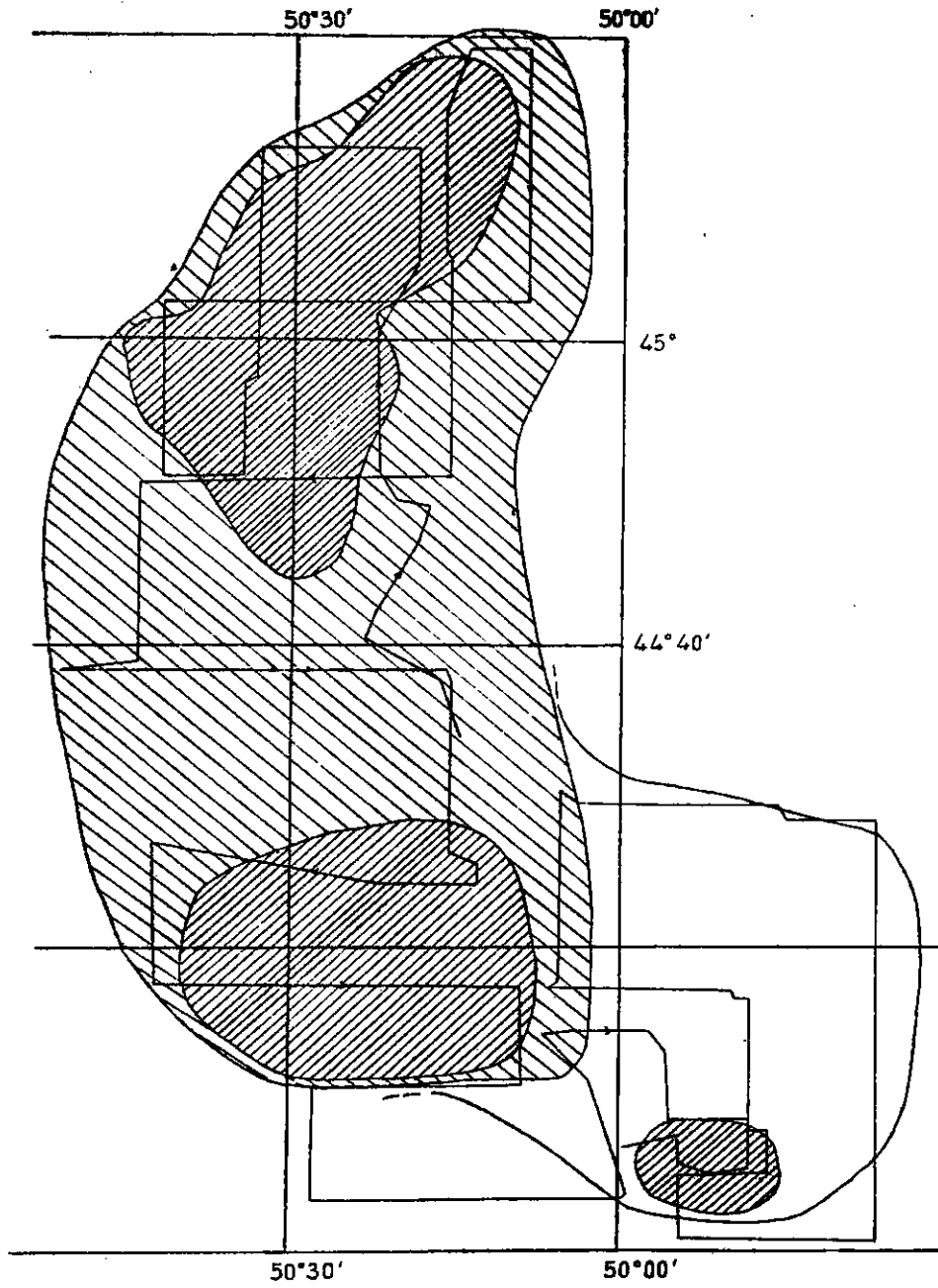


Fig.5 Principal echo and photo survey of the Newfoundland capelin abundance on 12-14 June of 1975 conventional signs in Fig.4