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Distribution of Various Age-groups of Cod in the Newfoundland Area by the 1988-1990 Survey Results

by

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ABSTRACT

The paper gives data on cod trawl catches obtained from the Soviet trawl surveys carried out in 1988, 1989 and 1990. The data are given separately for cod at age 1+, 2+ and over than 5+. Distribution of cod of various age-groups depending on Division, year of survey and bottom water temperature is compared. Average catches teken during the 1988-1990 surveys are considered with regard of depths of hauling and bottom temperatures. By calculations of mean depth of catches of cod of various ages the paper gives a conclusion that growth of cod influences the depth of their distribution. This conclusion is compared by various Divisions. It is noted that cod older than 5 years were captured in more shallow waters (compared with the long-term mean) in all Divisions except 3M.

INTRODUCTION

Despite the long-time series of cod stock state observations many aspects of it are still studied poorly. There arises a lot of questions as for the causes of cod recruitment fluctuations, which is, probably, related to a significant influence of various abiotic factors or to re-distribution of early stages of cod. In particular, the previous high estimates of cod abundance at certain age are sometimes not confirmed by surveys of the consequent years.

The aim of this paper is to study peculiarities of various age-groups of cod distribution by the results of surveys conducted during 1988-1990.

MATERIAL AND METHODS

The paper includes the materials of the Soviet fish-counting trawl surveys carried out to assess stocks of demersal commercial fish species in 1988, 1989 and 1990 in Divs 3KLMNO. During the surveys

otoliths were taken for age readings by the technique used in NAFO, besides, the samples were taken in Divs 3K, 3L, 3M and 3NO separately (Table 1). The cod age was determined from otolith cuts under binocular.

To study distribution of cod of various age-groups the length frequences from the catch data were recalculated into age frequences using the age-length keys. Length frequences of the Div. 3L cod for 1989 were recalculated by the Div. 3NO age key for 1989. Figs 1-9 show the distribution of juvenile cod at age 1 and 2 and that of mature cod (over 5 years old). Mean lengths of cod from various age-groups are presented in Table 2.
The duration of research haulings was 30 min. Bottom water temperatures were measured at hydrographic stations following trawl stations.
Trawls with zero catches were eliminated from mean catch calculations (Fig. 10).

RESULTS

In all the study areas covered by the 1988-1990 surveys the number of cod at age 1 was not large. The maximum catch of that age (226 individuals) was taken in Div. 3N in 1988 (Fig. 1). They were distributed mainly over the southeastern slope of the Grand Bank, and to a lesser extent - over southwestern and northeastern ones. In 1990 yearlings were not registered in catches in Divs 3N and 30. They were numerous in 1989 over the Flemish Cap; in 1988 and 1990 their number was smaller. It is worth mentioning that the number of cod at age 2 in 1990 was insignificant over the Flemish Cap, though one could expect that the 1988 year-class would be abundant in catches in 1990.

In all areas the distribution of 2-year-olds is similar to that of yearlings, but in Div. 3K they are distributed in more northerly waters. Two-year-olds were numerous in catches from the Flemish Cap area, in Divs. 3N, 30, 3K in 1988 and less numerous in those areas in 1989-1990.
The number of cod at age 3 years in 1990 was insignificant in all the areas; in shallow waters of the Grand Bank they were not found at all. Three-year-olds were numerous in catches of 1989 on the Flemish Cap which may be related to the strong 1986 year-class.
Four-year-old cod were most numerous in 1989 in catches from all the areas. The number of mature cod (age 5+) during the period 1988-1990 was most abundant in Divs. 3K and 3L but it was very scarce in Div. 3M. The cod from this age-group were distributed mainly in areas where bottom temperatures were 1-3°C.

In the shallow waters of the Grand Bank the bottom temperatures were usually about 1-2°C at insignificant inflow of warm waters over the southeastern slope. Negative temperatures (to -1°C) were registered mainly over the Grand Bank northern slope. In 1990 the lower heat content of the Grand Bank Shallows compared with that in 1988 and 1989 was registered. The temperature range within which cod were found in catches was small in Divs. 3NO and the least - in 3M (Fig. 10).

Recalculations of length frequences in catches resulted in estimation of mean depth of capture of cod of a definite age in various areas (Fig. 11). The calculations included depths of bottom haulings where cod of a definite age were taken.

Form the results obtained it should be noted that the mean depth of distribution of yearlings in Div. 3O is less than that in 3N. In all the areas mentioned mean depth of cod catches increased with the increase of cod age, but for fish at age 5+ and older the mean depth decreased, excluding Div. 3M. This may be related to more active migration of older age-groups of cod searching for food, in particular, capelin, and also to migrations during the prespawning period.

Yearlings had a wider range of confidence interval (95%), which may be explained by a small number of observations during the three years that constituted 33, 17, 14, 34 and 11 for Divs. 3M, 3N, 3O, 3L and 3K, respectively.

CONCLUSIONS

It should be noted that catches of cod at age 1+ in Div. 3K were considerably lower compared with the other Divisions.

At age 2+ cod are distributed in more northerly areas of Div. 3K than at age 1+.

Yearlings from Div. 3O are distributed at lesser depths than those from 3N.

Mean depth of cod catches increases with age of cod, i.e. older cod shift into deeper layers.

In all Divisions cod over 5 years are distributed at lesser depths except in Div. 3M.

Table 1. Age samples of cod (individuals) taken in Subarea 3 in 1988-1990

Year	Division			
	3M	3NO	3L	3K
1988	355	579	639	511
1989	294	540	-	375
1990	238	277	415	315

Table 2. Mean length (cm) of cod of various age-groups from age samples (X - mean value, SE - standard error)

Year		3M		3NO		3L		3K	
	Age	$\bar{X}$	SE	$\bar{X}$	SE	$\bar{X}$	SE	$\bar{X}$	SE
1988	1	14.5	0.57	18.4	0.10	14.8	0.31	14.4	0.58
	2	25.5	0.08	23.0	0.07	24.4	0.25	23.7	0.15
	3	35.0	0.11	31.0	0.09	31.5	0.10	33.3	0.13
	4	47.3	0.60	41.0	0.48	39.1	0.14	41.5	0.07
	5	63.8	0.80	49.1	0.72	48.5	0.12	47.9	0.04
	6	71.6	1.46	58.3	0.69	54.7	0.13	54.5	0.63
	7	80.8	2.32	66.7	0.72	62.2	0.14	60.3	0.14
	8	-	-	79.2	0.69	71.3	0.30	65.8	0.40
	9	-	-	93.1	0.85	78.9	0.59	81.3	0.92
	10	-	-	100.4	0.85	94.8	1.10	89.6	1.12
	11	-	-	109.5	1.12	105.6	1.36	89.7	2.06
	12	115.0	-	119.8	1.12	109.3	1.93	-	-
	13	-	-	119.8	3.93	117.0	2.65	118.0	-
	14	-	-	-	-	124.0	1.73	-	-
	15	-	-	-	-	-	-	-	-
	16	-	-	-	-	127.0	-	-	-
1989	1	16.4	0.11	13.0	0.42	-	-	-	-
	2	21.8	0.06	21.6	0.18	-	-	21.6	0.27
	3	35.3	0.06	31.2	0.15	-	-	31.8	0.13
	4	46.2	0.12	40.7	0.26	-	-	41.3	0.08
	5	62.6	0.55	52.4	0.55	-	-	50.5	0.04
	6	75.0	1.00	61.2	0.46	-	-	57.2	0.05
	7	79.0	3.00	69.9	0.35	-	-	62.2	0.08
	8	91.0	5.20	74.8	0.54	-	-	71.2	0.19
	9	100.0	-	82.9	0.98	-	-	81.8	0.27
	10	-	-	91.6	1.21	-	-	86.2	0.28
	11	-	-	101.2	1.59	-	-	93.6	0.41
	12	-	-	108.8	1.41	-	-	94.0	-
	13	-	-	116.6	1.52	-	-	-	-
	14	-	-	119.1	1.48	-	-	-	-
	15	-	-	123.5	2.62	-	-	-	-
	16	-	-	123.0	2.53	-	-	-	-
	17	-	-	127.0	2.12	-	-	-	-
	18	-	-	134.0	4.50	-	-	-	-
1990	1	15.3	0.75	-	-	15.0	1.00	-	-
	2	23.2	0.72	22.3	0.42	23.3	0.23	20.4	0.34
	3	30.1	0.38	29.4	0.44	29.7	0.11	30.1	0.13
	4	46.1	0.29	38.8	0.42	38.4	0.09	39.7	0.09
	5	60.7	0.52	46.9	0.47	47.1	0.10	48.1	0.07
	6	70.0	3.00	55.8	0.79	56.3	0.16	54.9	0.06
	7	-	-	66.8	1.29	60.7	0.24	59.3	0.07
	8	89.0	4.36	77.1	2.12	69.6	0.27	62.1	0.13
	9	88.0	-	89.7	2.47	78.7	0.52	70.7	0.22
	10	-	-	105.9	1.22	86.1	1.47	74.9	0.53
	11	-	-	116.1	1.95	96.7	3.26	84.0	2.00
	12	-	-	118.7	1.58	99.8	2.59	100.0	-
	13	-	-	127.0	3.00	106.4	4.26	-	-
	14	-	-	135.0	4.00	114.3	3.33	100.0	-
	15	-	-	133.0	-	118.0	1.73	-	-
	16	-	-	-	-	118.0	-	-	-
	17	-	-	145.0	-	133.0	-	-	-
	18	-	-	-	-	139.0	-	-	-

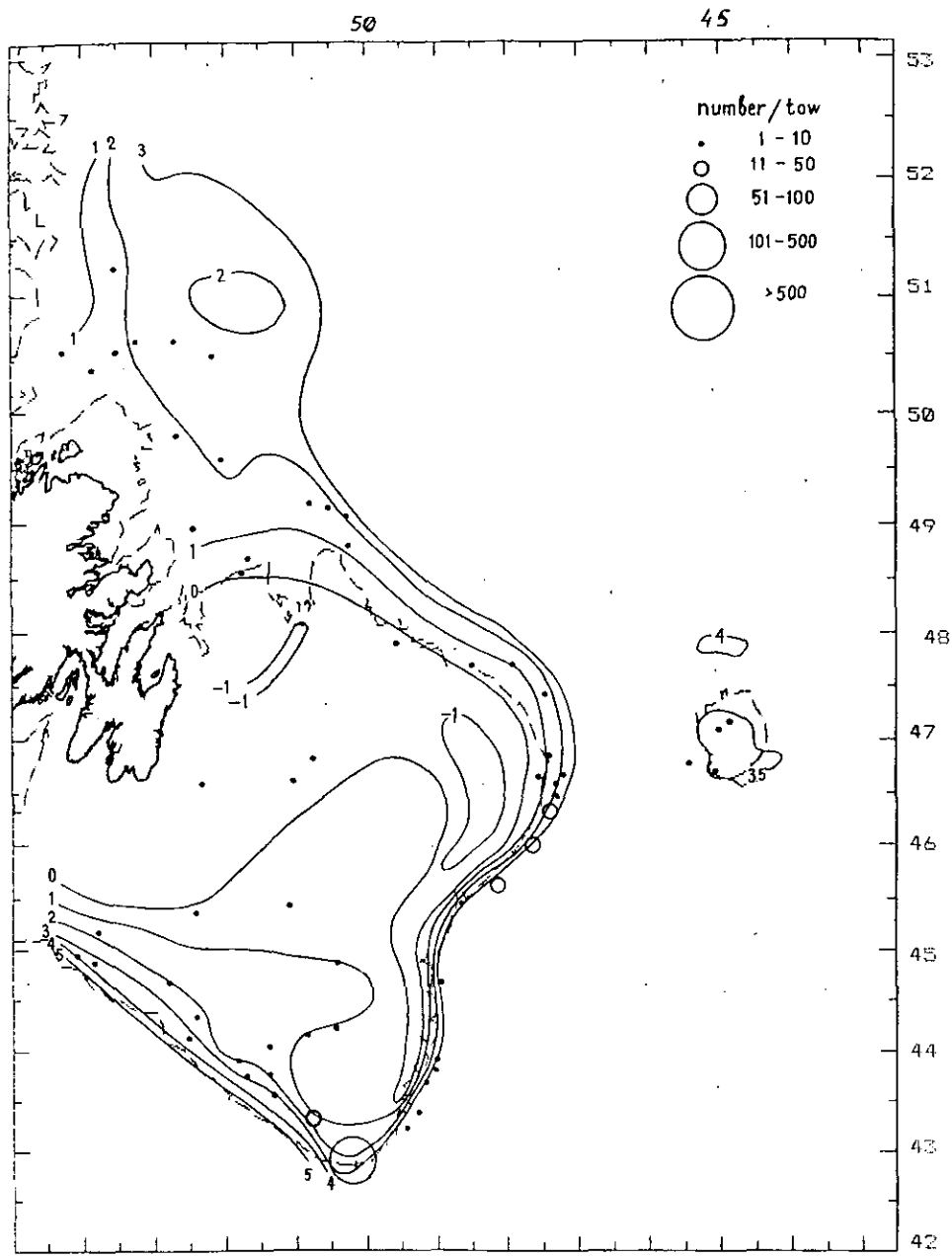

Fig. 1. Distribution of cod catches (specimens per hauling) at age 1 year from the 1988 survey results.
Solid line - bottom temperature isotherm;
Dashed line - 200 m isobath.

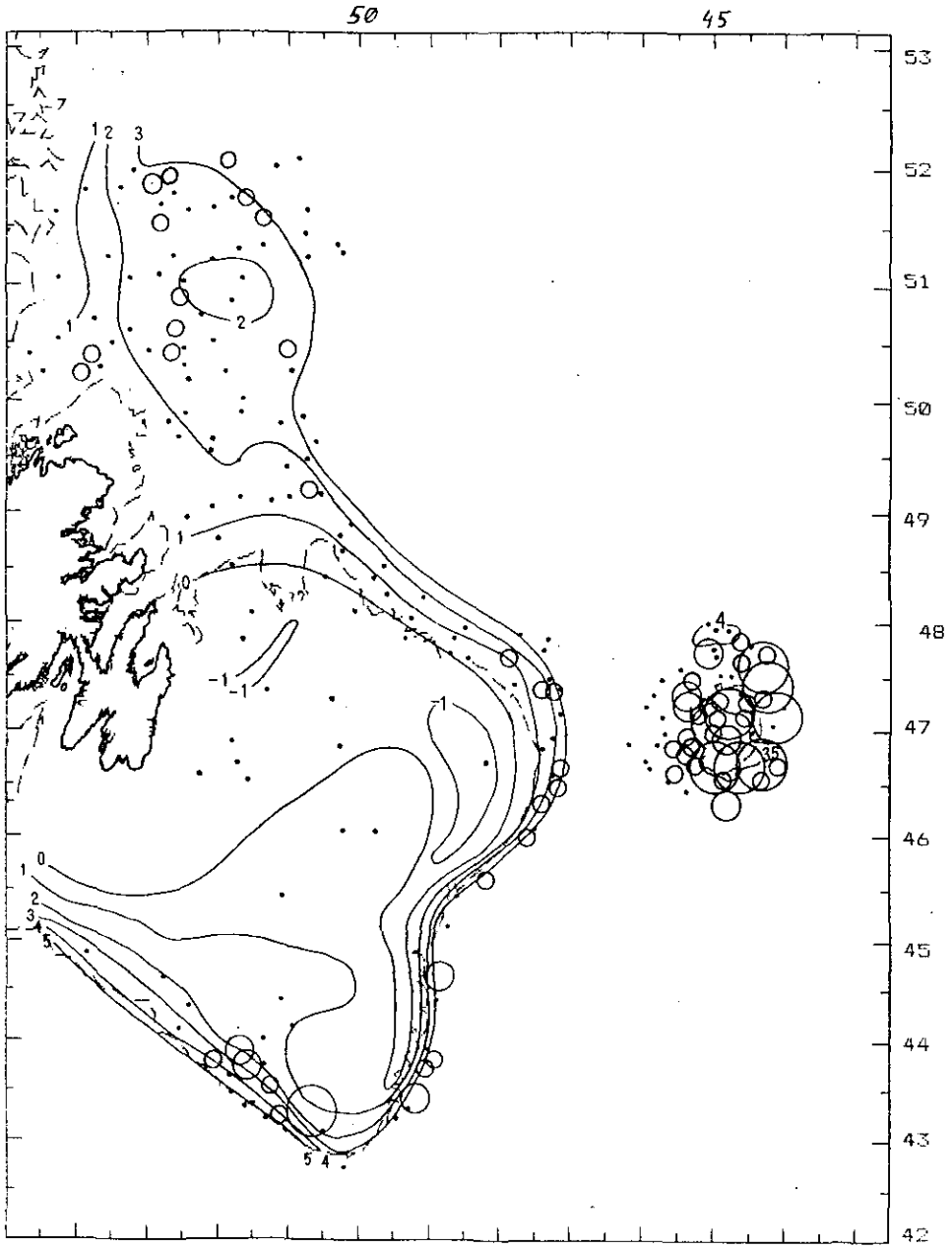

Fig. 2. Distribution of cod catches at age 2 years from the 1988 survey results.
Solid line - bottom temperature isotherm
Dash-line - 200 m isobath

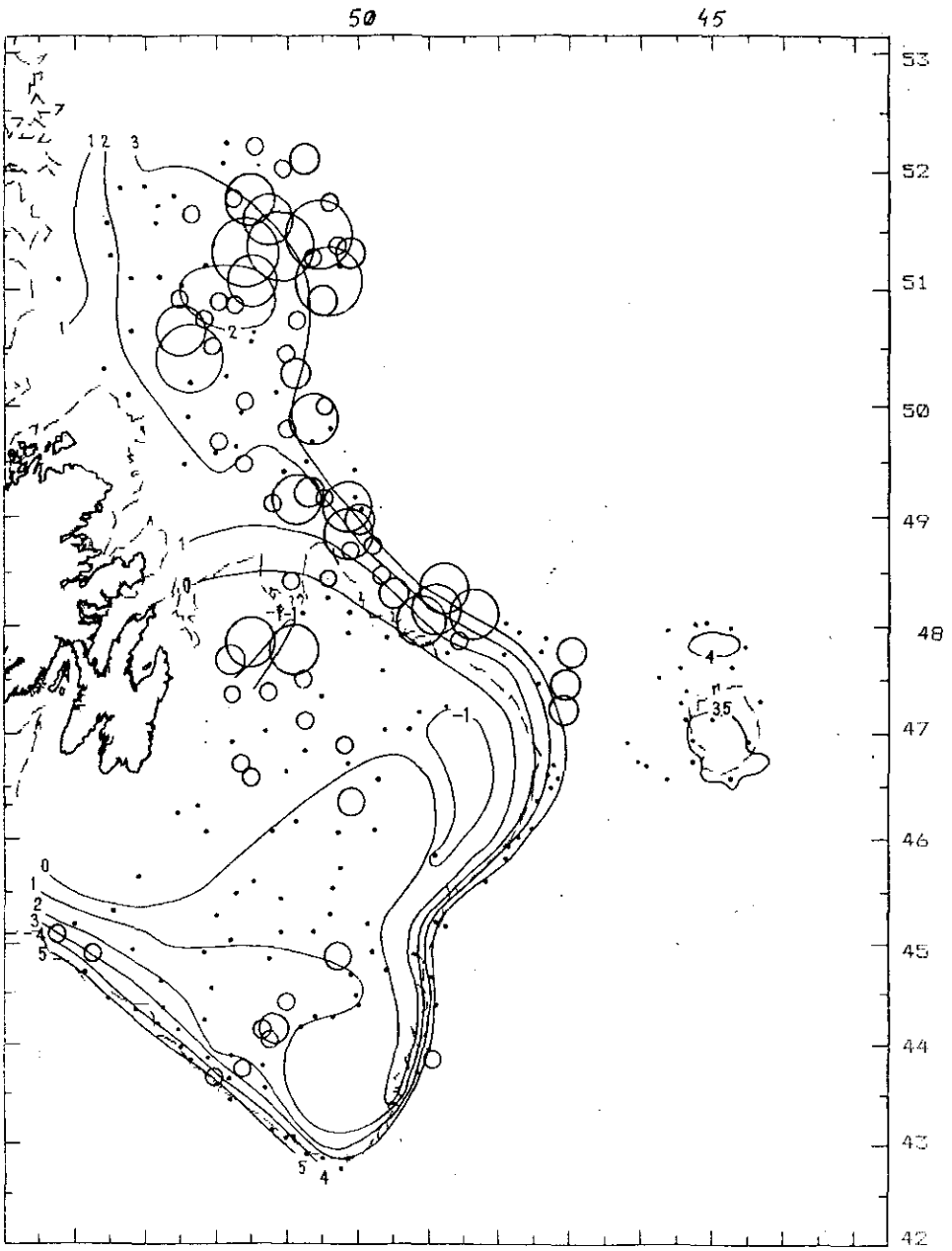

Fig. 3. Distribution of cod catches at age 5+ from the 1988 survey results.
Solid line - bottom temperature isotherm
Dash-line - 200 m isobath

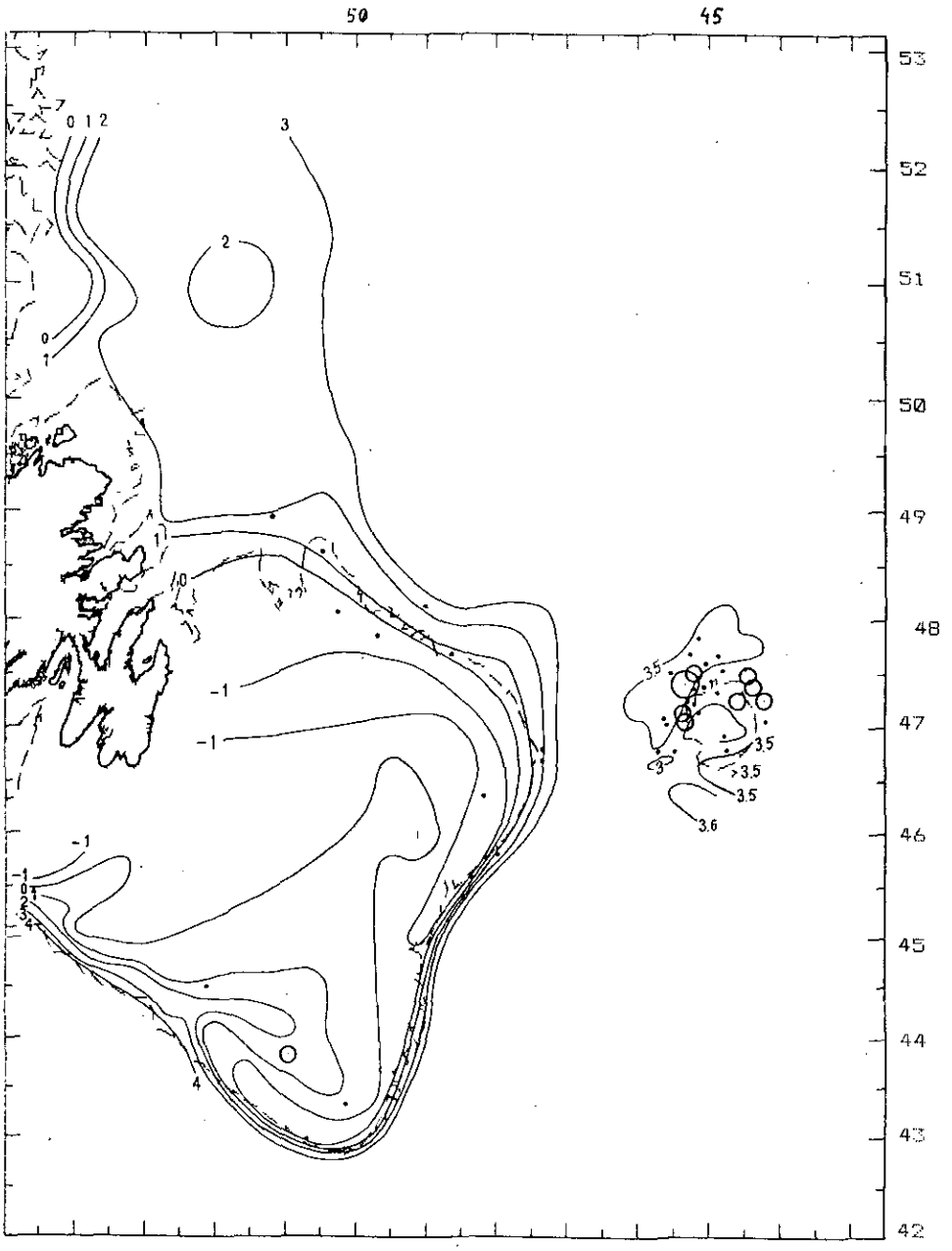

Fig. 4. Distribution of cod catches at age 1+ from the 1989 survey results
Solid line - bottom temperature isotherm
Dash-line - 200m isobath

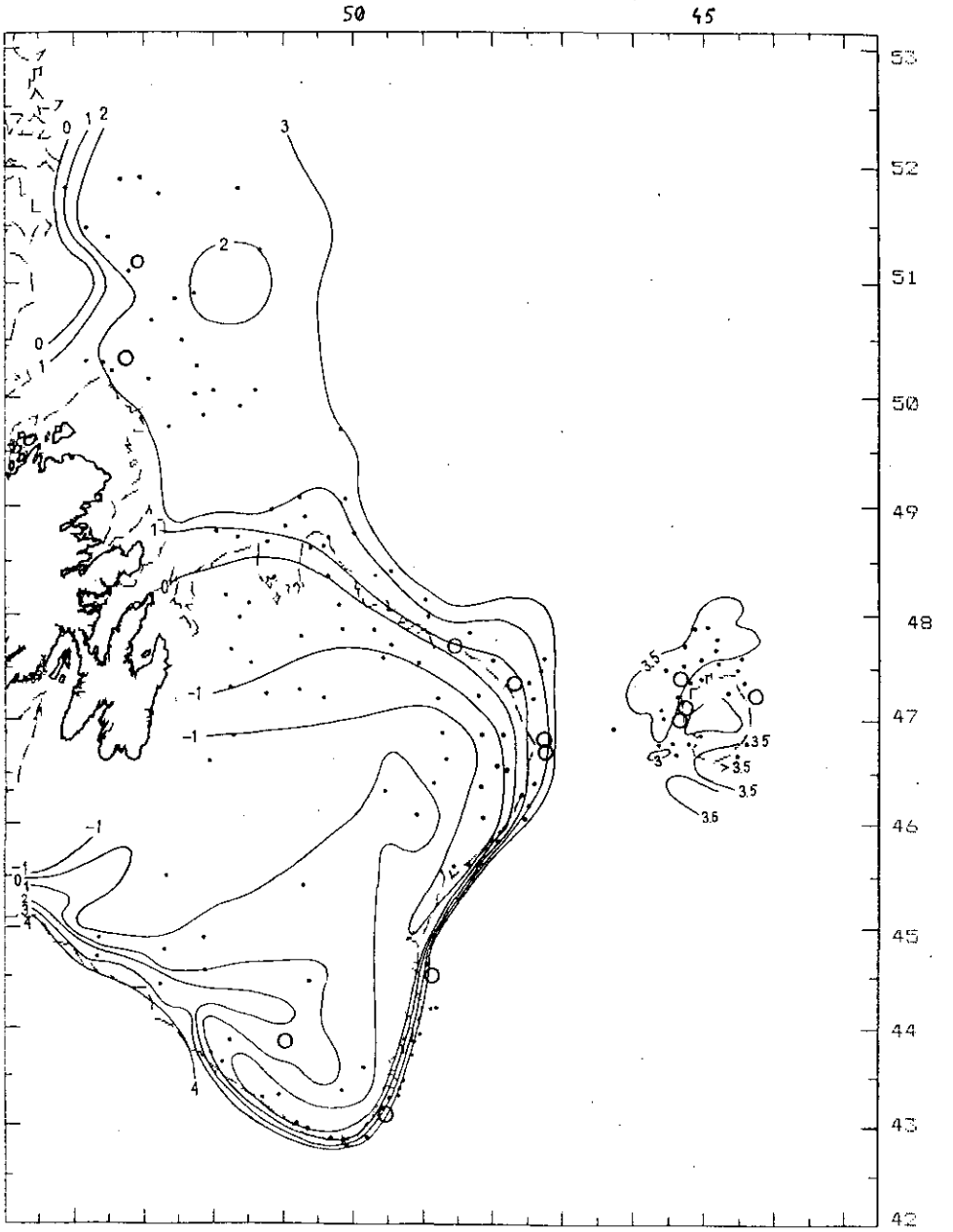

Fig. 5. Distribution of 2-year-old cod catches from the 1989 survey results
Solid line - bottom temperature isotherm
Dash-line - 200 m isobath

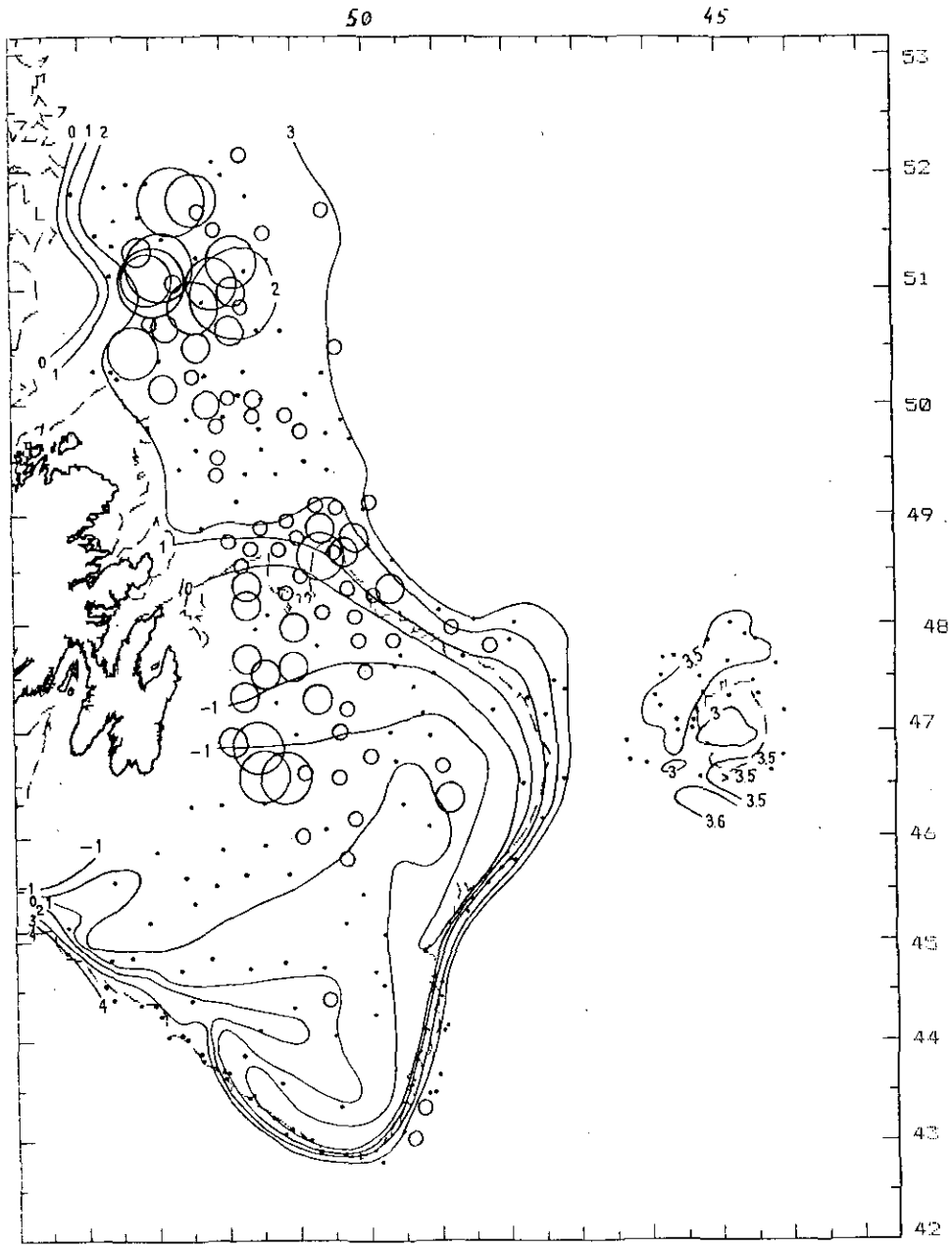

Fig. 6. Distribution of 5+ year-old cod catches from the 1989 survey results
Solid line - bottom temperature isotherm
Dash-line - 200 m isobath

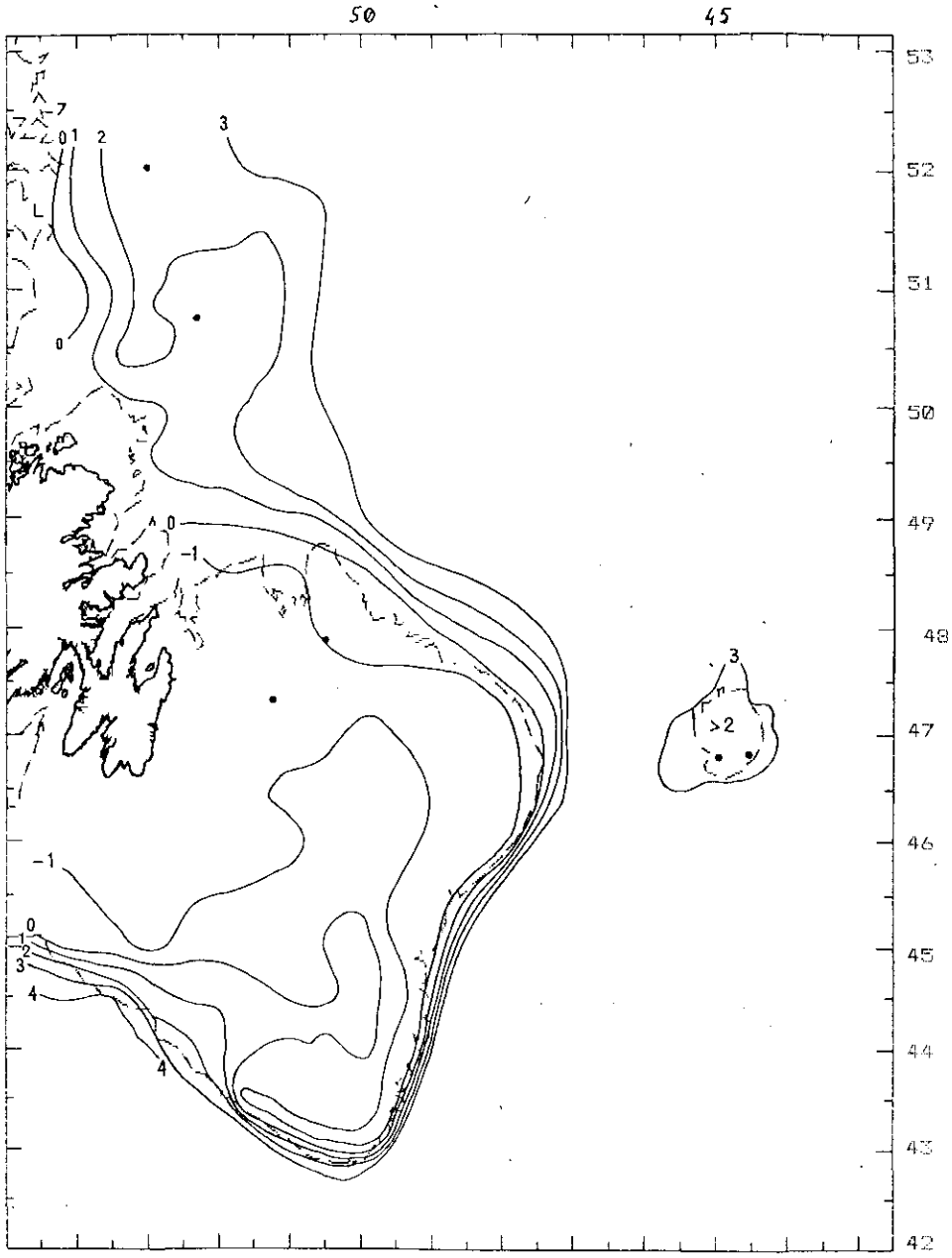

Fig. 7. Distribution of 1-year-old cod catches from the 1990 survey results
Solid line - bottom temperature isotherm
Dash-line - 200 m isobath

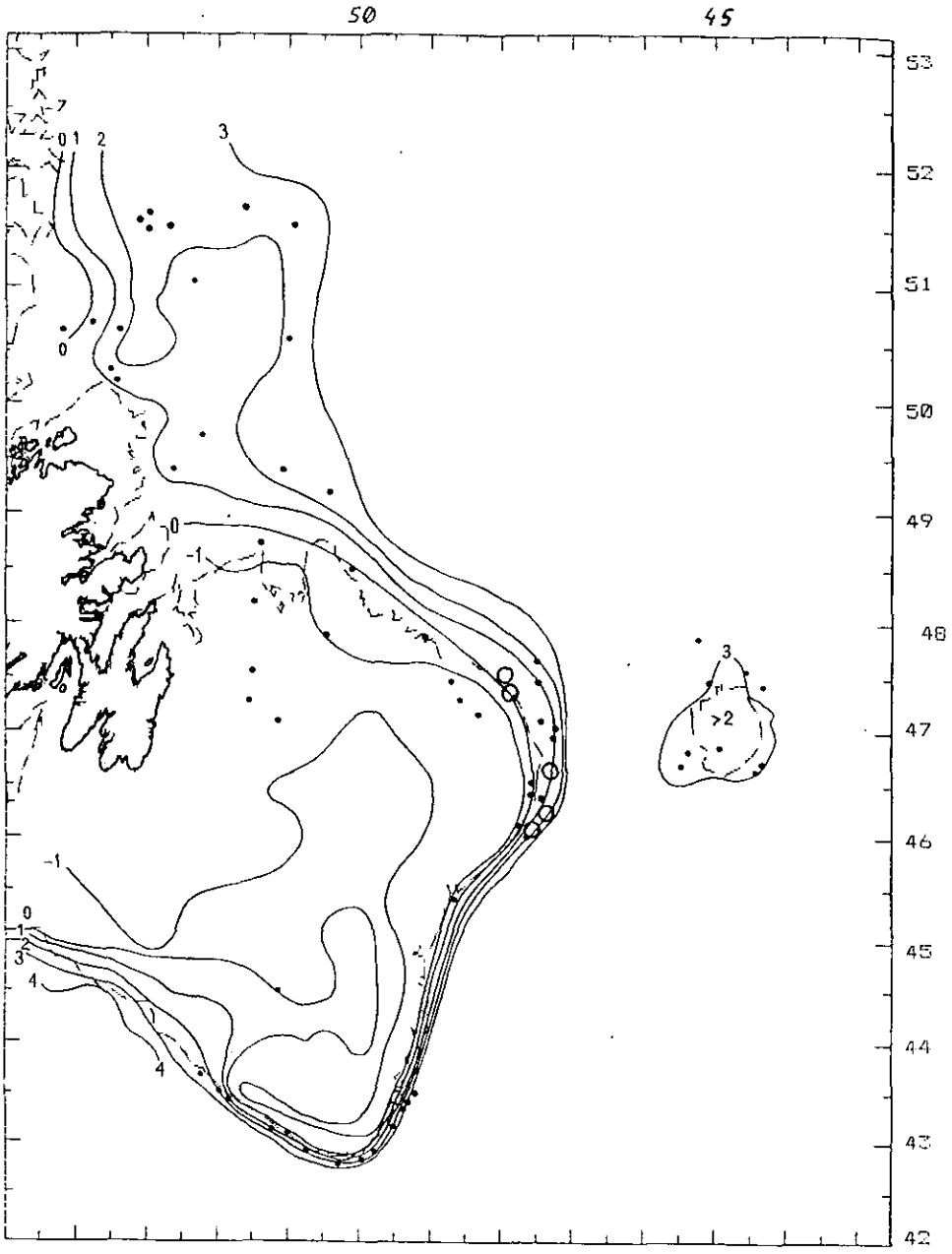

Fig. 8. Distribution of 2-year-old cod catches from the 1990 survey results
Solid line - bottom temperature isotherm
Dash-line - 200 m isobath

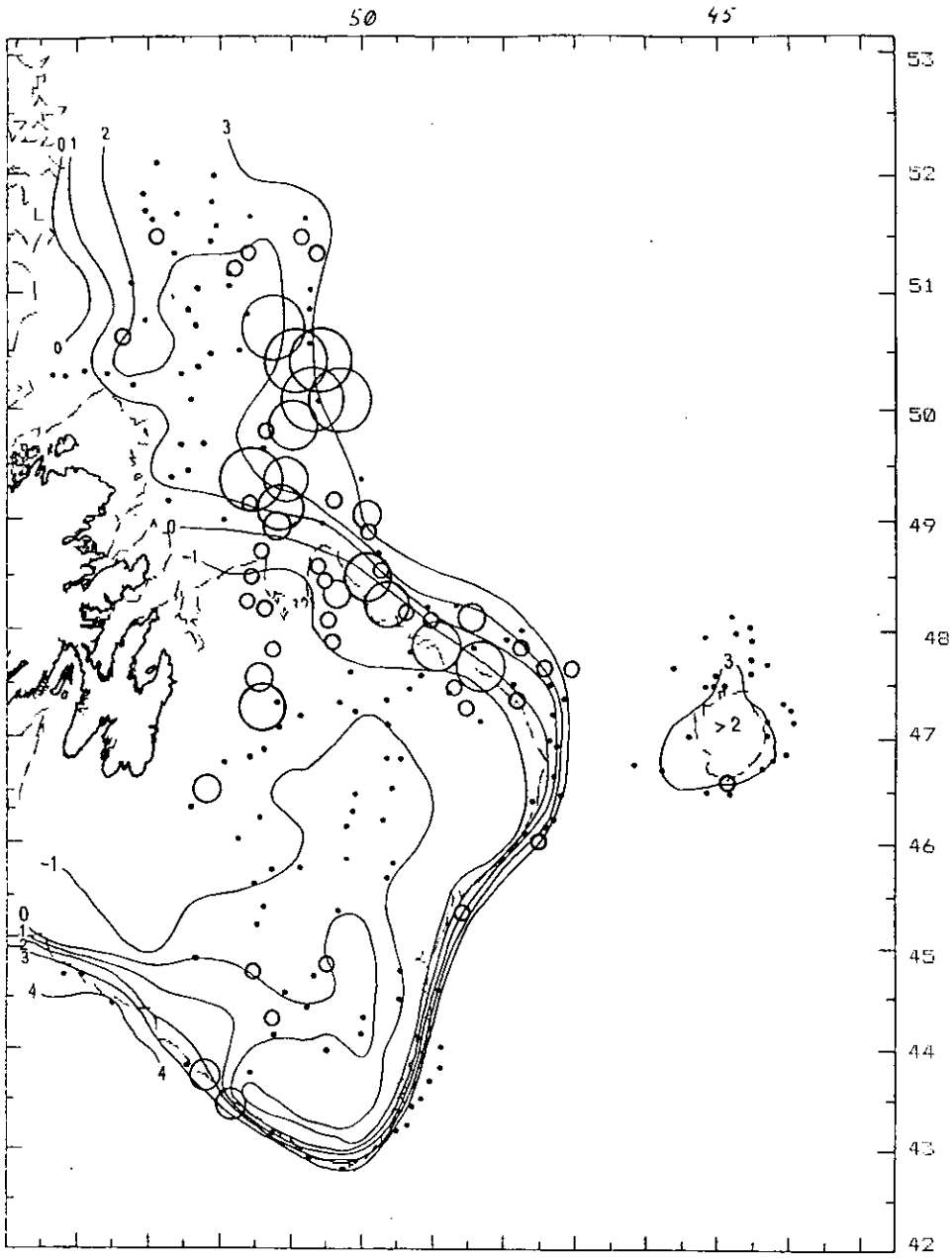

Fig. 9. Distribution of 5+ year-old cod catches from the 1990 survey results
Solid line - bottom temperature isotherm
Dash-line - 200 m isobath

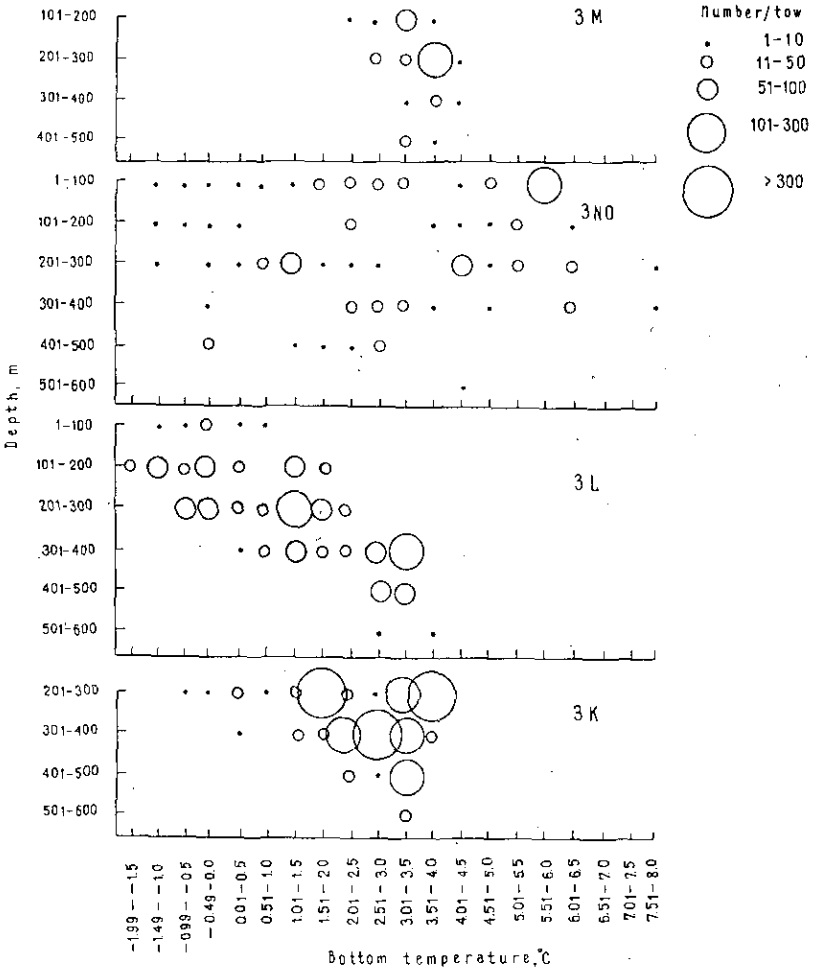

Fig. 10. Mean catches of cod (specimens per hauling) from the 1988-1990 survey results depending on depths and temperatures

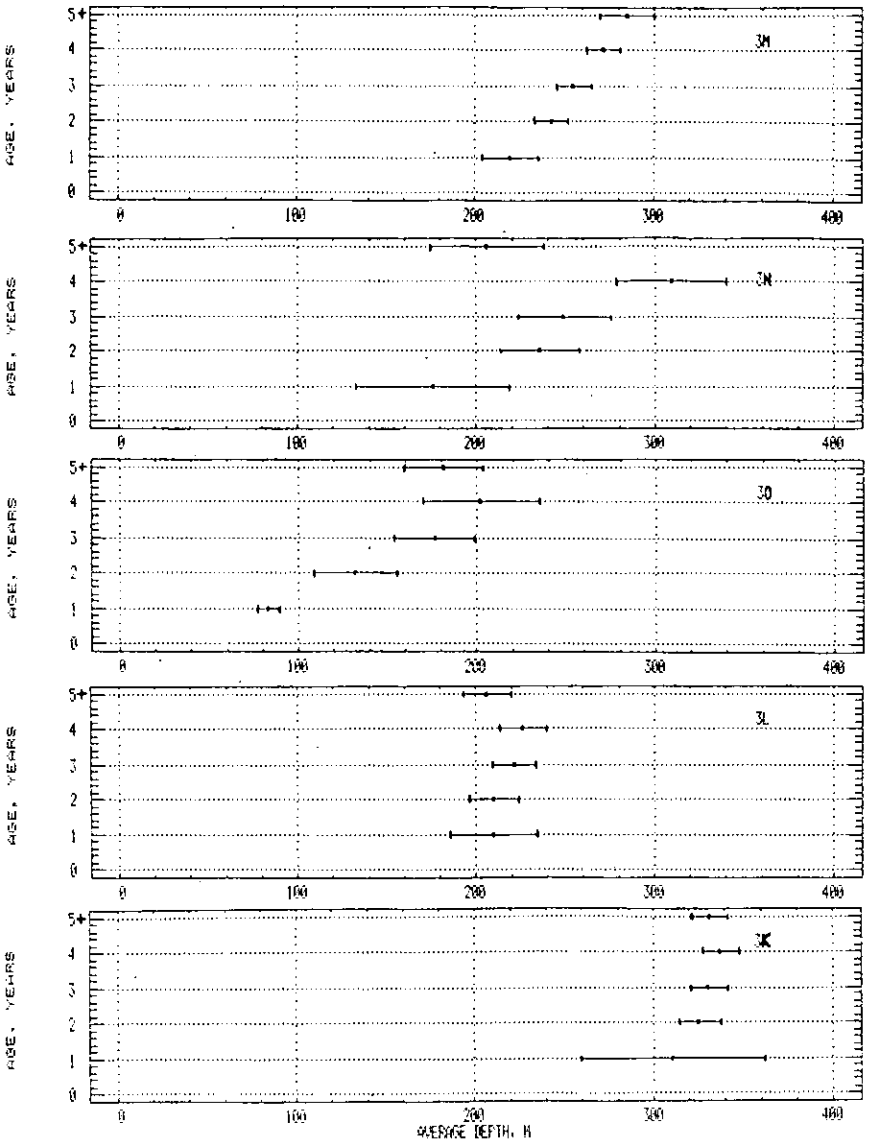

Fig. 11. Mean depths of catches of cod of various age-groups from the 1988-1990 survey results at 95% confidence interval (horizontal line).