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Preliminary assessment of abundance and biomass of cod on
Flemish Cap based on data from trawl surveys in 1972-1977

by

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Abstract

The methods of possible usage of data on the cod relative abundance and biomass for calculation of the absolute abundance and biomass are considered in the paper. The obtained results are confirmed by the data on the size-age and weight compositions. The changes in the cod stocks are explained by the appearance of the abundant year classes.

Introduction

Since 1971 the Polar Research Institute regularly conducts the trawl surveys of demersal fishes in the Newfoundland area. However, without the knowledge of the trawl catchability coefficient one can judge only the changes in the relative abundance and biomass of the investigated objects of fishery.

For the last years the investigations on the improvement of the trawl surveys aimed at the determination of absolute abundance and biomass of demersal fishes are conducted by PINRO (Serebrov, 1973, Chumakov and Serebrov, 1978, in press).

On the basis of the obtained catchability coefficient of the bottom trawl (Chumakov and Serebrov, 1978, in press) an attempt was made in the paper to receive the preliminary assessment of cod abundance and biomass on the Flemish Cap Bank. The methods, being applied for their calculation, permit at present, to register only the fish found on the ground and at a distance of 1.5 - 2.0 m from the

ground, therefore in the next surveys it is quite necessary to determine the possible influence of the diurnal vertical migrations of cod on the obtained results together with the more accurate definition of the trawl catchability coefficient. It is quite obvious that the diurnal vertical migrations of cod can lead to the underestimating of the results on the abundance and biomass assessment.

The aim of the present paper is to test practically the methods of investigations and receipt of the preliminary data with the same accuracy of observations on the abundance, biomass and the level of the cod removal from the Flemish Cap Bank in the period from 1972 to 1977. For carrying out such works this area in every respect is an unique one as an isolated cod stock locates here, that can be completely covered by the survey for a comparatively short period of time within a year.

Material and methods

The total trawl surveys of the demersal fishes on the Flemish Cap Bank were carried out by the FRV "Perseus III" in 1971-1977. About 26 trawlings were annually made on the standard stations with the fixed positions. The trawlings were conducted by the bottom trawl with a small-meshed netting in the codend (a 8 mm mesh size along the side). Each trawling was followed by the water temperature measurement from surface to bottom at depths : 0, 25, 50, 75, 100, 150, 200, 300, 400, 500 m.

According to the methods, all the cod taken in the catch, was completely measured. The age composition is given by enumeration of the data on the age samples on the size composition of fish from the trawl catches while estimating. The volume of the material collected is listed in Table 1.

The specific abundance (in spec.per sq.mile) was calculated for each trawling

$$a = \frac{n \cdot 100}{kf \cdot S} ,$$

where a - specific abundance of cod(in spec.per sq. mile)

n - catch in spec.per hour trawling

kf- catchability coefficient of a trawl, %

S - the square in sq.miles trawled ^{for} one hour

Table 1. Volume of the material collected and terms of conducting the total trawl survey on the Flemish Cap Bank in 1972-1977.

years	Terms of conducting the trawl surveys	Number of trawlings	Number of fish measured
1972	4-7 April	19	1244
1973	15-18 July	20	2161
1974	22-26 August	20	6929
1975	21-24 June	18	9901
1976	10-16 March	19	13167
1977	20-25 April	23	11239

While calculating the square trawled, the following parameters of the bottom trawl were accepted :

1. 100 m horizontal opening of the trawl between the boards
2. Average speed of trawling is 3.4 knots.

It follows that such a square is trawled through for 1 hour:

$$S = 0.1836 \text{ sq.miles}$$

After having calculated the specific abundance for each trawling, the specific biomass was determined :

$$W = Q \cdot P,$$

where P - average mass of 1 specimen in the given catch,

W - specific biomass of cod in kg per sq.mile.

Due to positions, the fish determining trawlings with the given specific biomass were plotted on the chart. The investigated area was divided into zones with the different specific biomass of cod. In this area we succeeded in the singling out of five zones with comparatively similar values of specific biomass (Figs.1-6).

Average values of specific abundance and biomass were found for each zone.

The total abundance and biomass were calculated by formulae :

$$W = W_1 \cdot S_1 + W_2 \cdot S_2 + \dots \dots \dots W_n \cdot S_n ,$$

$$Q = Q_1 \cdot S_1 + Q_2 \cdot S_2 + \dots \dots \dots Q_n \cdot S_n ,$$

where W_1, W_2, \dots, W_n - average specific biomass in zones 1, 2, ..., n;
 Q_1, Q_2, \dots, Q_n - average specific abundance in zone 1, 2, ..., n;
 S_1, S_2, \dots, S_n - square of zones 1, 2, ..., n .

Results of investigations

The main results are listed in Table 2 and agree with the data on the relative abundance and biomass and the total cod yield for these years (Table 3).

Table 2. Indices of abundance and biomass of the Flemish Cap Bank cod by data of the total trawl survey in 1972-1977.

Year	Quantitative indices	Zone					Total
		I	II	III	IV	V	
1972	Square, sq. miles		896.07	7589.82	364.14	89.25	8939.28
	Abundance, thou. spec.	-	7193.8	39939.9	2304.6	-	49138.3
	Biomass, thou. t.	-	21.3	25.8	0.3	-	47.4
1973	Square, sq. miles	-	824.67	7614.81	328.44	89.25	8857.17
	Abundance, thou. spec.	-	26114.0	36504.6	288.7	-	62907.3
	Biomass, thou. t.	-	11.3	26.6	0.2	-	38.1
1974	Square, sq. m. 103.53		628.32	7596.96	481.95	89.25	8900.01
	Abundance, thou. spec. 10629.1		47129.0	112792.8	27494.3	-	198045.2
	Biomass, thou. t. 6.2		15.4	19.8	0.3	-	41.7
1975	Square, sq. miles	-	1824.27	7050.75	-	89.25	8964.27
	Abundance, thou. spec.	-	178960.9	141000.0	-	-	319960.9
	Biomass, thou. t.	-	43.0	28.2	-	-	71.2
1976	Square, sq. m 132.09		1770.72	6226.08	856.80	89.25	9074.94
	Abundance, thou. spec. 57555.0		80666.3	119600.0	1882.8	-	259704.1
	Biomass, thou. t. 25.9		24.2	29.9	0.4	-	80.4
1977	Square, sq. miles 82.11		3369.84	4780.23	-	89.25	8921.43
	Abundance, thou. spec. 34716		121129	64760	-	-	220606
	Biomass, thou. t. 34.4		107.7	21.2	-	-	128.4

Table 3. Indices of the total trawl survey and the cod yield taken by all countries on the Flemish Cap Bank in 1972-1977.

Years	Yield per hour trawling		total yield in thou.t.
	: in spec.	: in kg	
1972	66	75	56.8
1973	108	46	22.9
1974	346	51	24.9
1975	550	121	22.0
1976	693	296	25.0
1977	489	448	

The fluctuations in the abundance and biomass during these years mostly depend upon the changes of abundance of separate year classes. Thus, since 1956, when the Soviet fishing fleet started for the first time the fishery on the Flemish Cap Bank, a series of abundant year classes was observed. According to our data the 1949, 1950, 1953, 1954, 1957, 1958, 1962, 1967, 1968, 1972 and 1973 year classes are referred to be abundant. The 1963 year class can be considered as an average one in strength (Templeman, 1976). It should be noted that approximately in every three years two abundant year classes of cod are to be occurred in succession on the Flemish Cap Bank. We have calculated the abundance and biomass since 1972, when the data on the survey were sufficiently complete and representative.

In 1972 the abundance of cod was the lowest for all years of fish abundance determination (Table 2). 4-5-year-olds of the abundant 1968 and 1967 year classes, but fished off in previous years, and one-year olds of the 1971 year class with a rather low abundance made up the bulk of the catches (Tables 4, 5). The large cod and that of the same size were predominantly caught. The mean length was 40.2 cm (Table 6). Specimens with the length above 51 cm made up 23%. Therefore regardless of the lowest abundance the biomass was higher than that of 1973.

In 1973 the abundance has increased. Small fish of 27-35 cm long (34.6 cm on average) at the age of 2,3 and 4 year of the poor 1969, 1970 and 1971 year classes predominated in the catches, the biomass has decreased.

Table 4. The mean number of cod specimens of different age in the average catch per hour trawling by data of the total trawl survey on the Flemish Cap Bank in 1972-1973.

Age	Year survey					
	1972	1973	1974	1975	1976	1977
I	14	3	229	144	27	5
2	9	21	81	177	77	39
3	2	48	16	137	188	47
4	17	21	8	74	364	202
5	14	9	8	13	34	168
6	4	4	2	3	2	19
7	2	1	1	1	1	4
8	1			1		2
9	1					2
10	1					1
II	1					
Number of spec.	66	107	345	550	693	489

Table 5. Age composition of cod on the Flemish Cap Bank in 1972-1977, % (by data of the total trawl survey).

Age	Year					
	1972	1973	1974	1975	1976	1977
I	20,1	3,1	66,2	26,1	4,0	1,1
2	14,3	19,3	23,3	32,2	11,1	7,9
3	3,3	44,5	4,5	25,0	27,1	9,5
4	26,0	19,1	2,3	13,5	52,5	41,4
5	20,9	8,1	2,2	2,4	4,9	34,4
6	6,4	3,4	0,7	0,5	0,3	3,9
7	3,5	1,2	0,4	0,2	0,1	0,9
8	1,4	0,4	0,2	0,1		0,3
9	1,0	0,3	-	-	-	0,3
10	1,8	0,4	0,1	-	-	0,2
II	1,0	0,2	0,1	-	-	0,1
II	0,3	-	-	-	-	-

Table 6. Average indices of the Flemish Cap Bank cod for 1972-1977.

Years	Mean length (cm)	Average age	Mean weight (g)
1	2	3	4
1972	40.2	3.8	1145
1973	34.6	3.3	532
1974	20.3	1.6	148
1975	26.0	2.4	220
1976	34.5	3.5	427
1977	43.1	4.2	917

In 1974, the recruitment to the stock with the specimens of the abundant 1973 year class has started. However, it was small cod ; specimens no longer than 50 cm made up 97% of the catches. Among these the fish of 15-20 cm long constituted 74%. The average weight was only 148 g. Therefore, in spite of the considerable increasing of the abundance (more than three times), biomass kept on the level ^{of 1973}.

In 1975 the abundance increased owing to the specimens of the strong 1972 and 1973 year classes at the age of 2 and 3 years and one-year olds of the 1974 year class. Besides, the specimens of the 1971 year class at the age of 4 years made up the considerable portion (13,5%). The mean length of cod increased to 26 cm compared to that of 1974, whereas the mean weight increased to 220 g. The biomass increased 1.7 times compared to that of 1974.

In 1976 the abundance of cod decreased and the biomass increased. The specimens of the abundant 1972 and 1973 year classes at the age of 3 and 4 years made up the main part. The weight and the mean length of cod increased. The recruitment to the stock was poor, one-year olds made up only 4% (Table 5).

In 1977 the specimens of the abundant 1973 year class and less abundant 1974 year class at the age of 4 and 5 years prevailed in the stock. The mean length increased considerably and the weight doubled (Table 3). The biomass doubles too, while the abundance was the same. The recruitment with the young specimens at the age of 1-2 years made up only 9% (in 1974 - 89.5%)(Table 5).

Thus, two abundant year classes of 1972 and 1973 appeared on the Flemish Cap Bank in the course of the total trawl survey (Tables 4,5). These year classes have considerably affected the changes of the abundance and biomass observed in 1974 - 1977. In 1979, the fish of these year classes at the age of 6-7 years will make up the bulk of the catches on the Flemish Cap Bank and will determine the abundance of the spawning part of the stock.

Conclusions

1. The data on the total trawl survey with application of the bottom trawl catchability coefficient permitted to calculate the absolute abundance and biomass of the Flemish Cap Bank cod.
2. The absolute abundance of cod increased from 49.4 thou.spec. in 1972 to 320.0 thou.spec. in 1975 and further decreased to 220.6 thou.spec. in 1977. The biomass increased from 38.1 thou. in 1973 to 163.4 thou.t. in 1977.
3. For the years of investigations the stocks increased owing to the recruitment of two rather abundant 1972 and 1973 year classes.

R E F E R E N C E S

- Serebrov, L.I. 1973. Application of the automatic underwater photcamera for studying the behaviour of demersal fishes. "Rybnoye khozyaistvo", No.7.
- Chumakov, A.K. and Serebrov, L.I. 1978. The determination of the catchability coefficient of bottom trawl for cod and Greenland halibut. Ann.Meet. ICNAF (in press).
- Templeman, W. 1976. Biological and Oceanographic Background Flemish Cap as Area for Research in the Research in the Reason for Year-Class Success and Failure in cod and Redfish. Res.Bull.int.Comm.Northw.Atlant.Fish., No.12, p.91-117.

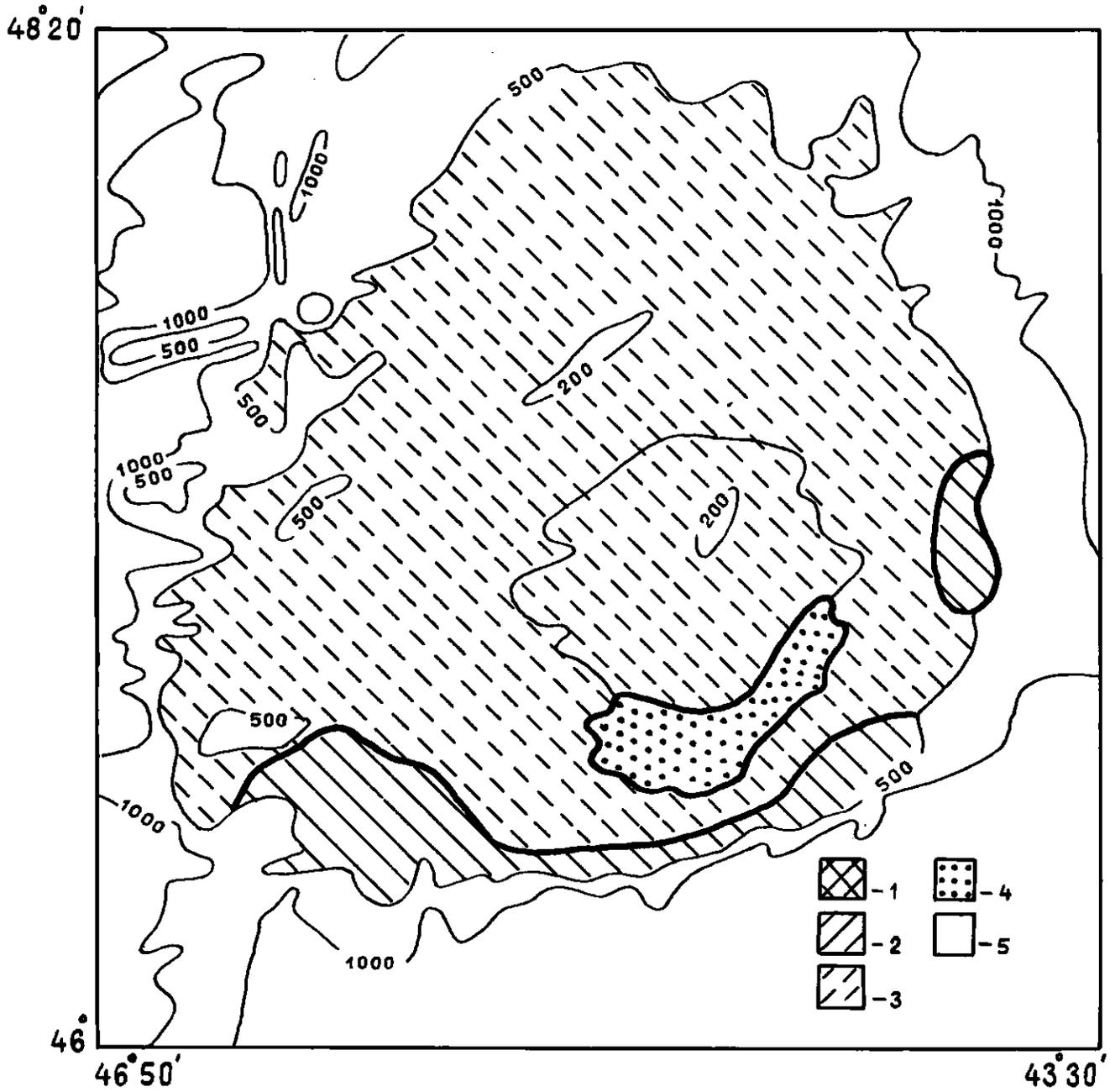


Fig. 1. Zones of specific biomass of the Flemish Cap Bank cod in 1972.

- 1 = >50,000 kg per square mile
- 2 = 10,001-50,000
- 3 = 1,001-10,000
- 4 = 101-1,000
- 5 = 0-100

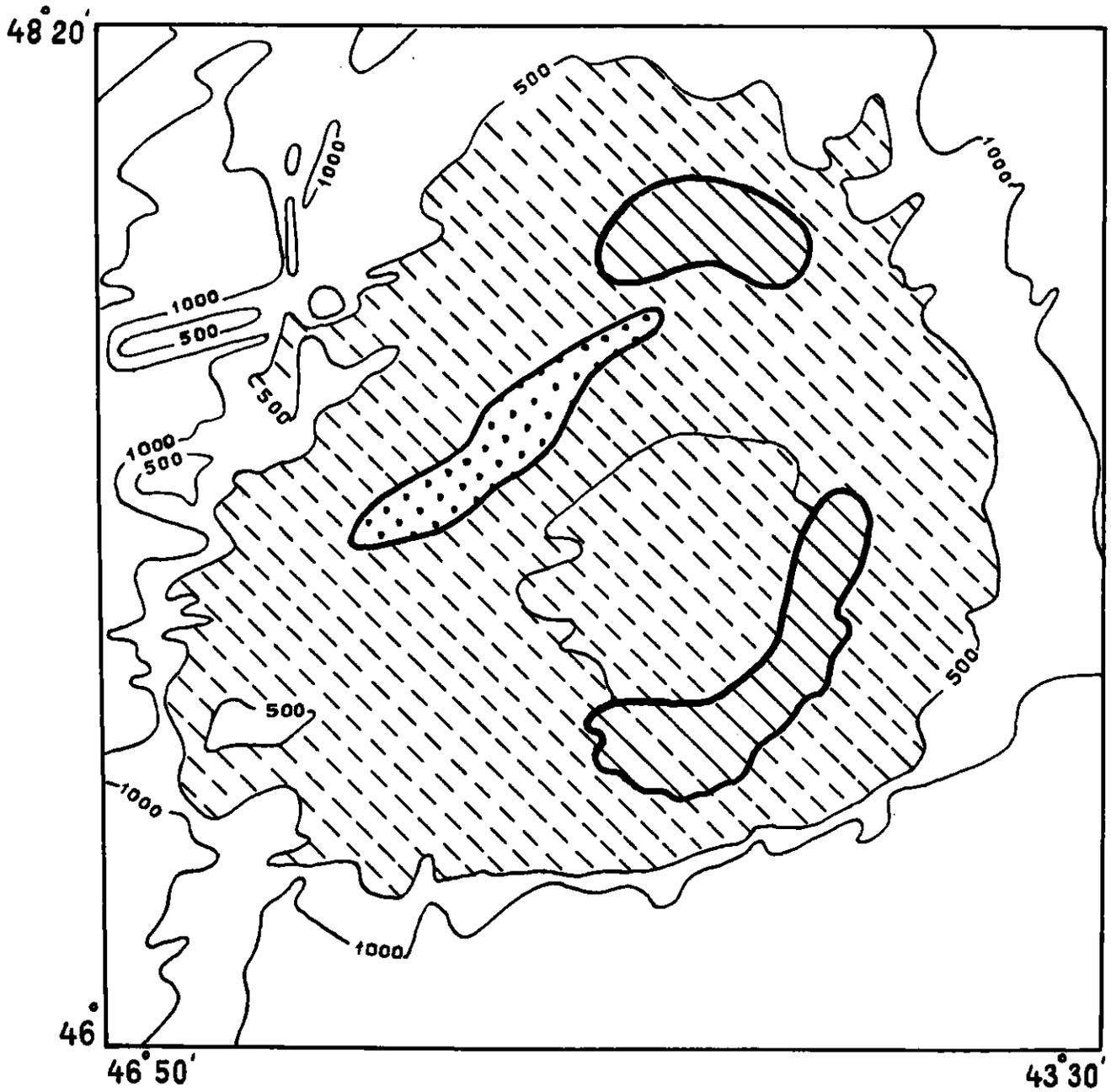


Fig. 2. Zones of specific biomass of the Flemish Cap Bank cod in 1973. (See Fig. 1 for key.)

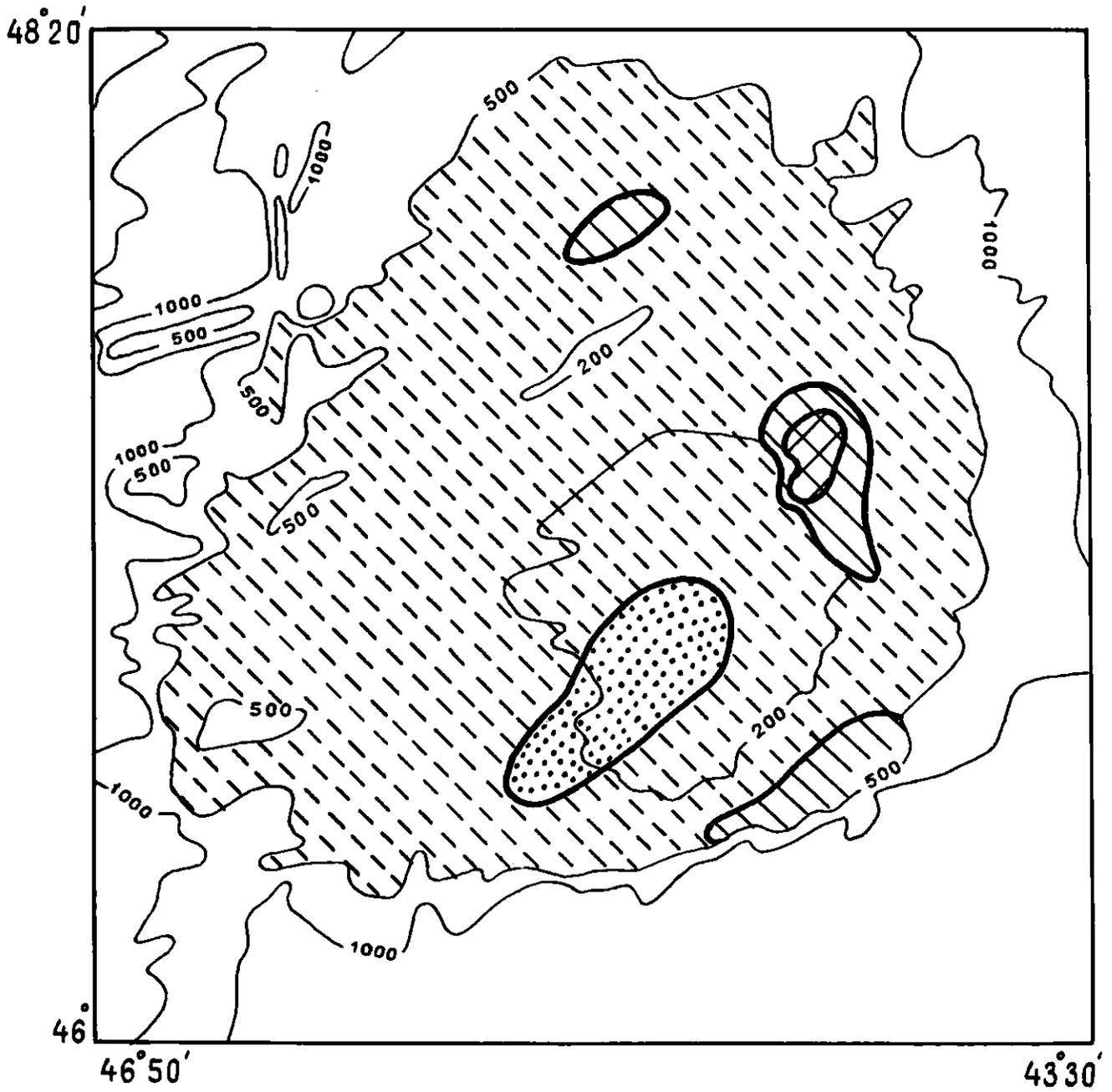


Fig. 3. Zones of specific biomass of the Flemish Cap Bank cod in 1974. (See Fig. 1 for key.)

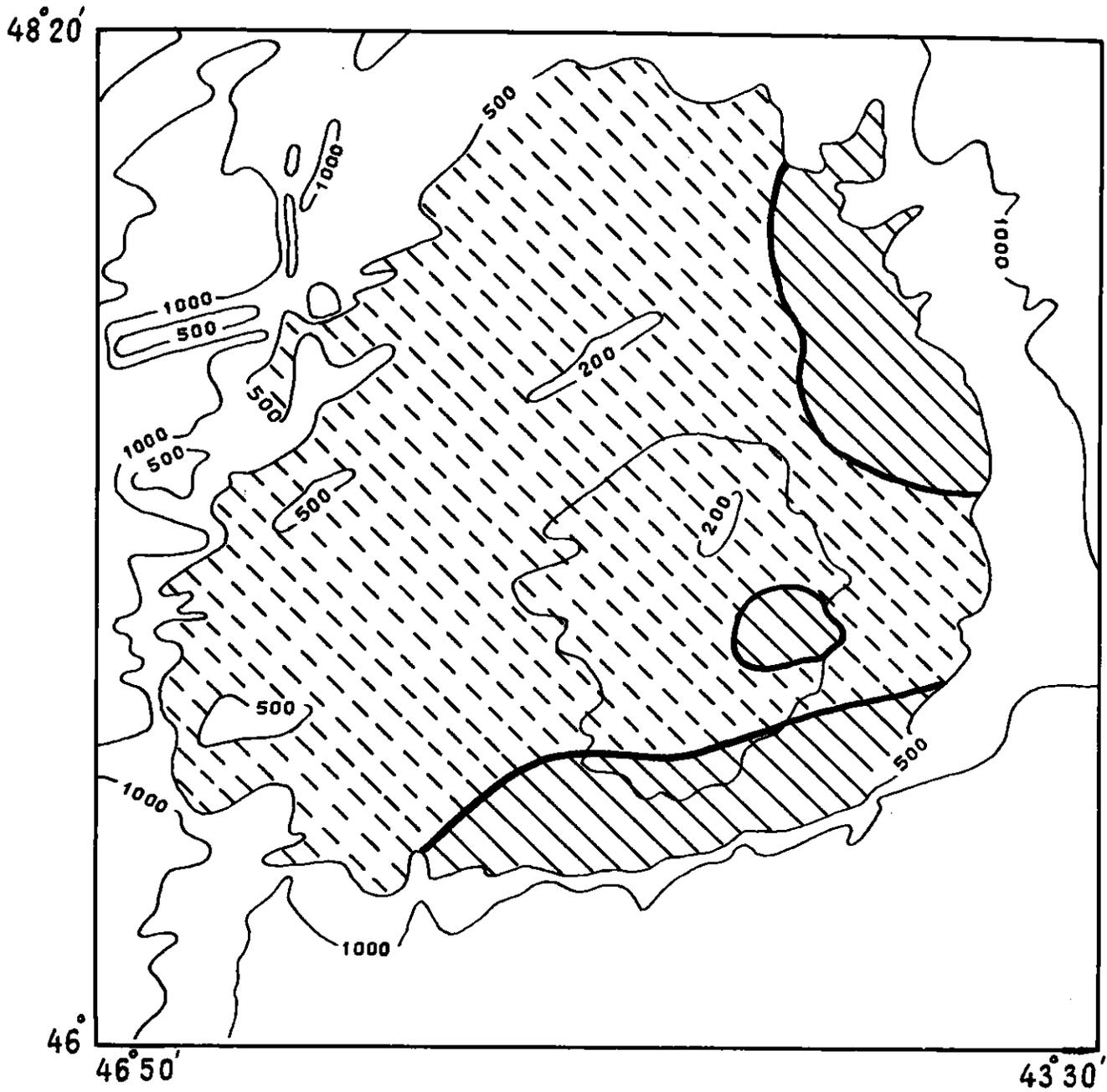


Fig. 4. Zones of specific biomass of the Flemish Cap Bank cod in 1975. (See Fig. 1 for key.)

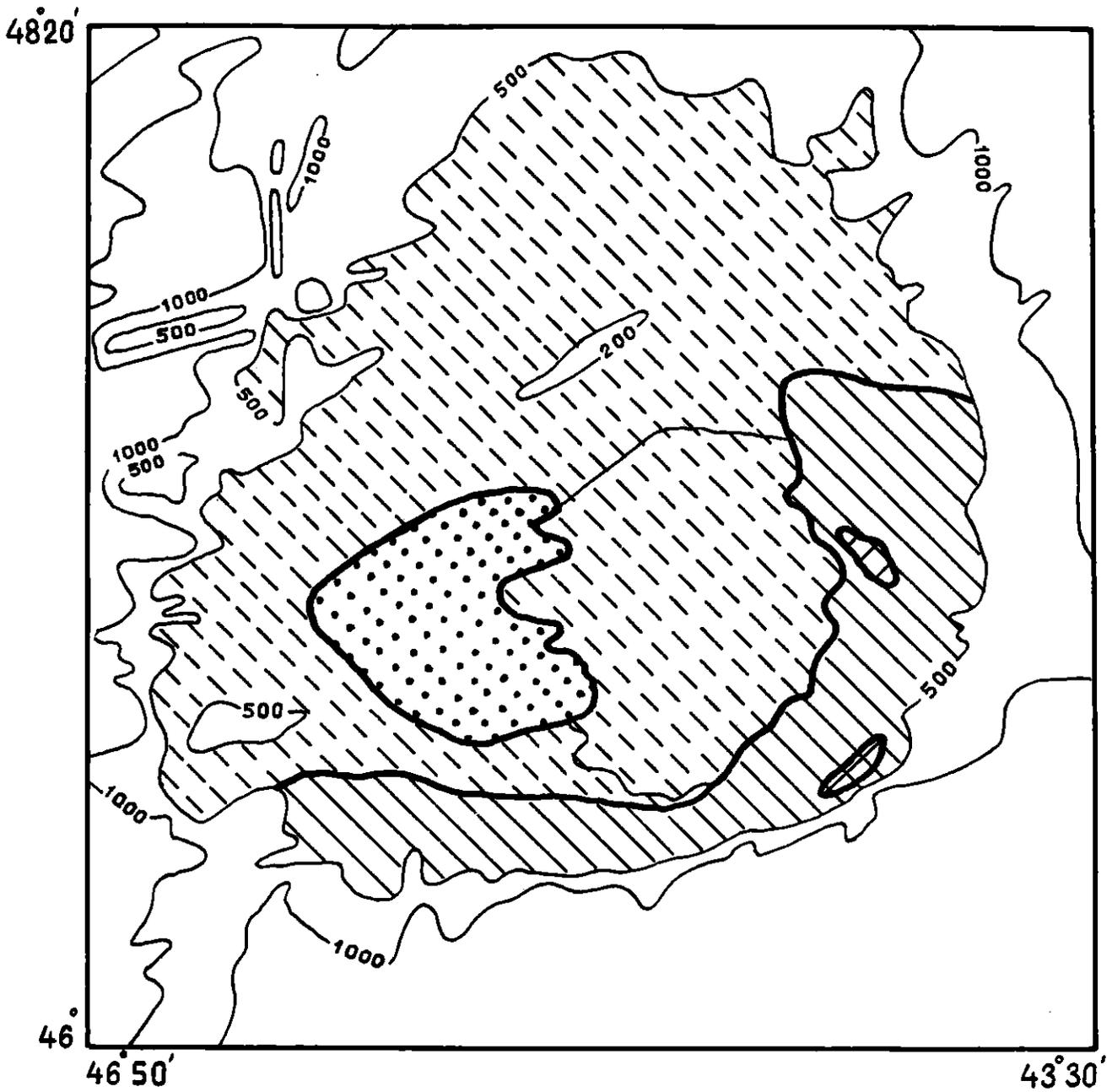


Fig. 5. Zones of specific biomass of the Flemish Cap Bank cod in 1976. (See Fig. 1 for key.)

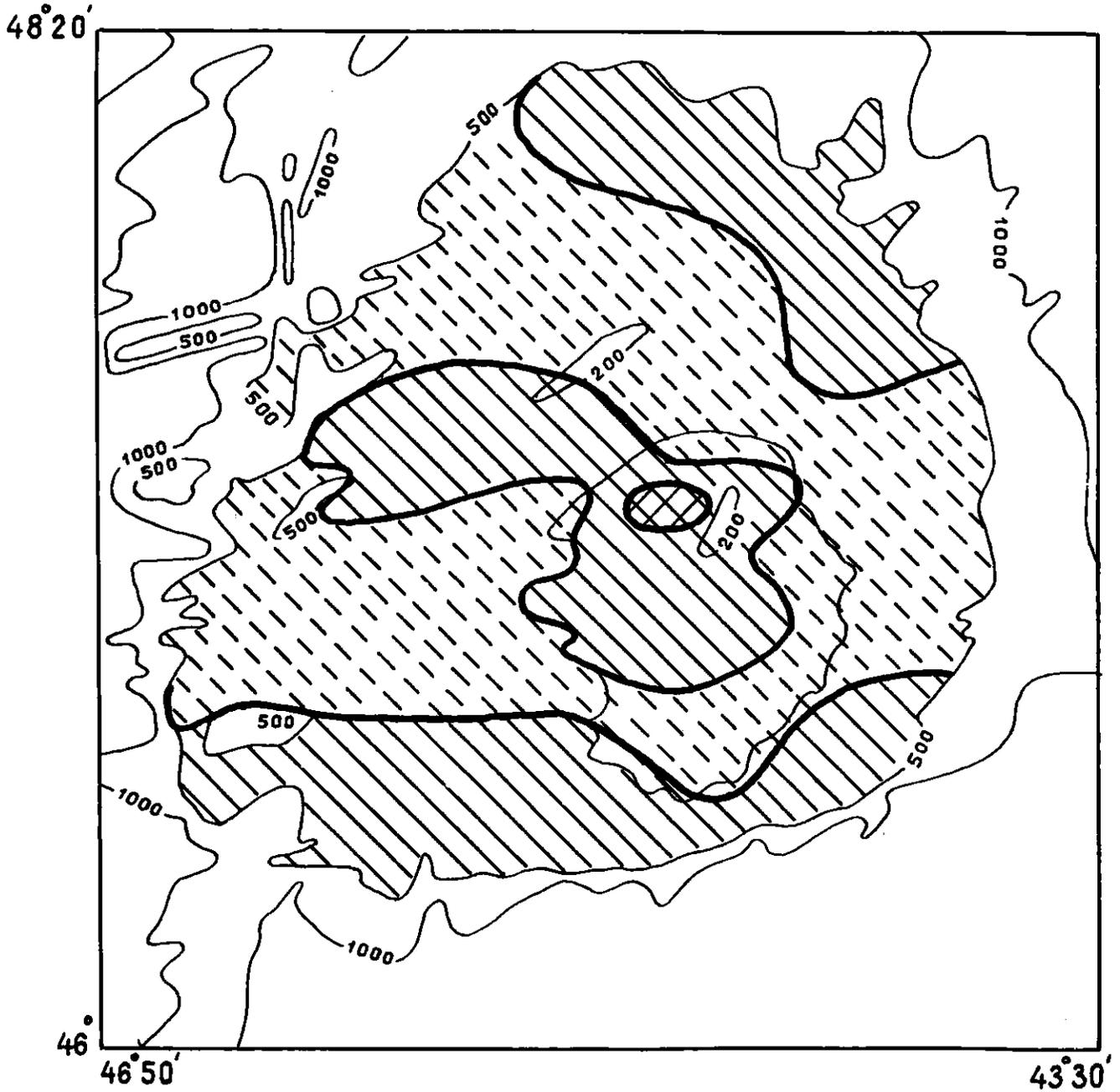


Fig. 6. Zones of specific biomass of the Flemish Cap Bank cod in 1977. (See Fig. 1 for key.)