

Northwest Atlantic



Fisheries Organization

Serial No. N073

NAFO SCR Doc. 80/II/41

SPECIAL MEETING OF SCIENTIFIC COUNCIL - FEBRUARY 1980

Cod Abundance and biomass in Divisions 3NO and 3M According to Data  
from Groundfish Trawl Surveys During 1977-79

by

V. A. Chekhova, A. K. Chumakov, and A. I. Postolaky  
Polar Research Institute of Marine Fisheries and Oceanography (PINRO)  
Murmansk, USSR

Abstract

Results of the trawl survey on the assessment of state of cod stock on the Flemish Cap Bank and Newfoundland stock in Divs. 3NO in 1977-1979 are being considered in the paper.

Total trawl survey data with regard to catchability coefficients of a fish counting trawl and distribution by areas indicate that in 1978 there occurred a sharp reduction of cod biomass on the Flemish Cap Bank, from the maximum value of 163 thou.t in 1977 to 75 thou.t in 1978.

In 1979 the biomass of cod decreased to 67 thou.t and abundance to  $67 \times 10^6$  sp., this resulted from poor recruitment caused by low abundance of the 1975 and 1976 year classes and high fishing mortality of the rich 1972 and 1973 year classes.

According to trawl survey data the biomass of cod in Divs. 3NO in 1977 constituted 284,4 thou.t and abundance  $408,1 \times 10^6$  sp. Notwithstanding a good recruitment of the Newfoundland stock with the rich 1973 and 1975 year classes the abundance and biomass of cod in Divs. 3NO decreased to  $112,2 \times 10^6$  sp. and 96,9 thou.t respectively. Mean catches per trawling hour also indicate a considerable reduction of cod stocks in Divs. 3NO.

## Material and methods

This paper is a continuation and one of the stages in investigations on the assessment of abundance and biomass of commercial fish in the North-West Atlantic which have been conducted by PINRO since 1971.

As in recent years the total trawl survey in 1978-1979 was conducted according to a standard grid of stations. Before 1979 all the investigations were carried out by IRV "Perseus-III" then by large refrigerator trawler "Suloy".

A standard fish counting trawl with a fine-mesh netting inserted into the codend was used in the survey. One hour trawlings were done on a 24-hour basis.

The processing of catches was carried out according to the methods worked out on IRV "Perseus-III" and described in detail in papers by Postolaky A.I. (1972) and Chekhova V.A. (1973, 1975).

Total weight of the catch and mean weight of one specimen were determined from the length frequency and length-weight key.

The total number of fish in the area trawled was calculated from the number of cod (n) in a catch and catchability coefficient (K). Then a specific abundance of cod (Q) in sp./sq.m. was determined.

The catchability coefficient had been calculated earlier as a result of continuous investigations on cod stocks in Labrador area (Chumakov and Serebrov, 1978).

A specific biomass of cod<sup>(W)</sup> was calculated from the weight of one specimen in the catch (P) and specific abundance according to the formula:

$$W = Q \cdot P$$

The methods of calculation of the absolute abundance and biomass had been described in detail in previous papers (Chekhova, Chumakov and Postolaky, 1978; Chumakov, 1979).

### Results of investigations.

#### Cod on the Flemish Cap Bank (Div. 3M).

4-8 year old fish with a length of 40-70 cm made up the bulk

of catches on the Flemish Cap Bank. The dominant age and length depend on the abundance of separate year classes. The 1949, 1950, 1953, 1954, 1957, 1958, 1962, 1968, 1972, 1973 and 1976 year classes are considered rich. It should be noted that every three years two rich successive year classes of cod appear on the Flemish Cap Bank.

Data from total trawl surveys for 1976-1978 (Table 1) indicated that on Flemish Cap the abundance of fish older than 6 was not high. 4-5 year old specimens made up the bulk of catches by research vessels. In March 1979 the abundance of cod at age 6-7 increased considerably and constituted 41,4%.

On Flemish Cap cod mature at age 4, mass maturation is observed at age 6-7. In 1979 almost all fish at age 7 and older participated in the spawning. Specimens of the rich 1972-1974 year classes - two rich year classes (1972, 1973) and one of poor abundance (1974) - make up the bulk of the spawning stock in 1980.

In 1979 compared to 1978 mean catches of cod grew up, but the values of absolute abundance and biomass indicate the further decrease in total stocks.

In March cod were scattered (Fig. 1). Specific biomass from 1 to 10 t/sq.m. was registered on major part of the Bank. Only in some places on the south-eastern slope in the west between isobaths 200 and 300 m and in the north outside the isobath 300 m the biomass exceeded the value of 10 t/sq.m. There were also two patches of a very low biomass (zone V) and three ones with biomass up to 1 t/sq.m.

Total length frequency obtained from all trawlings showed that cod 42-56 cm in length made up the bulk of catches - 49,5% (Fig. 2). Young fish 24-29 cm long constituted only 20,2% and inhabited the depths 100-300 m, mainly in the south-east of the Bank.

Tables 3 and 4 show the estimates of cod abundance and biomass on Flemish Cap according to data from the first (March/April, 1979) and second (June, 1979) trawl surveys. As it is seen from Table 3 the cod biomass during the first survey was 67,2 thou.t and their abundance  $67,4 \times 10^6$  sp.

The second survey <sup>in June</sup> showed that the area with the highest biomass increased slightly due to fish starting to distribute at smaller depths and concentrate on smaller areas (Table 4).

The area of high biomass was between the 200 and 300 m isobaths in the eastern part of the bank. Another area of high biomass was also at the 200 - 300 m depth mainly (division 3N). The cod were scattered over the area near the bank between 300 - 500 m isobaths (Fig. 3).

In June small cod of 23 - 35 cm long ( 48,5% ) predominated everywhere. A number of cod, having the length of 42 - 50 cm, during second survey reduced to 33,6 % (Fig. 2). It evidences that a certain amount of fish was not accessible for the trawl estimation and during second survey was not taken into account.

According to the calculations data absolute abundance and cod biomass were  $57,7 \times 10^6$  spec. and 51,2 thou.t (Table 4).

A comparison of results of the two surveys reveals some differences in both absolute abundance and biomass of cod.

The cod absolute abundance and biomass by the results of the second survey in June turned out to be lower than in March - April and amounted to 57,7 mill.spec. and 51,2 thou.t respectively.

Discovered differences in abundance and biomass estimates of cod by these surveys are, in our point of view, quite natural for the given method makes it possible to take into account only fish which keep on to the bottom or stay close to it but not higher than the hot line of a trawl. We measured the distance between the bottom and a hotline of a fish-counting trawl - it was 2,3 m ( Chumakov and Serebrov, 1978 ).

Thus, we can state that all fish which stay higher than 2,3 m above the bottom can not be taken by the trawl. In this connection one may take the obtained abundance and biomass values of cod for a lower limit of stock size. A degree of accuracy of the existing method of trawl estimation will be, undoubtedly, determined alongside with an accuracy of catchability coefficient and

biological state of concentrations and behaviour of cod and availability or absence of vertical<sup>t</sup> diurnal migrations.

It is known that in March - April cod fishery by bottom trawls on the Flemish Cap Bank is the most efficient. During this period mature specimens of the stock form spawning and postspawning concentrations in the south-west of the Flemish Cap Bank. Immature fish are dispersed throughout the shoal of the bank. On spawning cod move to smaller depths ( Mankevich, Prokhorov, 1962; Postolaky, 1963).

In summer cod feed actively and are distributed mainly on the shoal. The efficiency of trawl fishery during this period, therefore, sharply decreases.

It was established that during foraging period, depending on feeding pattern, cod can perform various types of diurnal vertical migrations which affect the daytime and night catches. ( Konstantinov, Turuk, 1972).

Lower results of second trawl abundance and biomass assessment of cod are, apparently, due to vertical migrations of cod for the survey had been carried out during their foraging.

Consequently, the first survey, carried out in March - April is the most indicative of cod stock state on the Flemish Cap Bank and is the most reliable.

Taking into consideration the fact that during a trawl survey only fish which stay close to the bottom are captured by the trawl, the obtained abundance and biomass estimation of cod will be too low.

According to preliminary calculations ( data on diurnal trawl stations for the previous years ) the existing method of trawl assessment of cod stock reduces the indices of abundance and biomass for a spring survey approximately by 30 - 40 % and for a summer one - by 50 - 60 %. Considering this the total biomass of cod on the Flemish Cap Bank will constitute about 100 thou.t.

Undoubtedly, all-out investigation of this question in future

trawl surveys will be needed for a more accurate and well-substantiated cod stock assessment.

The Grand Newfoundland Bank (Division 3NO)

The Grand Newfoundland Bank is inhabited by a distinct cod stock whose range of distribution stretches southward and south-westerly from the northern extremity of the bank to the Saint Pierre Bank ( Postolaky, 1962, Templeman, 1962 ).

We think it would be baseless to separate cod of a northern part of the Grand Newfoundland Bank (Division 3L) from a southern one ( Division 3N and 3O). No tagged cod from Labrador area and Division 3K were registered in the area of a southern part of the Grand Newfoundland Bank (3L) and vice versa. ( Postolaky, 1967, 1973 ).

The fluctuations in some cod year classes strength on the Grand Newfoundland Bank are considerable. According to the data on cod fry survey an abundant year class may be ten times as large as a poor one.

The 1973 and 1974 3-year-olds are to be considered the richest year classes whereas the 1971 and 1975 year classes relate to those of average abundance.

In 1978 the 1974 year class cod prevailed in catches of the PINRO research vessels, in 1979 - the 1975 year class specimens prevailed (Table 6).

In 1978 the 1973 year class cod predominated in catches on the north-eastern slope of the Grand Newfoundland Bank, in 1979- the 1974 and 1975 year class specimens predominated here.

In 1980 the rich 1974 and the moderate 1975 year class specimens will constitute the bulk of trawl cod catches in Divisions 3NO.

After 1977 the decrease in cod yield per hour trawling (Table 7) is noted on the southern slopes of the Grand Newfoundland Bank (Division 3NO ). In this case we have body weight increments from 621 gr. in 1977 to 928 gr. in 1979 what indicates to poor recruitment to the stock.

During the last two years the areas with dense concentrations of cod ( zones I and II ) became narrower and zone IV with specific biomass from 0,1 to 1 t per square mile extended. In 1979 only three tiny patches with specific biomass from 10 to 50 t per square mile (Fig,5) were located on the shelf in the central and in the north-western parts of Division 3NO. The III, IV mainly and in small patches the V zones were on the shelf. Like in previous years cod dense concentrations ( zone II ) inhabited the eastern slope of Division 3N.

In 1979 the slight increase of cod biomass index was observed in Division 3NO. It seems difficult to estimate the total commercial part of the Newfoundland cod stock because during this time a part of the stock is in the north of the Grand Newfoundland Bank. The obtained results do not however give grounds to think that the total cod biomass in Division 3NO somewhat increased in 1979 after sharp abatement in 1978.

#### References

- Chekhova V.A., 1973. The trawling survey of groundfish in the Newfoundland area. Annu. Meet. int. Comm. Northw. Atlant. Fish. 1973, Res. Doc. No. 40.
- Chekhova V.A., 1975. Trawl survey of Newfoundland area in 1974. Annu. Meet. int. Comm. Northw. Atlant. Fish., Res. Doc. 75/85.
- Chekhova V.A., Chumakov A.K., Postolaky A.I., 1978. Preliminary assessment of abundance and biomass of cod on Flemish Cap based on data from trawl surveys in 1972-1977. Annu. Meet. ICNAF, Res. Doc. 78/VI/27. Serial No. 5188, 14 pp.
- Chumakov A.K., Serebrov L.I., 1978. The determination of the catchability coefficient of bottom trawl for cod and Greenland halibut. Annu. Meet. ICNAF, Res. Doc. 78/VI/24, Serial No. 5185, 8 pp.

- Chumakov A.K., 1979. Abundance and biomass of Greenland halibut in ICNAF Divisions 2J and 3K in November/December 1978. Annu.Meet.ICNAF, Res.Doc.79/VI/103, Serial No.5468, 16 pp.
- Konstantinov K.G., Turuk T.N., 1972. On two types of diurnal vertical migrations of sea fishes. Int.Comm.Northw. Atlant.Fish.Redbook 1972, Part III, 39-43 pp.
- Mankevich E.M., Prokhorov V.S., 1962. On the biology of cod on the Southwestern slope of Flemish Cap. VNIRO-PINRO. Sovetskie rybokhozyaistvennye issledovaniya v severo-zapadnoi chasti Atlanticheskogo okeana. M., s.355-360.
- Postolaky A.I., 1962. Some data on biology of cod from Labrador and Newfoundland areas. VNIRO-PINRO. Sovetskie rybokhozyaistvennye issledovaniya v severo-zapadnoi chasti Atlanticheskogo okeana. M., s.345-354.
- Postolaky A.I., Maleev P.N., 1973. On migrations of cod in Newfoundland areas. "Rybnoe khozyaistvo" No.10, s.8-10.
- Postolaky A.I., 1963. Biology of cod and their fisheries in Labrador and Newfoundland areas. Murmansk, s.50.
- Postolaky A.I., 1967. Results of cod tagging in the areas of Labrador and North Newfoundland Bank (1960-1964). Materialy sessii Uchenogo Soveta PINRO (results of 1964), Murmansk, s. 80-90.
- Postolaky A.I., 1972. Preliminary results of Quantitative analysis of commercial fish in Subarea 3 in 1971. Annu.Meet.ICNAF Res.Doc.72/106, Serial No.2832.



Table 1. Age composition of cod on Flemish Cap (%) in catches by research vessels in 1976-1979.

| Year<br>&<br>month | Age, years |      |      |      |      |      |      |      |     |     |     |     |     | n    |
|--------------------|------------|------|------|------|------|------|------|------|-----|-----|-----|-----|-----|------|
|                    | I          | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9   | 10  | 11  | 12  | 13  |      |
| 1976,<br>March     | -          | 0,5  | 13,2 | 62,3 | 21,0 | 2,0  | 0,75 | 0,25 | -   | -   | -   | -   | -   | 400  |
| 1977,<br>April     | 0,4        | 9,4  | 22,4 | 27,0 | 33,4 | 4,8  | 1,0  | 0,4  | 0,6 | 0,4 | 0,2 | -   | -   | 500  |
| 1978,<br>July      | -          | 0,7  | 14,7 | 36,4 | 40,6 | 6,3  | 1,0  | -    | -   | 0,3 | -   | -   | -   | 300  |
| 1979*,<br>March    | 0,6        | 11,3 | 20,6 | 8,2  | 13,4 | 26,3 | 15,1 | 3,7  | 0,4 | 0,1 | 0,1 | 0,1 | 0,1 | 2188 |
| 1979,<br>June      | 0,7        | 6,7  | 11,3 | 39,3 | 30,7 | 8,0  | 2,7  | 0,7  | -   | -   | -   | -   | -   | 300  |

\* Sample for march was recalculated with regard to length composition of cod.

Table 2. Mean catches of cod (kg and sp. per trawling hour) on Flemish Cap according to data from the total trawl survey for 1972-1979.

| Relative indexes<br>of<br>stocks           | Year |      |      |      |      |      |      |      |
|--|------|------|------|------|------|------|------|------|
|  | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 |
| Catch in specimens<br>per trawling hour    | 66   | 108  | 346  | 550  | 693  | 480  | 95   | 122  |
| Catch weight<br>in kg per trawling<br>hour | 75   | 57   | 51   | 121  | 296  | 448  | 70   | 108  |

Table 3. Distribution of cod by zones with different density  
in Flemish Cap area according to data from the total trawl  
survey in March/April 1979.

| Zone  | Area,<br>sq.m. | Mean<br>specific<br>biomass, kg | Mean<br>specific<br>abundance, sp. | Absolute<br>biomass,<br>thou.t | Absolute<br>abundance,<br>sp.x10 <sup>5</sup> |
|-------|----------------|---------------------------------|------------------------------------|--------------------------------|---|
| I     | 33,48          | 56330,3                         | 58277,0                            | 1,9                            | 2,0   |
| II    | 1643,04        | 25748,9                         | 23234,9                            | 42,3                           | 38,2  |
| III   | 6733,04        | 3396,6                          | 4012,6                             | 22,9                           | 27,0  |
| IV    | 371,52         | 226,1                           | 615,3                              | 0,1                            | 0,2   |
| V     | 218,52         | 48,2                            | 87,9                               | 0,0                            | 0,0   |
| Total | 8999,6         |                                 |                                    | 67,2                           | 67,4  |

Table 4. Distribution of cod by zones with different density  
in Flemish Cap area according to data from the total  
trawl survey in June 1979.

| Zone  | Area,<br>sq.m. | Mean specific<br>biomass,<br>kg | Mean<br>specific<br>abundance, sp. | Absolute<br>biomass,<br>thou.t | Absolute<br>abundance,<br>sp.x10 <sup>5</sup> |
|-------|----------------|---------------------------------|------------------------------------|--------------------------------|---|
| I     | 42,12          | 167297,0                        | 268534,5                           | 7,0                            | 11,3  |
| II    | 1194,84        | 18245,1                         | 21550,1                            | 21,8                           | 25,8  |
| III   | 5606,52        | 4578,1                          | 4131,3                             | 21,1                           | 19,0  |
| IV    | 3120,12        | 420,9                           | 527,4                              | 1,3                            | 1,6   |
| V     | 36,0           | 17,6                            | 87,9                               | 0,0                            | 0,0   |
| Total | 8999,6         |                                 |                                    | 51,2                           | 57,7  |

Table 5. Distribution of cod by zones with different density  
in Flemish Cap area ~~according~~ from the total trawl  
survey in 1977-1979.

| Year | Quantitative<br>indexes          | Z o n e |        |        |       |     | Total  |
|------|----------------------------------|---------|--------|--------|-------|-----|--------|
|      |                                  | I       | II     | III    | IV    | V   |        |
| 1977 | Area, sq.m.                      |         |        |        |       |     |        |
|      | Abundance, sp. x 10 <sup>6</sup> | 82      | 3970   | 4780   | -     | 89  | 8921   |
|      | Biomass, thou.t                  | 34,7    | 121,1  | 64,8   | -     | -   | 220,6  |
|      |                                  | 34      | 108    | 21     | -     | -   | 163    |
| 1978 | Area, sq.m.                      | -       | 1173   | 7221   | 538   | -   | 8932   |
|      | Abundance, sp. x 10 <sup>6</sup> | -       | 48,6   | 28,0   | 3,1   | -   | 70,7   |
|      | Biomass, thou.t                  | -       | 37     | 37     | 1     | -   | 75     |
| 1979 | Area, sq.m.                      | 33,5    | 1643,0 | 6733,0 | 371,5 | 218 | 8999,6 |
|      | Abundance, sp. x 10 <sup>6</sup> | 2,0     | 38,2   | 27,0   | 0,0   |     | 67,4   |
|      | Biomass, thou.t                  | 1,9     | 42,3   | 22,9   | 0,1   | 0,0 | 67,2   |

Table 6. Age composition of cod on the south-eastern slope  
of the Grand Newfoundland Bank (%) in 1978-1979.

| Year | A g e ,   y e a r s |      |      |      |      |     |     |     |   |
|------|---------------------|------|------|------|------|-----|-----|-----|---|
|      | I                   | 2    | 3    | 4    | 5    | 6   | 7   | 8   | 9 |
| 1978 | -                   | 1,0  | 23,8 | 54,8 | 16,9 | 2,3 | 1,2 | -   | - |
| 1979 | 29                  | 13,5 | 24,6 | 31,9 | 19,6 | 4,6 | 2,2 | 0,7 | - |

Table 7. Mean number of specimens and mean catch (kg) of cod per trawling hour according to data from the total trawl survey in Divs. 3N0.

| Year | 3 N |     | 30  |    | 3N 0 |     |
|------|-----|-----|-----|----|------|-----|
|      | sp. | kg  | sp. | kg | sp.  | kg  |
| I977 | 452 | 254 | 70  | 70 | 522  | 324 |
| I978 | I8I | I22 | 43  | 23 | 224  | I45 |
| I979 | I03 | 83  | 22  | 33 | I25  | I16 |

Table 8. Distribution of cod by zones with different density in Divs. 3N0 according to data from the total trawl survey in 1977-1979.

| Year | Quantitative indexes           | Density zones |        |         |        |        | Total   |
|------|--------------------------------|---------------|--------|---------|--------|--------|---------|
|      |                                | I             | II     | III     | IV     | V      |         |
| I977 | Area, sq.m.                    | 252,8         | 9380,2 | 20868,8 | 2440,0 | III8,8 | 34030,6 |
|      | Abundance, sp.x10 <sup>6</sup> | 32,3          | 278,0  | 95,0    | 2,7    | 0,1    | 408,1   |
|      | Biomass, thou.t                | I8,2          | I80,9  | 84,0    | I,2    | 0,1    | 284,4   |
| I978 | Area, sq.m.                    | I57           | I967   | 28669   | 2258   | 98I    | 34032   |
|      | Abundance, sp.x10 <sup>6</sup> | 47,6          | 47,5   | I4,5    | 3,1    | 0,2    | II2,9   |
|      | Biomass, thou.t                | 30,1          | 33,2   | II,9    | I,2    | 0,0    | 76,4    |
| I979 | Area, sq.m.                    | 49            | 857    | I8240   | I4I28  | 758    | 34032   |
|      | Abundance, sp.x10 <sup>6</sup> | 9,2           | I6,1   | 76,1    | 10,4   | 0,4    | II2,2   |
|      | Biomass, thou.t                | 6,0           | 2I,9   | 62,1    | 6,9    | 0,0    | 96,9    |

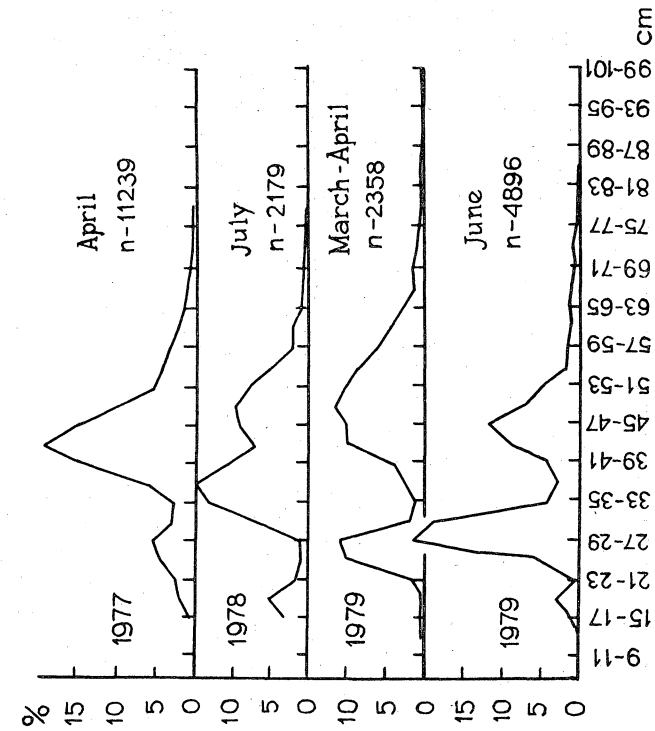


Fig. 2. Length composition of cod on the Flemish Cap Bank according to the data from total trawl survey in 1977-79. (Two surveys were conducted in 1979: in March/April and in June.)

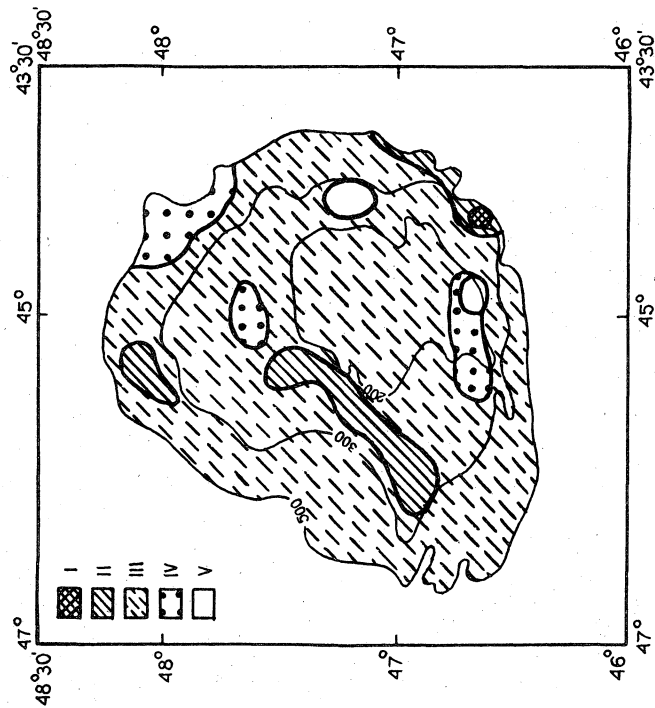


Fig. 1. Zones of cod specific biomass on the Flemish Cap Bank in March/April 1979, in t/sq.m. (I = over 50; II = 10 to 50; III = 1 to 10; IV = 0.1 to 1; V = less than 0.1).

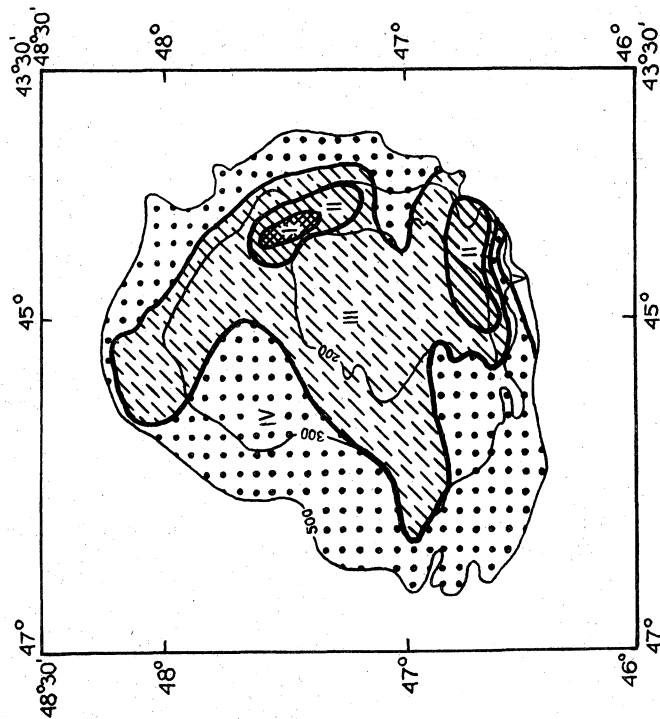


Fig. 3. Zones of cod specific biomass on the Flemish Cap Bank in June 1979 (for symbols see Fig. 1).

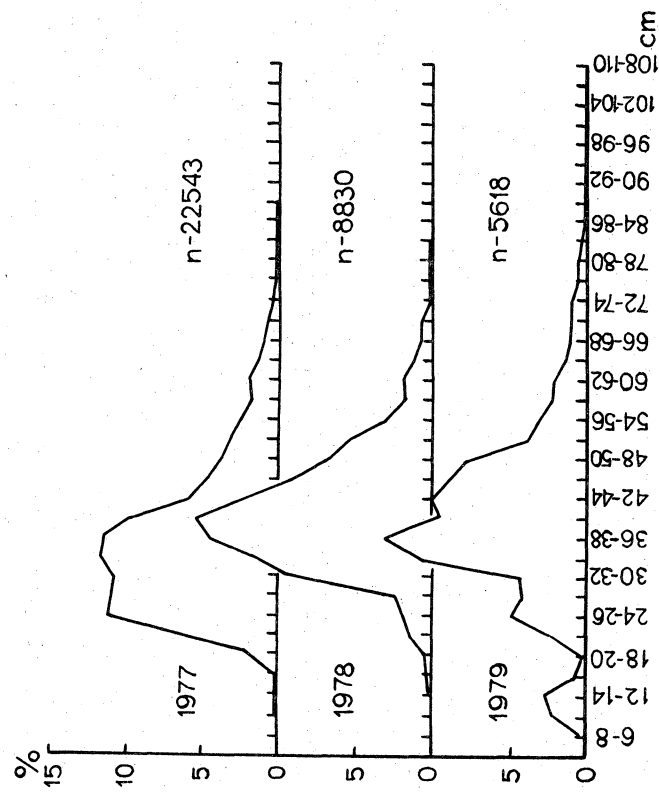


Fig. 4. Length composition of cod on the Grand Newfoundland Bank (Div. 3NO) according to the data from total trawl survey in 1977-1979.

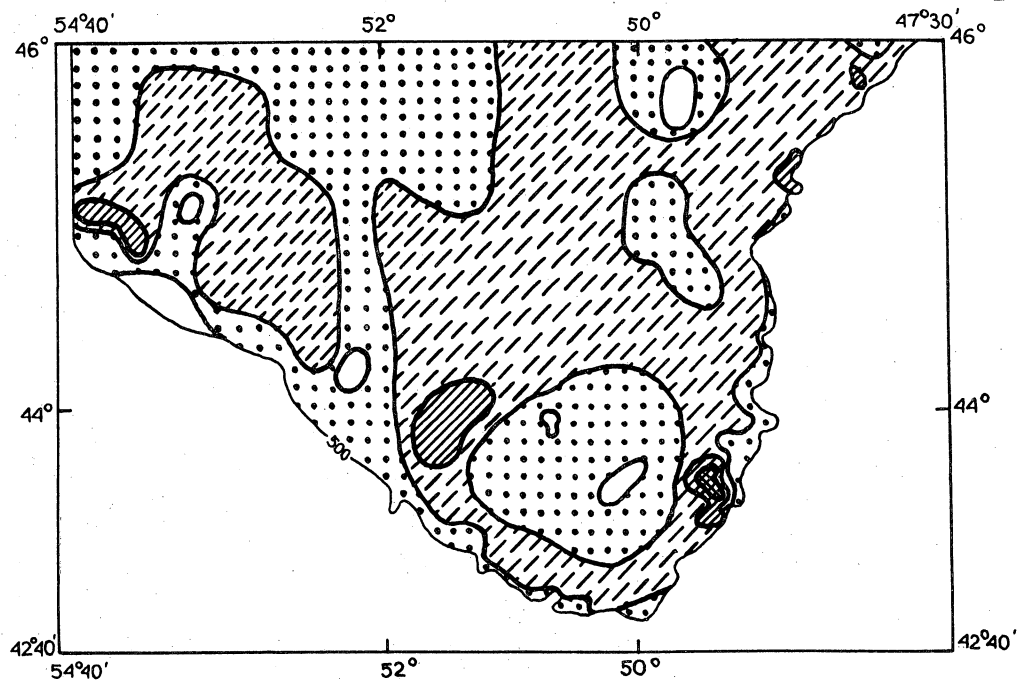


Fig. 5. Zones of cod specific biomass on the Grand Newfoundland Bank (Div. 3NO) in April 1979 (for symbols see Fig. 1).