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Localization of Newfoundland Cod Spawning Grounds During the Stock
Sharp Reduction (From 1978-1991 Russian Survey Data)

by

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Abstract

The paper analyses long-term data on distribution of prespawning cod at different maturity stages in spring and summer in Divs. 3KLNO. It was shown that under conditions of total cod stock reduction having been observed in all the surveyed areas since 1970, mass cod spawning in Divs. 3LNO is registered mainly on the shelf, in the coastal Newfoundland. Now cod almost do not spawn on the Grand Bank slopes. In Div. 3K cod spawning was observed both in the west, in the coastal area, and in the east, on the Funk Island Bank.

Based on the analysis of our and literature data on prespawning cod distribution and dynamics of their maturation we suggest a plot of cod spawning grounds localization on the Newfoundland shelf in the period of their stock sharp reduction.

Introduction

This work should be considered as continuation of the discussion on spawning time and spawning grounds of Labrador and Newfoundland Atlantic cod (*Gadus morhua* L.). Essentially, the problem is as follows.

Summarized by V.P. Serebryakov 1957-1963 data on prespawning Labrador and Newfoundland cod, their eggs and larvae distribution permitted him to conclude that the most intensive cod spawning was observed on the outer slopes, primarily, on the Northern Labrador slope. There were also some cod spawning locations on the shelf but spawning there was not intensive (Serebryakov, 1967). Other authors came to similar conclusions too; on the maps suggested by them the importance of slopes as spawning grounds emphasized stronger than by V.P. Serebryakov (Fitzpatrick & Miller, 1979). However, a more recent generalization of data on distribution of prespawning cod and their maturity stages in 1946-1992 showed the shelf, mainly coastal Newfoundland, to be the main cod spawning area (Hutchings et al., 1993).

In the present paper we tried to analyse peculiarities of prespawning cod distribution in 1978-1991, as well as to reveal possible reasons for the aforementioned differences in conclusions about their main spawning grounds.

Materials and Methods

This paper uses materials on distribution of Atlantic cod and their gonads maturity obtained during spring and summer bottom assessment surveys conducted by Russian specialists in 1978-1991 (Table 1).

Observations over cod gonad development were performed in the sea during analysis of feeding and age sampling. Maturity stages were ranked using a 6-point scale developed by V.P. Sorokin (1957, 1960).

When drawing plots of prespawning cod distribution, four "conditions" characterizing fish in readiness to spawn were established:

- 1 - females on maturity stage III-IV are present in the catch;
- 2 - males on maturity stage V-VI are present in the catch;
- 3 - females on maturity stage V-VI are present in the catch;
- 4 - females on maturity stage V-VI constitute more than a half of total females in the catch.

Values of those "conditions" were plotted geographically onto a regular grid (15'W x 10'N) (Fig. 1). For every point of the regular grid, series of those conditions values were made for 1978-1991. Arithmetical means were used to draw a summarized plot of prespawning cod distribution.

When summarizing data in Div.3K, results of 1978, 1981 and 1983 surveys were excluded from the analysis, because those surveys were conducted later in time when the main portion of mature cod became postspawning.

When drawing histogram characterizing maturation dynamics of cod, we included only mature females. Intermediate maturity stage IV-V was combined with stage IV and that permitted us to compare our results with results obtained by V.P. Serebryakov (1967).

Results and Discussion

The majority of plots drawn by us showed that in Div.3LNO, a process of mature cod concentration in the coastal Newfoundland became more prominent with cod readiness to spawn (Fig.2). Only in single years, mainly in the first half of the study period, females on maturity stages V-VI were observed over the restricted areas of the slope. Comparison of the maps and time of surveys suggested that peak spawning in the coastal Grand Bank was reached in May-June.

A map by V.P. Serebryakov (1967) showed the shelf of Div.3L to be an area where cod spawning was not intensive. However, in the paper by V.P. Serebryakov there was no information on the cod gonad status in Div.3L in May-June that may have caused some underestimation of the shelf importance as cod spawning ground (Fig.3).

Our analysis of cod maturation dynamics showed that prespawning cod (maturity stages III-IV) or postspawning (VI-II maturity stages) were predominant in Div. 3L from April to July (Fig. 4). Abundance of cod with gonads at V-VI maturity stages were relatively low throughout all the study months. It is quite probable, that the most intensive spawning on the shelf is taking place now, mainly within the coastal areas uncovered by Russian surveys.

Localization of cod spawning grounds in Div. 3K requires analysis in detail. Surveys in that area were usually conducted not early than in May. In that period concentrations of prespawning cod were regularly observed in the western part of the area. However, in some years, particularly in April-May 1988, concentrations of females on maturity stages V-VI were clearly recognized in the eastern part of the area, on the Funk Island Bank (Fig. 2).

According to V.P. Serebryakov (1967), the peak of cod spawning in the northern areas including Div. 3K was observed in March-April (Fig. 3). Our data indicated high abundance of females on maturity stage VI in April, May and June (Fig.4). Comparison of time and areas of cod spawning in Div. 3K identified by V.P. Serebryakov (1967) and by us permitted to suggest that cod spawning here was observed twice: in March-April on the Funk Island Bank slopes, in May-June in the coastal Newfoundland.

Summarized plot of cod redistribution according to their redness to spawn once again prove the importance of the Newfoundland coastal areas as spawning grounds (Fig. 5) and it is consistent with the conclusions made by Hutchings et al. (1993). Obviously, at present, The Grand Bank slopes can not be considered as the main spawning areas of cod.

Nevertheless, the above conclusion in no way excludes that in the earlier study periods cod spawned on the Grand bank slopes too. Spawning areas of cod can change their boundaries in dependence on climate and spawning stock size (Marti, 1980).

Assume, that dynamics of cod catches in Divs.3KLNO reflects their stock changes actually (Fig. 6). In this case works by V.P. Serebryakov (1967) corresponded to the period of total intensive growth of cod stock, which was evidently followed by expanding of both their dwelling area and spawning grounds. It is quite probable that in that period cod spawning covered not only the Grand Bank northern slopes but southern ones (Fig. 7, I). Later work devoted to that problem is referred to the period of cod stock maximum values and their maximum spawning intensity on the slopes (Fitzpatrick & Miller, 1979)(Fig. 7, II). Generalization of data for 47 years of observations emerged that prespawning cod occurred both on the slope and on the shelf, but on the shelf their abundance was higher (Hutchings et al., 1993)(Fig.7, III). During our study period cod stock has sharply decreased and stabilized on the low level. Obviously, this process has been followed by reduction of spawning grounds, mainly on the southern slopes of the Grand Bank (Fig. 7, IV).

References

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Table 1 Dates of Research Ground Trawl Surveys
in NAFO Div. 3KLNO in 1978-1991

Year	Division	3N0	3L	3K
1978		10.06-25.06	3.05-10.06	2.07-14.07
1979		8.04-29.04	30.04-13.05	14.05-25.05
1980		8.05- 1.06	5.05- 8.05 2.06-13.06	13.06-21.06
1981		11.06-27.06	8.06-10.06 27.06-11.07	12.07-22.07
1982		3.05-25.05	25.05-11.06	21.06- 1.07
1983		25.05-20.06	26.05- 1.06 1.07-12.07	12.07- 2.08
1984		30.04-30.05	6.06-22.06	23.06-12.07
1985		3.05-15.05	22.04-24.04 17.05-19.05 4.06-17.06	17.06-25.06
1986		19.04-10.05	16.04-19.04 10.05-22.05	22.05-15.06
1987		11.03-13.04	26.04-11.05	11.05- 6.06
1988		17.03- 6.04	7.04-23.04	24.04- 8.05
1989		5.03-21.05	27.04-21.05	5.06-19.06
1990		5.04-26.04	26.04-23.05	1.06-18.06
1991		9.04-27.04	9.05- 6.06	-

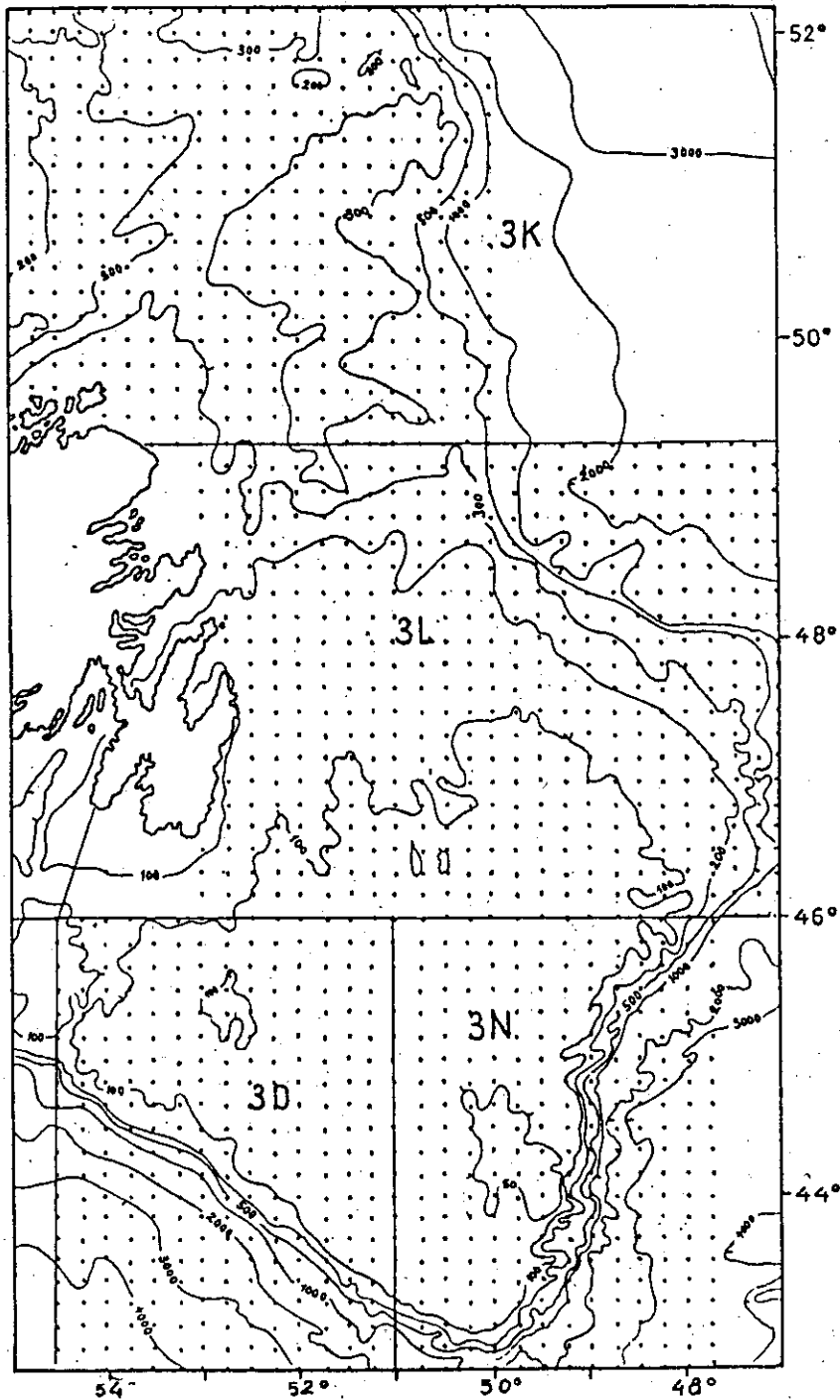


Fig. 1. NAFO Divisions and points of regular grid used to summarize data.

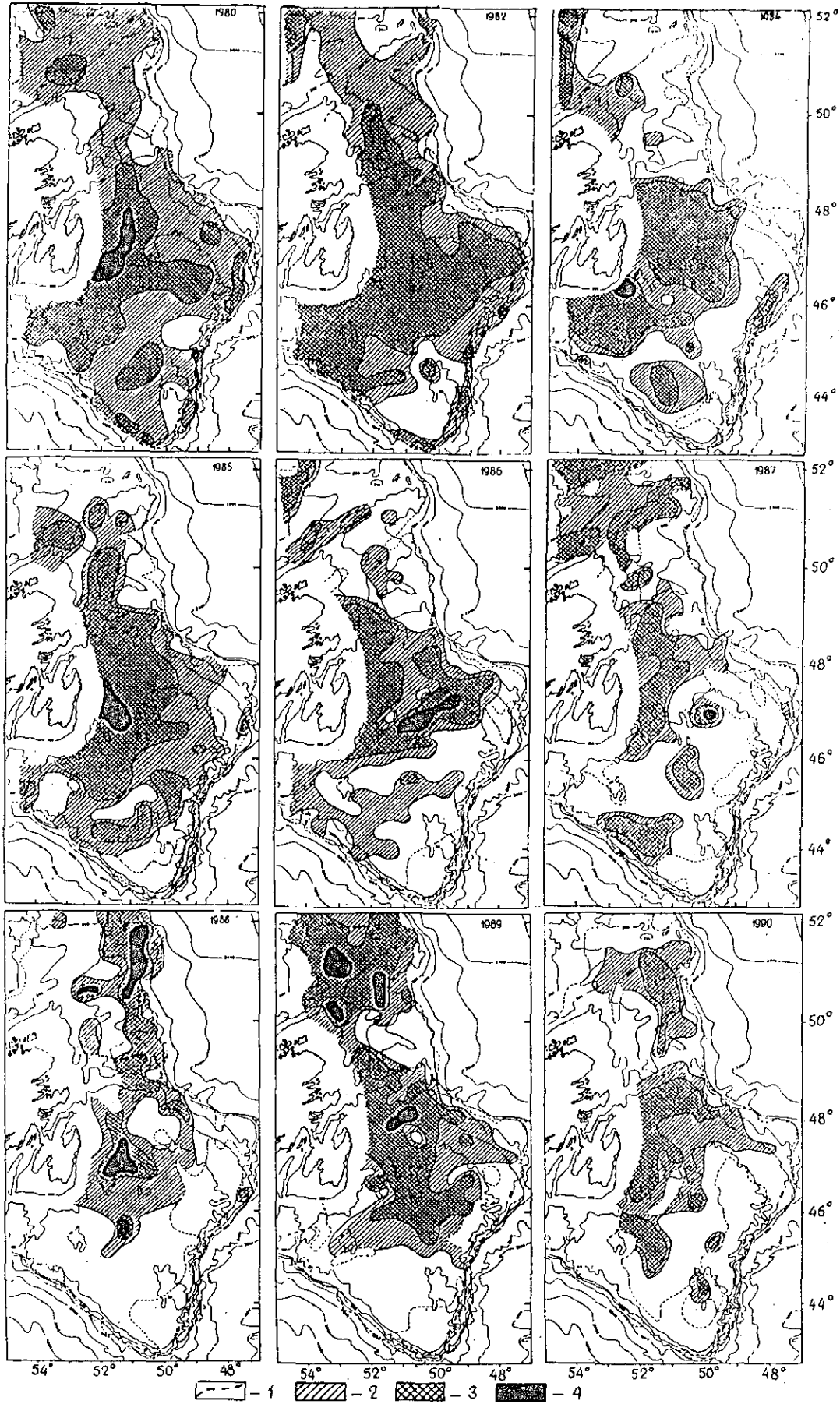


Fig. 2. Redistribution of mature cod with their maturation in Divs. 3KLNO in spring and summer 1980-1990.

1 - boundaries of cod distribution,
2 - "condition" 2

3 - "condition" 3
4 - "condition" 4

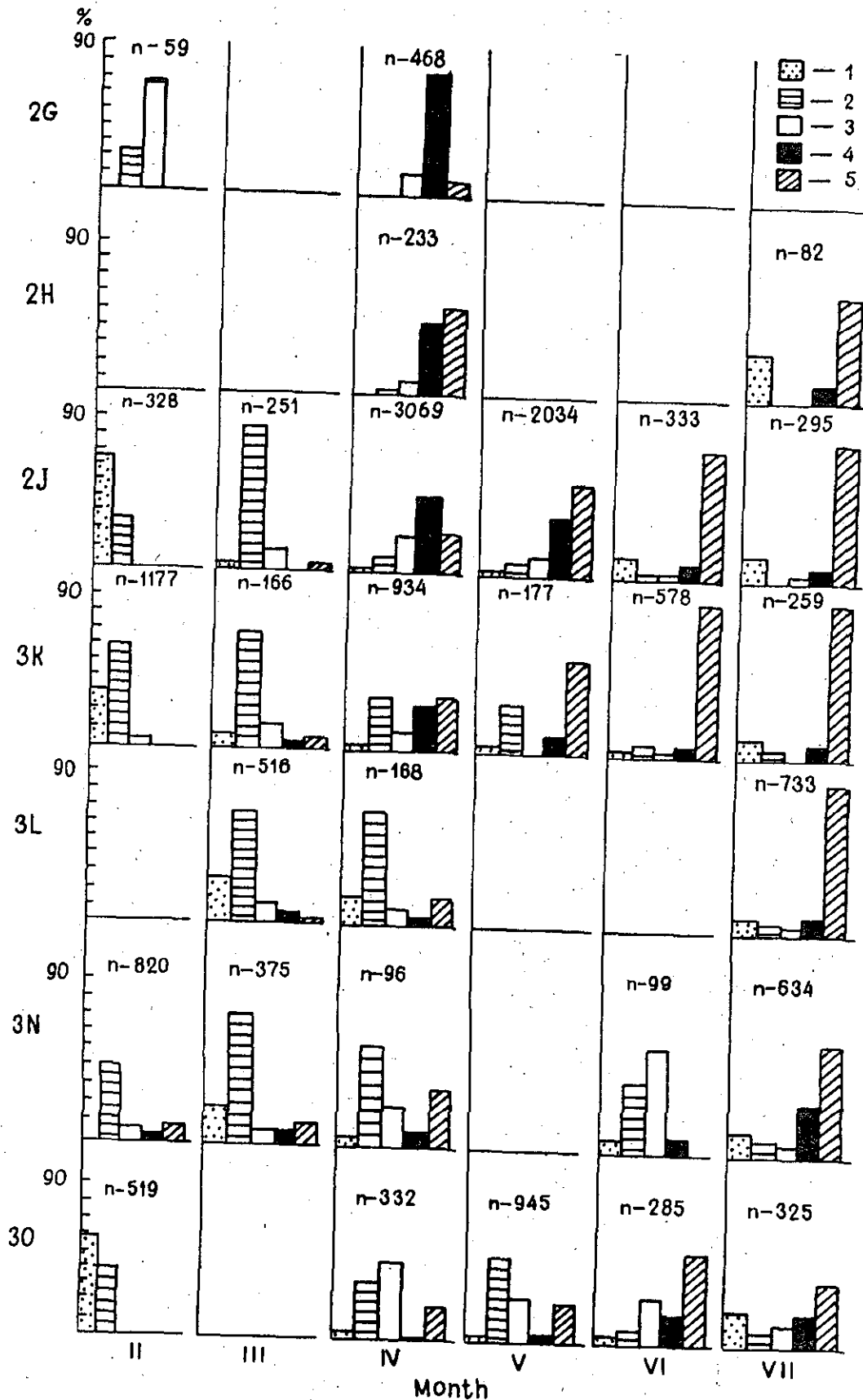


Fig. 3. Maturity stages of ood (according to V.P. Serebryakov, 1967)
 1 - III, 2 - IV, 3 - V, 4 - IV, 5 - VI-II.

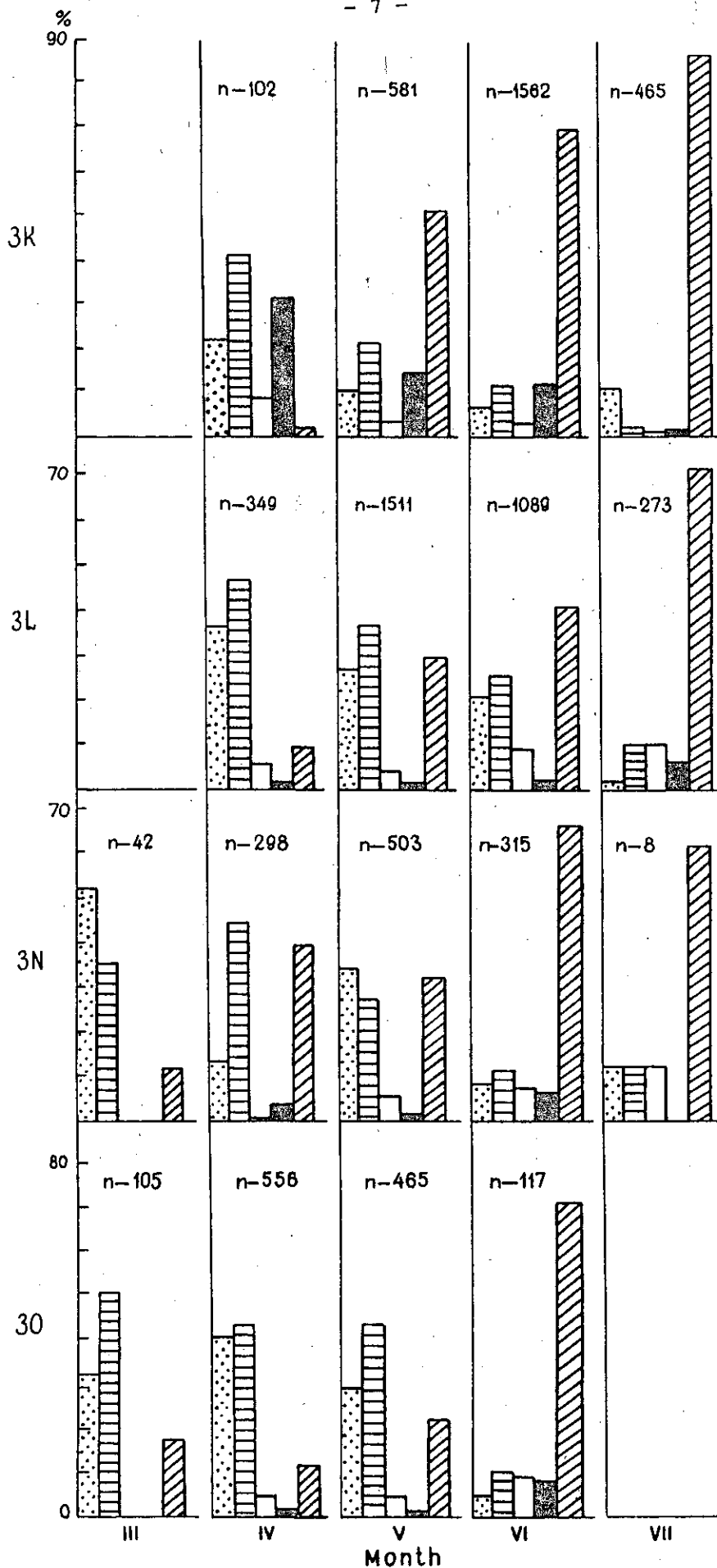


Fig. 4. Maturity stages of cod in Divs. 3KLNO in 1978-1991. See Fig.3 legend.

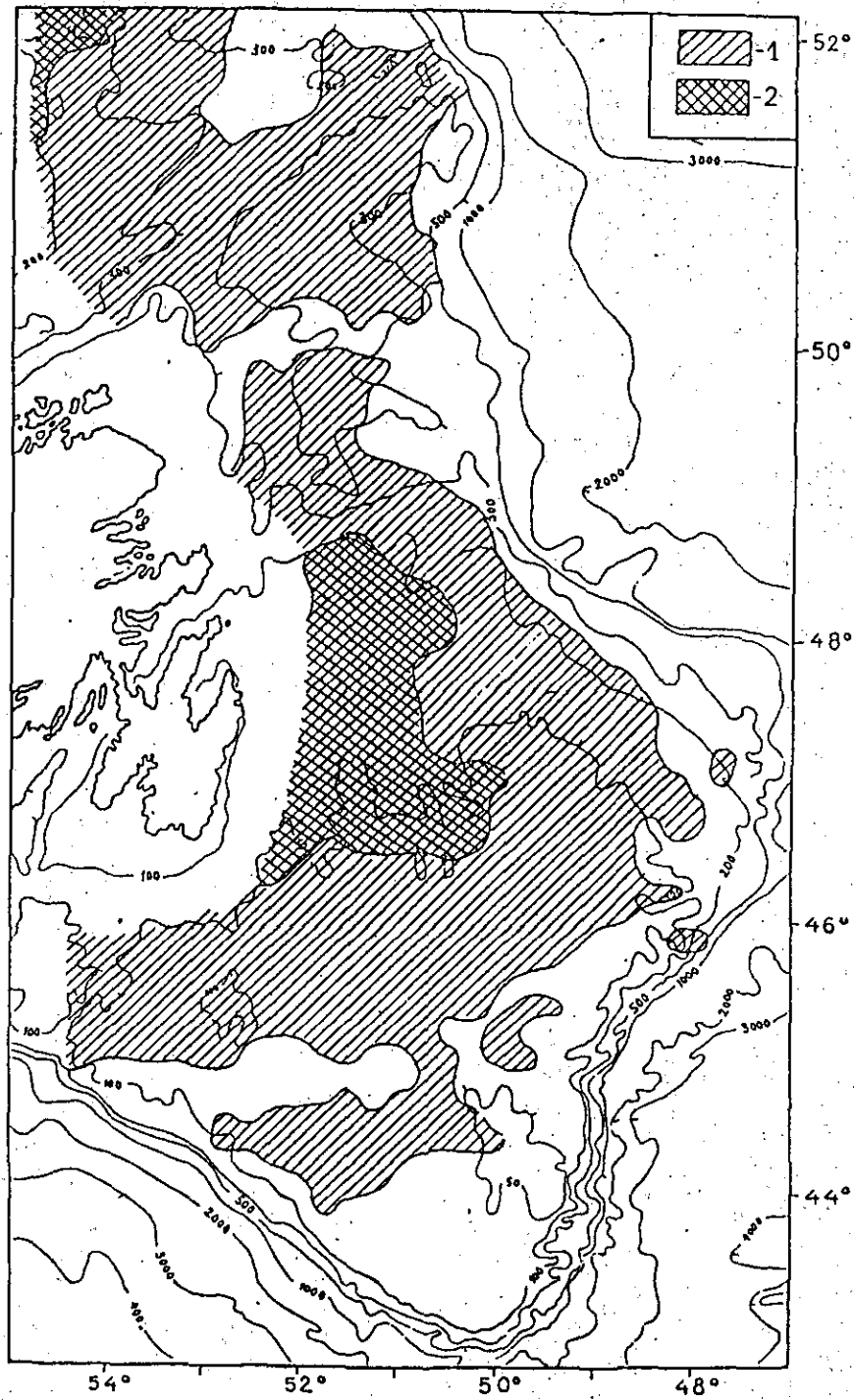


Fig. 5. Summarized plot of mature cod redistribution with their maturation in Divs. 3KLNO (from 1978-1991 data)
See Fig. 2 legend.

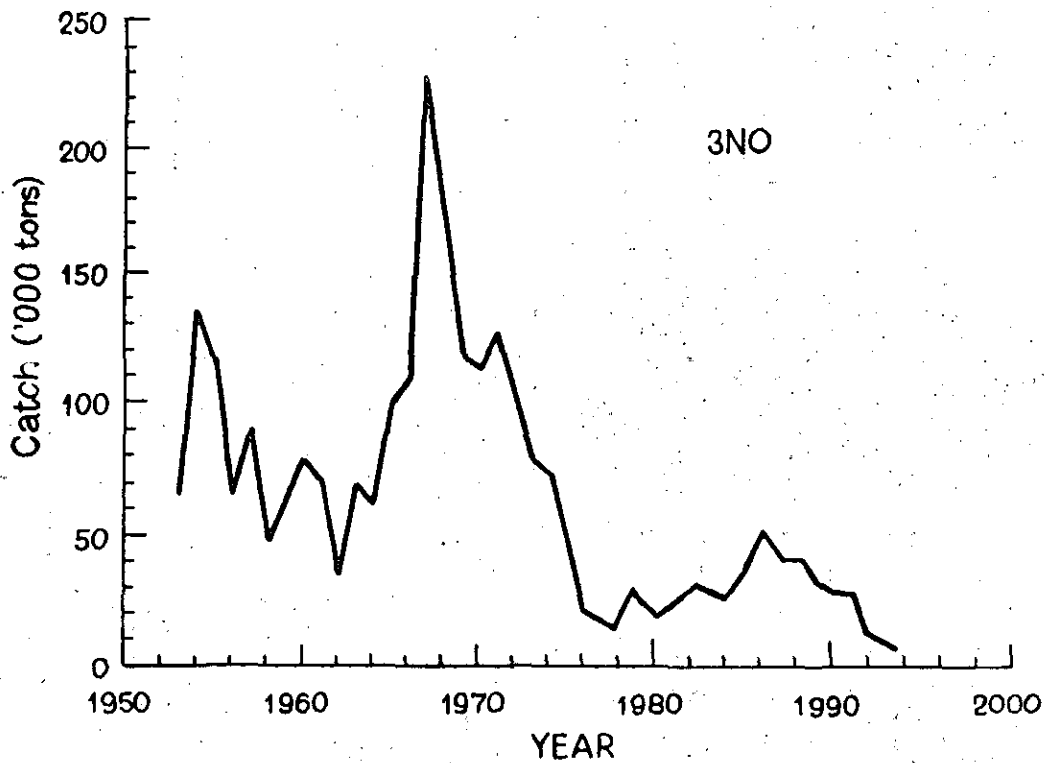
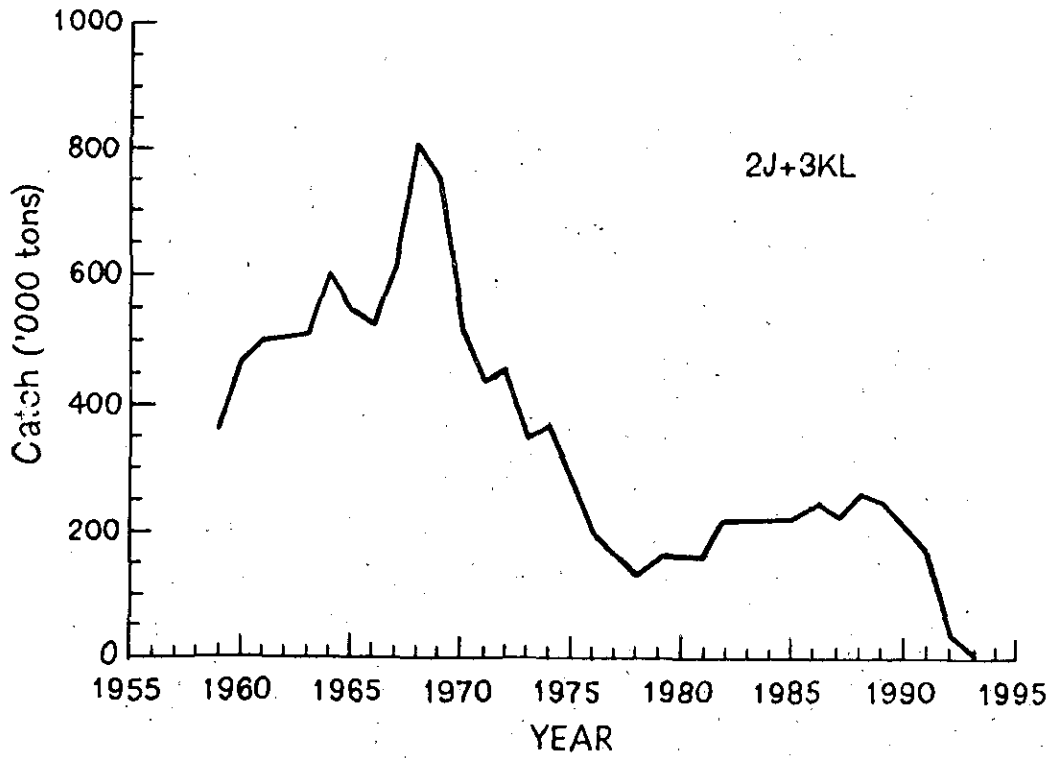


Fig. 6. Total catch of cod in 1955-1994 (Report ..., 1994)

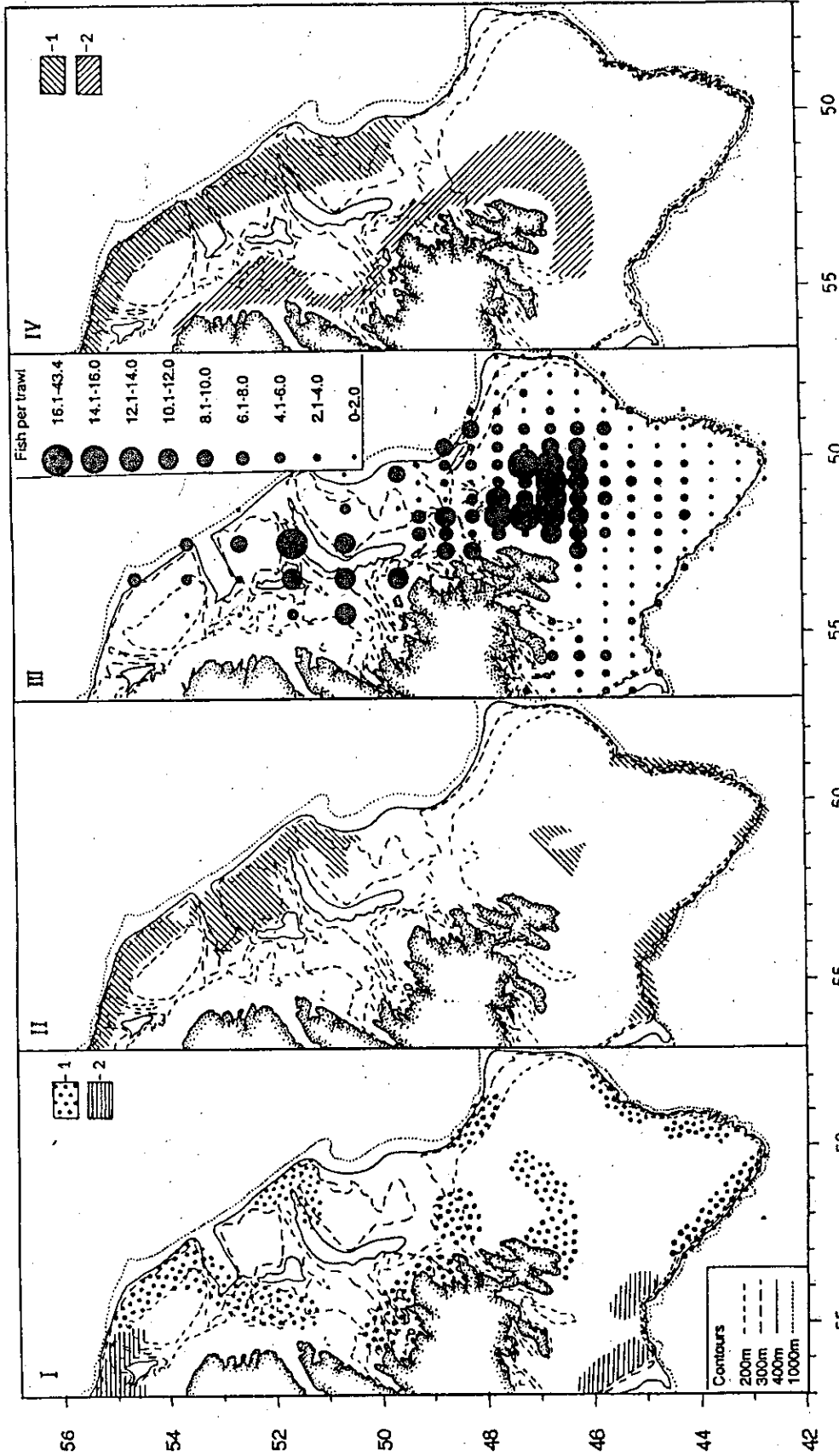


Fig. 7. Cod spawning areas according to different authors.

I - according to V.P. Serebryakov (1967): 1 - not intensive spawning, 2 - intensive spawning;

II- according to Fitzpatrick and Miller, 1979;

III-according to Hutchings et al., 1993, rings - mean amount of spawners (both sex) in the catch per area unit in the most probable spawning period (from 1946-1992 data

IV -according to our data: 1 - spawning in March-April, 2 - spawning in May-June.