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Pelagic *Sebastes mentella* stock structure in ICES Subareas XII, XIV and NAFO Conventional Area by the results of Russian investigations

by

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Abstract

The paper considers populational structure of *S. mentella* (*Sebastes mentella* Travin, 1951) distributed in pelagial XII, XIV of ICES Subareas and NAFO Conventional Area at the depths to 1000 m.

Results from Russian investigations of *S.mentella* spatial stock structure by parasitic fauna, biological and biochemical criteria, all over the vertical distribution, are presented. Analyzed were the results from Russian pelagic redfish fishery in 1982-2002 . The scheme of fishery and effort distribution in the different fishing areas both by seasons and in the year-to-year dynamics is given. Revealed is single commercial stock consisting of mature fish existing in pelagial XII, XIV of ICES Subareas and NAFO Conventional Area. During the investigations, there were no found barriers explaining the existence of redfish separate groups.

The forming of commercial concentrations in NAFO Conventional Area was considered and it was established that the changes of hydrographic conditions in the surface sea layer were one of the reasons of fishing concentration dislocation in the area of feeding (fishery).

The proposal to single out redfish concentrations in separate fishing areas with individual TACs based on seasonal migrations of redfish concentrations is not biologically substantiated and inexpedient.

For the purposes of pelagic redfish stock conservation and rational exploitation the single TAC to be kept is necessary.

Introduction

Populational structure of redfish *S.mentella* (*Sebastes mentella* Travin, 1951) distributed in pelagial XII, XIV of ICES Subareas and NAFO Conventional Area at the depth down to 1000 m has a determining influence in working out measures for this stock management and regulation.

At present, it has not been agreed upon the number of types (stocks) of *S.mentella* in this region of the North Atlantic. In the 1990s, the assumption about the existence of two redfish types (stocks) – "oceanic" and "pelagic deepwater" was made by Icelandic scientists. Russian experts hold the opinion that in the pelagial of the Irminger and Labrador Seas there is a single commercial stock of *S.mentella*, for which single TAC should be a measure for regulation. In the report of NWWG in April-May 2002 the agreed opinion of scientists concerning the structure of redfish stock and

possible actions to assess each component separately is given: “Considering the uncertainty related to definition of stock units, action must be taken in accordance with the precautionary approach and attempts be made to assess each stock component separately until better knowledge on the relationship between each stock or stock components are known”.

Results of Russian research on S.mentella stock structure

Russian investigations of the stock structure are based on study into *S.mentella* biology (Pavlov and Shibanov, 1984; Pavlov, 1992; Shibanov, Melnikov and Pedchenko, 1996; Melnikov, 1998; Melnikov, Pedchenko and Shibanov, 2001; Melnikov and Bakay, 2002), parasitic fauna (Bakay and Melnikov, 2001; Bakay, 1988, 1997, 1999b, 2000, 2001), populational and genetic characteristics (Novikov et al., 2002). When carrying out investigations we proceed from the conception that the notions stock/population/management unit have the similar definition which is based on: 1) self-reproduction; 2) this or that extent of geographical and/or time isolation; 3) availability of all spectrum of age groups (life history stages). In the Irminger Sea, adult individuals prevail, hence, we deal with the spawning part of *S.mentella* certain population, for this, it is a very numerous spawning stock distributed in the wide area and over a broad depth range. Despite the wide area of distribution, the redfish spawning grounds were only found over the Reykjanes Ridge.

In the paper on study of redfish concentration vertical structure (Bakay, Melnikov, 2001) presented were the results of using natural marks (parasites, pigment spots) and compared biological characteristics of fish from 0-500m, 500-1000 m layers in the Irminger Sea pelagial . Based on revealed similar peculiarities of fish infestation with copepod *Sphyrion lumpi* and pigment spots and the essential resemblance of linear and weight growth and sexual maturity rates, the conclusion on redfish common origin and single stock all over vertical distribution was drawn. The elder redfish concentrations distributed at the depth over 500 m are the deepwater constituent of single redfish population, but not a discrete stock or type, as some scientists assume.

The analysis of spatial populational structure all over the habitat (Melnikov, Bakay, 2002) showed that in summer, in the pelagial of the Irminger and Labrador Seas, *S.mentella* concentrations were characterized by complicated structure and marked spatial and vertical variability of length-age and sex composition and the ratio of immature and mature individuals. This variability is conditioned by the existence of differentiated ontogenetic and geographical habitats of redfish juveniles and mature fish in this region of the North Atlantic, and, as well as by the redfish seek to change ecological conditions of their existence. The links between mature and immature parts of population are effected by means of return migrations of redfish individuals reaching sexual maturity from the area of their distribution to the areas of mature population distribution and reproduction, i.e. from shelf and slope of Greenland to the pelagial of the open sea (Fig.1). The analysis of redfish length composition in the area of international trawl-acoustic survey (TAC) in 2001 allowed some peculiarities of concentration spatial structure having been studied by us before to be specified (Pedchenko, Shibanov and Melnikov, 1997). It was established that in the upper
500 m layer the large individuals with the average length of 35-39 cm occurred in the central feeding area. In the outlying parts the mean length was less by 3-6 cm (Fig.2A). At the depth of more than 500 m the most part of large redfish with prevailing length of 40-46 cm was related to the northern areas of the Reykjanes Ridge. To the south of 55°N, in the area of the ridge, fish mean length amounted to 33.7-36.6 cm (Fig.2B). In the course of investigations, all over the area of concentration distribution, there were no found separate length groups of the redfish. It was revealed that spatial and vertical variability of redfish length composition was not the evidence of the existence of some redfish types (stocks) in the sea pelagial, but was conditioned by the number of factors. First, it is the change of the life cycle stages, when the redfish, as they grow, try to change ecological conditions of their existence. Second, the fish have seasonal migrations, when during a year, in the area of population distribution, fish concentrations actively dislocate. Besides

seasonal migrations of redfish fishing concentrations from the sites of larva extrusion to the feeding and wintering grounds, vertical daily migrations of fish are well-pronounced in the pelagial of the Irminger Sea. Every day, the amplitude of redfish vertical migration during which the mixing of redfish from different layers of their occurrence takes place equals to hundreds of meters. Thus, common nursery and feeding areas, single life and migration cycles, the lack of spatial and time isolation of redfish from the different parts of the stock, the similar peculiarities of infestation of fish caught in the different parts of the area with copepod *S.lumpu* and pigment spots indicate the existence of single population and stock of *S.mentella* occurring in the pelagial of the Irminger Sea and in the adjacent area of the Labrador Sea.

On the basis of made genetic analysis, by means of electrophoretic investigations (Novikov et al., 2002), it was verified, that in the pelagial of the Irminger and Labrador Seas genetically single self-reproductive redfish population occurs.

Russia is among the countries actively participating in pelagic *S.mentella* fishery in the Irminger Sea. Since 1982, the total Russian catch of redfish was estimated at about 0.83×10^6 t or above 40% of the total international catch in the area. Fishing data accumulated by us during the period of more than twenty years permit the scheme of redfish fishery and effort distribution in the different fishing areas both by seasons and in year-to-year dynamics to be estimated. During the first seven years (1982-1988), fishing was carried out, primarily, in the ICES Subarea XIV, at the depth less than 500 m (Figs.3-6). Fishery season started in the late March-April and terminated in August. In 1989-1993, the fishing area was widened due to the dislocation of some vessels to the ICES Subarea XII in May, for this, fishing continued in
Subarea XIV. The fishing season lasted from March till August. Since 1994 the Russian vessels started harvesting redfish at the depth over 500 m, for this, the fishing season was completed in October-November. By the results from fishery, there were two singled out areas, where the redfish commercial concentrations were distributed. The first one having been exploited since 1996 was located on the border with the Icelandic Economic Zone (Subarea XIV). The second fishing area was much southward, between 57-59°N and 33-37°W (Subarea XII), and intensively exploited in 1994-1995. Since 1999, the Russian fleet enhanced the areas of fishery and started to harvest feeding concentrations in the Conventional Area of NAFO (Divs. 1F, 2GHJ). In NAFO area, fishing took place at the depth less than 500 m, in July-October.

The movement of Russian vessels during the fishing season was caused by redistribution of redfish concentrations in the course of seasonal migrations. In spring-summer period, in the northern Irminger Sea, fishery is based on spawning and postspawning concentrations. In the second half of the year, feeding migration of these concentrations starts southwestward – to the southern ICES Subarea XII and NAFO Conventional Area. The fishing fleet dislocate in the same period and direction (Fig.7). Obviously, in the north-eastern area, in the first half of the year, and, in the south-west, in the second half, the fishery of redfish is prosecuted on concentrations of single *S.mentella* population, but not on the locally isolated stock components. In the late three years, in the ICES Subarea XII and NAFO Area, the average size of fish was less by 6 cm, than in Subarea XIV (Fig.8). Despite the difference in length composition, in all the areas, mature fish were predominating: 92% -in
Subarea XIV, 86 % - in Subarea XII, 88% - in NAFO Area (Fig.9). Thus, redfish fishery was based on adult mature stock and did not do any harm to recruitment. The proposal to single out isolated fishing areas with TAC divided by seasons, which is only based on seasonal migration of redfish concentrations and changes in catch length composition connected with it is biologically groundless. It is well-known, that the existence of separate reproductive, nursery and feeding areas is typical for the most of large stocks of commercial fishes (cod, haddock, herring, blue whiting, mackerel and others). The common feature of fish migration cycle is the larger individuals occurred in catches in spawning grounds and the increase in the portion of smaller size fish in the

feeding area. But, in the world practice there are no examples of using TAC divided by seasons and areas for one widely distributed stock.

By the results from Russian summer TASs in 1982-1993, the main concentrations of redfish were not registered to the west of 42°N, but were related to 200-mile fishing zone of the eastern Greenland. Starting since 1994, the shift of concentrations westward, to the Labrador Sea area, was recorded. The most considerable shift of fishing concentrations to the NAFO Conventional Area was noticed in 1999-2001 (Fig.10). Forming essential fishing concentrations in the NAFO Conventional Area is of irregular character and takes place at the expense of redfish concentration redistribution from the traditional feeding area to the Irminger Sea that is caused by the increase in advection of Atlantic waters by the Irminger Current and the temperature rise in the upper 200 meter sea layer (Melnikov, Pedchenko, Shibanov, 2001). So-called south-western fishing area having not been registered before is only recorded in the recent three-four years. Probably, the change of hydrographic conditions in the Irminger Sea (the decrease in water temperature in the sea surface layer) will lead to the shift of redfish concentrations in the north-east direction to the traditional area of feeding and fishery, as it was in 1982-1995.

Conclusions

1. The results from Russian investigations into populational structure of *S.mentella* concentrations by parasitic fauna, biological and biochemical criteria indicate the existence of single commercial stock in the pelagial of the ICES Subareas XII, XIV and NAFO Conventional Area. In the course of investigations, there were no found barriers explaining the existence of discrete groups of the redfish.
2. One of the reasons of fishable concentration migrations in the area of feeding (fishing) is the change of hydrographic conditions in the sea surface layer.
3. In different seasons, in the pelagial of the ICES Subareas XII, XIV and NAFO Conventional Area the single commercial stock of *S.mentella* consisting of mature fish is exploited.
4. Singling out redfish concentrations in the separate fishing areas with divided TAC on the basis of seasonal migrations of redfish concentrations is biologically groundless and inexpedient.
5. For the purposes of conservation and rational exploitation of the pelagic redfish stock the single TAC must be kept.

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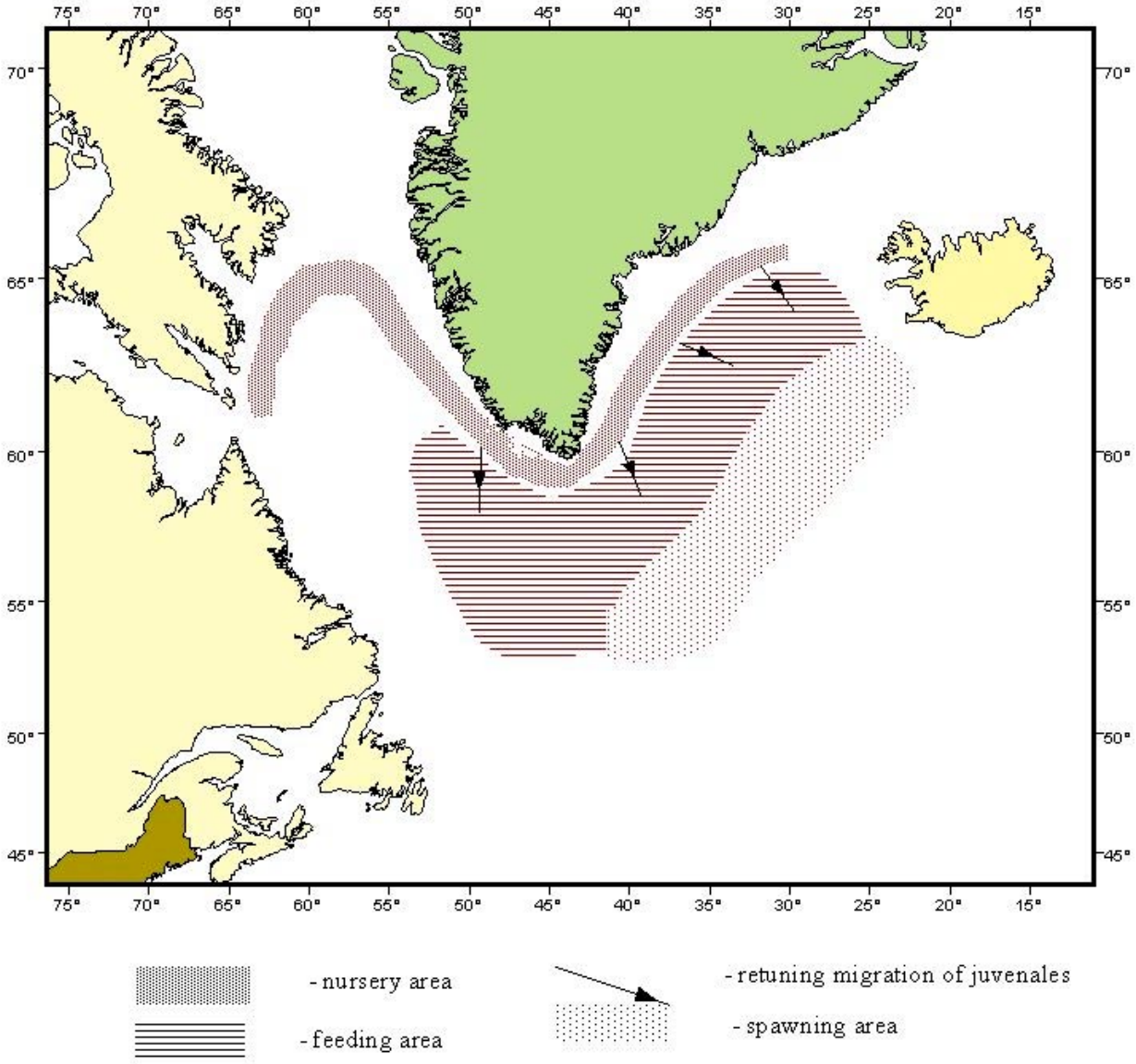

Fig. 1. Structure of redfish area in the North Atlantic.

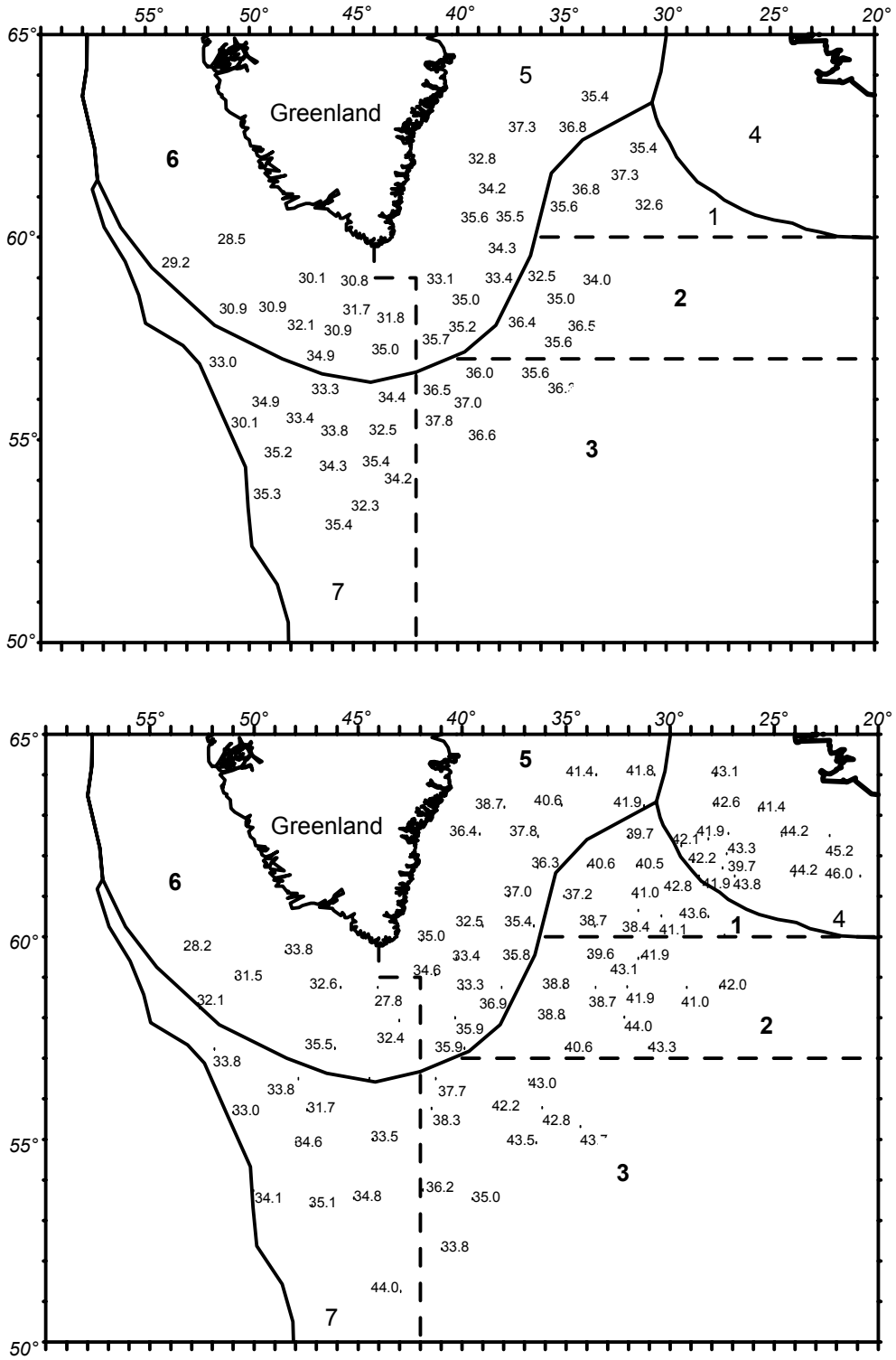

Fig. 2. Mean length of redfish in catches taken in 0-500 m (A), 501-1000 m (B) layers by the results from international TAS in 2001.

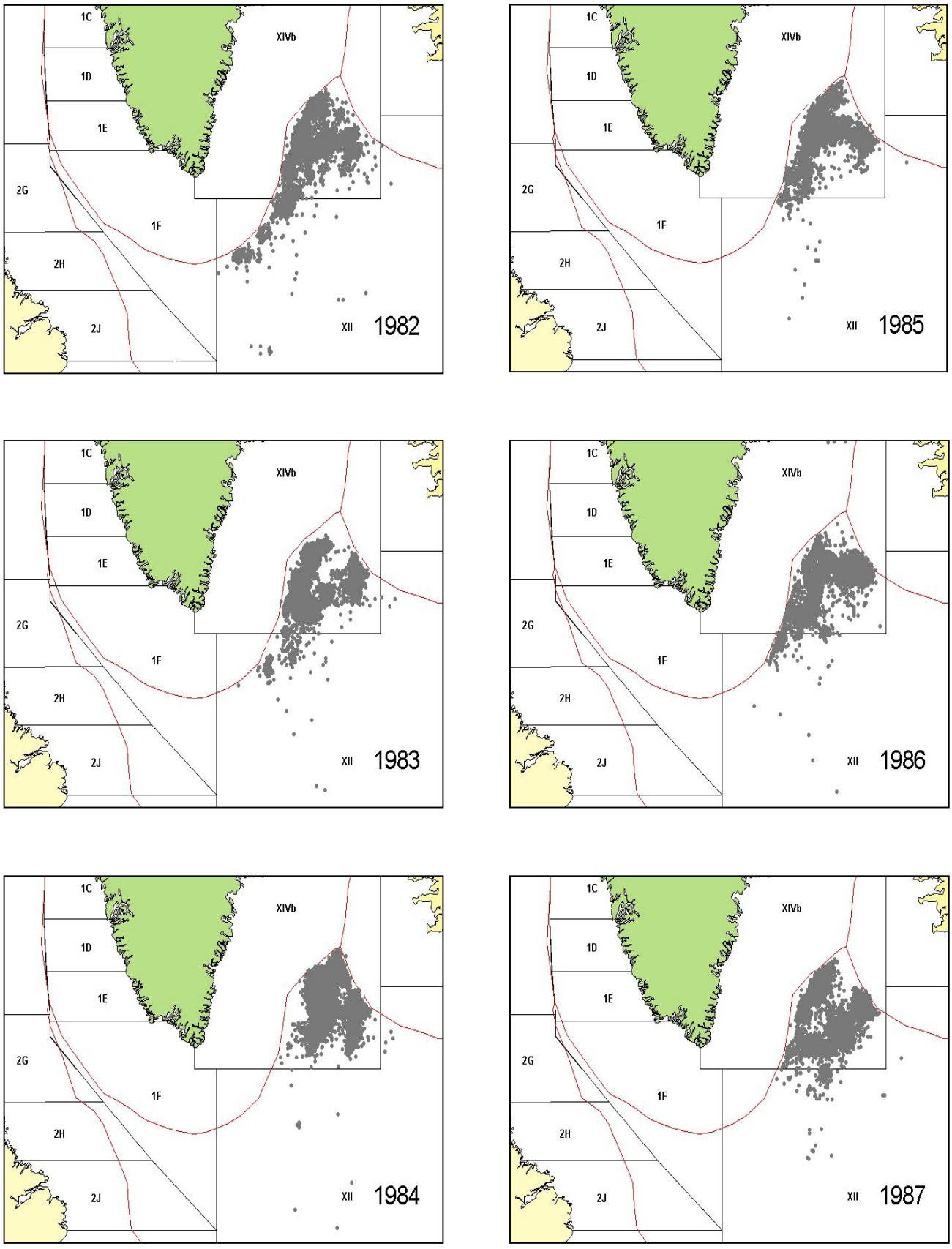

Fig. 3. Position of Russian fleet when fishing redfish in 1982-1987.

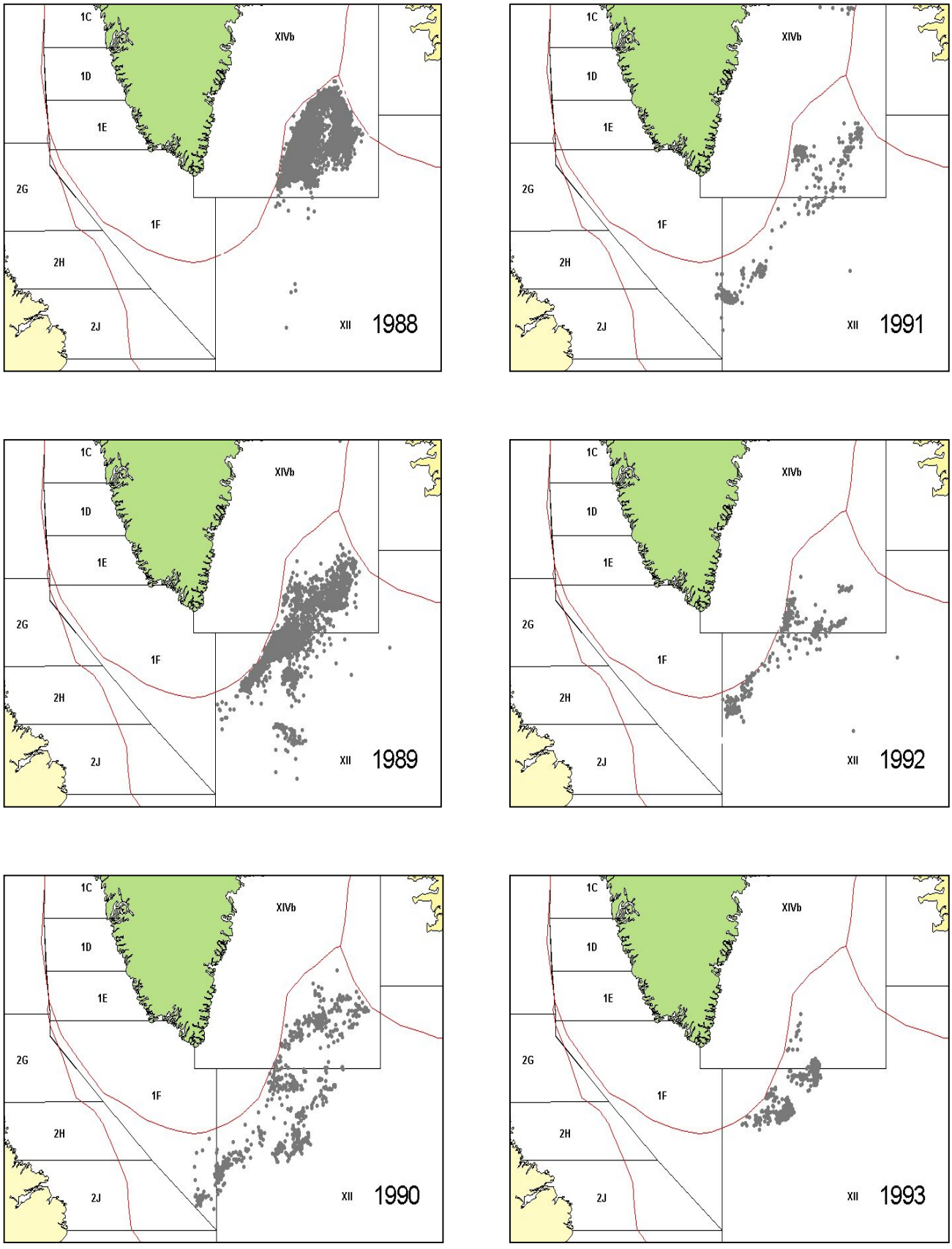

Fig. 4. Position of Russian fleet when fishing redfish in 1988-1993.

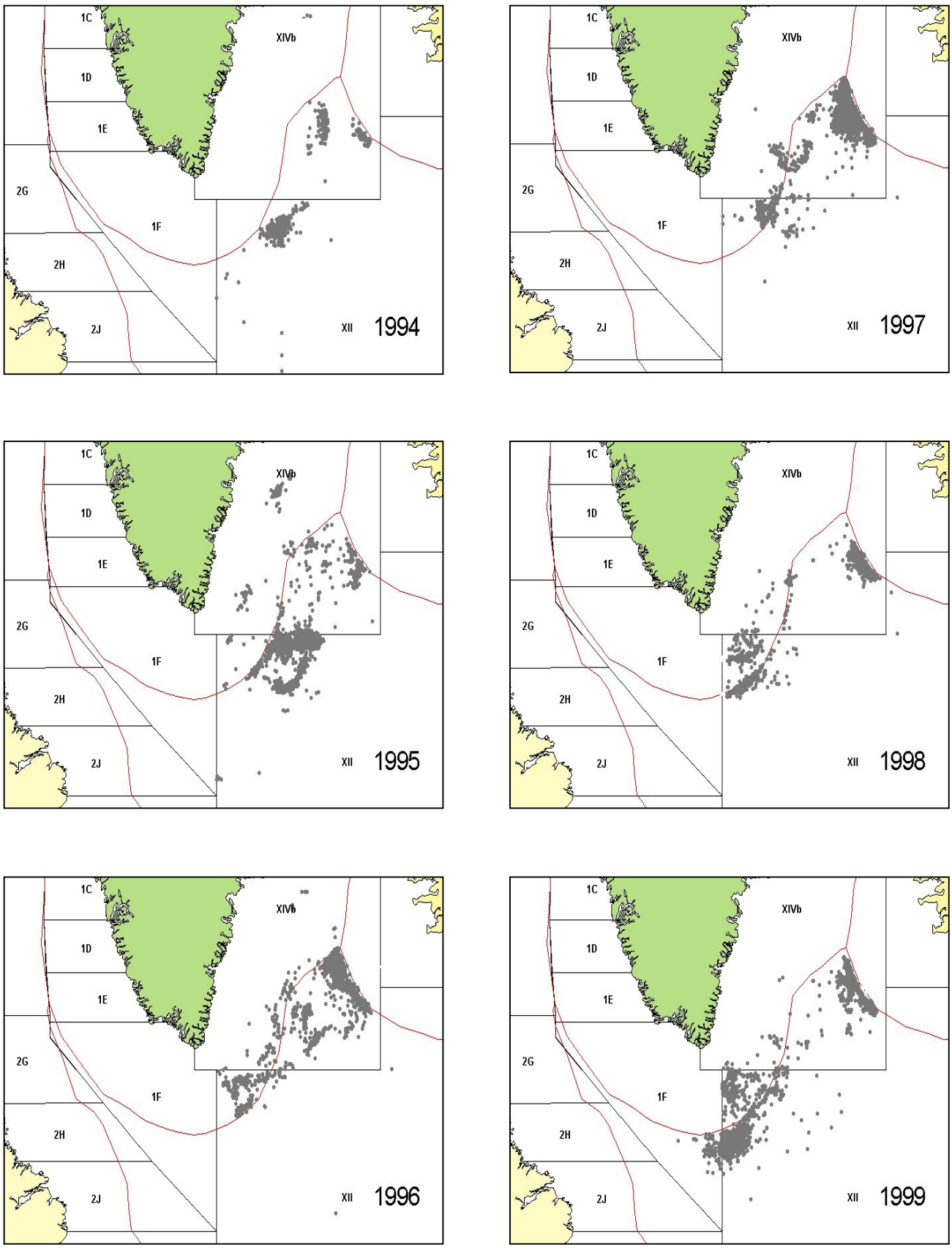

Fig. 5. Position of Russian fleet when fishing redfish in 1994-1999.

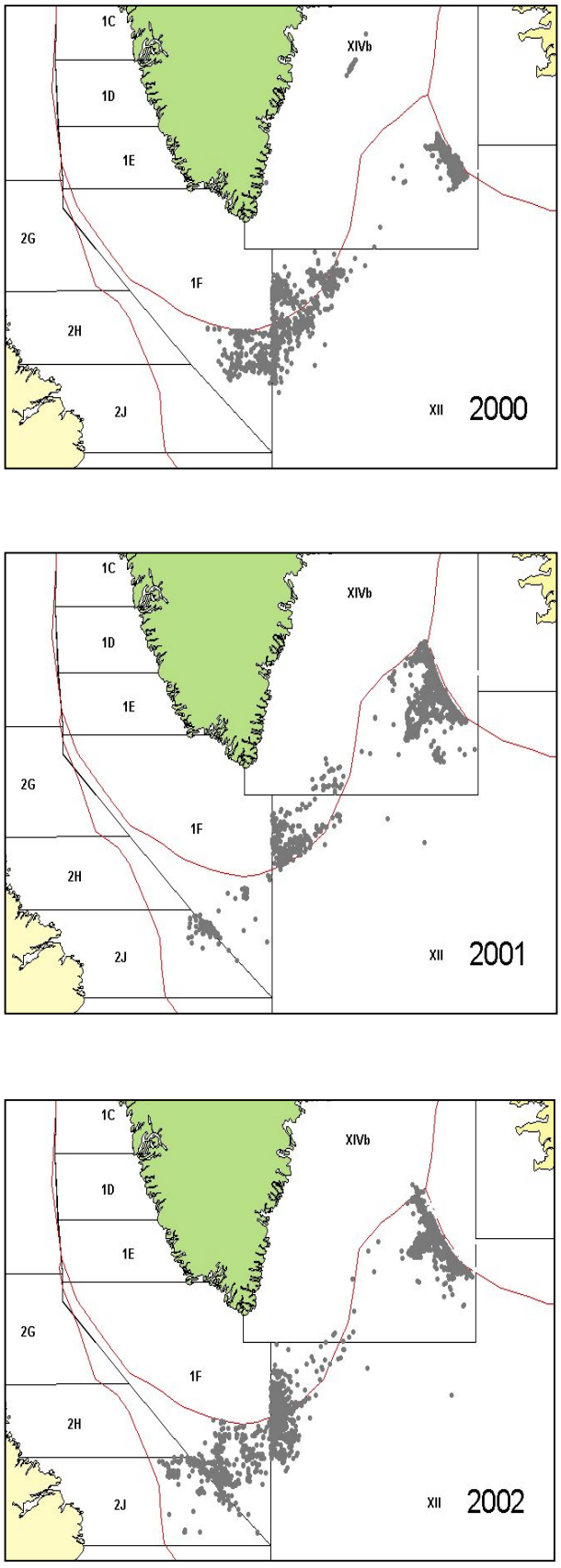

Fig. 6. Position of Russian fleet when fishing redfish in 2000-2002.

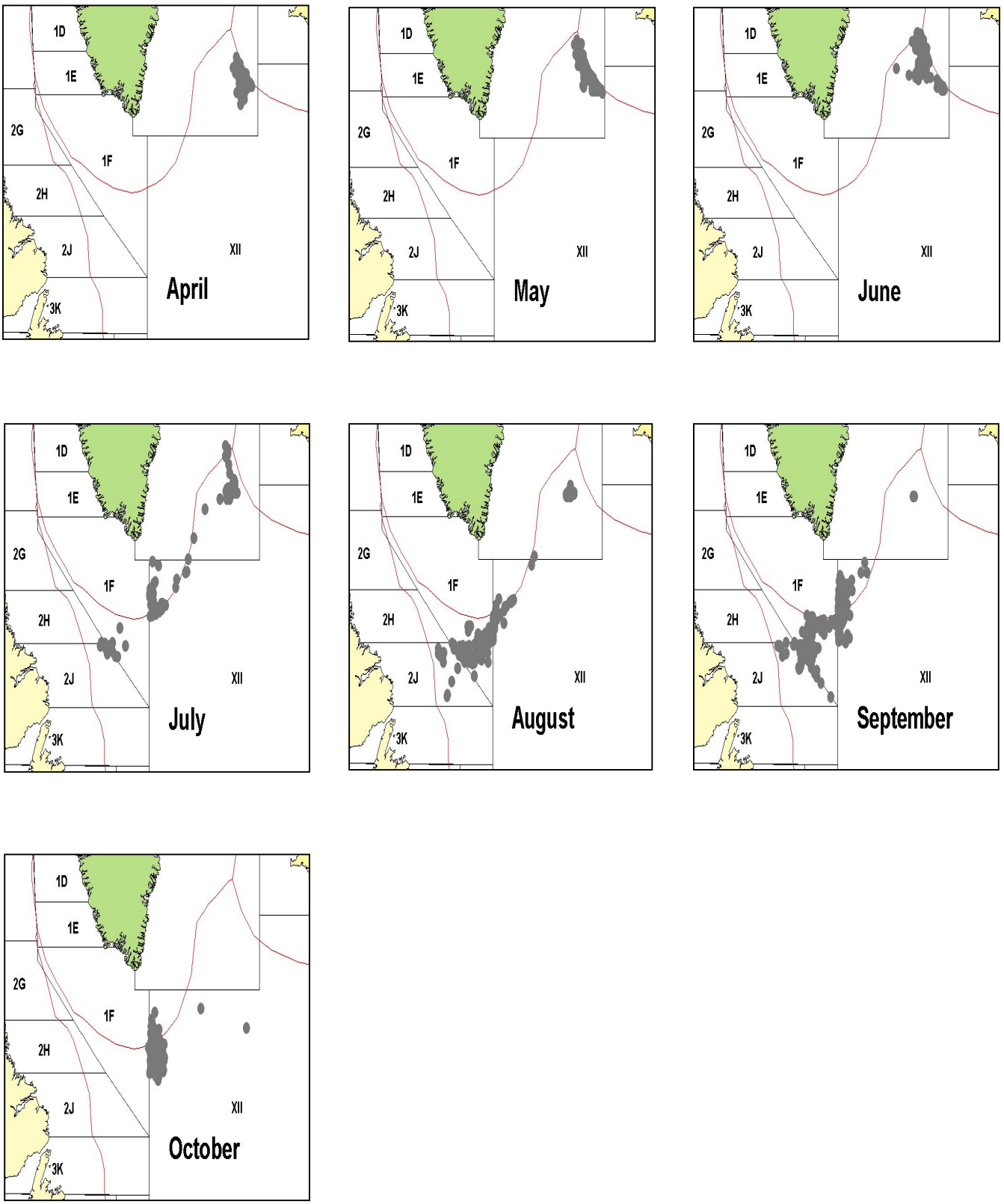

Fig. 7. Russian fleet position in the Irminger Sea in 2002, by months.

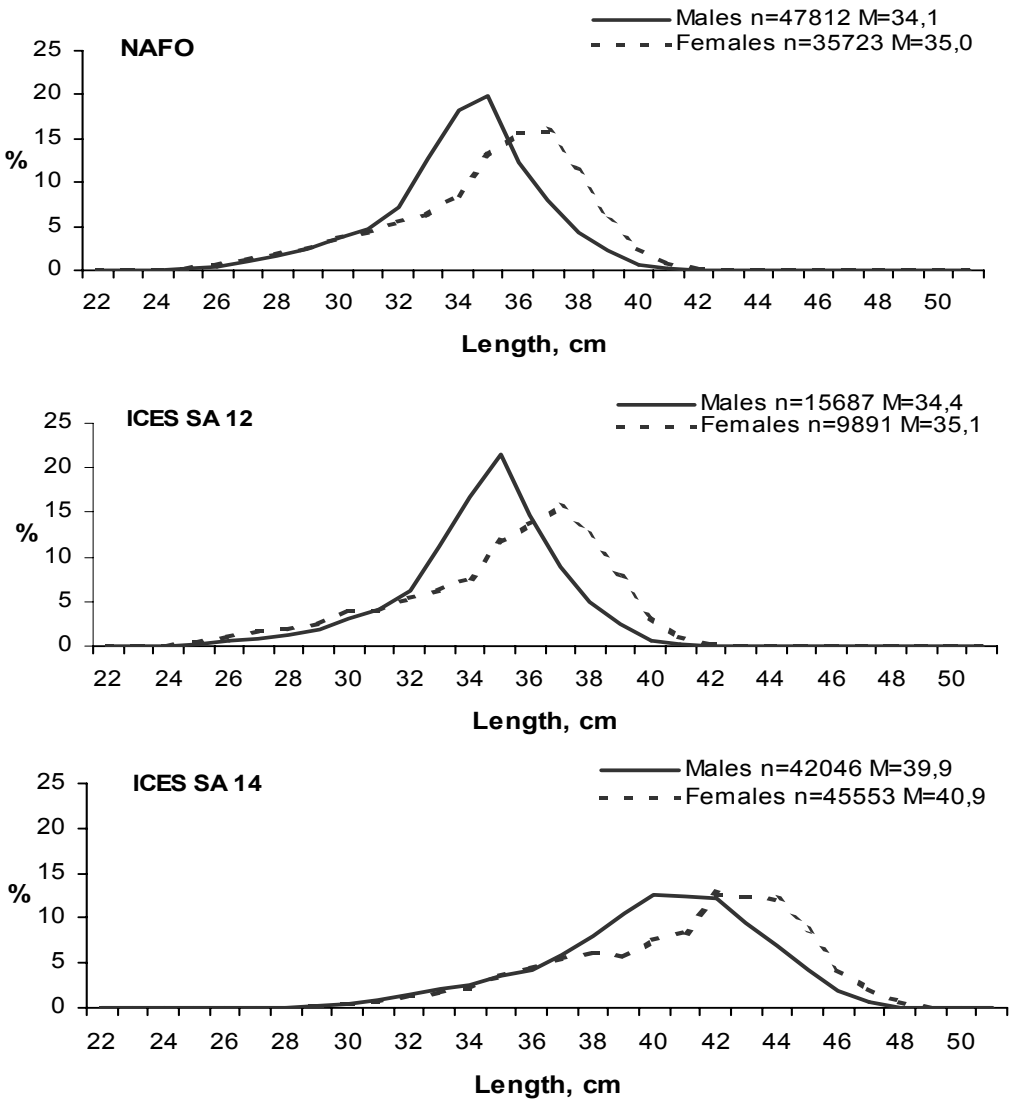

Fig. 8. Length composition of redfish in commercial catches by Russian vessels in 2000-2002.

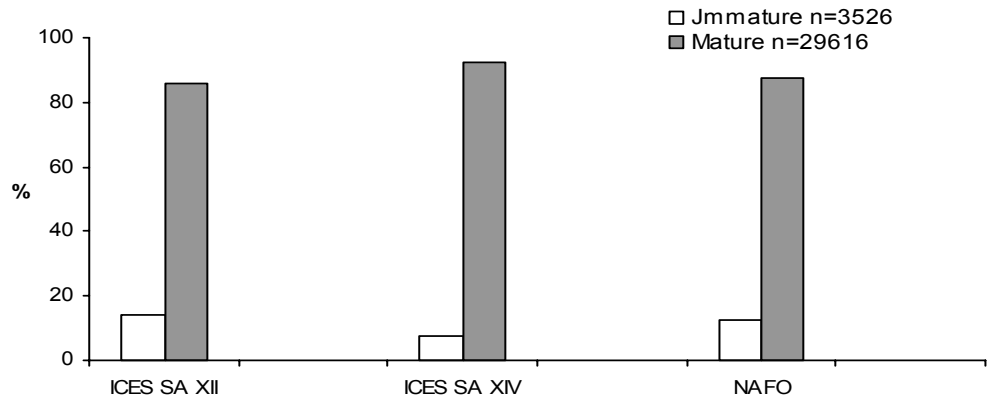

Fig. 9. Redfish maturity in commercial catches in 2000-2002.

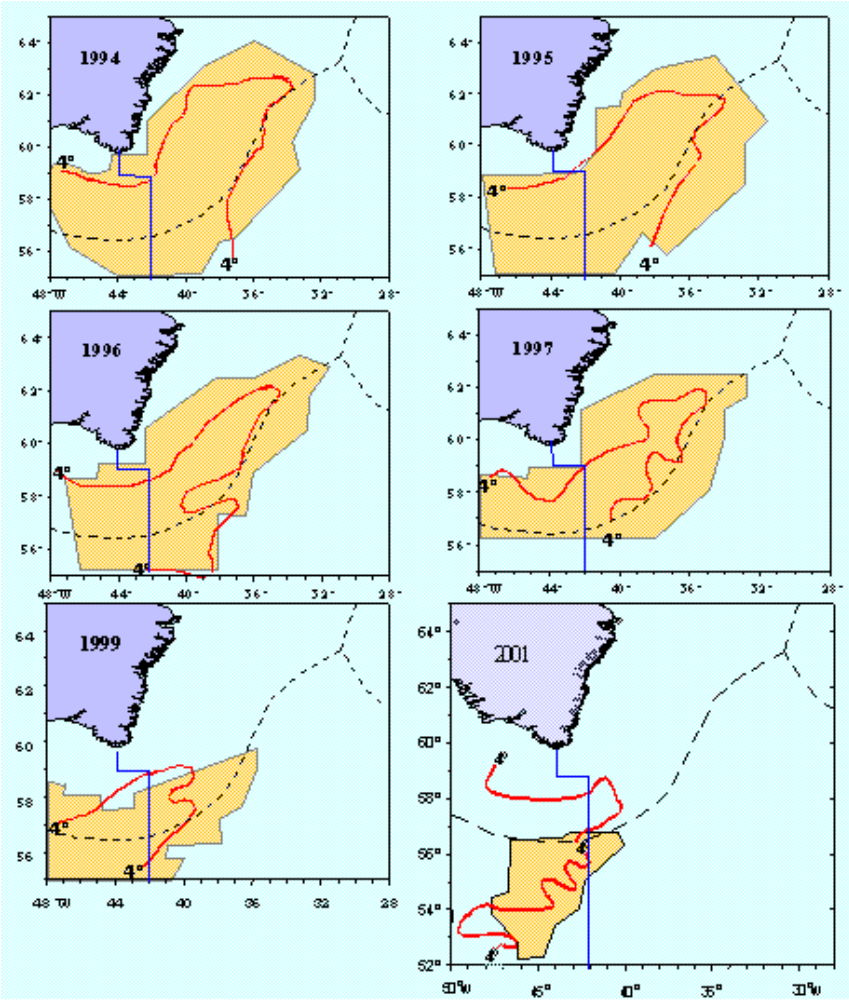

Fig. 10. Position of redfish commercial concentrations in the period of summer TASs, 1994-1997, 1999, 2001 гг.