International Council for
the Exploration of the Sea

C.M. 1992/G:58
Demersal Fish Committee
Ref.L

The conditions of redfish aggregations formation in spring in the Irminger Sea

by

A.P.Pedchenko

Polar Research Institute of Marine Fisheries
and Oceanography (PINRO), 6 Knipovich Street,
183763, Murmansk, Russia

ABSTRACT

By the data of ichthyoplankton surveys carried out by PINRO in 1990 and 1991 environmental conditions on Sebastes mentella spawning grounds in the Irminger Sea are considered. Aggregations of redfish during larvae extrusion were often formed in the areas where at a proper thermohaline condition of water there existed a local upwelling of the latter which created a favourable for early stages ecologic situation.

INTRODUCTION

In spring the main object for fishery in the Irminger Sea is beaked redfish (Sebastes mentella). During this period the reproduction of the population - hatching of larvae - takes place. Studies of this stage of life history of redfish, which have been carried out by PINRO since late 1970-ies, indicated that over a large reproductive area the fish form only local aggregations. Besides, their geographical distribution is not permanent from year to year.

The goal of this paper is to try to reveal physical processes facilitating formation of favourable environmental conditions in some areas for reproduction of redfish; and also to estimate some parameters of sea water which may serve as indicators of these conditions and used for finding redfish concentrations during the larvae extrusion period.

MATERIALS AND METHODS

The materials of ichthyoplankton surveys conducted in the open Irminger Sea by PINRO's R/V "Professor Marti" in April - May 1990-1991 are used in this paper. The surveys included collection of oceanographic and hydrobiological data, and also materials on biology of redfish and distribution of its larvae.

Oceanographic observations were carried out down to 1000 m using a sonde CTD MARK-IIIB and SCTD "SMART" made by "EG&G Ocean Products". Sea water was sampled for hydrochemical analysis with a "Rozett" sampler (1990) and Nansen bottles (1991).

RESULTS OF INVESTIGATIONS

The Irminger Sea frontal zone separating sub-Arctic waters of western and eastern types is the area of propagation for beaked redfish (Svetlov, Alexeeva, Balabanova, 1989). Concentrations of redfish during the larvae extrusion period are formed in local areas which may lay at a distance from each other. Judging by redfish cincentrations distribution ans also by certain oceanographic features the area under study was divided into two subareas - northern and central. From the data of stations made in places of redfish concentrations mean values of temperature and salinity at depths 200-400 m where the fish are most frequently distributed during propagation were estimated for each of these sub-areas (Table). The calculated thermohaline indices turned out rather close to T,S-characteristics obtained for Aprils 1982-1987 (Svetlov, Alexeeva, Balabanova, 1989).

Table . Mean water temperature and salinity at depths 200-400 m in beaked redfish concentrations.

Area	Year	Temperature, °C	Salinity, psu
Northern	1990	5.3-5.9	35.00-35.05
(60-63°N)	1991	5.3-6.0	34.99-35.06
Central	1990	5.0-5.5	34.98-35.02
(57-60°N)	1991	5.0-5.6	34.99-35.03

A comparative analysis of the Table data revealed an insignificant difference in T,S-indices between 1990 and 1991 within each area. More significant differences were registered between thermohalines in waters of the northern and central areas

of the reproductive zone. Nevertheless, overstepping of mean water temperature of the first area compared with the second one by 0.3-0.4°c and salinity by 0.03 psu may be considered as insignificant. This allowed us to use in further analysis the temperature value of 5.6°C and salinity value of 35.03 psu for the whole study area as indices which were most specific for those places where redfish formed their aggregations. Those zones within which the water at depths 200-400 m had the above mentioned T,S-values may be regarded as zones where environmental conditions are favourable for redfish propagation; though, availability of redfish aggregations only in some parts of the areas distinguished (Fig.1) indicates that there should exist an additional factor (or several factors) effecting the process of fish aggregation.

The more thorough analysis of hydrographic parameters vertical distribution has shown that in some parts of the study area there are inversions in temperature and salinity of water at depths 600-800 m (Fig.2). Most often this was observed in areas of redfish distribution. Formation of thermohaline irregularities is related to the processes of local vertical mixing and lateral advection (Fedorov, 1976; Turner, 1985). Distribution of conventional density and oxygen dissolved in sea water serves as indirect confirmation of deepwater upwelling in such areas (Fig.3). Presumably, the process of waters of intermediate structure upwelling to the surface is one of the conditions sine qua non for the redfish propagation. The biological necessity of this phenomenon is in the fact that favourable feeding conditions for larval redfish are formed and maintained due to transport of biogenous elements into the photic layer in a result of upwelling. In those areas we registered increased fluorescence in the 10-30 m layer.

CONCLUSIONS

Aggregations of redfish during the larvae extrusion period in spring 1990 and 1991 were formed in the area where the following combination of environmental conditions took place:

- in the 200-400 m layer the water temperature was 5-6°C and salinity was 34.98-35.06 psu;
- stable local upwelling promoting transport of larvae into the surface layer and creating favourable feeding conditions for them was observed.

The further studies and monitoring of all stages of upwellings development will allow us to investigate the mechanism of effecting of this process upon formation of higher biological productivity zones in the ocean.

REFERENCES

Svetlov, I.I., A.G.Alexeeva, L.G.Balabanova. Peculiarities of oceanographic conditions in the open Irminger Sea in spring. Voprosy promyslovoy okeanologii Severnogo basseyna: Proceedings, PINRO, Murmansk, 1989, pp.16-27.

Fedorov K.N. The thin thermohaline structure of oceanic water. L.: Gidrometeoizdat, 1976, p.184.

Turner J.S. Convection in multicomponent systems. Natur Wissenschaften, 1985. 72, No.2, pp.70-75.

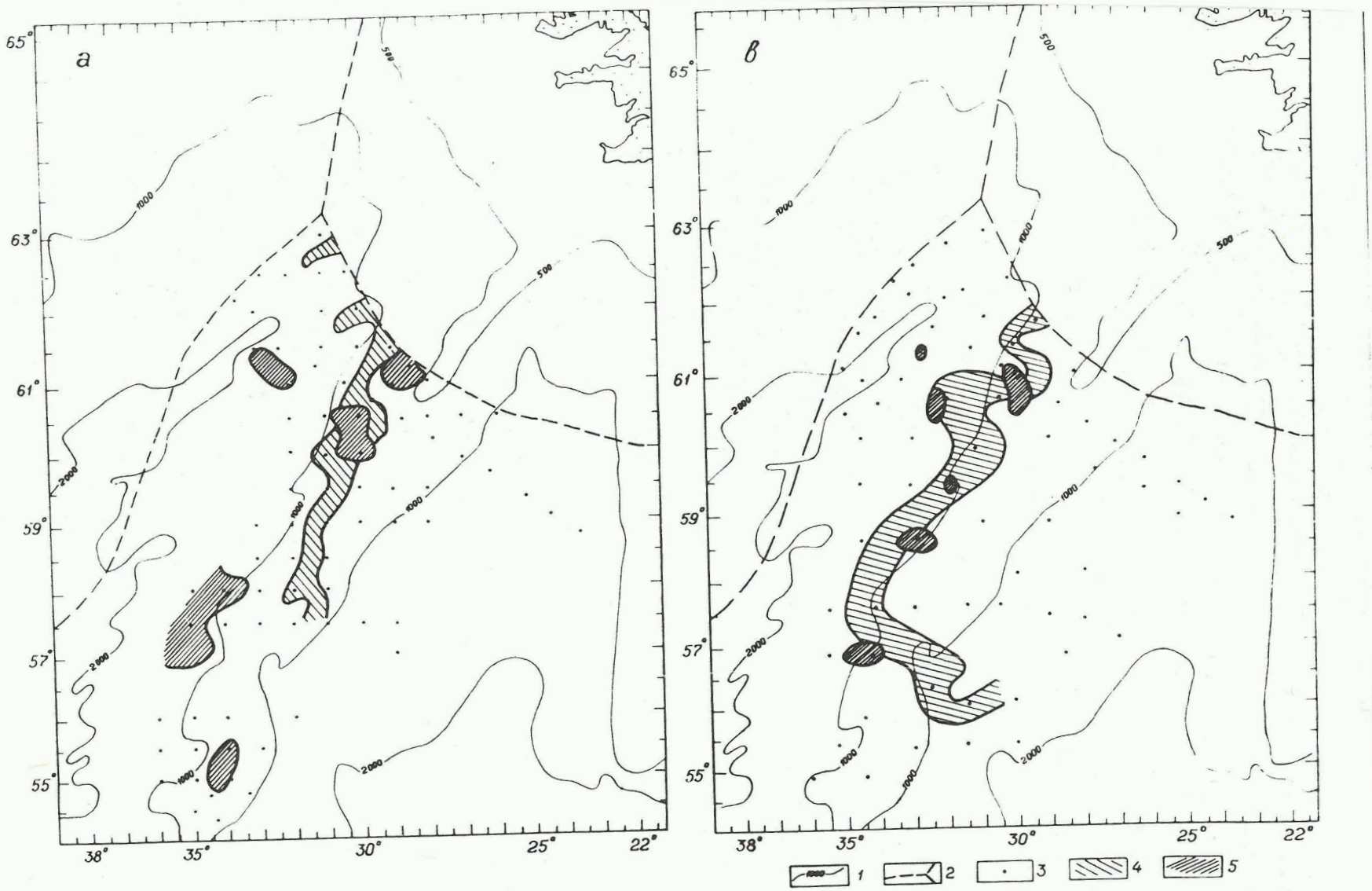

Fig.1. Areas of optimum thermohaline conditions for redfish aggregations formation (4) and their actual location (5) in spring 1990 (a) and 1991 (b).

1 - isobaths, m; 2 - fishing zones boundaries; 3 - oceanographical stations

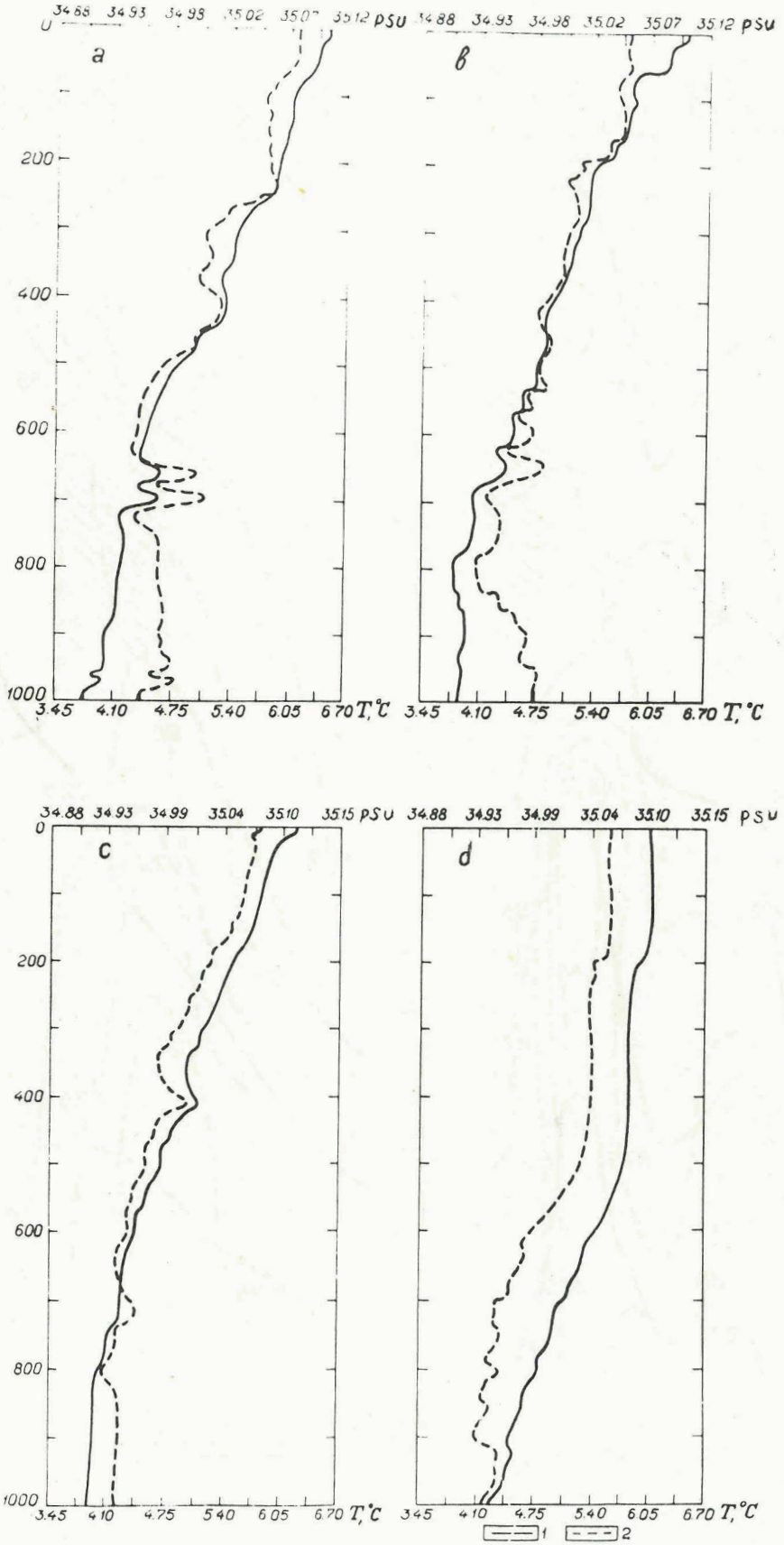

Fig.2. Temperature (1) and salinity (2) profiles in areas of redfish concentrations in spring 1990 (a,b) and 1991 (c,d)

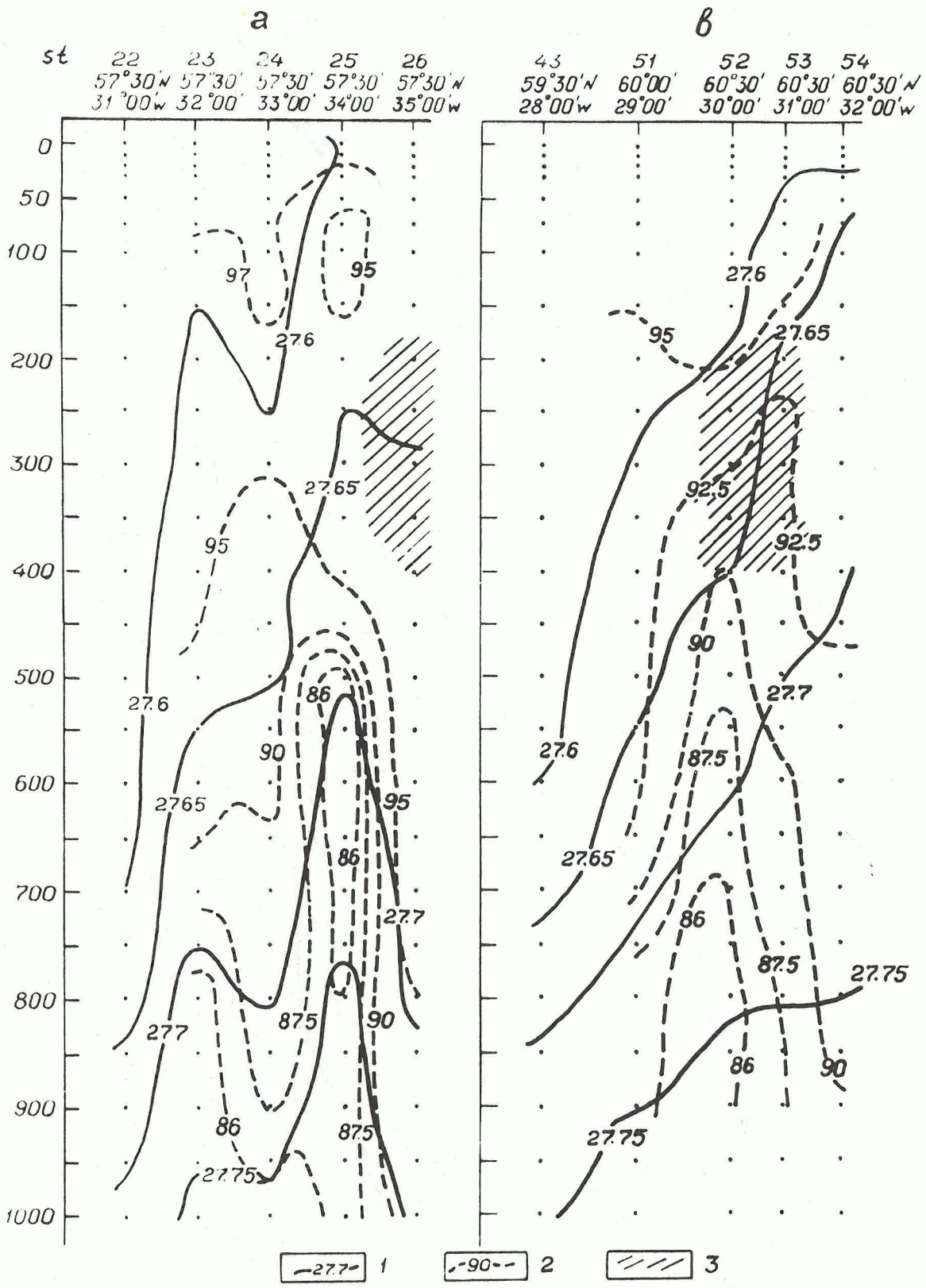

Fig.3. Distribution of convencional density (1) and dissolved oxygen (2) in areas of redfish concentrations (3) in spring 1990 (a) and 1991 (b)