International Commission for the Northwest Atlantic Fisheries

Serial No. 5243
(D.c.1)

ICNAF Res. Doc. 78/VI/72

ANNUAL MEETING - JUNE 1978

Peculiarities of distribution of surface plankton in water masses of Flemish Cap Bank in the spring-summer period of 1970-1977

by

N. V. Plekhanova and V. M. Ryzhov
Polar Research Institute of Marine Fisheries and Oceanography (PINRO)
Murmansk, USSR

ABSTRACT

An analysis of the seasonal dynamics of phyto- and zooplankton development is given on the basis of a series of the eight-year plankton investigations in the Flemish Cap Bank area and factors determining the high bioproduction in this area are considered in the paper. Data on the species composition and quantitative characteristics of plankton population in the upper 50 m layer are shown. The role of certain organisms in general bioproduction of the area is demonstrated.

INTRODUCTION

Plankton investigations in the fishing areas of the North-western Atlantic are characterized with a certain history. More than once plankton of the Northwestern Atlantic was investigated by the Canadian scientists, but in the majority of works the Labrador area and the areas situated southwards of the Newfoundland Banks were analysed. Special works on research of plankton of the Newfoundland Banks were carried out by the Soviet scientists aboard the R/V "Sevastopol" (Cruises 16,17) in March-July 1960 and in the period from summer 1961 to summer 1962 (Semenova, 1962). These investigations permitted to determine the zooplankton composition and its seasonal changes in the areas of the Labrador shelf, Great Newfoundland Bank and Flemish Cap Bank.

At present, the qualitative composition, quantitative characteristics and some peculiarities of seasonal distribution of plankton in those areas have been known (Semenova, 1962; Kanaeva, 1962; Vladimirskaya, 1962; 1965).

The importance of such researches is obvious. Thus, data on abundance of plankton reported by Kusmorskaya A.P. (Kusmorskaya, 1960) well correlate with data on richness of fish stocks in the Newfoundland area. The high and sustainable catches of redfish are registered in the periods of their intensive feeding with plankton and a positive correlation between the feeding conditions and survival of cod larvae is revealed (Sysoeva, 1964).

Due to the increasing intensity of international fishery on the Flemish Cap Bank it is important to know the basic principles of forming the food supply in the above-mentioned area aimed at its potential productivity determination.

Determination of peculiarities of plankton distribution in the central part of the Flemish Cap Bank in the spring-summer period of 1970-1977 and its most productive sectors can be attributed to the first stage of this work, which will permit later on to start the studying of plankton in other parts of the area and the establishing of its role in the feeding of the larvae and young of commercial fishes.

MATERIAL AND METHODS

The present paper is based on 152 plankton samples collected with a Juday net (a 37 cm diameter of the opening, gauze No.38) in the 0 - 50 m layer on the Flemish Cap Bank along 47°N (Section 6A) in March-June 1970-1977 according to the VNIRO methods.

As a result of these researches the species composition of plankton, its quantitative characteristics and peculiarities of distribution by the area and water masses were determined. It should be noted that using of net collections for characteristic of phytoplankton permitted to take account of only large cells and mass colonial forms of plankton algae.

The chart of stations of plankton collection (Fig.1), the diagram of variations of abundance and plankton biomass, temperature and vertical water stability (Fig.2), the diagram of variation

of age composition of Calanus finmarchicus (Fig.3) are presented.

Numbers of the stations are taken conventionally (Stations 1-8) as the collection of plankton from year to year was carried out at the same stations. Charts of variation of Calanus age composition, of distribution of abundance and plankton biomass, of temperature and vertical water stability are constructed by the long-term means.

RESULTS OF OBSERVATIONS

There is a certain relationship between plankton distribution in the area and water masses interaction of different origin.

According to our data the most intensive and prolonged development of phyto-and zooplankton is typical for the stations situated in these zones.

Phytoplankton of this area is presented by cosmopolites of diatoms and peridinea. March can be accepted for the beginning of vegetation when the number of algae cells reaches hundreds of specimen per m^3. However, the most intensive development of phytoplankton is marked in April-May when the diatomaceous complex presented by genera Fragillaria, Chaetoceros, Thalassiosira, Rhyzosolenia vegetates intensively. The number of cells in this period amounts to hundreds of thousands-millions per m^3. As far as the solar heating of the photic layer and appearance of significant stratification that hinders the entering of biogens from underlayers, the diatomaceous complex takes place instead of the mixed one when large peridinea Peridinium depressum, Ceratium longipes play the greater part, especially as to biomass.

Besides, abundance of diatoms of the summer complex Coscinodiscus occulus-iridis, Thallasiothrix longissima, Rhyzosolenia styliformis, Rh. hebetata f. semispina which in the greatest numbers are met with on the extreme stations of the section both in the west and in the east, is increasing in June. Their abundance often exceeds tens of thousands of cells per m^3 .

The species composition of zooplankton on the Flemish Cap Bank is mainly presented by the boreal oceanic complex. Usually these are Calanus finmarchicus, Oithona atlantica, Thysanoessa longicaudata, Metridia lucens, Tomopteris.

Cold water organisms Calanus hyperboreus,C.glacialis,Metridia longa occur in small numbers (1-2%) and their abundance is increasing to 8% only in "hydrologically cold" (Burmakin,1972) and "hydrologically moderate" (Burmakin,1976) years. Such cold water forms as Clione limacina,Limacina helicina are found in cold and moderate years,most commonly they being observed in the western part of the area where the influence of the Labrador Current is mostly visible.

On the whole by the area the species composition of zooplankton from 1970 to 1977 has more or less a constant,only abundance of some zooplankters changed by years and during a season. Thus,in May 1972 the mass development of Oikopleura labradoriensis reached 653 spec/m^3 against the long-term mean of 33 spec/m^3,while in June 1975 on the station No.5 Calanus finmarchicus had the larger abundance (4213 spec/m^3) against the long-term mean 1403 spec/m^3.

From March to June Copepoda makes up the bulk of zooplankton. The most numerous are C.finmarchicus (61-77%) and Oithona similis (20-29%). In March zooplankton is presented mainly by C.finmarchicus and Oithona similis;in April the plankton stages of Echinodermata are often found together with Calanus and the young Euphausiacea ;in May Echinodermata are not found but Temora longicornis,Acartia longiremis appear.

According to both literature data (Vladimirskaya,1962;1965) and ours (Flekhanova,Ryzhov,1976) the area investigated can be regarded by zooplankton abundance and biomass as highly productive. Over the spring-summer period abundance and biomass of zooplankton makes up on the average 2229 spec/m^3 and 315 mg/m^3,respectively. At the same time it should be noted that during the whole period observations abundance and biomass of zooplankton on the extreme stations of the section was higher than on the central ones (Fig.2).

With the seasonal rise in water temperature the increasing of zooplankton abundance to 316-3639 spec/m^3 (March-May) and biomass to 193-487 mg/m^3 (March-June) are to be observed on the whole of the area. It occurs as a result of the mass spawning of Calanus and growth of its young as well as of the appearance of summer zooplankton. As for decreasing of zooplankton abundance

to 3074 spec/m^3 in June, it occurs probably due to the end of Calanus spawning.

As an example for analysis of zooplankton development in the given period C.finmarchicus was taken being its most widely-distributed species (Fig.3). In March C.finmarchicus is in pre-spawning condition (females prevail in the population, eggs and nauplii are singly found). In April the mass spawning of Calanus and the development start of its juvenile are to be observed (I,II copepodite stages predominate in the age composition of the population, eggs and nauplii are found in large numbers). In May the growth and development of the young Calanus are being continued, I,II,III copepodite stages prevail; eggs and nauplii are observed in great numbers, especially on the stations 1,2,3,7,8, though their abundances assume the lower values compared to those in April (Fig.3). In June the spawning of Calanus comes basically to an end (III,IV copepodite stages prevail in the population, eggs are not found and nauplii are observed in small numbers) and the young Calanus (at I,II,III copepodite stages) are found in great numbers only on the extreme stations of the section (Fig.3). Thus, the more intensive spawning of Calanus coincides with the mass development of phytoplankton. The beginning of a biological spring in the Flemish Cap Bank area falls on the middle-end of April. The abundance of phyto- and zooplankton of separate sectors of the area (Fig.3) confirm the known statement about the raised productivity of zones adjacent to the areas of water masses interaction different by genesis (Vladimirskaya et al., 1976).

CONCLUSIONS

1. The long-term investigations in the spring-summer period of 1970-1977 on the Flemish Cap Bank showed that the pattern of phytoplankton development is determined by different degree of algae-cosmopolites dominating in the waters of the given area: in spring these are of a diatomaceous complex and in summer-of the mixed diatomaceous-peridinean one. On occurrence of the summer stratification of the photic layer the mass vegetation

of phytoplankton depends on zones of interaction of different water masses.

2. Zooplankton is mainly presented by one boreal oceanic complex which assumes a comparatively constant value. During a season the abundance of only some zooplankters is changing;the species range of complex changes slightly. The tendency for increasing of zooplankton abundance is maintained from March to May while biomass increases from March to June.

The largest concentrations of zooplankton,the mass and prolonged spawning of Calanus correspond to places with the most phytoplankton development.

ACKNOWLEDGEMENTS

The authors express their deep gratitude to Burmakin V.V. for help in the interpretation of hydrological data.

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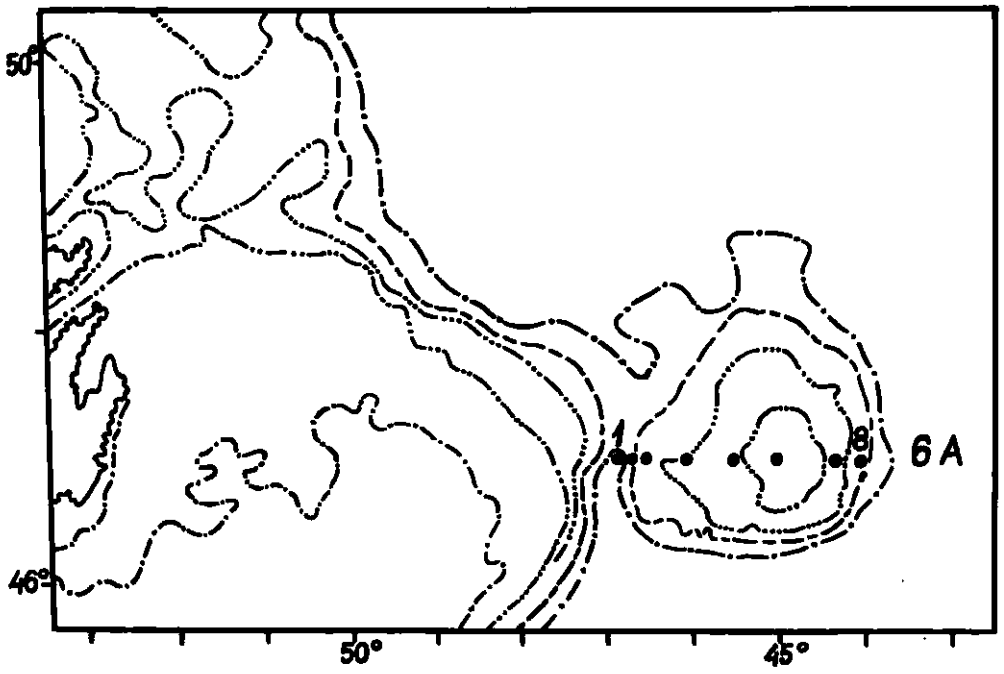

Fig.1. The chart of stations of plankton collections in the Flemish Cap Bank area in the spring-summer period of 1970-1977

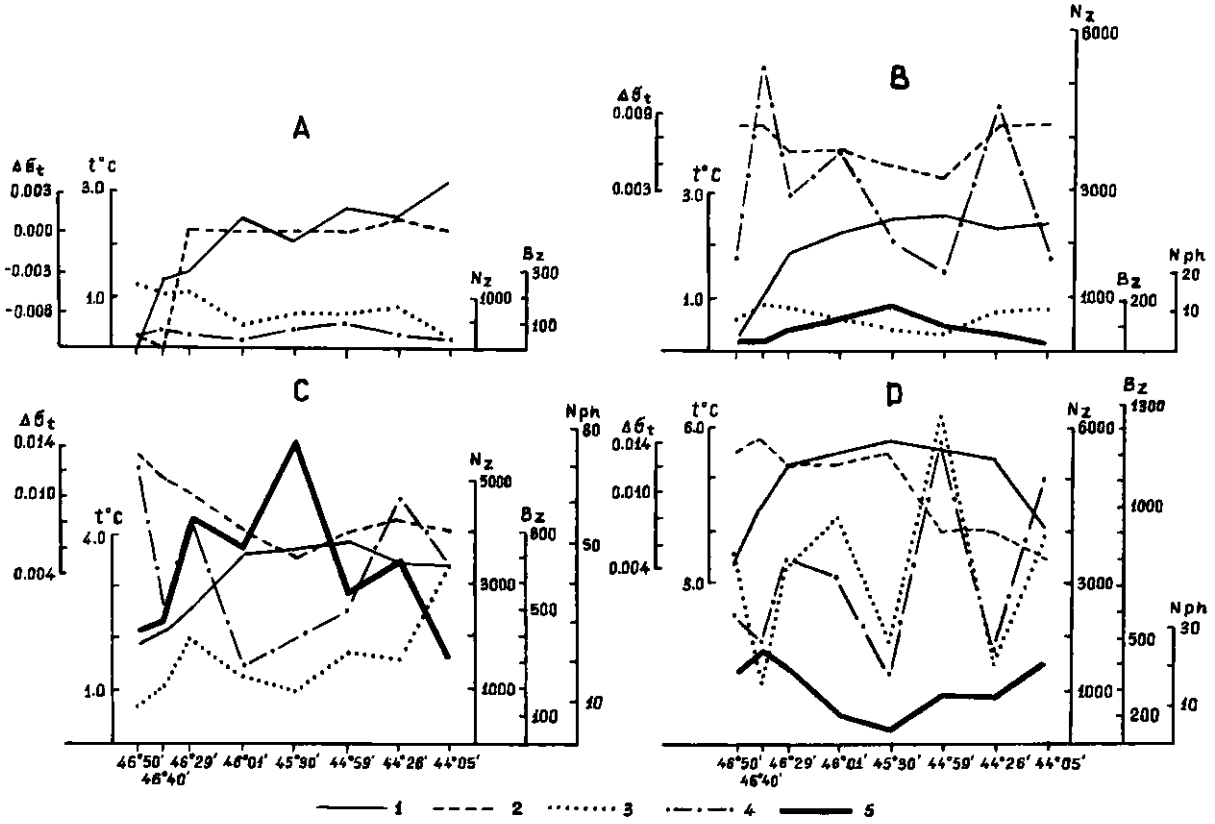

Fig.2, Changes of the long-term means of plankton abundance and biomass, of temperature and water vertical stability of the 0-50 m layer in the Flemish Cap Bank area (A - March, B - April, C - May, D - June)
Symbols:
1 - t°C temperature
2 - $\Delta\sigma t$ density gradient (vertical stability)
3 - B_z biomass of zooplankton, mg/m^3
4 - N_z abundance, spec./m^3
5 - N_{ph} abundance of phytoplankton, tens of thousands/m^3

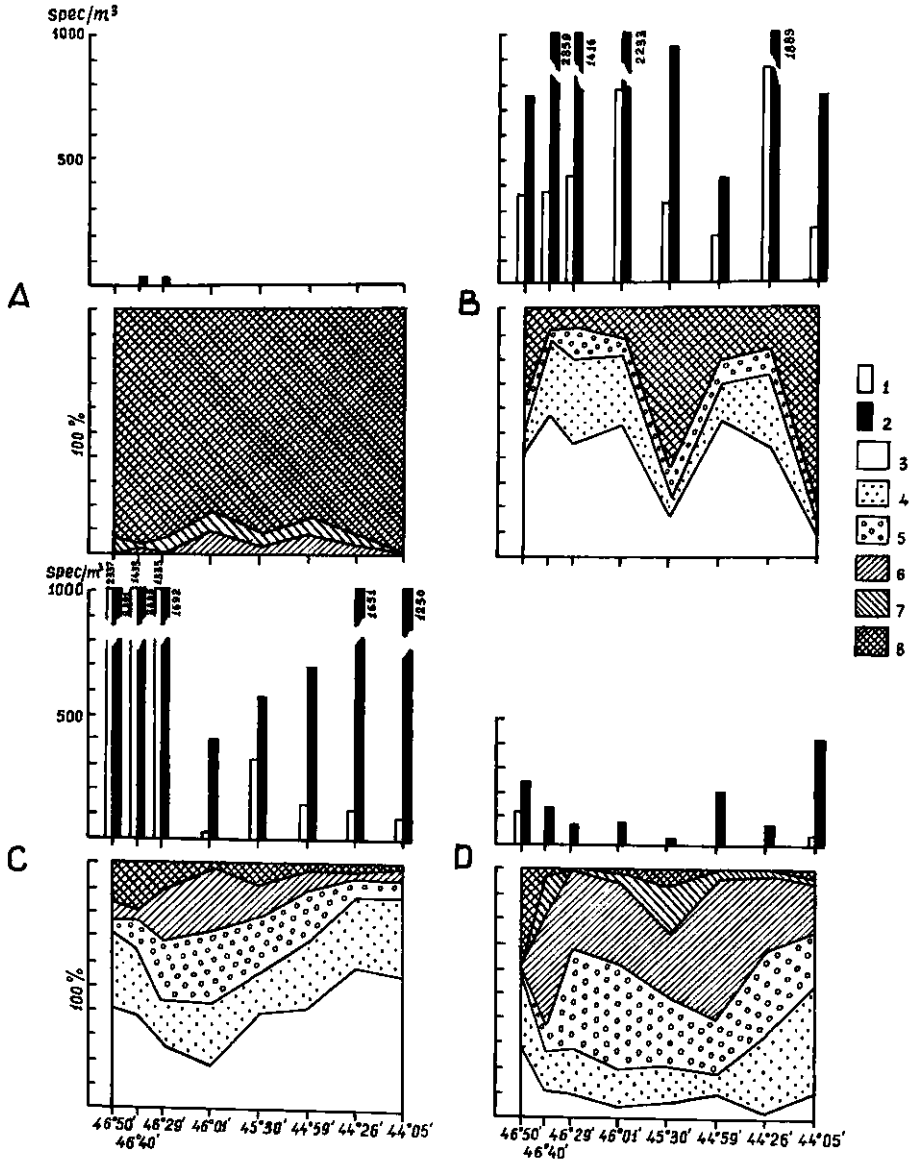

Fig.3. Change of the age composition of Calanus finmarchicus in the Flemish Cap Bank area in the spring-summer period of 1970-1977 (A - March, B - April, C - May, D - June)

Symbols:

I - eggs; 2 - nauplii, in stages; 3 - I copepodite stage; 4 - II copepodite stage; 5 - III copepodite stage; 6 - IV copepodite stage; 7 - V copepodite stage; 8 - VI copepodite stage.(♀)