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The Soviet shrimp investigations in the West Greenland Area in 1976

by

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I N T R O D U C T I O N

The Soviet investigations on distribution, biology and behaviour of shrimp in the area off the West Greenland were continued in 1976. In July-October the scientific scouting vessels " Medvezhy ", " Persey III " and " Kronstadt " undertook the observations on the bank slopes and in the underwater deeps in the area situated between 66° and 71°N. As in 1975 dense shrimp concentrations were observed in the Holsteinsborg Deep, on the western and northern slopes of the Store-Hellefiske Bank. On the basis of data obtained a specified assessment on the shrimp stocks in the ICNAF Sub-area 1B is given.

M A T E R I A L A N D M E T H O D S

The catching of the shrimp was carried out with bottom trawls with selective net and escape valve for fish. The gear used is a trawl with a cod-end mesh size of 18 mm (knot-to-knot). The application of the modernized fishing gears allowed to decrease the by-catch of the young fish. The catches taken by the Soviet vessels constituted 5-10 centners per one hour trawling.

697 scouting trawlings, 22 biological analyses, 13 hydrobiological stations, 20 hydrological stations, 105 water temperature measurements, 10 submersions of the hydrostate " Sever - 1 " and 16 settlings of the camera " Triton " were carried out in the area of investigations.

The measurements of shrimp, determination on sex and maturity stages of gonads were conducted due to methods by Rasmussen, B., 1953; Allen, J., 1959. The stock of shrimp concentrations observed was assessed by the method of instrumental trawl survey and underwater observations (Berenboim, B.I., Zaferman, M.L., Klimenkov, A.I., Lysy, A.Yu., Umakhanov, A.K., 1976).

The classification by M. Lebour (1940) was applied to determination of the larvae stages.

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D I S T R I B U T I O N A N D B I O L O G Y

In 1976 the commercial concentrations of shrimp were registered on the western and northern slopes of the Store-Hellefiske Bank, and also in the Holsteinsborg Deep (Fig.1). The best indices while catching the shrimp (the catch per effort unit) are obtained on the western slopes of the Store-Hellefiske Bank over a depth range between 220 and 300 m, where the interaction of the West Greenland and Baffin Land Currents waters has been observed. As in 1974-1975 the water temperature near bottom in the areas of shrimp concentrations fluctuated from 1.6 to 2.5°C, but an influence of relatively cold waters was marked in the 50-150 m layer (Fig.2). The stability of the polar hydrological front zone and cold waters wedge in considerable degree determined the distribution and density of shrimp concentrations. In contrast to the last year the changes in the catches related to the temperature conditions variations have been observed more often. At the stabilization of hydrometeorological regime the density of the shrimp concentrations increased, especially in clear weather.

Due to the data of observations from hydrostate " Sever-1 " and near-trawl camera, the density of shrimp concentrations in the near bottom 10 m layer was considerably higher in the

day-time, than at night. The transitionals actually migrated into the upper layers up to 150 m and higher during the night hours. The transitionals constituted 92.5%, females - 7.5% in the catches taken with pelagic trawl; but in the bottom catches transitionals constituted 42% and females - 58%.

In 1976 the shrimp spawning in the Store-Hellefiske Bank area started in late August and it insignificantly differed by its intensity from the spawning in 1975 (Fig.3). The transitionals and females as usually made up the bulk of the commercial catches (Fig.4). Size-weight composition of concentrations from the offshore waters in the ICNAF Subarea 1B had no sufficient changes for the last three years of fishing. The modal carapace length of transitionals was 22-23 mm, and of females - 26-27 mm. An average weight of shrimp was 9.2 g. The by-catch of small shrimp weighted less than 3 g constituted less than 1%.

In August-September while sampling the plankton with near trawl net (the trawl opening diameter - 50 cm, gas N° 140) a great number of larvae *Pandalus* of 4-6 stages was marked. The fact of occurrence of shrimp larvae in the near bottom layers in the Store-Hellefiske Bank area with due regard for a well-known scheme of the Davis Strait Currents (Kiilerich, A., 1945) is the confirmation of our hypothesis (Berenboim, B.I., Zaferman, M.L., Klimenkov, A.I., Lysy, A.Yu., Umakhanov, A.K., 1976) concerning the drift of the larvae of pelagic stages transported with the West Greenland Current waters (Fig.5). An analogous conclusion was drawn by Smidt (Carlsson, D. and Smidt, E., 1976), who on the basis of the long-term investigations explained the existence and recruitment of concentration of shrimp in the Upernavik district because of a wide spreading of larvae and their drift in the northern direction.

Thus, shrimp concentrations in the offshore waters of the Store-Hellefiske Bank can be considered as populations of semi-dependent type, recruitment to which depend not so much upon the own reproductive features as also upon the intensity and direction of the larvae drift from more southern areas.

A S S E S S M E N T O F S T O C K S

The estimates of the total biomass of the shrimp concentrations in the offshore waters of the ICNAF Subarea 1B were carried out due to the method described in our paper (Berenboim, B.I., Zaferman, M.L., Klimenkov, A.I., Lysy, A.Yu., Umakhanov, A.K., 1976) with application of the newest data on the area, density and vertical development of concentrations.

Due to the data of the observations from hydrostate and underwater photography, the average density of shrimp concentrations in the 1 m layer from the ground was defined as:

$\bar{\rho}_1 = 0.619 \text{ m}^{-3}$, that was by 23 times higher than that in the 150 m layer. Therefore, the assessment of shrimp stocks was given by us differentially by the near-bottom layer and upper ones. In the day-time the shrimps were observed up to the height of 150 m, but at night - from the ground up to the surface. The area of the densest part of the concentrations constituted 1 250 miles².

The value of the concentration biomass in the 1 m layer from the ground at the mean weight of one specimen of shrimp $q = 9.2 \text{ g}$ was the following:

$$G_1 = 3.43 \cdot 10^6 \cdot 0.619 \cdot 1250 \cdot 9.2 \cdot 10^{-6} = 24416 \text{ tons}$$

The biomass of the shrimp concentration in the 150 m layer at the mean specific density $\bar{\rho}_{150} = 0.027 \text{ m}^{-3}$ was equal to:

$$G_{150} = 3.43 \cdot 10^6 \cdot 0.027 \cdot 150 \cdot 1250 \cdot 9.2 \cdot 10^{-6} = \\ = 159752 \text{ tons.}$$

Mean specific densities, obtained in the day-time were used in the estimates.

The total biomass of the shrimp concentration on the western slopes of the Store-Hellefiske Bank was:

$$G = G_1 + G_{150} = 24416 + 159752 = 184168 \text{ tons.}$$

DISCUSSION ON RESULTS

The stock of the shrimp in the offshore waters of the ICNAF Subarea 1B due to the results of the survey 1976 is in a good state inspite of the discontinuous intensive fishing. While catching the shrimp over the area of 1 600 miles² the capacity of the Soviet vessels was on the previous level (5-10 centners per hour trawling).

The assessment of the data obtained allows to judge, that the fishing didn't noticeably influence upon the size-weight and age compositions. While fishing by trawls with a mesh size of 18 mm (knot-to-knot) in 1974-1975, the 4 and 5 year-old shrimps with carapace length of 22-27 mm constituted over 80% of the catches.

By the method of the instrumental trawl survey and underwater observations the total biomass of the shrimp in the offshore waters of the ICNAF Subarea 1B was evaluated as to be equal to 184 000 tons (due to the densest part of the concentrations). The obtained value of the total stock is to be considered as an approximate one due to some reasons.

1. Due to the data available it's impossible to evaluate the annual fluctuations in abundance, the strength of the year classes, the conditions and direction of the larvae drift.
2. Up to the present time, the effect of the hydrometeorological conditions on the distribution and behaviour of shrimp has been poorly studied.
3. While the determination of the average density and the value of the vertical development of concentrations, the data were obtained only on large specimens.

An average weight of shrimp in the formula of the stock estimate was determined by samples from the commercial catches.

For the purpose of assessment on total shrimp stock in the West Greenland area, rational exploitation of concentrations and biological basis of yield quotas we consider to be advisable to continue the international shrimp investigations in the following trends:

1. Determination on the genetic relationship between the populations from the different areas of West Greenland.
2. Development of the methods of shrimp stock assessment, including the application of the instrumental methods.
3. Definition of the influence of the hydrometeorological conditions upon the distribution and behaviour of shrimp.
4. Continuation of the work on development of fishing gears and selectivity of shrimp trawl meshes.

It is necessary to establish a minimum mesh size and introduce the scientifically founded yield quotas as the measures on protection of shrimp stocks in the West Greenland area.

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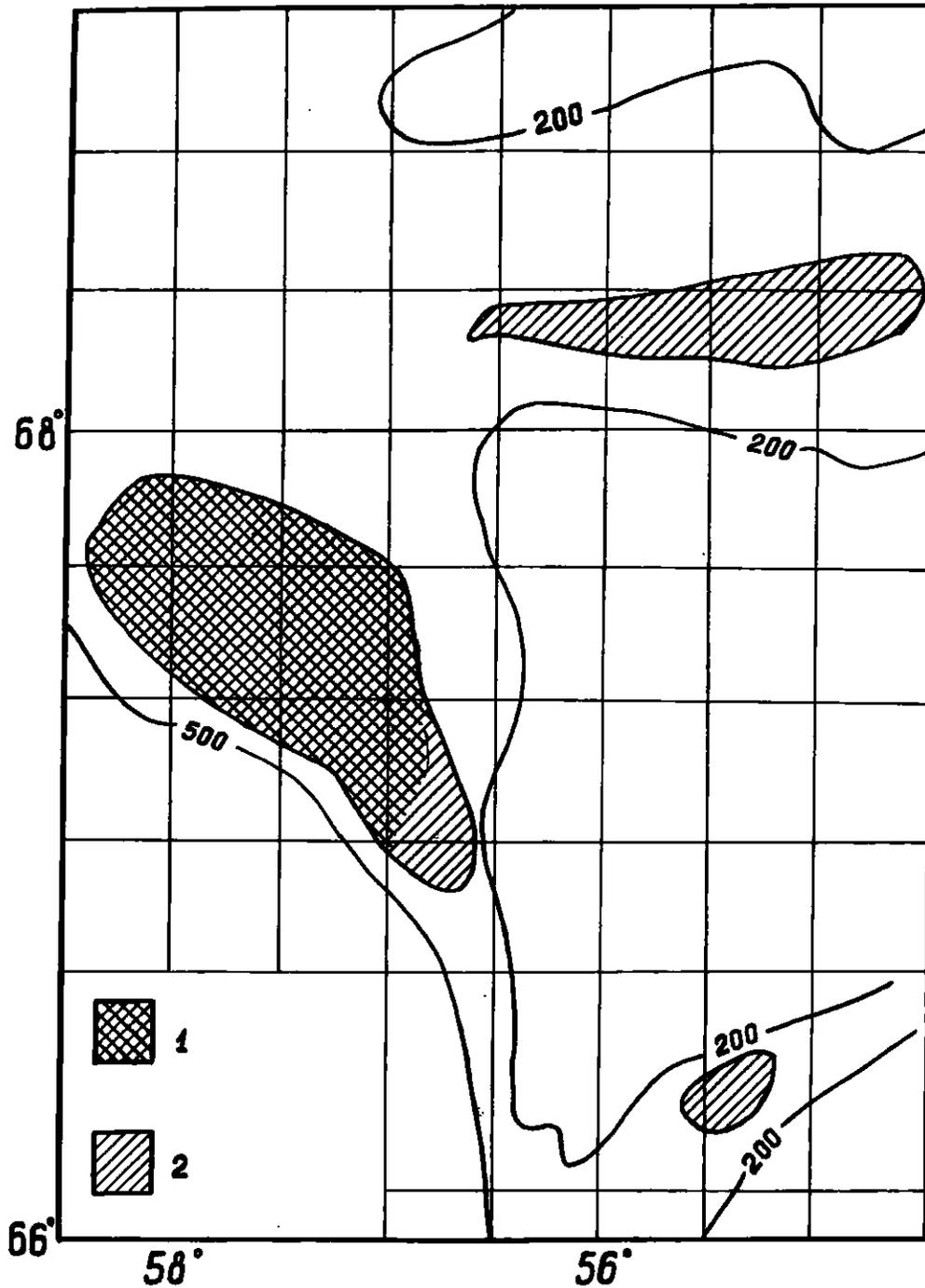


Fig.1 Distribution of shrimp concentrations in the offshore waters of the ICNAF Subarea 1B. 1 - shrimp catches (5-10 centners per hour), 2 - shrimp catches (less than 5 centners per hour).

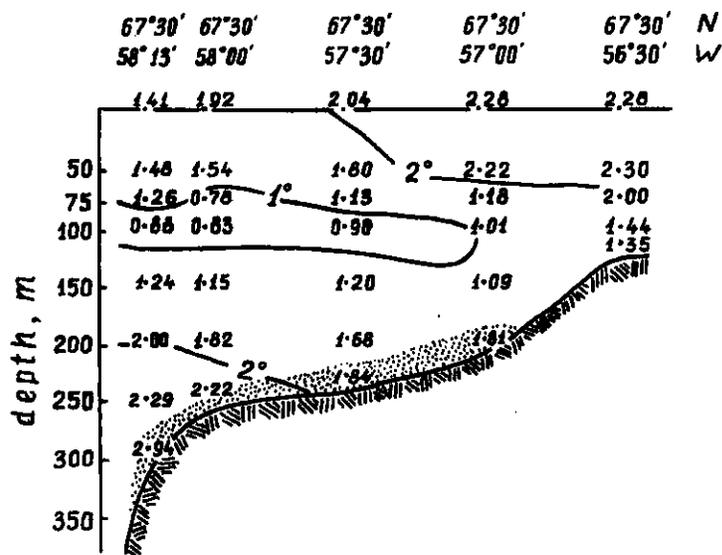


Fig.2 Vertical temperature distribution in the area of shrimp concentrations on the western slope of the Store-Hellefiske Bank (dotted areas indicate concentration of the shrimp).

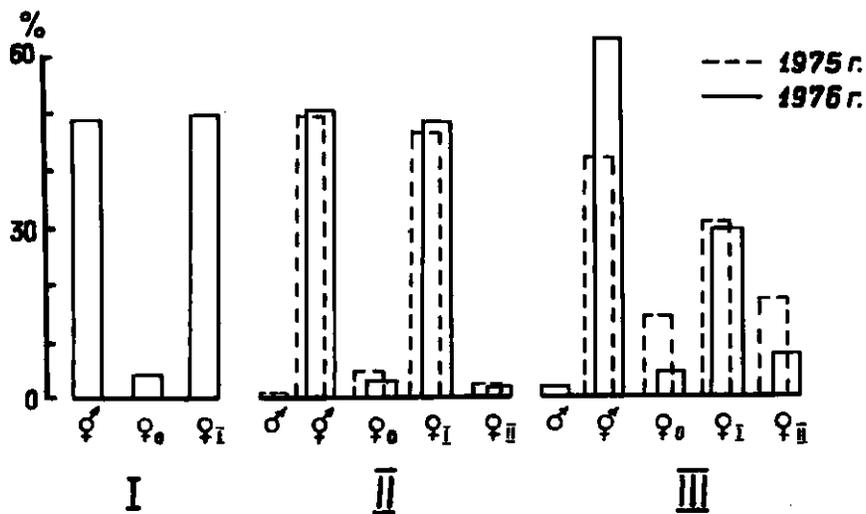


Fig.3 Relations between the sexual groups in the shrimp concentrations on the Store-Hellefiske Bank in August-September 1975, in July-September 1976 (♂ - males, ♀ - transitionals, ♀₀ - females not participating in spawning, ♀ᵢᵢ - females with eggs on pleopods, ♀ᵢ - females with developed oocytes in gonads.)
I - July, II - August, III - September.

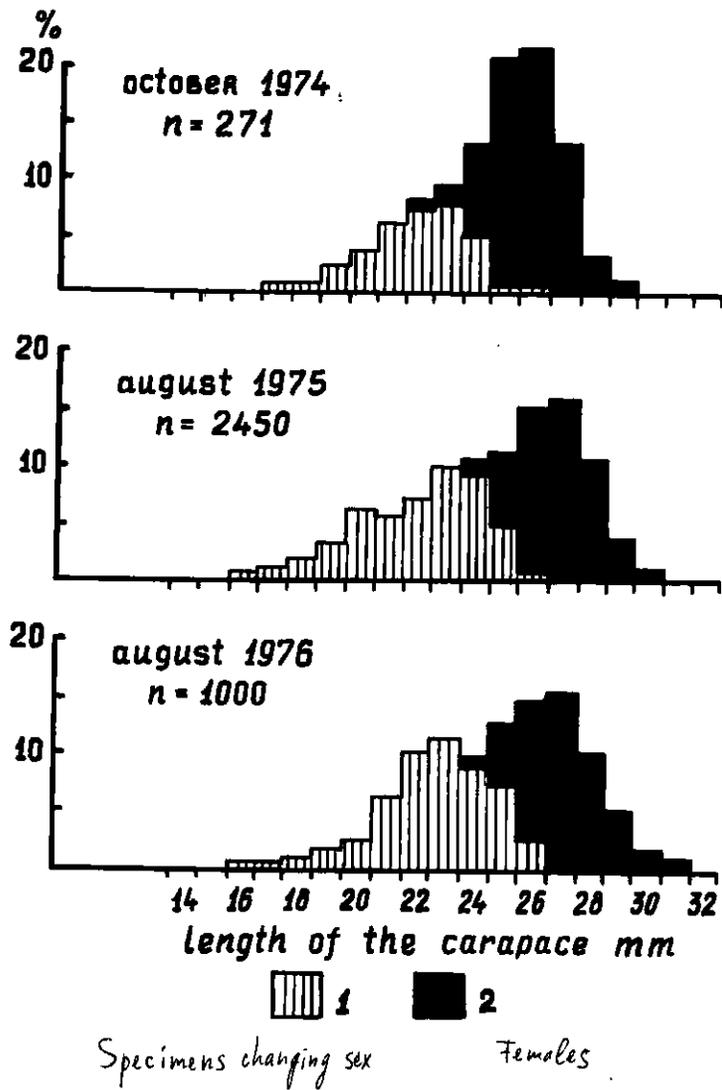


Fig.4 Size composition of shrimp concentration on the Store-Hellefiske Bank in 1974-1976.

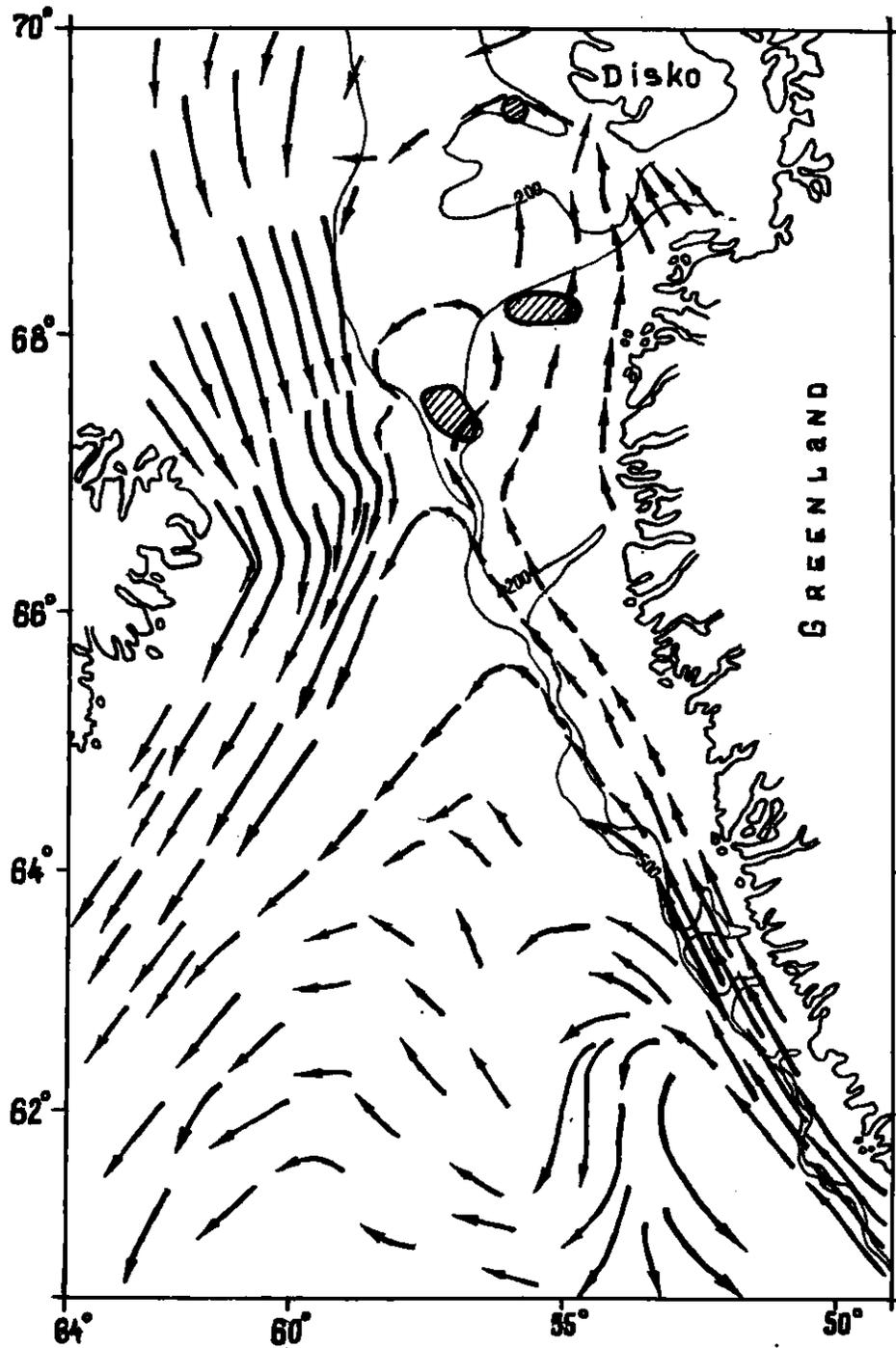


Fig.5 The areas of *Pandalus borealis* larvae occurrence in the West Greenland and a scheme of the Davis Strait currents (Kiilerich, 1943). /shaded areas indicate larvae concentrations/.