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Estimation of ecosystem changes exemplified by fish community from the Irminger Sea as a result of active warming in the North Atlantic in the last decade

by

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EXTENDED ABSTRACT

Perennial observations in the World Ocean waters have shown, that the biological cycles of fish are closely connected to the natural cycles (hydrographical) in the sea and depend on factors, forming them (Beklemishev, 1969). The distribution of some of fish species in the areas with certain environmental conditions allowed us to consider the possibility of biocenosis divisions in the ocean districts of ocean (Vinogradova, Grusov, 1990).

Despite the regular integrated investigations started in the Irminger Sea in 1981, when the dense concentrations of deepwater redfish were found by Soviet scientists (Pavlov et al., 1989), the species composition of the ichthyofauna was only studied enough completely (Gustschin and Kukuyev, 1981; Kukuyev et al., 2000). Data on the structure and distribution of the Irminger Sea fish community were practically absent.

Investigations were carried out on the basis of Russian data from the International Trawl-Acoustic Surveys for redfish stock in 2003 and 2005 the complete assessment of all the fish species from the trawl catches was done for the first time. It has allowed the fish community structure of the Irminger Sea and its spatial and bathymetric dynamics to be considered. Totally 111 pelagic trawls and 125 CTD stations were made in 2003 and 2005.

The materials of the integrated investigations show drastic changes in the Irminger Sea ecosystem. One of the most important reasons of these changes is long-term warming of the waters of Sub-polar Gyre which has been found last decade (Pedchenko, 2005).

The high positive air and SST anomalies have been registered in the Irminger Sea and adjacent areas since 1995 and their maximum was observed during 2003-2005. From the hydrographic data collected in 2003 and 2005, the temperature in the upper 500 m in the Irminger Sea and adjacent waters exceeded the long-term mean level of 1954-2000 by 0.3-1.7 °C. In 2003, the temperature of the Irminger Current water which was maximal during the late 12 years was recorded.

The mentioned increase in temperature within the Sub-polar Gyre during 10 years made changes into the Irminger Sea ecosystem. It has an effect on spatial and vertical distribution of redfish and its aggregations in the layer shallower than 500 m in the feeding area. In connection with the continuation of positive anomalies of temperature in the survey area, the redfish concentration were distributed mainly at the depths of 450-800 m within and deeper then a deep scattering layer. Favorable condition for aggregation of redfish in the layer above 350 m have been noticed only in the southwestern part of the survey area with the temperature of 3.6-4.5 °C.

The data on the habitat characteristics of more then 50 common or abundant fish species from the Irminger sea were obtained. The minimal, maximal and mean weighted values of the sea floor depth, the habitat depth as well as the water temperature and salinity were calculated for each fish species. The analysis of the results showed the considerable differences between the species both in the single habitat characteristics (depth, temperature and salinity) and its ranges and its complex. Some groups of species were revealed related to the depth (deepwater (e.g. Ceratoidea) or shallow water (e.g. Entelurus aequoreus)) and water temperature (coldwater (e.g. Borostomias antarcticus) or warmwater (e.g. Scopelogadus beani)), as well as the species which occurred in the whole range of the depth, temperature and salinity (e.g. Chauliodus sloani).

The species composition and the fish community structure in the four water masses of the Irminger Sea were analysed (the Irminger current water mass, the Sub-Arctic water mass, the Sub-Arctic intermediate water mass and the Labrador Sea water mass). The maximum species number and its maximum range (from 6 to 35) were registered in the Sub-Arctic intermediate water mass, where mean number fish species number per 1 trawling reached 21,7. The species number in the Irminger current and the Labrador Sea water masses consisted approximately 18-19 species per 1 trawling. The minimal species number (13.8 species per 1 trawling) was observed in the Sub-Arctic water mass.

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Three group of species, which distribution was related to the different water masses, were revealed. The first group consisted of the warm water species (Nansenia groenlandica, Evermanella balbo, Melanostomias bartonbeabi and others), which manly occurred in the catches in the Irminger current water mass, despite some specimens could observed in the Sub-Arctic intermediate water mass. The second the most abundant group combined the species which occurred practically in all water masses, but the highest catches registered in the Sub-Arctic intermediate water mass (Bethosema glaciale, Chauliodus sloani, Notoscopelus kroyeri and others). The species from the third group mainly occurred in the catches in the Sub-Arctic water mass, but these species could occur the Sub-Arctic intermediate water mass too (Lampanictus macdonaldi, Bathylagus euryops and others).

Some new species were registered in the catches in the Irminger Sea (Polyipnus polli, Argyropelecus gigas, Neonesthes capensis). Earlier these species occurred only in more southern areas of the North Atlantic.

In opinion of authors, warming-up of the upper layers of Irminger Sea coupled with the increasing advection of the Irminger Current water (‘warm and high saline’) and a weak input of the Labrador Sea Water (‘cold and low saline’) also had an effect on the distribution and density of plankton in the scattering layer and biocenosis species diversity.