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Changes in biomass of macrozoobenthos in the eastern part of the Barents Sea during last century

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Summary
The Barents Sea, located on the border of the boreal and arctic zones, is one of the most productive fishery areas of the Arctic shelf. Benthos is an important component of the ecosystem of this relatively shallow sea. Knipovich Polar Research Institute (PINRO) has a nearly century-old history of the study of benthos in the Barents Sea, the latest of quantitative survey was carried out in 2003-2006. The analysis of the benthos biomass from the Russian part of the Barents Sea showed a considerable effect of climate on benthos biomass. During the cold period in the early 20th century, the average biomass of benthos in the eastern part of the Barents Sea was 149 g · m^{-2}. In the followed warm period (1930-1962) it increased to 230 g · m^{-2}. In the second cold period (1963-1988) the biomass of benthos reduced to 68 g · m^{-2}. The current period is the warmest during the whole interval of investigations in the Barents Sea. The average biomass of macrozoobenthos in 2003-2006 was 335 g · m^{-2}. The result of analysis showed that in the eastern part of the Barents Sea, where the influence of the fishery is low, the average biomass of macrozoobenthos was two- five times higher in the warm periods compare to the periods of cooling.

Introduction

Benthos of the Barents Sea has been studied for over a hundred years. Accumulated during this period the material can be used to determine the impact of climate change on benthic communities. Studies have shown the presence in the Barents Sea four climatic periods since 1900 (Ozhigin et al., 2011). First, a cold, period lasted until 1929. Second, warm, lasted from 1930 to 1962. Third, cold, lasted from 1963 to 1988. The current warm period has been observed since 1989. Thus, by comparing the qualitative and quantitative characteristics of the benthos in each of these periods, we can assess the impact of climate change on benthic communities in the Barents Sea.

Materials and methods

The eastern part of the Barents Sea (north of 71° N and east of 44° E) was selected for analysis due to low level of human impacts. Benthic data from the four periods were analyzed (141 stations from 1924-1929, 205 stations from 1930-1950, 204 stations from 1968-1970 and 164 stations from 2003-2006).

In benthic studies of the 20th century were mostly used the bottom grabs Petersen (0.1 m^2 area of capture, five samples at each station) and the "Ocean" (0.25 m^2 area of capture, two samples at each station). The resulting sample was washed through a 1 mm sieve and processed by taxonomic group on board. During the last survey, the quantitative samples were taken by using the van Veen grab (0.1 m^2 area of capture). At each station, five replicate samples were taken and washed gently on a 0.5 mm mesh size. The retained material was preserved in buffered 4-5 % formaldehyde solution. Following sorting of the samples the animals were preserved in 70-75 % ethanol in laboratory. Organisms were identified to the lowest possible taxonomic level with the help of taxonomists. Animals of each taxon were enumerated and weighed. When estimating biomass the effect of alcohol preservation was taken into account (biomass was recorded as alcohol-preserved wet weight).

Due to the differences in the collection of material, we cannot compare the abundance (numbers of individuals) and species composition for previous and our surveys. However, data on biomass can be used for comparison. To obtain comparable data, station data was converted into metadata of nodes of a regular lattice (100x100) by "Inverse Distance to Power". Nodes, that are not related to the area under consideration, were rejected. The mean biomass in the study area was calculated finding the average biomass in the remaining nodes.

Results and Discussion

During the cold period in the early 20th century, the average biomass of benthos in the eastern part of the Barents Sea was 149 g · m^{-2}. In the followed warm period it increased to 230 g · m^{-2}. In the second cold period the biomass of benthos reduced to 68 g · m^{-2}. The current period is the warmest during the whole interval of investigations in the Barents Sea. The average biomass of macrozoobenthos in 2003-2006 was 335 g · m^{-2}. The result of analysis showed that in the eastern part of the Barents Sea, where the influence of the fishery is low, the average biomass of macrozoobenthos was two-five times higher in the warm periods than in the periods of cooling. Is also possible there is a link between the level of biomass and stability conditions preceding the survey. The first survey was preceded by a few dozen of cold years, which allowed the bottom fauna to adapt to these conditions and to show the value of the average biomass of two times greater than in the survey of the second cold period, which was preceded warming. Stations of the first warm period made substantially immediately after the cooling period, so they showed biomass one and half times smaller than stations of the second warm period, which is performed after 15 warm years.

The distribution of biomass in the cold periods more homogeneous than in the warm one (Figure). This is probably due to the fact that in the eastern part of the Barents Sea in cold years dominated by homogeneous hydrological conditions, and the contrast between different areas is enhanced in warm conditions through a reinforced brings a warm waters from the south-west of the sea.

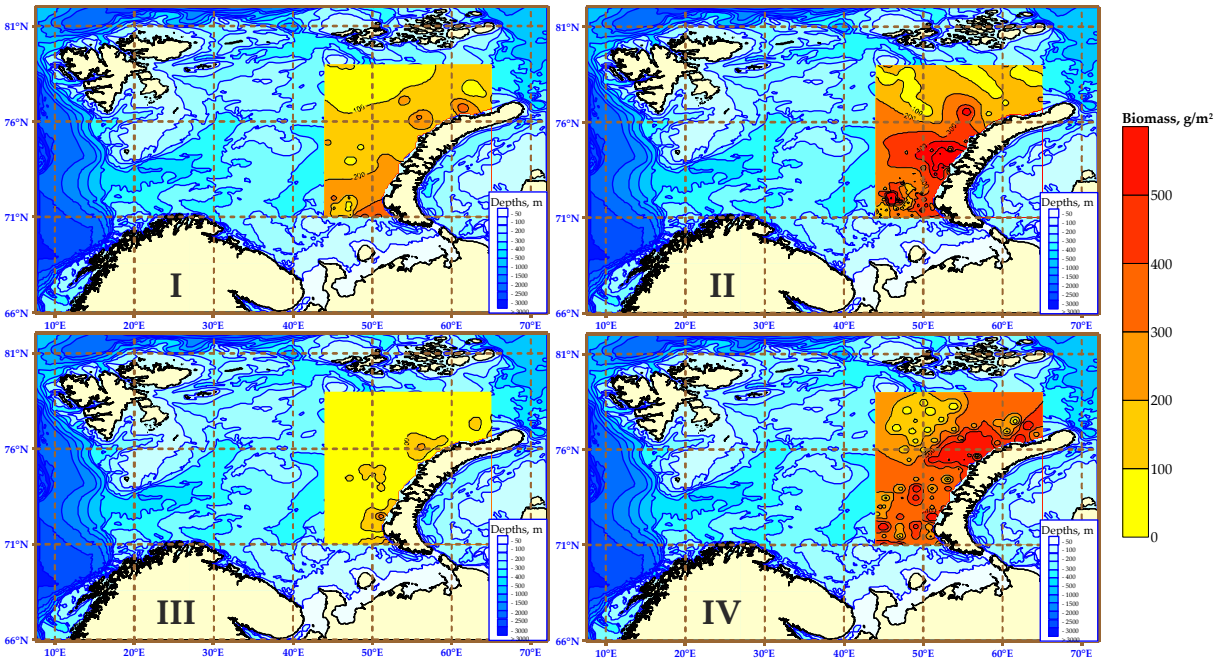

Figure. Biomass distribution of macrozoobenthos in the eastern part of the Barents Sea (I – 1924-1929, II – 1930-1950, III – 1968-1970 and IV – 2003-2006)

References

Ozhigin V.K., Ingvaldsen R.B., Loeng H., Boitsov V.D., Karsakov A.L. 2011. Introduction to the Barents Sea. *In* The Barents Sea. Ecosystem, resources, management. pp. 39-76. Ed. by T. Jakobsen and V.K. Ozhigin.