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# Effect Of Biological Invasions On Eutrophication Of The Baltic Sea

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Eutrophication is recognized as the factor that caused the most serious changes in natural ecosystems of the Baltic Sea. It is known that disturbed ecosystems are particularly vulnerable to biological invasions. The greatest number of discoveries of alien species in the Baltic Sea is confined to the most eutrophic areas - bays and inlets of the southern Baltic, the Neva River estuary. Many colonizing species (for example, the North American crayfish Balanus improvisus, Ponto-Caspian mollusc Dreissena polymorpha) also reach the greatest quantitative development in eutrophic areas. It can be derived into three groups of alien organisms, which actively influence on the processes of eutrophication through alteration of biogeochemical cycles and / or structure of the food web. The first group: these species directly affect the flow of biogenic matter to the aquatic environment. The appearance in the Baltic Sea polychaete genus Marenzelleria, who dug up the soil much deeper (up to 40 cm) than the native inhabitants of the Baltic Sea, has led to a sharp intensification of flows of matter between the water column and sediments. It is shown that the activity of these polychaetes facilitates revenues of biogenic matter from the sediments. It is found that in the area of Stockholm, activity Marenzelleria sp. led to the removal of phosphorus in two times more quantities than by urban wastewater treatment plants; that is associated with a significant reduction of concentrations of phosphate and reduced of water’ trophicity in the Baltic Sea area after the colonization of the Polychaeta. Recently, similar processes have been registered in the Russian part of the Gulf of Finland, where, after the emergence and development of mass polychaetes M. arctia in 2008-2009, the ratio of nitrogen / phosphorus has dramatically increased in the waters of the Gulf, which resulted in a cascading changes in the plankton: decrease in the number of colonies of nitrogen-fixing blue-green algae that cause "blooming" ; the total biomass of phytoplankton and the concentration of chlorophyll "a" has also been decreased. The second group of species contribute to the strengthening or, opposite, weakening of the signs of eutrophication, such as over-development of the planktonic and benthic algae, the deterioration of the optical properties of water. Some manifestations of eutrophication, partly, can be directly related to invasive species. For example, in the number of the Baltic mass development of filamentous algae was caused by recent quantinty outbreaks of colonizing Pacific filamentous algae, Gracilaria vermiculophylla. Alien species in the intertidal communities of tops of the Gulf of Finland (amphipods Gmelinoides fasciatus and Pontogammarus robustoides), that are nourished on algae, in

contrast, are one of the factors limiting the biomass of filamentous algae due to predation. The third group consists of species, whose effect on the manifestation of eutrophication is indirectly implemented through changes in food chains. In the 1990's the Baltic was penetrated by predatory Ponto-Caspian cladocera Cercopagis pengoi. Invasion of Mnemiopsis leidyi has caused fundamental restructuring of ecosystems of the Black and Caspian Seas. In 2006, the infestatin ctenohhore Mnemiopsis leidyi was discovered in the Baltic Sea. However, the quantity and biomass of ctenophores in the Baltic Sea itself is too low to significantly affect the zooplankton community. Competition (primarily for food resources), predation by invasive species, and also the possible influx of parasites by new invasive species, pathogenic to local fauna, can cause changes in the structure of communities of native species. Some indirect results indicate that acclimatization amphipods and mysid shrimp served to the increase the the food supply for fish and, ultimately, increase in the productivity of aquatic ecosystems. Thus, the results suggest a complex interaction of processes of biological invasions, and eutrophication. Invasive species is rightly considered a threat to the environment. Therefore, in the literature to usually focus on the negative aspects of biological invasions. However, introduced materials show that very often the consequences of the new species' activity (biofiltration, aeration of sediments) may facilitate reduction of eutrophication and (or) its negative manifestations, and, in this aspect, it can be assessed as a positive event. This work was supported by a grant of the Ministry of Education and Science of Russia.