[OP 3.5]

Metal Accumulation in Sediments and Whitefish of Kola Peninsula Lakes, Murmansk Region, Russia

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On the basis of research performed on whitefish pathology and the concentration of heavy metals (Ni, Cu, Zn, Co Mn, Sr, Al) in its organs, which has been carried out for the last 20 years in Kola Peninsula lakes, a subject which in various degrees of influence may be attributed to emissions and wastes from mining and metallurgical enterprises, the dependences of metal accumulation and pathologies of whitefish from total and mobile concentrations of heavy metals in sediments have been determined. Whitefish is chosen as a test organism because it is benthophage and final part in the foodweb of metal accumulation from water columns and sediments, and its state is a good index for lake water quality.

The highest accumulating ability in relation to Ni, and a high correlation with total and mobile concentration of this element in sediments, has been noticed in most functionally important whitefish organs - kidney, liver and gills. It can be a good indicator for the pollution of surface waters by this metal. The levels of disease incidence of whitefish is closely dependent on the total and mobile concentrations of Ni in sediments. With increasing total and mobile concentrations of Cu and Zn in sediments, there are decreasing contents of these heavy metals in the functionally important whitefish organs, that is these both are features of metal metabolism and antagonistic interactions with other elements, primarily – Ni. The influence of the increasing concentrations of Cu, Zn and Co in sediments on the whitefish state under water pollution by a number of heavy metals leads to an increasing incidence of disease. The correlation of the incidence of whitefish disease with mobile concentrations are higher (r=0.56–0.85), but they are even sufficiently high with a total concentration (r=0.34–0.85). A combination of the increased concentrations of Ni, Cu, Zn and Co in water and sediments for fishes are more toxic in many times, than for each element separately. The distribution of Mn in whitefish organs from its total and mobile concentrations in sediments differs from the earlier considered metals – negative dependence on the total, positive dependence on the mobile. Therefore, it is possible to conclude that the accumulation of Mn in whitefish organs is determined by the concentration of the mobile forms in sediments. It is accepted that Mn not be considered a very toxic element for water biota. This is also proved in our investigations – parameters of disease incidence in whitefish have negative coefficients of correlation (r=-0.20 – -0.46) with the total and mobile concentrations of Mn in sediments. In zones of influence of mining and metallurgical enterprises, and in territories of natural strontium geochemical provinces of the Kola Peninsula, there is an accumulation of Sr in all vital organs of the fish. Sr is able to be accumulated in all systems of fish organs, to maximum quantities in a skeleton. Increased concentrations of Sr in water and sediments, and its accumulation in the vital fish organs, are connected with the replacement of Ca salts by other elements, in this case Sr. The reliable dependencies of the percentage of diseased fishes from total concentrations of Sr in sediments are revealed. The precise dependence of accumulation of Al in whitefish organs (liver, skeleton, gills) from the contents in sediments is revealed. The increased contents of Al in sediments is marked in the zone of influence of wastewater from the apatite industry, where the concentrations of Al in the gills and skeleton of whitefish is tens time higher than in other lakes.

The unique data on anthropogenous loadings and response of water biota on this influence have been collected. These can be used for the development of theoretical bases of an estimation of anthropogenous influence, its restrictions and reduction.