

EFFECTS OF LONG-TERM RADIATION EXPOSURE ON AQUATIC BIOTA IN LENTIC ECOSYSTEMS WITHIN THE CHERNOBYL EXCLUSION ZONE

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Abstract

Self-purification of the lentic water bodies in the Chernobyl exclusion zone (CEZ) is extremely slow processes and though of the 30 years, past after the Chernobyl NPP accident in 1986, the ecosystems of the majority of lakes, dead channels and crawls possess high level of radioactive contamination of all the components. During 1998-2015 we studied dynamics and bioavailability of the main dose-forming radionuclides in components of lake ecosystems as well as effects of long-term radiation exposure on aquatic biota within the CEZ. The absorbed dose rate for hydrobionts of the researched water bodies was registered in range from 1.3 mGy year⁻¹ to 3.4 Gy year⁻¹. It is determined that the rate of chromosomal aberrations in the roots of the helophyte plants of the most contaminated lakes on average in 2-3 times and in cells of the pond snail embryos in 4-6 times exceeding the spontaneous mutagenesis level, inherent to aquatic organisms. Leukogram analysis of peripheral blood of fish showed the decrease of part of lymphocytes, responsible for the implementation of immunological reactions. At that it is registered increase in the number of granulocytic elements (neutrophils and pseudoeosinophils), responsible for phagocytic function and involved in allergic and autoimmune reactions. Along with changes in leukograms an increased level of morphological damages of erythrocytes (deformation of nucleus and cell membrane, nucleus and cytoplasm vacuolization, pyknosis and lysis of cells, forming of microcytes, schistocytes, double nucleus cells and micronuclei) was determined, which is generally for pray fish in 4-12 times and for predatory fish in 7-15 times higher than in fish from reservoirs with background levels of radioactive contamination. Analysis of the viability of the seed progeny of the common reed at germination in the laboratory showed that in gradient of absorbed dose rate from 0.03 to 11.95 cGy/year for parental plants in lakes, there is a reduction in technical germination (from 93 to 60%), germination energy (from 91 to 30%) and seed viability (from 54 to 38%). At the same time significantly increased the number of abnormalities of seed seedlings: necrosis of roots (from 1.3 to 14.7%); disturbance of gravitropism (from 2.6 to 17.0%); damages of organogenesis (from 4 to 24%) and disturbance of chlorophyll synthesis (from 0 to 2%). Hereby the long-term radiation exposure of aquatic biota in lakes within the CEZ causes reactions, showing the damage of important biological systems. The special significance may acquire cytogenetic and genetic effects resulting from disorders of the genome stability with high probability of appearance in the form of increased mutation rates, decreased fertility and loss of the most sensitive species. Cumulative radiobiological processes can last for many generations allowing currently assume the possibility of incomplete realization of the long-term effects of irradiation. Against the background of the discernible welfare of aquatic biota population in the CEZ, the radiation-induced lesions of biological systems of hydrobionts at different levels of organization could pose a real threat to the manifestations of the negative effects of long-term radiation exposure in the future.