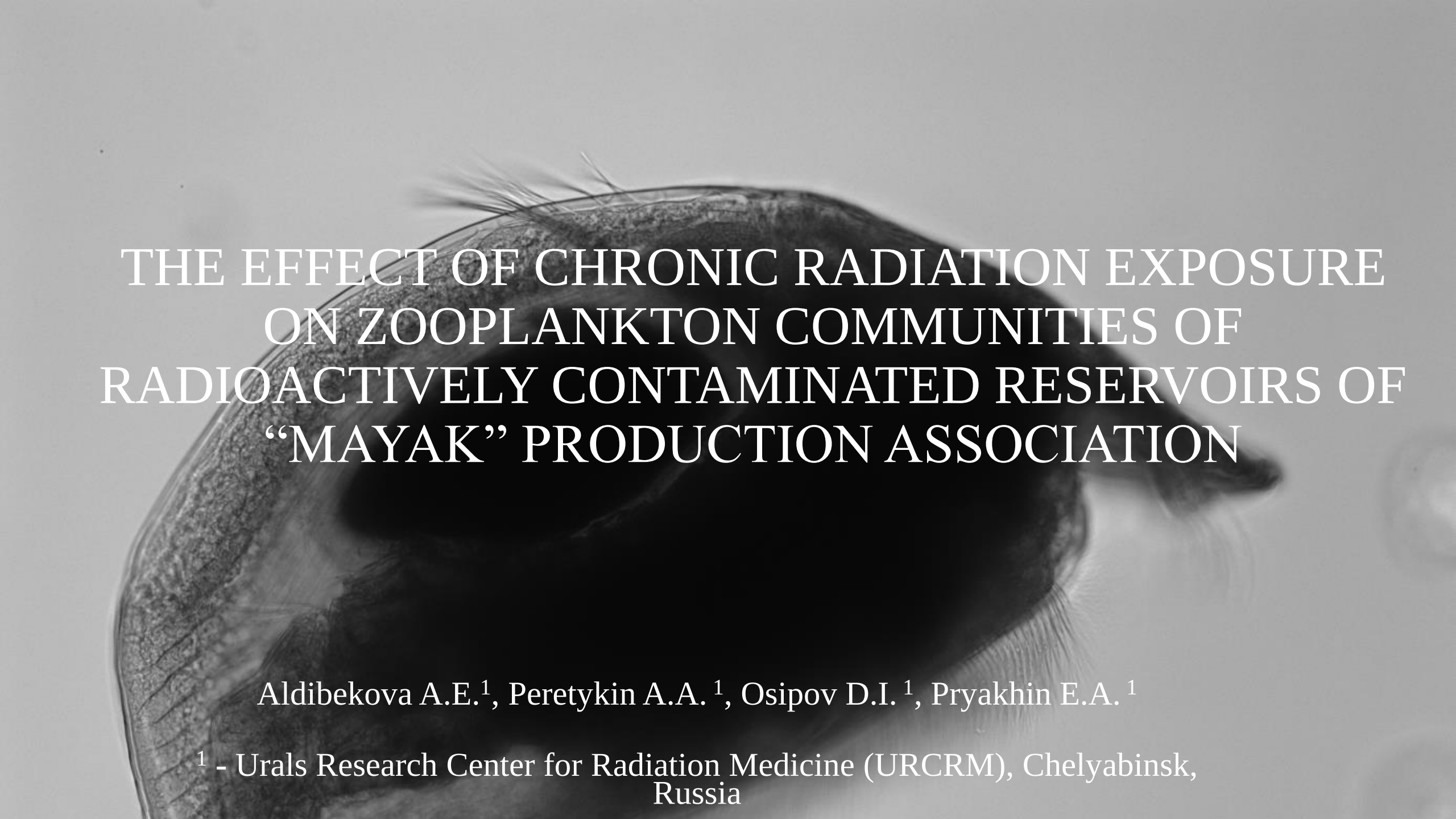

THE EFFECT OF CHRONIC RADIATION EXPOSURE ON ZOOPLANKTON COMMUNITIES OF RADIOACTIVELY CONTAMINATED RESERVOIRS OF “MAYAK” PRODUCTION ASSOCIATION

Aldibekova A.E.[1], Peretykin A.A. [1], Osipov D.I. [1], Pryakhin E.A. [1]

[1] - Urals Research Center for Radiation Medicine (URCRM), Chelyabinsk, Russia

Introduction

The reservoirs of the Techa cascade have been used for many years as storage reservoirs for liquid radioactive waste at «Mayak» Production Association (South Ural, Russia) (Fig.1). Discharge of liquid low-level waste is carried out only in water bodies R-4, and then the water by gravity (through special weirs) sequentially flows into the underlying reservoirs R-4, R-10 and R-11. Reservoir R-17 is an artificial reservoir, which is located in a natural depression in the relief. Radioactive contamination of water and bottom sediments is determined by such radioisotopes as 137Cs, 90Sr and uranium isotopes.

At the same time, there is a pronounced gradient in the content of radionuclides in these reservoirs in ascending order - R-11, R-10, R-4, R-17, which makes it possible to study the radiobiological patterns of the reaction of zooplankton communities. We studied the state of zooplankton communities in the period August-September in 2009, 2010, 2015 and 2016.

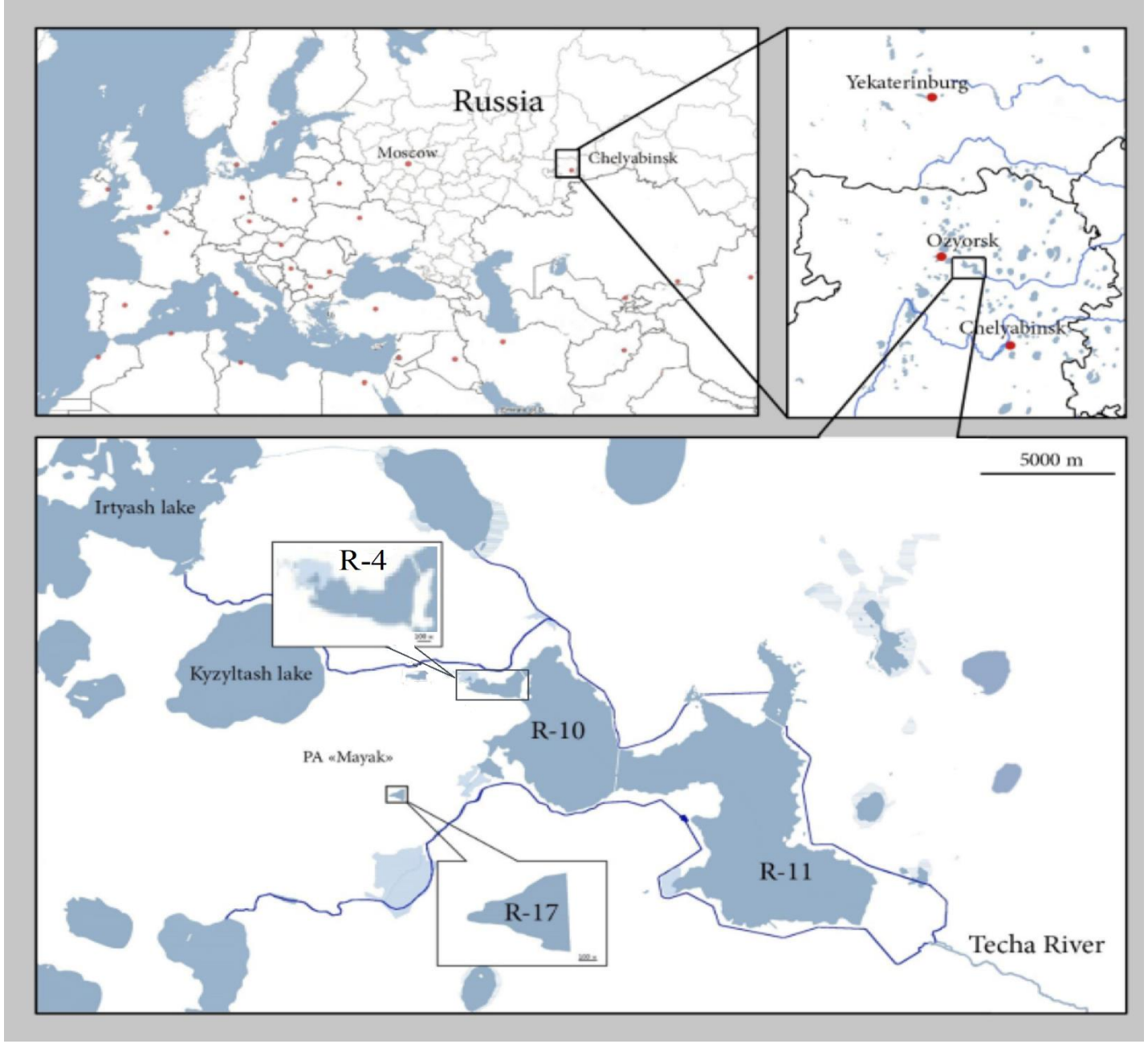

Figure 1. Map of reservoir locations

Results and discussion

The content of ^{137}Cs, ^{90}Sr radionuclides and alpha-emitting radionuclides in water, bottom sediments and zooplankton was determined. The dose rate of exposure to zooplankton is presented in the Table 1 [Pryakhin E. A., 2018].

Table 1. Dose rate for zooplankton , μGy/h

Reservoir	R-11	R-10	R-4	R-17
Dose rate, μGy/h	$1.2x10^2$	$3.5x10^2$	$1.8x10^3$	$4.74x10^3$

Results and discussion

In the studied water bodies, the contribution of rotifera was invariably higher than the contribution of cladocerans and copepods (Fig. 2).

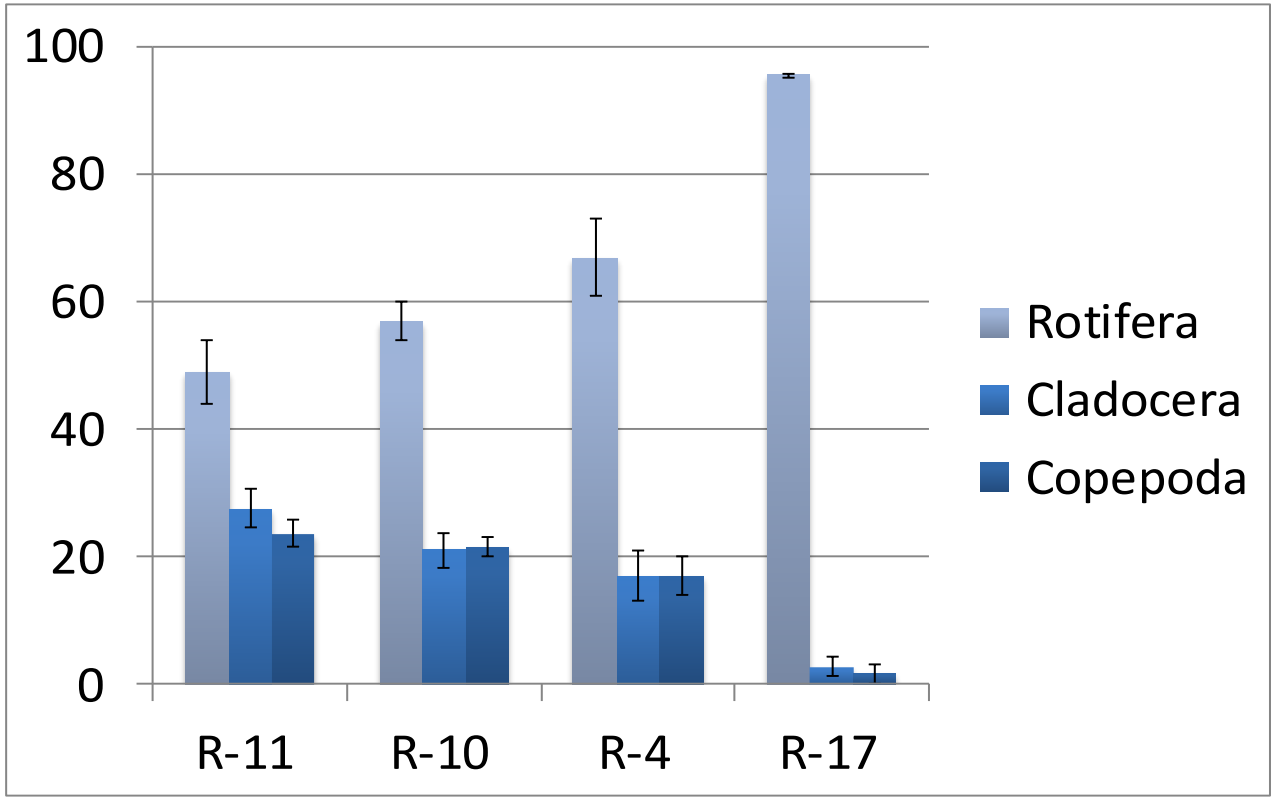

Figure 2. Ratio of zooplankton representatives

To determine the species richness, species diversity and evenness of the reservoir, the Margalef index and Shannon index was used.

The average value of the Margalef index for zooplankton from reservoir R-11 was 2.1±0.6, R-10 - 2.1±0.3; R-4 - 2.4±0.3; R-17 - 0.56±0.06.

We reviled that the that dependence of indexes values was described by an exponential function best of all. The equation of the Margalef Index was:

$MI = 2.46*\exp^{(-0.0003*P)}$,

($R^2 = 0.64$; $F=17.45$; $p=0.002$),

where,

MI - the Margalef Index,

P - the dose rate, μGy/h.

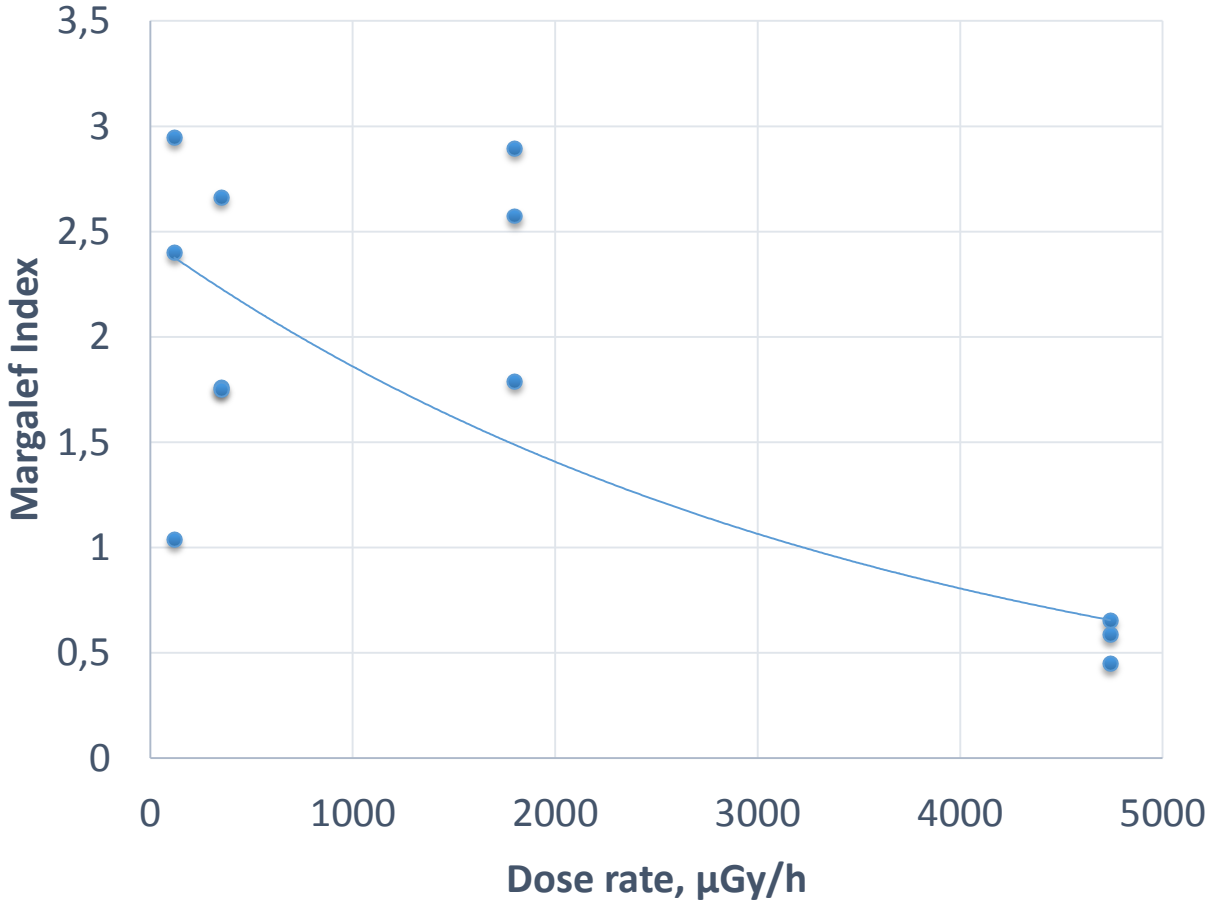

Figure 3. Dependence of the Margalef indexes on the dose rate

The average values of the Shannon index from the studied reservoirs were 2.82±0.14, 2.55±0.27, 2.4±0.6 and 0.99±0.23, respectively, for the reservoir R-11, R-10, R-4 and R-17.

The equation for the Shannon index was:

$SI = 2.94 * \exp^{(-0.0002*P)}$,

(R^2 =0.71; F=24.96; p=0.0005), where,

SI - the Shannon Index,

P – the dose rate, μGy/h.

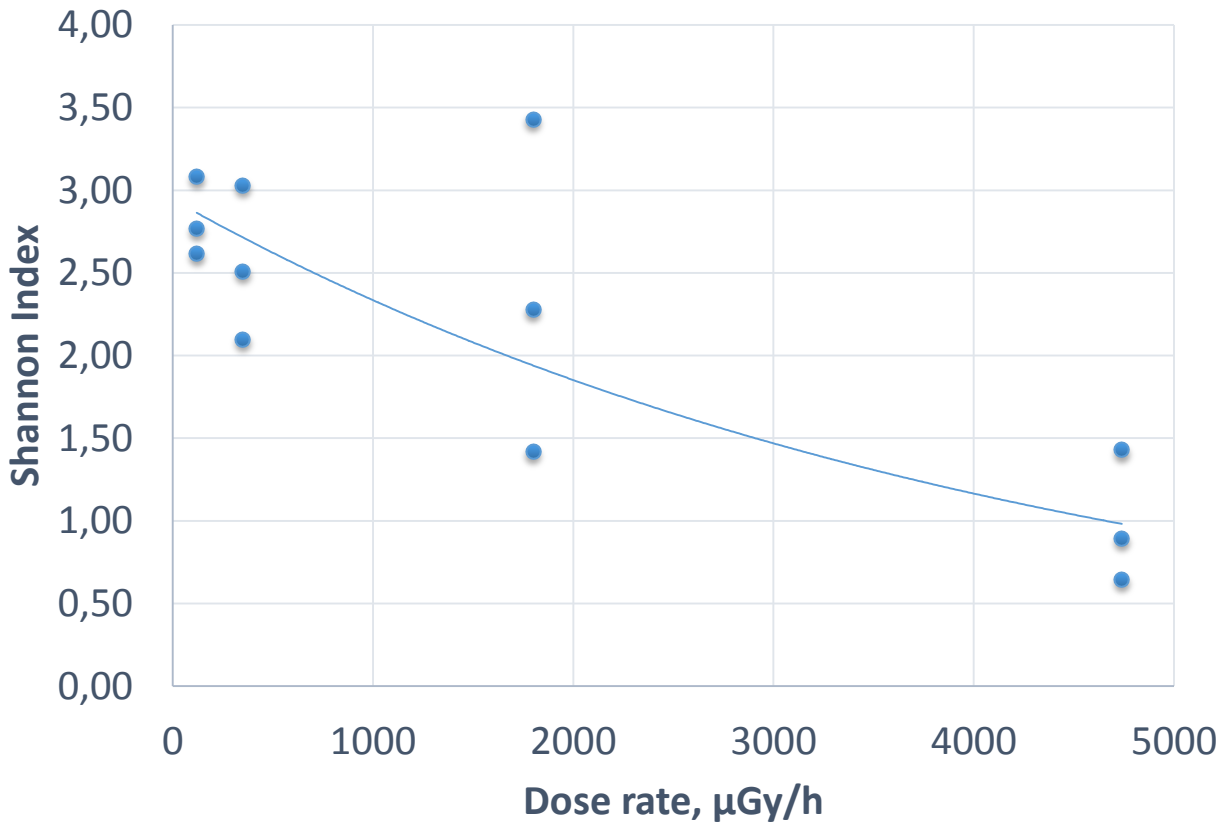

Figure 4. Dependence of the Shannon indexes on the dose rate

CONCLUSION

Thus, a dose-dependent change in the indices of species diversity was revealed, which may indicate the influence of chronic radiation exposure on these zooplankton species richness and species diversity. It should be noted that the above results do not take into account the influence of the characteristics of the chemical composition of water in the studied reservoirs. It requires further study of the influence of chemical factor on the analyzed indicators.

Contact information

Albina Aldibekova
Senior engineer of Experimental department of The Urals Research Center for Radiation Medicine (URCRM), 68–A Vorovsky Street, Chelyabinsk 454141, Russia

albinaaes@gmail.com