Salt Lakes Help Predict Climate

The biophysicists of Siberian Federal University and the Institute of Biophysics, SB RAS, have demonstrated the results of long-term monitoring of the Lake Shiraecosystem in Khakassia. The ecosystem has changed due to global climate change. The water in the lake has began to mix, and the level of the lake has also increased significantly due to the increased amount of precipitation. As a result, the Shira hasbecome less salty, and the amount of mini-algaehas increased.

According to Denis Rogozin(co-author of the study, professor of SibFUDepartment of Biophysics and leading researcher of the Institute of Biophysics, SB RAS), in the 1920s, the salt lakes of the Minusinsk Basin were much smaller due to the arid climate.Rainfall was less than at present, and Lake Shira was twice as salty. Then the level of the lake rose significantly due to the increased amount of precipitation, and its salinity changed accordingly. Since atmospheric precipitation enters the lake from the surface, the waters of the modern Shira resemble a Bloody Mary cocktail of two layers, where the bottom one is denser and more concentrated salty, and the upper one is more desalinated and rarefied.

> In 2015-2016 scientists noted that the salinity of the Shira became more uniform. *“We predicted this event a couple of years before the start of the process. In 2015, the lake seemed to be stirred with a giant spoon, and, of course, this affected its flora and fauna,” said* ***Denis Rogozin****. “The mixing of waters in Lake Shira was episodic. Interestingly, in these two years, the number of some types of mini-algae has increased.”*.

The algae of Lake Shira need nutrition. The main fertilizers for microalgae, i.e. nutrient compounds of nitrogen and phosphorus, accumulate in the lower water layer. Thanks to the mixing of the waters, these compounds accumulated over the years entered the upper layer. This probably provoked an explosive growth of algae, which received an excess of previously inaccessible nutrients. However, after the outbreak of 2015-2016, the number of these algae has decreased almost to the previous level.

It is impossible to see the algae boom with the naked eye. The water will just seem cloudier than usual. However, under a microscope, the biophysicists recorded a sharp increase in the number of so-called cryptophyte microalgae, while neither cyanobacteria, nor green algae reacted to the changes in a similar way. For other inhabitants of Lake Shira, for example, anaerobic bacteria, the mixing of lake waters had rather a negative effect. Anaerobic purple bacteria, whose comfortable environment is the airless and hydrogen sulfide-saturated deep layers of the lake, ended up in a hostile upper oxygen layer and nearly disappeared. Until 2014, they were notable inhabitants of Lake Shira, but after mixing, their population has not yet recovered. The changes had almost no effect on the inhabitants of the coastal zone of the lake, including crucian carp living in reed thickets at the confluence of the small Son River into the Shira. To date, the two-layer structure of the lake is also not stable. If the lake level stops rising, the layers will tend to mix. The dynamics of this process is set by strong winds and ice, which freezes and melts on the surface of the lake every year. A possible reduction in freeze-up time due to global warming will intensify this process.

> *“Tourists visiting Lake Shira can physically feel the decrease in the salinity of the lake: the water has become softer and does not leave a feeling of tightness on the skin. The level of the*

lake has risen by one and a half meters over the past ten years, which means that the salinity has fallen. It is important to study bottom sediments in order to find out what happened in the lake millennia ago. Judging by the findings of our team, in the past Shira had already experienced processes that are happening now. In the 17th century, the water level rose significantly, the waters mixed. Thisclearly indicates that the climate was also undergoing significant changes then," summed up the researchers.

Press Service SibFU, 29 august 2022

Web page address: https://news.sfu-kras.ru/node/26670