Climate change is currently one of the greatest challenges to biodiversity worldwide. Rising temperatures, extreme weather events, and increasingly frequent periods of drought are disrupting the water cycle and leading to the degradation of many ecosystems. While the impact of climate change on agriculture and forests is often discussed, growing attention is being paid to mountain regions in the context of global warming. Particularly sensitive to changes in the water balance are mountain springs. Even though these ecosystems are stable and relatively isolated from direct human activity, they are now under threat. Springs are natural outflows of groundwater that create unique habitats that serve as refuges of biodiversity for many organisms. This project focuses specifically on such spring ecosystems located in the Western Bieszczady Mountains, and on their microscopic inhabitants – diatoms.

Diatoms are unicellular organisms that are highly sensitive and capable of rapid response to environmental changes. They inhabit a variety of substrates (such as stones, mosses, and sediments) and are extremely reactive to environmental conditions – changes in their species composition can reflect modification in temperature, pH, conductivity and chemical compounds in water. For this reason, diatoms are recognized as bioindicators, useful in monitoring water quality and environmental change.

The aim of the project is to investigate whether and how diatom communities in springs located in the Bieszczady National Park and its buffer zone are changing in response to shifting climate conditions. The research will employ both classical microscopy-based approaches and modern molecular techniques, allowing for detailed species identification including potentially undescribed taxa.

Six springs located at different altitudes above sea level will be studied. At each site, water samples and diatom material will be collected, and environmental parameters of water such as temperature, pH, and electrical conductivity will be measured. An important hydrological aspect of the project will be the measurement of spring discharge rates, providing insight into changes in spring water supply. The collected material will undergo classical microscopic analysis using light and scanning electron microscopy, as well as molecular studies involving DNA isolation from diatom strains cultured in laboratory conditions.

A key aspect of the project will be the temporal analysis of change. Both historical data from previous research conducted in the Bieszczady National Park and new samples collected in subsequent seasons will be used. This will enable the identification of long-term trends in spring ecosystems and help determine whether these systems are resistant to climate change.

The project is interdisciplinary, combining ecology, hydrology, taxonomy and bioinformatics. The results will contribute to our understanding of spring biodiversity in the Polish Carpathians and provide insights into how these sensitive ecosystems are responding to a changing climate. Genetic data, including DNA sequences, will be shared in open-access databases to support the development of biomonitoring tools and future conservation efforts.

While scientific in nature, the project also has practical significance. Its results may improve monitoring and protection of unique spring habitats in Poland's mountain regions. Moreover, uncovering the diatom diversity in these relatively unexplored ecosystems may lead to the discovery of previously unknown taxa.