

Objective of the project

Extensive Arctic areas are characterized by extremely low temperatures, long-term lack of light and UV exposure (winter and polar summer) and the limited access of nutrients. However, recent reports in the literature show that these oligotrophic ecosystems inhabited by diverse and relatively numerous groups of microorganisms that have developed unusual strategies for survival anywhere else. The close relationship between abiotic and biotic factors, however, make these areas extremely sensitive to even the slightest changes in climate. Accordingly, microorganisms can be considered as a specific indicator of environmental changes. Diversity and abundance of bacteriocenosis indicate an absence / presence / bioavailability of some nutrients, enabling their growth and development. This is very important because in recent years it has been shown that despite the remoteness of the Arctic areas from highly urbanized areas, pollutants can be transported there in the form of aerosols, mainly from Europe and the former Soviet Union. Despite a significant weight problem, relatively little is known about the fate and bioavailability of the aerosol deposition. An interesting area for this kind of research are proposed within the river basins of the Arctic, along with snowfall, melting snow, river water and coastal water, or mixing zone of fresh and marine water. Even if the water chemistry is already pre-known, there is a lack of information on the relationship between the amount and bioavailability of nutrients and biodiversity of microorganisms in these areas. The specific objective of the project is to verify the hypothesis if phosphorus is a limiting factor for the proper development of bacteria. It will be verified through the following research tasks:

- estimation the natural sources (e.g. weathering of rocks, the presence of birds colonies) of nutrients (P:N) and their bioavailability and estimation of deposition of marine and land aerosols containing nutrients;
- exploration the response of the bacterial and *archeal* community to the P:N absence/presence/bioavailability;
- definition the major factors limiting bacterial and *archaeal* activity via seasons (factor analysis)

Detected groups of microorganisms are extremely important because they are regarded as indicators of the changes in habitat observed in various aquatic ecosystems.

Research to be carried out

Research area includes arctic river basins and its tributaries of glacial waters that operates under different environmental conditions. In order to identify groups of compounds and nutrients present in the selected area of research and quantify, the most modern equipment in the Department of Analytical Chemistry will be used. Collection and testing of samples during the campaign research will help to determine temporal changes in the levels of chemical compounds concentration. In order to identify the diversity of bacteria and archaea, the total DNA will be isolated from samples of snow, river water and coastal sea water. Using the modern techniques of PCR (polymerase chain reaction) and quantitative real-time PCR (qPCR) genes associated with the metabolism of phosphorus and nitrogen will be determined.

Reasons for choosing the research topic

The project will help to determine whether the deposition of aerosols in the polar regions, is an important, anthropogenic source of pollution in these areas. This issue will be dealt especially in terms of bioavailability of nutrients. An important achievement of the project will then refine existing analytical techniques in order to achieve low detection and quantification limits not only of the total concentration of phosphorus and nitrogen compounds, but also all their forms of those biologically degradable. At the same time planned microbiological tests, will allow a better understanding of the interaction between abiotic factors and the functioning of bacteriocenosis. The project (the results and conclusions) will help to understand better the impact of environmental stress on the abundance and biodiversity of identified groups of microorganisms and potential relationships between them. It is also expected that the results will be used as indicators of environmental change and contribute to verify the hypothesis contemplation of phosphorus as a factor limiting microbial activity.