

# SUMMARY

The biodiversity, ecosystem services and climate changes in Antarctica are of enormous importance of the whole planet. Antarctic soils provide some of the most extreme conditions in the Earth - they are young, poorly developed, unfruitful; low-humidity, freezing and warming make them a physically unstable environment. These soils are habitats of relatively simple but unique biological communities. They are particularly vulnerable to disturbances and pollution, but the insufficient researches of soil characteristics in many areas of Antarctica hinder the understanding of their role for biotic communities that inhabit them and limits the possibilities for monitoring and predicting environmental changes. Today, human activities increasingly threaten the unique Antarctic habitats, increasing the risk of pollution and introduction of non-indigenous species and their impact on local fauna, especially on endemic species. One of the effects of human activity is the toxic elements concentration change. At the limit of existence of life nematodes are a major component of soil food webs. Changes in their diversity can be an important indicator of anthropogenic impacts and environmental changes, for example, for assessing soil disturbances or the effects of heavy metal pollution. In a number of studies, it has been found that representatives of order Dorylaimida and Mononchida, which are omnivores and predatory nematodes, and considered K-strategists are particularly sensitive to environmental disturbances. For the realization of the proposed project an integrative approach will be applied to the study of the main soil characteristics, morphology, geochemical composition, content of toxic elements and the diversity of omnivorous and predatory nematodes in soils of Livingston Island. The project aim is to investigate the variability of soil characteristics, the presence and concentration of toxic elements, and their relationship to the diversity of omnivorous and predatory nematodes in different habitats in three areas on Livingston Island.

The research tasks include characterisation of mosses from the studied habitats, determination of basic soil properties and morphological characteristics, determination of the geochemical composition of organic and inorganic matter and concentration of heavy metals (Pb, Zn, Cu, Ni, Mo, etc.) and other toxic elements (Hg, As, Cd, Se), determination of omnivorous and predatory nematodes on the basis of morphological and molecular approaches, as well as some diversity parameters, analysis of the relationships between soil characteristics, toxic elements and nematode diversity.

To perform the tasks of the project, the following activities are planned, grouped in work packages: WP1 (Work Package 1) - Soil and habitat characterisation - includes field work, processing and preparation of soil samples for analysis, laboratory analyses, optical and spectroscopic analyses, identification of mosses; WP2 – Nematological analyses - includes laboratory analyses, preparation of nematodes for study (isolation, fixation, dehydration, preparation of permanent slides, identification), molecular analyses, statistical analyses; WP3 - summarising and dissemination of results - includes creating a project website, preparation of manuscripts and a leaflet, participating in scientific meetings. Methodological approaches include: isolation of nematodes, preparation of permanent slides by Seinhorst method (1959) and for scanned electron microscopy; light microscopy with modern highly specialised light microscopes, a digital camera, digitising tablet and specialised software for morphological characterisation. In addition, different genetic markers (18S, D2-D3 28S rDNA) will be used for species identification and to clarify their phylogenetic relationships, specialised software tools and programs for alignment and editing (MEGA 7.0, etc.) and for phylogeny reconstruction will be applied. For the analysis of nematode communities, the following parameters will be used: dominant and taxonomic structure, Shannon - Wiener ( $H'$ ) diversity index, Simpson's dominance (C). For the geochemical analyses will be applied the following analytical, microscopic and spectroscopic methods: 1) Analytical chemical methods for determining the main characteristics of the soil and the basic oxides in its composition; 2) Optical microscopy to determine the morphological characteristics of the samples. Observations will be performed with Leica EZ4D Optical Microscope; 3) XRD for determination of soil

mineral composition and ICP-MS for determination of chemical composition, including toxic elements of samples.

The detailed work plan of the proposed project includes the following activities:

1) Participation in the 27th Bulgarian Antarctic expedition where the field sites will be selected, soil samples collected in the area of the Bulgarian Antarctic Base, Hannah Point and Kaleta Argentina for nematological and geochemical analysis, data on soil characteristics on site will be collected, initial processing of collected soil samples will be done (WP1 and WP2). 2) Determination of mosses of the studied habitats (WP1). 3) Soil characterisation, which includes: determination of basic soil and morphological characteristics, investigation of geochemical composition of organic and inorganic substance, determination of the concentration of heavy metals (Pb, Zn, Cu, Ni, Mo, etc.) and other toxic elements (Hg, As, Cd, Se) (WP1). 4) Nematological analysis of collected soil samples, which includes: processing and primary analysis of collected soil samples - isolating additional material and material for molecular study, fixation, preparation and mounting of permanent microscopic slides, preparation of materials for scanning electronic microscopy, morphological and molecular characterisation of the omnivorous and predatory nematode species in the collected soil samples (WP2). 5) Analysis of the relationships between soil characteristics, toxic elements and nematode diversity (WP3). 6) Dissemination of the results through the creation of a project web-site, preparation of a leaflet for dissemination of the activities and results of the project, preparation and participation in a scientific meetings, and preparation of a scientific paper (s) in refereed journals (WP3).

As a result of the proposed project, new information on geochemical characterisation of soil, soil formation processes in the studied areas and new information on the presence and concentration of toxic elements of the field sites will be obtained. Data on moss species of selected sites will be collected. It is also essential to obtain new data on the morphological and genetic nematode diversity in the studied sites regarding the target trophic groups as well as on the presence of non-indigenous species. New taxa are to be discovered and described in accordance with the modern taxonomic standards. The knowledge of the relationships between the soil characteristics and variability of omnivorous and predatory nematodes and the relationship between the toxic elements and variations in omnivorous and predatory nematodes in the studied sites will be very important results.

The results achieved will be essential for the system of knowledge related to the functioning and conservation of the soil systems of the Polar Regions and for assessment of global changes. It is particularly important to gain primary data which will serve as reference data for exploring future Antarctic changes. The results of the proposed project can be used to start long-term biomonitoring for observation of the geochemical characteristics of soils, the presence and change in concentrations of toxic elements, and the diversity of nematodes and other soil organisms. In addition, the obtained sequences of nematode species will be deposited with GenBank and will be used in the future for a much faster method - metabarcoding for rapid biodiversity analysis. This method will be increasingly important in the biomonitoring of Antarctic habitats. The results obtained will be presented in scientific meetings, and in scientific publications in IF journals. A leaflet and website of the project will be prepared to promote the main activities and results of the project. They will be of high importance for future research on the functioning and conservation of soil systems in Polar Regions and on global change assessment.