The modern classification of various groups, including animals, plants, fungi and many other is based on their natural history, reflecting the evolution of a given group. In order to understand evolutionary processes, scientists use the phylogenetic analysis that allows to uncover the relationships between the organisms. Phylogeny is a description of a 'family tree' of a given group. Traditionally, morphological characters were the main source of data, but currently molecular data, for example fragments of DNA or entire genomes (genetic material of a given organism), are mainly used to untangle phylogenetic relationships as they provide incomparable richer and much more reliable datasets. Many researchers are studying the 'roots' of their groups of interest, to disclose the appearance of the ancestors of particular group and to understand how various traits (e.g. morphological) evolved in the course the natural history. This can be achieved by the identification of the most 'basal' lineages within the studied group, i.e. lineages that are sister to all remaining living lineages (very often, such 'basal' lineages did not diversify and they retained many of the ancestral traits).

Tardigrades (phylum Tardigrada, known also as water bears) are microscopic animals, that can be found in various environments across the world, but many of them can be found in mosses and lichens. These animals, famous for their resistance to extreme conditions, are still understudied and their phylogenetic relationships are a lively topic of current research. Water bears are considered as problematic when it comes to solving their evolutionary relationships. This is because of their small size (typically less than half a millimetre), a small number of characters that can be used to classify them, and often because of difficulties of finding them. One group among tardigrades, called order Apochela, encloses exclusively carnivorous species, which are also among the largest tardigrades, with body length often exceeding 1 mm.

The proposed project aims to identify the most basal lineages of this peculiar group of tardigrades, thanks to the reconstruction the phylogenetic relationships, with the use of DNA data extracted from individuals collected from the Southern Hemisphere, where we suspect (based on earlier studies) this group may have originated. Apart from the molecular investigation, also morphological traits will be analysed thanks to the use light and electron microscopy. Moreover, the geographic origin and type of reproduction (sexual or asexual, where only females are present) of analysed species will be studied. Thanks to mapping these data onto the phylogenetic tree, it will be possible to achieve several more goals. For example, by mapping the morphological traits onto the phylogenetic tree, will allow to reconstruct the evolution of these traits and hypothesise what the ancestors of this group looked like. It will also be possible to compare the current systematics with the molecular phylogeny to ensure that taxonomy reflects the natural history of this group. Moreover, as geographic data will be collected, we will try to discover on which continent/area this group has originated and to estimate the time when this has happened. Thanks to answering questions concerning the evolution of Apochela, it will be possible to infer about the early evolution of Eutardigrada (a larger group, that encompass two orders, abovementioned Apochela and the sister group – Parachela), which is one of the most important topics in the current phylogenetics of Tardigrada. Finally, as the project will examine samples from localities, where tardigrade research has never been carried out, it is almost certain that species, and even maybe genera, new to science will be found and described.