Parasitism or the exploitation of the host resources to the advantage of the parasite is one of the most common modes of life. The nature and small size of parasites have made them unpopular in the fields of nature conservation or paleobiology where focus lies on their hosts. This hampers our ability to predict how parasite-host associations and disease risk are and will be affected by ongoing global environmental changes and related host extinctions. Mathematical models have revolutionized the field but currently only rely on modern distributions and the assumed co-extinction of parasites with their hosts. Just like the excrements of pets today provide a diagnosis of parasite infections, mineralized coprolites (fossilized excrements) provide a time capsule of the changes in past parasite diversity in the form of resistant eggs of helminths (flatworms, nematodes).

The project performs an unprecedented systematic sampling of resistant parasitic remains in coprolites attributable to aquatic as well as terrestrial hosts across the Permian-Triassic mass extinction - Earth's most severe evolutionary crisis. Combined with modelling, these remains will help us identify when and how parasites went extinct or switched their hosts. In our project, two main types of modeling will be used: I) statistical modeling to evaluate the relationship between parasite diversity, host and environmental controls; and II) Bayesian „total evidence" modeling to place a subset of helminth parasite fossils within phylogenies among their modern representatives. In addition, photogrammetry and computed tomography will be used to quantify the morphology and internal structure of coprolites to support their assignment to their producers. Such comprehensive assessment will also allow and help plan their subsequent partial destructive sampling. Microscopy and image recognition techniques will be used to diagnose and measure helminth eggs in thin sections and dissolved samples which have proven to be the most reliable, even though time-consuming, methods.

New stratigraphic and morphological data together with data available in the literature will allow to calibrate phylogenies of helminth parasites more accurately. By comparing time-calibrated phylogenies of parasites with those of their vertebrate hosts, we will be able to more accurately infer host switching and parasite extinction based on the degree of correspondence between their phylogenies using novel cophylogenetic methods. In turn, the proportions between these evolutionary events can be used to estimate their impact on parasite extinction risk empirically which will be highly relevant to conservation studies such as predicting the changes of parasitic diseases in ecosystems in a changing world. In essence, this research will tell us if mass extinctions have a noticeable impact on the representation of parasitic remains in coprolites as well as on parasite phylogenies and the extinction risk estimates derived from them.