The vastness of the sea is full of various forms of life that dwell in water and at sea bottom. Most of this marine biome is composed of microorganisms or small size animals that form the base of marine food web. They are abundant and highly diversified. They play a key role in the functioning of marine ecosystem and potentially could be a rich source of information about past environment. Unfortunately, most of them disappeared without leaving any fossil traces. Only few microbial groups, those with hard skeletons, are preserved in the fossil record. These scarce microfossils provide a precious but very limited glimpse into the infinite richness of marine biodiversity and its response to past environmental change.

Our project proposes a novel way to study the past environment using the DNA preserved in marine sediments. After their death, the organisms living in the sea sink to the bottom where they are eaten or decomposed by the others. Fortunately, their DNA remains preserved either inside the undigested cells or as free molecules attached to the sand. Although this DNA is strongly degraded, it is still possible to recover its fragments and identify their origin. Thus, the marine sediments provide invaluable archives of almost everything that has been living there in the past.

In this project we will use this archived DNA to reconstruct the history of marine life in Nordic Seas during the last 20’000 years. We will analyze sediment DNA in the six well-dated cores collected at Svalbard, Greenland and Jan Mayen shelfs. By using multiple genetic markers, we will follow changes in composition of different groups of organisms, from microalgae to single-cell protozoans and animals. We will integrate these historical biodiversity data with the information about environmental change provided by classical palaeoceanographic proxies. The results of our study will help understanding how the marine organisms respond to climate change in the past and whether this response is similar to what we observe today. In particular, we will analyze the impact of climate change on biodiversity during the mid-Holocene Thermal Maximum, about 5’000-9’000 years ago and compare it to the current global warming. We will test the hypothesis that the past increase of sea surface temperature in Nordic Seas was associated with the increase of biodiversity, lower productivity and reduced carbon burial. Our conclusions will show what can be expected in the near future if the Nordic Seas continue to warm at the current pace.