

As early as the 10th century, the Eurasian beaver (*Castor fiber*) was under the protection of Polish princes and kings, with hunting rights reserved for the ruling class. By the 13th century, designated beaver-keepers were still tasked with guarding and managing them. Over time, however, the population dramatically declined. After World War I, *C. fiber* survived only in the Neman and Pripyat river basins (in present-day Lithuania, Belarus, Ukraine, and Russia). For decades, beavers in Poland were restricted to the northeast, with no signs of natural dispersal. In northern regions, they had vanished for 150 years until successful reintroductions began in the 1970s and 1980s.

The Eurasian beaver—the largest rodent in Eurasia (up to 30 kg)—is a territorial species and a powerful ecosystem engineer. Its dam-building and landscape modification reshape entire freshwater systems, altering hydrology and inducing long-term geomorphological changes. Beyond these physical impacts, beaver activity increases habitat heterogeneity, promotes wetland formation, and enhances biodiversity by creating niches for a variety of aquatic and semi-aquatic organisms.

This project assumes that beaver activity has left a measurable imprint on river–lake systems throughout the Holocene.

It aims to:

1. Quantify beaver-induced transformations of modern hydrology, sedimentation, and channel morphology;
2. Reconstruct high-resolution records of beaver-driven ecological change over the past 2,000 years (with particular attention to the onset of intensified land use during the Wielbark culture);
3. Trace the presence and relative abundance of beavers back to the Late Glacial (~14,700 BP), exploring their interactions with climate variability and human activity.

The Struga Czechowska catchment, located in the Tuchola Forest of northern Poland, plays a pivotal role in achieving these research objectives. This natural laboratory has featured more than 20 active beaver dams in recent years, which have raised water levels in the stream channel and adjacent lakes by up to one meter. Within the catchment, two lakes—Czechowskie and Głęboczek—contain annually laminated (varved) sediments that preserve rich biological and geochemical archives. These sediments enable high-resolution, annual-scale reconstructions of beaver–environment interactions, spanning from the modern era through the entire Holocene and into the Late Glacial period.

The project employs an integrated methodology combining real-time monitoring of hydrological and geomorphological processes; sedimentological and geochemical profiling using micro-lithofacial analysis and X-ray fluorescence (XRF); LiDAR-based terrain modeling; and high-resolution, multiproxy analyses of lake sediment cores. Proxies include sedimentary DNA (sedaDNA) targeting not only *C. fiber* but also selected microbial functional genes, providing insights into key biogeochemical processes influenced by beaver-induced environmental change. Diatoms, chironomids, pollen, and macroscopic plant remains will complement the biological record, while geochemical markers will help reconstruct past human activity, including the introduction of fertilizers and pollutants.

By identifying how beavers—and the environmental and microbial signatures associated with their engineered habitats—have shaped freshwater systems over millennia, this study presents the first high-resolution, multi-proxy reconstruction of long-term beaver-driven landscape evolution in the European Lowland. By combining sedaDNA, varved lake archives, and multi-proxy analyses, this project delivers the first high-resolution reconstruction of beaver-driven ecosystem change—tracing their ecological impact and engineering legacy across millennia.