Nitrogen gain and loss in changing coastal lagoon ecosystems of the Baltic Sea (GLOB)

Estuarine systems, being situated between land and marine environments, are potentially important sites for nitrogen (N) turnover due to long water retention time and high rates of biogeochemical processes. The estuarine systems receive significant nutrient and organic matter loads via riverine inputs from their surrounding catchment. It has been posited that much of the received material within the estuarine systems can be retained and removed through pelagic and benthic biogeochemical processes. As a result, estuarine systems are perceived as coastal filters that play an essential role in regulating nutrient delivery to adjacent coastal areas. Among estuarine systems, the coastal lagoon is most dominant, receiving varying amounts of nutrients seasonally, especially N. Today, all estuarine systems are undergoing profound changes as benthic animals, including invertebrates, are harvested and key habitats are lost, degraded or expanded due to ongoing climate change and human interventions. Any shift in ecosystem functions in sediment or water column could indicate a response to changes in nutrient cycling and microbial communities. Consequently, the dominant pathway for nutrient cycling may be lost or become redundant for ecosystem functioning. Therefore, we urgently need to revise our understanding of estuarine system functionality. A concerning recent trend is marine heat waves, which can cause high thermal stress on pelagic and benthic habitats and strongly influence biogeochemical processes within estuarine systems, impacting their ecological capacity to transform nutrients. The project aims to develop a fundamental knowledge base on the functional role of estuarine systems in N gain and retention, and how these ecosystem functions respond to recurring heatwaves in shallow vulnerable lagoons (Curonian and Vistula Lagoon) located around the Baltic Sea. These coastal areas were selected, because 1) they have the potential to attenuate loads to the Baltic Sea, and 2) lagoons are experiencing rapid ongoing changes that impact the diversity of micro- and macroorganisms, and their contribution to ecosystem functioning.

The main hypothesis is: the lagoon functions in nutrient cycling vary seasonally, and summer heat waves may substantially impact these processes and consequently influence ecosystem functioning.

The project objectives are:

- The potential of the lagoon to gain N through internal processes
- To track the fate of fixed N through the different dissimilatory processes conducted by microorganisms
- Determination of taxonomic diversity and metabolic capabilities of microbiota in lagoons and its response to environmental stressors like temperature and nutrient availability.
- Assess how activity of microbial communities affect ecosystem functions and evaluate how climate changes affect this functions.