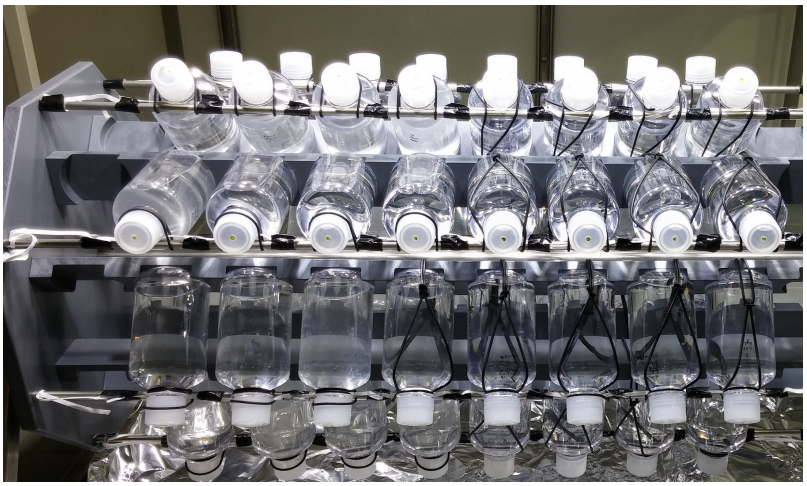
COMMUNITY ECOLOGY

Functional Ecology
BRITISH ECOLOGICAL SOCIETY

CONTEMPORARY ECOLOGICAL AND EVOLUTIONARY CHANGES EXPLAIN PHYTOPLANKTON NUMBERS

Giannina S. I. Hattich, Luisa Listmann, Lynn Govaert, Christian Pansch,Thorsten B. H. Reusch, Birte Matthiessen



Our phytoplankton communities where exposed to future Ocean Acidification for about 50 generations and kept in suspension by constant rotation on a plankton wheel. The plankton wheel avoids sedimentation of the cells at the bottom of the small bottles which would lead to very unnatural conditions.
Image credits: Giannina Hattich

Phytoplankton are microscopically small photosynthetic unicellular organisms at the base of aquatic food webs. Their largest habitat, the open sea ecosystem, is rapidly moving into a new human-mediated geological epoch - the Anthropocene. A likely consequence is major compositional shifts in phytoplankton communities across the global ocean, subsequently affecting the entire marine food web. These shifts are driven by ecological and evolutionary processes that can interact and jointly affect the functions phytoplankton provide. Evolution was originally associated with very long periods of time, but short generation times and huge population sizes promote rapid evolution in phytoplankton. It has been shown that it is possible for phytoplankton to evolve to become better adapted to new environmental conditions in one year – in humans a study with a comparable number of generations would last six thousand years. Even though scientist have realized the potential of evolution to affect ecological shifts, both aspects were so far rarely studied together. Here we set rapid evolutionary change into an ecological context and developed an experimental approach that allowed us to assess the importance of both processes to phytoplankton community change. Over 50 generations we observed that the number of cells that grew in a mL of seawater was substantially reduced in those communities that were exposed to increased CO2 concentration in the seawater, a result of the increased anthropogenic use of fossil fuels. This decline of phytoplankton cell numbers under increased CO2 concentration could be predominantly explained by ecological shifts reflected in altered species composition and to a lesser extent by evolution. The importance of evolution could, however, be higher if the study would have run for even longer time and likely depended on the species present in the community. Overall, this project is another step towards a better understanding of phytoplankton responses to climate change and can help to improve the predictions of how human action will affect phytoplankton communities in the future.