Popular science summary

The Arctic region is the fastest warming area in the world. The warming of Arctic water masses affects species distribution ranges, species composition, phenology and food-web structure. Species with narrow Arctic distributions could be replaced by boreal species or simply vanish. In the light of current rapid physical change it is key to examine recent and current marine communities to provide scientific insight and potential management advice to protect an important ecosystem in the tumultuous decades to come. Yet we still do not understand basic biological processes such as ecological succession, impact of environmental or biological factors on succession of many Arctic marine communities. The proposed project will attempt to cover some of these gaps and build crucial knowledge and understanding of Arctic ecosystem processes.

In 2004 the Institute of Oceanology established a long-term field experiment using artificial substrata to explore gaps in our knowledge about diverse aspects of colonization and succession processes in Arctic waters (Svalbard). The experiment continues to this day and is the longest continuous polar recruitment experiment of this type (15 years and counting) as far as we are aware and has already generated a wealth of important knowledge about Arctic systems. The current proposal will focus on a range of issues concerning the succession of benthic organisms, development of communities with different starting points (seasons) of community development as well as influences of predation and competition on these processes. This will be one of the first experimental studies undertaken in the Arctic to gain an understanding of community development patterns from recruitment until following stages of succession and the first on such a long temporal scale, which uses colonisation plates.

The goal of this PhD project would be to analyse 15 years of current data with an overarching scientific question: How do hard substrata succession processes vary in the Arctic and which are the key factors driving variability at particular stages of community development? To answer this overarching question, detailed analysis of existing material will include the following tasks (1) Establish the tempo and mode of ecological succession in Svalbard and compare these parameters with those in other polar regions and around the world; (2) Quantify the process of succession with respect to environmental parameters (including depth, water temperature, sea currents); (3) Examine the impact of different starting points of community development (season) on the path of succession; (4) Determine the frequency, importance and outcome of organismal interactions and their role in determining community composition; (5) Quantify impact of predation and predator types at given stages of succession; (6) Determine species traits which lead to spatial superiority at given stage of community development (e.g. size, defensive apparatus).

This PhD project will combine training in broad topics including systematics, taxonomy, ecology, biodiversity, statistics and ecological modelling for an integrated study of sessile benthic community development. The PhD thesis will be divided into four chapters focusing on the analysis / tasks mentioned above.

Isfjorden was selected as a model system for this investigation . It is the largest fjord on the west coast of Spitsbergen (the largest island of the high Arctic Svalbard Archipelago). The thesis material comes from 5 sites with rocky, gravelly bottoms. Selected experimental locations are characterised by different environmental conditions caused by the influence of water masses of different origin and properties. For the planned investigation of succession processes, experimental artificial substrates in form of plastic (Perspex) flat square plates were used. The construction protocol followed that described in literature to ensure comparable methodology with existing similar studies from elsewhere. The data for the study will be generated by analysis of panels' images which were taken underwater annually for last 15 years. By analysing images of the photographed panels the successional history of this samples of the community will be tracked back.