WORK IN PROGRESS

ALFRED-WEGENER-INSTITUT
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Quantitative models link declining sea ice to pan-Arctic benthic diversity and ecosystem functioning

Sea ice is declining in the Arctic Ocean (**Fig. 1**). This has a profound impact on Arctic marine food webs, influencing their structure, function and biodiversity (**Fig. 2**). Yet, Arctic research thus far focused on "footprints" in terrestrial systems and threats to marine mammals[2]. Therefore, knowledge is virtually lacking regarding benthic systems in the Arctic Ocean[3].

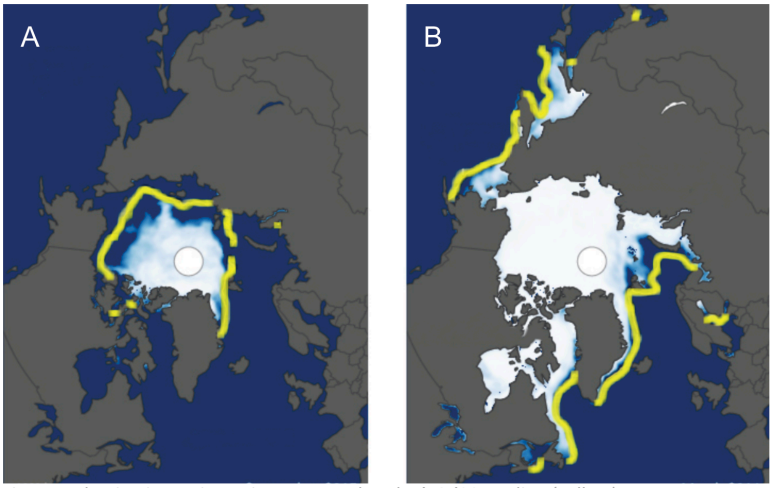

Fig. 1. *Reduction in Arctic sea ice compared to the '79-'00 median (yellow): (A) min. (Sept. 2015) and (B) max. (March 2016). (from NASA)*

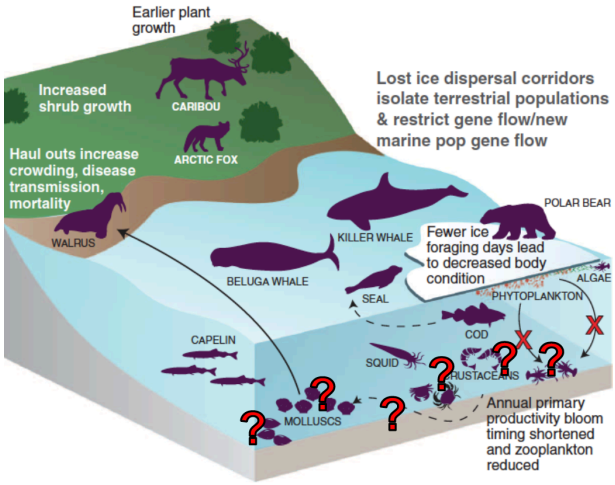

Fig. 2. Predicted changes of the Arctic food web under future conditions[4]

AIM

Offer more insight in the distributions and abundance of macrobenthic species in Arctic seascapes. Scaling-up pan-Arctic community data based on more than *7000 locations* (**Fig. 3**)[3], we will employ recent *quantitative models*. These enable assessing spatial diversity patterns and link community organisation and ecosystem functioning. This is complementary to planned initiatives that target the pelagic system, such as *MOSAiC*.

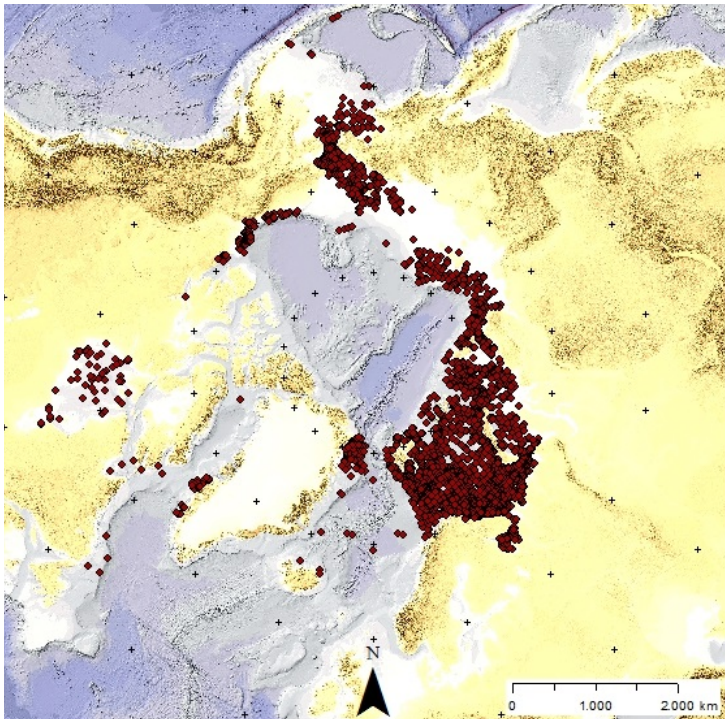

Fig. 3. Sampling locations on the Arctic Ocean shelf currently available

Quantitative models

Multi-species distribution models[5]

Bayesian models that allow for species distributions and co-occurrences to be organised by ecological mechanisms, such as competition, as well as sea ice parameters.

Trait-based distribution models[6]

Hierarchical models that analyse information contained by species occurrences as a function of sea ice variables, species traits, and their interactions. These enable assessing which traits are particularly vulnerable to climate change.

Structural equation models[7]

Whether benthic Arctic systems will exhibit intrinsic dynamics or simply track environmental forcing is unknown. Structural equation models (1) assess the potential for these types of interactions to exist and (2) evaluate the potential for changes across environmental gradients.

References
[1]Department of Functional Ecology, AWI, Germany
[2]Wassmann *et al.* (2011) Footprints of climate change in the Arctic marine ecosystem. *Global Change Biology* **17**:1235-1249
[3]Piepenburg *et al.* (2011) Towards a pan-Arctic inventory of the species diversity of the macro- and megabenthic fauna of the Arctic shelf seas. *Marine Biodiversity* **41**:51-70
[4]Post *et al.* (2013) Ecological consequences of sea-ice decline. *Science* **341**:519-524
[5]Warton *et al.* (2015) So many variables: joint modeling in community ecology. *Trends in Ecology & Evolution* **30**:766-779
[6]Brown *et al.* (2014) The fourth-corner solution – using predictive models to understand how species traits interact with the environment. *Methods in Ecology & Evolution* **5**:344-352
[7]Lamb *et al.* (2014) Spatially explicit structural equation modeling. *Ecology* **95**:2434-2442

MARIE CURIE ACTIONS