Benthos in the Antarctic Weddell Sea in decline

May 7 2020

Multibox Corer on board of Polarstern. Credit: Alfred-Wegener-Institut

Over the past quarter-century, changes in Antarctic sea-ice cover have

had profound impacts on life on the ocean floor. As biologists from the Alfred Wegener Institute report in the latest issue of the journal *Nature Communications*, between 1988 and 2014, total benthic biomass on the continental shelf of the northeast Weddell Sea declined by two thirds. In addition, the composition of the benthos changed drastically, and the ecosystem's productivity suffered. This period coincides with a significant increase in sea-ice cover in the region, a trend that peaked in 2014.

The Antarctic is home to a unique variety of benthic fauna, with an extraordinarily diverse range of species, and many groups of organisms that are rarely if ever found in other marine regions. Predators like large crabs are nowhere to be seen; as a result, sponges and gorgonians (soft corals), which normally have to hide in the sediment to avoid predators, can grow in denser clumps. In fact, in some areas of the Antarctic continental shelf these species cover the ocean floor like a carpet. They have adapted to conditions of extreme cold and scarce food, and grow slowly, which allows them to reach unusual sizes and ages. "Due to their slow growth, changes in the structure and composition of benthic communities in the Antarctic are extremely difficult to detect," explains Prof. Claudio Richter, a biologist at the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI). "Consequently, to date it's been impossible to predict how benthic communities in the Antarctic would react to climate-based changes in their environment," says the co-author, who is a Professor of Marine Animal Ecology at the University of Bremen.

In the current issue of the journal *Nature Communications*, the AWI biologists show that, over a 26-year-long timeframe, benthic biomass on the continental shelf of the Antarctic Weddell Sea steadily declined. The team began their work back in the 1980s, collecting samples from the seafloor when the research icebreaker Polarstern first visited the region. One of the study's authors, Dieter Gerdes, was among the pioneers, and

developed a sample-gathering device specifically for this type of research: the two-metric-ton multibox corer, which can simultaneously collect nine seafloor samples every time it is deployed. From 1988 to 2014, the behemoth was used 59 times in the Kapp Norvegia/Auståsen research area, located 81 miles southwest of Germany's Neumayer research station. In the course of eight Polarstern expeditions, the experts gathered more than 300 seafloor samples, sifted through 45 metric tons of sediment, and sorted and counted tens of thousands of marine organisms. "The side effects of our study were aching limbs and ending up covered in mud from head to toe on the freezing working deck, not to mention a good deal of eye strain from too much time behind the microscope," reports Claudio Richter, offering a tongue-in-cheek portrayal of the demanding working conditions on the Antarctic expeditions.

The study's first author, Santiago Pineda-Metz, an Argentinean student from the Universidad de Magallanes in Chile, dedicated a major section of his doctoral dissertation at the University of Bremen to developing the statistics needed in order to analyse the diverse range of data. In addition, he compared the data gathered by the team with that from global archives in order to map their biological findings to changes in the Antarctic environment during the research period. The researchers analysed how various factors, e.g. iceberg 'keels' scraping along the seafloor, collapsing ice shelves, the amount of sea-ice cover and snow atop it, as well as the prevalence of icebergs in a 'whitening Antarctic' affect benthic fauna and ecosystem productivity. What they found: though icebergs adversely affect productivity, there were no major changes in their abundance during the research period. In contrast, the increased sea-ice cover and thicker snow cover produced concrete negative effects.

"We had always suspected that the sea ice might be the key," says project leader Claudio Richter. "The Antarctic is quite different from

the Arctic: in the Arctic, the sea ice is disappearing. But in the vast majority of the Antarctic, until recently the sea ice was growing. More snow-covered ice floes means: less light to support the growth of tiny algae (phytoplankton) at the water's surface, and less dead phytoplankton that drifts down to the bottom. In this 'whitening Antarctic', benthic organisms can sometimes go hungry." Pineda-Metz, Gerdes and Richter have succeeded in finding evidence of precisely this trend: they confirmed a substantial loss in both the frequency and biomass of Antarctic benthos in the research area. In addition, they determined that there was a shift in the community, from suspension feeders to deposit feeders.

The year 2014 marked both the end of data gathering and a possible turning point for the Antarctic sea-ice cover, which has since dropped from its all-time maximum back then to roughly the same levels as in the 1980s. The AWI team is currently preparing for an expedition in early 2021, where they will investigate whether sea-ice retreat has reversed the above-mentioned effects on the benthos. They plan to return to past sample-gathering sites in order to see if benthic organisms have bounced back under the recent ice-poor conditions. "Exploring the benthic reaction is extremely important since carbon storage in the benthos represents an important feedback for the climate system," says Pineda-Metz, who intends to focus on this reaction in his postdoctoral thesis. "Our study also shows how important long-term ecological monitoring is when it comes to a region that is vulnerable to rising temperatures," Richter adds.

More information: Santiago E. A. Pineda-Metz et al, Benthic fauna declined on a whitening Antarctic continental shelf, *Nature Communications* (2020). DOI: 10.1038/s41467-020-16093-z

Provided by Alfred Wegener Institute