Research Highlights Underwater Forest's Climate Change

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Due to changes related to climate change, submerged brown algae, so-called kelps, will probably only be able to grow in shallower areas in the Arctic in the future. This is the conclusion reached by researchers from the University of Bremen as part of the EU project FACE-IT.

Doctoral student Sarina Niedzwiedz and Professor Kai Bischof recently published the results of the study in the renowned international journal Limnology & Oceanography. The two researchers had examined two different types of kelp off Spitsbergen. These large brown algae form extensive underwater forests in arctic fjords. Their role in ecosystems can be compared to that of trees in forests on land. For example, they serve as food, habitat and nursery for many species. In addition, they preserve fish stocks and protect the coasts by slowing down waves. Therefore, they are also of great socio-economic importance.

Due to climate change, many environmental factors in kelp habitats are changing drastically. Rising water temperatures have already caused kelp forests in southern distribution areas, such as off the Atlantic coast of northern Spain, to decline. In the Arctic, on the other hand, the warming of the waters can lead to the spread of some types of kelp. However, there is something else standing in the way of this development: "Due to the melting of glaciers and thawing permafrost, sediments such as fine sand or silt are increasingly eroding into the water," says Sarina Niedzwiedz. Where the sediment concentration is particularly high, in so-called sediment plumes, less light is available to the kelps. However, they need this in order to carry out photosynthesis and to grow. The Bremen researchers therefore investigated

Rise in temperature: types of algae react differently

In the Kongsfjord near the island of Spitsbergen, the researchers took samples of two species of kelp that are common in the Arctic: Saccharina latissima and Alaria esculenta . In the laboratory, they exposed the samples to water at different temperatures. They measured changes in chlorophyll, carbon and nitrogen content in the kelps. In addition, they determined the rate of respiration and photosynthesis and how much light the kelps need at least for growth. In the fjord, they also determined the light conditions in the sediment plumes. Later, using the measured light needs of the kelps and the light conditions in the fjord, they were able to model the maximum distribution depth of the kelps at different water temperatures.

The team found clear differences between the two types of kelp in their response to rising temperatures. The metabolism of S. latissima accelerated with increasing temperatures, the algae had more energy available. Due to the increased metabolic rates, however, the carbon content in the algae decreased. The lower carbon stores could affect their ability to survive the polar night in warmer waters. Compared to S. latissima , the second species, A. esculenta , had a higher concentration of the pigment chlorophyll aresponsible for photosynthesis. However, this species also required higher light intensities to grow in warmer conditions. Higher temperatures in combination with low light intensities therefore have an unfavorable effect on both species.

Prognosis: Underwater forests in the Arctic will tend to be in shallower areas in the future

The researchers concluded that the species composition and distribution of future Arctic kelp forests will

change. “Since higher sediment concentrations lead to a reduction in light intensity and quality, the distribution depth of the kelps will probably shift to shallower regions,” says Kai Bischof. This reduces the area in which kelp forests can grow in the Arctic in the future. This in turn will have far-reaching consequences for the entire ecosystem. Kelps are at the base of the food web and serve as food, habitat or nursery for many species. With the loss of kelp forests, many species in the Arctic are being deprived of their livelihoods.

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