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Heat waves can change coastal ecosystems Long-term study shows effects of short-term extreme events

06 July 2018 / Kiel. As a result of the ongoing climate change, oceanographic models predict an increase in extreme events such as heat waves. In a long-term experiment, in the Kiel Outdoor Benthocosm experimental facility, scientists at GEOMAR Helmholtz Centre for Ocean Research Kiel have found clear indications that such events on a time scale of a few days or weeks can change coastal ecosystems in the long term. The results of the study have recently been published in the international journal *Global Change Biology*.

When talking about climate change, discussion tend to focus on rising global mean temperatures. But the shifts in the climate system have other effects, too. Oceanographic models predict an increase of extreme short-term events such as heat waves or upwelling events. With an experiment lasting several months over the summer of 2015, scientists at GEOMAR Helmholtz Centre for Ocean Research Kiel, together with colleagues from Portugal and Bermuda, investigated whether short-term heat waves could have a lasting impact on coastal ecosystems.

“Our findings actually suggest that even relatively short extreme events have the potential to shift the existing balance between species in a habitat,” says Dr. Christian Pansch from GEOMAR. He is the lead author of the study, which has recently been published in the international journal *Global Change Biology*.

The experiment was conducted in the Kiel Outdoor Benthocosms (KOBs), which consist of a total of 12 experimental chambers installed on a pontoon directly on the shores of the Kiel Fjord. In each of these chambers the researchers held a community of seagrass, bladderwrack and their associated animals such as snails, crabs and mussels, for almost four months. “These are typical species of shallow waters in the Baltic Sea,” explains Dr. Pansch.

The KOBs are special in that the researchers can precisely control various environmental parameters in each chamber, including seawater temperature, salinity, pH or oxygen content. “The water in the basins originates from the Kiel Fjord directly. So we have a close-to-natural environment in the tanks”, explains Dr. Pansch.

In the course of the study, the participants simulated the temperatures of the year 2009 within the KOBs. “It was a year without major extreme events with an almost ideal temperature curve. That’s why this year was a good baseline for our experiment,” says Dr. Pansch.

The organisms in four of the experimental chambers experienced the 2009 temperatures. In four chambers, the scientists applied an additional summer heat wave in August. In the last four chambers, the species community experienced two weaker heat waves in June and July, before reaching the severe summer heat wave in August.

About half of the species in the KOBs showed clear reactions to the heat waves. “But the reactions differed strongly. Some species showed negative effects, which accumulated over the three heat waves, while other species coped better with the summer heat after experiencing the two spring

warming events. Some species apparently benefitted from the heat waves as they only showed positive effects," explains Dr. Pansch.

So, if the frequency and intensity of heatwaves increases in the future, there will be winners and losers in coastal ecosystems. The current structure of the species is likely to shift. However, not all relevant factors have been examined in detail yet. Currently in the Kiel Indoor Benthocosms another long-term experiment dealing with the effects of heat waves is being conducted. Here the focus is on the impact of longer and more severe heat waves. Also in the current experiment in the Kiel Outdoor Benthocosms, warming supplemented by phases of oxygen depletion is a factor. "Low oxygen is another phenomenon that we have observed several times in recent years and that could lead to a change in the species composition," explains Prof. Dr. Martin Wahl, co-author of the current study and head of the benthic ecology research unit at GEOMAR.

Note:

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Reference:

Pansch, C., M. Scotti, F. R. Barboza, B. Al-Janabi, J. Brakel, E. Briski, B. Bucholz, M. Franz, M. Ito, F. Paiva, M. Saha, Y. Sawall, F. Weinberger, M. Wahl (2018): Heat waves and their significance for a temperate benthic community: A near-natural experimental approach. *Global Change Biology* 2018; 1-11, <https://doi.org/10.1111/gcb.14282>

Links:

www.geomar.de GEOMAR Helmholtz Centre for Ocean Research Kiel

Images:

At www.geomar.de/n5991-e images are available for download.

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