Leibniz Institute for Baltic Sea Research Warnemünde

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Recognizing patterns within the whirling biology of coastal seas: new approaches to analyse long-term data from highly dynamic waters

Biological long-term data series are valuable tools when it comes to identifying the human impact on ecosystems or to recognizing climate driven regime shifts. However, in coastal waters, where the freshwater inflow together with weather events and local currents leads to rapidly changing values in salinity, temperature and oxygen, their informative value is limited. The reason is that the marine communities primarily respond to these fast environmental changes, which more or less mask possible responses to any other impact factors. Yet, a group of scientists from Warnemünde has now succeeded in identifying further influences by means of specialized statistical approaches.

At first glance, it seems impossible to correlate changes in the abundance of benthic organisms or in species richness of the communities with other parameters than the rapidly changing salinity or seasonal oxygen deficiency. Does this mean that the interpretation of biological long-term data from coastal waters can never go beyond recognizing these basic influences?

Michael L. Zettler, marine biologist at the Leibniz Institute for Baltic Sea Research Warnemünde (IOW), and his colleagues did not want to accept this. In the renowned journal PLoS ONE, they recently published the results of a study, in which they applied the statistical DistLM approach (distance based linear model permutation test) for the first time to a set of macrozoobenthos long-term data series of 35 years from three locations within the German part of the Baltic Sea. The study focuses on stations within the Mecklenburg Bight, at Darss Sill and within Arkona Basin. All three stations differ considerably with regards to community structure, abundances, biomass and species numbers. Furthermore, the results from the three sampling stations differed considerably in terms of the statistical significance and the importance of environmental parameters for any explanation of the observed temporal variability of macrozoobenthic data, both, between the stations and depending on the specific biological parameter.

By means of the DistLM method, the authors were able to identify those variables, which most likely are responsible for changes in the specific macrozoobenthos parameters at each station. Besides the already mentioned dominant variables „salinity changes“ and „oxygen deficiency“, they found climate driven variables like the North Atlantic Oscillation Index (NAOI) turned out to be to a great extend responsible for changes and trends in biological parameters.

So, how did the macrozoobenthic communities develop during the last 35 years? Michael Zettler concludes: “While we recognize neither regime shifts nor trends at the stations Mecklenburg Bight and Arkona Basin, both characterized by frequent oxygen deficiency situations, we can see at the Darss Sill that the benthic communities underwent

several drastic changes during the last 35 years. We assume two major regime shifts, one at the end of the 1980s and one in the middle of the 1990s. This could be the delayed benthic response to the climate driven North Atlantic regime shift, which is by now generally accepted within the scientific community."

Considering the ecological importance of the benthic communities, it is essential to understand and predict their reaction on climate change and other anthropogenic or natural influences. The current study demonstrates that even in highly dynamic marine environments the continuation of biological long-term data series is most reasonable.

The long-term data referred to in this document were gained under the umbrella of the HELCOM monitoring which IOW is running on behalf of the Federal Maritime and Hydrographic Agency (BSH).

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