IOW Press Release of 9 August 2012

The smallest predators in the Baltic Sea

Bacteria-consuming unicellar organisms, the heterotrophic flagellates, are known to be the smallest predators in the oceans. To shed light onto the vastly unresolved biodiversity of the Baltic Sea's tiniest hunters – researchers of the IOW did just the opposite: they turned off the light!

A better understanding of ecosystem functioning requires a close examination of the complex interactions between organisms that constitute the food web of a given ecosystem. But this leads to a fundamental question: Who eats whom? Who is the predator, who is the prey? Under water, the classical interactions between predator and prey play out on a miniature scale: between unicellular microorganisms. Unquestionably, the most successful predators acting at the very base of the marine trophic pyramid are the so-called heterotrophic flagellates – tiny unicellular organisms that are propelled by whip-like organelles (flagella) and which prey on even smaller bacteria.

Predacious flagellates have long (since the 1980s) been known to massively impact bacterial growth, through grazing pressure, and to be a relevant link between bacterial production and higher multicellular organisms such as zooplankton or fish. Yet, many questions remain to be answered, including: Who are the key players in the hunt for bacteria? Which species comprise the natural assemblage of heterotrophic flagellates?

Marine scientists associated with the team of Prof. Dr. Klaus Jürgens, from the Leibniz Institute for Baltic Sea Research Warnemünde (IOW), and his colleagues from the Institut de Ciències del Mar (ICM) in Barcelona are the first to successfully obtain deep insight into the largely unknown species diversity of predatory flagellates in the Baltic Sea, identifying a range of novel and undescribed species. "Flagellates belong to the domain of protists and as they are only between 2 and 20 µm in size single species are hardly distinguishable under the microscope", says Felix Weber, the first author of the study. "For that reason, molecular methods have been applied for over a decade to investigate natural protist assemblages and to describe the species inventory of various aquatic systems."

However, such methods, which are based on the characterization of certain genes (18S ribosomal RNA), lead to the detection of bacterivorous protists as well as their photosynthetically active counterparts. "This implies a fundamental drawback of commonly used molecular methods since a protist detected in the water sample exhibits its 'genetic identity' whereas the functional role played by the protist in the ecosystem at the time of sampling remains concealed, i.e., whether it is a predator or synthesizes its biomass through the power of sunlight, just as green land plants do", explains Felix Weber.

To avoid this problem, the team came up with a simple solution: The water sample was left to stand for a while in the dark. The underlying trick was that these conditions acted as a "functional filter" on the protistan community: light-dependent phototrophic flagellates declined in number whereas bacteria-consuming species increased in abundance. "After one week of incubation, the ratio of phototrophic to heterotrophic organisms reached a value favourable for the characterization of the tiny predators on the basis of their 18S rRNA genes," states Weber. "Especially by applying a molecular comparison of the community composition at the start and end of the incubation, we were able to draw conclusions about which taxa developed in the dark and thus are very likely bacterial consumers."

Thus, the scientists identified various as-yet-undescribed flagellate taxa and simultaneously addressed their ecological role. "In the Baltic Sea, prey – in this case meaning bacteria - have already been subject to intense studies," says Klaus Jürgens. "But this most recent investigation was the first to gain important insights into the biodiversity of the smallest predators in the Baltic Sea – the heterotrophic flagellates."

Furthermore, according to the results of the IOW and ICM scientists, the community composition of the small predators in the brackish southern Baltic Sea very closely resembles a fully marine system such as the North Sea. The crucial question, whether the predator composition changes within the steep salinity gradient of the Baltic Sea, similar to the observed shifts of other organisms in the Baltic, will be the subject of further research.

The results were published in the article:

Weber F., del Campo J., Wylezich C., Massana R. & Jürgens K. (2012) Unveiling Trophic Functions of Uncultured Protist Taxa by Incubation Experiments in the Brackish Baltic Sea. PloS ONE, DOI:10.1371/journal-pone.0041970.

This study was partly funded by the German Academic Exchange Service (DAAD), (F2100GKSD), http://www.daad.de, and the German Science Foundation (DFG) (JU 367/11-1).

Contact:

Felix Weber, Biological Oceanography, IOW
(Tel.: 0381 / 5197 252, Email: felix.weber@io-warnemuende.de)

Dr. Barbara Hentzsch, Public Relation, IOW
(Tel.: 0381 / 5197 102, Email: barbara.hentzsch@io-warnemuende.de)

Nils Ehrenberg, Public Relation, IOW
(Tel.: 0381 / 5197 106, Email: nils.ehrenberg@io-warnemuende.de)

The IOW is a member of the Leibniz Association, which currently includes 86 research institutes and a scientific infrastructure for research. The Leibniz Institutes' fields range from the natural sciences, engineering and environmental sciences, business, social sciences and space sciences to the humanities. Federal and state governments together support the Institute. In total, the Leibniz Institute has 16 800 employees, of which approximately are 7,800 scientists, and of those 3300 young scientists. The total budget of the Institute is more than 1.4 billion Euros. Third-party funds amount to approximately € 330 million per year. (www.leibniz-gemeinschaft.de)