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IOW discovers and cultivates two previously unknown unicellular species from the Baltic Sea

IOW researchers, in collaboration with their Russian colleagues, are the first to have successfully cultivated unicellular collared flagellates from oxygen-depleted areas of the ocean. The two previously unknown species from the Baltic Sea appear to have adapted extremely well to the changing oxygen conditions of their native environment and have a cell structure that heretofore has not been observed in collared flagellates.

The funnel-shaped collar accounts for the scientific name of these protozoa, choanoflagellates (choano [Greek]: depression, funnel). They are among the protists and bacterial feeders that play a major role in the microbial food web. The collar consists of a series of filamentous cellular appendages, the microvilli. Protruding from the collar is a single flagellum, which these one-celled organisms use both to propel themselves and to swirl their bacterial food, which is then captured by the funnel and, via the microvilli, transported into the cell.

Cultivation — that is, the establishment of pure cultures under laboratory conditions — is extremely difficult and only rarely successful for these types of microorganisms. Consequently, only a small proportion of the existing marine microbial biodiversity is known. Previous research carried out by members of the IOW indicated that choanoflagellates in the oxygen-depleted areas of the central Baltic Sea are present in elevated concentrations. However, until now it has not been possible to obtain pure laboratory cultures of choanoflagellates isolated from marine low-oxygen environments (redox zones).

Exactly this feat was recently accomplished by IOW researchers with the support of Russian visiting scientists. The addition of *Codosiga minima* and *Codosiga balthica*, two previously completely unknown species of collared flagellates, further enriches the extensive culture collection of the IOW, which already includes representatives of a number of bacterial, flagellate, and ciliate species central to the Baltic Sea ecosystem. These two new members have been examined by electron microscopy and characterized in detail. *Codosiga minima* was so named because of its small size (about 3 microns) and it is probably one of the rarer species in the Baltic Sea. Its "big brother" (about 5 microns), however, is a common species that seems to preferentially reside in the Baltic Sea, hence the name *Codosiga balthica*.

Both species make use of the food sources of the low-oxygen redox zone and feed on its abundant supplies of bacteria and archaea. At the same time they enjoy a degree of protection from predators, since multicellular zooplankton (e.g., small crustaceans) rarely ventures into the low-oxygen layers. In order to take advantage of the living conditions of the redox zone,

the two choanoflagellates — which evolved from oxygen-loving ancestors — have adapted in many ways to the lack of oxygen. Thus, the normally oxygen-dependent mitochondria — the energy-producing "power plants" of cells — have undergone an important change in that they can function with little or even no oxygen. This form of adaptation is absolutely unique among the collared flagellates as it has never been observed before in this group of organisms. Another surprise for the IOW researchers was that *Codosiga balthica* harbors intracellular bacteria. Thus, numerous bacterial cells live within each flagellated cell, where they presumably serve to support energy metabolism.

These two closely related species are now available for the first time as model organisms, which will allow experimental investigations of choanoflagellate metabolism under low-oxygen conditions. The results of such studies will no doubt help to clarify many of the as yet unanswered ecological, physiological, and evolutionary questions regarding collared flagellates.

The described work was supported by the German Research Foundation conducted. Further information on these results can be found in:

Wylezich,C., Karpov,S.A., Mylnikov,A.P., Anderson,R. and Jürgens,K. (2012) Ecologically relevant choanoflagellates collected from hypoxic water masses of the Baltic Sea have untypical mitochondrial cristae. BMC Microbiol. 12 (1), 271

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