

Microheliella maris

A phylogenetically non-positioned eukaryote despite early discovery

The modern eukaryotic tree of life is constantly changing. Supergroups are regularly revisited and studied to get a better understanding over the relationship between these groups and thereby over the evolution of eukaryotes. Some groups, however, have been challenging to position due to the lack of species or the complex morphological traits which could include a species in multiple groups. Microhelida is one of these groups, that was established in a study from 2012 only for an organism called *Microheliella maris*. Despite an early description *M.maris* has still not been positioned phylogenetically within the tree of life and is therefore classified as an “orphan” eukaryote (Yazaki *et al.* 2022).

Microheliella maris is a very small (approximately 4 µm in diameter) phagotrophic organism that only lives as an amoeba. Because of the cell size it is difficult to observe outstanding morphological characteristics under a light microscope. However, four main features could be recognized: 1) the radiating axopodia, 2) central centrosomes, 3) a nucleus that is not located in the cell center and 4) the absence of cilia. The cell body seemed to be spherical and had a small vacuole that is most likely related to prey ingestion (figure 1). The radiating axopodia was found to consist of microtubules through electron microscopy, while the nucleus had a cup-like shape surrounded by a few mitochondria (Yabuki *et al.* 2012). These properties together with the electron microscopy images indicated that *M.maris* is distinctly different from any earlier discovered heliozoan-like protists, and instead shows novel morphological traits (Yabuki *et al.* 2012). Even though this was established jointly with the original description of the organism, many following studies included *M.maris* as a member of the Heliozoa group, because of the morphological similarities shared with this group.

To try and solve some of the uncertainties and to clarify the foundation of the tree of life, a recent study reassessed the phylogenetic position of *M.maris*. With the help of 319 genes they analysed a new phylogenomic alignment, meaning that corresponding positions in the sequence was matched to these genes (Yazaki *et al.* 2022). The result suggested, with high statistical support, that *M.maris* should instead be placed at the base of the Cryptista group. Furthermore, *M.maris* proved to be crucial for understanding the evolution of Cryptista and the sister relationship between Archaeplastida, Cryptista and *M.maris*. This study proposes therefore to collect the last two named groups into a new clade called Pancryptista which is perhaps a more correct position for *M.maris* (Yazaki *et al.* 2022).

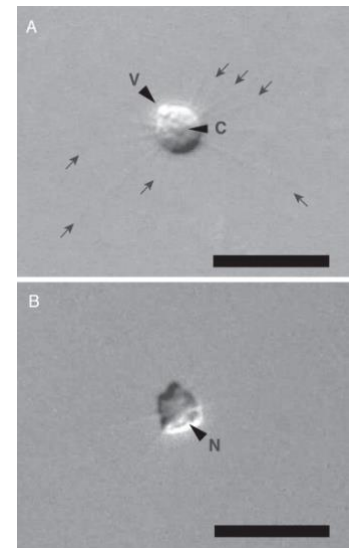


Figure 1. Living cells under a light microscope. **A.** Cell with axopodia and a small vacuole (V), centrosomes (C) are located at the cell center. **B.** Cell with an off centered nucleus (N).

References

Yabuki A., Chao E. E., Ishida K., Cavalier-Smith T. (2012). *Microheliella maris* (Microhelida ord. n.), an Ultrastructurally Highly Distinctive New Axopodial Protist Species and Genus, and the Unity of Phylum Heliozoa, *Protist*, 163(3), Pages 356-388.

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