



## **Molecular diversity of early foraminifera**

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Monothalamid foraminifera are a diverse group that is characterized by single-chambered agglutinated or organic test. They occur in all marine habitats and are also present in terrestrial and freshwater environments. Monothalamids branch at the base of foraminiferal tree, as a paraphyletic group with some clades branching at the base of Globothalamea and Tubothalamea.

We have currently more than 1500 sequences of monothalamids in our database that can be divided in at least 20 clades among which certain are particularly well presented by sequence numbers and/or number of different species. These are members of clade BM that contain Bathysiphon and Micrometula, clade C that contains among others xenophyophorans, saccaminids, and a large variety of organic-walled or agglutinated genera, clade E that contains the genera Psammophaga, Vellaria and Nellya and four clades that contain freshwater foraminifera. In general, the monothalamid clades comprise both agglutinated and organic-walled genera. Some common genera, such as Crithionina, Saccamina, Hippocrepina, are polyphyletic. Our results clearly show that monothalamids are highly diverse and their molecular diversity by far surpasses their morphological variety. Based on phylogenomic studies, monothalamids evolved early in the evolution of eukaryotes, as a part of the supergroup of Rhizaria, comprising also radiolarians and other amoeboid protists. The monothalamids have diverged from ancestral radiolarians, probably about 1000 million years ago, but the exact time is difficult to infer because of the uncertainties concerning a calibration of a eukaryotic phylogenomic tree.