

Anaerobic scuticociliates: A diverse ciliate lineage hosting ecologically important symbiotic prokaryotes.

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Ciliates are one of the most studied protists lineages, yet we still know a little about their diversity in anoxic habitats including both marine and freshwater sediments. Scuticociliates (class Oligohymenophorea) are common ciliates in oxygen-depleted environments, especially in marine habitats. Nevertheless, present knowledge about the molecular diversity of anaerobic scuticociliates is based almost solely on environmental data. We have cultured over 30 strains of mostly marine anaerobic scuticociliates and analyzed their 18S rRNA gene sequences. The results of our analysis show that anaerobic scuticociliates constitute a novel diverse clade and thus represent an important fraction of the overall diversity of scuticociliates.

Anaerobic ciliates often form symbiotic associations with prokaryotes. Indeed, symbioses with methanogenic Archaea are widespread among our cultured anaerobic scuticociliates. Although methanogenic endosymbionts were described only in a few freshwater species, we confirmed the presence of methanogens also in many marine strains. In addition, we noticed a common presence of ectosymbiotic prokaryotes living on the host cell surface. Interestingly, it seems that the presence/absence of the ectosymbionts is ciliate-lineage-dependent. According to our preliminary results from CARD-FISH method, the ectosymbionts are sulfate-reducing bacteria. Although symbioses of anaerobic protists and prokaryotes were shown to be considerably important in anoxic habitats, we lack information about the true nature of the interactions. Thanks to maintaining many anaerobic strains in long-term cultures and the persistence of various symbioses in the culture, we have a great opportunity to study the symbioses in detail. Further research can provide a new insight into the evolution of protists living in poorly studied anoxic environments and their symbioses with prokaryotes.