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The relevance of epilithic foraminifera in ecological studies

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This study aims to emphasize the ecological importance of foraminifera contained within the > 1000 µm sediment fraction. Stones and gravel offer a habitat for diverse and rich epilithic foraminiferal communities. However, gravel-rich sediments > 1000 µm are usually not the subject of quantitative benthic foraminifera studies, because most foraminifera species used as proxies or bioindicators are sediment-dwelling and found within smaller sediment size fractions. Therefore, there is a current lack of knowledge about the biology and ecology of epilithic foraminifera, specifically about agglutinated species.

During a cruise at the Gullmarfjord/Sweden in September 2018, we retrieved a core at a station at 7 m water depth, which contained organic-rich material and a relatively large portion of gravel and shell fragments, which were densely populated by monothalamus, agglutinated foraminifera.

A faunal analysis of foraminifera in the > 1000 µm sediment fraction showed, that the most abundant species (> 85 %, 54 ind. 10 cm^{-3}) in > 1000 µm consisted of *Tholosina vesicularis*, an unicellular agglutinated species that can reach up to 4 mm diameter. SEM-analysis revealed, that large quantities of partially decomposed diatom frustules were embedded within the protoplasm of *T. vesicularis* individuals, which were supposedly the remains of the foraminiferal diet. The sediment fraction of 125 - 1000 µm was dominated by *Ammonia* species (58 %, 190 ind. 10 cm^{-3}), a genus known for its fast turnover of diatom-derived carbon and as key-players in benthic nutrient fluxes. Preliminary biovolume analysis of the two genera (*T. vesicularis*: n = 74, *Ammonia* spp.: n = 110) resulted in far higher values for *T. vesicularis* (853 ± 944 $µm^{-3}$ 10 cm^{-3}, med. = 506 $µm^{-3}$ 10 cm^{-3}), than for *Ammonia* spp. (117 ± 56 $µm^{-3}$ 10 cm^{-3}, med. = 96 $µm^{-3}$ 10 cm^{-3}), within the uppermost sediment layer of 0 - 1 cm. Therefore, *T. vesicularis* could be a main driver of benthic carbon turnover in gravel-dominated sediments. We hypothesize, that the epilithic fauna, when present is at least as relevant as sediment-dwelling species.

Additionally, biodiversity indices (species diversity, Shannon-Index, Evenness), show a slightly higher diversity and a more even distribution within the softer substrate, compared to the stones.

This is most likely due to the motility of the free-living forms of the smaller size fraction, which

allows them a flexible response to spacial competition. However, niche separation between hard and soft-substrate allows the co-existence of the opportunistic species *T. vesicularis* and *Ammonia* spp..

In conclusion, this study shows, that if present, the > 1000 µm fraction can contain important information for the interpretation of ecological studies on the communities of live foraminifera and their role in marine ecosystems.