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**Tiny titans:
Impact of meiofauna diversity and activity on
coastal sediment biogeochemistry**

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Akademisk avhandling för filosofie doktorsexamen I naturvetenskap med inriktning marine biogeokemi och ekologi, som med tillstånd från Naturvetenskapliga fakulteten kommer at offentligt försvaras fredagen den 6e december, 2024, kl. 13:00 i Korallrevet (rum 3401), Natrium, Institutionen för marina vetenskaper Medicinaregatan 7B, 41390, Göteborg

ISBN: 978-91-8069-903-7 (Printed)

ISBN: 978-91-8069-904-4 (PDF)

Tillgängling via: <http://hdl.handle.net/2077/83198>



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Abstract

Chemical reactions in marine sediments and the resulting fluxes across the sediment-water interface influence ecosystem functioning, global carbon cycling, and ultimately global habitability. Although previous research has recognized the major role of microorganisms and macrofauna (invertebrates > 1 mm), it still debated whether meiofauna (invertebrates < 1 mm) can make significant contributions to ecosystem functioning due to their small size. This motivated me to estimate meiofauna contribution to total oxygen uptake and methane release from the sediment, and further investigate meiofauna activity and diversity under environmental perturbations, such as microplastic pollution and climate change.

In this thesis, I described a microsensor-based method for respiration measurements, with ability to induce desired experimental conditions (**paper I**). This method revealed that traditional theoretical estimates of respiration can lead to a four-fold overestimation of measured rates. Although respiration rates were highly variable within each meiofauna group, rates were lower (and thus contribution to ecosystem processes was smaller) under hypoxic compared to oxic conditions (**paper II**). Macrofaunal bioturbation significantly enhanced methane release from coastal sediments, but this effect was somewhat offset by meiofauna due to interactions with microorganisms (**paper III**). Bioturbation depth, however, was reduced when communities were exposed to microplastic pollution (**paper IV**) which may affect organic matter mineralization and nutrient fluxes over longer periods. Lastly, climate change is intensifying environmental stressors such as river discharge and coastal erosion, which were shown to affect meiofauna community, but not nematode diversity (**paper V**). In addition, nearshore habitats, which are particularly impacted by these stressors, favored colonizer-dominated nematode communities, whose future dominance may reduce ecosystem stability as river discharge and coastal erosion increase.

Overall, the results provide new insights into meiofauna's role in sediment biogeochemistry by quantifying its contribution to essential ecosystem processes. This thesis presents the first direct measurements of respiration rates for specific meiofauna, the first investigation of macrofauna-meiofauna-microorganism interaction effects on methane release, impact of microplastics on bioturbation, and the application of molecular tools to study metazoan diversity in Siberian Arctic. The presented findings are especially relevant as growing oxygen-deprived bottoms, intensifying microplastic pollution, and accelerating climate change increasingly threaten marine ecosystems. Such ecosystem-level changes may negatively impact meiofauna and could potentially lead to previously overlooked cascading effects on sediment biogeochemistry.

Keywords: meiobenthos, biogeochemistry, sediment, oxygen uptake, hypoxia, greenhouse gasses, Arctic, metabarcoding, microplastic