

Microplastics in marine species within the Wadden Sea along the coastline of Lower Saxony, Germany

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Introduction

Studies on selected benthic and demersal species in the Schleswig-Holstein Wadden Sea have shown that large proportions of the animals studied in almost all of the species were contaminated by microplastics (Fischer 2019). In the species investigated, the studies resulted in significant differences and a spatial gradient tendency with increasing contamination from north to south. This study covered the northern coastline of Schleswig-Holstein only, an investigation along the coastline of Lower Saxony has not been carried out and is targeted within the present study. Thus, the project will contribute to implementing requirements according to MSFD by: recording and evaluating the nature and extent of microplastics in biota based on five selected species at six investigation sites; major objectives are:

- determining differences in microplastic contamination of the species studied and major influencing factors;
- showing potential spatial gradients and
- based on the results, making recommendations for a future monitoring strategy to detect microplastics in biota in the coastal waters of Lower Saxony, Germany.

Material and Methods

Study Area

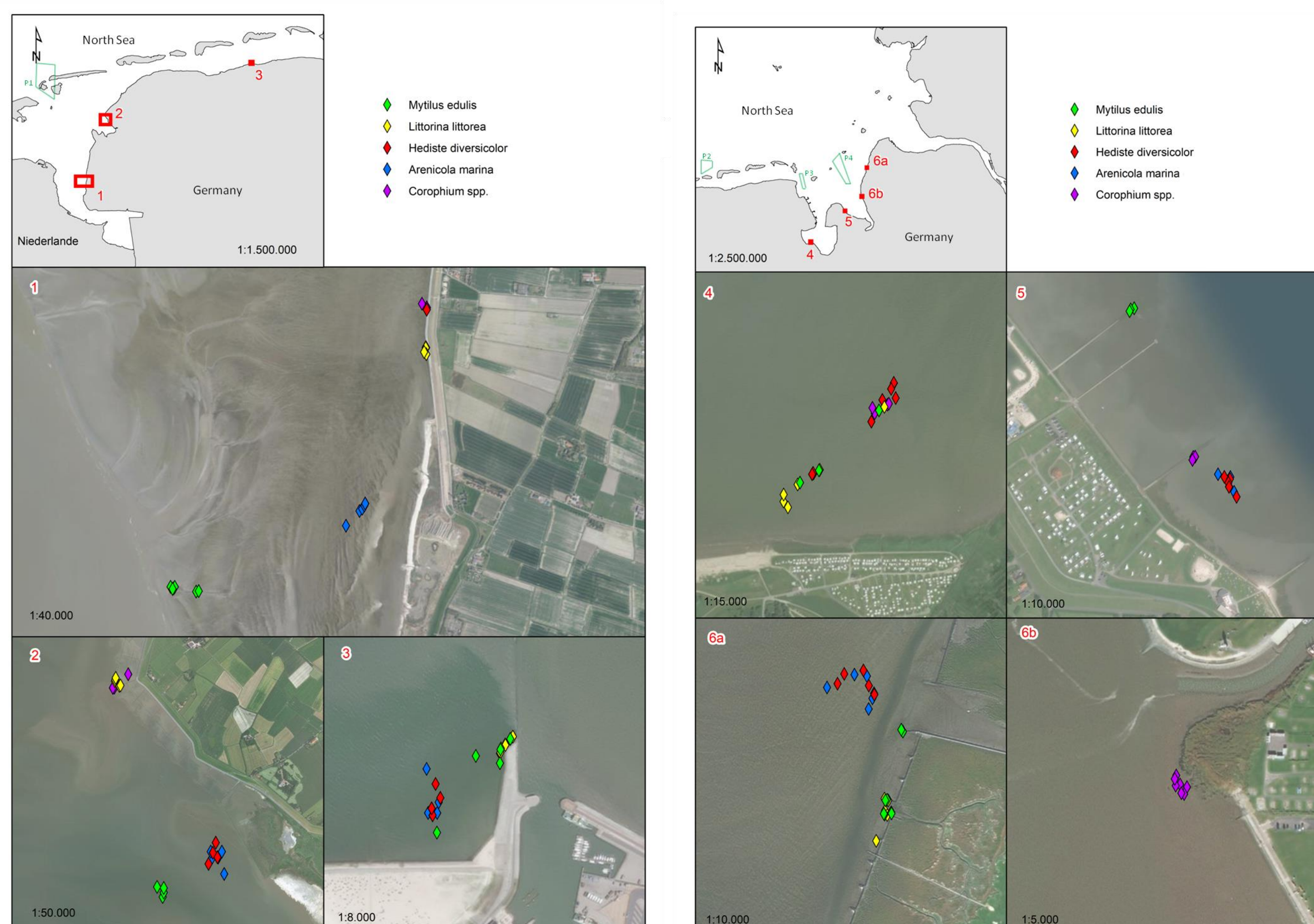


Fig. 1: Sampling sites along the Lower Saxony coastline: west (left) and east (right) invertebrates (1 – Dollart, 2 – Leybucht, 3 – Neuaharlingersiel, 4 – Tettens, 5 – Jadebusen, 6 – Cappel/Neufeld) and pisces (P1 - Borkum, P2 - Baltrum, P3 - Jadebusen, P4 – Weser estuary (AuWe)).

Sampling campaigns

Sampling of invertebrates took place in August 2019 and June/July 2020. Four selected species (*Mytilus edulis*, *Corophium* spp., *Arenicola marina* and *Littorina littorea*) were sampled according to their prevalent habitat at six investigation sites along the coastline of Lower Saxony (see Fig. 1). A total number of >3,200 individuals were taken and pooled from three (*Arenicola marina*) to twenty (*Corophium* spp.). Fish samples were taken in parallel with the regular contaminant monitoring within the region, the gastrointestinal tract was dissected and all samples were stored frozen (-18°C) in aluminium foil until further treatment.

Sample treatment

After dissection and recording of basic parameters such as dimensions and weight (Fig. 2), samples were digested in a solution consisting of potassium hydroxide (KOH) and sodium hypochlorite (NaClO) (300 ml KOH 10M + 150 ml NaClO 6-14 % filled to 1000 ml with MilliQ water) and left to stand for 48 h under a fumehood. Samples were transferred onto filters (613, VWR International 5-13 µm retention), stained with 1 ml Nile red solution (1 mg Nile red/ml chloroform) and left to dry.

QA/QC management

In order to reduce background contamination as much as possible, precautions have been taken, such as the use of glass and stainless steel materials, the filtration of all chemical solutions applied and the integration of procedural blanks.



Fig. 2: Recording of basic parameters (dimensions and weight) – *Mytilus edulis*, *Arenicola marina*, *Corophium* spp., *Littorina littorea*, *Platichthys flesus*.

Analysis of synthetic polymers

Synthetic polymers were detected via Nile red staining and fluorescent microscopy (AxioScope7 – FTIC filter, Zeiss). All particles larger 20 µm were recorded, measured and classified according to their shape (fragments and fibers). A subset of identified particles are analyzed for polymer composition implementing µRaman spectroscopy (DXRxi2, ThermoFisher Scientific) (Fig. 3).

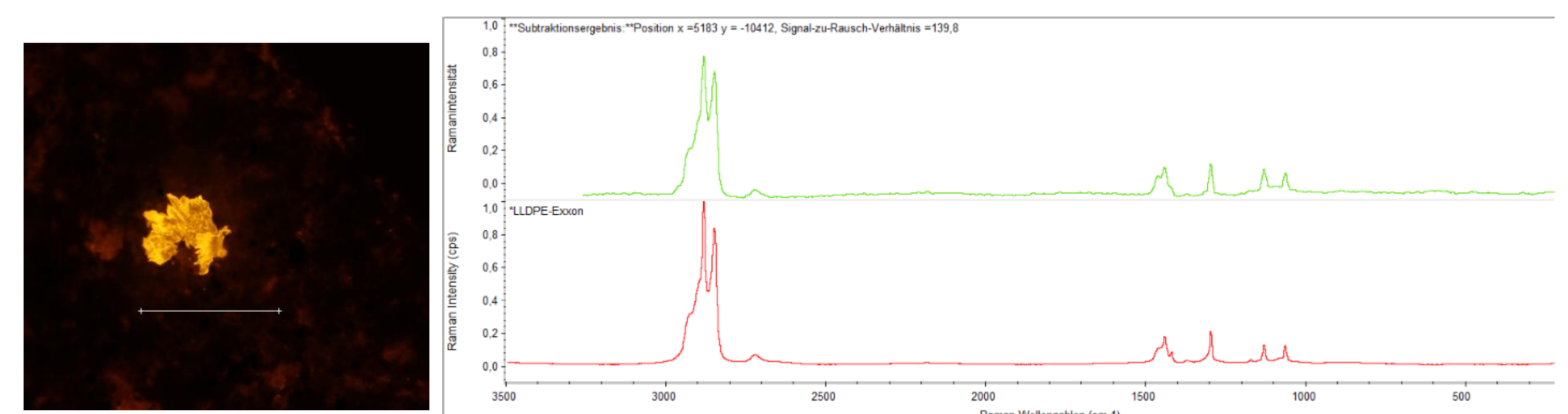


Fig. 3: Detection of synthetic particles (Nile red staining/ fluorescent microscopy) and polymer composition via µRaman spectroscopy

Preliminary results

Preliminary results on synthetic fragments from a subset of all species (except for *Littorina littorea*) and individuals covering 143 samples representing 850 individuals are shown in Fig. 4 and 5.

Results on concentrations show that all species investigated are affected by microplastic pollution. Fragments are clearly dominating (>90 %) compared to fibers within all samples. Thus, within the preliminary results only fragments are considered.

Highest abundance of microplastic particles per individual according to invertebrate species are found in *Arenicola marina* with median concentrations of 15.4 fragments per individual (mean 22.2) followed by *Mytilus edulis* (median 14.1 / mean 18.7) and *Corophium* spp. (median 0.70, mean 0.75). The low abundance in *Corophium* above all results in the small size and weight of the species. Fig. 4B shows concentrations per fresh weight where relations between species differ accordingly. Considering different investigation sites the preliminary results clearly reflect the tendency of highest values at the site Neuaharlingersiel being affected by ferry and shipping activities. Results on the fish species *Platichthys flesus* overall range from 3.0 to 63.0 particles per individual (median 18.0, mean 21.9) and show lowest concentration at the site P1_Baltrum and highest at P4_Jadebusen (Fig. 5A and B). Please note that results are not yet corrected for blank values ranging from 0.0 to 5.0 particles per individual (except for *Corophium* ranging from 0.0 to 0.7 particles per individual).

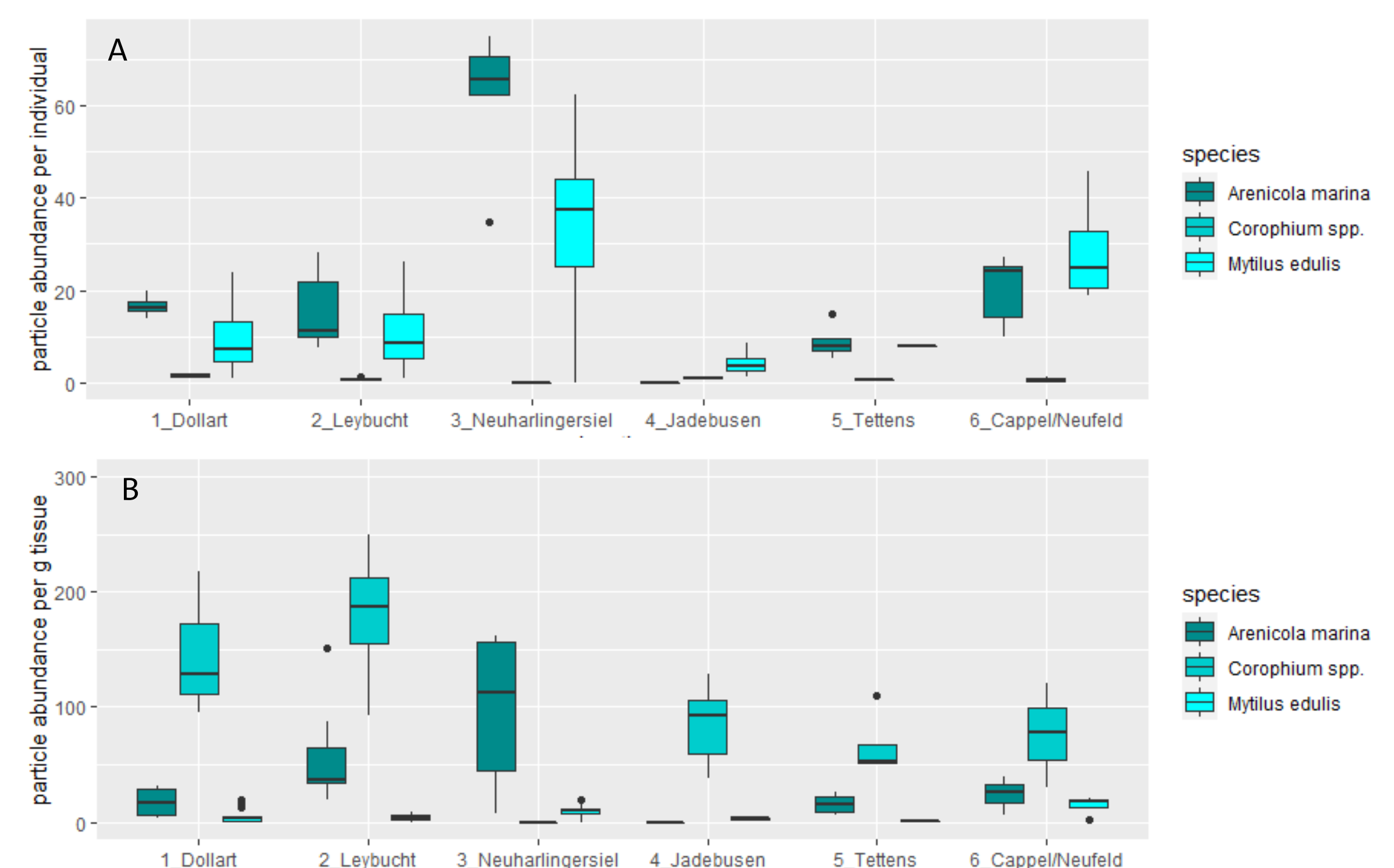


Fig. 4: Microplastic concentrations in invertebrate species (*Arenicola marina*, *Corophium* spp., *Mytilus edulis*) according to investigation sites (A – per individual, B – per g tissue weight)

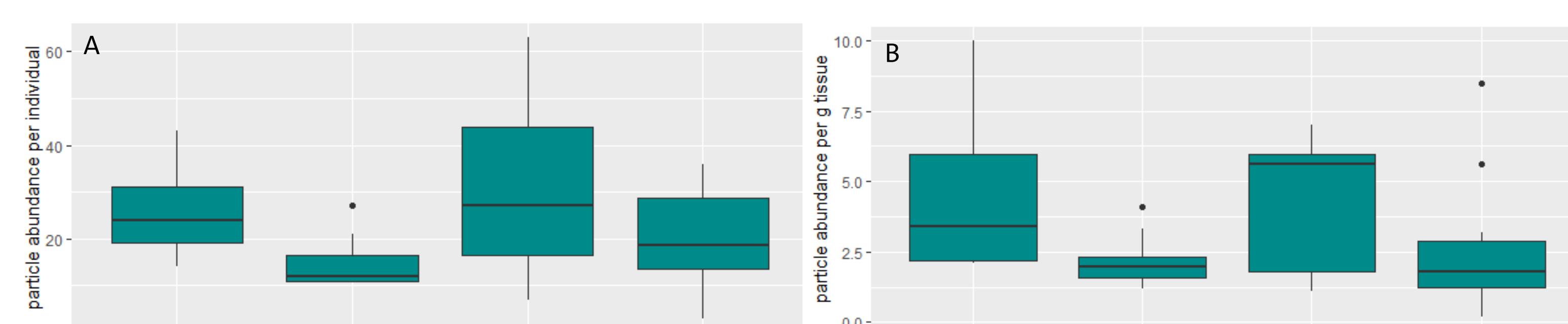


Fig. 5: Microplastic concentrations in *Platichthys flesus* according to investigation sites (A – per individual, B – per g tissue weight)

Conclusions / Outlook

The preliminary results already provide a good overview but needs to be backed with a larger data set that will be generated in the following months. Furthermore, statistics concerning correlation to influencing factors such as individual characteristics, spatial gradients and local factors will be calculated and data will be compared with other findings from the North Sea. Additionally, sediment cores are investigated and the specific correlation of sediment-species interaction will be investigated focussing on *Arenicola marina*.

References

Fischer, E.K. (2019): Distribution of microplastics in marine species of the Wadden Sea along the coastline of Schleswig-Holstein, Technical Report. (pdf available via Researchgate)