Quantifying microplastic pollution in marsh habitats

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Introduction

Plastic disposable products have contributed to an estimated 4.8–12.7 millions tons of plastic entering marine systems each year\(^1\). Microplastics are those pieces of plastic that are 5 mm or less in length; thus they are usually hard to see with the naked eye. They can come in different shapes, sizes, and colors, and can be found everywhere, including marine habitats. Many organisms that encounter microplastics will consume them, which can cause biological defects.

The purpose of this study was to quantify the microplastics within algal epiphytes and marsh sediment (Fig 1). To our knowledge, there are no previous studies that have examined microplastics within epiphytes.

Methods

Field Collection Methods: Epiphytes from three sites were examined by collecting 2 mm by 2 mm samples from Spartina alterniflora stems. For sediment, we collected 1 ml samples from the low tide waterline at two sites. The epiphytes were collected from Rodney J. Hall Boat Ramp, McQueen’s Island Trail Bike Path, and Tybee Island, while sediments were collected from Rodney J. Hall Boat Ramp and McQueen’s Island Trail Bike Path. Ten epiphyte samples and ten sediment samples were collected from the designated sites.

Laboratory Analysis: Epiphytes were teased apart to separate branches and were examined under a light microscope to visually determine if microplastics (Figs 2 and 3) were present.

For sediment samples, we transferred 0.1 ml of sediment into two new microcentrifuge tubes. In one tube, we added 0.4 ml of water and 5 μl of Nile Red dye solution. The samples were stained for 30 min and vortexed twice at 15 min and 30 min. For the unstained samples, we added 0.4ml of water and vortexed the tubes once after 30 min. All sediment samples were viewed under a light microscope. The samples stained with Nile Red were illuminated under a blue light and viewed with orange goggles, which caused the stained microplastics to fluoresce, making them easier to see.

Statistical Analysis: Differences in the number of microplastic pieces between stem type, epiphyte species, sites, and stained and unstained samples were analyzed using Mann–Whitney U or Kruskal–Wallis tests.

Results

1. **Fig. 5** Percentage of various microplastics found in epiphytes at the three sites.
2. **Fig. 6** Average plastic particles on bare and epiphytized stems.
3. **Fig. 7** Average plastic particles in sediment seen without the addition of Nile red dye. Data did not differ significantly by site (Mann–Whitney U). Error bars are ± 1 SD.
4. **Fig. 8** Average plastic particles in sediment seen without the addition of Nile red dye. * indicates significant difference (Mann–Whitney U). Error bars are ± 1 SD.
5. **Fig. 9** Average plastic particles in sediment seen with addition of Nile red dye. * indicates significant difference (Mann–Whitney U). Error bars are ± 1 SD.

Discussion

- Blue fibers were the most abundant type of microplastic in epiphyte samples (Figs. 5, 10).
- S. alterniflora stems with epiphytes had a significantly greater abundance of microplastics in comparison to bare stems (Fig. 6).
- Ulva epiphytes had the greatest abundance of microplastics per cm\(^2\) (Fig. 7).
- Ulva and Bostrychia contained more plastic particles than bare S. alterniflora stems (Fig. 7).
- Within the sediment, similar quantities of fibers and plastic particles were found at both sites. Fibers were more abundant than particles (Fig. 8).
- Fibers and particles were visible without the Nile red stain, however significantly more particles were visible when stained with Nile red (Fig. 9).
- Based on these results, microplastics are abundant within marsh sediments and epiphytes.
- Future research will explore the impact of microplastic consumption on mud snail growth and reproduction (Fig. 11).

Literature Cited


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