Survey and Spatial Distribution of Microplastics in the Midland Rivers System of South Carolina

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Abstract

Microplastics (particles <5mm), have been considered as a contaminant of emerging concern in the aquatic ecosystems. Few studies have assessed the distribution of the different types and concentration levels of microplastics in freshwater river systems in the United States. The objective of the current study is to provide new insights on microplastics density and distribution on the midland freshwater river systems. This study investigated the levels of microplastics in the sediment and surface waters of more than 54 nautical miles of the Saluda, Broad, and Congaree rivers system within the Columbia basin in the midlands of South Carolina. Field collected sediment and water surface samples were analyzed using a dissecting microscope to quantify and characterize (e.g. size, shape, color, type) the microplastic-fragments. The implications for future studies include identifying point sources to mitigate microplastics contamination discharges in aquatic systems and determining the impact that microplastics exposure have on the growth and energy metabolism of select aquatic organisms.

Background

- Microplastics (particles <5mm) are an important component of global plastic pollution; microplastic estimated densities range in the thousands to 100,000 particles per m^3 in surface waters and in the range of 100,000 particles per m on shoreline areas (Eerkes-Medrano et al. 2015).
- Less than 4% of published microplastics studies are associated with freshwater systems (Li, et al. 2018). Studies of microplastics in the freshwater rivers of the United States indicate that the Los Angeles River surface water concentration of microplastics are 1,293 particles/L (Moore et al. 2011) and the river systems of the Great Lakes found microplastics in 12% of freshwater fish (Baldwin, et al. 2016).
- Ingestion of microplastics by marine animals have shown adverse health effects such as increased immune response, decreased growth rate, and energy depletion (Naji, et al. 2018).
- Freshwater fishing is viable to South Carolina's economy; direct costs related to fishing were an estimated 686 million dollars in 2014 (Willis and Straka, 2016).

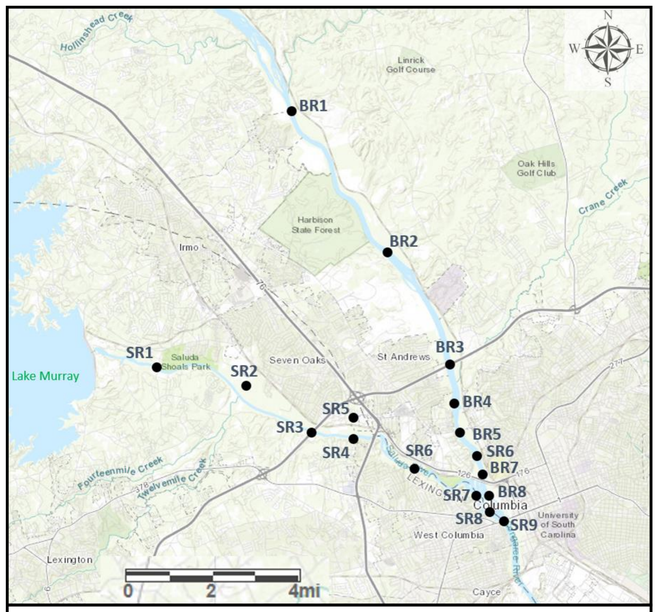

Figure 1: Sample locations along the Saluda (SR) and Broad (BR) Rivers within the basin area of Columbia, SC.

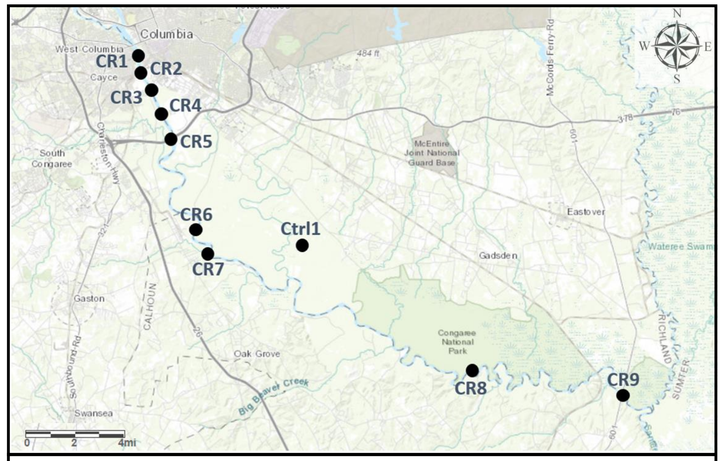

Figure 2: Sample locations along the Congaree (CR) and within the Midlands basin area in South Carolina.

Aims

Purpose: To categorize the different types, quantities, and concentrations of microplastics found in the sediment and surface water of the Saluda, Broad, and Congaree Rivers.

Hypothesis: There will be a difference in the microplastic concentrations found between the Saluda, Broad and Congaree Rivers.

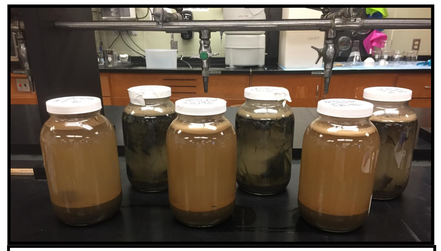

Figure 3: Sediment samples undergoing density separation.

Figure 4: Particles captured on a 38 µm sieve.

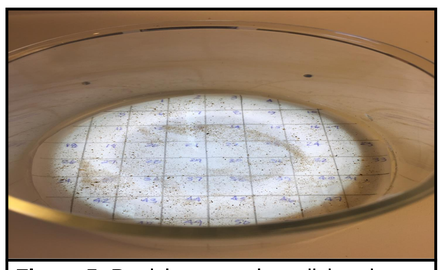

Figure 5: Particles on a glass dish, prior to quantifying on a microscope.

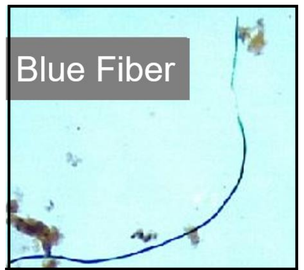

Figure 6: Blue fiber from a Congaree River sample.

Methods

- Sediment and water surface samples (n = 492) were collected from 27 sites in the midland rivers system (Fig.1, Fig. 2).
- A density separation method using sodium chloride (Fig. 3) was used to extract microplastics from the field collected sediment samples (Hidalgo-Ruz et al. 2012).
- Organic material in water and sediment samples were dissolved in 10 mL of 30% hydrogen peroxide for seven days and remaining material was sieved for further processing and identification (Fig. 4).
- Microplastics were recorded and observed using a dissecting microscope (Fig 5).

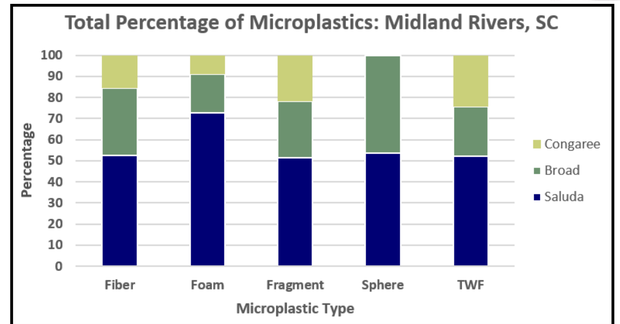

Figure 7: Microplastic percentages in the sediment samples of the Midlands Rivers.

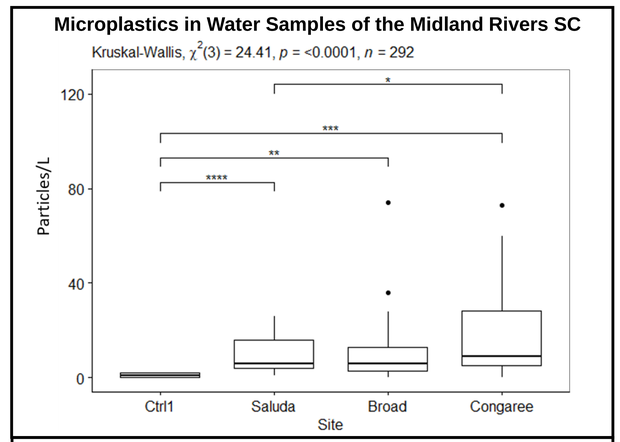

Figure 8: Mean concentration differences of microplastics among the Saluda, Broad, and Congaree Rivers.

Preliminary Results and Discussion

- Microplastics to include fibers, foam, fragments, spheres, and tire wear fragments were found in all the water and sediment samples of the Saluda and Broad Rivers (Fig. 7).
- The most abundant types of microplastics in the Midland Rivers were fibers (31.5%) and tire fragments (55.4%).
- There was a significant difference in the mean concentration of particles per liter (Water surface) between the Congaree and Saluda Rivers (Kruskal-Wallis, p<0.0001, Fig. 8).
- There was a significant difference in the mean concentration of particles per m^2 (Sediment) between the Congaree and Saluda Rivers (Kruskal-Wallis, x^2 (3) = 12.85, p = 0.005, n = 200).
- Future analysis include comparing water and sediment concentrations of microplastics to similar studies and determining spatial differences of microplastics among each of the Midland Rivers.

References

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