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Tidewater Oyster Gardeners & Chesapeake Bay Trust
High School Writing Contest

"Sunset Over Beach Creek", Stella Mayhew

The Rappahannock's Deeper Story: Unveiling Microplastic Levels - *An ecological essay*

Field Work and Essay by Estella Mayhew

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Introduction:

Microplastics are the most prevalent marine debris in the oceans (NOAA, 2020), defined as plastic pieces 5mm in length or smaller (roughly the size of an eraser tip;)(National Oceanic and Atmospheric Administration, 2024). This plastic waste permeates our rivers, from sediments to marine life stomachs. Microplastics contain high levels of chemicals, far exceeding organisms' natural nutrients, causing severe impacts on aquatic ecosystems, primarily due to human-induced pollution (What are the impacts of microplastics?, NOAA).

Plankton, crucial floating organisms that absorb nutrients, are significantly affected by microplastics (NOAA, 2020). Contact with microplastics can alter plankton's buoyancy, cause sinking, or impair nutrient uptake. Other aquatic animals, like fish, mistakenly ingest microplastics, leading to death from chemical exposure. Filter feeders prevalent in the Rappahannock River, such as oysters, are particularly vulnerable as they filter water to obtain nutrients.

Because microplastics in the Rappahannock River, Virginia, U.S.A., harm plankton, they consequently harm the entire river ecosystem, impacting the economy through species decline and overall river health. Efforts to solve and prevent microplastic sources are crucial. However, lacking exact knowledge of their location, origin, and quantity in the river, investigation is vital. In this study, microscopes were used to find microplastics filtered from plankton nets in the Rappahannock River. The hypothesis is that if fibers are less dense than other microplastics, they should float, resulting in a greater mean number of fibers in surface samples compared to bottom samples.

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Methods:

Microplastics were surveyed in 2025 at the lower Rappahannock River, 11 km from the Chesapeake Bay, near Christchurch School, Virginia USA. Shoreline microplastics were sampled for 5 minutes using 4 x 4 foot seine nets at a stream and river beach. Microplastics were also surveyed via 30-second horizontal tows with a 15-inch Wildco Fieldmaster Student Plankton Net (5-inch opening). All nets, made of 153-micron mesh, captured objects >0.153 mm. Plankton net tows occurred by hand-towing off Christchurch School dock and by boat in the river's middle (surface and 1-3 m depth). Samples were examined in a laboratory using dissecting and optical microscopes (20-100X). Objects were identified via a microplastics key, and means calculated per location and microplastic type. Sampling and identification techniques were consistently controlled. The independent variable was location and depth; the dependent variable, the mean number of fibers on surface and bottom.

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Results:

After collecting data from 48 samples in the Rappahannock River, microplastic fibers and bundles were higher in the depths of the river as opposed to the surface.

Figure 1. In May 2025 Rappahannock River (Virginia USA) microplastic survey, Despite fibers being less dense than other microplastics, the mean number of fibers from shallow river areas is less than the deeper areas.

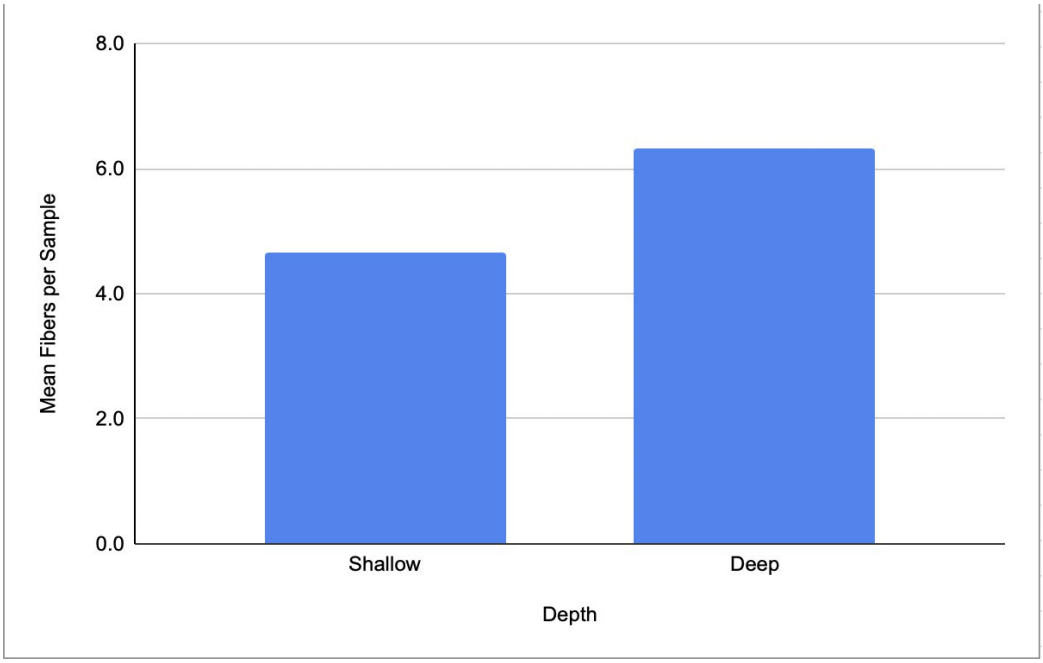

Table 1. Measurements of shallow and deep microplastics in the lower Rappahannock River, Virginia USA May, 2025.

Depth	**Samples**	**Fibers, Fiber Bundles**	**Other microplastics**	**Total microplastics**	**Mean fibers per sample**
Shallow	39	182	273	455	4.7
Deep	9	57	53	110	6.3

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Discussion:

The research found the microplastic fibers and fiber bundles have the highest rate in the deep parts of the Rappahannock River compared to on the surface and shallows. My hypothesis was not supported. Previous data showed fibers were less prevalent in deeper layers than surface waters (Dai et al., 2018). This established consensus for fiber distribution did not align with our Rappahannock River findings.

The mean fiber amount was 4.7 in shallows and 6.3 in deep areas, indicating greater deep concentration. More data collection should occur after no rainfall (1-2 weeks), significant rainfall, and large storms. This would show how weather and runoff impact microplastic levels and how water disruption changes levels across depths. More samples (e.g., 4 to 6 areas instead of two) would improve variety.

Regarding microplastic fibers and bundles, our initial hypothesis was that fibers, being less dense, would float, resulting in higher surface levels. This suggests fiber microplastics can cause a greater problem for bottom feeders than air-breathing sea life.

Overall, fibers are more concentrated in the deep Rappahannock River. While surface microplastics impact all creatures, especially air-breathing sea life, this deep concentration also significantly affects bottom feeding sea life, filter feeders, and vegetation.

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