Plastics Unleashed:
Assessing Microplastic Environmental Impacts and Remobilization Risks in Freshwater Sediments

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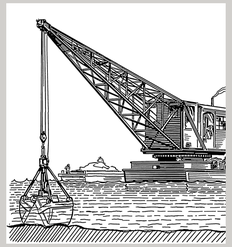
Background

Microplastics' widespread presence in freshwater ecosystems threatens environmental health and biodiversity. Originating from various sources, notably wastewater treatment plants, these pollutants particularly affect sediments, impacting benthic species and ecosystem services. Understanding their full impact is crucial for developing solutions. This study focuses on the effects of microplastics in sediments and evaluates the risk of their remobilization during sediment disturbances.

Definitions

Microplastics are plastic particles smaller than 5mm (Grbic et al., 2020). Primary microplastics are intentionally manufactured to be a small size and secondary microplastics are fragments of larger plastic items (Henry et al., 2019).

Sediment Disturbant Events are occurrences that disrupt the natural deposition and arrangement of sediment particles, often caused by natural phenomena like storms or human activities such as dredging (CEFAS, 2005).



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Research Question

Question:

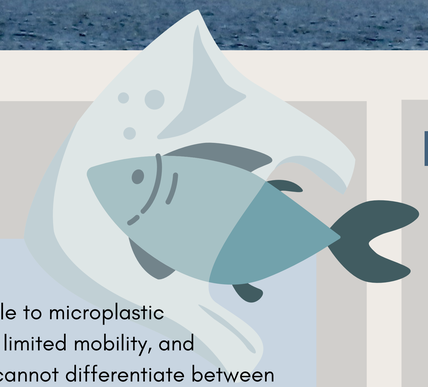
What are the environmental impacts of microplastics in the sediments of freshwater ecosystems, and what are the potential risks of remobilization during sediment disturbance events?

Methdology

A comprehensive literature review was the chosen methodolgy for this project. This was chosen due to the wealth of recent studies available on microplastics.

- Base search terms including: microplastics, freshwater, environmental impact, sediments, lake ecosystems, sediment disturbance, benthic fauna, etc.
- 78 articles were reviewed and categorized based on theme.
- 16 categorization themes including: benthic fauna, food webs, trophic transfer, bioaccumulation, chemical transfer, aged microplastics, nutrient cycling, causes of remobilization, impact of remobilization, biodiversity loss

Key Findings



Environmental Impact

Aquatic Life

- **Benthic Organisms**:are highly vulnerable to microplastic pollution due to their confined habitats, limited mobility, and dependence on sediment quality. They cannot differentiate between microplastics and natural food, leading to ingestion that causes a false sense of fullness, nutritional deficiency, decreased energy, and increased starvation risk. This affects their growth, survival, fecundity, and reproduction, ultimately harming the species' health. (Straub et al., 2017).
- **Chemical Transfer**: microplastics interact with chemicals, absorbing them from their surroundings and potentially leaching toxins into organisms that consume them (Liu et al., 2019).

Ecosystem Services

- **Nutrient Cycle**: microplastics absorb nutrients like nitrogen and phosphorus, reducing their availability for nutrient cycling, which can disrupt and diminish ecosystem services (Yu et al., 2022).
- **Eutrophication**: microplastics alter sediment properties and enzymatic activities, affecting carbon storage and conversion, pH levels, and nutrient flow, potentially leading to eutrophication and disruptions in nutrient availability for aquatic organisms (Zhang et al., 2020).

Remobilization

- **Causes of Remobilization:** there are both natural and anthropogenic causes for sediment remobilization. The physical forces of these causes results in aged microplastics resurfucing and polluting new areas of the water column (CEFAS, 2005).
- **Aged Microplastics:** Remobilization of aged microplastics from sediments, following their physical and chemical changes like surface weathering and biofouling, can heighten their ecological impact and capacity to absorb harmful pollutants, ultimately increasing exposure to aquatic organisms and the risks of bioaccumulation and biomagnification, threatening ecosystem health and biodiversity (Bellasi et al., 2020).

Future Research

Research on microplastics, particularly in freshwater environments, is relatively new and requires further study to address knowledge gaps, include:

- Influence of hydrological dynamics, such as flow regimes, water velocity, and sediment transport, on the distribution and accumulation of microplastics in freshwater sediments
- An interdisciplinary approach such as the intergration of hydrological data
- Knowledge about the spatial and temporal distribution of microplastics in freshwater areas is lacking, which is essential for understanding their distribution patterns and causes.

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