Fate of Microplastics at the Mouth of an Urban Coastal Watershed

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Introduction

Plastics are pervasive in urban watersheds (Fig. 1) and have high potential for chemical adsorption, transport, ingestion (1), and leaching of constituent semi-volatile organic compounds (SVOCs), which bind to fats and sediments (2). Little is known, however, about the incorporation of these contaminants into coastal food webs.

Our project goal was, therefore, to determine the extent to which wetland fish living at the mouth of an urban coastal watershed are contaminated with microplastics and SVOCs.

We tested the following hypotheses:
1. Microplastics in fish will reflect the composition and abundance in sediments (i.e. fish will display non-selective consumption)
2. SVOC contamination of fish tissue will be common in all species

Methods

- In June 2015, we sampled a 250 m long reach of intertidal Chollas Creek, located about 1 km upstream of the mouth (Fig. 2).
- Wetland resident fish were collected using baited traps (Fig. 3) for gut content and SVOC analysis.
- Sediment (10 cm diam. x 5 cm depth cones) was collected for micropastics classification and enumeration.
- Fish diet preference was explored using Manly’s alpha (3).

Results & Discussion

Sediment

- All sediments contained microplastics with an average (±1SE) of 9.638±1.636 pieces per m²
- Synthetic fibers and hard and soft plastic pieces made up 90% of microplastics (Fig. 4)

Fish

- ~25% of fish ate microplastics (12% of 61 California killifish, 32% of 74 saffin molly, 0% of 4 longjaw mudsuckers)
- Of the 59 types of sediment plastics, killifish and molly consumed a subset (Fig. 4) of 10-11 types
- 7-B type of plastic were preferentially eaten, including blue, yellow, orange, and red hard pieces, fibers of any color, and microbeads (killifish):
  - Preferred plastics often resembled prey items such as snails, fish eggs, filamentous algae, nematodes, and worms (Fig. 5)

Takeaways

- Plastics pollution has ecosystem-level impacts through incorporation into the food web
- Species natural history, including differences in behavior and requirements among species, Ontogeny and sex, can affect rates of plastic ingestion
- Some fish selectively ingest plastic items that resemble their prey
- Plastics entering coastal watersheds will likely be incorporated into food webs; the most effective solution is to stop initial entry through (a) reduced use of plastics in production of goods; (b) encouraging reduced use and recycling of plastics by consumers; and (c) improving enforcement of illegal dumping, trash management, street cleaning, and stormwater filtration strategies.

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References


Fig. 1. Study site at flood tide
Fig. 2. Chollas Creek sub-watershed
Fig. 3. Collecting fish from trap at Lower Chollas Creek
Fig. 4. Fish fed selectively on fibers and hard pieces from sediments
Fig. 5. Prey and plastics often looked similar.
Fig. 6. All fish contained SVOCs
Fig. 7. All fish contained SVOCs

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