Final Presentation - Ingestion of Common Microplastics

Dalton Blackwell, Amelia Ehlers, Andy Gardner, Kyle Guevarra, Jasper Nevis

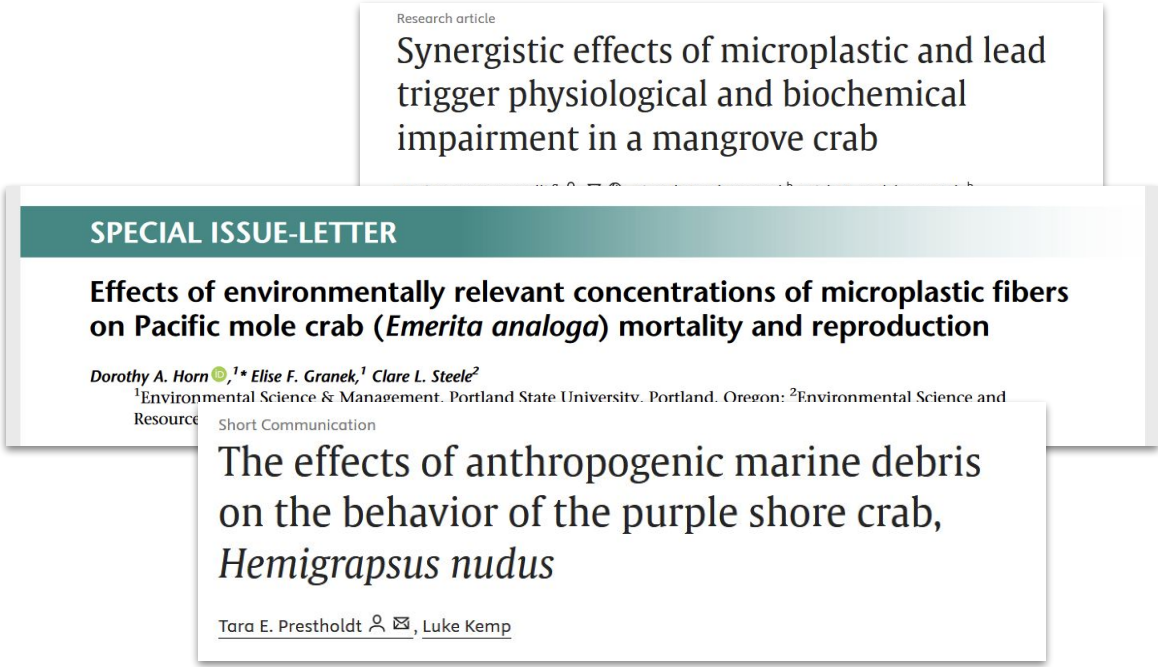
Background: Microplastics in Crabs

Impacts of exposure to microplastics:

Mangrove crab (Capparelli et al. 2024):
- increased accumulation of lead

Pacific Mole Crab (Horn et al. 2019):
- increased adult mortality
- decreased retention in egg clutches

Purple Shore Crab (Prestholdt and Kemp 2020):
- Avoidance of plastics



Research article

Synergistic effects of microplastic and lead trigger physiological and biochemical impairment in a mangrove crab

SPECIAL ISSUE-LETTER

Effects of environmentally relevant concentrations of microplastic fibers on Pacific mole crab (*Emerita analoga*) mortality and reproduction

Dorothy A. Horn[1]*, *Elise F. Granek*[1], *Clare L. Steele*[2]

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Short Communication

The effects of anthropogenic marine debris on the behavior of the purple shore crab, *Hemigrapsus nudus*

Tara E. Prestholdt, Luke Kemp

Background: Microplastics & Invasive Species

Effect of Microplastic on the Gills of the Shore Crab *Carcinus maenas*

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Supporting Information

ABSTRACT: Microscopic pl
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nor natural sediments altered
(COOH) and aminated (NH_2
a significant adverse impact
compared to the physiologica
exposure to both anthropogen

Ingestion of Plastic Microfibers by the Crab *Carcinus maenas* and Its Effect on Food Consumption and Energy Balance

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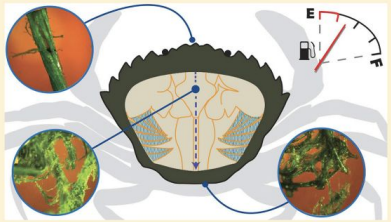
Supporting Information

ABSTRACT: Microscopic plastic fragments (<5 mm) are a worldwide conservation issue, polluting both coastal and marine environments. Fibers are the most prominent plastic type reported in the guts of marine organisms, but their effects once ingested are unknown. This study investigated the fate of polypropylene rope microfibers (1−5 mm in length) ingested by the crab *Carcinus maenas* and the consequences for the crab's energy budget. In chronic 4 week feeding studies, crabs that ingested food containing microfibers (0.3−1.0% plastic by weight) showed reduced food consumption (from 0.33 to 0.03 g d^{-1}) and a significant reduction in energy available for growth (scope for growth) from 0.59 to −0.31 kJ crab d^{-1} in crabs fed with 1% plastic. The polypropylene microfibers were physically altered by their passage through the foregut and were excreted with a smaller overall size and length and amalgamated into distinctive balls. These results support of the emerging paradigm that a key biological impact of microplastic ingestion is a reduction in energy budgets for the affected marine biota. We also provide novel evidence of the biotransformations that can affect the plastics themselves following ingestion and excretion.



Research Question:

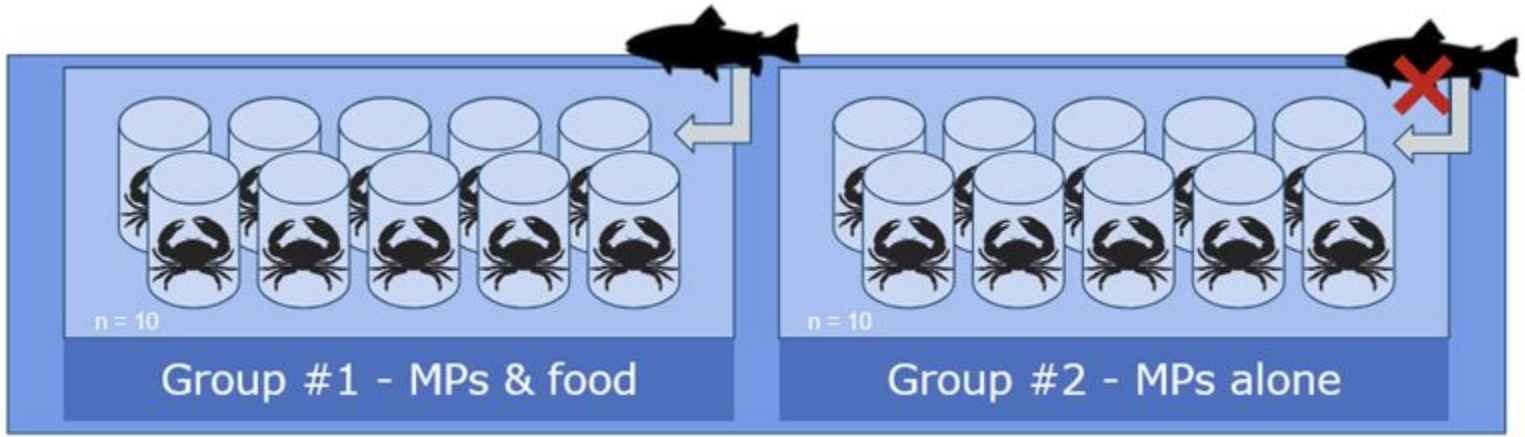
Do microplastics impact oxygen uptake in hairy shore crabs and/or accumulate in their gills and tissues?

Objective: Hypothesis & Null-Hypothesis

H_0: No impact of oxygen uptake and microplastics will not accumulate

H_A: Decreased oxygen uptake and microplastic accumulation in gut and gills

Experimental Design: Set-Up

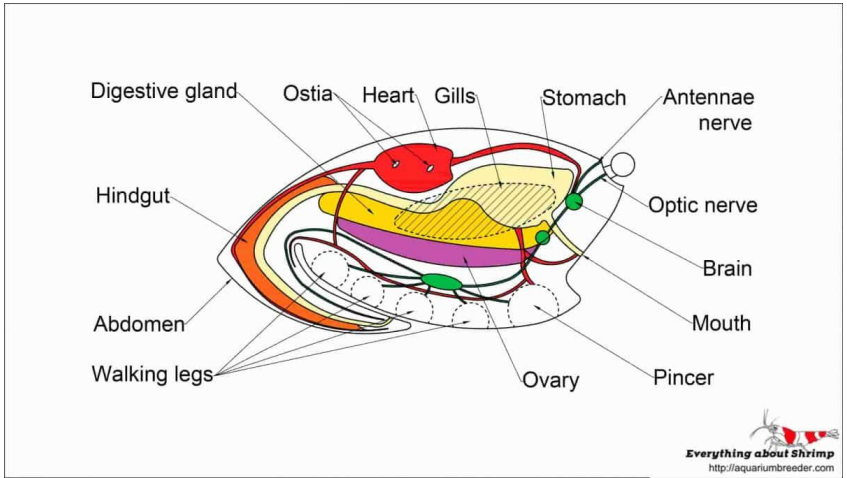


Experimental Design: Choice of Plastic

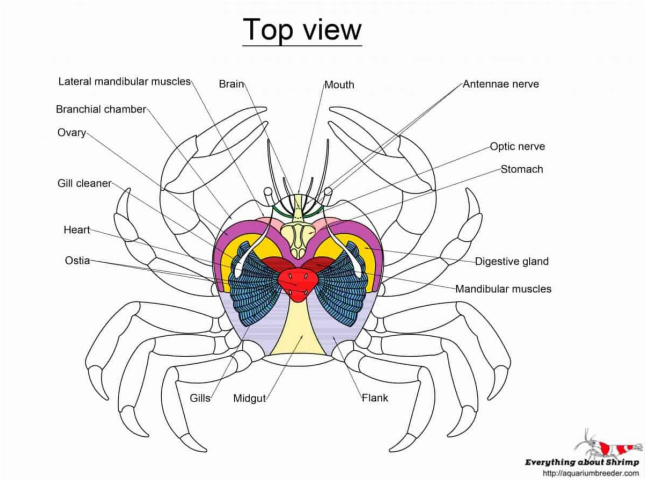
- “Recycled” plastic, simulating what’s available in the water column rather than a specific isolated type of plastic.
- Blue color easily visible against beige crab tissues

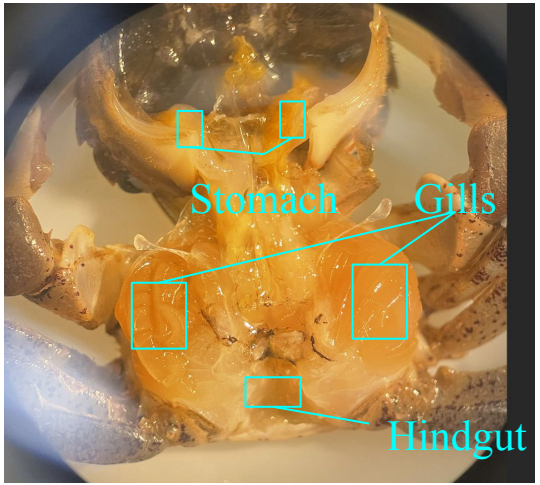
Experimental Design: Data Collection

- Claw hemolymph extracted- tested for L-lactate concentration
- At end of experiment, all crabs weighed & dissected
- Examining digestive tract & gills for plastic particles



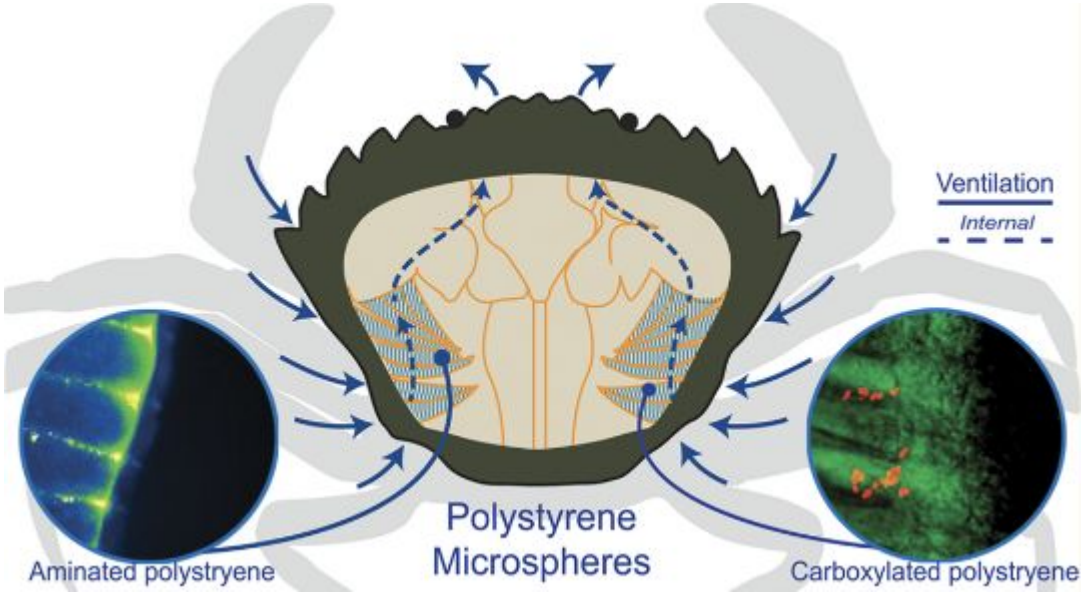
Dissections & Accumulation





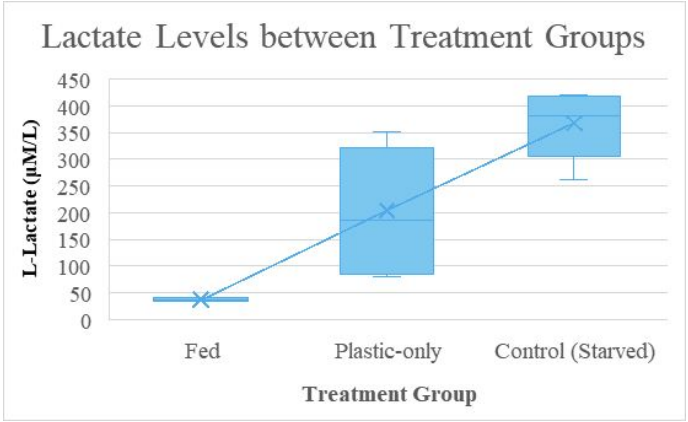
Comparison to Green Crabs

No accumulation,
unable to compare to *C. maenas*



Watts et al. 2016

Lactate



Control groups - Group FOUL and Group CAFF

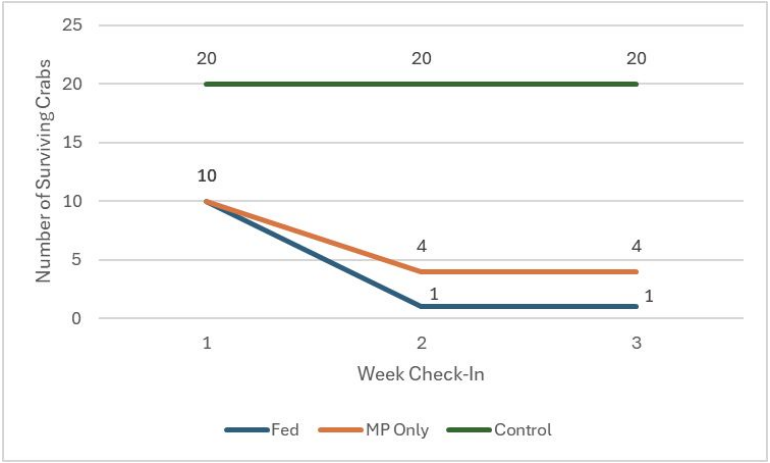
- Average ~ 300 micromolar lactate

Experimental group

- Group PLAST - Fed: ~40 micromolar lactate
- Group PLAST - Fast: ~200 micromolar lactate

Control groups and PLAST Fast had larger sample sizes (Between 3 to 5 crabs per sample group)

Complications & Adjustments



Mass mortality event

- Group A: 60% Mortality Rate
- Group B: 90% Mortality Rate

Causes

- Hypoxia: Low Oxygen saturation due to restrictive water flow
- Ammonium Toxicity: Toxic compounds from decaying food matter

Adjustments

- Transition from individualized jars to communal tank setups
- All MP and food matter was also transferred into the tank setups

Implications

Pilot studies are important

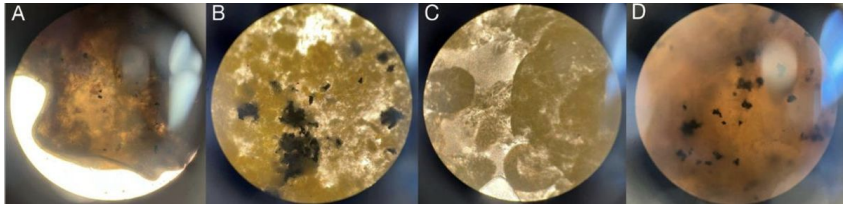
- Fully communal tank design vs. individual jar design to minimize hypoxia and nitrogen toxicity
- Collect behavioral data
- Perform water changes daily as opposed to a bi-weekly structure
    - Allows for prompt diagnosis of novel issues
    - Dead crabs can be preserved faster to prevent internal organ decay & loss of specimen for visual analysis

Data Analysis

- Small sample size implies less conclusive findings
- Mortality caused limitations on what assays could be done

Implications

- Fed individual had lower lactate than both control and plastic only group.
- Lactate is proportional to anaerobic respiration, which is a stress response
- Possible reasons:
  - Low Fed
    - Reduced food stress
    - Hearty individual
  - Higher MP
    - Particulate stress
    - HDPE toxicants
- Lack of consumption compared to FISH 497C Tire Tread Team 2024
  - Our HDPE was…
    - Buoyant
    - Colored brightly
    - Hard and non-porous



Future

CLASSIFY		SURVEY		PROTECT
PLASTIC A -> SP.A PLASTIC B -> SP.B	⟹	20% PLASTIC A 80% PLASTIC B	⟹	SPECIES B > A

- Plastic type likely has some impact
  - Classifying plastics risk, I.E. species specific bioavailability
  - Allows risk assessment if a pollution survey is conducted
- Recycled hard plastics may be less detrimental to crab populations than tire tread
  - Efforts to reduce runoff from road -> ocean
  - Prevention/cleanup of tire dumping

Conclusion

Key takeaways:

- Low lactate levels in Fed individual
  - Lactate = stress
- The type of plastic could have an impact in ingestion rates
  - “Food like” plastic actually consumed
- Bioavailability based risk assessment