

NANO AND MICROPLASTICS IN MARINE ECOSYSTEMS: TEMPORAL TRENDS, SEDIMENT SINKS, AND ECOLOGICAL IMPLICATIONS IN ESTUARINE AND GULF ECOSYSTEMS

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Just because you can't see it, doesn't mean it isn't there

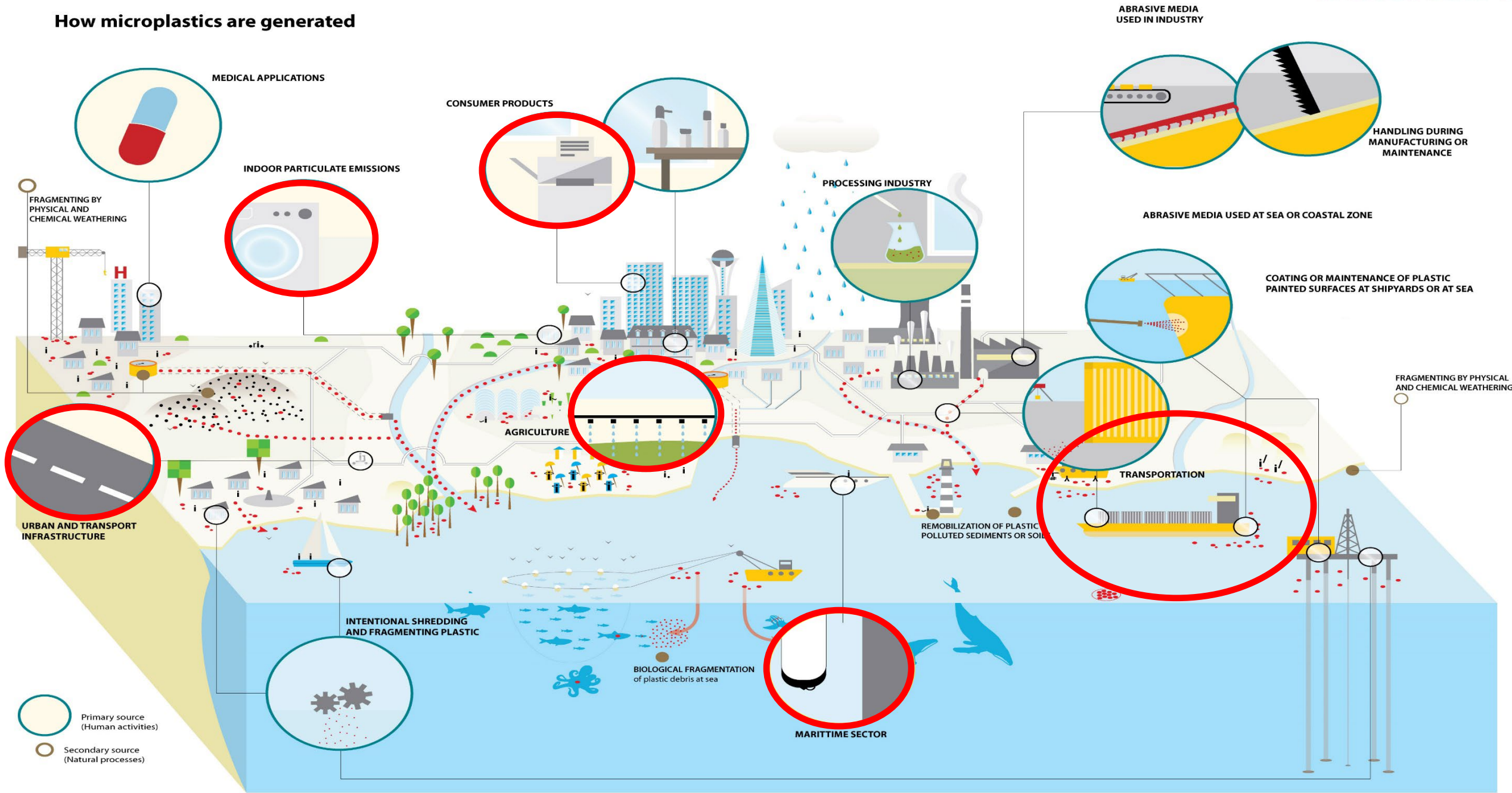
“Every bit of plastic ever made still exists.” (EPA)



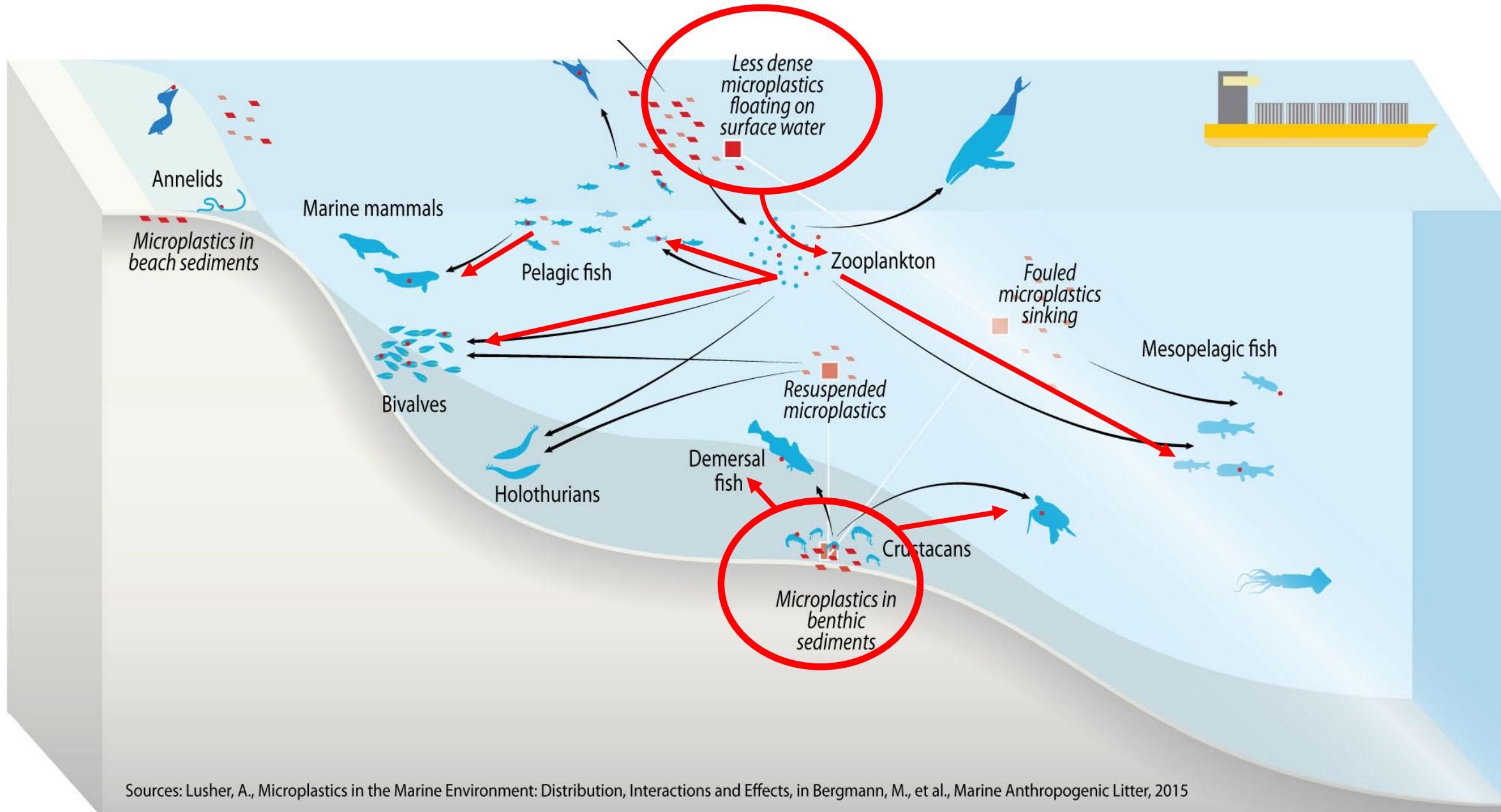
How NMPs Are Generated



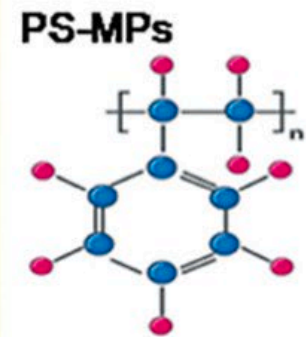
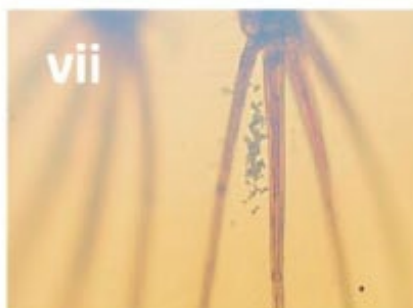
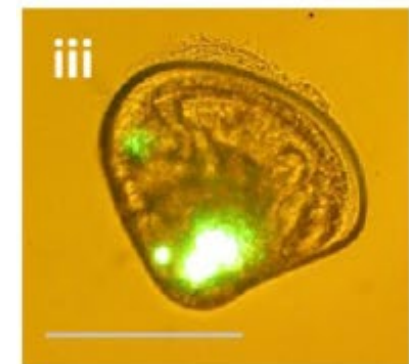
How microplastics are generated



How Plastics Enter the Food Web

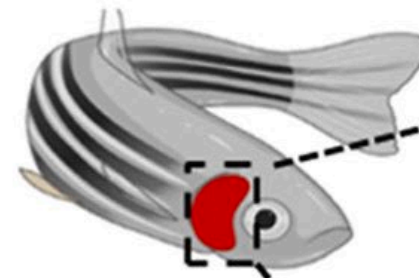


Biological Effects



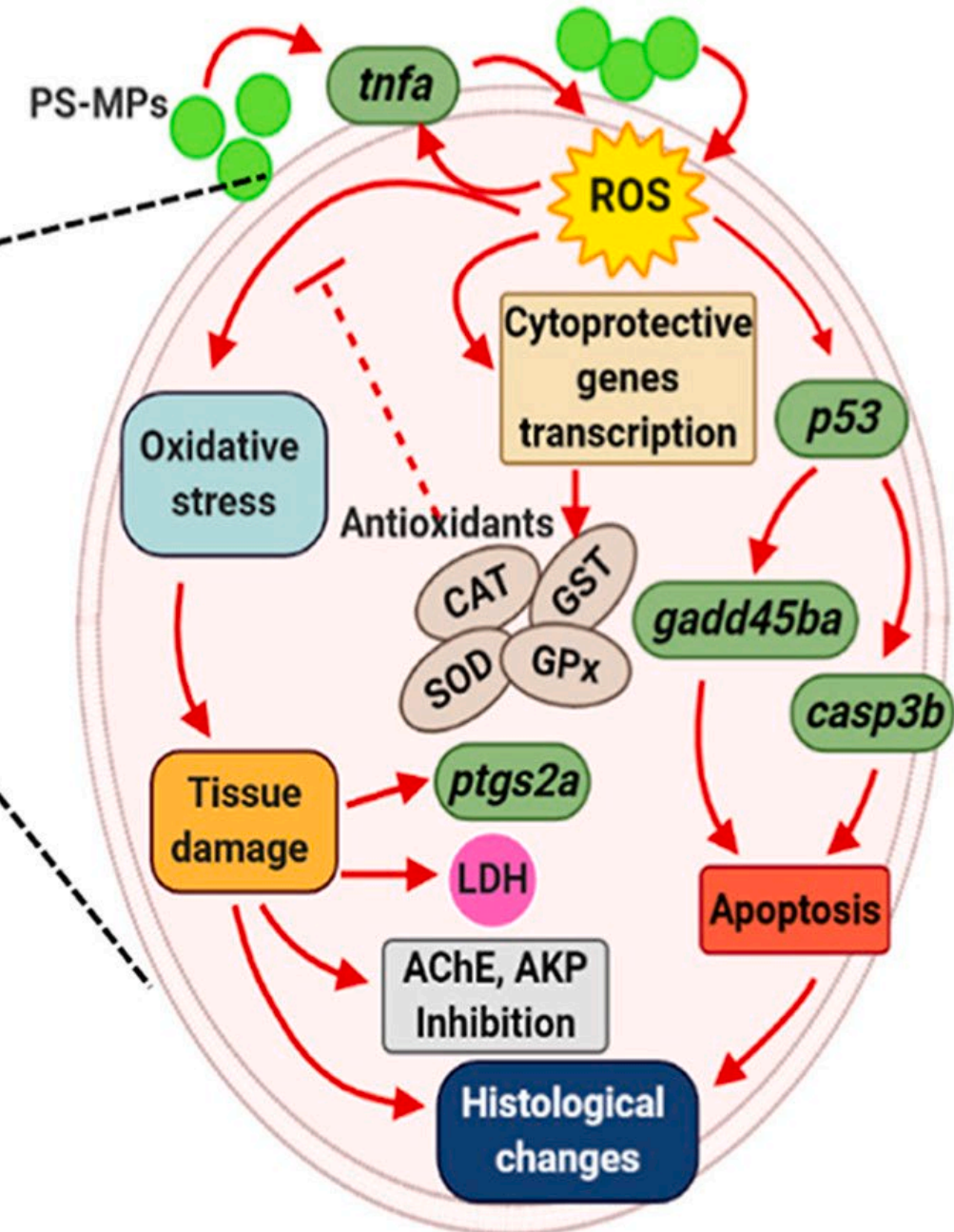
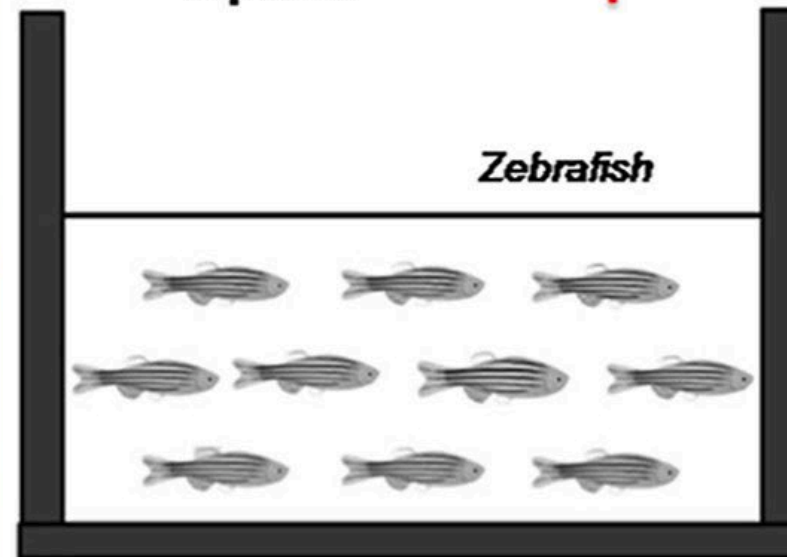
35 days of
PS-MPs
exposure

Gills excision



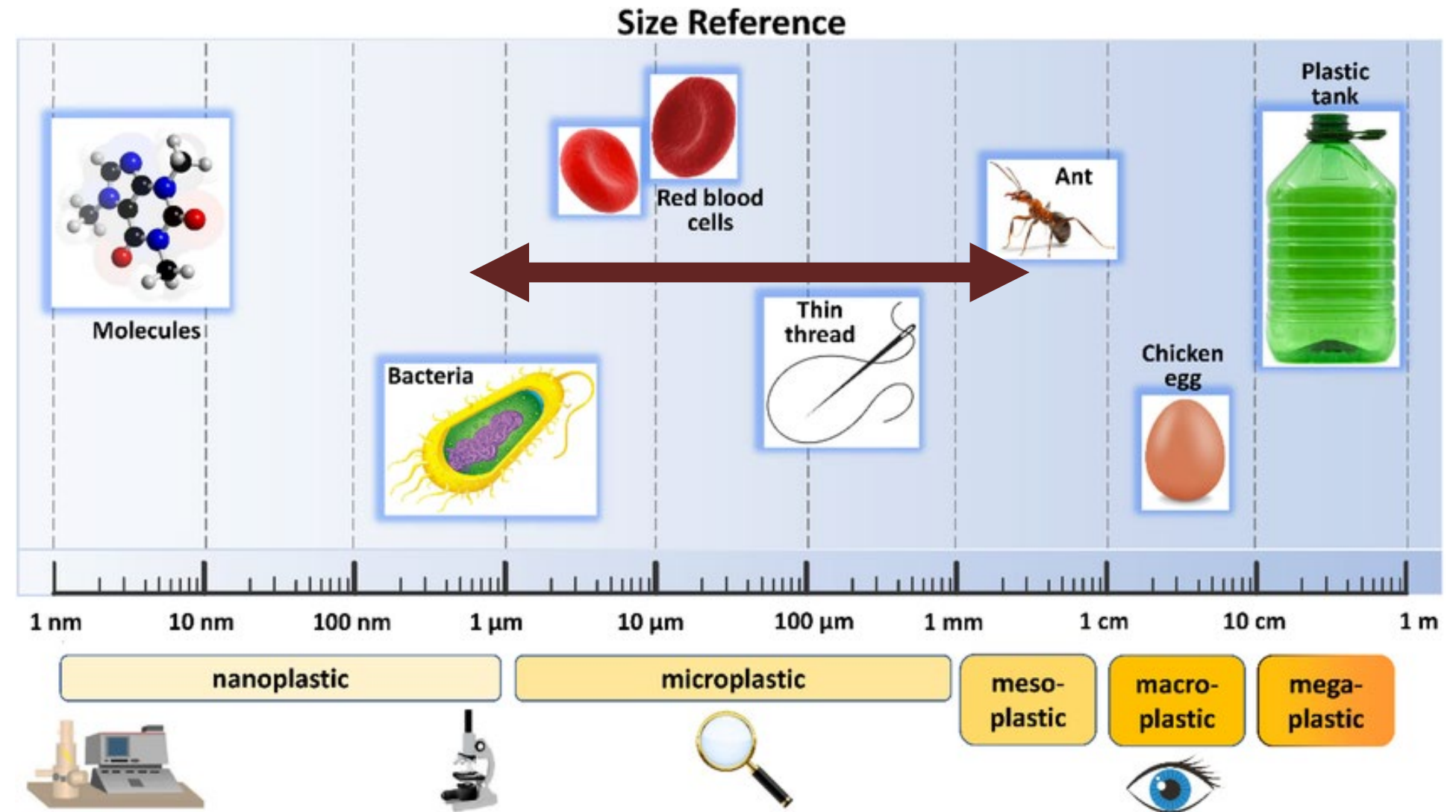
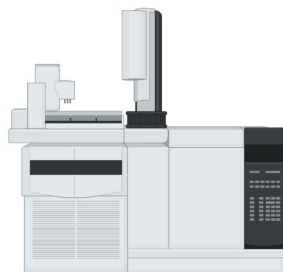
After 35
days

Zebrafish



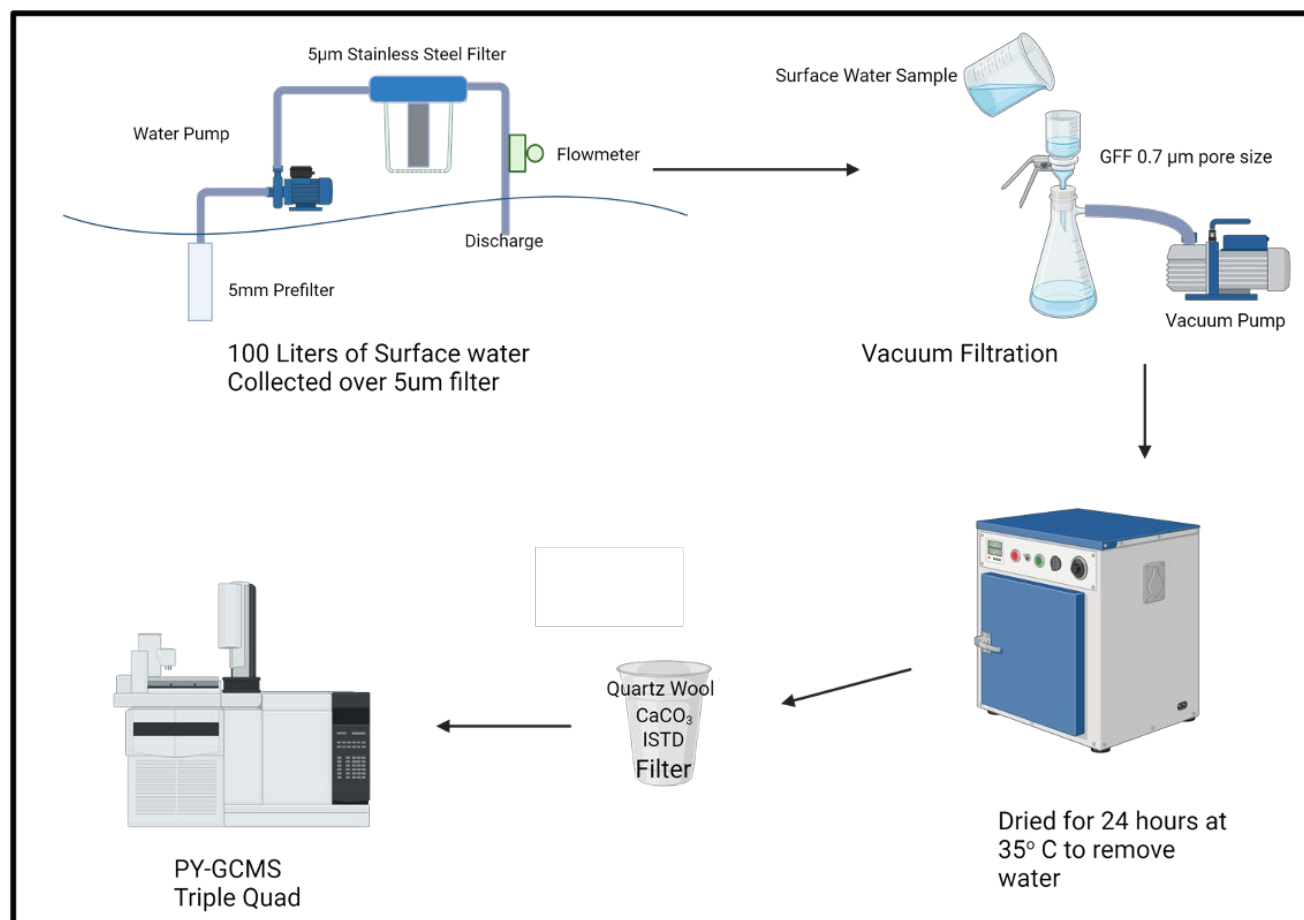
Quantification is required across several orders of magnitude

- Use of thermo-analytical techniques, such as Pyrolysis-GCMS/MS, can provide precision with quantifying nano- and microplastics.

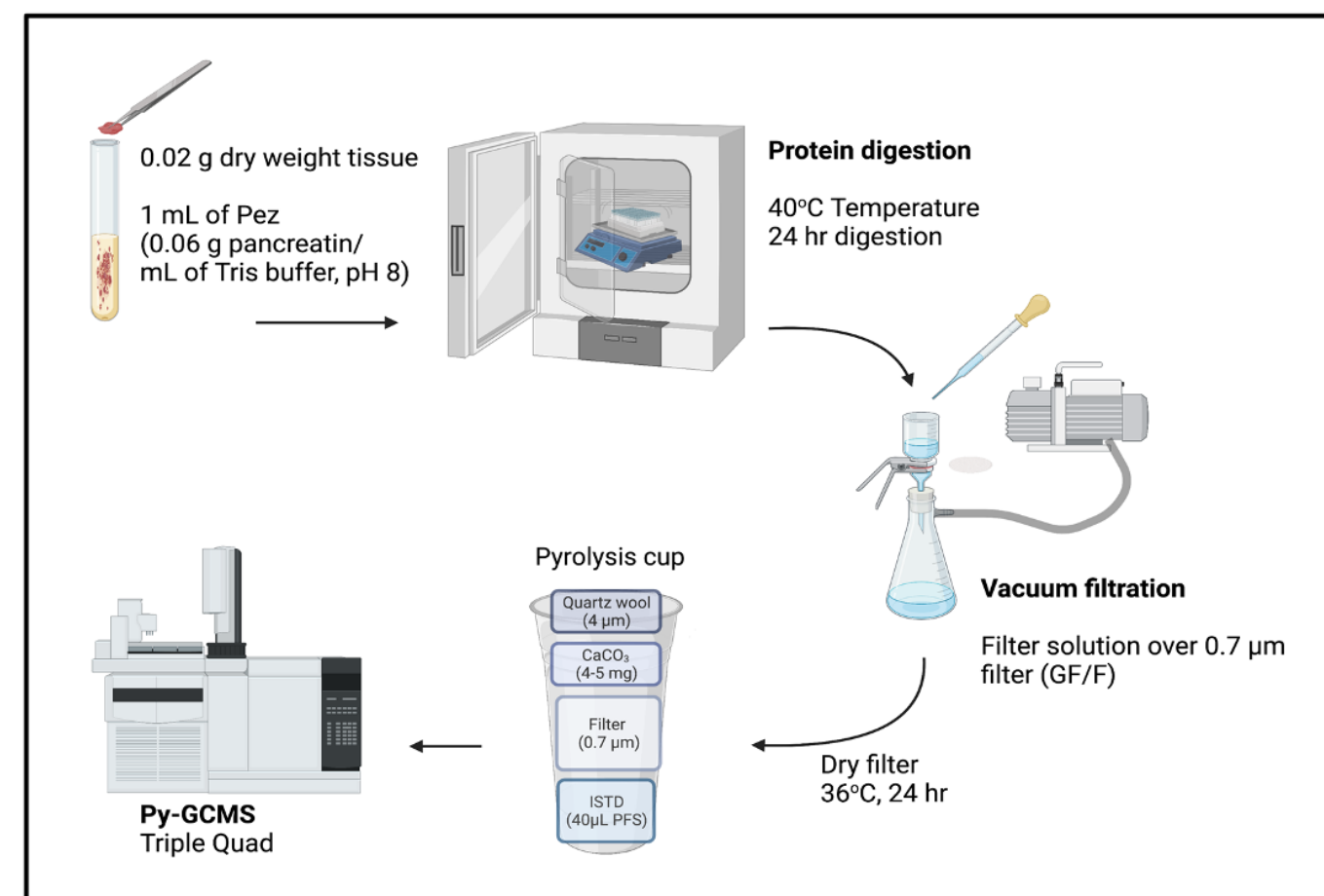


Methods: Collection, processing and analysis

Water



Biological tissue



Muscle Digestion

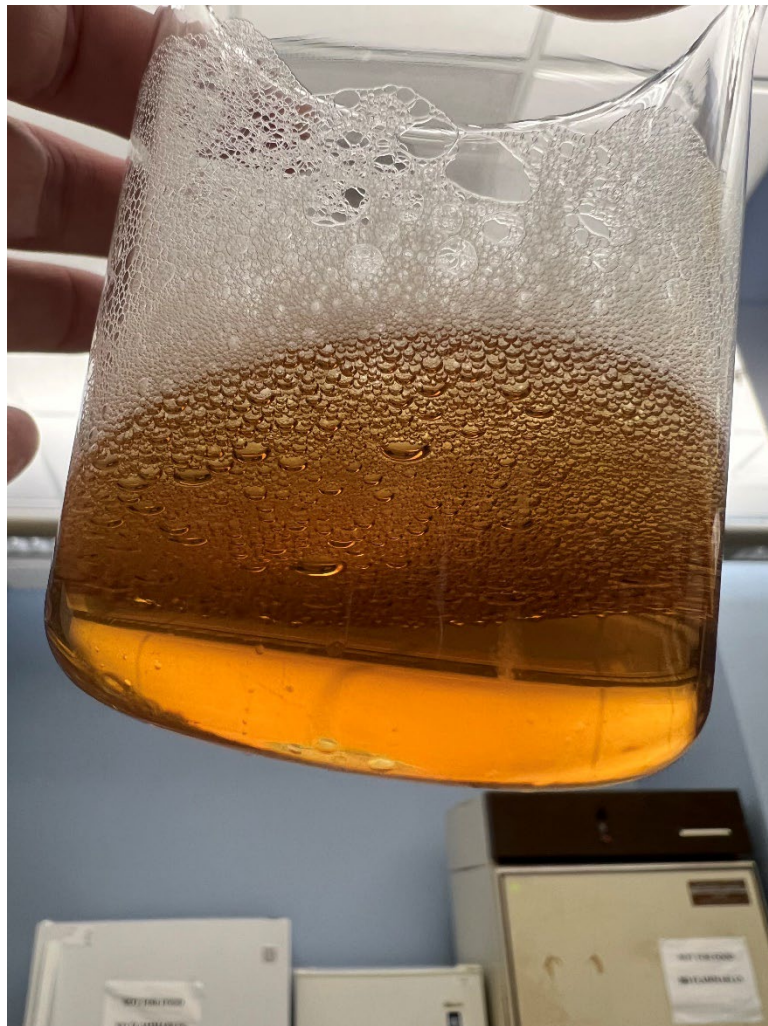
Filtered Enzyme



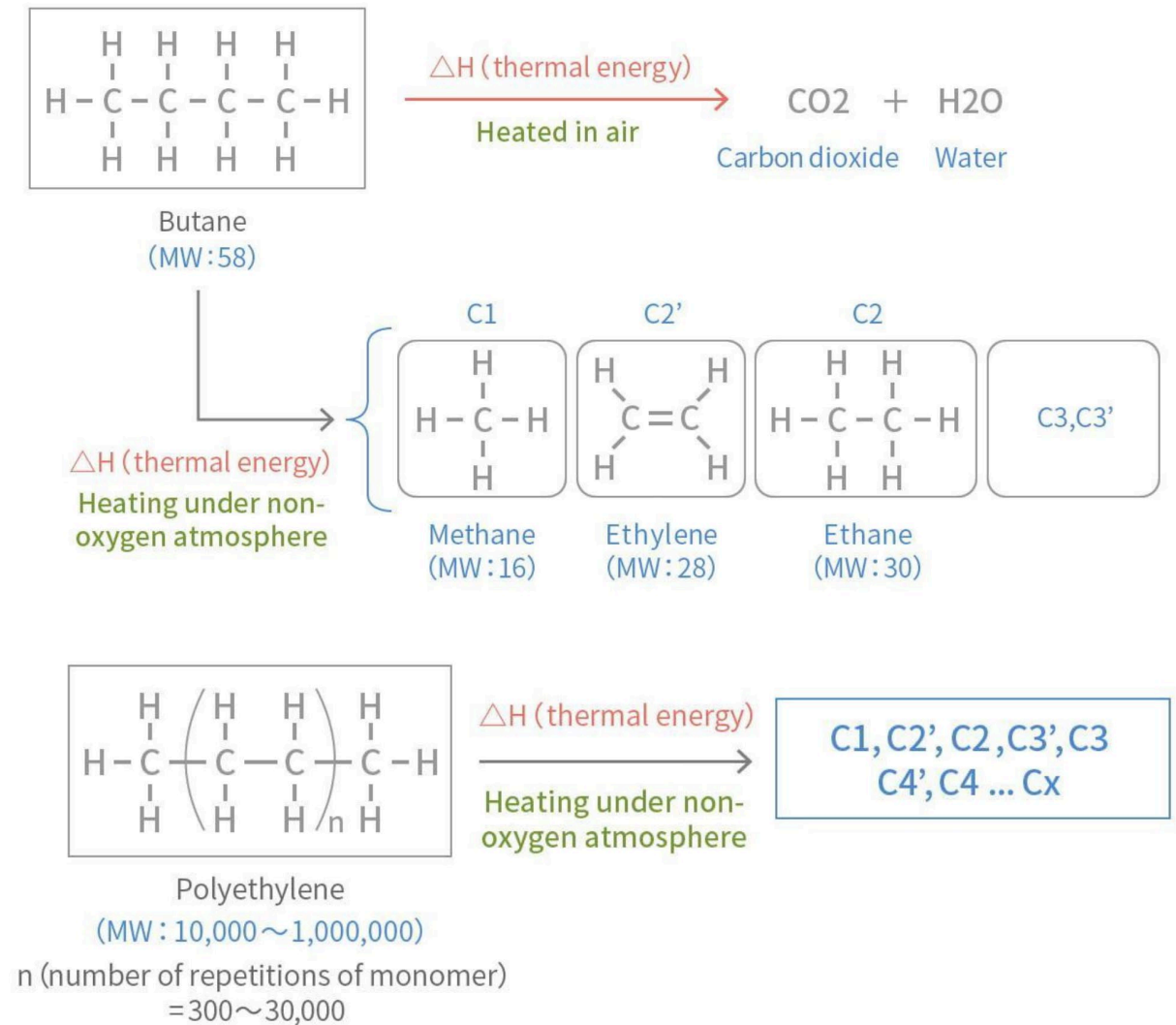
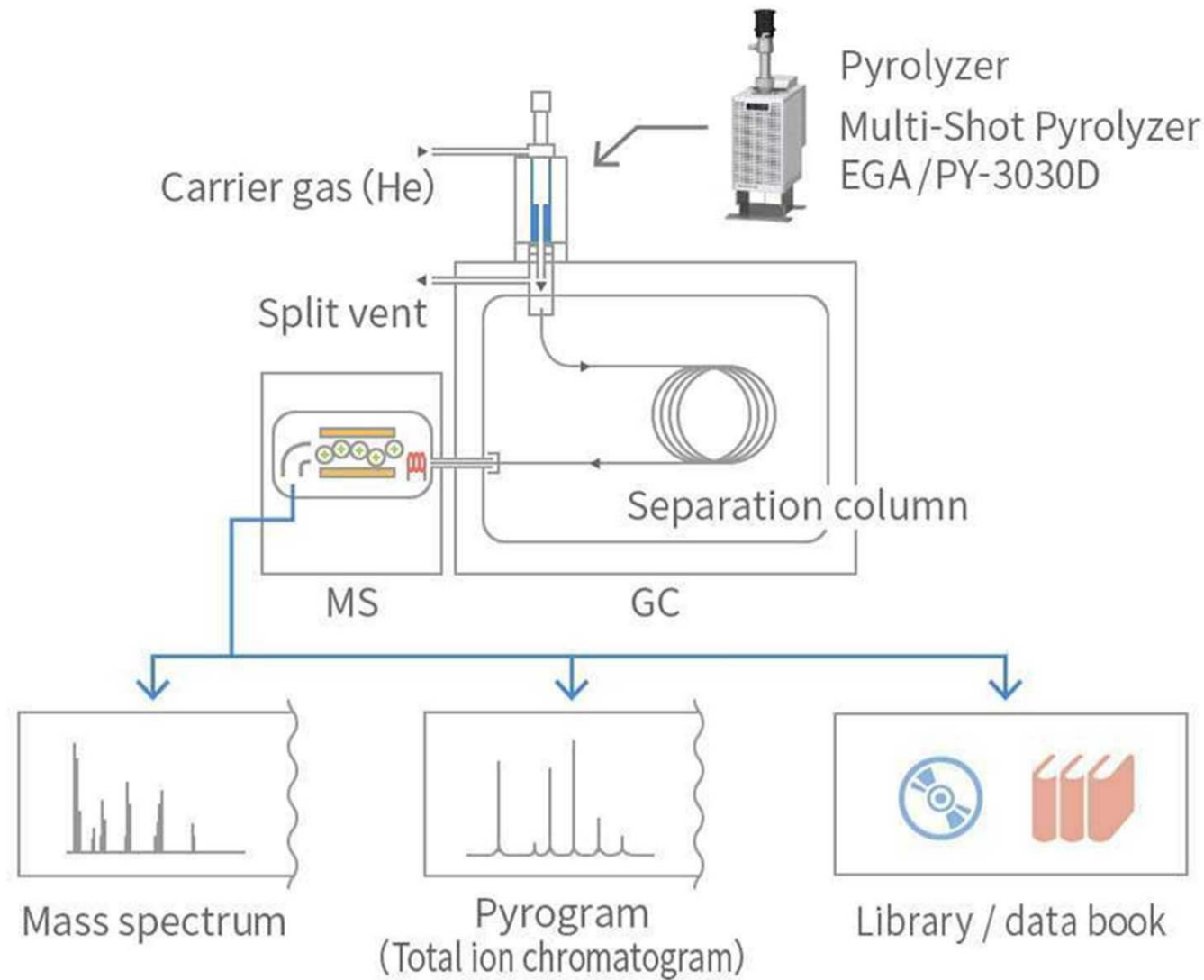
Muscle Tissue



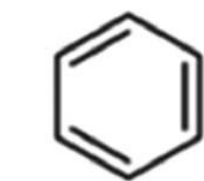
Digested Muscle Slurry



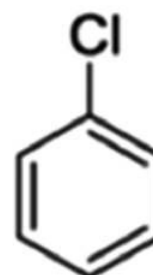
Pyrolysis Gas Chromatography Tandem Mass Spectrometry



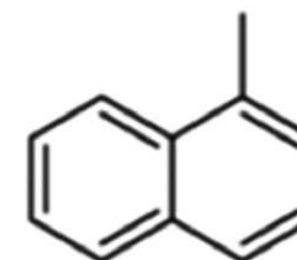
Pyrolysis Products of PVC



benzene
m/z 78



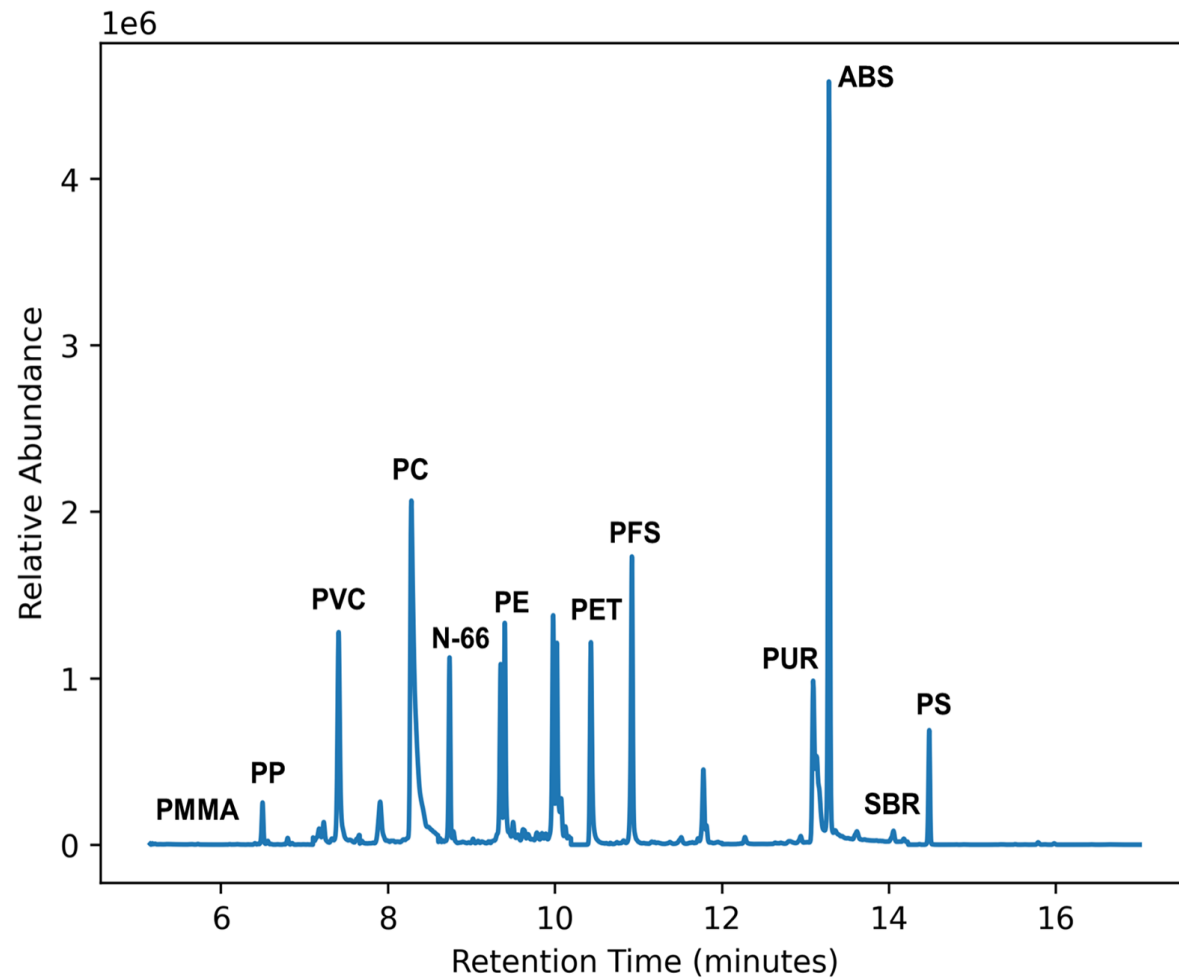
chlorobenzene
m/z 112



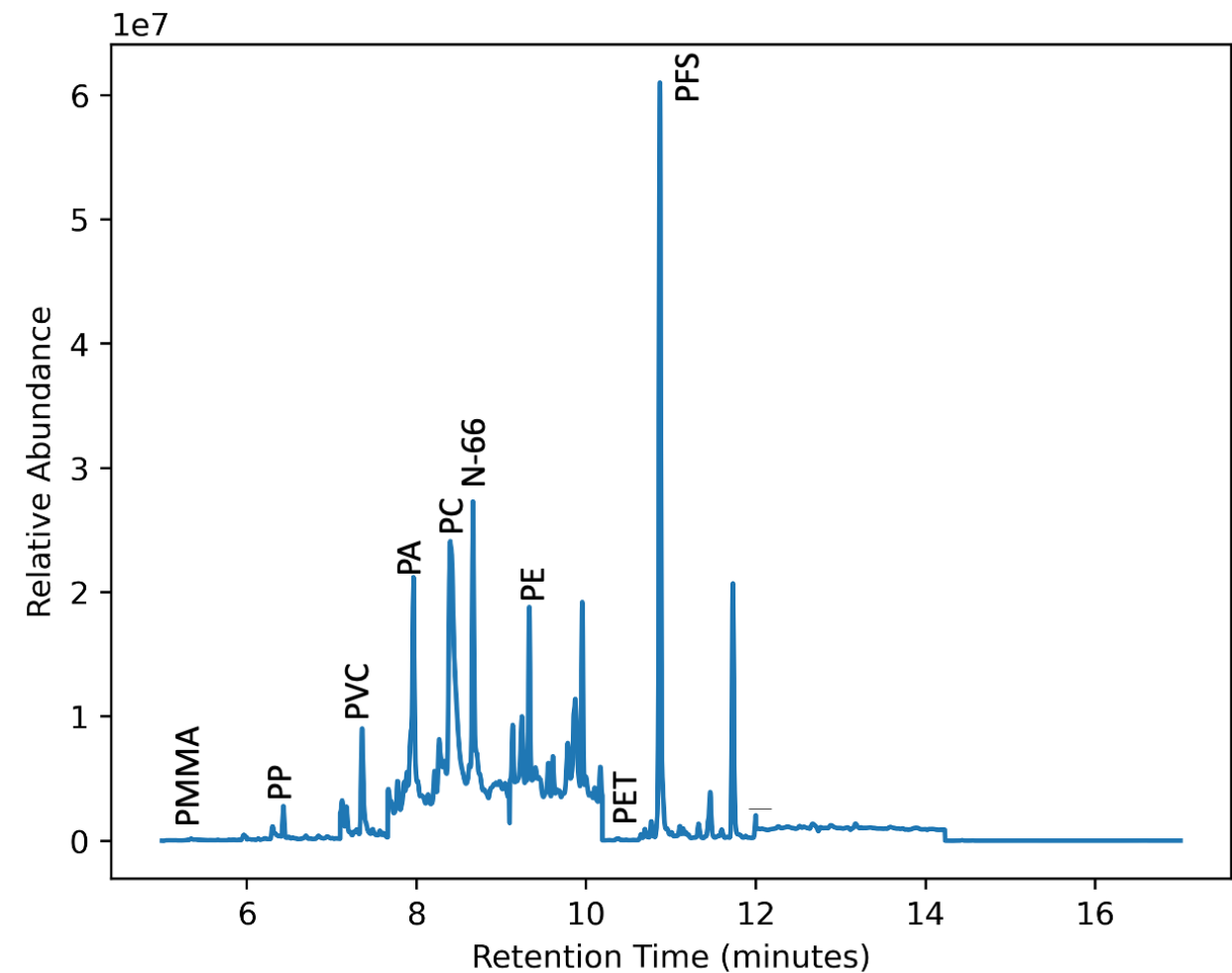
1-methylnaphthalene
m/z 142

Standard and Trout Chromatogram

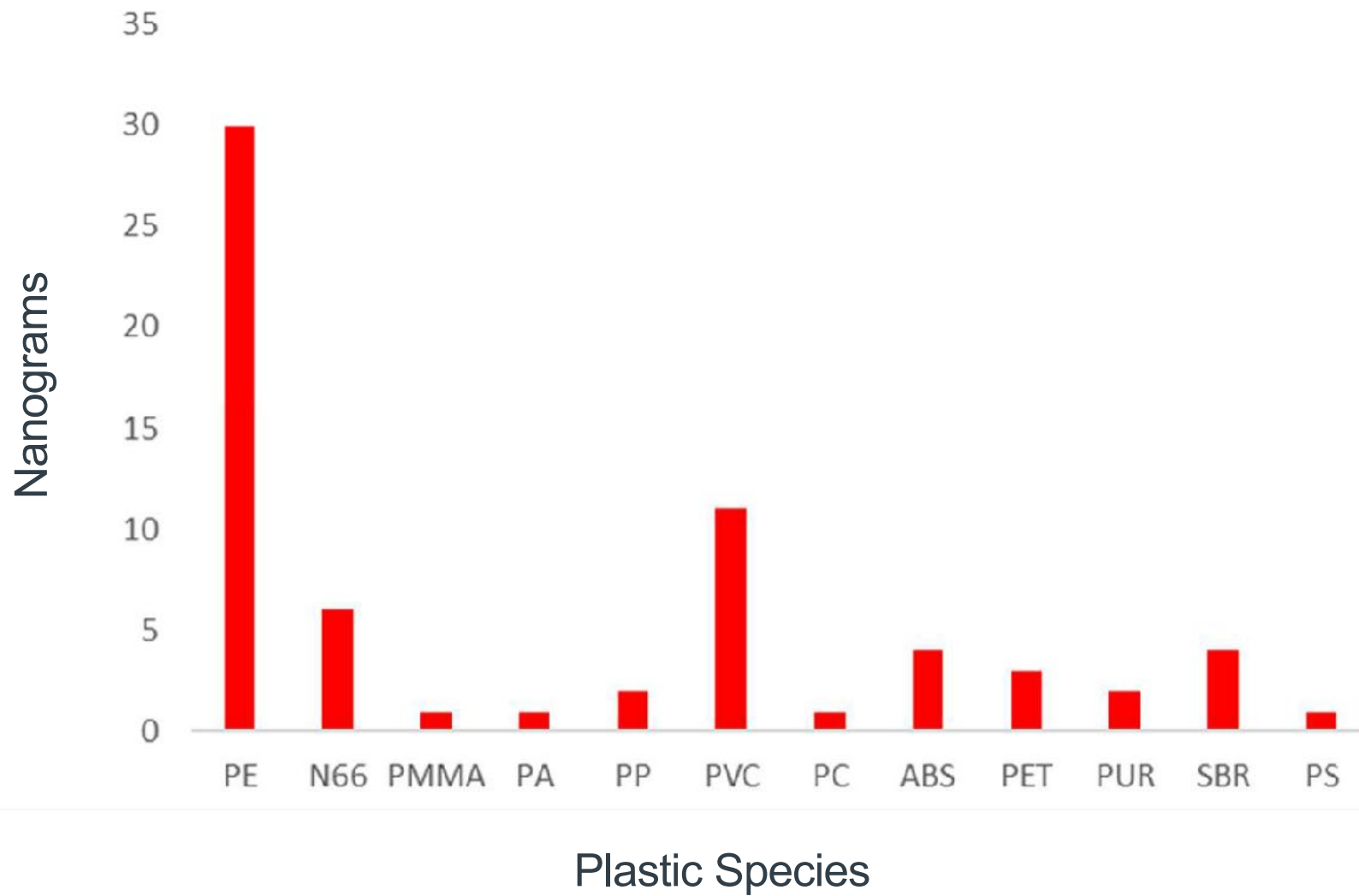
12 Plastics of Interest – Standard



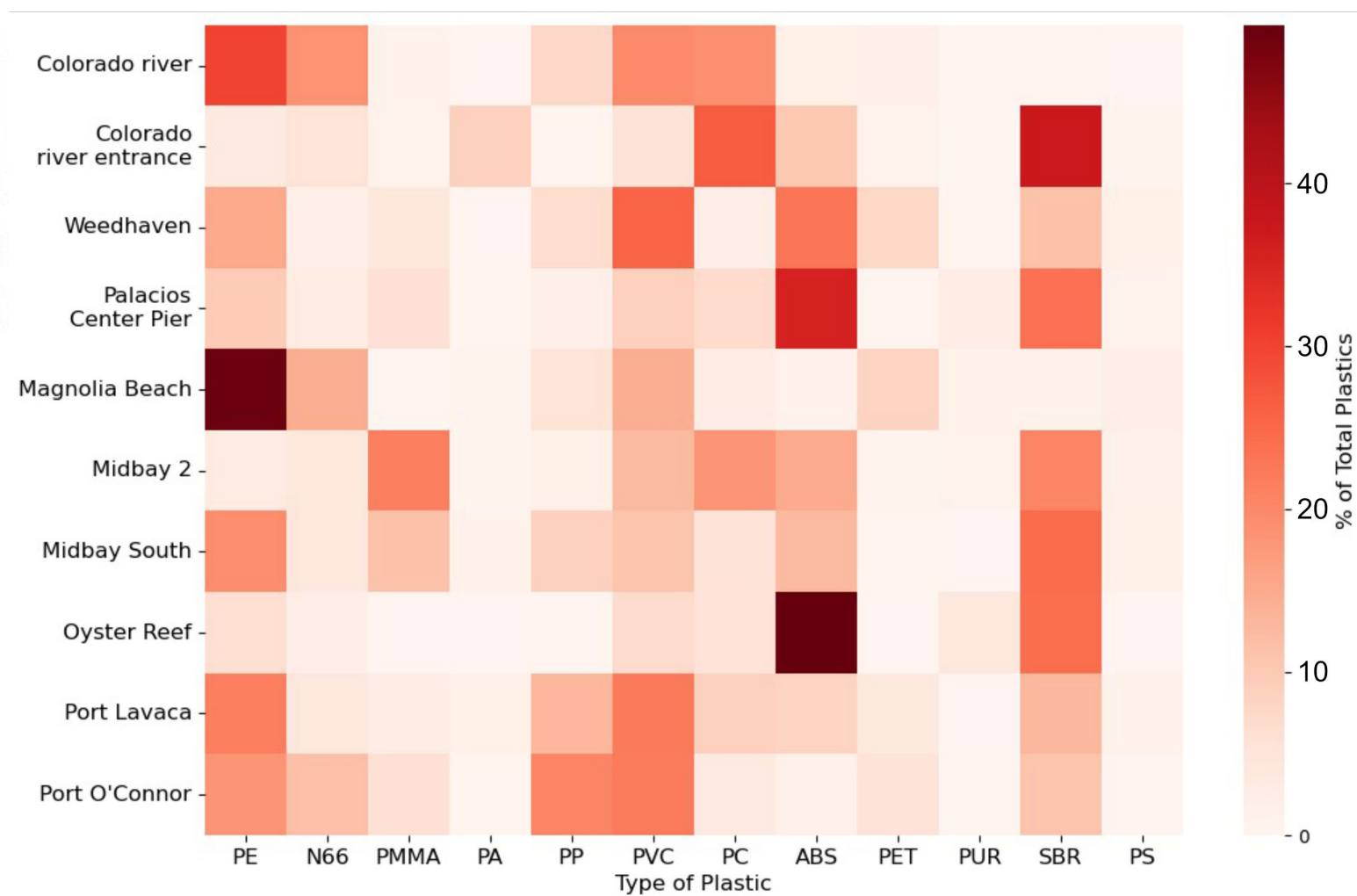
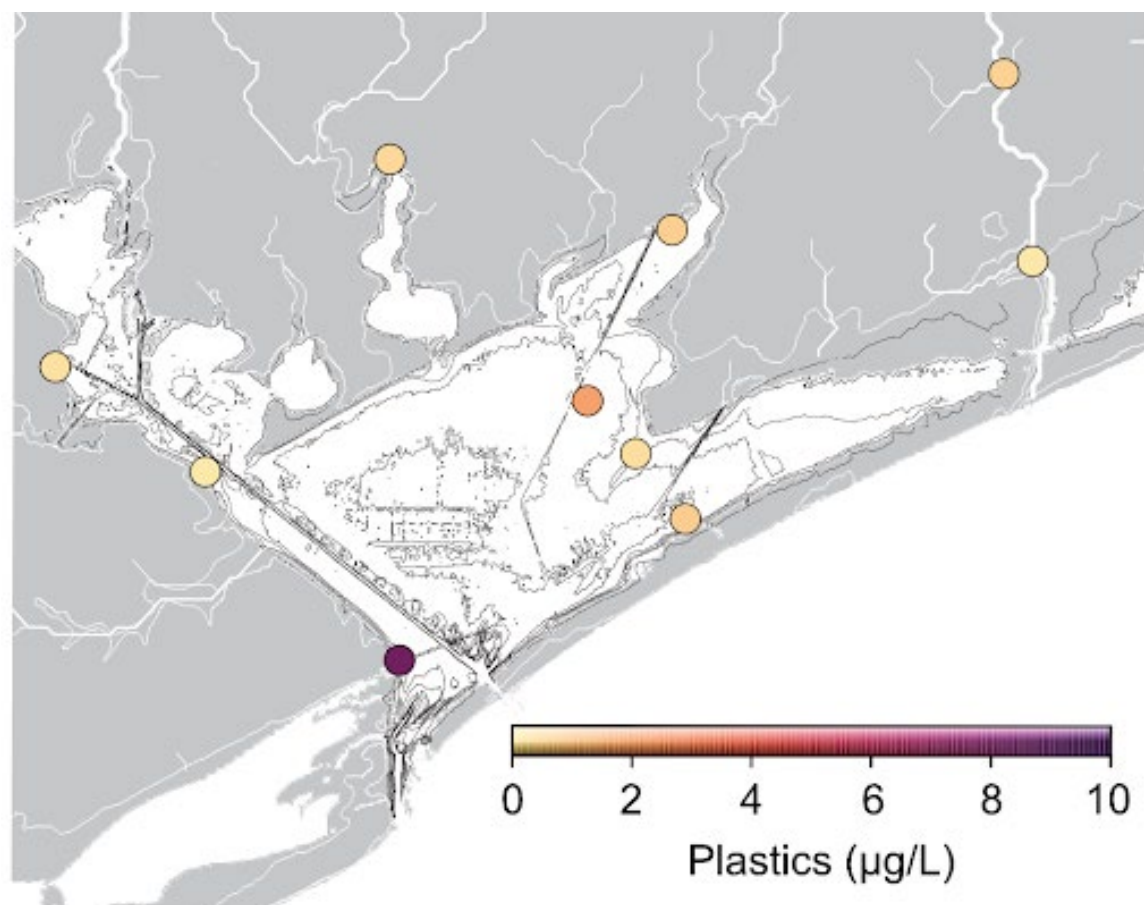
Spotted Sea-trout



Method Limits of Detection: Plastics are detectable at > 1 ng

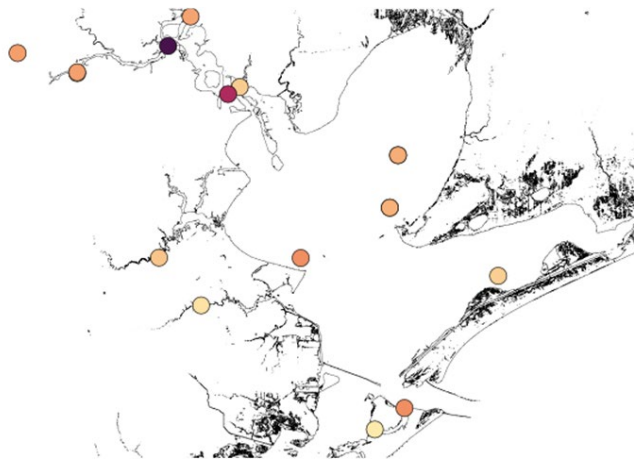


Matagorda Bay microplastic and compositions



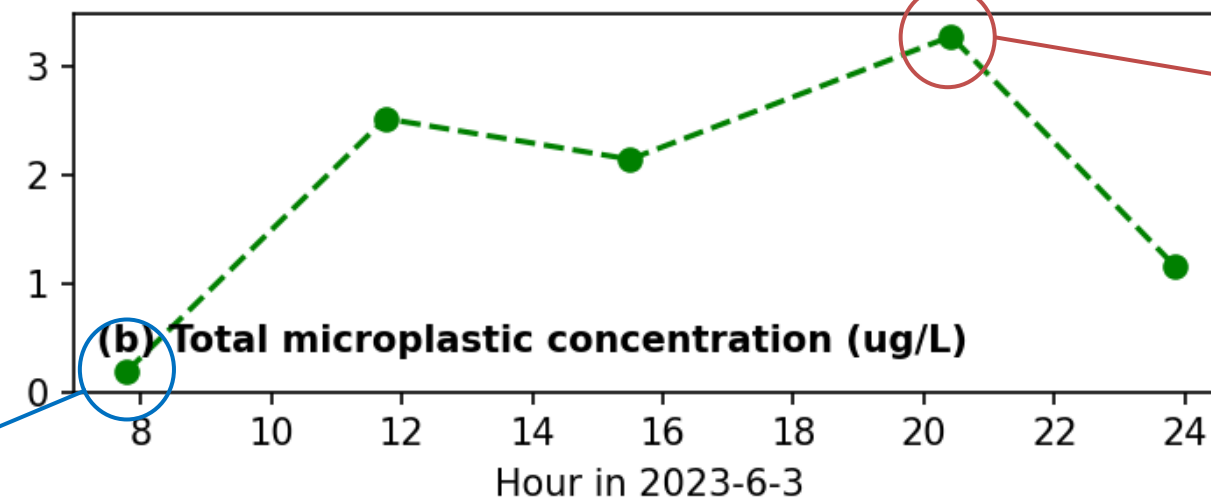
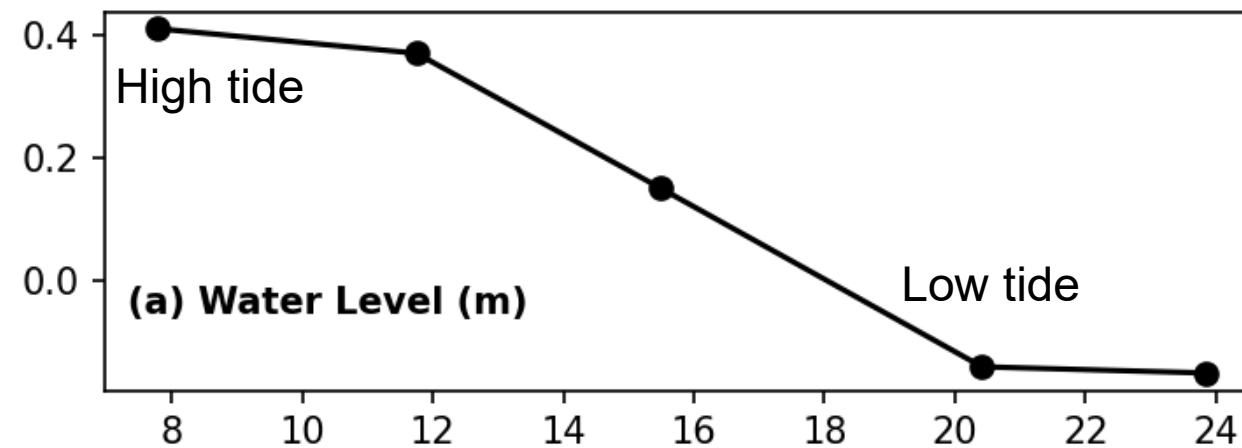
Microplastic concentrations vary with tidal phase at the bay mouth

Galveston Bay



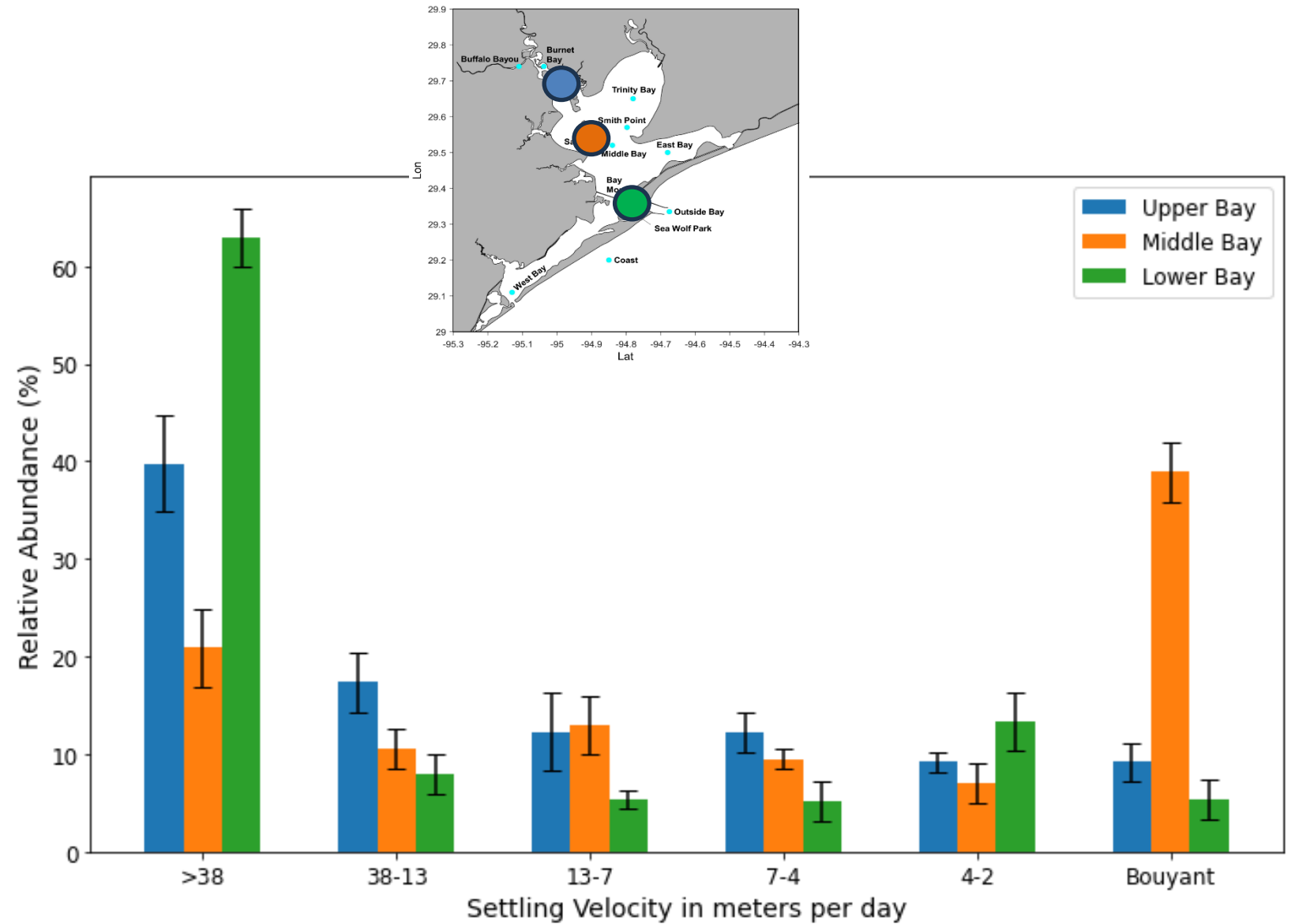
Seawolf Park

Shelf water at high tide, low microplastic conc.

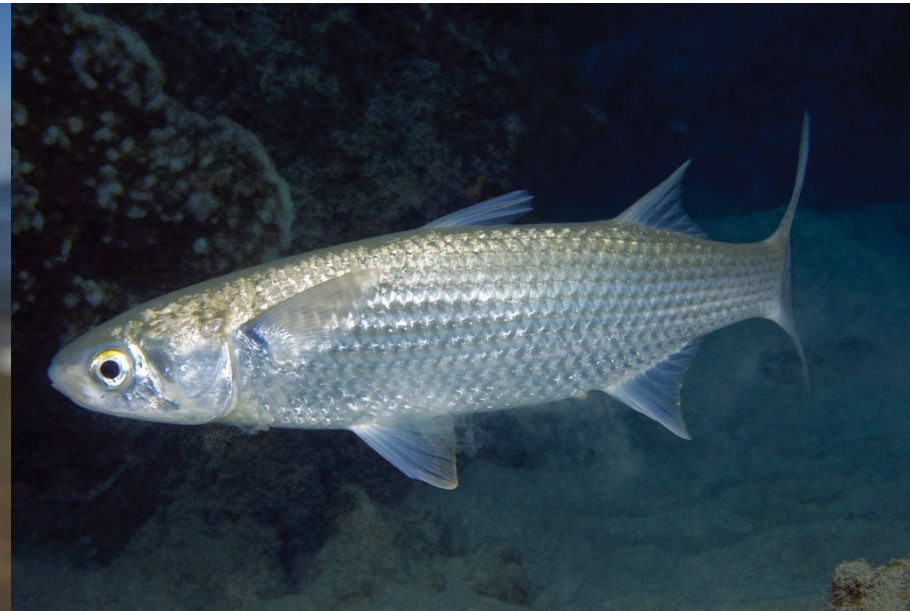


Bay water at low tide, high microplastic conc.

A large portion of microplastics are part of sinking aggregates



What about historical plastic concentrations?



Gulf Menhaden:

- Filter feeder / small prey
- Base of marine food webs
- Support some of the largest processing industries in the USA - > \$170 million in 2016

Striped Mullet:

- Filter and suction feeder
- One of the most abundant and preyed upon fish

Spotted Sea Trout:

- Suction feeder / larger prey
- Higher trophic level
- On our dinner plate

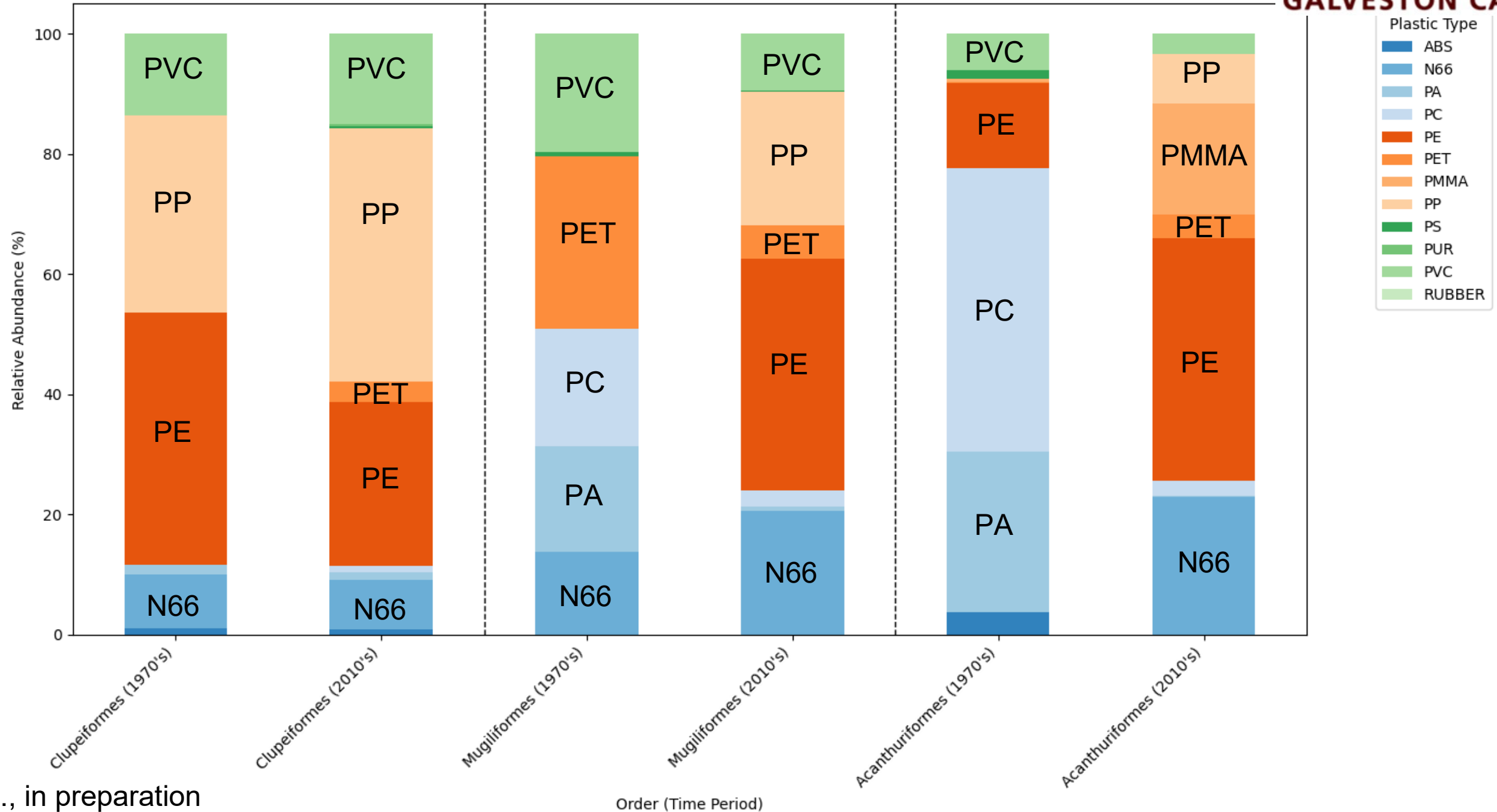
Texas Parks and Wildlife Department's list of Species of Greatest Conservation Need include many species which prey on Clupeiformes and Mugiliformes (e.g. blue fin tuna, red snapper and black tip sharks)

Results: Relative Abundance

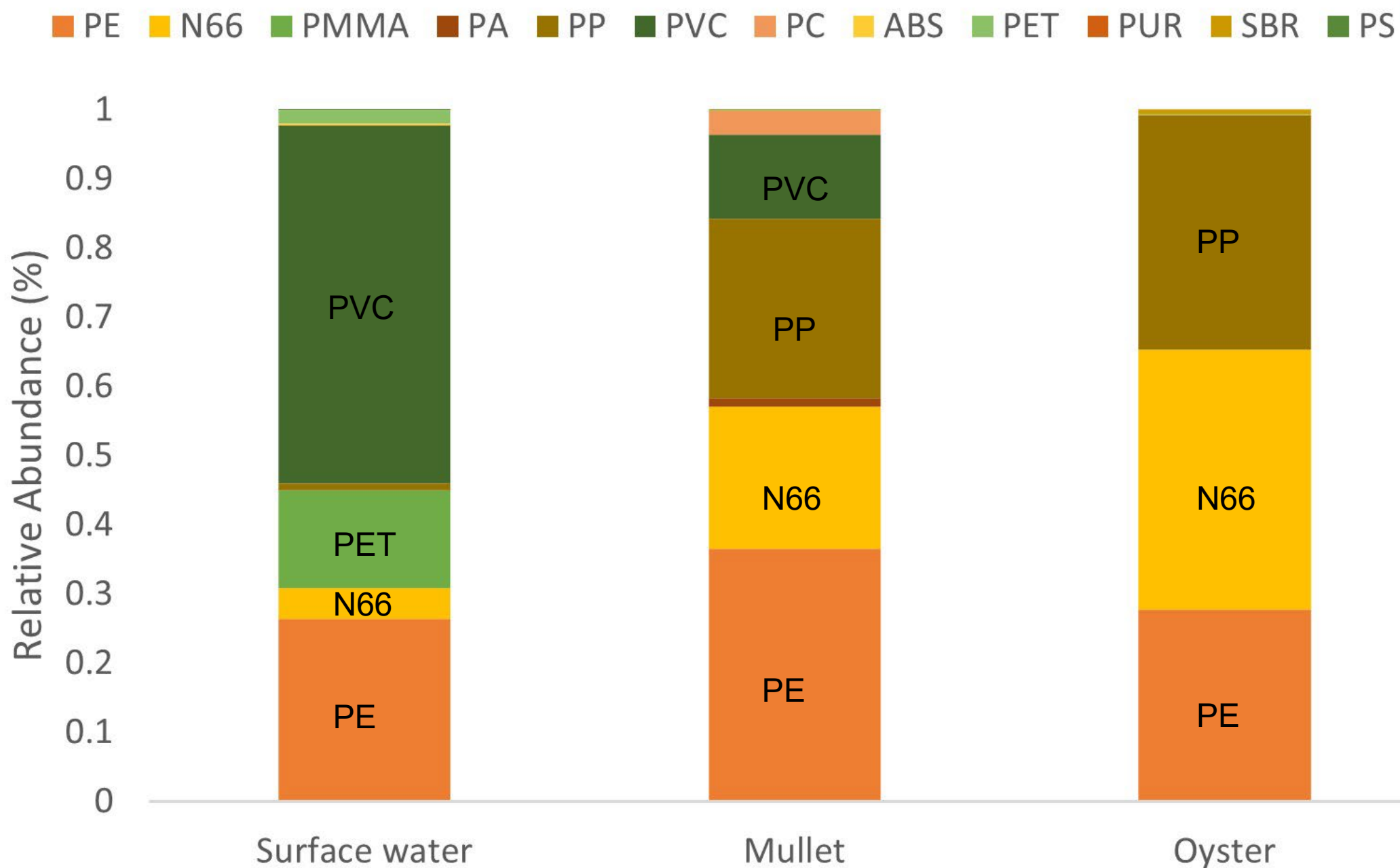


GALVESTON CAMPUS

Microplastic Relative Abundance: 1970's vs 2010's



Results : Environmental vs Biological Abundance



Acknowledgments:
 Marcus Warton
 Asif Mortuza

Results : Historical Accumulation



Historical Sediment: Significance of Matagorda Bay



Colorado Discharge

Before 1900s – East Matagorda Bay was a free-flowing extension.

1920s – Flooding and drainage issues precipitated a massive dredging campaign, which failed.

1934 – Local residents decided to change the course into the Gulf of Mexico – Created East Matagorda Bay

1991 – USACE divert the Colorado River back into Matagorda Bay



Sediment: Significance of Matagorda Bay Study Location



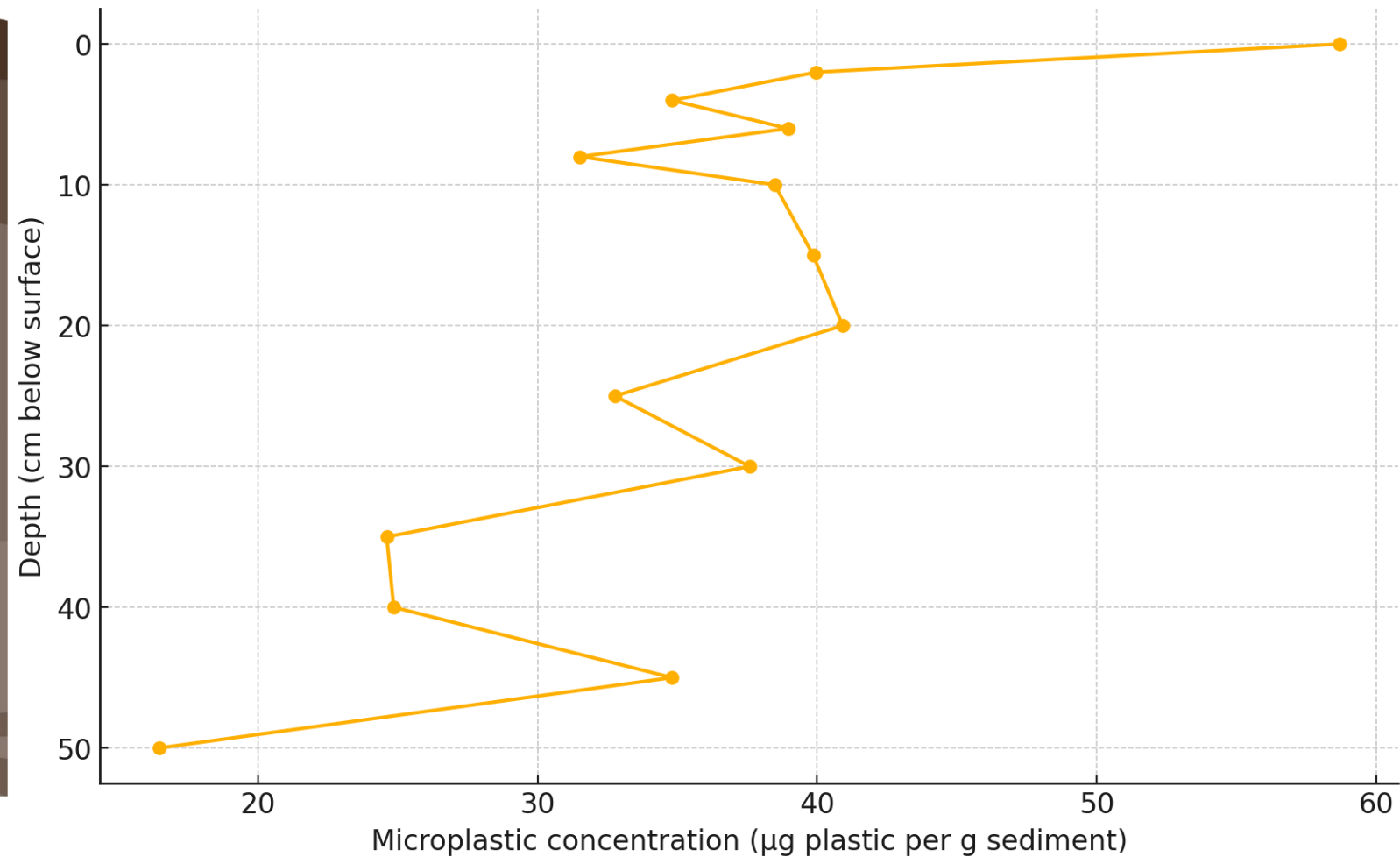
Formosa "Spill": Ongoing leakage since at least 2010



Preliminary Historical Sediment Core

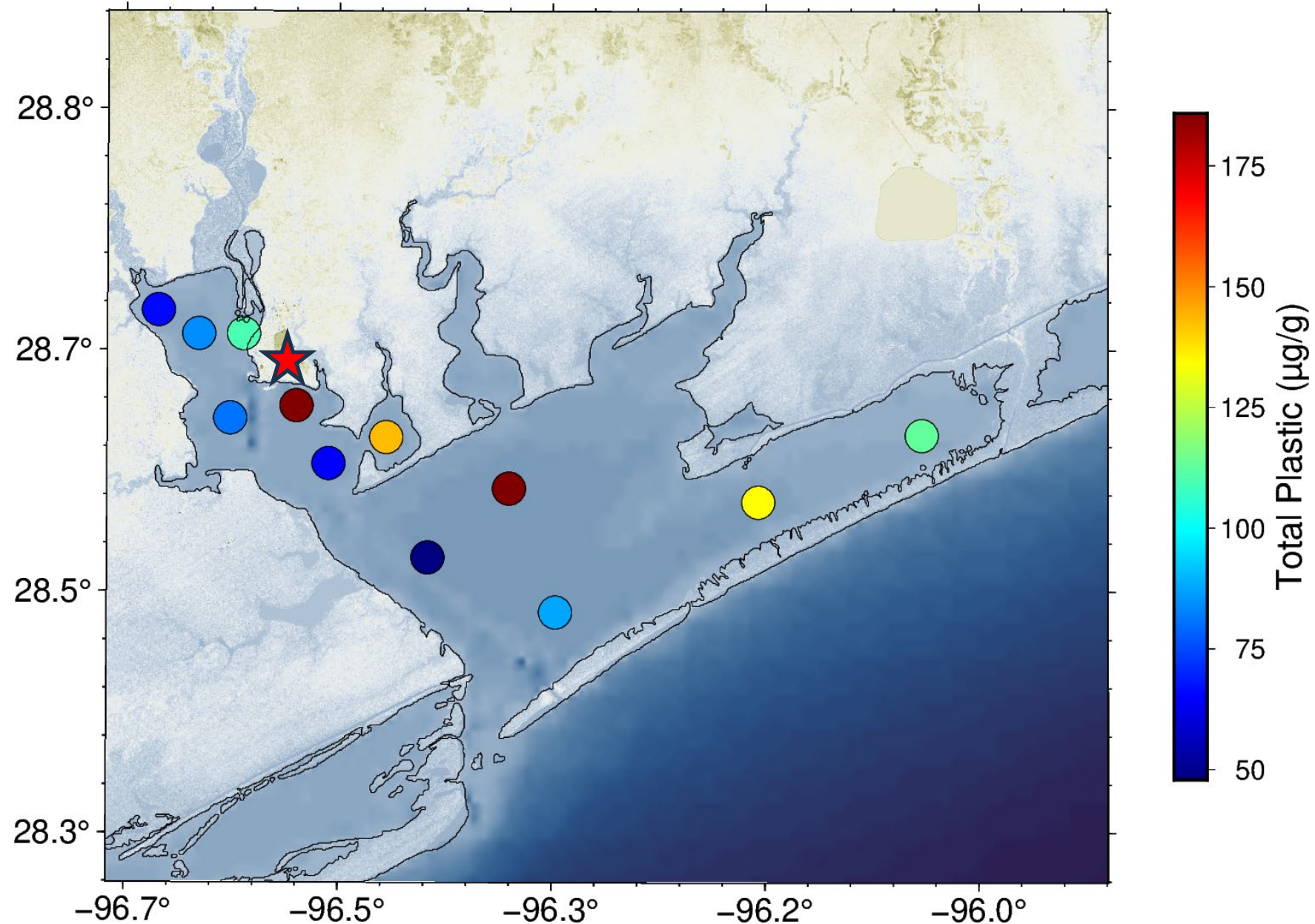
Historical Core

MBMT 5 - Sediment Core



Preliminary Surface Sediment Samples

Surface Samples



Summary

- ❖ Plastics are pervasive and persistent in the environment.
- ❖ Nanoplastics and microplastics are incorporated into fish muscle tissue. Significant correlation to global plastic production.
- ❖ Measured nanoplastic and microplastic concentrations in water and sediment show high variability spatially and temporally.
- ❖ Estuarine dynamics and settling properties of nanoplastics and microplastics greatly affect their retention in coastal waters.

Questions?



Current and Historic Levels of Persistent (PAHs, PCBs) and Emerging Nano-Microplastics (NMPs) Pollutant Body-Burdens in Oysters and Fish from Galveston Bay

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