Microplastic in the diet of juvenile fish from Corpus Christi Bay

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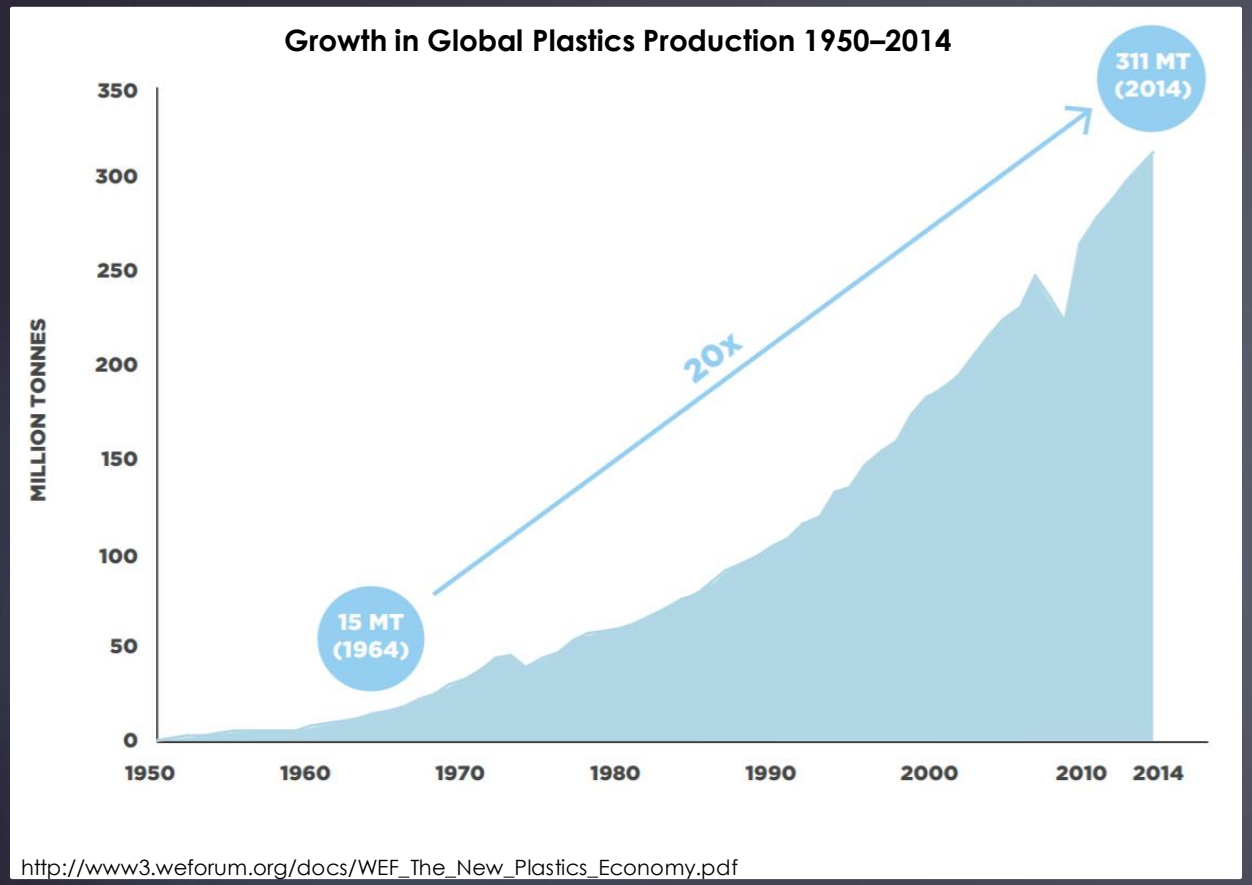
Texas Plastic Pollution Symposium, October 30th Corpus Christi, Texas

Plastic Pollution



http://www3.weforum.org/docs/WEF_The_New_Plastics_Economy.pdf

http://www.dailymail.co.uk/news/article-2141911/Scientists-Amount-plastic-Texas-sized-Great-Pacific-Garbage-Patch-increased-HUNDREDFOLD-1970s.html

(Derraik, 2002; Andrady, 2011; World Economic Forum 2016)

Impacts of Plastics

- Macroplastic (>500 µm)

Entanglement

Introducing Invasive Species

Ingestion

(Allen *et al.*, 2012; Rech *et al.*, 2016; Phillips and Bonner, 2015; Poon *et al.*, 2017)

Impacts of Plastics

- Microplastic (100-500 µm)

Primary

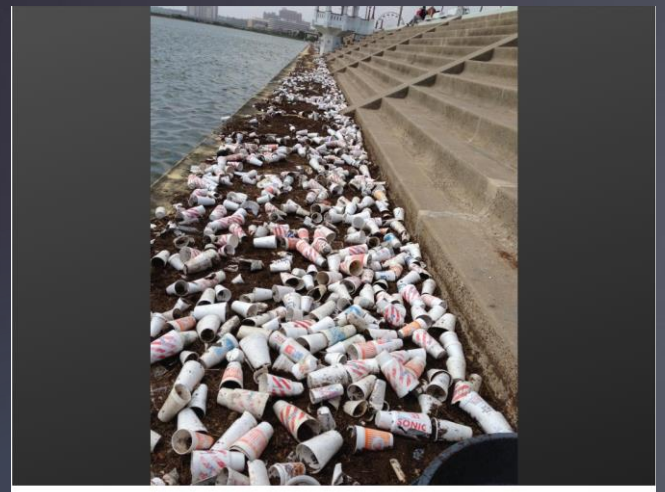
http://www.nydailynews.com/life-style/microbeads-causing-major-damage-waterways-marine-life-article-1.1843474

Secondary

https://www.ecoevoblog.com/2015/08/20/microplastics-a-macro-problem-for-remote-islands-in-the-south-atlantic/

(Setälä et al., 2014; Zitko and Hanlon, 1991; Cole et al., 2011)

Plastic Pollution Corpus Christi Bay



Thousands of plastic foam cups have washed up at the Port of Corpus Christi.

ENVIRONMENT TEXAS

https://www.bizjournals.com/sanantonio/news/2018/06/26/environmental-groupwants-a-new-whatacup.html

All The Cups - by Jack

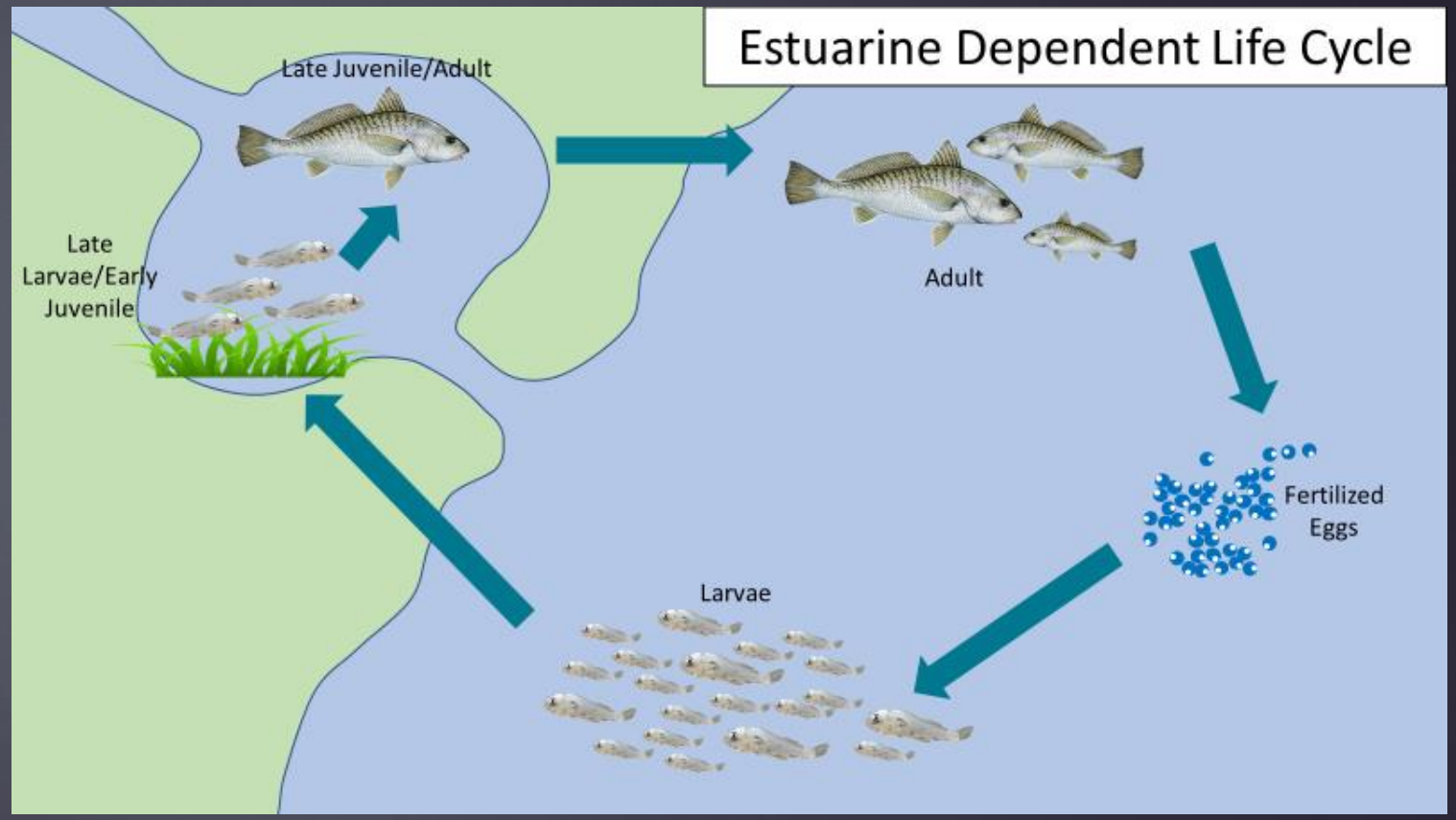
https://www.youtube.com/watch?v=LhIBSOITYdQ

Pollution Sources in Corpus Christi Bay

- Urbanization
  - High population density
  - High levels of industry
  - 6th busiest port of USA
  - Stormwater outfalls
  - Wastewater treatment plants
- Nueces River
- Water exchange with the Gulf of Mexico

Ecological Importance of Corpus Christi Bay

- Estuarine dependent life cycle
- Important nursery habitat for juvenile fish
- Increased vulnerability of early life stages



(Tolan *et al.*, 1997; Miller and Kendall, 2009; Thorson, 1950; Hunter, 1981)

Microplastic Pollution in Corpus Christi Bay?

Uptake by juvenile Fish?

Focus Species Representing Different Feeding Guilds

Plankton Feeders

Anchovy (*Anchoa spp.*)

Menhaden (*Brevoortia spp.*)

Silverside (*Menidia spp.*)

Benthic Feeders

Red Drum (*Sciaenops ocellatus*)

Atlantic Croaker (*Micropogonias undulatus*)

Spot Croaker (*Leiostomus xanthurus*)

Objectives

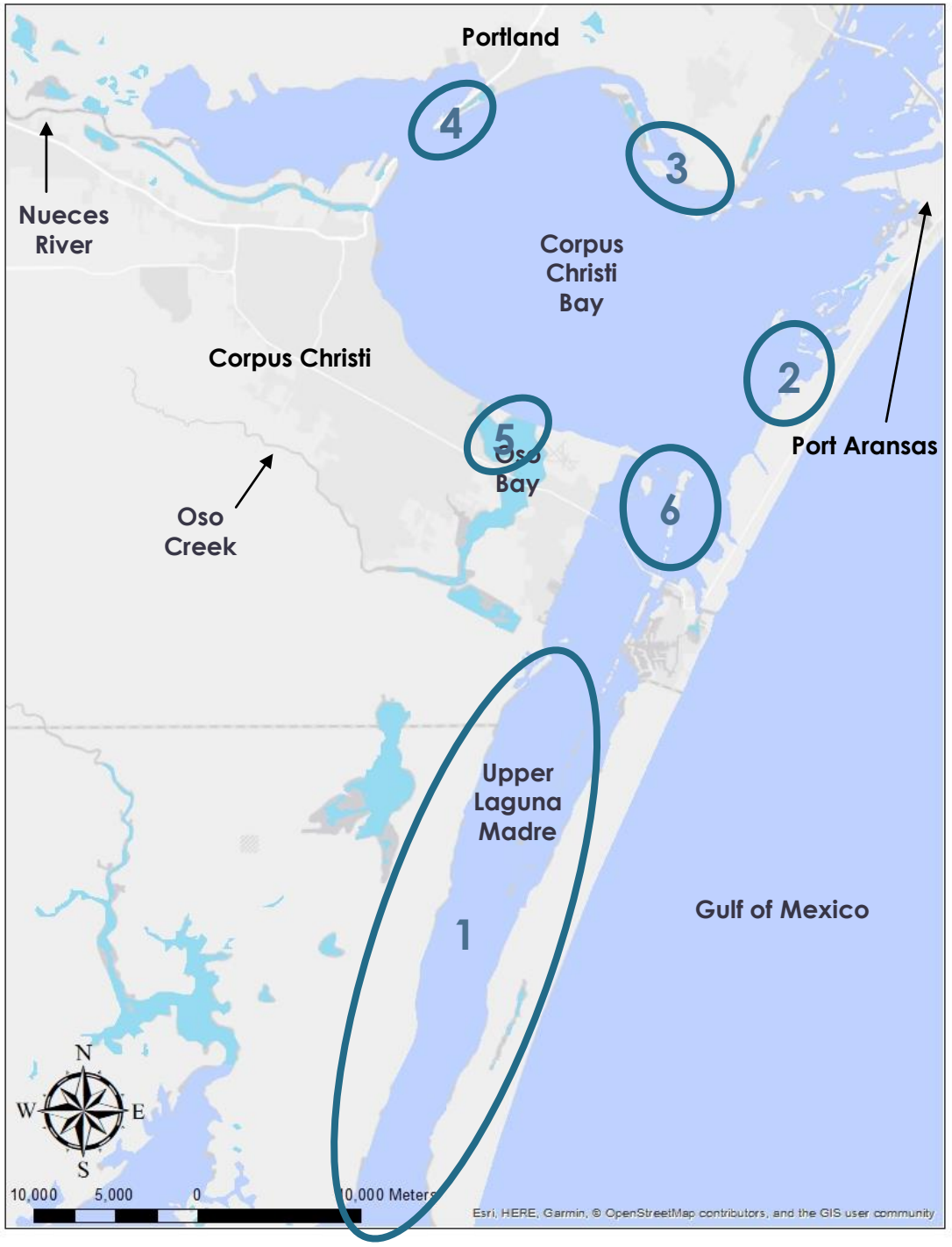
Assessment of microplastic pollution in the water column

Assessment of microplastic ingestion in juvenile fish

- Differences between feeding guilds
- Difference between species

Study Sites

- Site 1 (Upper Laguna Madre – Pita Island to mouth of Baffin Bay)
- Site 2 (Shamrock Island)
- Site 3 (Ingleside on the Bay)
- Site 4 (Texas State Aquarium)
- Site 5 (Oso Bay)
- Site 6 (Intercoastal waterway/Packery channel)



Field Sampling – Water Samples

Vertical Net Tow

Washed and Sieved Down

Store in DI Water

Field Sampling – Juvenile Fish

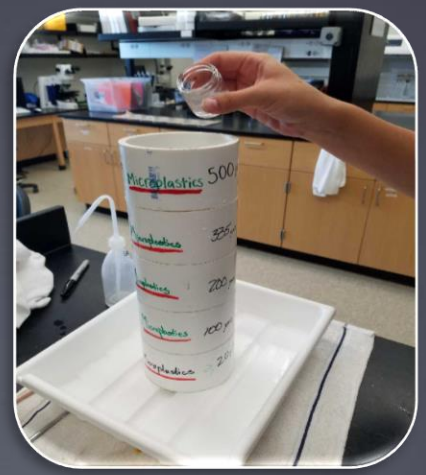
Pulled Bag Seine

Picked Out Juvenile Fish

Sort and Bagged Catch

Methods – Water Samples

Water Sample



Sieve Tower

Filter

Individual petri dishes

Analyze for microplastics

Methods – Juvenile Fish

Standard Length (mm)

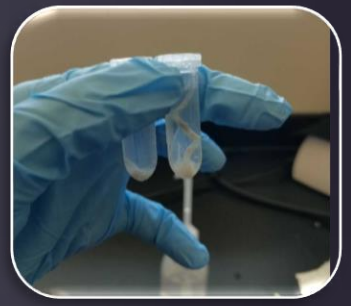
Total Wet Weight (mg)

Dissection

Body

Gutted Wet Weight (mg)

Digestive Tract (DI)

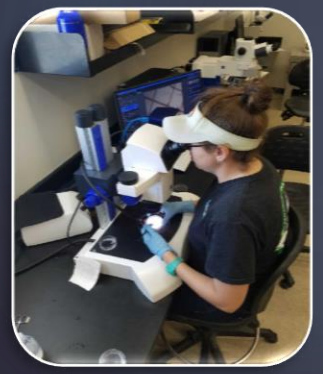


Microtube w/ 10% KOH

Digestion at 40°C for 1-3 hours

Filter

Individual petri dishes



Analyze for microplastics

Results – Water Samples

- 27 water samples
  - Blue (38%) and black (31%) fibers were the most abundant

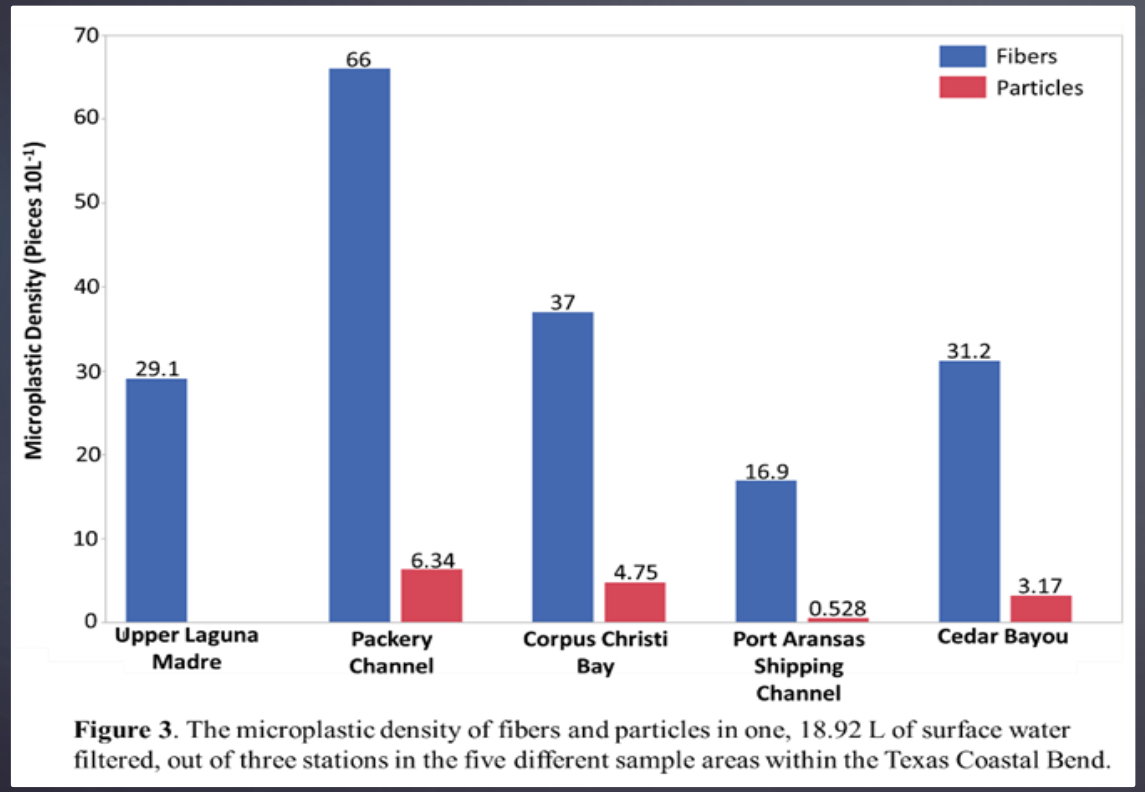
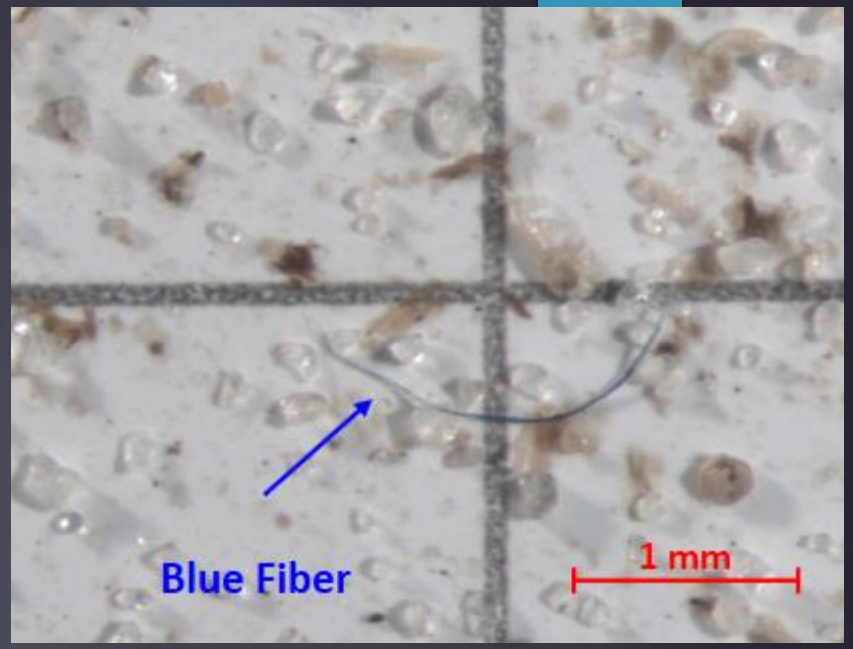
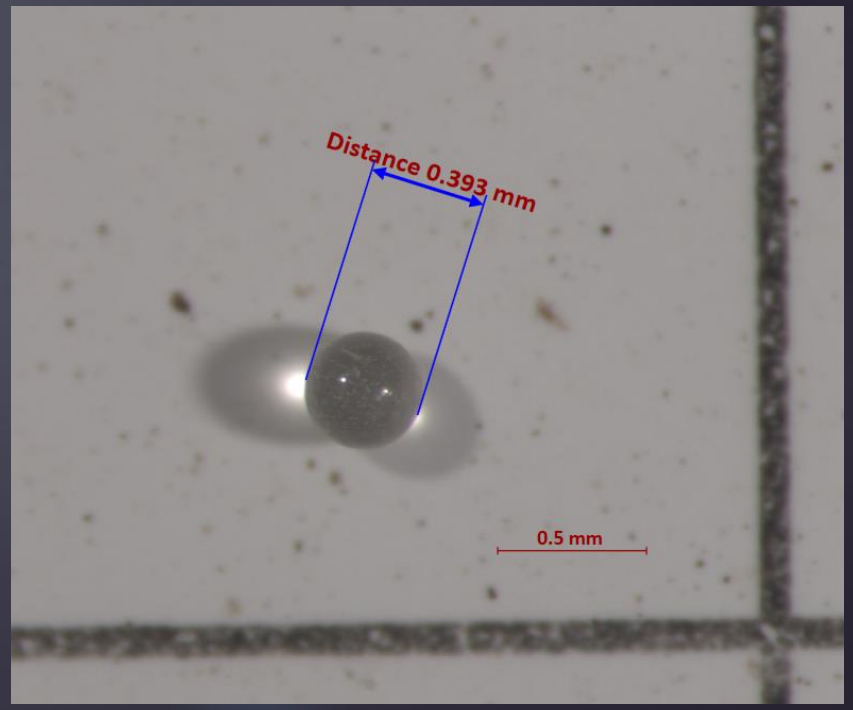


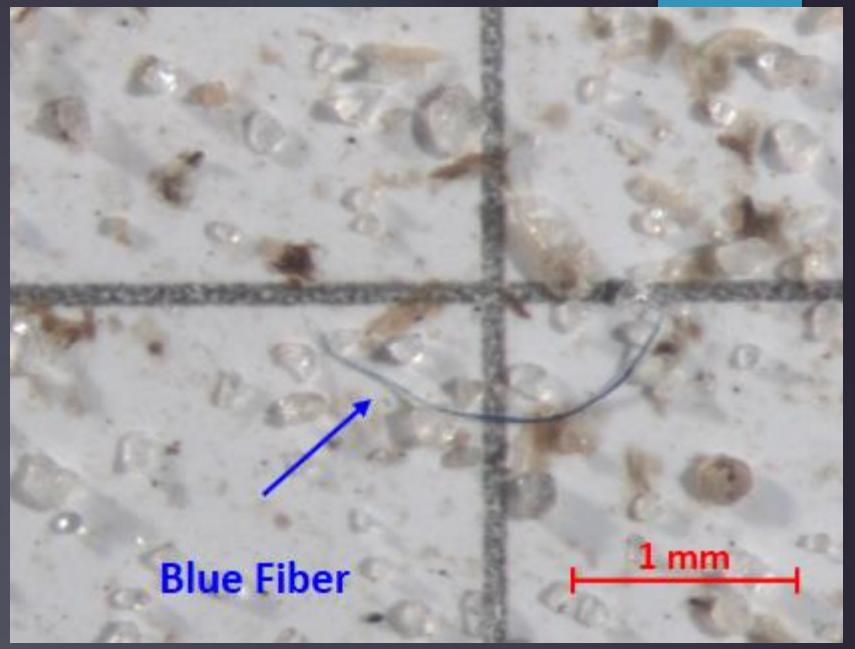
Figure 3. The microplastic density of fibers and particles in one, 18.92 L of surface water filtered, out of three stations in the five different sample areas within the Texas Coastal Bend.

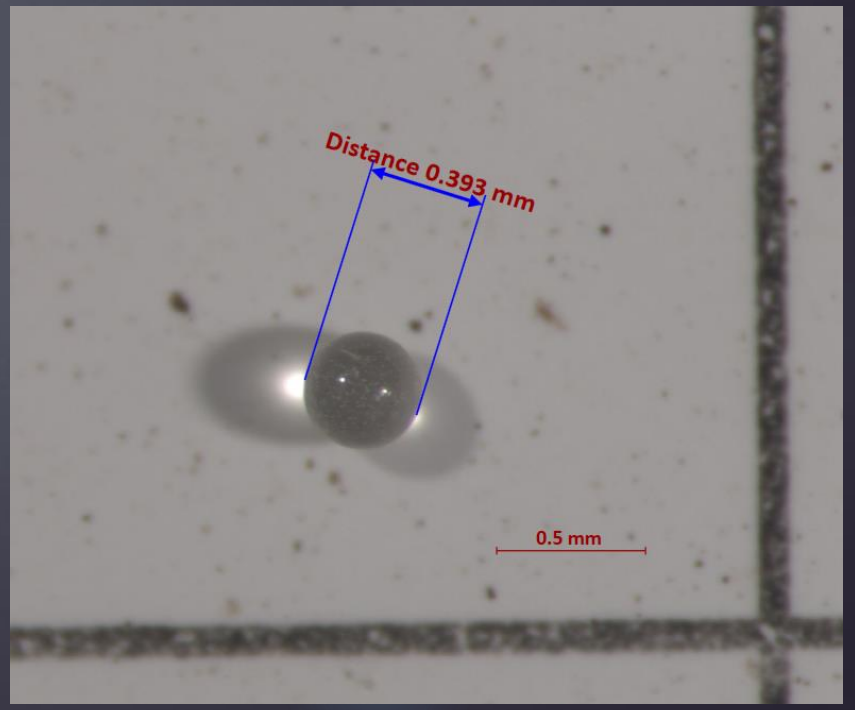




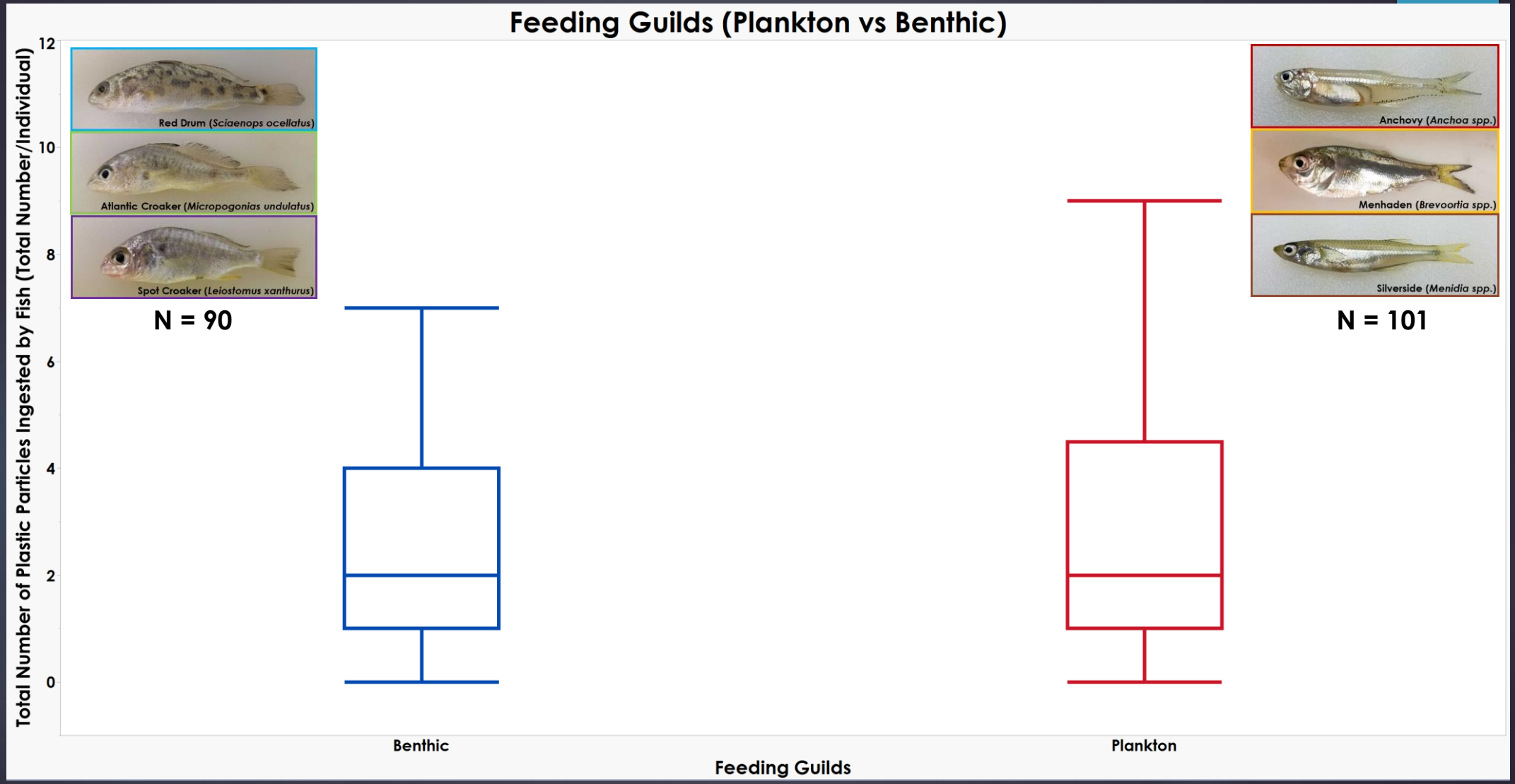
Results – Juvenile Fish

- 191 juvenile fish
  - 84% had one or more suspected microplastic
  - Blue (46%) and black (35%) fibers the most abundant
  - Average length of 1.317 mm



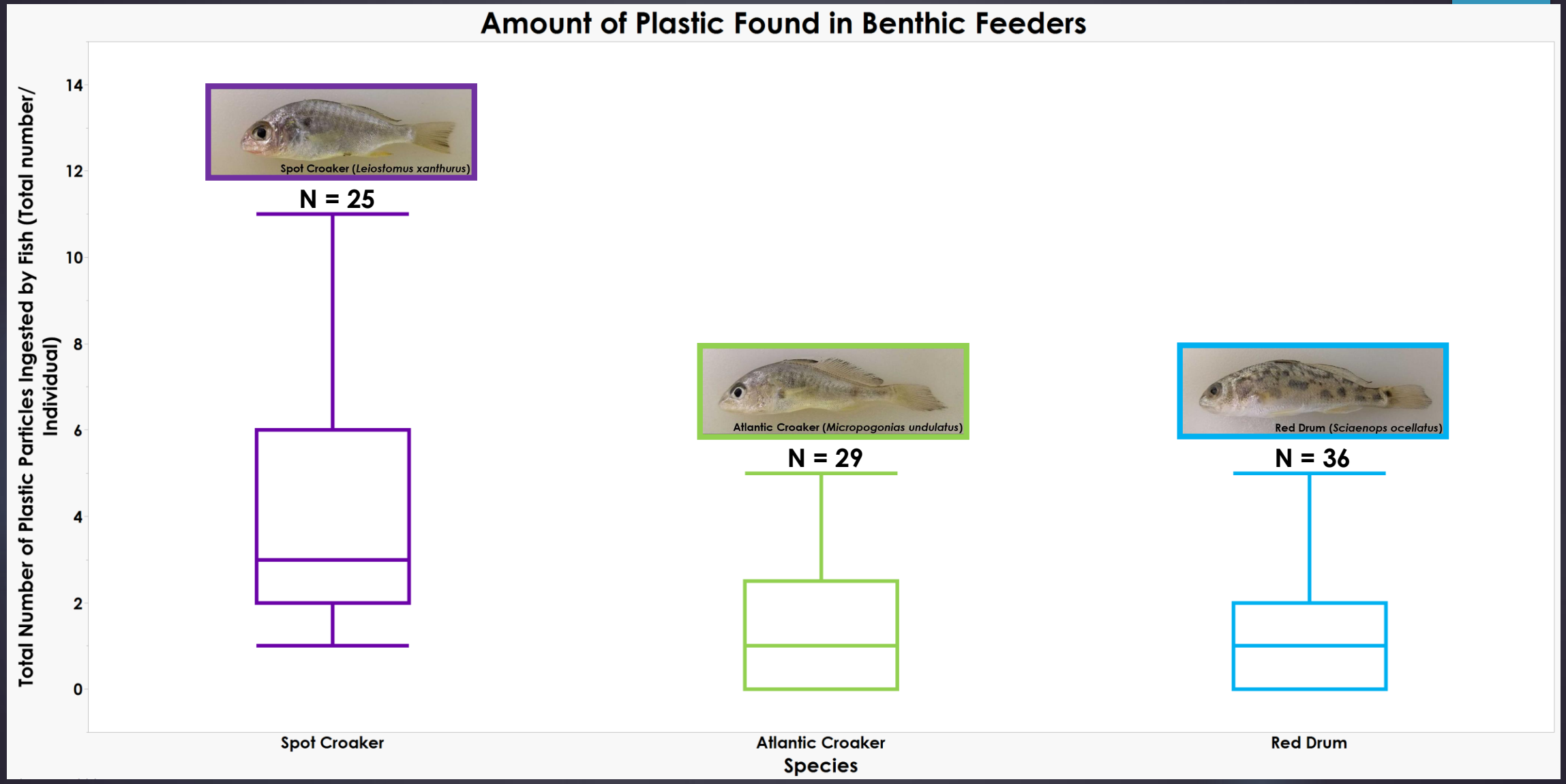


Results - Benthic vs Plankton Feeder



Not significant (p=0.1793)

Difference in Species



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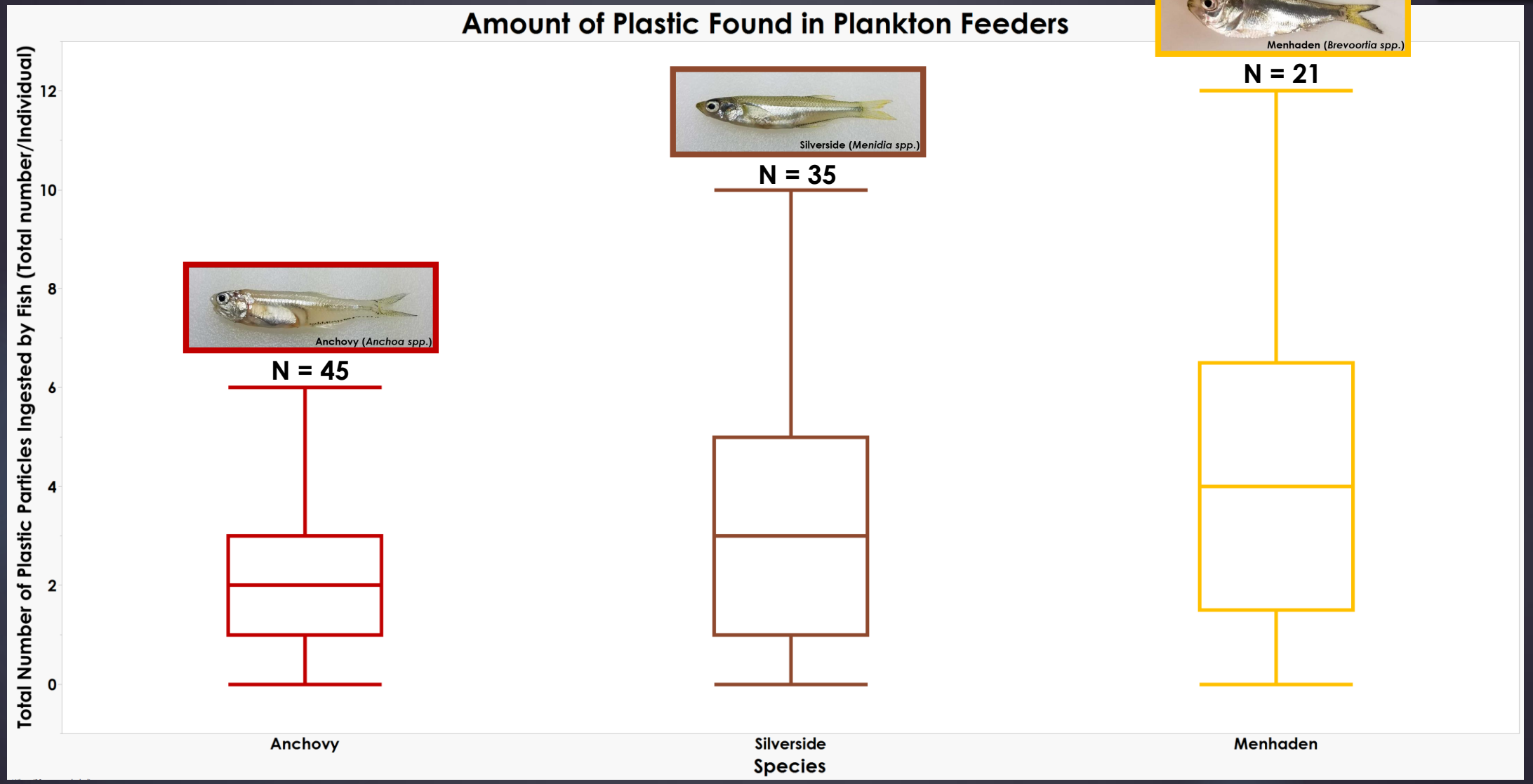
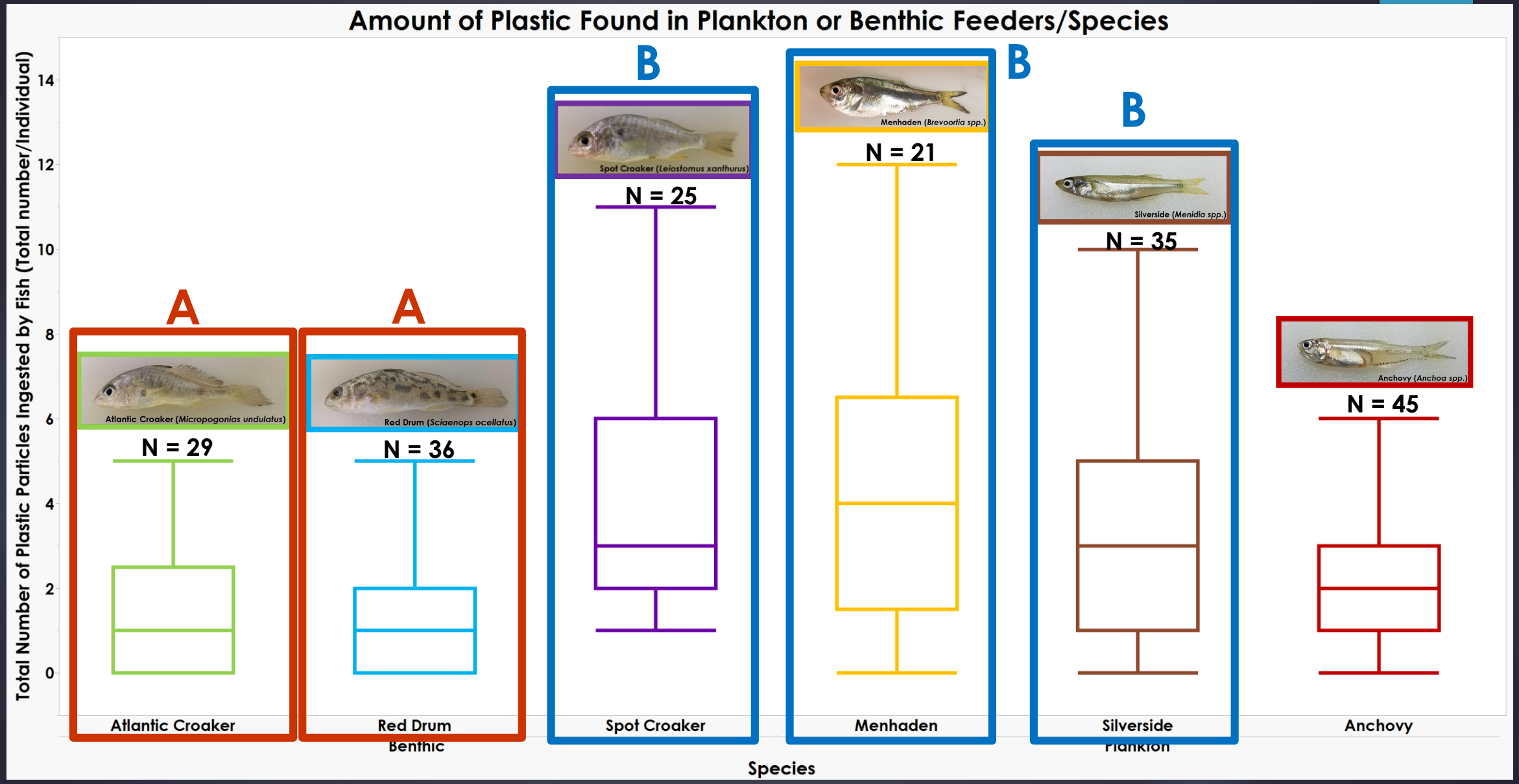


Difference in Species



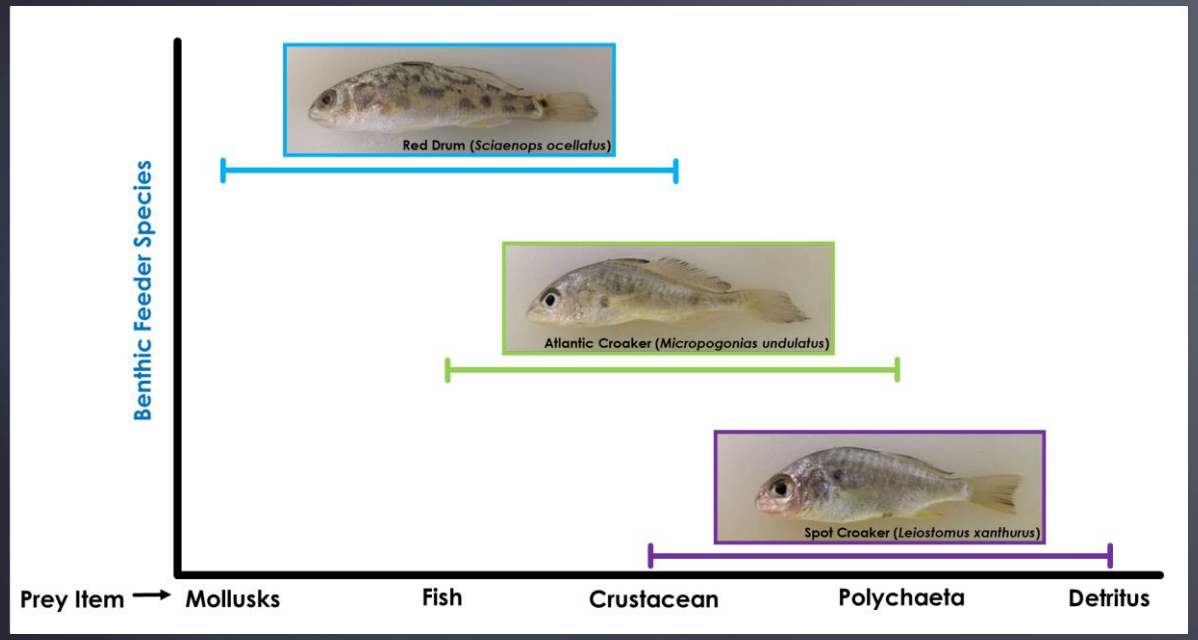
Discussion

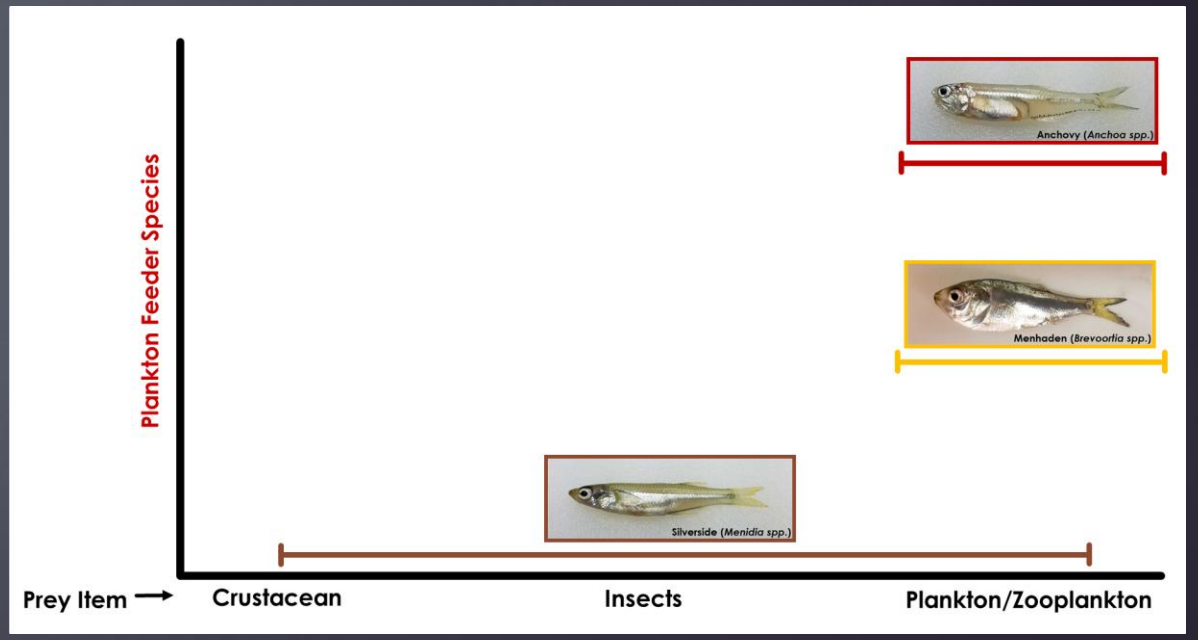
- Are juvenile fish ingesting microplastic?
  - **YES**
- Feeding guild influence on amount of microplastic ingested?
  - Benthic vs. Plankton
  - **NO**

(Phillips and Bonner, 2015; Peters and Bratton, 2016; Peters *et. al*, 2017)

Discussion

- Species influence on amount of microplastic ingested?
  - **YES**
- **Differences in microplastic ingestion related to prey item and position in the water column?**





(Kells and Carpenter, 2011)

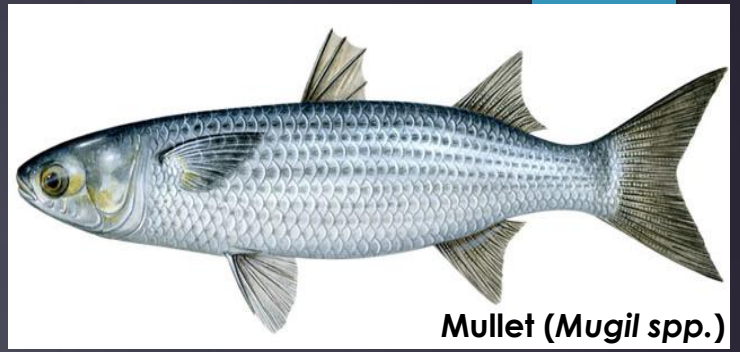
Potential Effects on Fish Health and Survival

- Compromise energy uptake
- Physical damage to membranes in digestive tract
- Chemical poisoning - Ecotoxicology
  - Plastic can absorb harmful chemicals and heavy metals
  - Leaching, accumulation and harming the organism

(Nakashima *et al.*, 2012; de Sá et al., 2015, Thorson, 1950; Hunter, 1981; Wilcox *et al.*, 2018)

Next Steps

1. Complete stomach content analysis
2. Test for spatial differences
3. Correlation between ingested plastic and condition factor
4. Micro-FTIR analyses on suspected microplastic


Mullet (*Mugil spp.*)


Bay Whiff (*Citharichthys spilopterus*)


Pinfish (*Lagodon rhomboides*)

Acknowledgements

- Geist Early Life History Lab: Stormy Paxton, Andrew Windham, Andrew Ricken, Judy Pope, Zachery Sawyer, Daniel Hardin, Pilar Harkless & Asheigh Campbell
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(References upon request)

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