



**RUTGERS**  
School of Environmental  
and Biological Sciences

# MICROPLASTICS

“FOREVER COMPOUNDS”

MORPHOMETRIC EFFECTS OF  
MICROPLASTICS ON SAC FRY ZEBRAFISH

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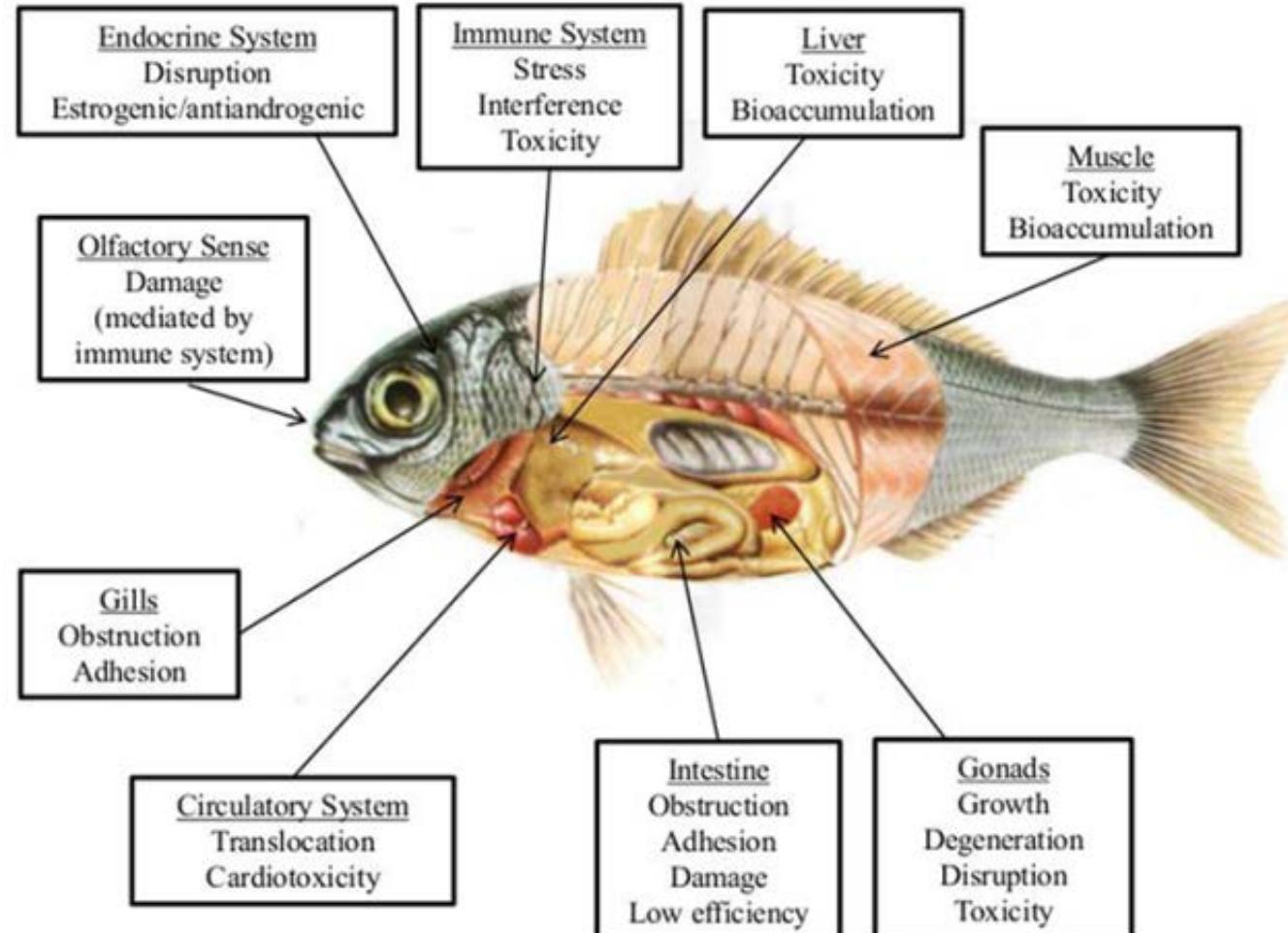
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# OVERVIEW

- **Microplastics**
  - Primary / Secondary
  - Chemical composition
- **Hypothesis**
- **Experimental Design**
- **Results**
- **Conclusions**

# MICROPLASTIC AFFECT ENDPOINTS

- Total Body Length
- Pericardial Sac Size
- Interocular Distance



<https://www.intechopen.com/books/toxicology-new-aspects-to-this-scientific-conundrum/microplastics-in-aquatic-environments-and-their-toxicological-implications-for-fish>



# MICROPLASTICS

**According to National Oceanic and Atmospheric Administration (NOAA), US Dept. of Commerce, MICROPLASTICS are small plastic pieces/ debris that range from 5mm to 1nm in length.**



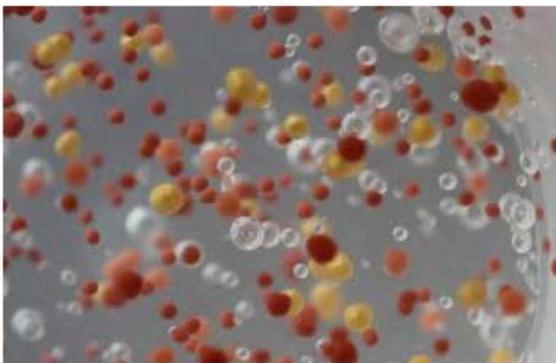
<https://oceanservice.noaa.gov/facts/microplastics.html>



# PRIMARY MICROPLASTICS

- **Intentionally manufactured microplastic particles as microbeads, capsules, pellets, and fibers.**
- **Used in cosmetic and personal care products, as well as industrial scrubbers used in abrasive blast cleaning, virgin resin pellets for plastic manufacturing processes, and microfibers in textiles.**

MICRO BEADS (Scrub)



MICRO BEAD (Detergent)



NURDLES (Pellets)



NA NOFIBRE (clothing)



<http://www.boomerangalliance.org.au/mpp-blog-02-microplastics>



# SECONDARY MICROPLASTICS

- **Produced from larger plastic pieces that break down into microplastic particles.**
- **Breakdown can occur via photodegradation, weathering, abrasion or wave action (mechanical) creating fragments, or microbial breakdown.**

SECONDARY MICROPLASTIC



TYRE DUST



NURDLES (Flake)



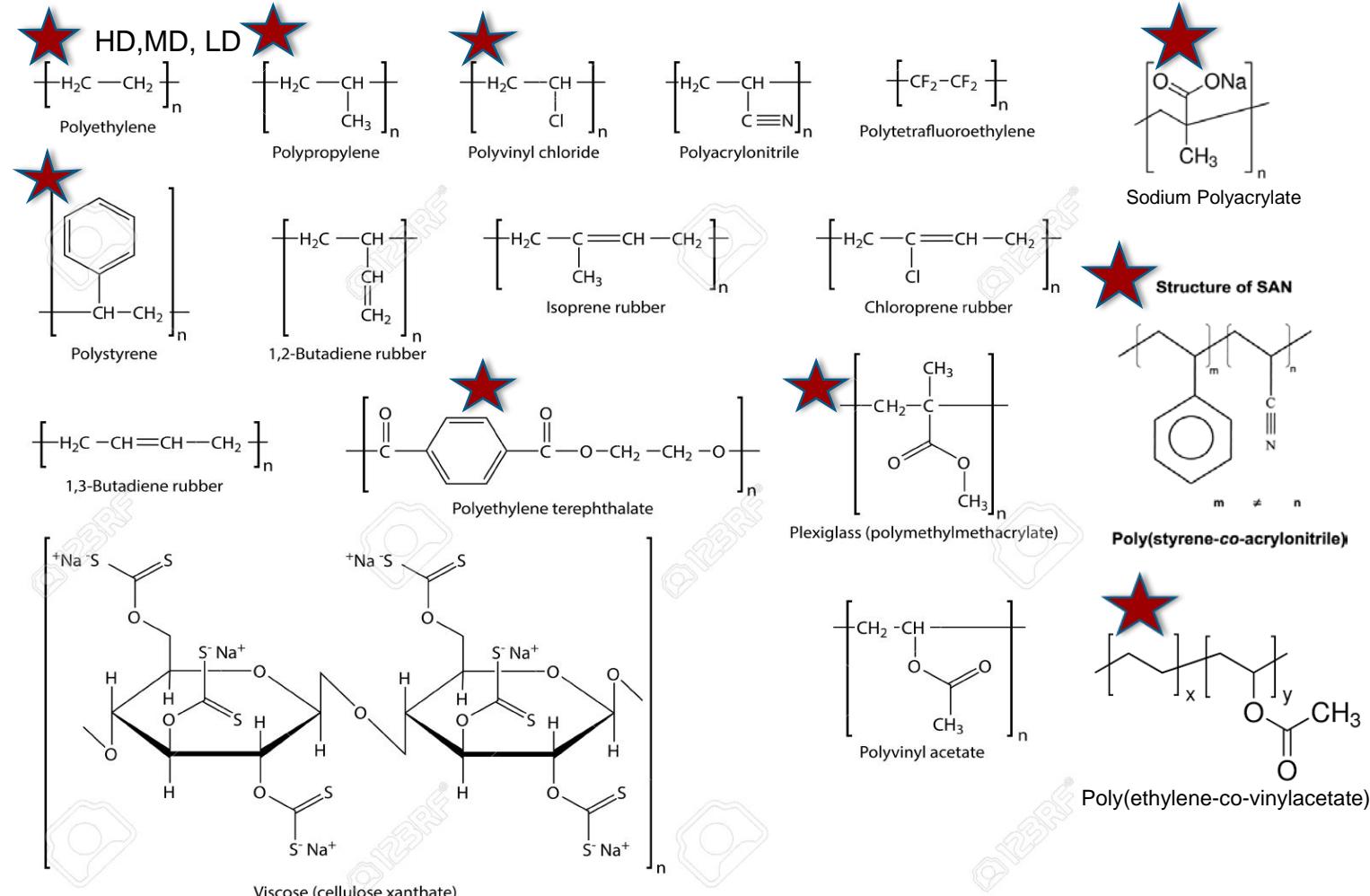
NANOFIBRES (Butts)



<http://www.boomerangalliance.org.au/mpp-blog-02-microplastics>

# CHEMICAL COMPOSITION OF PLASTICS

- Polyethylene High density HDPE
- Polyethylene Medium Density MDPE
- Polyethylene Low Density LDPE
- Poly vinyl chloride PVC
- Polyurethane PU
- Poly methyl methacrylate PMMA
- Polyethylene terephthalate PET
- Polypropylene PP
- Sodium Polyacrylate SPA
- Polyethylene(co- vinyl-acrylate) PEVA
- Polystyrene (co- acrylonitrile) PSAN





## HYPOTHESIS

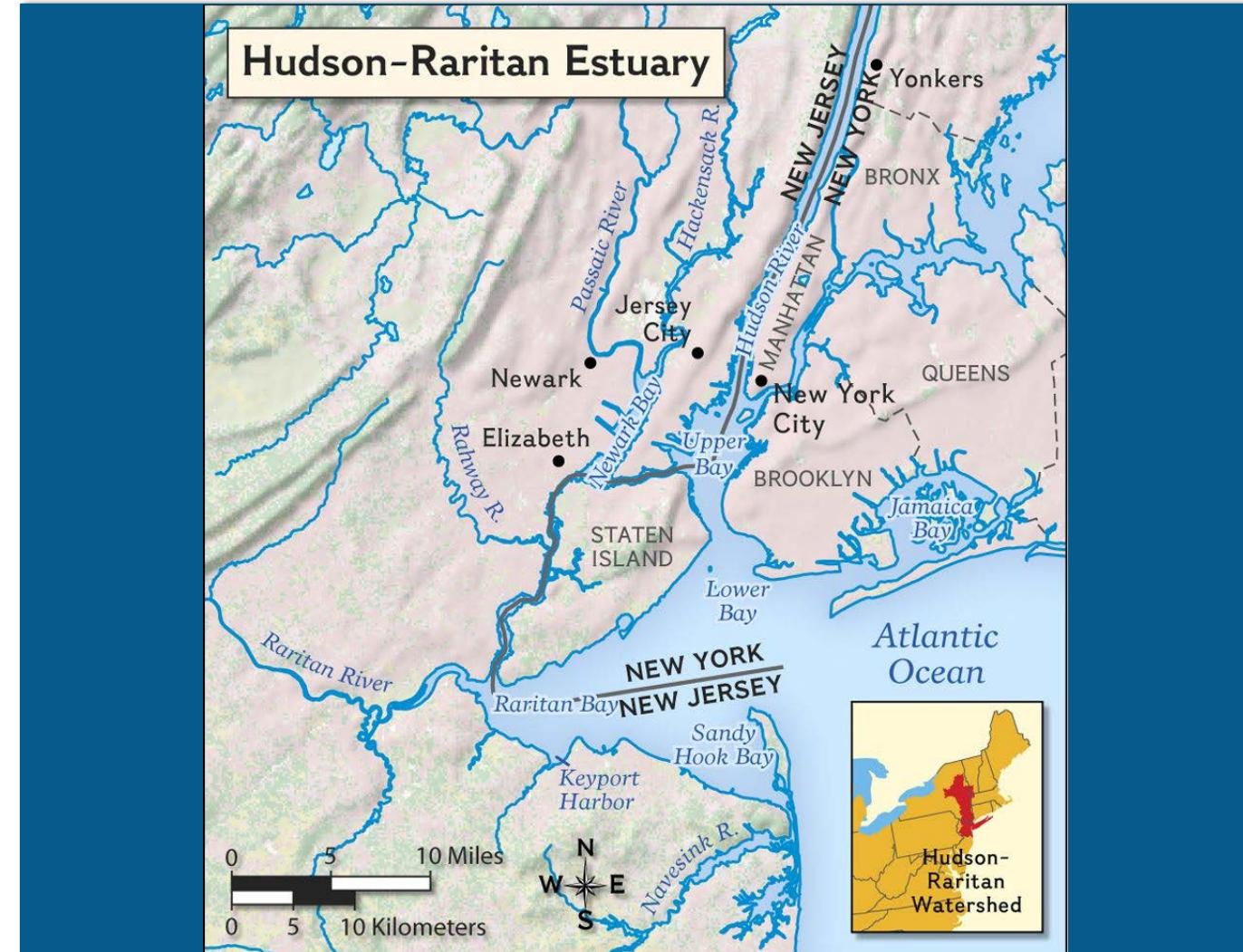
**Embryonic exposure to microplastic particles will interfere with development in embryonic Zebrafish, and will be seen in morphometric endpoints.**

**Structurally different plastics will result in different toxic responses based on structure.**



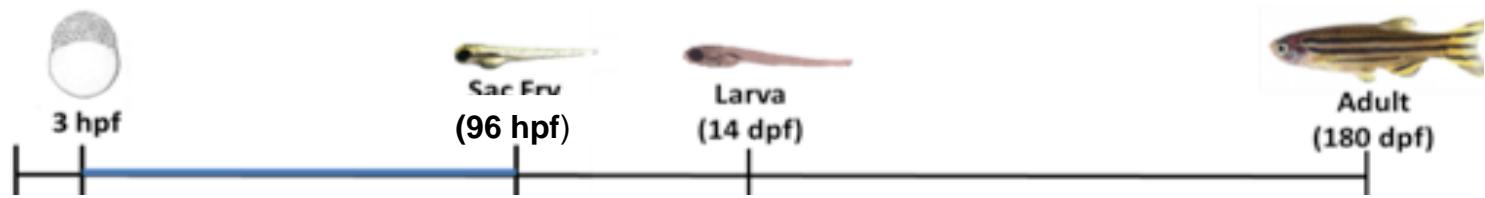
# MICROPLASTICS STUDY AREA

- Fresh water to Tidal Transect
- Three microplastics samples were identified via pyrolysis GC-MS
  - Polypropylene
  - Polyethylene
  - Polyethylene, PVC, and palmitic acid mixture



# EXPERIMENTAL PARADIGM

1. Microplastics of unknown composition, from several field locations in New Jersey were collected according to the Erikson et al., 2013 protocol and subjected to Fenton reaction.
2. Pure Microplastics were purchased from Sigma Aldrich and the larger plastic particles were pulverized via Dremel with a diamond tip followed by glass homogenization in ethanol.

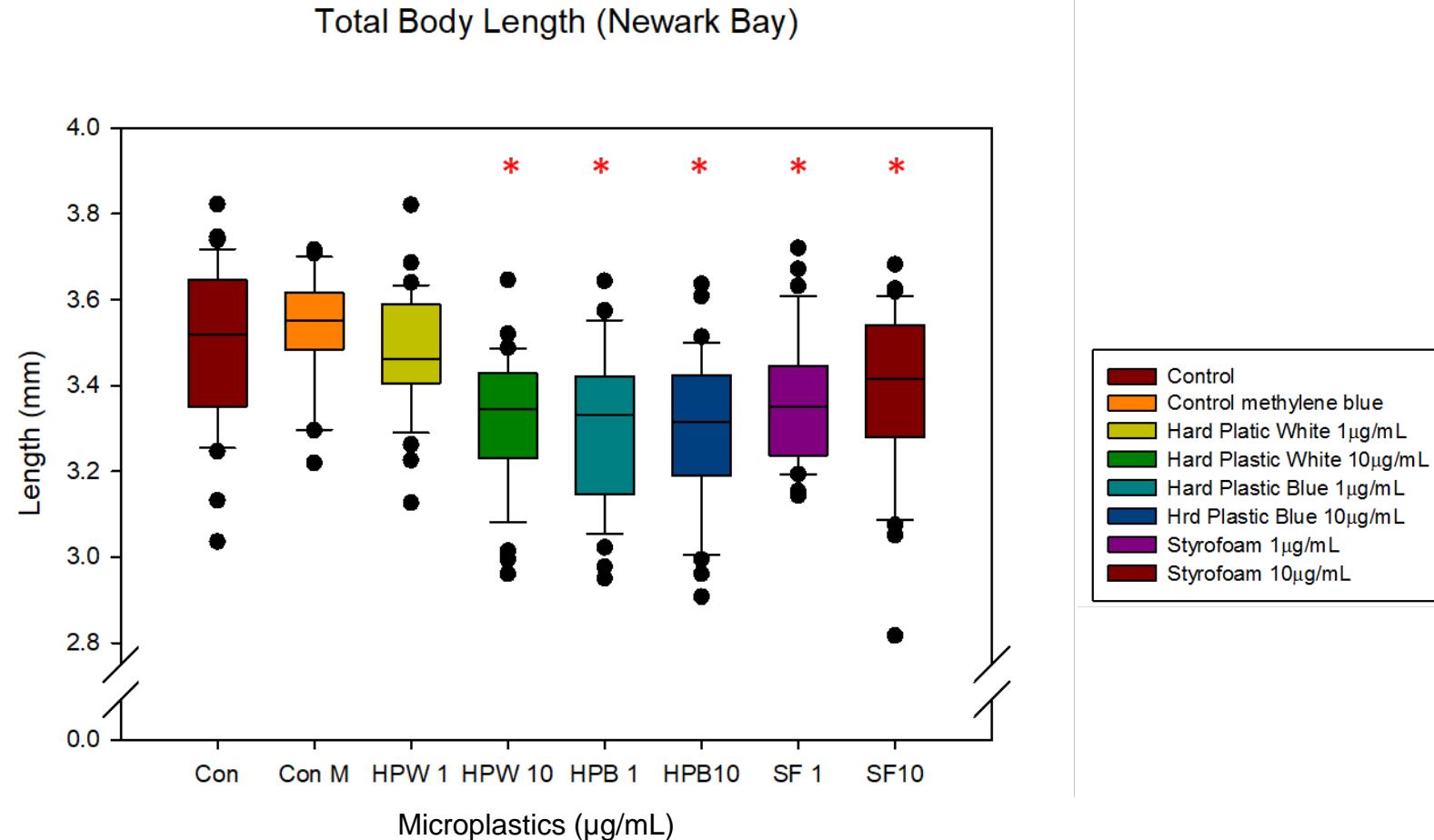


- AB strain Zebrafish embryos, exposed to one microplastic per embryo at 3 hpf until 96 hpf in individual glass vials.
- 1.0  $\mu\text{g}/\text{mL}$  or 10  $\mu\text{g}/\text{mL}$  concentrations were used.
- At 96 hpf the sac fry larvae were sacrificed.



# RESULTS

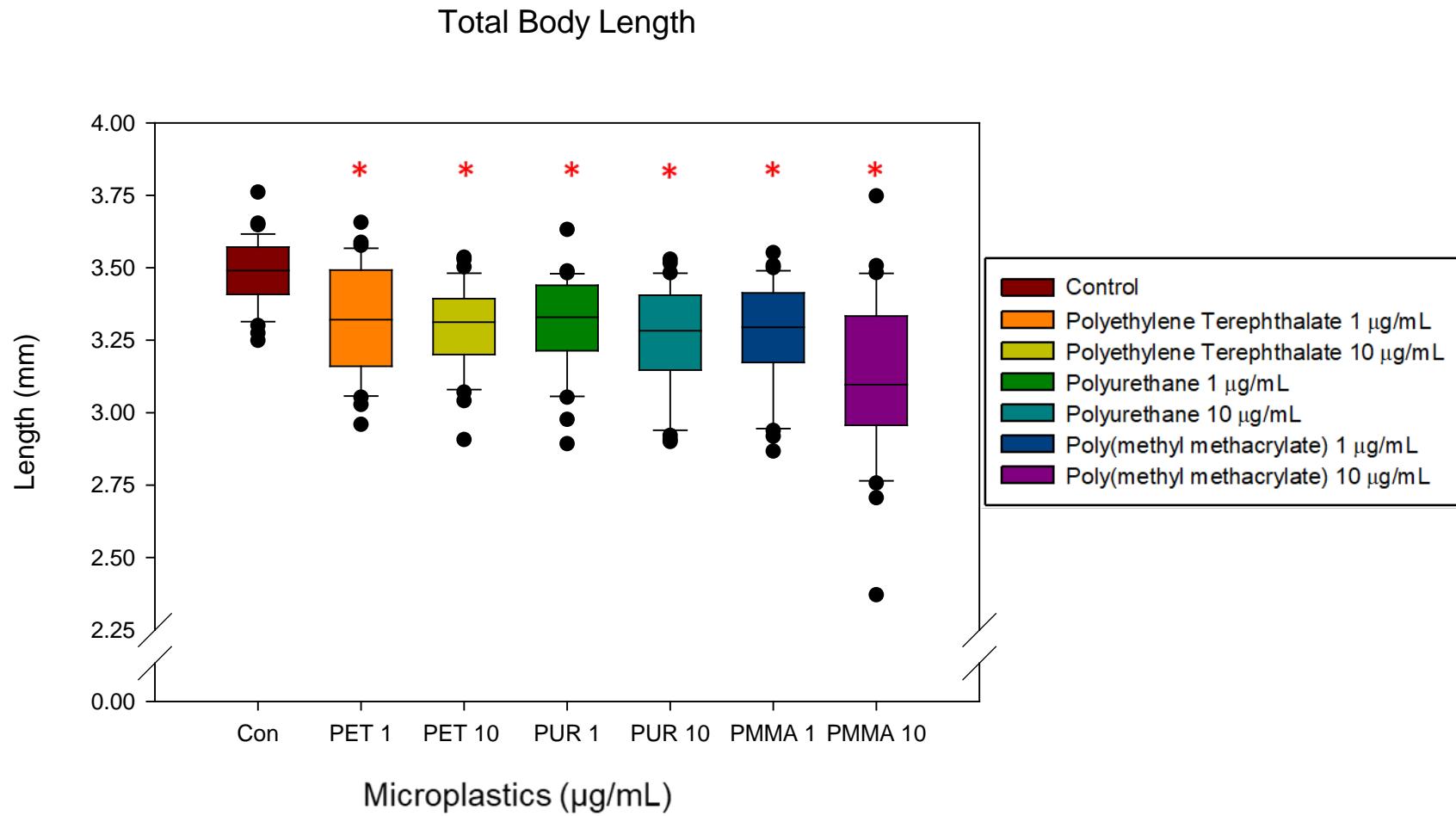
- Total body length (mm)
- Unknown Plastics from Newark Bay.
- Two controls used: egg water and egg water with methylene blue
- N=40
- One way ANOVA
- significance of  $P < 0.05$  reported





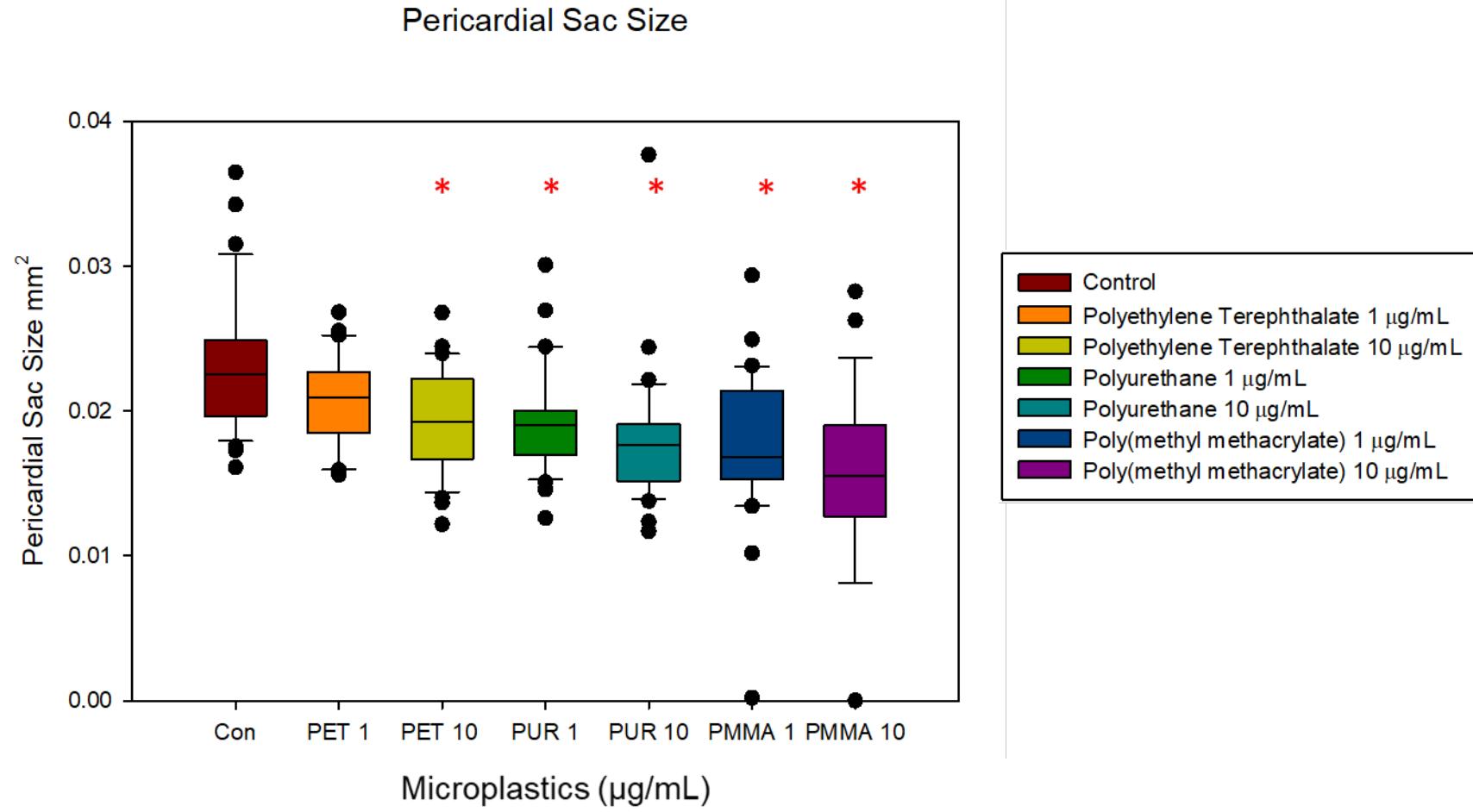
# RESULTS

- Total Body Length (mm)
- Pure plastics Polyethylene Terephthalate (PET), Polyurethane, Poly (Methyl methacrylate)
- N=40
- One way ANOVA
- significance of  $P < 0.05$  reported.



# RESULTS

- Pericardial Sac Size ( $\text{mm}^2$ )
- Pure plastics Polyethylene Terephthalate, Polyurethane, Poly (Methyl methacrylate)
- N=40
- One way ANOVA
- significance of  $P < 0.05$  reported.



## Microplastic Effects on Morphometrics

| Microplastic sample              | Total Body Length | Pericardial Sac Size | Interocular Distance |
|----------------------------------|-------------------|----------------------|----------------------|
| Newark Bay PP 10 $\mu$ g/mL      | ↓                 | ↓                    | ↑                    |
| Newark Bay PE 1 $\mu$ g/mL       | ↓                 |                      |                      |
| Newark Bay PE 10 $\mu$ g/mL      | ↓                 |                      |                      |
| Newark Bay PE, PVC 1 $\mu$ g/mL  | ↓                 |                      | ↑                    |
| Newark Bay PE, PVC 10 $\mu$ g/mL | ↓                 |                      | ↑                    |
| PET 1 $\mu$ g/mL                 | ↓                 |                      |                      |
| PET 10 $\mu$ g/mL                | ↓                 | ↓                    | ↑                    |
| PU 1 $\mu$ g/mL                  | ↓                 | ↓                    |                      |
| PU 10 $\mu$ g/mL                 | ↓                 | ↓                    |                      |
| PMMA 1 $\mu$ g/mL                | ↓                 | ↓                    |                      |
| PMMA 10 $\mu$ g/mL               | ↓                 | ↓                    |                      |

Morphometric significance result table.

One-way ANOVA was applied, significance of  $P < 0.05$  reported.

No significant changes in morphometrics were seen with Pure LDPE, MDPE, HDPE, PS, SPA, or PVC



# CONCLUSIONS

- **Embryonic exposure to field collected microplastics interfered with cardiovascular development and linear growth in embryonic exposed Zebrafish.**
- **Structurally different plastics can be ranked for toxic responses using the zebrafish model.**
- **Polyethylene resulted in no significant observed effects while .....**