Understanding scleractinian coral microplastic ingestion: calcification, size limits, and retention

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EXPERIMENT 1:
CALCIFICATION

Methods
• *M. cavernosa* & *O. faveolata*
• 2 treatments: exposed & controls (*n*=5)
• Size classes (cured) each at 0.0100 g L\(^{-1}\) for total of 0.2400 g/chamber
  • 90-106 μm
  • 425-500 μm
  • 850-1000 μm
• 2 day static exposure
• Total alkalinity measure before/after
  2 μmol alk = 1 μmol CaCO\(_3\)
• μPs recaptured: coral tissue & chamber water (Duffy et al. poster #132)
Results

- No sig difference in calcification ($p=0.05$)
EXPERIMENT 1: CALCIFICATION

Results
• No sig difference in calcification ($p=0.05$)
• Corals ingested μPs
EXPERIMENT 1: CALCIFICATION

Results
• No sig difference in calcification ($p=0.05$)
• Corals ingested $\mu$Ps...but less than expected

WHY?
EXPERIMENT 2: SIZE LIMITS & RETENTION

**Methods**
- 3 μPs/coral frag (w/ food, 5-50 μm Golden Pearls)
- Size classes (uncured)
  - 2.4-2.8 mm
  - 1.7-2.0 mm
  - 850-1000 μm
  - 425-500 μm
  - 212-250 μm
- 24 & 48 hour observations
**EXPERIMENT 2: SIZE LIMITS & RETENTION**

**Results**

Ingestion (n=10/size class)

<table>
<thead>
<tr>
<th></th>
<th>425-500 μm</th>
<th>850-1000 μm</th>
<th>1.7-2.0 mm</th>
<th>2.4-2.8 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>M. cav</em></td>
<td>100%</td>
<td>90%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><em>O. fav</em></td>
<td>96.7%</td>
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<td>20%</td>
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</tr>
</tbody>
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Released after 48 hours

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<td><em>O. fav</em></td>
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<td>100%</td>
<td>75%</td>
<td>100%</td>
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</table>
EXPERIMENT 2: SIZE LIMITS & RETENTION

Feeding Response

*Montastraea cavernosa*

*Orcibella faveolata*
EXPERIMENT 2:
SIZE LIMITS & RETENTION

Montastraea cavernosa

Orbicella faveolata

Photos: Cheryl Hankins
EXPERIMENT 3: 
µBEADS vs µFIBERS

Methods
• 3 µPs/coral frag (w/ food, 5-50 µm Golden Pearls)
• µPs:
  • 425-500 µm µbeads (polyethylene)
  • 3-5 mm µfibers (polyester)
• 24 & 48 hour observations
EXPERIMENT 3: \( \mu \text{BEADS vs } \mu \text{FIBERS} \)

**Results**

**Ingestion (n=10/size class)**

<table>
<thead>
<tr>
<th></th>
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<th>( \mu \text{fiber} )</th>
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<td>( O. \text{ fav} )</td>
<td>100%</td>
<td>97%</td>
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<td>100%</td>
</tr>
<tr>
<td>( O. \text{ fav} )</td>
<td>80%</td>
<td>76.7%</td>
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</table>
CONCLUSIONS
LABORATORY EXPERIMENTS

• No short term effects on calcification
• Corals actively ingest μ beads 425 μm-2.8mm & μ fibers
• Short retention times

QUESTIONS

• Max size limit?
• Long term effect on calcification?
• Do the retained μPs impair digestion?
• Biofilm impacts?
Locations
• St. John, USVI 2017
• Florida Keys, FL 2018

Samples
• Subsurface (3 m) water samples filtered with 63 μm sieve
• M.cav & O.fav corals frags

Analysis
• Quantification
• Polymer identification (FTIR microscopy)
Hooyay for the Clean Water Act

Clean Water Act (CWA)

- “…restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” [sec 101 (a)]
- EPA’s regulating authority for inland and coastal (w/in 3 miles of shore) waters
QUESTIONS?

Where do microplastics in the ocean come from?

- Microplastics added to other products: 50 tons
- Indoor dust: 65 tons
- Illegal dumping of paint: 90 tons
- Waste treatment: 100 tons
- Washing of textiles: 110 tons
- Painting and maintenance of buildings, constructions and roads: 310 tons
- Loss from plastic production: 400 tons
- Wear and tear from car tyres: 2250 tons
- Painting and maintenance of ships and boats: 650 tons
- Cosmetics: 4 tons

Source: "Sources of microplastic-pollution to the marine environment" / Maps

Thank you