DO MICROPLASTICS INFLUENCE DISEASE SUSCEPTIBILITY IN THE COMMERCIALLY IMPORTANT RAINBOW TROUT?

10.1

2023 Virginia Water Monitoring Council Conference





In the Real World – exposure to multiple-stressors! Q: Does microplastic/virus co-exposure increase mortalities/disease susceptibility in an important salmonid species?

Fish: rainbow trout (Oncorhynchus mykiss)

Disease: Infectious hematopoietic necrosis virus (IHNV)

-causes major disease & mortality in salmon & trout

-can cause 90% mortality in juvenile salmonids







IHNV - transmission electron microscope

Dixon et al., 2016



Project Details: Plastic Choices & Preparation



In-vivo Experimental Design





Fish exposure setup



68 tanks and 1,340 fish total!



Project Details: In-vivo Experimental Design Chronic particle exposure: 8 weeks One-time IHNV intro @ 4 weeks Daily mortality & water quality monitoring. **IHNV** Dose Water for IHNV titer collected 10x post-dosing Tissue Collection Tissue Collection Tissue Collection Tissue Collection **END** Day 56 Day 0 *Day 14* Day 21 Day 49 Day 7 Day 28 Day 35 Day 42 *Particle exposure every other day* 24 hour exposure in 1st half 8-10 hour exposure in 2nd half

Results: Trout mortalities following exposure to microplastics/particles & IHNV



No significant mortality observed in particle-only treatments (no virus)!



- Presence of particles in virus co-exposure increases IHNV virulence
- Nylon fibers had a greater effect than non-fibrous PS or Spartina

Why?



Histopathological exam of trout gill tissues

Microscopic images of gill tissues at 40x magnification black bar: 20 µm (Olympus AX-70 photomicroscope)

Severity 0: Healthy tissue (on left) **Severity 3: unhealthy tissue** sections (on right).

B. Severity of Gill Histopathological Response



Heightened damage from Nylon fibers following IHNV challenge



Fibers physically disrupt gill membranes?

Virus Only

Virus + Microparticle

Virus + Microfiber

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Microplastics exacerbate virus-mediated mortality in fish



^a Virginia Institute of Marine Science, William & Mary, Gloucester Point, VA 23062, United States of America
^b William & Mary, Department of Biology, Williamsburg, VA 23187, United States of America

HIGHLIGHTS

- Interaction between microplastics and environmental pathogens is poorly understood.
 A salmonid fish was co-exposed to virus and
- microplastics or natural microparticles. • Mortality increased when co-exposed
- to virus and microplastics, especially microfibers. • Mortality correlated with host viral burden,
- gill damage and inflammation.
- Microplastics may increase severity of infection, necessitating further research.

GRAPHICAL ABSTRACT



ARTICLE INFO

ABSTRACT

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Microplastics are a persistent and increasing environmental hazard. They have been reported to interact with a variety of biotic and abiotic environmental stressors, but the ramifications of such interactions are largely unknown. We investigated virus-induced mortalities in a commercially important salmonid following exposure to microplastics, plastic microfibers, and natural (non-plastic) microparticles. Microplastics or microparticles alone were not lethal. Mortality increased significantly when fish were co-exposed to virus and microplastics, particularly microfibers, compared to virus alone. This presents the unique finding that microplastics (not natural microparticulate matter) may have a significant impact on population health when presented with another stressor. Further, we found that mortality correlated with host viral load, mild gill inflammation, immune responses, and transmission potential. We hypothesize that microplastics can compromise host tissues, allowing pathogens to bypass defenses. Further research regarding microplastics increasing environmental burden.

Do MPs damage biological membranes, worsening infection/mortality...

Then... Nylon microfibers dosed pre-virus will increase virus-related mortality, but nylon microfibers dosed post-virus will not.





Experimental Design



Mortality monitored daily.

Water samples collected 10x post-IHNV for viral titer.





Again, plastic-only exposures caused modest mortality



- Exposure to virus significantly increases mortality.
- Exposure to nylon fibers has a greater effect than nylon
 powder.
- Chronic exposure has greater effect than pre-virus exposure alone.

No significant differences between treatments in viral shedding.

Does UV treatment alter effects of microplastics on fish (with & w/o virus exposure)?



Artificially weathered particles for 500 hours in full UV spectrum. Equivalent to 6 months exposure to Florida sunlight.





THANK YOU! HALE@VIMS.EDU

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