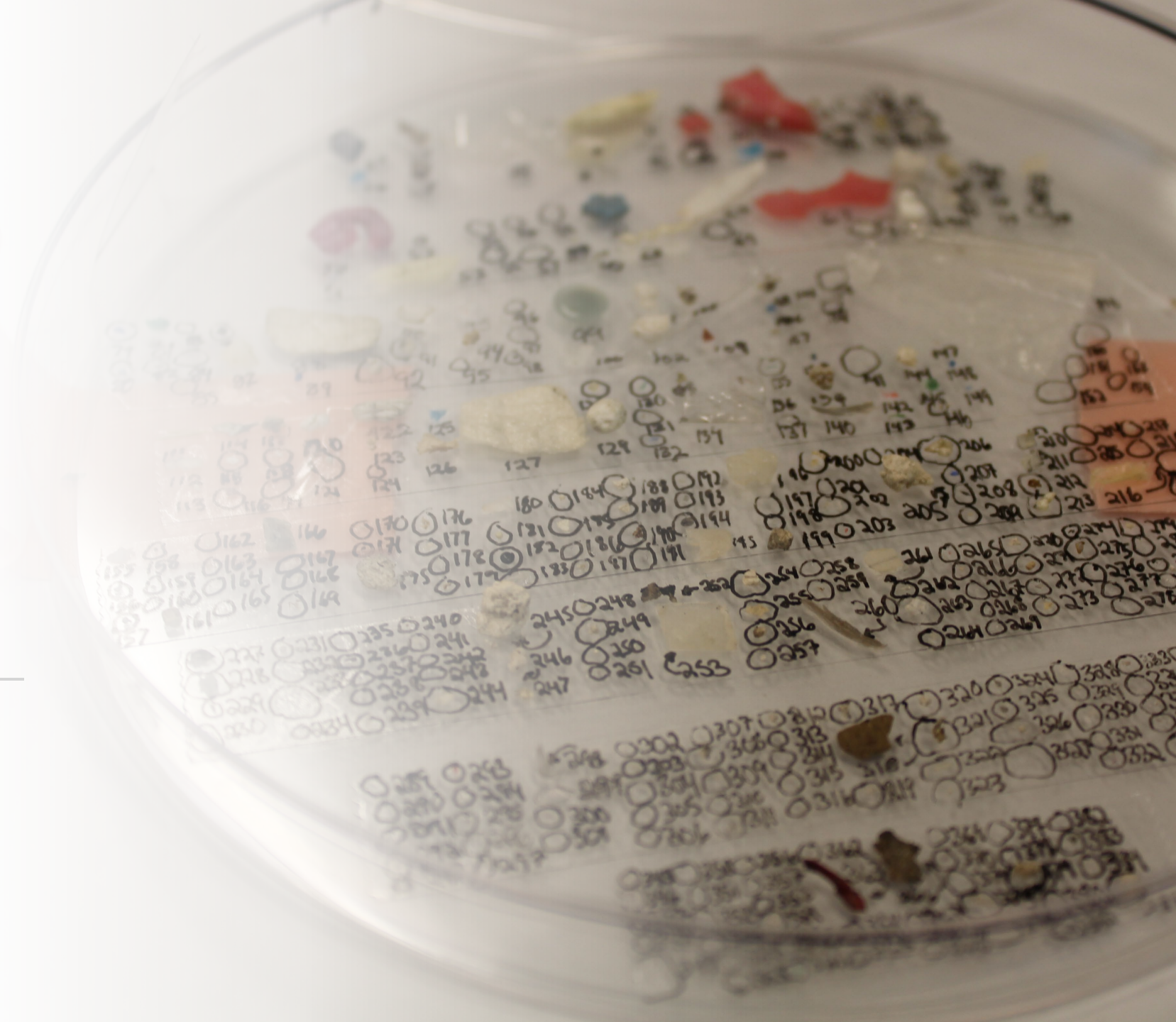
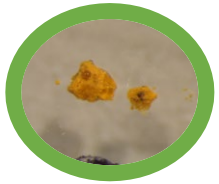
Microplastic characteristics and their relevance to risk assessment



September, 8th, 2021;

Chelsea M Rochman, U of Toronto
chelsea.Rochman@utoronto.ca



Microplastics are a diverse & multi-dimensional contaminant suite

Polymer
- PP
- LDPE
- HDPE
- PVC
- PU
- PET
- PS
- ABS
- PMMA
- POM
- PBT
- PC
- PA
- SAN
- PEEK
- PSU
- PU
- ...

Additives
- Plasticizers
- Colorants
- Reinforcements
- Fillers
- Flame retardants
- Stabilizers
- ...

Product types

Primary
- Pre-production pellets
- Personal care products
- Industrial abrasives...

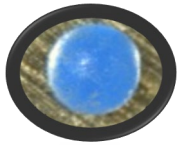
Secondary
- Agricultural materials
- Beverage bottles
- Carry bags
- Construction materials
- Containers
- Clothing
- Cutlery
- Electronics
- Food packaging
- Film
- Furniture
- Insulation
- Mattresses
- Medical
- Pillows
- Pipes
- Textiles
- Toys
- Tires
- ...

Size
- <5mm
- ...
- Nano
- ...

Morphology
- Fiber
- Fiber bundle
- Fragment
- Sphere
- Pellet
- Film
- Foam
- ...

Colour
- Red
- Orange
- Yellow
- Tan
- Brown
- Off white
- White
- Grey
- Blue
- Green
- ...

Eco-toxins
- PAHs
- PCBs
- DDT
- Heavy metals
- PBDEs
- ...

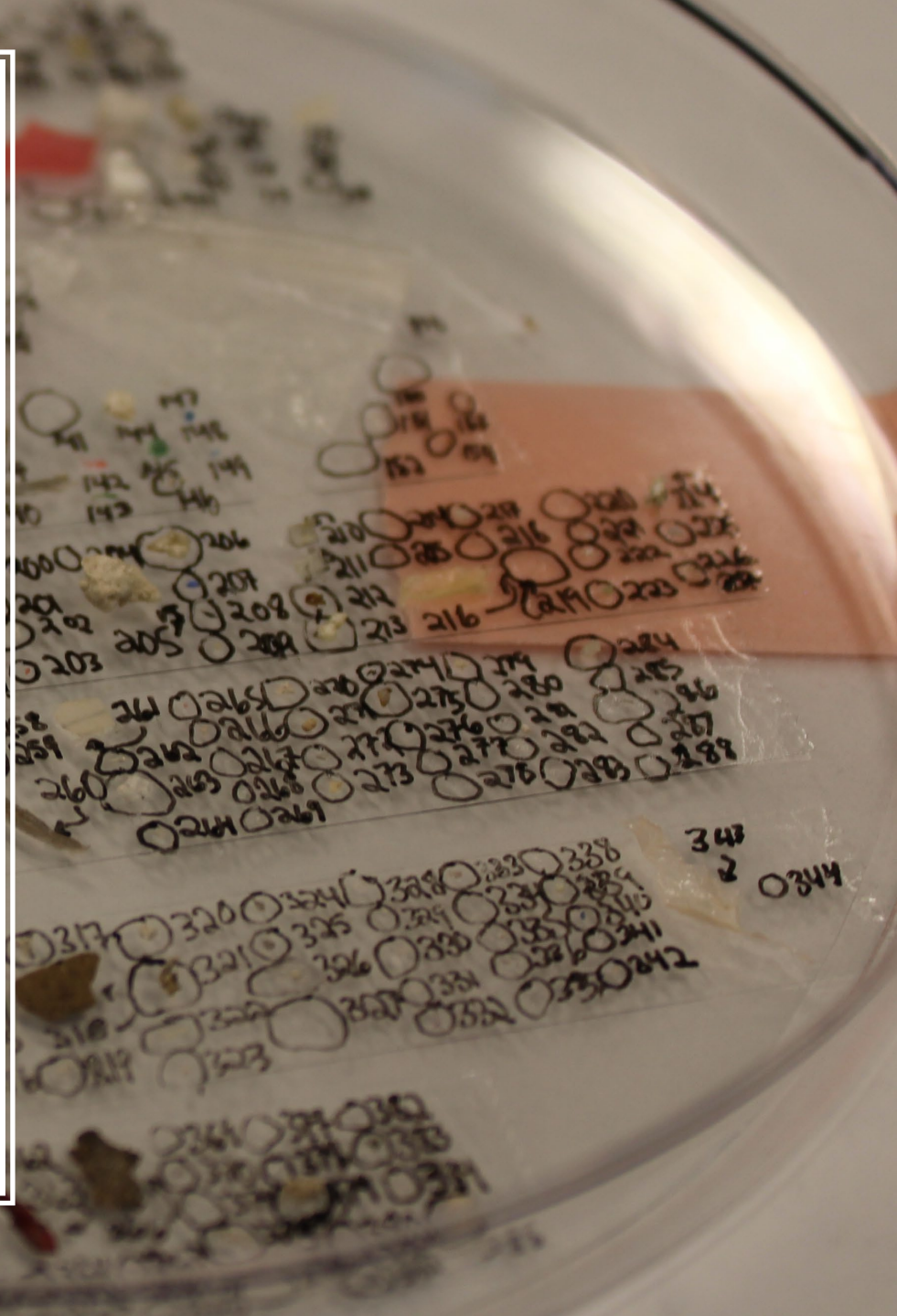


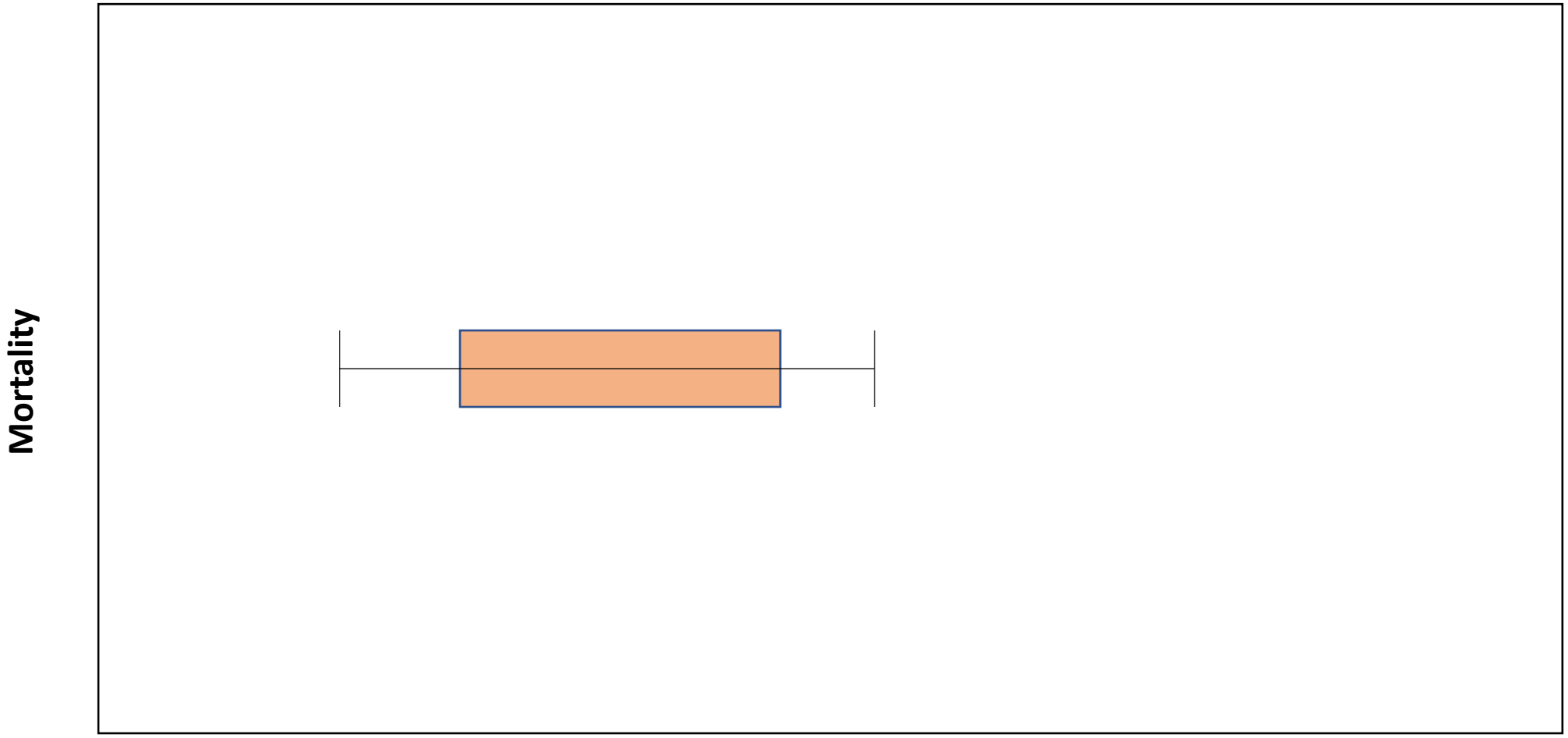
Rochman et al., 2019 *ET&C*

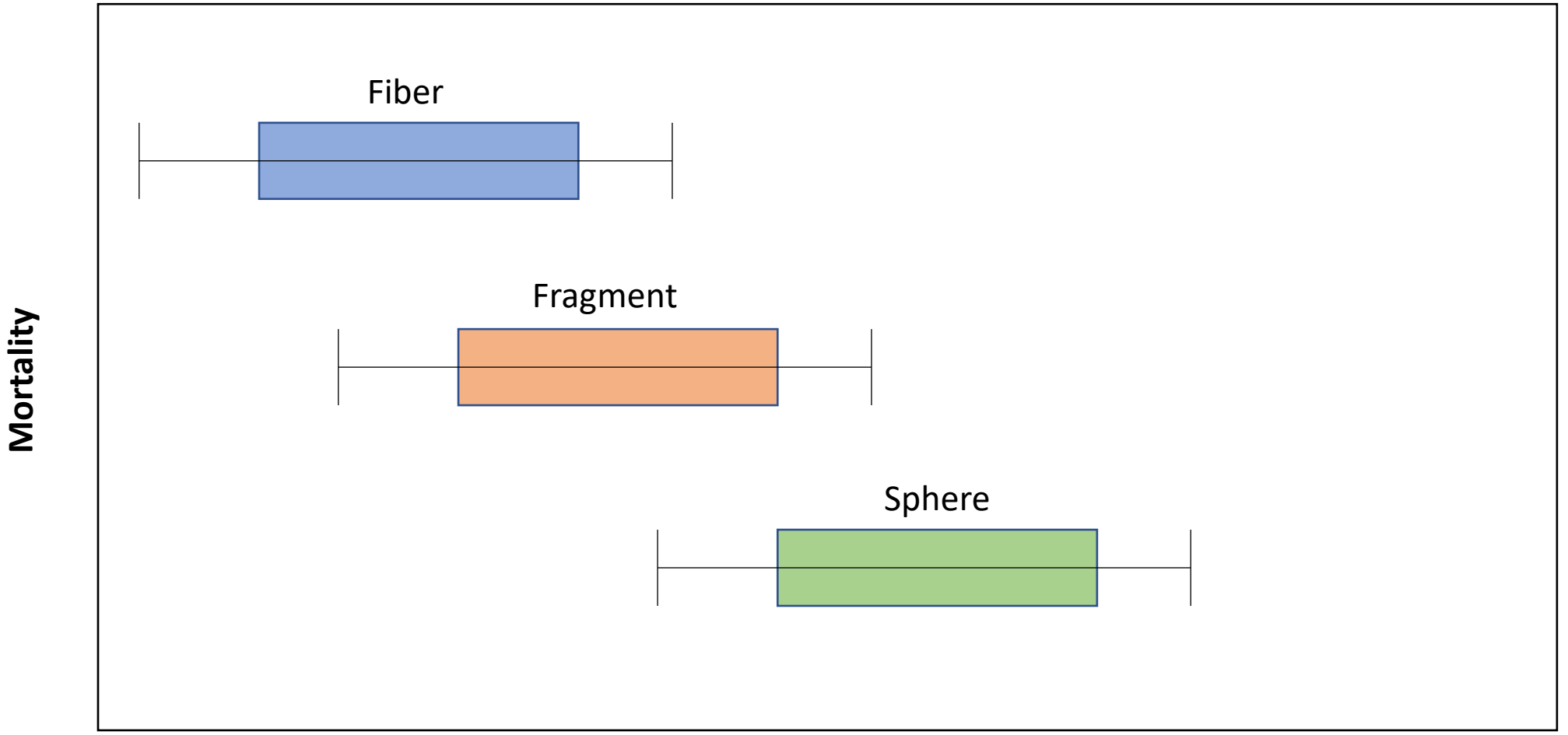
Food Dilution	→	**Volume**
Inflammation (after translocation)	→	**Size & Count**
Loss of pigmentation from additive chemicals	→	**Mass & Polymer Type**

Overarching Question

- Which microplastic characteristics are most relevant and/or meaningful for risk?
  - Counts vs. mass (vs volume vs surface area)
  - Size, type, shape of microplastics

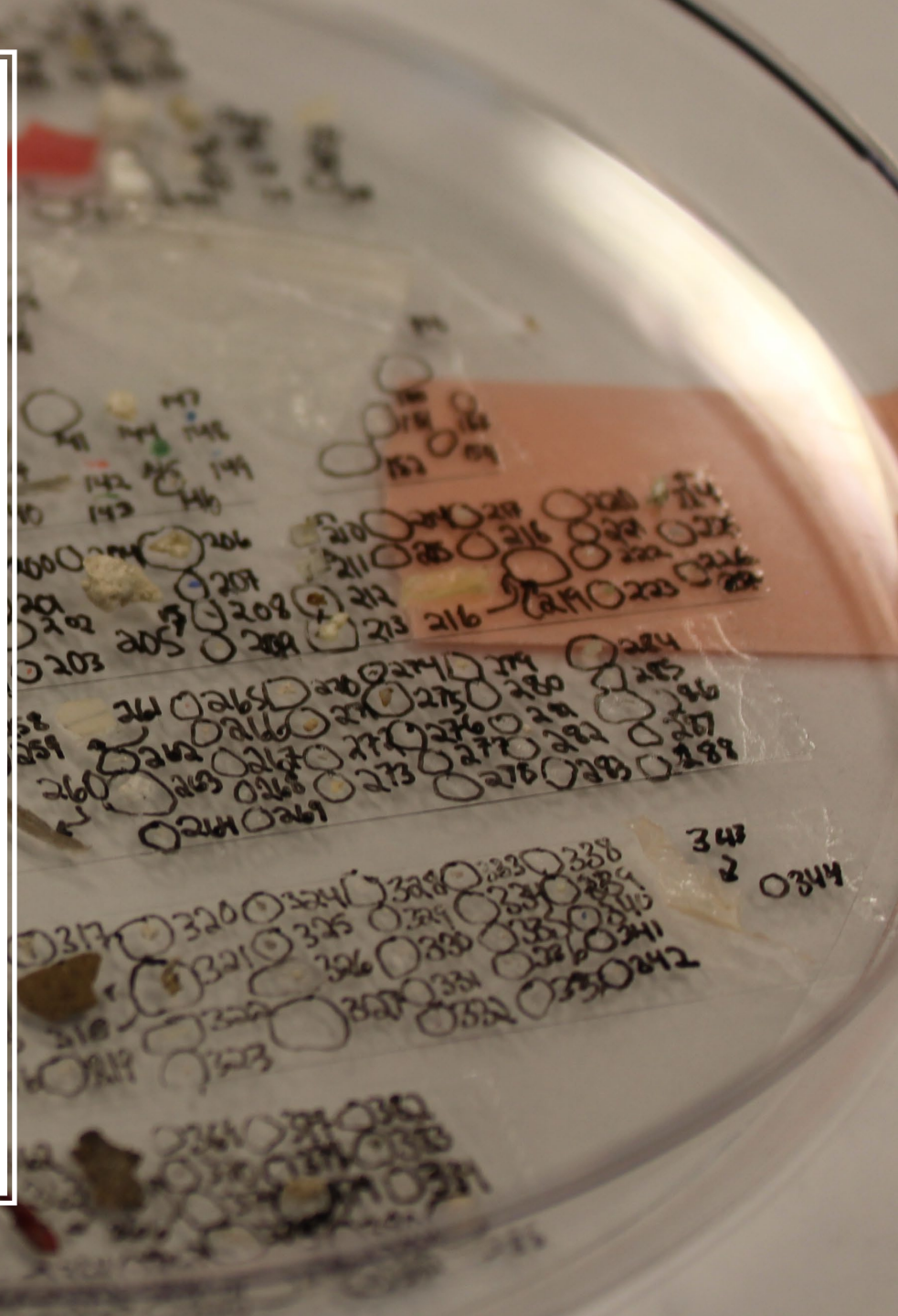



Mortality
Concentration of Microplastics
(MASS concentration OR PARTICLE COUNT concentration)


Fiber
Fragment
Sphere
Mortality
Concentration of Microplastics
(MASS concentration OR PARTICLE COUNT concentration)

Overarching Question

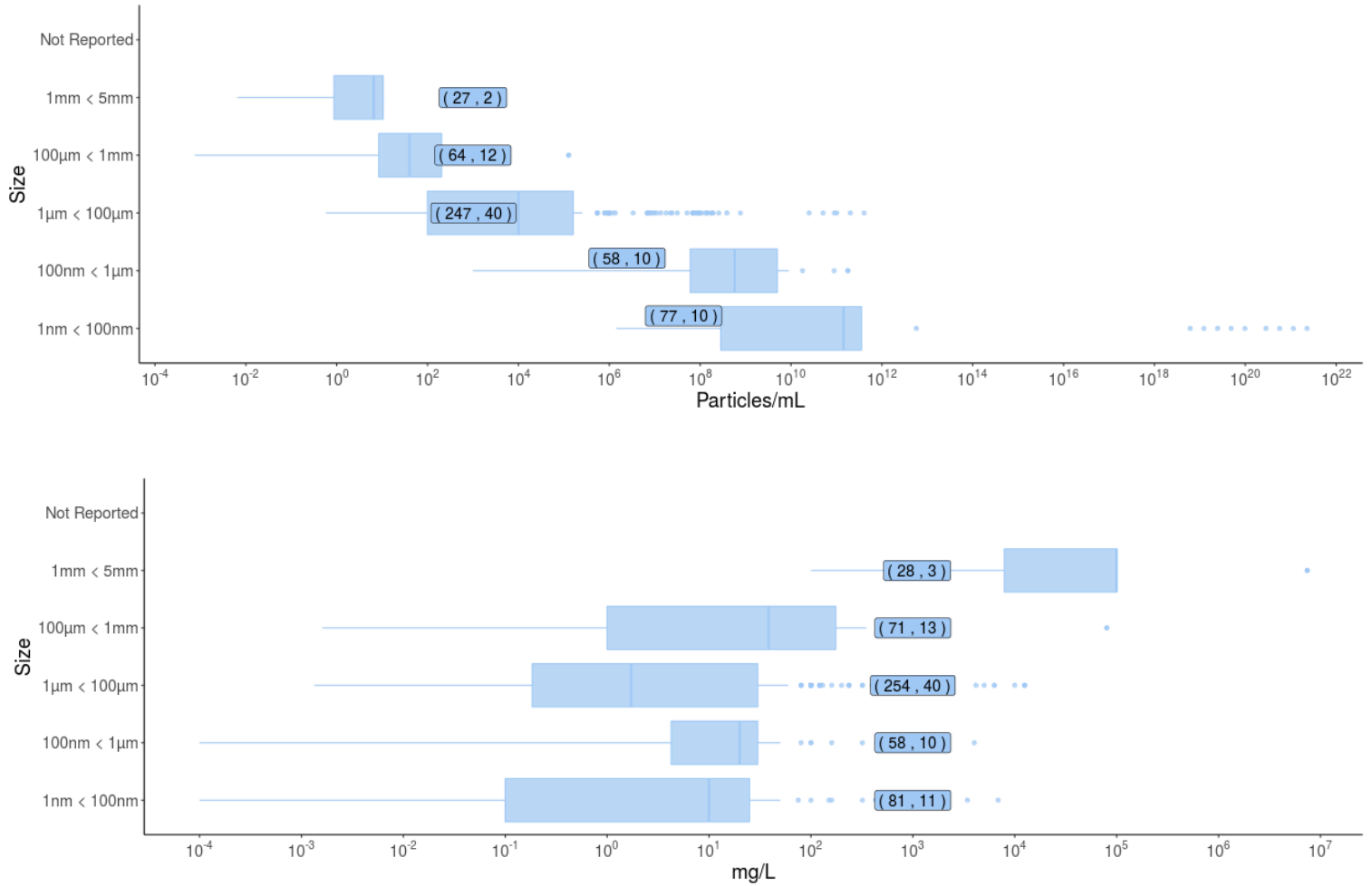
- Which microplastic characteristics are most relevant and/or meaningful for risk?
  - **Counts vs. mass**
  - Size, type, shape of microplastics



Count, shape, colour, size

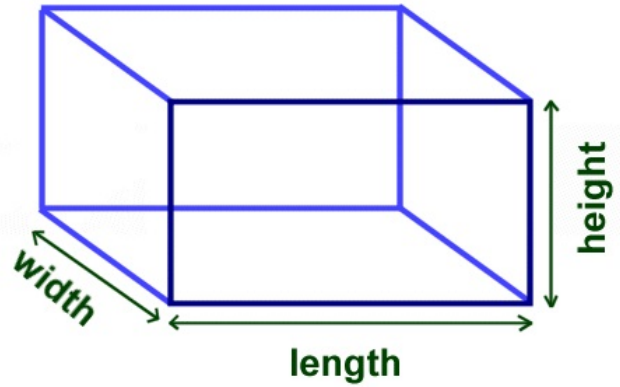
Mass, maybe size fraction

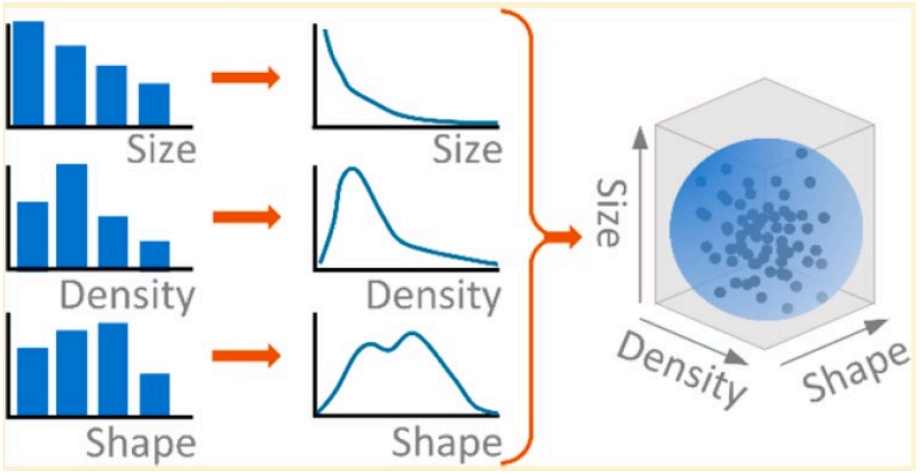
Patterns for mass and count concentrations don't always align



Food Dilution	→	**Volume**
Inflammation (after translocation)	→	**Size & Count**
Loss of pigmentation from additive chemicals	→	**Mass & Polymer Type**

Can we be flexible??





Kooi and Koelmans 2019 *ES&T*

Overarching Question

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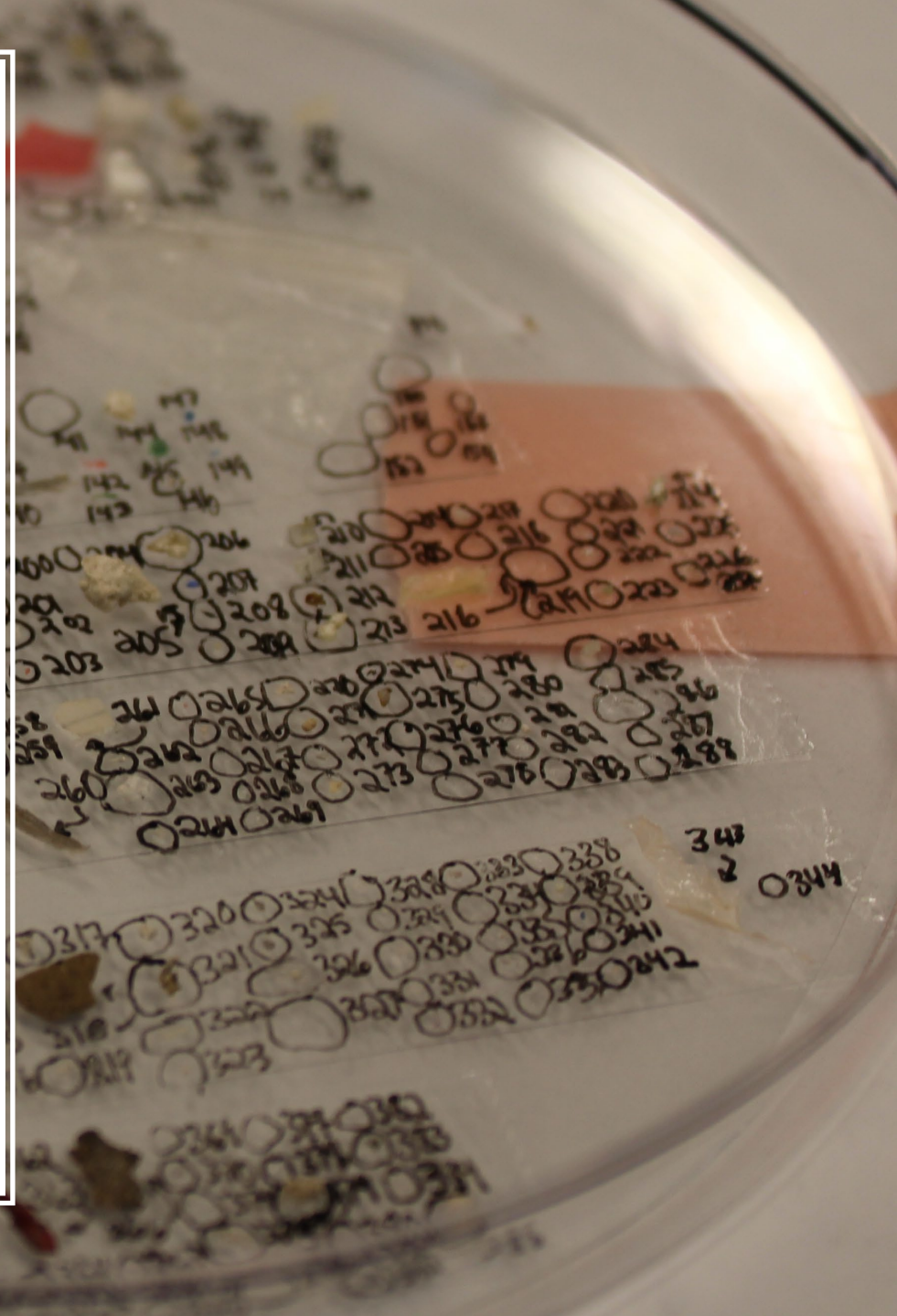
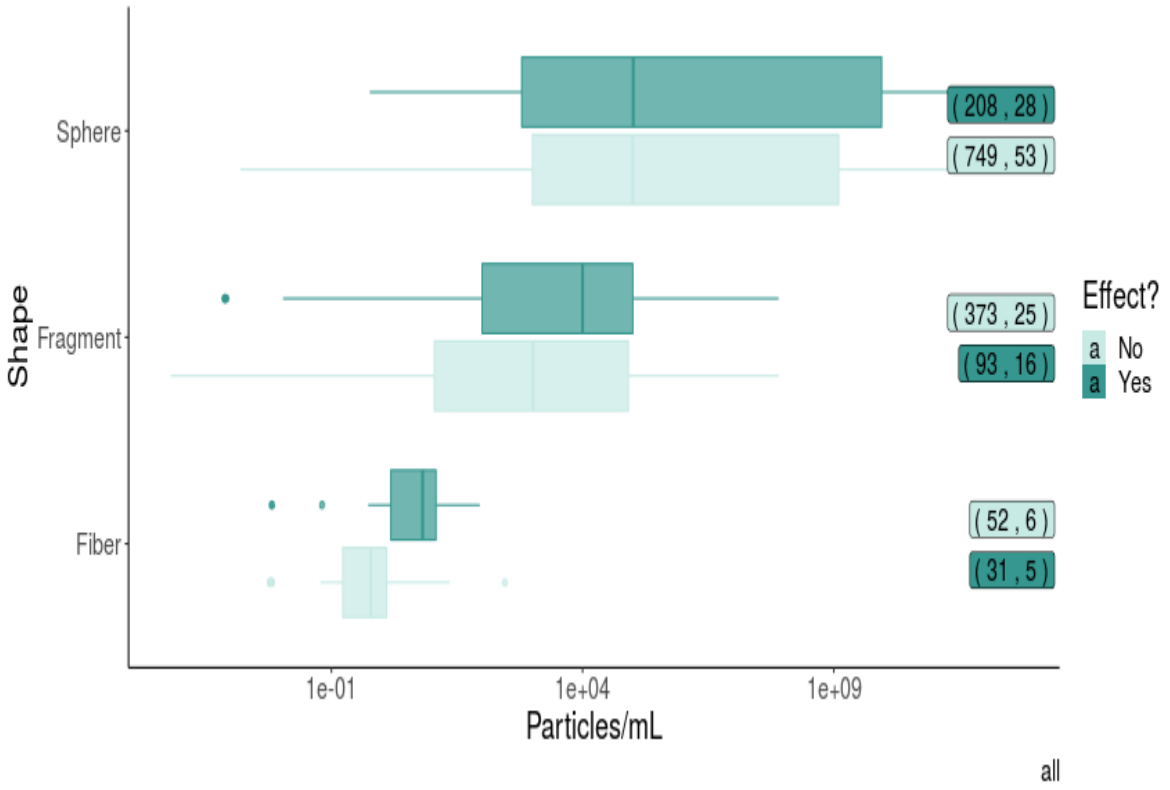
  - Counts vs. mass
  - **Size, type, shape of microplastics**

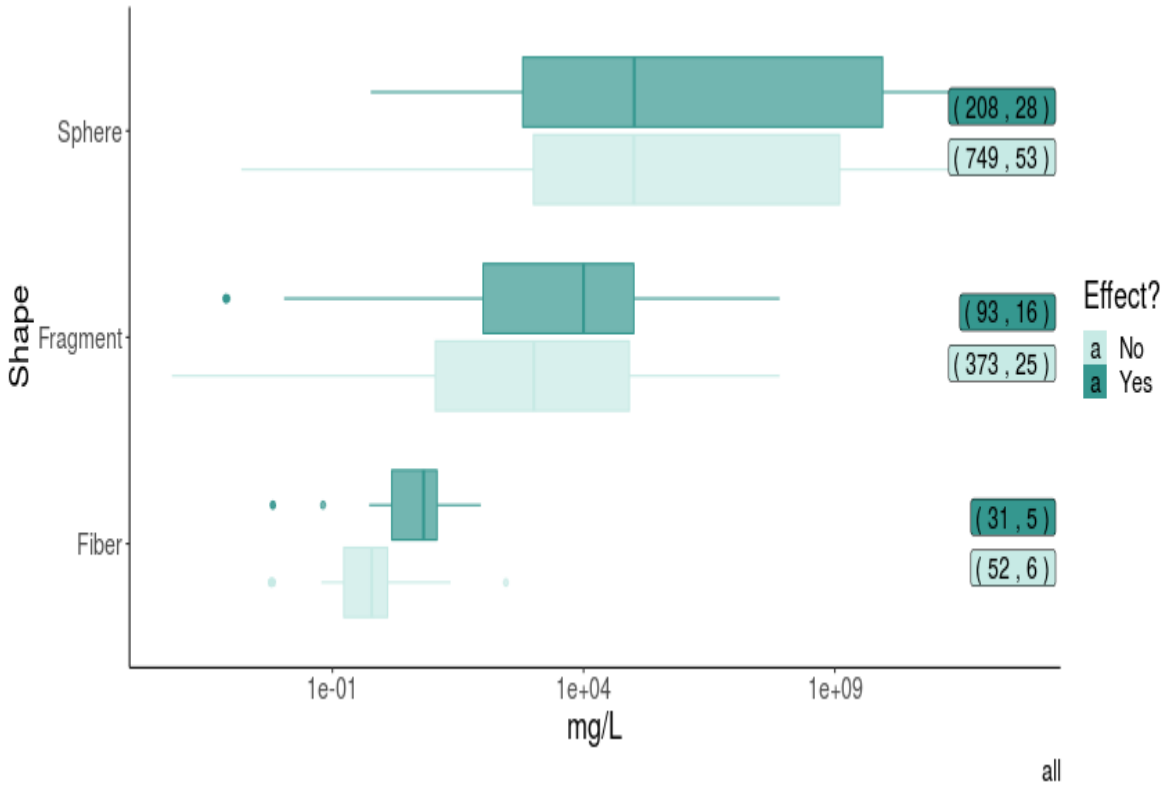


Worth noting:

- The dataset is biased towards PE and PS spheres (and fragments), generally purchased for science and thus less relevant to plastic products (i.e., less complex morphologies and chemistries).

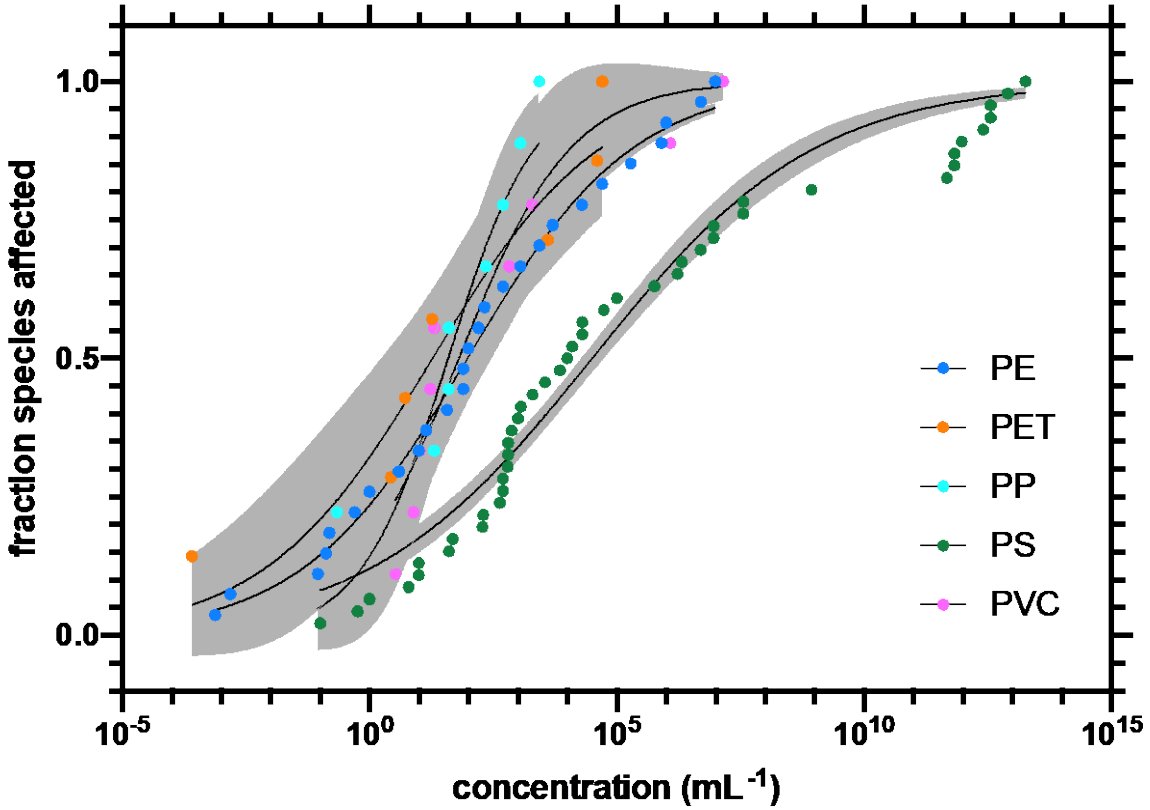
Shape might matter… too early to tell

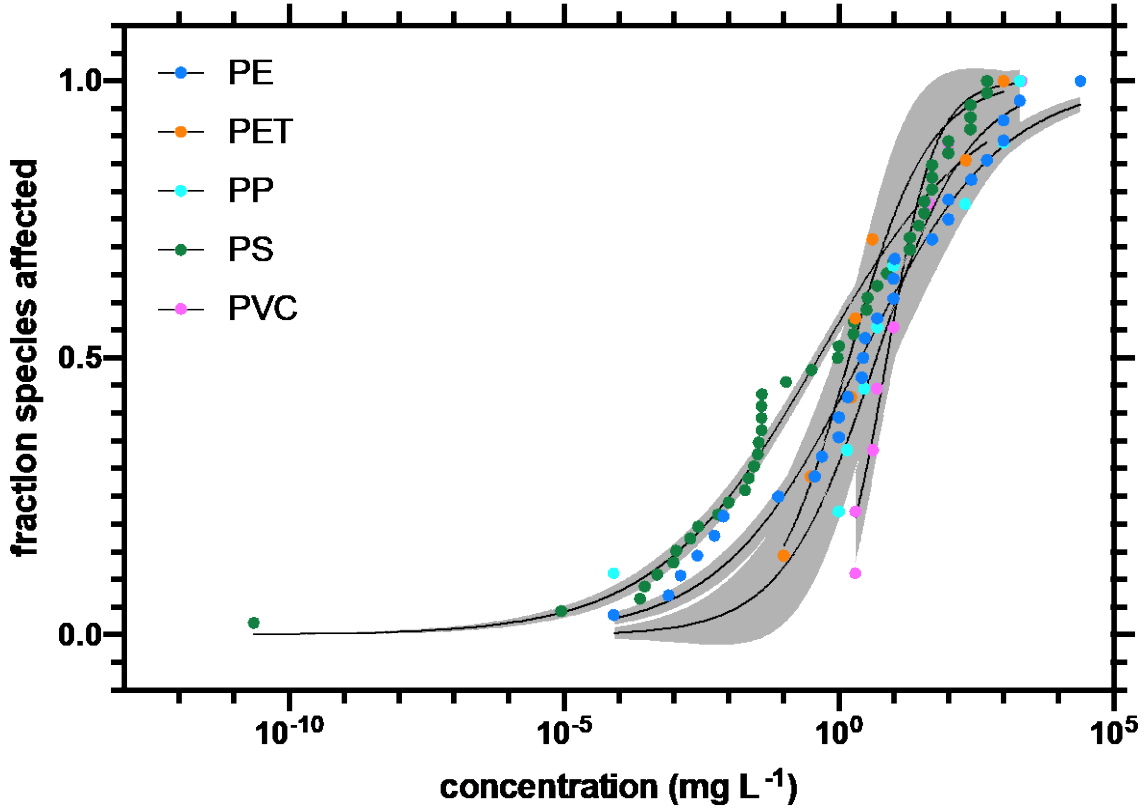




More complex shapes may be more hazardous?
There is plentiful SPHERE data but very little for FIBRES (research priority).

Polymer type MIGHT matter… too early to tell





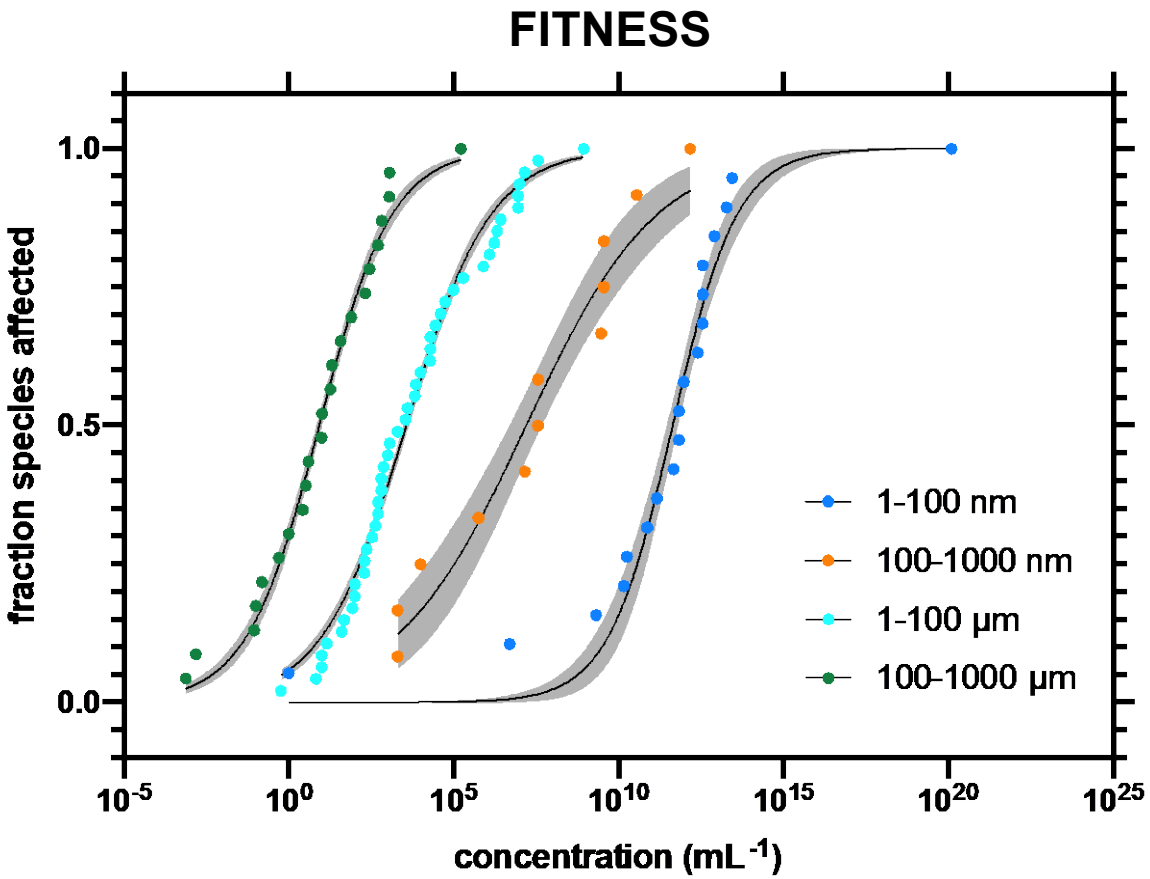
YES for numerical concentrations

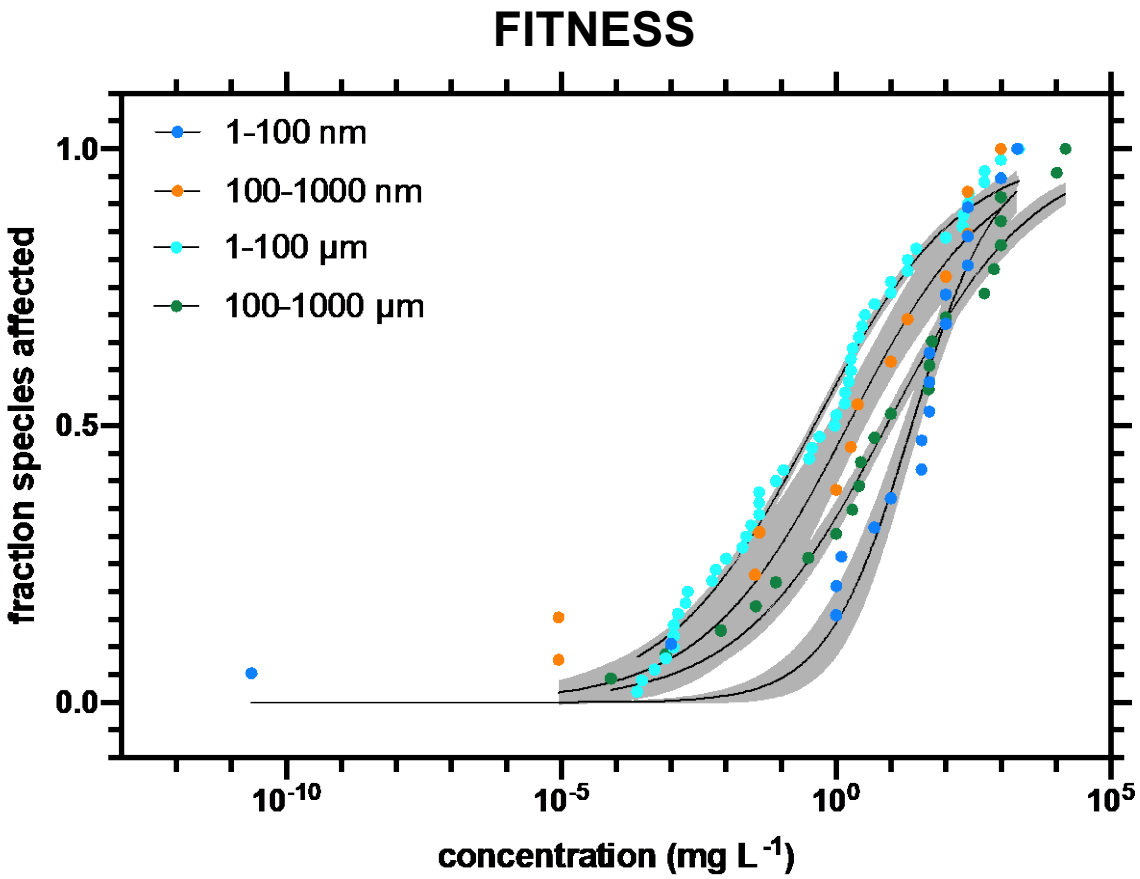
→ PS particles less toxic than the other polymer types

Ambiquous for mass-based concentrations

→ PE and PS similarly toxic, other polymers tested at high conc. only

SIZE MATTERS

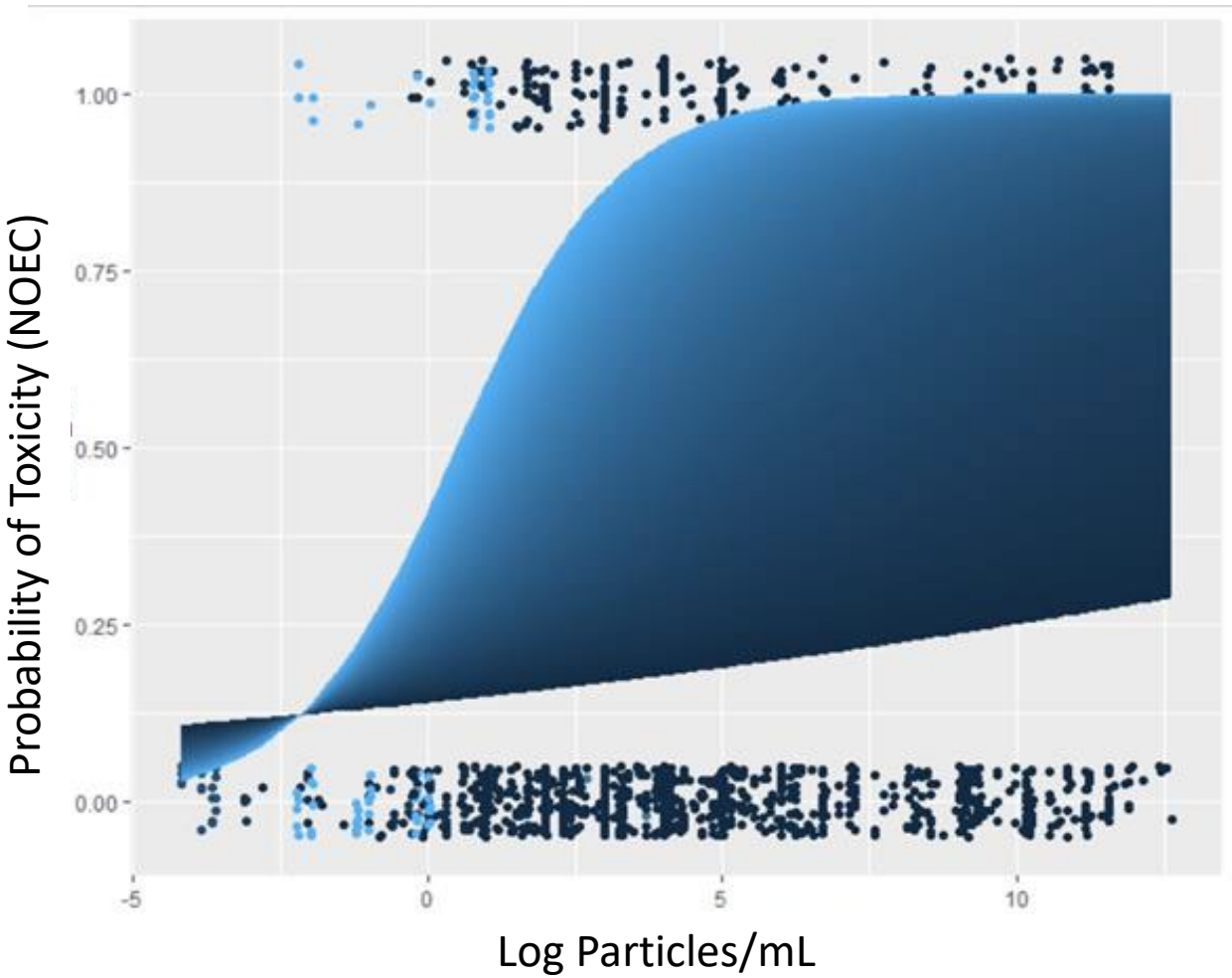


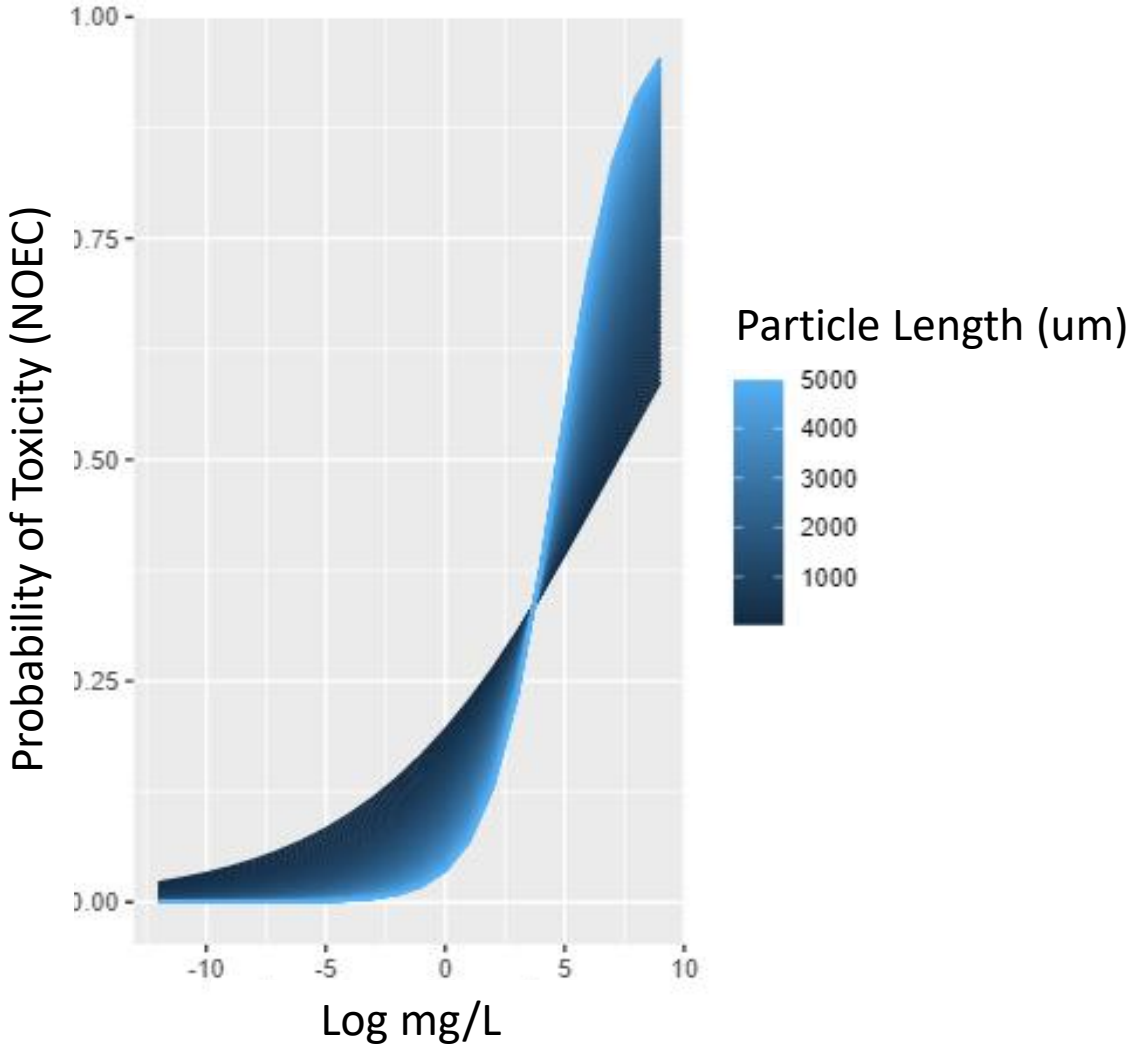


For numerical concentrations
→ 100 µm to 1 mm particles most toxic, 1-100 nm particles least
For mass-based concentrations
→ 1-100 µm particles most toxic, 1-100 nm particles least

Size Matters

At lower concentrations larger plastics are more hazardous;
at higher concentrations smaller particles are more hazardous

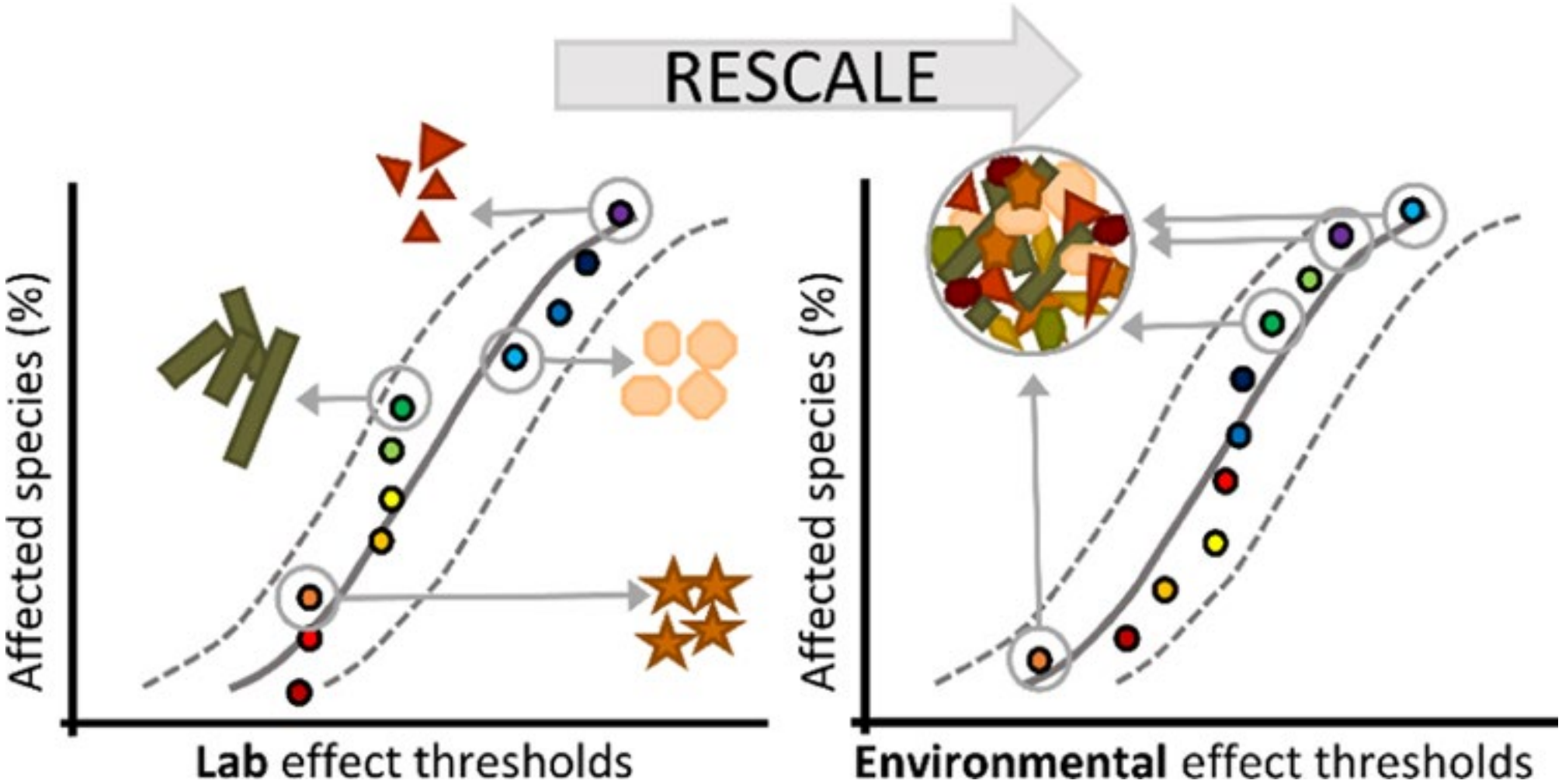




Crustacea, Fitness, Organism-level Effects Only

Future Research Needs:

Experiments designed to test whether polymer type and shape are drivers of toxicity.



Koelmans et al., 2020 *ES&T*

Thank you!