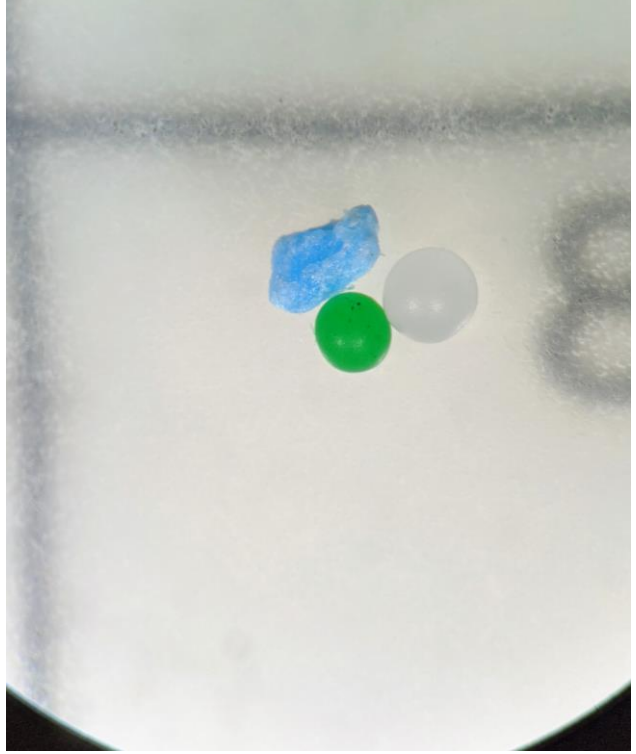
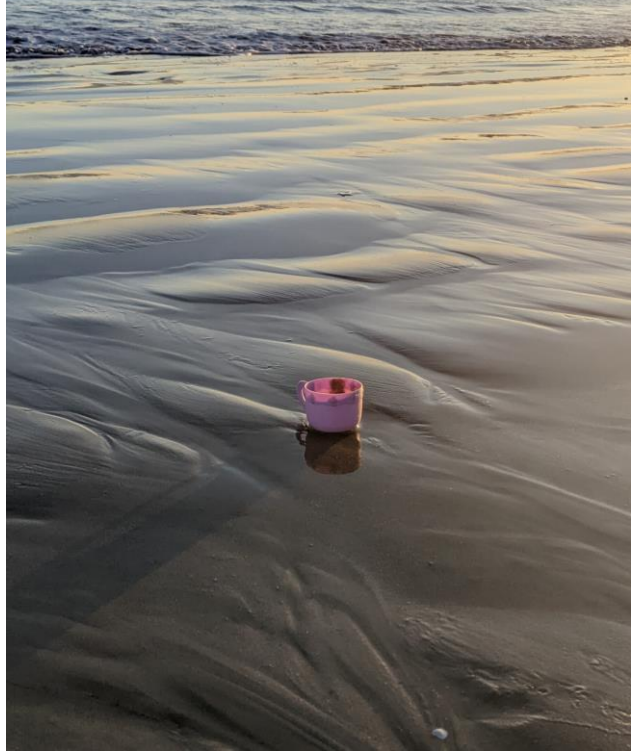





CURRENT RESEARCH INITIATIVES & STRATEGIES FOR MICROPLASTIC MANAGEMENT IN CALIFORNIA

Leah Thornton Hampton

Southern California Coastal Water Research Project Authority

2018 CALIFORNIA STATE SENATE

Drinking Water

Senate Bill 1422

Ecological Risk

Senate Bill 1263

Health Effects Workshop

- Concentration Metrics
- Particle Characteristics
- Adverse Effects
- Threshold Framework

CONCENTRATION METRICS

- The most meaningful concentration metric (e.g., mass, count) depends on the **effect mechanism**

- Understanding of microplastic toxicity is **incomplete**, so we should be flexible

PARTICLE CHARACTERISTICS

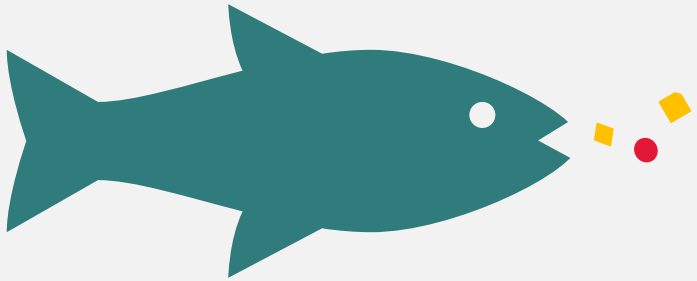
- Some evidence that particle **shape** & **polymer** *might* matter
- **Strong evidence that size matters**

Large particles more toxic at lower concentrations

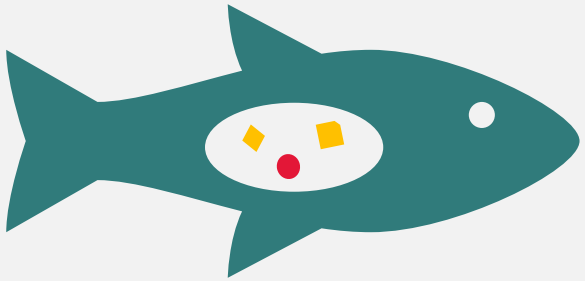
Small particles more toxic at higher concentrations

SIZE DEPENDENT TOXICITY

Food Dilution

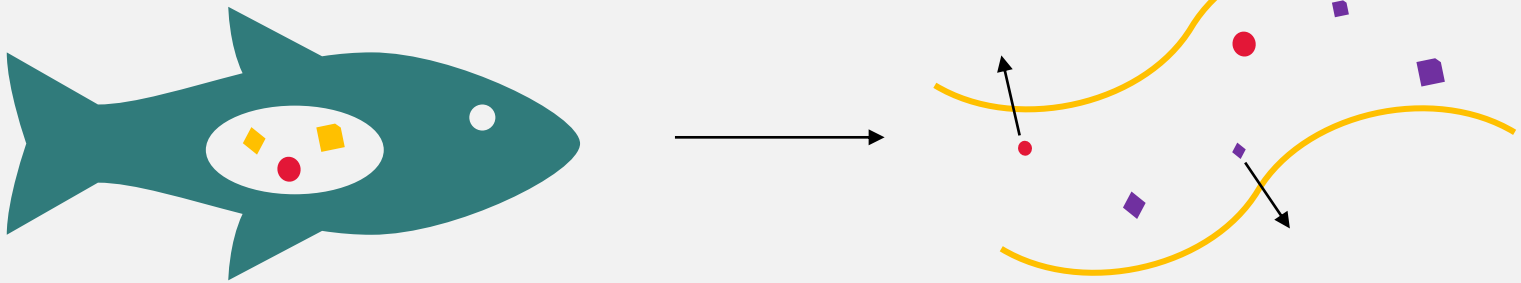


Ingestibility



Volume in Gut

Translocation



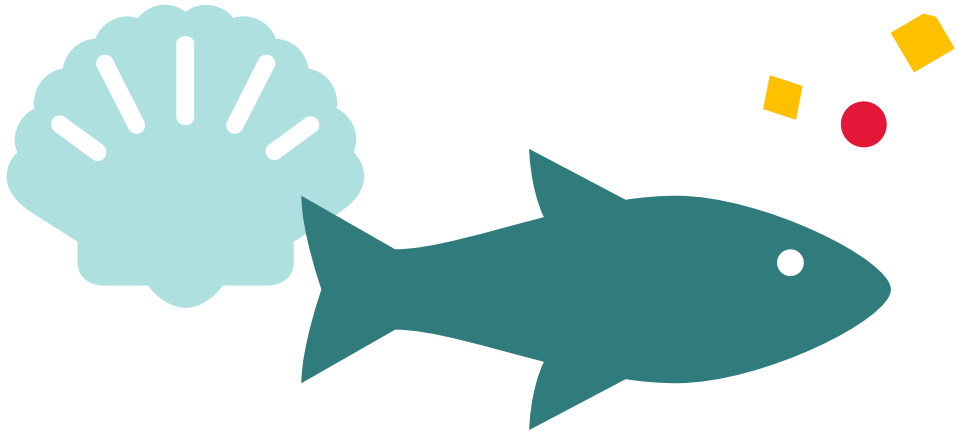
Smaller Particles More Likely to Translocate

THRESHOLD DEVELOPMENT APPROACH

1. Select appropriate decision **framework** for microplastics assessment in ambient waters

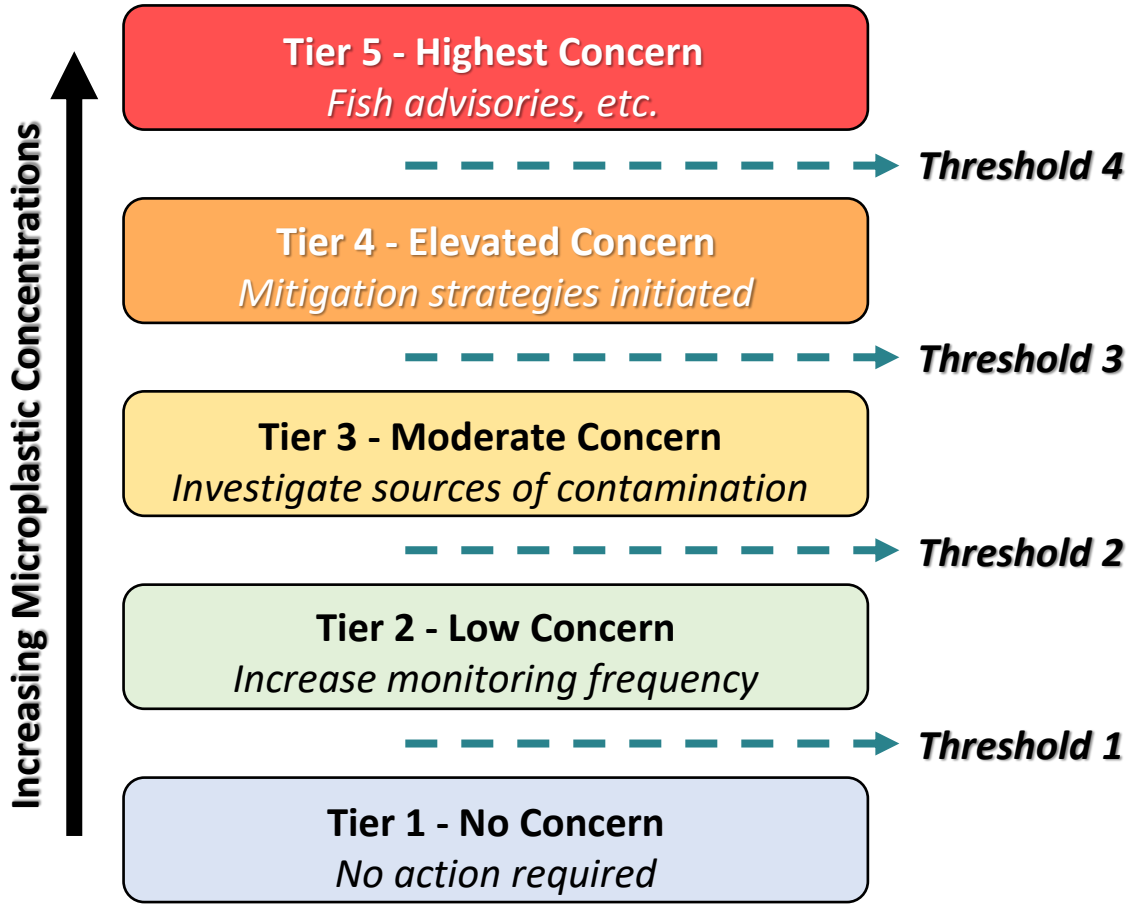
2. Develop and apply process to **calculate** thresholds

3. Conduct **expert evaluation** of the confidence level in the framework, analytical process, and thresholds



TIERED MANAGEMENT FRAMEWORK

- Experts agreed on the development of multiple thresholds
- Decision framework adapted from model used by the state of California to monitor emerging contaminants

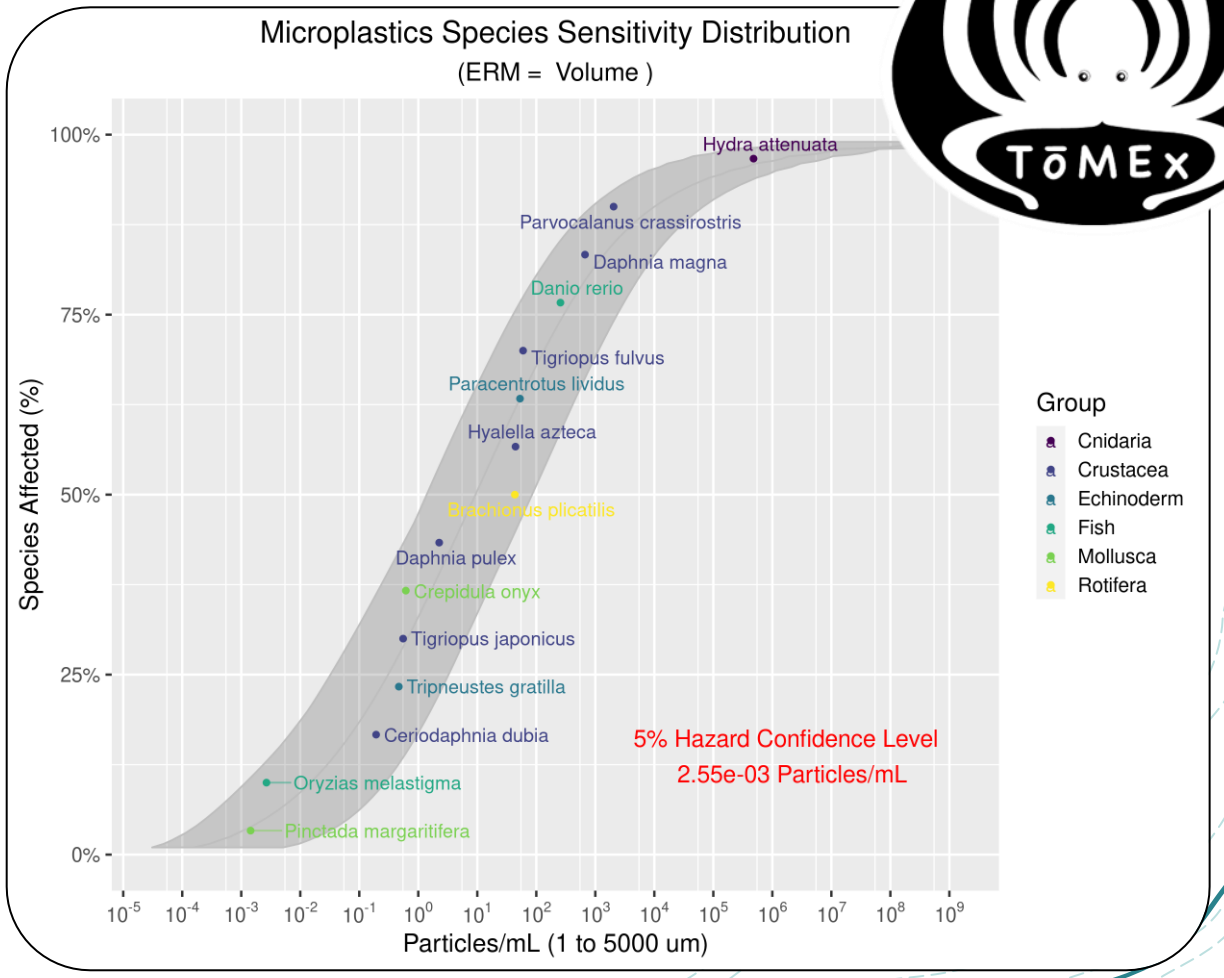


Mehinto et al., 2022, *Microplastics and Nanoplastics*

DERIVING THRESHOLDS

- Species Sensitivity Distribution approach

- Data screened:
  - Minimum reporting requirements
  - At least 3 doses + control
  - Relationship with higher level of biological organization



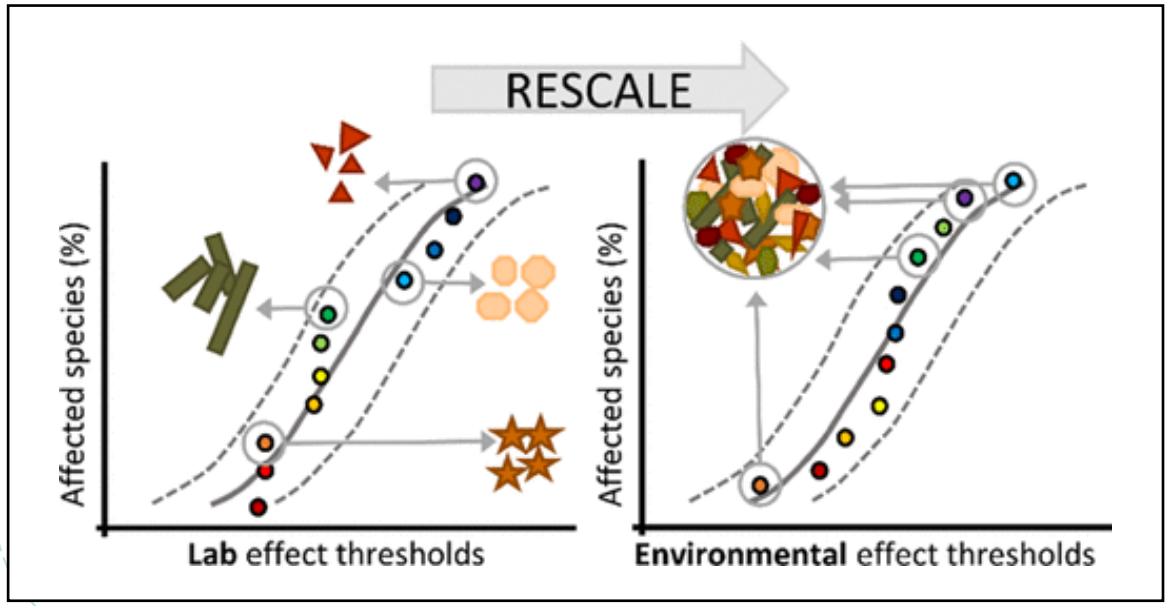
Mehinto et al., 2022, *Microplastics and Nanoplastics*

DERIVING THRESHOLDS

Threshold	Hazard concentration (HC)	Data collapsing	HC metric	Biological endpoints
1- Investigative monitoring	HC5	1st Quartile	Lower 95%	Molecular to Population
2- Discharge monitoring	HC5	1st Quartile	Mean	Molecular to Population
3- Management planning	HC5	Median	Mean	Organism and Population
4- Source control measures	HC10	Median	Mean	Organism and Population

Mehinto et al., 2022, *Microplastics and Nanoplastics*

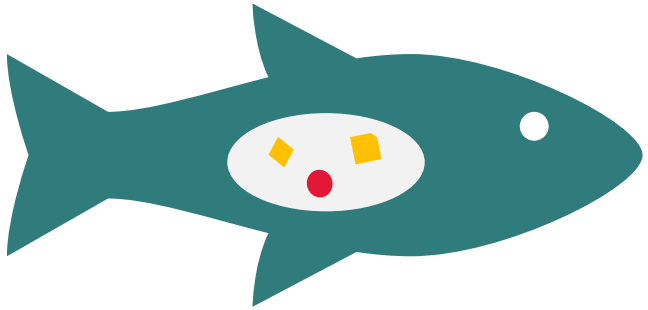
DERIVING THRESHOLDS



Koelmans et al., 2020, *Environmental Science and Technology*

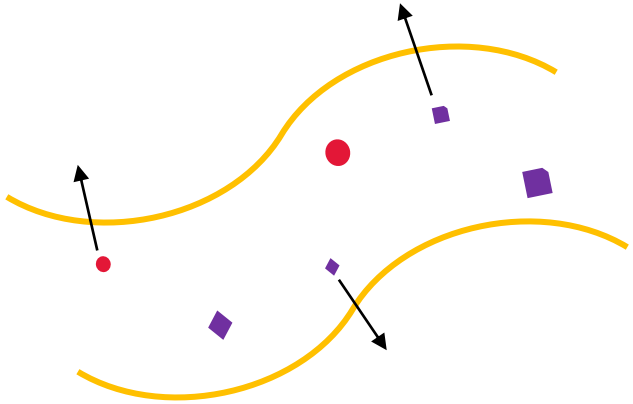
- Difficult to compare lab-based effect concentrations across studies
- Lab-based studies do not reflect complexity of environmental microplastics
- Applied modelling approach developed by Koelmans Lab

DERIVING THRESHOLDS



Food Dilution

Volume



Translocation

Surface Area

AQUATIC ORGANISM THRESHOLDS

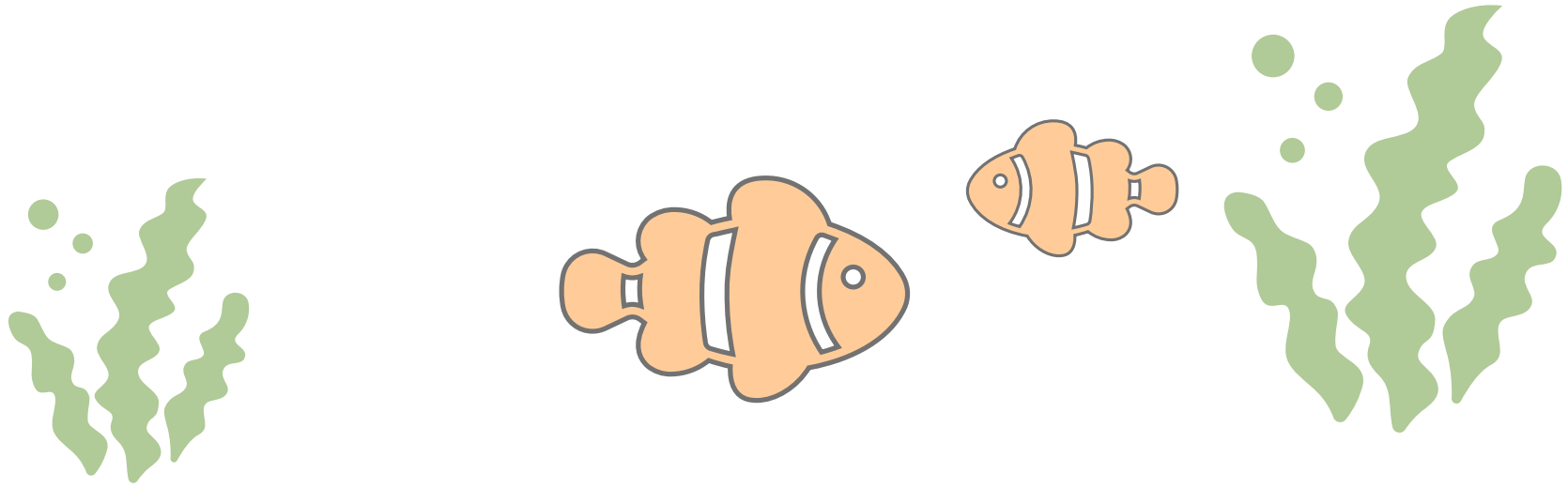
Threshold	Food Dilution		Translocation	
	mg/L	Particles/L	mg/L	Particles/L
1- Investigative monitoring	**0.05**	**0.3**	**10**	**60**
2- Discharge monitoring	**0.4** (0.05-11)	**3** (0.3-66)	**51** (10-770)	**312** (57-4680)
3- Management planning	**0.9** (0.07-36)	**5** (0.4-219)	**146** (19-3120)	**890** (118-19000)
4- Source control measures	**6** (0.4-141)	**34** (3-859)	**676** (81-11400)	**4110** (493-69100)

Threshold 1 is the lower 95% CI of the HC5 for Threshold 2. Therefore, CI cannot be reported for this threshold.

Mehinto et al., 2022, *Microplastics and Nanoplastics*

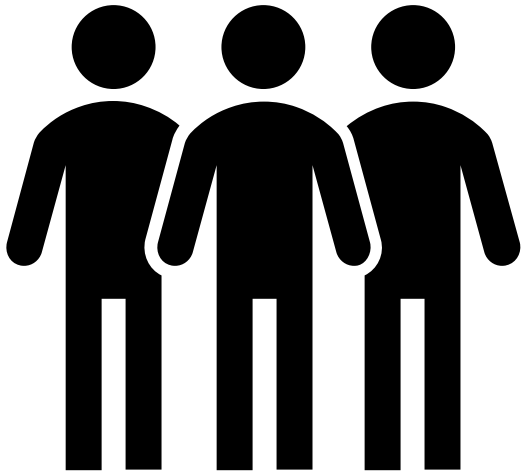
CONFIDENCE

- **High** confidence in the **framework** and **analytical methods**
- **Low to medium** confidence in the **thresholds**
- **Underlying data is limited and imperfect**



HUMAN HEALTH EFFECTS

- Mammalian toxicity data is **severely limited**
  - Only 12 in vivo toxicity studies deemed fit for threshold development
  - Most use only polystyrene spheres
- Particle **size** likely to play a key role in toxicity
- Consistent trend in effects related to **inflammation** and **oxidative stress**
- Conservative **screening level** derived to inform monitoring but not possible to derive human health-based threshold



RESEARCH RECOMMENDATIONS

- Particle characterization
- Polydisperse particle toxicity
- Dose-response data
- Adverse outcome pathways
- In vitro → In vivo
- Exposure characterization

IMMEDIATE OUTCOMES

The New York Times

CALIFORNIA TODAY

In a First, California Plans to Clean Up Microplastics

The state has adopted a strategy to monitor and reduce the ubiquitous form of pollution.

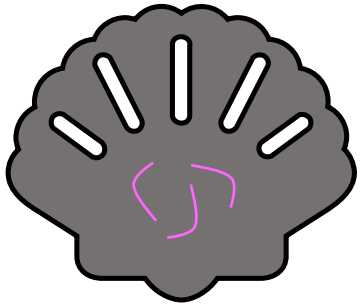
By Livia Albeck-Ripka

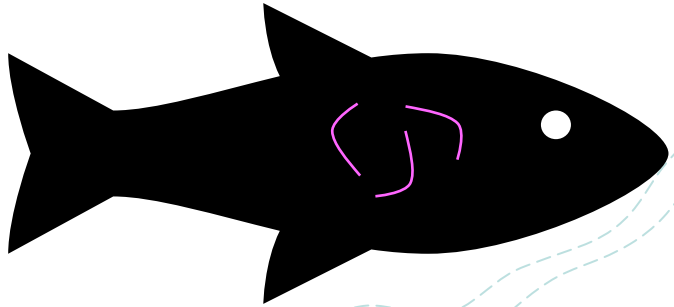
March 7, 2022

- **California Statewide Microplastics Strategy** adopted early last year
- Generating **applicable toxicity data for threshold development** is a major strategy component

NEXT STEPS: PRIMARY RESEARCH

- Primary research to **improve thresholds** and identify potential **bioindicators for microplastic impacts**
- Example: Impact of microplastic ingestion on fish and bivalves
- Applies lessons learned:
  - ✓Microplastic fibers
  - ✓California resident species
  - ✓Understand relative species sensitivity





NEXT STEPS: TOMEX 2.0

- **Toxicity of Microplastics Explorer** database and web application
- Update to improve thresholds
- **ToMEx 2.0**
  - Virtual collaborative workgroup
  - 67 contributors from 14 countries
  - **Both aquatic organisms and human health database have roughly doubled in size**
  - Public release fall 2023

Scan to access ToMEx 1.0!

NEXT STEPS: REGIONAL MONITORING

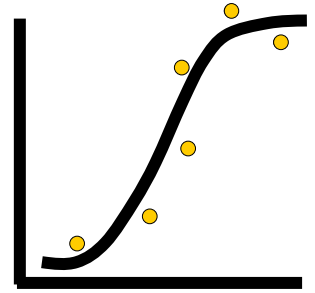
- Integrated, coordinated monitoring answering basic questions about environmental status and trends not captured any other way

- Microplastics to be assessed for the first time
  - Sediment and shellfish

- **First large-scale occurrence data set for microplastics** in Southern California for sediments and shellfish in near shore habits

MONITORING TOOLBOX

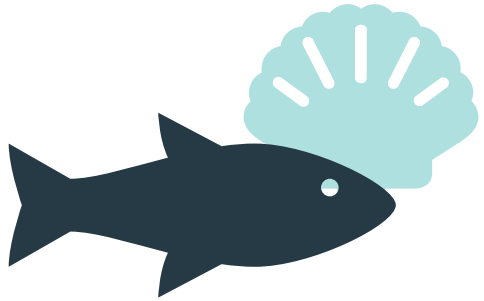
Collection



Thresholds

Risk Characterization

Analysis



Bioindicators

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* Has subsequently retired or change affiliation

Academia/Other
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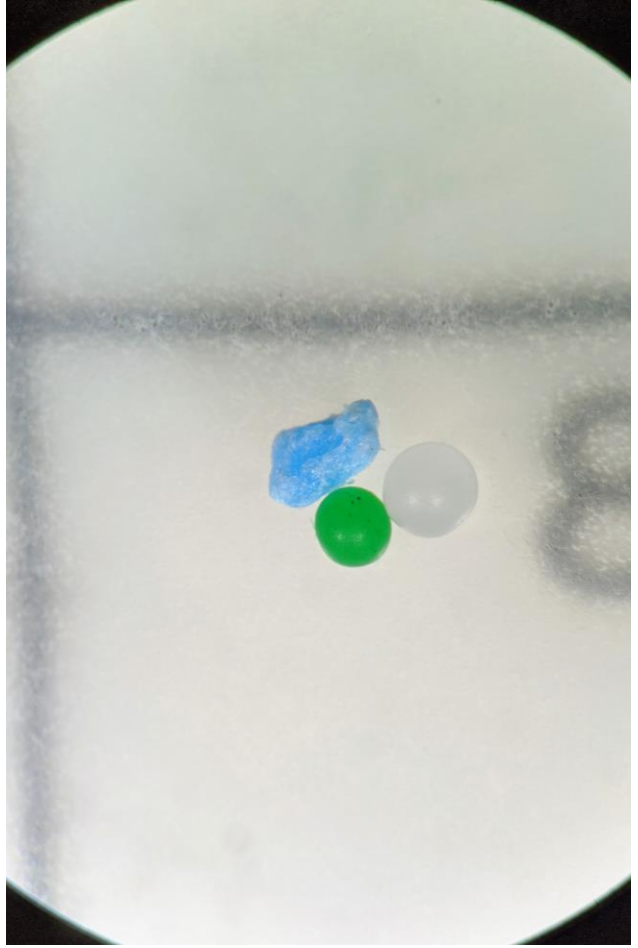
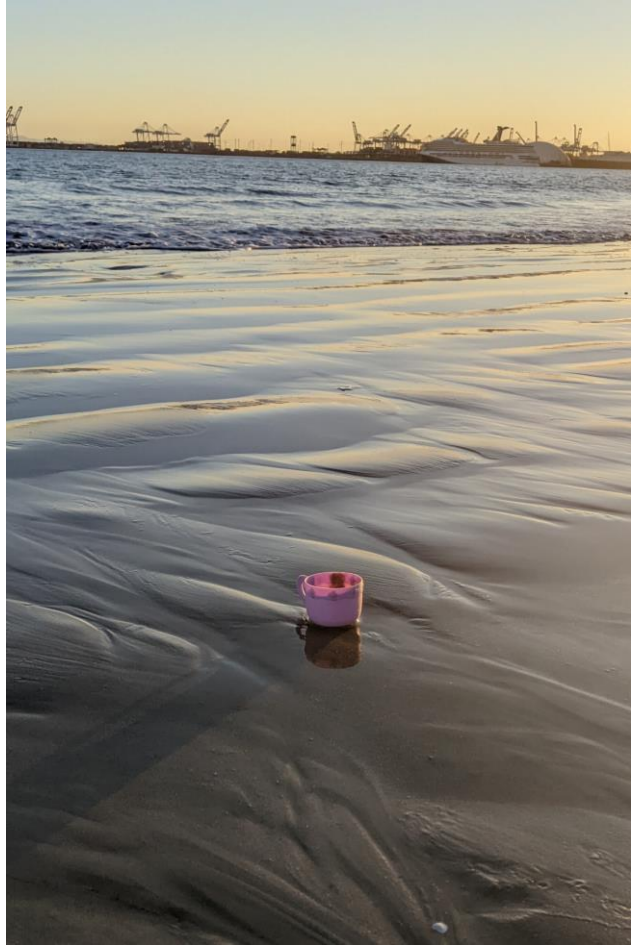
Chelsea Rochman – University of Toronto
Bart Koelmans - Wageningen University
Susanne Brander – Oregon State University
Todd Gouin - TG Environmental
Hans Bouwmeester - Wageningen University


THANK YOU!

Leah Thornton Hampton

Southern California Coastal Water Research Project