Potential for Health Effects of Microplastics:

San Francisco Bay Area Example

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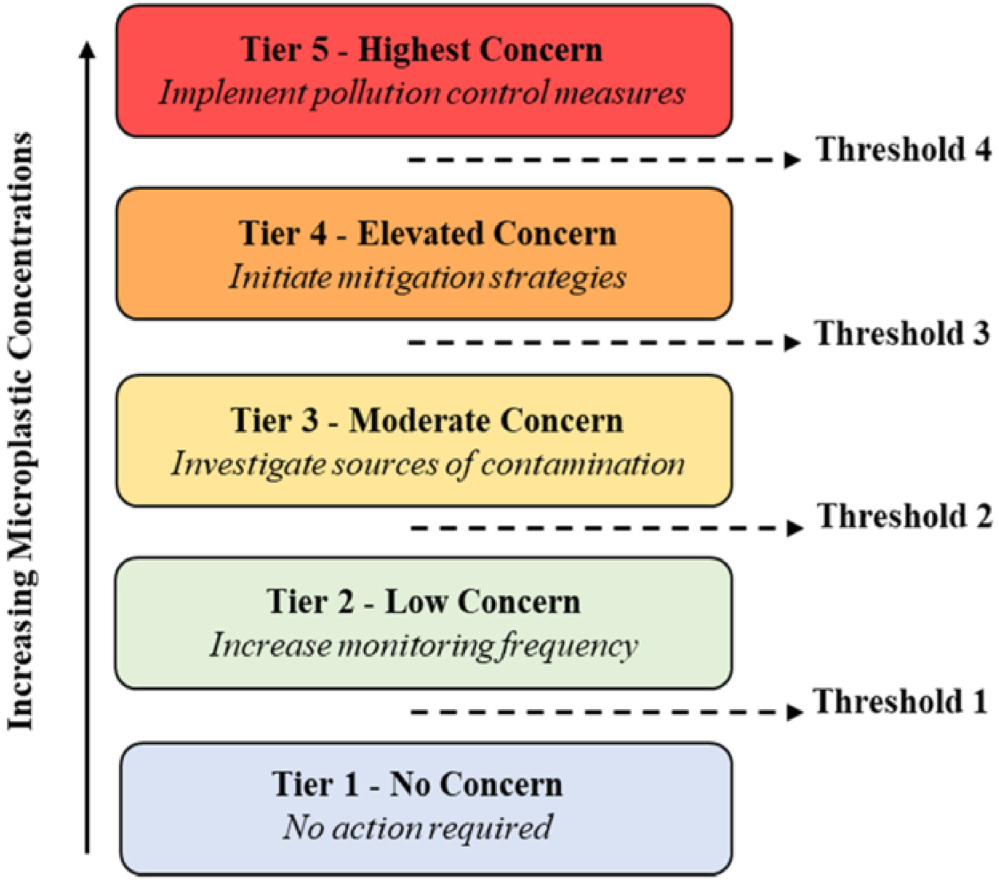
Outline

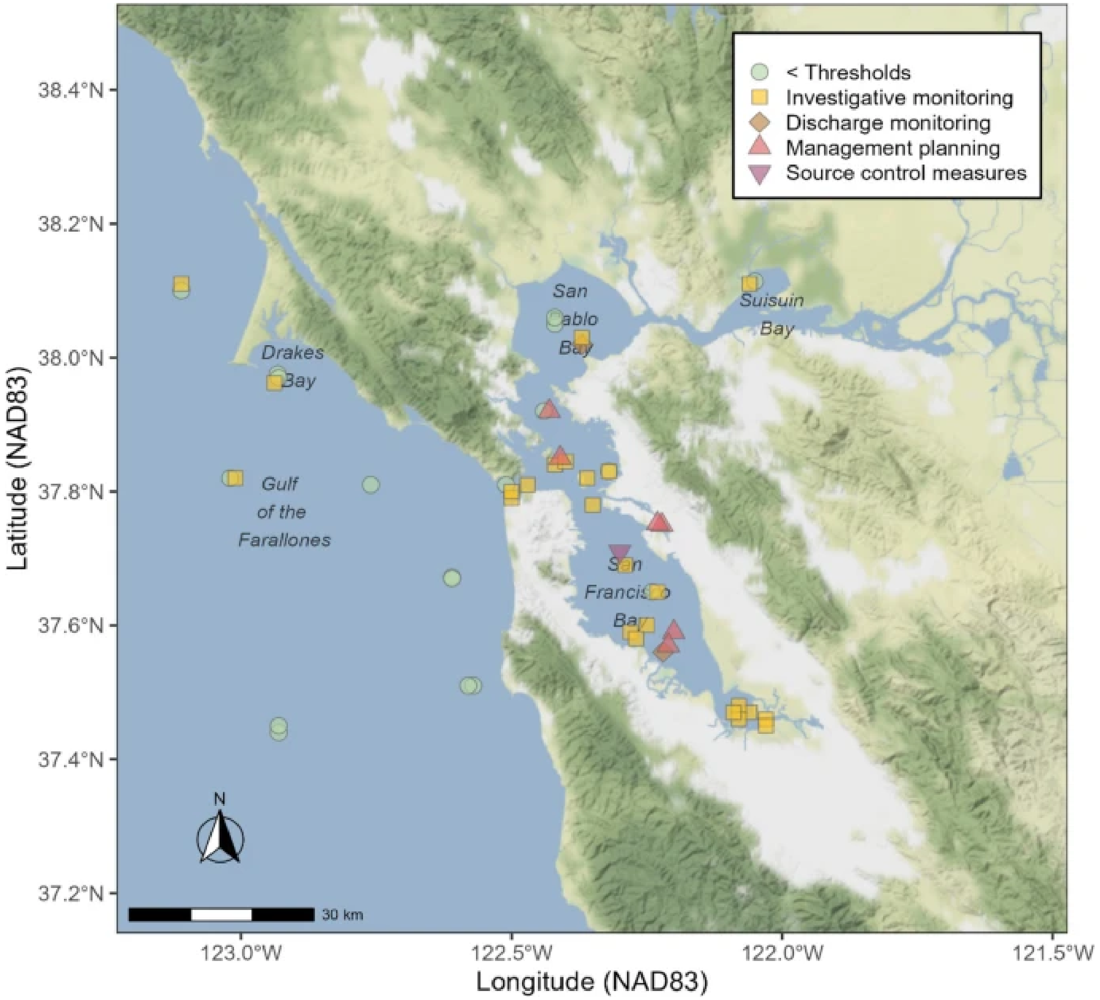
- **How can we manage Microplastics health risks?**
  - Risk screening and management
  - Mitigation and abatement
  - Product regulation

- **Do we know enough to characterize MP risks?**
  - Nature of MP
  - Assessing hazard and toxicity
  - Quantifying exposure levels

- **Where do we go from here?**

San Francisco Bay – Preliminary Risk Screening





Sources: Mehinto et al, 2022, Coffin et al, 2022

Nature of Microplastics (1 nm – 5mm)

Microplastics

Natural Microparticles

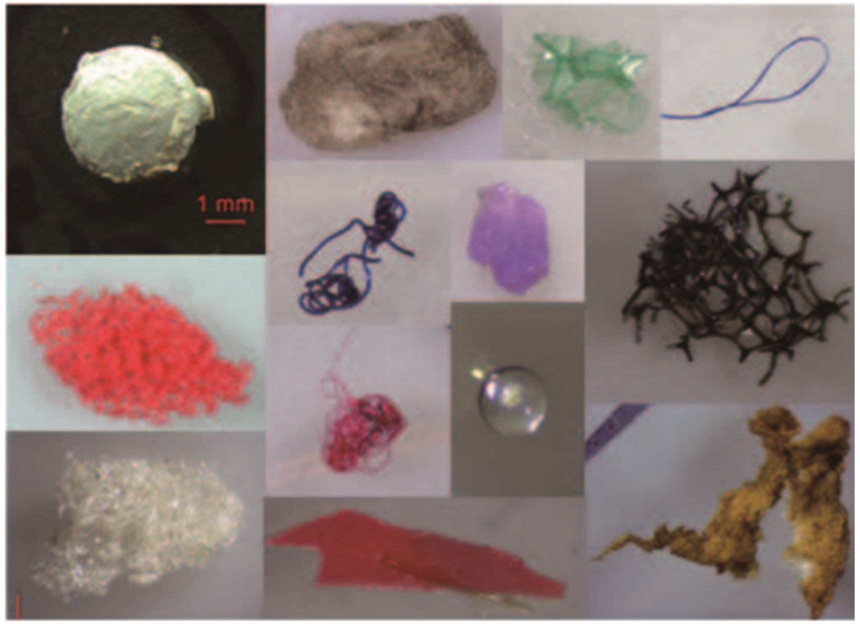
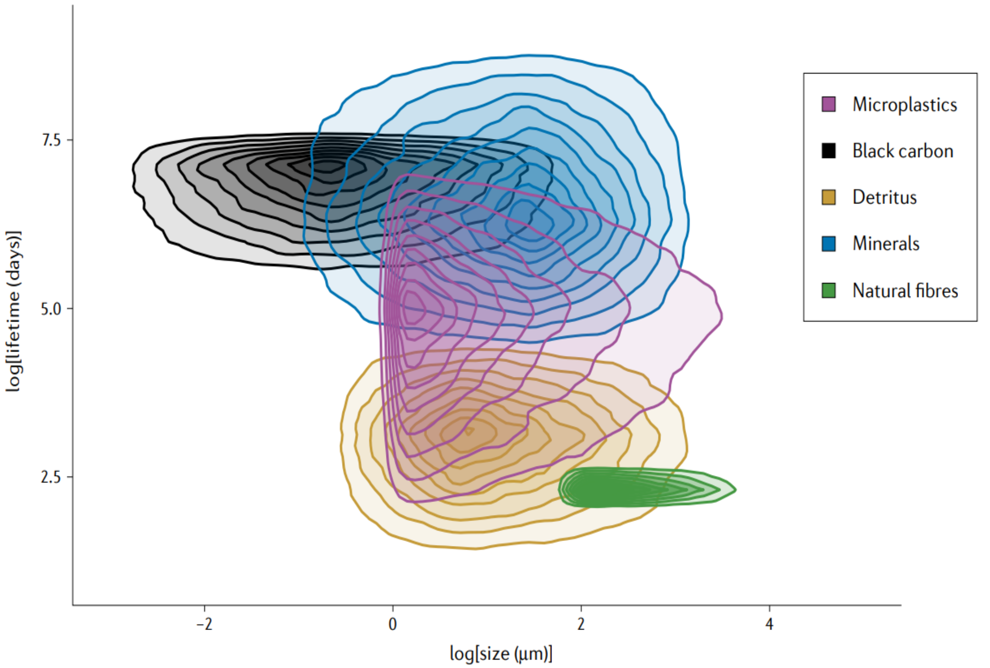


Figure 1-4. Various shapes, sizes, and colors of microplastic particles.
Source: Martindale, Weisberg, and Coffin (2020).

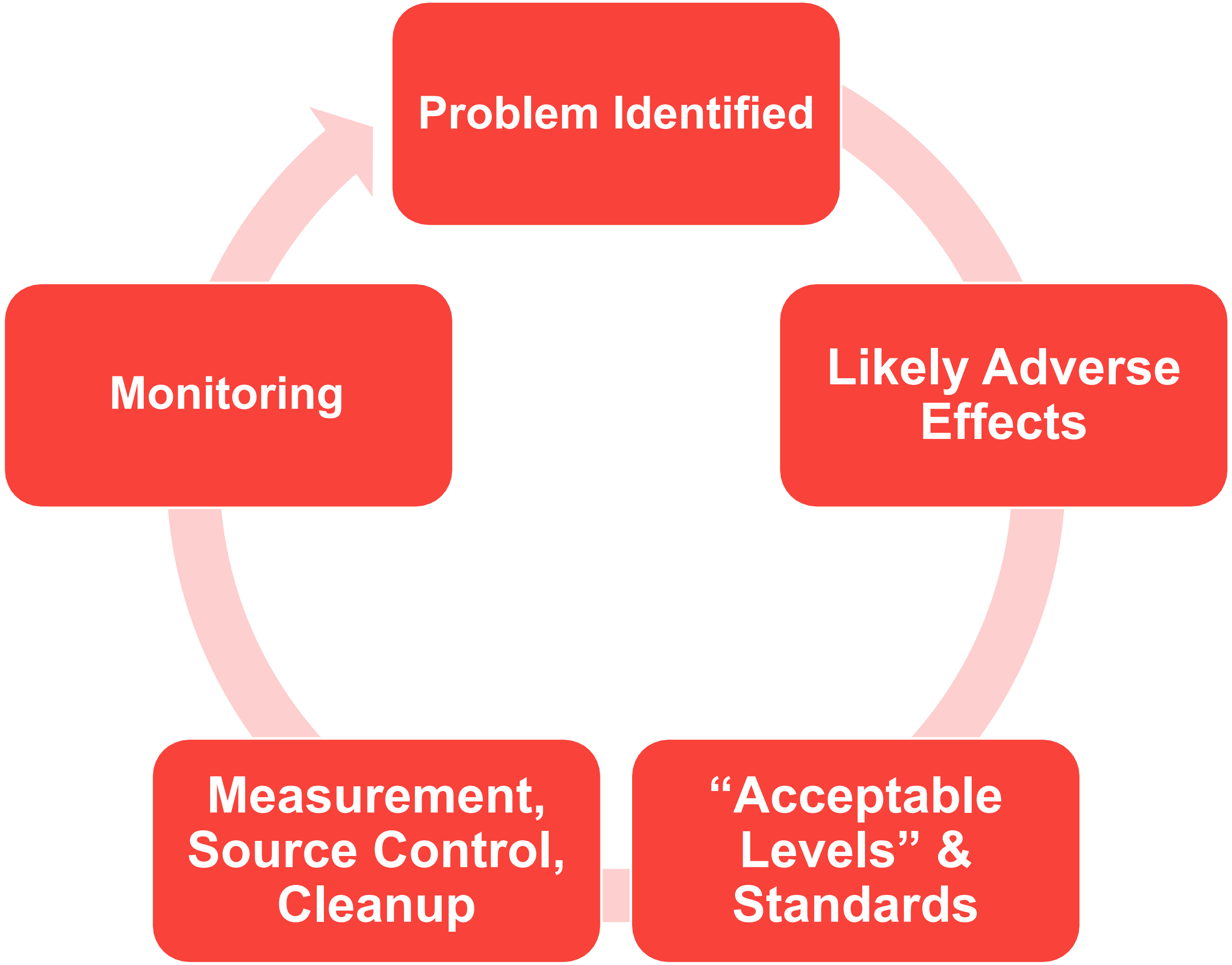


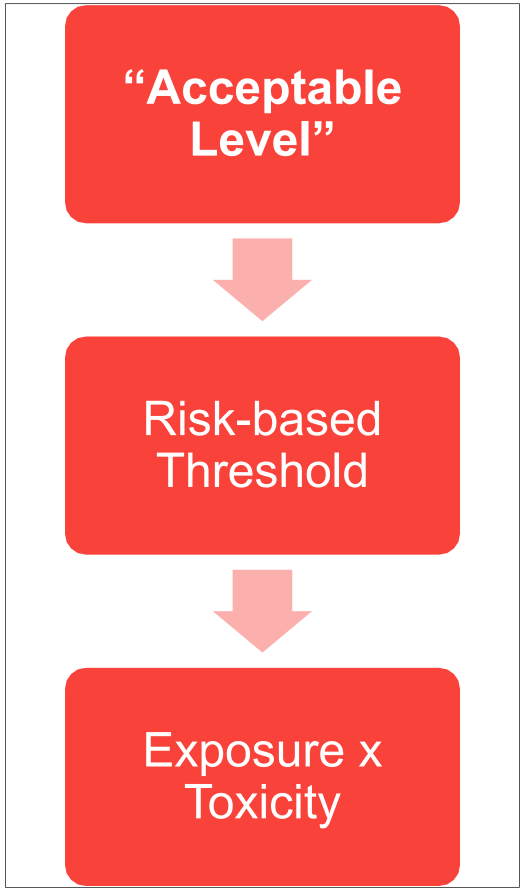
Source: ITRC 2022

Source: Koelmans et al, 2022

- Fragments Beads Pellets Foams Sheets Filaments Fibers Films
- PET, HDPE, PVC. LDPE, PP, PS/EPS, POS, PMMA, ABS, PA, P, PBT, PC, PEEK, PE, PLA, PSU,PTFE, PUR, SAN

Typical Regulatory Policy and Actions

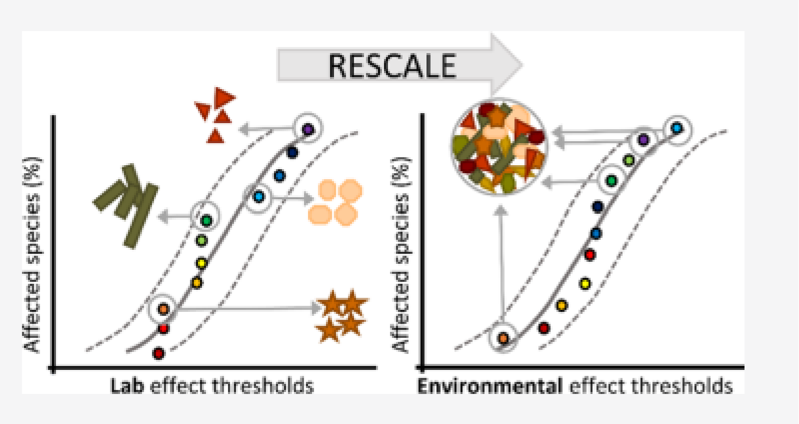




MP Exposure Assessment

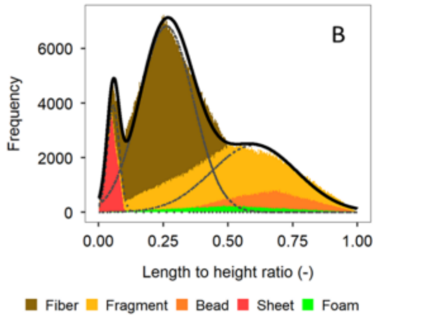
Variations in Data

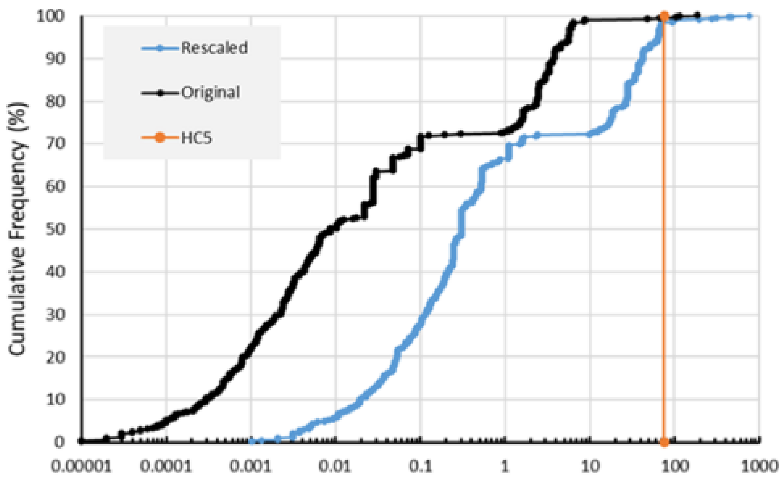
- Size, sampling methods, reporting
- Fibers, non-plastics, small particles <300 um



Exposure Metrics/ Environmental Concentrations

- Koelman et al (2020), Mehinto et al (2022)
- Unified representation of all particles in size range
- "Rescaling" to common size distribution
- Used probability density functions (pdfs)
- Developed Correction Factors
- Quantifying plastics as a proportion of total particles





MP Hazard Assessment - Multidimensional

- **Physical particles**
  - A few larger particles vs many smaller particles

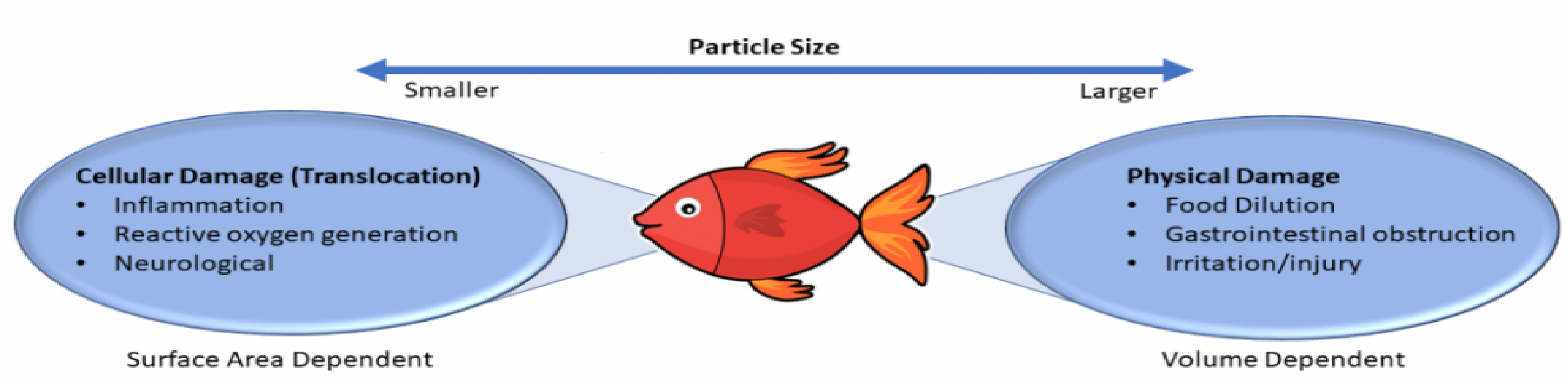


Figure 4-3. Conceptual diagram of aquatic organisms exposed to MP showing surface area and volume dependent toxicological endpoints in relation to MP particle size.
Source: Microplastics Team, created using concepts described in Mehinto et al. (2022)

- **Chemical adsorption/constituents**
  - Heavy metals, PAHs, PCBs, OCPs, **PFAS**
- **Biological vectors**
  - Pathogens
  - Disease potential

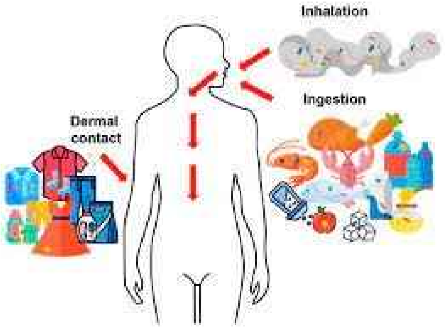
Align comparisons



MP Toxicity Assessment

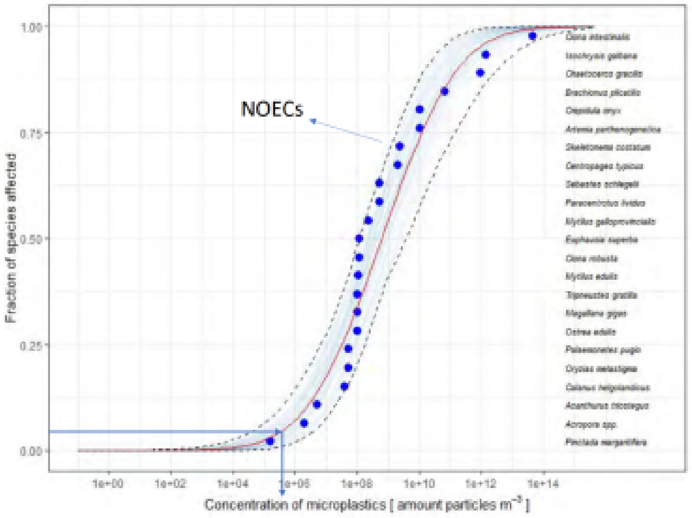
Human Health

- **Insufficient information** to develop human health-based threshold values



Aquatic Biota

- Few useable studies; unrealistic lab studies
- Fibers and smaller particles (<300 um) **underrepresented**
- **Metadata approach** selected (Species Sensitivity Distribution, SSD)
- **Ecologically relevant** fitness-based endpoints
  - *Preferred but harder to demonstrate - survival, growth, reproduction*
  - *Lab studies less relevant - sub-cellular/tissue-based effects*
  - ***Selected – food dilution and tissue translocation***
- **High confidence** in the approach but **low confidence** in the toxicity data
- Mehinto et al, 2022, Koelman et al, 2022



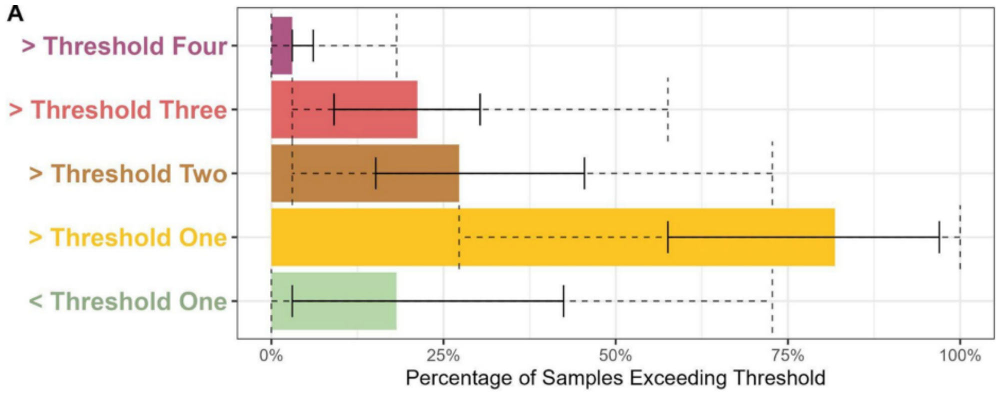
Suggested Numeric Toxicity Thresholds

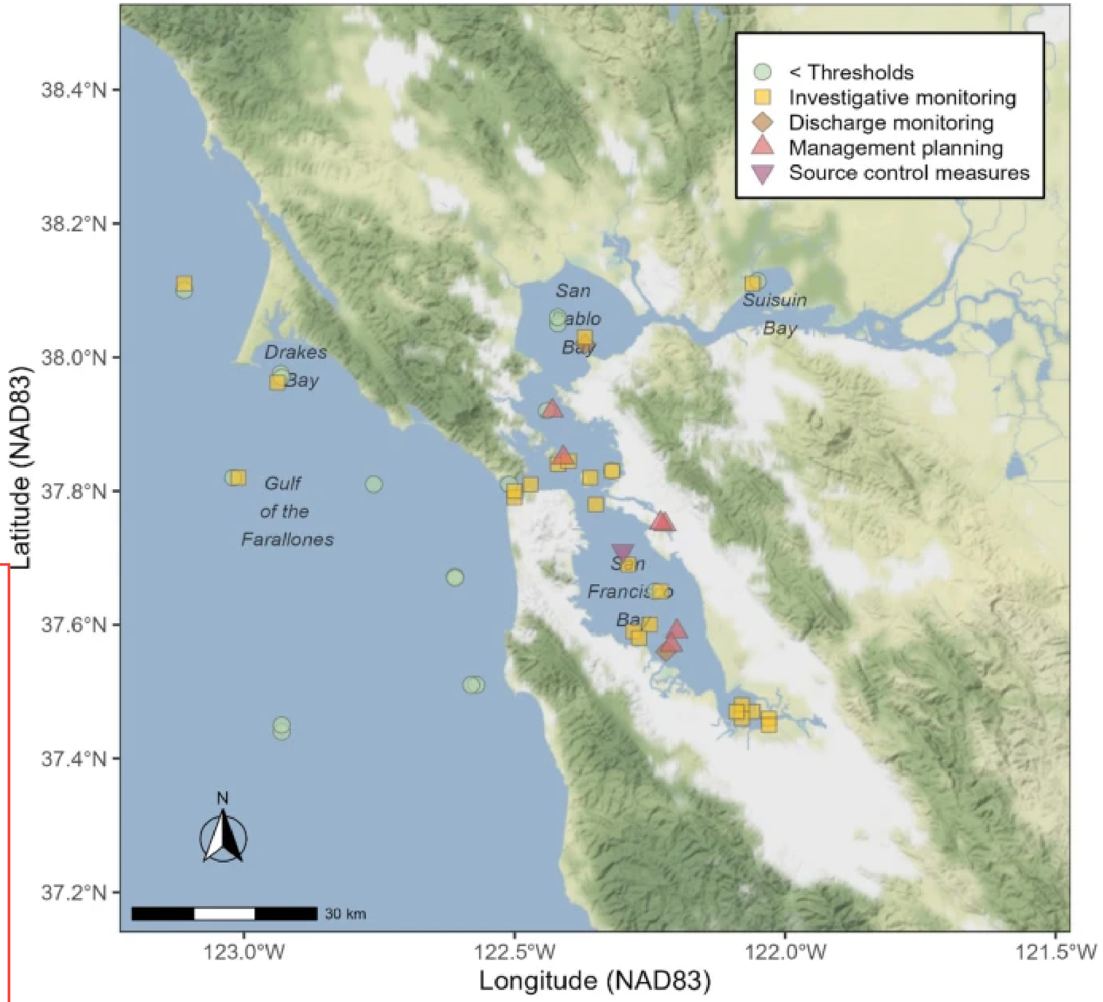
Threshold - Particles/L (95% CI)	Food Dilution (1-5,000 um)	Tissue Translocation (1-83 um)
1 – Investigative monitoring	0.3	60
2 – Discharge monitoring	3	312
3 – Management planning	5	890
4 – Source control measures	34	4110

Threshold – Mass (mg/L)	Food Dilution (1-5,000 um)	Tissue Translocation (1-83 um)
1 – Investigative monitoring	0.05	10
2 – Discharge monitoring	0.4	51
3 – Management planning	0.9	146
4 – Source control measures	6	676

Source: Mehinto et al, 2022. Threshold 1 is the lower 95% CI of the HC5 and Threshold 2 is median HC5 for cellular endpoints; Thresholds 3 is median HC5 and Threshold 4 is HC10 for organismal endpoints including mortality

San Francisco Bay – Preliminary Risk Screening

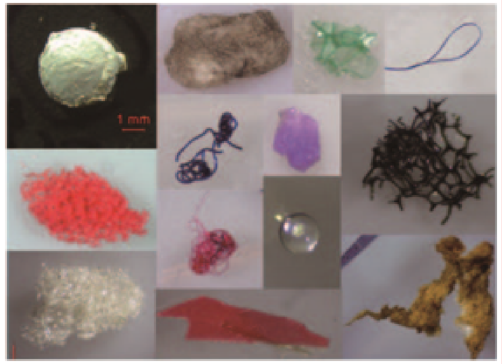




- Unexpected trends
- Only lowest food dil. threshold exceeded often
- More exceedances in rainy season
- No exceedances in open ocean
- Tissue translocation threshold never exceeded
- Very localized potential for risk?
- Risk underestimated?

Future Developments

- Technical Development - Apples to Apples
  - **Standardizing** diversified data – size, shape, density, composition
  - Field-relevant exposure and toxicity metrics – **concentration, mass, volume**
  - Hazard and toxicity **endpoints** – physical, chemical, biological
  - Is **PFAS** a unique co-occurrence of chemical concern?
  - Risk assessment – defining exceedances and **“high” risk**



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Source: Martindale, Weisberg, and Coffin (2020).

- MP Management Concerns
  - **Standards Development**
    - Releases, Discharges and Permitting
    - Risk Management
  - **Performance and Effectiveness Monitoring**
    - Mitigation and Abatement
    - Pollution Liability

Key References

Interstate Technology and Regulatory Council (ITRC). 2022. Microplastics Technical Guidance. Microplastics (itrcweb.org)

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Thank You

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