The Potential Distraction of Superficial Microplastics Risk

G. Allen Burton, Jr.

University of Michigan

burtonal@umich.edu

Human Dominated Watersheds and Coastal Waters

Runoff and Point Source Stressors Impairing Receiving Waters – *sometimes…*

- Habitat alteration
- Nutrients
- Pathogens
- Pesticides
- Petroleum products (PAHs)
- Pharmaceuticals & personal care products
- Metals
- Salts
- Litter
- Tire particles
- Microplastics

Does peer-reviewed science = Truth & validation?

- The peer-reviewed process **varies dramatically** in quality
- Most MP papers published in journals were reviewers not “eco-risk” experts
- ***Highly*** ranked journals are publishing MP papers with grossly unrealistic exposure concentrations
- Publication conclusions should be questioned and validated by others

Wading through the “science”…

- ***Risk = Exposure x Effects. Exposure does not equate to risk***

- Adverse effects ONLY found in lab studies - at concentrations **1-10 orders of magnitude higher** than in North America and Europe.

- **Worst MP concentration in North America is ~32/1,000 L (median 1.9 in streams receiving WWTP effluent**). Algae ~1000 -10 million higher (7-10 orders of magnitude). Highest concentrations in Asia (untreated sewage).

- ***No adverse effects on aquatic populations can occur at realistic concentrations – possible exception: Benthic invertebrates below outfalls***

Other lit review take aways…

- MPs not a vector for chemical transfer
- Fibers dominate. PE fleece most common (>1,900 per wash)
- Lab exposures excessively high – needed to detect effects.
- WWTP remove 90-99% of MPs
- Presence of MPs in gut does not equate to adverse effects. Most egested.

Massive QA/QC problems – misidentification and quantification

- False positive error rates 33-70%.
- Counts may vary from 17 to 100,000+ at a site.
- Largest error with fibers (plastic vs natural)
- No one analytical method identifies all MPs. No one sampling method can collect relevant sizes (2 to 500 micron)
- **Studies CANNOT be compared**

Analytical Methods

Accurate quantification requires advanced instrumentation (usually 2 types)

- Raman micro- spectroscopy,
- Fourier transform infrared spectroscopy (FTIR)
- Focal plane array- based reflection FTIR
- Combining atomic force microscopy and infrared spectroscopy,
- Field flow fractionation, or
- *Optical microscopy - prone to error.*

Where may MPs be an ecological problem?

Depositional sediments near WWTP outfalls?

- Benthic invertebrate communities below poorly treated outfalls *(4 - 120/L sediment; @ 3mm will 0.4% of a liter with 7.96 billion silt or 7.96 million sand particles)*

Urbanized rivers and harbors with little to no wastewater treatment (e.g., Asia)

Smaller-sized microplastics and particles (< 100 u)?

- Likely more common – but little known. Difficult to assess.
- Highest MPs likely small antifouling paint chips/fibers from boat hulls in coastal marine areas.

Absence of Standard Methods!

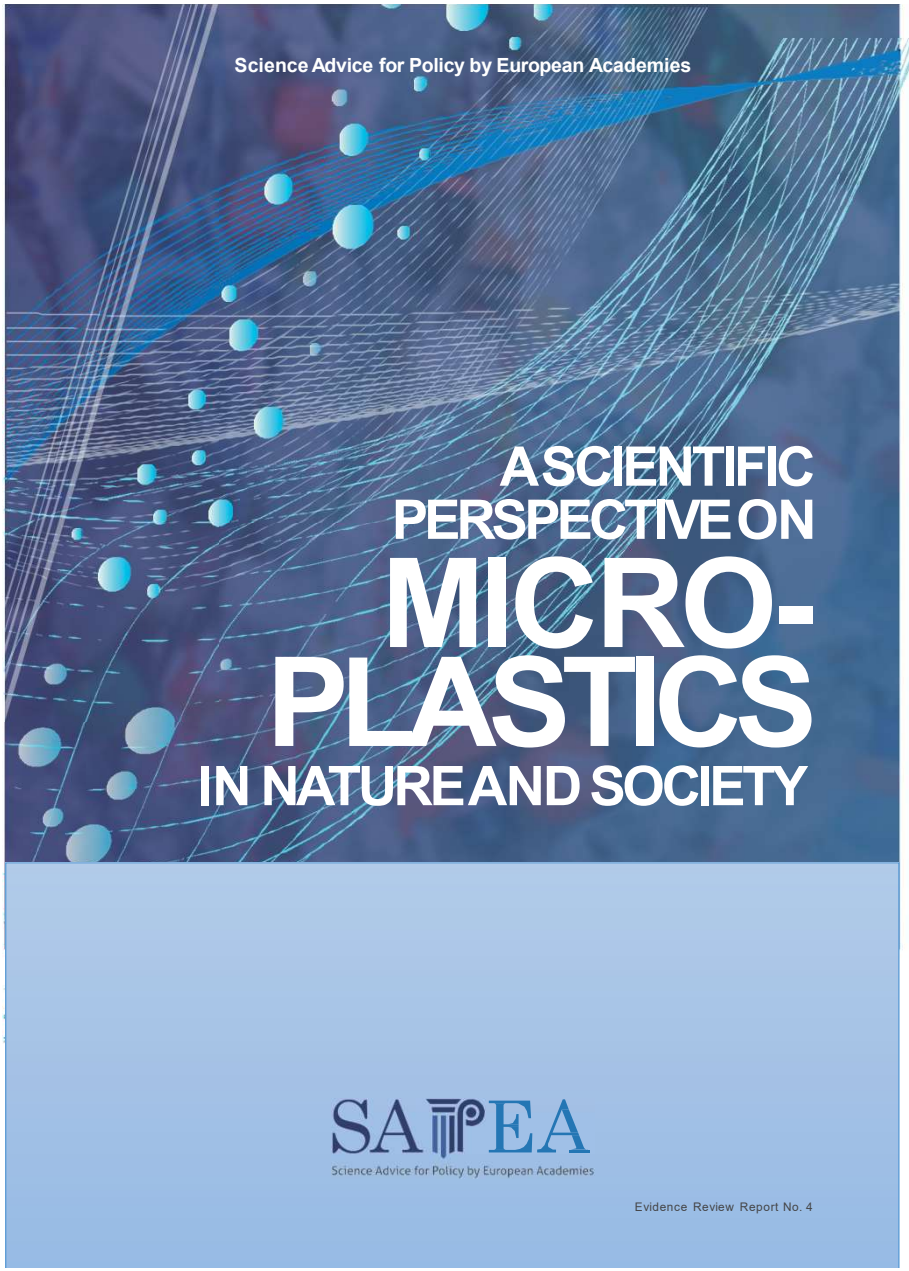
- Difficult or impossible to compare studies due to lack of standardized methods. Numbers and types of MPs vary by method and often two analytical methods needed.

- Microbeads banned in the US but MPs will not decrease (due to fibers and fragments) and likely increase.

There is now a "Weight-of-Evidence"

Recent Critical Reviews & Reports

1. Burns and Boxall 2018
2. Burton 2017
3. Connors et al. 2017
4. ET&C 2019, near release
5. Koelmans et al., 2016 and 2017



Science Advice for Policy by European Academies (2018)
https://doi.org/10.26356/microplastics
www.sapea.info/microplastics

Prof. Bart Koelmans (U. Wageningen),
Chair + 25 other scientists (academia and government)

No apparent ecological risks in aquatic ecosystems due to exposures
below effects levels

Concluding Perspectives

Focus on plastic pollution will continue – but in developed countries, ecological risk is from **macroplastics** – not microplastics

If MPs > effect levels (e.g., non-treated, urbanized Asian waterways) – other stressors *(e.g., organic waste, nutrients, low dissolved oxygen, metals, pesticides, habitat degradation, pathogens)* drive risk

Key needs:

Standard methods for collecting and quantifying, including MPs smaller than 1 mm

Improved exposure models

Public and governmental education