MINNESOTA

Microplastics and Nanoplastics in the Environment

Background

In 2019 the Minnesota Legislature appropriated from the Clean Water Fund $400,000 in FY20 and $400,000 in FY21 to the Minnesota Department of Health (MDH) to "work in cooperation with the commissioners of agriculture, the Minnesota Pollution Control Agency, and natural resources to sample surface water and groundwater, including drinking water sources, and for an assessment to evaluate potential risks from microplastics and nanoplastics and identify appropriate follow-up actions." This information sheet provides background on the issue of micro- and nanoplastics, and preliminary plans for how state agencies intend to move forward on this issue.

What are they?

- Microplastics (MPs) are two types of particles ranging from 0.1 – 5 millimeters (mm).
  - Primary: manufactured (e.g, microbeads and industrial abrasives)
  - Secondary: breakdown from larger plastic litter, car tires, plastic mulch, and synthetic fibers from textiles
- Nanoplastics (NPs) are particles <0.1 mm
- Commonly detected plastics are polyethylene, polyvinyl chloride, polypropylene, polyethylene terephthalate, and polystyrene.

Microplastics (Source: Florida Sea Grant)

How do they enter the environment?

There are many sources and routes of transport to surface water, stormwater, groundwater, sediment, soil, effluent, biosolids, air, aquatic & terrestrial biota, and humans. Research is active and evolving:

- The marine environment has received the most attention (Great Pacific Garbage patch)
- MPs found in Lake Superior, Mississippi River, and urban rivers in Illinois
- Soils are potentially the largest environmental reservoir of MPs and NPs

Why should we be concerned about MPs and NPs in the environment?

MPs are accumulating worldwide, including in remote places like the Arctic. Microfibers (most likely from textiles) are the most common MP.

- MPs and NPs weather over time, leaching out plastic compounds into the environment. Some of these compounds could disrupt the endocrine system.
- Metals and hydrophobic organic contaminants (e.g., PCBs, PAHs, DDT) can sorb to their surfaces, be transported throughout the environment, and be ingested/inhaled by organisms.
- MPs are being found in some food products, sea salt, and beverages (bottled water, beer) that people consume.

Are there ecological risks from MPs and NPs?

Plastics in general pose physical hazards to aquatic life. Small aquatic organisms can become entangled in plastic materials or suffocated by them, and MPs can negatively impact the growth, reproduction, and survival of organisms.

- MPs and NPs trigger a wide variety of effects in benthic (i.e., bottom-dwelling) invertebrates. The results of sediment toxicity tests on six benthic species showed that the risks of environmentally realistic concentrations of MPs were low. However, they may still affect the biodiversity and functioning of aquatic communities.

- MPs may bioaccumulate up the food chain.
- Biological effects may be amplified by the presence of contaminants attached to the surface of MPs and NPs. NPs appear to be more toxic than MPs due to their greater surface area.
- Fibers and fragments (0.8-1.6 mm) are the most common form of MPs in aquatic organisms, most likely from ingestion.

What are the human health risks from MPs and NPs?

Human health risks are possible, but have not been quantified. Research is needed to characterize human exposure to and impacts from MPs in drinking water (including source water), seafood, freshwater fish, and dust to assess potential risks.

- From food consumption, toxic effects of MPs and NPs may be possible from:
  - The plastic particles themselves,
  - The release of persistent organic pollutants adsorbed to MPs and NPs, and
  - The leaching of additives in the plastics, including phthalates, alkylphenols, bisphenol A, organotin compounds, PBDEs, and tetrabromobisphenol A.

How are they sampled and analyzed?

Research is in the earliest stages and there are many challenges in this area:

- Few standard sampling and analysis methods exist for water, sediment, or animal tissue and those that do are time intensive.
- No standard way of reporting or interpreting results makes it difficult to compare studies.
- MPs have different densities and shapes (e.g., fragments, pellets, and fibers) and occupy different zones in the water column of surface waters. Sampling is usually done with plankton nets of different mesh sizes that capture the zone of interest, and the MPs manually counted.

What are the state agencies doing about this issue?

An interagency work group is forming to carry out the work outlined in the appropriation language. This work will include evaluation of sampling and analytical methods for MPs and NPs, pilot sampling of surface water, groundwater and drinking water for MPs and NPs, evaluation of risk assessment methods and possible guidance development, and identifying follow up actions. In the meantime, the MPCA will continue pollution prevention efforts and public education to reduce, recycle, and reuse larger forms of plastics. MDH will also be holding a public forum on MPs and NPs in the environment in the fall of 2019. MNDNR Sentinel Lakes Program in cooperation with UMD has begun to sample MPs in surface water, lake sediment, and fish tissue.

Contact

James Kelly, M.S.
Manager, Environmental Surveillance & Assessment
Minnesota Department of Health
651-201-4910 | james.kelly@state.mn.us