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Microplastics—What's the BIG deal?

The term "microplastics" has been increasingly used in the media over the past few years. This term is generally used to refer to pieces of plastic that are smaller than 5 mm in size (about 0.2 inches). Recent research has shown that microplastics can be found throughout the world's ocean and coastal habitats—from surface waters to deep sea sediments. Microplastics have also been found in the stomachs of a variety of types of marine life—from plankton to whales.

Where do microplastics come from?

Microplastics are grouped into two categories. **Primary microplastics** are deliberately made as small beads, pellets or plastic fragments. Many of the manufactured microplastics (e.g. polyethylene "microbeads") are ingredients in some toothpastes, many facial scrubs and body washes, as well as makeup products, deodorants and other personal care products. Others are pellets (often called "nurdles") which are the form in which raw plastic is transported to plastic manufacturers. Some microplastics are created for use in sandblasting or polishing processes.

Secondary microplastics are microplastics that form as a result of the degradation of larger pieces of plastic. Petroleum-based plastics may never biodegrade, but physical and chemical processes (e.g. exposure to ultraviolet light, heat, or mechanical abrasion) can cause them to fracture into smaller and smaller pieces over time. Dr. Anthony Andrady, a plastics expert, said in the early 2000's, "Except for a small amount that has been incinerated, every bit of plastic manufactured in the world for the last fifty years or so still remains. It's somewhere in the environment." One source of secondary microplastics is the laundering of synthetic fabrics. Thousands of tiny fibers can be shed in this process.

How do microplastics get into the ocean?

There are probably two primary pathways by which microplastics enter the ocean—through wastewater treatment plant effluent and dumping/improper disposal of plastic waste (Often aided by stormwater runoff). Loss of shipping containers at sea is another source of microplastic pollution.

- Wastewater treatment plants are quite efficient at removing fibers from doing laundry and "microbeads" from personal care products, but such large numbers of these enter the plants that even if 99% are removed, that still results in significant numbers of plastics making their way into the environment in the effluent. Additionally, sewage sludge is often dried and pelletized to make fertilizer. These pellets contain large numbers of microplastics, and the fate of these once applied to the land is unknown.

- Large plastic items are most likely to photodegrade on land, when exposed to sunlight. Plastics on land are easily washed into coastal water bodies during rain events. Many urban stormwater drains feed directly into bays or rivers. Microscopic plastic fibers are common in air; rainfall will transport those fibers to the land or water.
- It is not unusual for cargo ships to lose containers overboard in storms. Often these containers are filled with plastic items (including nurdles, but also as packaging materials).

What is the issue with microplastics in the ocean?

In the ocean, there are many toxic chemicals (often called "persistent organic pollutants" or POPs). These chemicals are attracted to the surface of plastics and will often chemically bond to microplastics. One study found that some pollutants had concentrations a million times higher on the surface of plastic than in the surrounding water. Additionally, some of the chemicals used in the manufacture of plastics (e.g. bisphenol A, phthalates) are known to be potentially harmful if eaten. Research has shown that when marine animals eat plastic, the toxins on and in the plastic can end up in the animals' tissues. The impacts of this are not yet known.

A few studies have investigated the impacts of plastic consumption on marine animal health. These studies have not been able to accurately replicate "natural" conditions (i.e. types and quantities of plastics that the organisms would be expected to encounter in the ocean). They do suggest that, at least for some types of animals, there might be an energetic cost associated with consuming and excreting microplastics. Additionally, larval growth and survival might be negatively impacted by the presence of plastics in the water.

Scientists have estimated that between 4.8 and 12.7 million metric tons of plastic entered the ocean (worldwide) in the year 2010. They further predict that this amount will increase by an order of magnitude by the year 2025. This is a global issue, and one to which everyone contributes. Of the top ten (identifiable) types of items collected in the International Coastal Cleanup, eight are plastic.

What can we do?

Microplastics researchers generally agree that it is not feasible to remove plastics from the ocean (because of their distribution throughout all ocean bodies at all depths, and because of their size range). However, some feel that removal of "beach plastics" might be helpful in reducing the amount of weathered plastic (that will break down into microplastics) accumulating in the ocean. There is a need to reduce the amount of plastic waste generated. At an individual level, this is best accomplished by avoiding single-use plastic items (including drinking straws, shopping bags, water bottles, foam dishes/cups, utensils and even personal care products like cotton swabs that have plastic sticks).

Recycling is often promoted as a solution for plastic waste, but the feasibility of plastic recycling is based on the price of oil. When oil prices are low, it is cheaper for companies to buy "virgin" plastic rather than recyclable plastic. Additionally, unlike metal, glass and paper, plastic can usually only be

recycled one time. Unfortunately, even if plastic is collected in a residential recycling program, it might still end up at the landfill if there is nobody to purchase it for recycling.
Reducing the plastic microfiber production (much of which is generated by wearing/laundering synthetic fabrics) is a challenge. Some groups are trying to develop devices that would be added to a load of laundry to trap these fibers. The tiny size of the fibers makes them difficult to remove using filters, as the filters would clog very easily.

What do we know about microplastics in Florida?

The Florida Microplastic Awareness Project (FMAP) is a citizen science effort (funded by a 2015 NOAA Marine Debris Program Outreach and Education Grant) that was designed to have people learn for themselves how prevalent microplastics are in Florida's aquatic environments. FMAP has two main goals:

1. To train citizen scientists to look for the presence of microplastics in Florida coastal waters, and
2. To teach people ways to reduce their personal contribution to microplastic pollution (in part by selecting and using personal care products that do not contain polyethylene.)

Between September 2015 and January 2017, 874 water samples have been analyzed from 315 locations around the state of Florida.

- 89% of these one-liter samples contained at least one piece of plastic
- On average, there were 7.7 pieces of plastic in a liter of water
- 83% of the plastic found are tiny fibers; 9% are fragments, 6% are microbeads and 2% are film

How can I learn more?

Visit the Florida Microplastic Awareness Project's website at www.plasticaware.org or contact Maia McGuire, PhD, at mpmcg@ufl.edu or 386-437-7464.