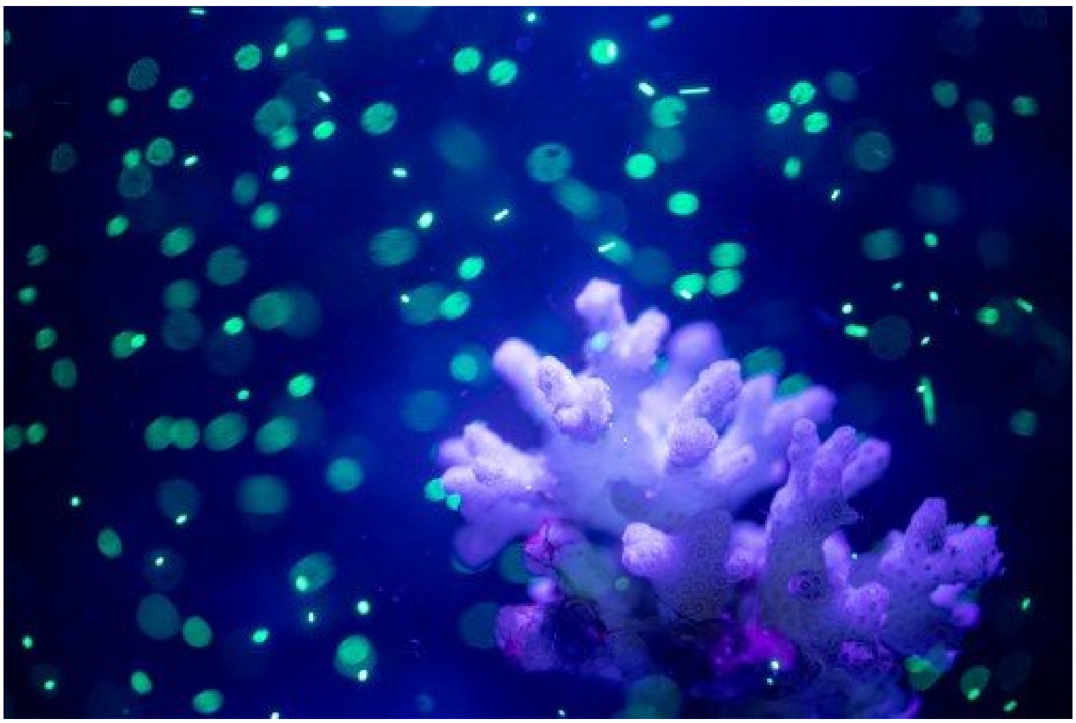
Q&A: Two ways researchers are studying marine microplastics

April 19 2023



Under a black light, fluorescent green microplastics are seen in the water during a small demonstration experiment. In the 2018 experiment described in Padilla-Gamiño's paper, cauliflower coral (above) ingested microplastics when prey was also present in the water, but avoided eating microplastics when no prey was there. Credit: Dennis Wise/University of Washington

Tiny pieces of plastic in the ocean might seem innocuous on their own, but their growing presence is a frustrating issue facing marine ecosystems. The particles' small size makes them difficult to clean up, and it also allows them to easily burrow into marine environments or even get ingested by ocean organisms.

Two University of Washington researchers are using very different methods to investigate the issue of marine microplastics. Jacqueline Padilla-Gamiño, a UW associate professor of aquatic and fishery sciences, plans to study how microplastics are affecting coral reef ecosystems. Michelle DiBenedetto, a UW assistant professor of mechanical engineering, will study how microplastics move across the ocean surface.

For Earth Day, UW News asked them to discuss their research.

Professor Padilla-Gamiño, your lab's experimental study in 2019 showed that corals are ingesting microplastics along with their typical food. Why are microplastics a problem for corals and other marine organisms?

Jacqueline Padilla-Gamiño: This material can prevent them from feeding, or damage their tissues. Plastics also contain plasticizers—chemicals used to provide flexibility and to reduce brittleness—which may cause hormone disruption and affect the organisms' reproduction.

What have you learned since then?

JPG: We have continued to explore the abundance and diversity of microplastics in coral reefs, including in water, sediments and other organisms, such as sea cucumbers.

We are also doing other experiments to learn how different types of plastics can affect the performance of corals, because not all plastics are the same.

It's scary to think that corals and other marine organisms, which are already stressed by warming and acidifying oceans, are at the same time also consuming microplastics. How can research offer any hope?

JPG: Research can help us to understand what species are more sensitive to plastics. It can also help us to generate ecological baselines that can be used to assess impacts. Both can help us design strategies to reduce plastic pollution's impacts.

What motivated you to incorporate microplastics into your wider area of research on how climate change affects marine organisms?

JPG: Plastic pollution is a global problem and it is also a carbon dioxide problem. The process of plastic manufacturing creates more than a billion tons of greenhouse gases per year. At least 14 million tons of plastic end up in the ocean every year. We need to understand the impacts of these plastics in marine ecosystems.

Professor DiBenedetto, what motivated you to study the movement of microplastics?

Michelle DiBenedetto: Plastic pollution is a relatively new issue and there is still a lot we do not know about what happens to plastic once it is in the ocean. For example, we do not know exactly how long it takes to degrade in the ocean, where it might settle out or at what rates it will be deposited on our beaches.

Many of these processes are influenced by the fluid dynamics in the ocean, such as waves, turbulence, wind and currents. How plastic behaves and is transported in the ocean is an interesting problem because plastic is different from traditionally studied ocean topics, such as bubbles, oil spills, sediment and biology. Thus, it leads to a lot of interesting physical questions that we can study in the lab.

Can you describe what those experiments look like?

MD: We turn on an adjustable wind tunnel that blows over the surface of a wave tank. This creates waves, turbulence and current in the water.

Next, we release particles upstream in the tank. In the middle of the tank, we have an area where we can take images of the particles. We use cameras and lighting to illuminate the particles so we can track their position and orientation (when using non-spherical particles). We either track the particle shadows, or we track the particles themselves.

How will tracking the particles in this way better inform our knowledge of microplastics transport in the ocean? Could this potentially help us design future cleanup methods?

MD: The goal of this research is to be able to develop a fundamental model for microplastics' vertical distribution at the ocean surface: How far below the surface do we expect buoyant microplastics to be mixed under different conditions?

This model would increase the accuracy of simulations of microplastics transport (ocean currents are typically faster at the surface) and degradation rates (sunlight degrades microplastics and is strongest at the surface). A model would also decrease uncertainty in measurements—we have many surface measurements of microplastics, but these need to be corrected for the number of microplastics mixed below the surface.

To design effective cleanup methods, we need to know how fast microplastics leave the ocean surface naturally, so that we can decide the value in designing cleanup methods—or focus our energies on polluting less plastic in the first place. This work's goal is to better our understanding of plastic's natural transport and fate in the ocean so we can decide how best to manage it.

Provided by University of Washington