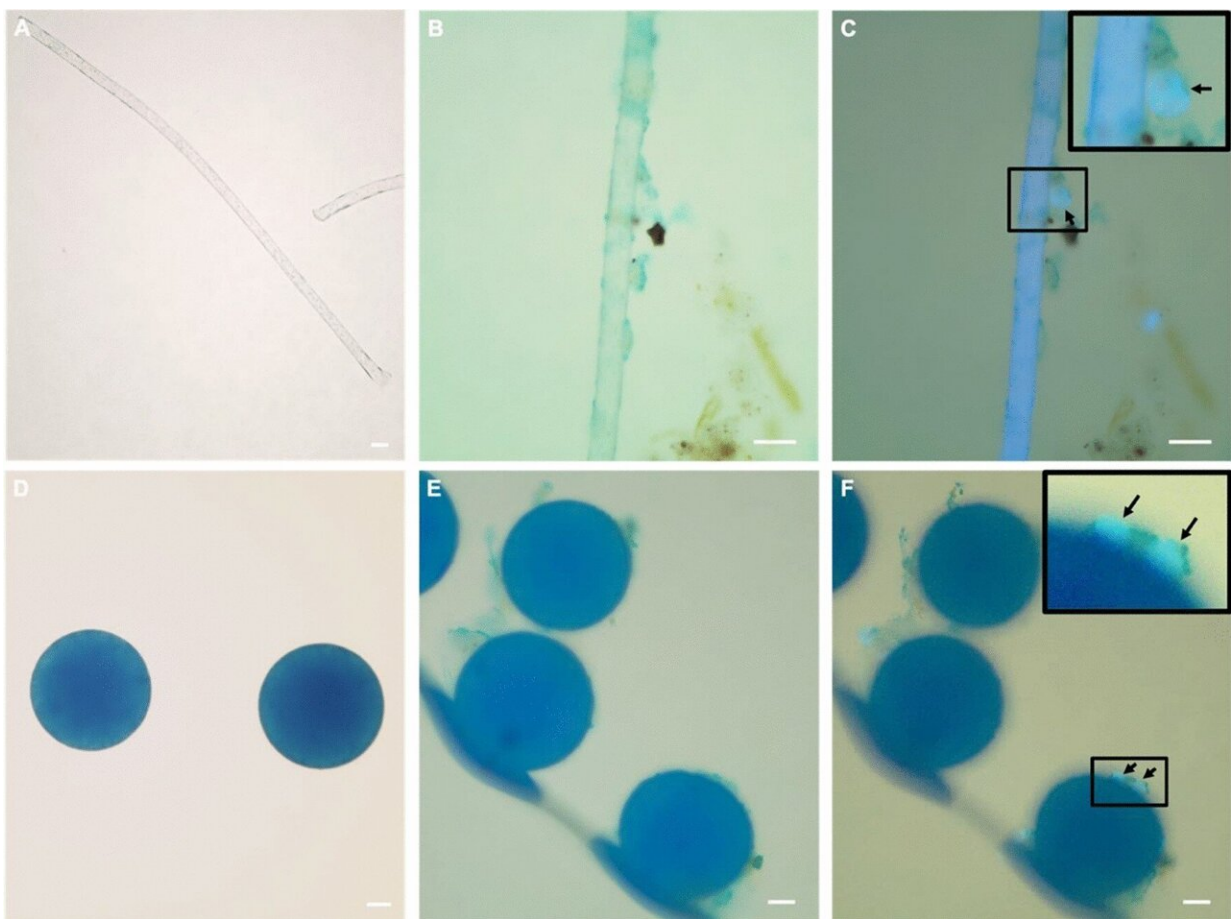


Disease-causing parasites can hitch a ride on plastics and potentially spread through the sea

April 27 2022, by Karen Shapiro and Emma Zhang



Micrographs depicting the association of *Toxoplasma gondii* with microplastics. Alcian blue, a stain that binds to exopolymer substances prevalent in biofilms, was used to visualize the association between the plastic surface and parasite oocysts. Polyester microfibers (A) and 100 μm blue polyethylene microbeads

(D) that were not pre-conditioned in seawater demonstrate a lack of biofilm on the plastics prior to the experiments (no visible light blue matrix on their surface under brightfield illumination). Microfibers and microbeads following pre-conditioning and incubation with *T. gondii* were imaged under brightfield illumination (B and E, respectively) and a combination of brightfield illumination and UV epifluorescence that allows visualization of naturally autofluorescent *T. gondii* oocysts (C and F, respectively). Enlarged inset shows a *T. gondii* oocyst embedded in biofilm (blueish irregular matrix) on the fiber and bead surface. All scale bars are 20 μm . Credit: *Scientific Reports* (2022). DOI:10.1038/s41598-022-10485-5

Typically when people hear about plastic pollution, they might envision seabirds with bellies full of trash or sea turtles with plastic straws in their noses. However, plastic pollution poses another threat that's invisible to the eye and has important consequences for both human and animal health.

[Microplastics](#), tiny plastic particles present in many cosmetics, can form when larger materials, such as clothing or fishing nets, break down in water. Microplastics are now widespread in the ocean and have been found in fish and shellfish, including [those that people eat](#).

As [researchers studying](#) how waterborne pathogens spread, we wanted to better understand what happens when microplastics and disease-causing pathogens end up in the same body of water. In our recent study published in the journal [Scientific Reports](#), we found that pathogens from land can hitch a ride to the beach on microscopic pieces of plastic, providing a new way for germs to concentrate along coastlines and travel to the deep sea.

Investigating how plastics and pathogens interact

We focused on three [parasites](#) that are [common contaminants](#) in marine water and seafoods: the single-celled protozoans *Toxoplasma gondii* (Toxo), *Cryptosporidium* (Crypto) and *Giardia*. These parasites end up in waterways when feces from infected animals, and sometimes people, contaminate the environment.

[Crypto and Giardia](#) cause gastrointestinal disease that can be deadly in young children and immunocompromised individuals. [Toxo](#) can cause lifelong infections in people, and can prove fatal for those with weak immune systems. Infection in [pregnant women](#) can also cause miscarriage or blindness and neurological disease in the baby. Toxo also infects a wide range of marine wildlife and kills endangered species, including [southern sea otters](#), [Hector's dolphins](#) and [Hawaiian monk seals](#).

To test whether these parasites can stick onto plastic surfaces, we first placed microplastic beads and fibers in beakers of seawater in our lab for two weeks. This step was important to induce the formation of a [biofilm](#)—a sticky layer of bacteria and gellike substances that coats plastics when they enter fresh or [marine waters](#). Researchers also call this sticky layer an [eco-corona](#). We then added the parasites to the test bottles and counted how many became stuck on the microplastics or remained freely floating in the seawater over a seven-day period.

We found that significant numbers of parasites were clinging to the microplastic, and these numbers were increasing over time. So many parasites were binding to the sticky biofilms that, gram for gram, plastic had two to three times more parasites than did seawater.

Surprisingly, we found that microfibers (commonly from clothes and [fishing nets](#)) harbored a greater number of parasites than did microbeads (commonly found in cosmetics). This result is important, because microfibers are the most common type of [microplastic](#) found in [marine](#)

[waters](#), on [coastal beaches](#) and even in [seafood](#).

Plastics could change ocean disease transmission

Unlike [other pathogens](#) that are commonly found in seawater, the pathogens we focused on are derived from terrestrial animal and human hosts. Their presence in marine environments is entirely due to [fecal waste contamination](#) that ends up in the sea. Our study shows that microplastics could also serve as transport systems for these parasites.

These pathogens [cannot replicate in the sea](#). Hitching a ride on plastics into marine environments, however, could fundamentally alter how these pathogens move around in marine waters. We believe that microplastics that float along the surface could potentially [travel long distances](#), spreading pathogens far from their original sources on land and bringing them to regions they would not otherwise be able to reach.

On the other hand, plastics that sink will concentrate pathogens on the sea bottom, where filter-feeding animals like clams, mussels, oysters, abalone and other shellfish live. A sticky biofilm layer can camouflage synthetic plastics in seawater, and animals that typically eat dead organic material may [unintentionally ingest them](#). Future experiments will test whether live oysters placed in tanks with and without plastics end up ingesting more pathogens.

A One Health problem

[One Health](#) is an approach to research, policy and veterinary and [human medicine](#) that emphasizes the close connection of animal, human and environmental health. While it may seem that [plastic pollution](#) affects only animals in the ocean, it can ultimately have consequences on human health.

Our project was conducted by a multidisciplinary team of experts, ranging from microplastics researchers and parasitologists to shellfish biologists and epidemiologists. This study highlights the importance of collaboration across human, animal and environmental disciplines to address a challenging problem affecting our shared marine environment.

Our hope is that better understanding how microplastics can move disease-causing pathogens in new ways will encourage others to think twice before reaching for that [plastic](#) straw or polyester T-shirt.

More information: Emma Zhang et al, Association of zoonotic protozoan parasites with microplastics in seawater and implications for human and wildlife health, *Scientific Reports* (2022). [DOI: 10.1038/s41598-022-10485-5](#)

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