MICROPLASTICS CAN TRANSPORT ZOONOTIC PATHOGENS IN COASTAL WATERS

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Microplastic pollution is often treated as a physical and chemical threat, but these particles may also carry disease-causing pathogens through marine environments. In California and other coastal areas, microplastics are widely ingested by fish and shellfish intended for human consumption. Land-based pathogen inputs can occur in the same places, creating a pathway for pathogen exposure in humans through seafood consumption and in wildfire through marine food webs. For instance, the protozoan parasite *Toxoplasma gondii* is already a documented threat to California sea otters and can cause fatal disease and reproductive impacts in affected individuals. The potential for microplastics in coastal waters to associate with land-based pathogens is a vastly understudied topic, yet critically important for understanding the full threat of microplastic pollution and disease in coastal ecosystems and communities.

We tested whether three zoonotic protozoan parasites, *Toxoplasma gondii, Cryptosporidium parvum,* and *Giardia enterica*, can attach to microplastics suspended in seawater. These three pathogens were selected because they are recognized by the World Health Organization as underestimated sources of human illness from shellfish consumption. We also compared whether the protozoan parasites were more likely to be associated with microbeads versus microfibers, representing two common forms of microplastics found in nature.

KEY RESEARCH FINDINGS

All three protozoan parasite species associated with microbeads and microfibers. Over seven days, parasite counts on plastic surfaces generally increased while counts in the surrounding seawater declined, showing that microplastics can concentrate pathogens from seawater.

Microplastic type and size influenced pathogen association. Larger polyester microfibers generally carried more *Giardia* and *Cryptosporidium* than smaller fibers or microbeads. Microfibers tended to associate with more protozoan parasites than microbeads, which is important because microfibers are among the most common microplastic types found in environmental surveys and have been detected in fish and shellfish.

Biofilms on plastic surfaces may help trap pathogens. Biofilms can make plastics resemble natural particles, which may increase their ingestion by lower-trophic organisms and facilitate pathogen entry into food webs.

POLICY IMPLICATIONS

Expand California and federal microplastic monitoring to include pathogen carriage, not just particle abundance and chemical contamination, especially in shellfish-growing and wildlife-sensitive coastal waters.

Prioritize microfiber-source reduction, including improved capture of textile fibers in wastewater and other major discharge pathways, because fibers showed particularly strong pathogen association.

Integrate microplastic–pathogen interactions into shellfish and coastal water-quality risk assessments, especially following runoff or wastewater contamination events.

Fund field and live-organism studies to determine whether pathogen-coated microplastics increase contamination risk in oysters, other shellfish, and fish, as well as risk of infections in marine mammals.

Coordinate wildlife-health and pollution monitoring in California sea otter habitat, where *T. gondii* is already associated with sea otter mortality.

MORE INFORMATION

This policy brief summarizes findings from the article "Association of zoonotic protozoan parasites with microplastics in seawater and implications for human and wildlife health" by Emma Zhang and colleagues. The full article is available at https://doi.org/10.1038/s41598-022-10485-5. For more information, contact Karen Shapiro at kshapiro@ucdavis.edu.

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