07 June 2018
Issue 509

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Source: Ziajahromi, S., Kumar, A., Neale, P.A. *et al*. (2017). Impact of Microplastic Beads and Fibers on Waterflea (*Ceriodaphnia dubia*) Survival, Growth, and Reproduction: Implications of Single and Mixture Exposures. *Environmental Science & Technology* 51: 13397-13406. DOI: 10.1021/acs.est.7b03574

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European Commission

Science for Environment Policy

Fibres from polyester clothes could be more damaging to marine life than microbeads

Tiny polyester fibres, which are washed into rivers, lakes and seas every time we do our laundry could cause more harm to animals than plastic microbeads, finds a new study. The researchers looked at the effect of microbeads and fibres on a small crustacean called *Ceriodaphnia dubia*, which lives in freshwater lakes. They found that although both types of plastic were toxic, microfibres caused more harm. Both microplastics stunted the growth of the animals, and reduced their ability to have offspring; microfibres, however, did this to a greater degree, and also caused noticeable deformities in the crustacean's body and antennae.

Microplastics are emerging as a serious risk to marine and freshwater environments. A report, published by the UK Parliamentary Office of Science and Technology in 2016 found that more than a third of fish in the English/French Channel are contaminated with microscopic plastic debris. Plastics can get into lakes and seas via different routes. For example, they can be washed into the sea via waste water from treatment plants.

Microplastic polyethylene (PE) beads, in particular, have been recognised as a problem for some time. They can be taken up as food by fish and other marine animals, including filter feeders such as clams, oysters and barnacles. Once they are eaten, they can accumulate in aquatic animals' digestive tracts, stopping them from eating real food. This can stunt their growth and hinder their reproductive efforts.

One study found that as much as 58% of the stomach content of filter feeders was composed of PE microplastics. The plastic can poison the whole food chain, as predators feeding on filter feeders accumulate more and more beads in their stomachs. There are concerns that microplastics could also affect human health, as many of the marine animals affected end up on our plates as seafood.

As well as microbeads, waste water can also contain millions of tiny plastic fibres. These microfibres originate from synthetic fabrics such as polyester, nylon and acrylics, and are released into the water supply every time we wash our clothes. For example, one load of laundry may unleash 700,000 fibres of plastic. The EC has asked the European Chemicals Agency to prepare a dossier to restrict the microplastic intentionally added in products under the chemicals legislation (REACH Regulation).

A report[1] by the International Union for Conservation of Nature (IUCN) found that, of the 9.5 million tonnes of plastic released into the ocean each year, fibres accounted for 15–30%. That's the equivalent of every person on the planet dumping a plastic bag into the ocean every week.

In this study, the researchers examined the effect of microplastic polyester fibres and polyethylene beads on the survival, growth and reproductive health of the water flea (*C. dubia*), a small crustacean that lives in freshwater lakes. To measure the effect of **acute** exposure, they placed *C. dubia* into three glass beakers for 48 hours; each beaker contained a different concentration of either microbeads (0.5–16 mg/L) or fibres (0.125–4 mg/L) mixed into 25 ml of mineral water. Some *C. dubia* were also placed in control beakers containing just water, or a water mixed with a solvent.

To calculate the effects of **chronic** exposure, the researchers left *C. dubia* in beakers of various concentrations of microbeads and fibres (62.5–2 000 µg/L for PE beads and 31.25–1 000 µg/L for polyester fibers) for eight days. Control organisms were also left in beakers of water and solvent for the same length of time.

Continued on next page.

1. Boucher, J., Friot, D. (2017). Primary microplastics in the oceans: a global evaluation of sources. IUCN, Global Marine and Polar Programme. https://doi.org/10.2305/IUCN.CH.2017.01.en

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2.http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/pdf/microplastics_final_report_v5_full.pdf

European Commission

Science for Environment Policy

Fibres from polyester clothes could be more damaging to marine life than microbeads *(continued)*

They found that both polyester fibres and polyethylene beads were toxic to *C. dubia*. Short-term exposure to the highest concentrations of both types of microplastics were lethal (4 mg/L for polyester fibers and 8 mg/L for PE beads), although, these concentrations are unlikely to be found in nature. The study did find, however, that long-term exposure to lower concentrations of microplastics, including those seen in nature, could cause deformities, stunt growth, and harm *C. dubia*'s ability to reproduce; for polyester fibers, a concentration of 500 µg/L was enough to significantly reduce numbers of young, and adult body size, while higher exposure to PE microbeads was needed to produce a similar effect (1 000 µg/L for neonate numbers and 2 000 µg/L for adult body size).

Interestingly, the fibres were more toxic to the water flea than the beads. Whilst chronic exposure to both beads and fibres reduced the crustaceans' body size and the number of young they produced, this effect was greater for fibres. For example, water fleas exposed to a concentration of 1 000 µg/L of PE microbeads had 56% fewer young than a flea from the control beaker, while water fleas exposed to the same concentration of polyester fibres had 84% fewer offspring.

The researchers believe the two types of plastic exert their effects in different ways, as mixing microfibres and beads together did not harm the crustaceans as much as expected. They argue that *C. dubia* probably mistake PE beads for food, and this was confirmed when they looked inside the animals' stomachs with a microscope. Their guts were full of tiny white PE beads, and the higher the concentration the water fleas were exposed to, the fuller their stomachs were. A full stomach could stop the organisms from eating real food, depriving them of vital energy. With depleted energy reserves, *C. dubia* may be forced to invest more in survival rather than growth and reproduction, resulting in a reduced number of offspring.

Microplastic fibres, on the other hand, were not taken up as food, but rather appeared to interfere with the crustaceans' ability to swim. At high concentrations, the creatures became entangled and immobilised in the fibres, whilst a microscope showed that prolonged exposure to lower concentrations of 500 µg/L caused deformities in their shell and antennae. The stress of physical contact with the fibres, and damage to the body, may explain their reduced reproduction and growth, argue the researchers.

The study is one of the first to show the serious harm that microfibres can do to aquatic animals. Until now, the focus of policymakers has been on microbeads. Individual EU Member States that have banned, or plan to ban, the use of microbeads in cosmetics include Finland, France, Ireland, Luxembourg, Sweden, and the UK. However, this research suggests microfibres from our clothes may be just as harmful, if not more so.

The EU is already trying to combat the build-up of plastics in oceans through the Marine Strategy Framework Directive (MSFD), which requires EU Member States to ensure that, by 2020, the "properties and quantities of marine litter do not cause harm to the coastal and marine environment". The European Commission also announced, in January 2018, the first-ever Europe-wide strategy on plastics, which includes actions to restrict the intentional addition of microplastics to products and to curb microplastics' pollution from major sources such as tyres, textiles and preproduction plastic resin pellets. A dedicated study by the European Commission[2] investigated, among other areas, options for reducing the release of microfibres in the aquatic environment and their respective socioeconomic and environmental impacts. In the follow-up to the plastics' strategy and, taking into account the above-mentioned study, the Commission will examine which additional legislation or measures will be needed to address the specific problems presented by microfibres.