Study finds plastic fibers stunt growth in mussels by more than a third—here's why this is a concern

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Credit: AI-generated image (disclaimer)

Plastic pollution poses a threat to marine wildlife. The plastic bags, bottles and straws that we see strewn across beaches have long been identified as a danger. But tiny fragments of plastic—called microplastics—that are less than 5mm in size are also a major source.

Microfibers are the most common type of microplastic and account for up to 91% of the microplastics that float around our seas. These minuscule fibers are shed from textiles as a result of the wearing and washing of clothes, and from the weathering and abrasion of marine equipment.

Marine animals will encounter and even consume these microplastics. Shellfish, which feed by filtering organic particles from the water, are particularly vulnerable. One study found that shellfish ingest far higher concentrations of microplastics than most other marine animals.

At the Plymouth Marine Laboratory, my colleagues and I studied the effect of microfiber exposure on young blue mussels (only 1cm in length) over three months. Younger animals are generally more vulnerable than adults to changes in their environment. Younger mussels, for example, have higher mortality rates in the wild, mainly due to predation. Therefore, the impact of microplastic contamination on younger mussels is likely to be profound.

In our paper, now published in *Microplastics and Nanoplastics*, we found that prolonged exposure to polyester microfibers led to smaller mussels that grew at a slower rate.

Blue mussels are an important indicator species for scientists as they reveal wider trends in the ecosystem. By constantly filtering water, blue mussels are exposed to pollutants, so are a good indicator of water quality. Mussels, as part of a group of shellfish called bivalves, are also an important part of marine food security. So, if reduced growth is also happening in the wild, it could send shockwaves through the marine ecosystem and the bivalve aquaculture industry.

Smaller mussels

In a controlled-temperature laboratory, we exposed the mussels to polyester microfibers (between 0.01mm and 0.5mm in size) at two concentrations: 8 and 80 microfibers per liter. We also exposed mussels to cotton microfibers at 80 microfibers per liter.

Scientists have found marine microplastic concentrations of 10 particles per liter of seawater to be common. So, the concentrations used by our study are representative of natural environments.

The blue mussels that were exposed to the higher concentration of polyester microfibers were significantly smaller and showed a 36% lower growth rate on average than mussels that were not exposed to any microfibers. This result was only observed in the mussels exposed to the highest concentration of polyester microfibers. Exposure to cotton microfibers did not cause a significant decline in the growth rate of young mussels.

Spending energy wisely

Toxicity studies have shown that microplastics can cause damage at the molecular and cellular level in adult mussels. One study recorded a strong inflammatory response in mussel cells after six hours of exposure to polyethylene microplastic particles.

The reduction in mussel growth in response to plastic microfibre exposure could stem from a shift in their energetic budget (the balance between the energy taken in and the energy used). These changes could be caused by the mussels altering their feeding behaviors to avoid consuming microfibers, diverting energy away from growth into processing ingested microfibers, or towards repairing the damage caused by these microfibers.

Reduced growth rates in mussels could in turn affect the wider ecosystem.

Young mussels grow at a rapid rate—reaching marketable size in 12 to 24 months. However, they must compete for food and space both with each other and with other species. Younger mussels that cannot grow as fast may be outcompeted by other species and are subject to higher predation.

Smaller mussels are also of less nutritional value. Predators, like crabs, whelks, starfish and many bird species, may find themselves having to eat more of these smaller mussels. This could impact the populations of both the mussels and their predators.

Humans, as consumers of seafood, will also be affected by smaller mussels. Oysters, mussels and scallops alone provide over 8 million tons of food to the global population each year. But lower growth rates mean that mussels will take longer to grow to a harvestable size. Smaller animals and longer time-to-market may reduce the profitability of bivalve aquaculture in the future.

Polluted waters

Microplastics have a clear impact on the growth of young blue mussels. But the actual impact could be even more severe.

In some more polluted marine environments, scientists have identified microplastic concentrations of up to 182 particles per liter—over double the concentration used in our experiment. Separate research also suggests that microplastic concentrations in our oceans may be even higher than currently found, as many particles are too small to capture and count.

Our study highlights the importance of conducting long-term experiments when evaluating the impact of microplastics on marine life. The impact on the cells and tissues of an organism when exposed to microplastics can become evident over short timescales.

But the impact of environmentally relevant concentrations of microplastics on growth, reproduction and survival, which have the greatest relevance to entire populations, require far longer observation periods.

Marine environments are already threatened by overfishing and climate change. Studies like ours are now starting to shed light on the damaging effects of microfibers and other microplastics on the animals within our oceans.

More information: Christopher Walkinshaw et al, Impact of polyester and cotton microfibers on growth and sublethal biomarkers in juvenile mussels, *Microplastics and Nanoplastics* (2023). DOI: 10.1186/s43591-023-00052-8

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