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Synthetic textiles: A primary source of microplastics

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Plastic pollution is a growing issue globally with many potential and recognised sources. This ECG Environmental Brief focuses on microfibres as a source of microplastics and their impact on ocean organisms and human health.

Microplastic pollution from washing synthetic textiles has been identified as the primary source of ocean microplastics. Microplastics are defined here as plastic particles with a diameter of < 5 mm, and include microfibres (MFs). Plastic pollution is released into the ocean from multiple sources. However, recent literature and news articles have been primarily focused on the effects of plastic garbage entering the ocean. Therefore the public often has a more limited understanding of MFs in comparison to single-use plastics. In part this is due to their novelty. MFs have been in use in textiles for more than 50 years, but were only identified as a source of plastic pollution in 2011 (*1*).

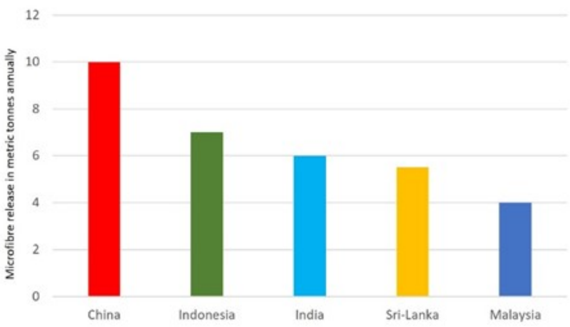

Figure 1. *The top five countries that release the most microfibres (4).*

MF pollution is primarily caused by the chemical and mechanical stress that fabrics undergo during the washing process in a domestic laundry machine. As a result, MFs detach from clothing threads. Frequently used textiles such as polyester, continue to release fibres for the entire lifetime of the product. Furthermore, the estimated quantity of MFs released during a standard washing machine cycle, ranges from 124 to 308 mg per kg of clothing (*2*).

Synthetic textiles account for 60% of fibres globally (*3*). However, five countries have been identified which produce the majority of microfibres (**Figure 1** (*4*)). These fibres typically consist of polyethylene, polyester, acrylic or elastane. Significant amounts of these synthetic fibres were observed in multiple *in situ* sampling studies of marine sediments and open water.

Due to their small size, detached MFs pass from domestic washing machines through wastewater treatment plants (WWTPs) and reach open water bodies, such as rivers and oceans. The proportion of MFs that are filtered out by WWTPs is debated; however, MFs have been detected in WWTP effluents, regardless of the treatment plants' efficiency. It has also been recognised that, due to the large volumes of effluents constantly entering water bodies, only a low concentration of MFs passing through WWTPs would likely be required for them to quickly become abundant in rivers and oceans.

Impacts on wildlife

The negative impacts of MFs are less obvious than other forms of plastic pollution, as they are often not visible to the naked eye. Their release into aquatic environments, however, has far reaching consequences.

Table 1. *Taxa commonly affected by MFs.*

Taxa affected	Some primary consumer species found to contain MFs
Invertebrates	MFs were present in 60% of macro-invertebrates found in three wetlands, along the Eastern Atlantic (4).
Mammals	Of 102 turtles dissected for a study, 85 had synthetic particles in their gut (5).
Fish	Microplastics were found in 52 of 263 fish from 26 species. 65.8% were present as MFs (6).
Crustaceans	24% of dissected bivalves contained textile fibres (7).

Due to their small size, many primary consumer species mistake MFs for prey, ingesting them (**Table 1**). This can cause physical damage to the organisms' digestive system, such as creating a blockage, potentially leading to starvation. Primary consumers may then be eaten by larger organisms, allowing the MFs to bioaccumulate up the food chain, affecting a range of ocean taxa. There is also increasing awareness and concern over the ability of microplastics such as MFs to break down into smaller fragments (nanoplastics) releasing further toxic pollutants that can cause harm to organisms. Ultraviolet light from the sun can cause the further degradation of MFs. Toxic pollutants which could be released include cadmium, lead and bisphenol A.

Impacts on human health

Research suggests that human health can also be negatively impacted by MFs. Routes of MF exposure include ingestion (*e.g.* by consumption of contaminated seafood), inhalation and dermal contact. A 2018 study found that MFs can absorb chemicals such as pesticides, which leach into organisms ingesting the fibres (*5*). Many pesticides are neurotoxins, meaning MFs have been proposed as a cause of neurotoxicity, and immune system dysfunction. Nanoplastics have also been hypothesised to cross the blood-brain barrier. Furthermore, MFs can remain in the body for long periods of time, potentially causing irritation of the digestive tract, cancer, and lung issues. The nature and severity of MFs' impact on the human body is still being debated among scientists, and further research on this topic is needed.

What are the solutions?

Potential solutions for reducing MF release from synthetic textiles have been developed, with more being suggested as research on the topic increases (**Table 2**).

There is currently very little legislation on synthetic textile pollution in the UK. The UK government has even rejected proposals aiming to reduce MFs, stating that current voluntary measures are sufficient. There is only one main regulation relating to MFs in place: *The Textile Products (Labelling and Fibre Composition) Regulation 2012* (*6*). This states that textiles sold must have labels detailing names and weight (as a percentage) of each fibre, the marketer or manufacturer's name and the country of manufacture. This allows consumers to make more environmentally friendly purchasing choices.

Conclusion

MFs can cause severe harm to wildlife and human health. They can bioaccumulate up food chains, often blocking digestive systems, leading to starvation. MFs can break down into smaller particles, releasing toxic chemicals which can also affect humans, causing a range of potential illnesses. Current solutions generally relate to consumer choice, such as using a gentle wash cycle or using a filter in washing machines. There is very little government enforced legislation on synthetic textile pollution. Without legislation imposed by the government, MFs will continue to be a problem for ocean life. Further research is needed to enable changes to washing machine technology and clothing design that will help limit the emissions of synthetic textiles.

Table 2. Some solutions (with explanation) for reducing synthetic textile pollution in the environment.

Solution	Explanation
Use gentle wash cycle	Low temperatures with low spin speeds will agitate fabrics less, releasing fewer fibres.
Re-wear clothes	Wear clothing items as many times as possible before washing them. Fewer washes mean fewer fibres are released.
Filters in washing machines	Install filters in washing machines that can remove the majority of fibres, reducing the amount that enter WWTPs and the ocean.
Buy used clothing	Clothing that has already been worn and washed will shed fewer fibres in a wash cycle than brand new, unwashed clothing.
Textile innovation	Natural textiles that do not undergo chemical processing and are biodegradable will have a lessened environmental impact.

References

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