Early Careers Environmental Brief **(ECGECB No 5)**

A sea of synthetics: microfibres in the environment

Jasmin Urwick (University of Reading BSc Ecology and Wildlife Conservation student, jasminurwick@hotmail.com)

Plastic pollution is a global issue with many different sources. This Environmental Brief focuses on synthetic microfibres released during domestic washing processes and the impact this has on wildlife and humans.

Plastic pollution encompasses a range of contaminants from different sources. Recent research and news articles have been dominated by microplastics due to their impacts on the environment, particularly marine and freshwater habitats. Synthetic microfibres (MFs) have been used in textile production for over 50 years, and have now been identified as a major source of plastic pollution (*1*). Globally, synthetic fibres account for 60% of fibre production and include polymers such as polyamides (e.g. nylon), polypropylene (PP) and polyesters (e.g. polyethylene terephthalate (PET)) (*2, 3*).

Synthetic MFs have been detected in a number of aquatic and terrestrial environments across the world, highlighting the need to tackle this pollutant at the source. There is growing concern over the process of washing textiles as a pathway for MFs to enter the aquatic environment, with Browne *et al.* (2011) being the first to identify this as a source of plastic pollution (*4*).

Several studies since have attempted to quantify emissions of fibres via wastewater from domestic washing machines. Pirc *et al.* (2016) investigated the MF emissions of a new polyester fleece textile after 10 successive washes. Their results indicated that fibres continued to be released over the entire lifetime of the product, suggesting 70 mg of MFs are released annually per person in northern climates. However, multiple variables such as frequency of washing and use of other MF products, dependent on an individual's lifestyle, could affect this value (*5*). Napper *et al.* calculated that an average 6 kg load of washing could release up to 700,000 MFs into the environment (*1*). MF emissions also vary seasonally, as more clothing is worn and washed during winter months than in summer (*4*).

Impacts on wildlife

In contrast to the larger types of plastic pollution that can entangle animals, synthetic MFs have internal implications to wildlife that may be less obvious. They typically have a diameter of <5 mm, placing them into the microplastics category (*1*). This small size mimics prey species resulting in the ingestion of MFs by predatory organisms. Not only can this cause physical damage to digestive system, but also negatively affects the food chain at a number of trophic levels (*3*). This has been found to increase mortality rates in species including the freshwater water flea (*Daphnia magna*) which has been observed ingesting polyester fibres as illustrated in **Figure 1** (*2*).

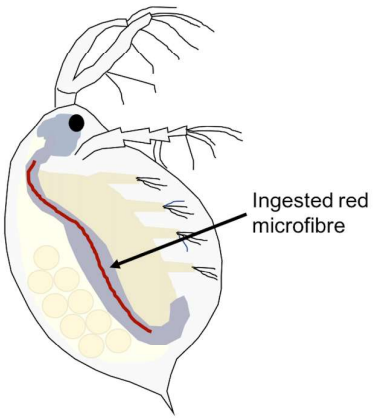

Figure 1. Drawing of Daphnia magna shown to have ingested a red PET fleece fibre.

The shape of MFs may also lead to differing effects on wildlife in comparison to more commonly studied microplastics, which tend to have a rounder shape (*2*). There is growing concern over the ability of microplastics, such as MFs, to act as a concentrator of pollutants, releasing even more toxic chemicals into the organism following ingestion (*6*).

Whilst much of the media focus of microplastics has been on threats to marine ecosystems, there is clearly evidence that freshwater and terrestrial species are also at risk. MFs can persist in sewage sludge that is used as agricultural fertiliser, exposing terrestrial organisms in the soil. This can then enter river systems via surface runoff, and ultimately enter marine environments (*2*).

Impacts on human health

The ability of MFs to enter the food chain is not only a risk to wildlife, but humans too. There is evidence of

human food sources such as blue mussels and honey containing microplastics (*2*). The ingestion of microplastics could lead to leaching of toxic chemicals used in the treatment of MFs, for example, fabric dyes or sewage contaminants (*4, 5*). Studies have also suggested that MFs inhaled by humans have the potential to become associated with developing tumours (*4*).

What are the solutions?

The release of MFs is largely due to a process called pilling. Small balls of fibres collect on the fabric's surface which can then detach during washing and enter the environment, as show in **Figure 2** (*1*). Research into the release of MFs via domestic washing machines agree that the process of washing needs to be adapted to reduce emissions. There is currently a push towards designing filters for modern washing machines that will collect the MFs shed during the cycle. However, there are concerns over how the collected MFs will then be disposed of to prevent polluting both aquatic and terrestrial habitats (*1*).

The colour of most MFs makes them relatively easy to identify, however colours such as black and brown become harder to distinguish from natural fibres and therefore more likely to be missed (*4*). Whilst there is still the need to prevent the spread of MFs in sewage sludge, the use of small mesh filters during wastewater treatment could help prevent synthetic MFs discharging directly into aquatic habitats (*2*).

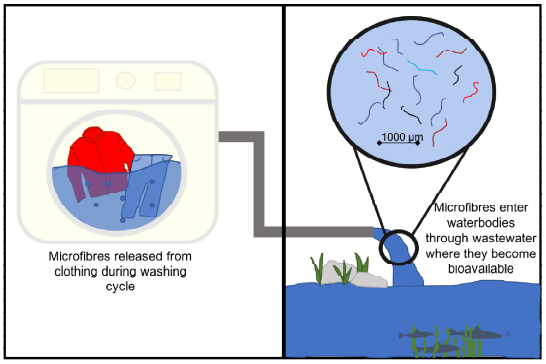

Figure 2. Diagram showing microfibres released during domestic washing process entering a waterbody via wastewater.

It should also be acknowledged that clothing design must be re-evaluated if we are to reduce our emissions of synthetic MFs. Between 1950 and 2010, the production of textiles and clothing using synthetic fibres increased from 2.1 million tons to 50 million tons per annum (*2*). There is a clear distinction between the amount of MFs released by textiles made from purely synthetic materials compared to those of a synthetic-natural combination. Research conducted by Napper and Thompson (2016) found that pure acrylic fabric released ~80% more fibres than fabric combined with a natural material such as cotton (*1*).

Processes involved in the production of textiles also act as a source of fibres being released into the environment. Companies are encouraged to consider different knitting techniques and controlled washing and drying methods to reduce the number of fibres released once the product is in the care of the consumer (*2*).

Despite these discoveries, the effects of microplastics such as MFs are still largely unknown. Further research is needed to facilitate advances in washing machine technology and clothing design to limit emissions. To support these changes, adequate policies specifically targeting plastic pollution must be introduced. Educating consumers about the impacts of particular clothing items and encouraging behaviours that may limit MF emission, such as less frequent washing, will also help to reduce the impact of synthetic MFs on the environment (*2*).

Whilst this brief focuses on the release of MFs through domestic washing, the design of other products such as fishing nets and personal care products could also be improved by this research and reduce their contributions to MF emissions (*3*).

References

1. Napper, I.E., Thompson, R.C., *Marine Pollution Bulletin*, **112**, 39–45 (2016). doi.org/10.1016/j.marpolbul.2016.09.025

2. Carney Almroth, B.M., Åström, L., Roslund, S., Petersson, H., Johansson, M., Persson, N.-K., *Environ Sci Pollut Res*, **25**, 1191–1199 (2018). doi.org/10.1007/s11356-017-0528-7

3. Gago, J., Carretero, O., Filgueiras, A.V., Viñas, L., *Marine Pollution Bulletin*, **127**, 365–376 (2018). doi.org/10.1016/j.marpolbul.2017.11.070

4. Browne, M.A., Crump, P., Niven, S.J., Teuten, E., Tonkin, A., Galloway, T., Thompson, R., *Environmental Science & Technology*,**45**, 9175–9179 (2011). doi.org/10.1021/es201811s

5. Pirc, U., Vidmar, M., Mozer, A., Kržan, A., *Environmental Science and Pollution Research*, **23**, 22206–22211 (2016). doi.org/10.1007/s11356-016-7703-0

6. Jemec, A., Horvat, P., Kunej, U., Bele, M., Kržan, A., *Environmental Pollution*, **219**, 201–209 (2016). https://doi.org/10.1016/j.envpol.2016.10.037