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Microfibers in the ocean: are they all made of plastic?

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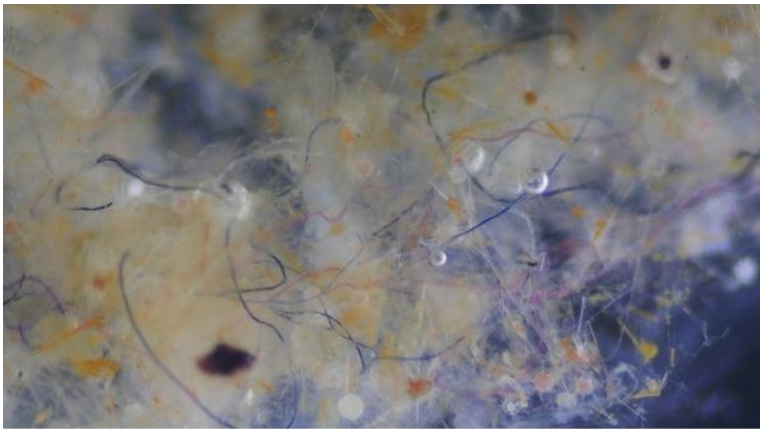
Many people are now aware of the danger microplastics pose to oceanic wildlife. However, textile fibers released from fabrics we use every day have been overlooked until recently. The vast majority of these tiny thread-like particles - which have long been assumed to be plastic - are actually natural fibers like cotton and wool.



Textile fibers entangled with plankton and other organic matter in seawater samples. Image credits: Patti Virtue / UTAS

Textile microfibers are fine strands of thread used to make clothing, carpeting and a myriad of very common household items like mops, table cloths and curtains. With use, these fibers are released and can now be found in the air we breathe, the water we drink, and throughout the world's oceans, being now considered major contributors to marine pollution.

Up to a million of these tiny colored fibers can be released by a single machine wash and are then washed down the drains, directly into our waterways. A certain portion of these fibers - if not retained by waste water treatment plants - will finally make its way into the natural environment. As a consequence, considerable amounts of fibers have been already detected in land and freshwater environments, in the air around us, in the stomach of hundreds of marine organisms, in the Arctic sea ice, in deep sea sediments and even in human lungs, foods and drinks.

When we first realized the real extent of this problem, we were in Antarctica, sailing around the Southern Ocean during the Antarctic Circumnavigation Expedition, a large international voyage organized in 2016 by the Swiss Polar Institute. We were in charge of studying microplastics in one of the most remote ecosystems of the world, but we soon realized that we were missing something important. Up to this point, we used nets to collect microplastics. Only when other team members, dedicated to studying phytoplankton, brought our attention to the presence of many bright and colored fibers in their seawater samples, did we realized that our nets were

too coarse to retain these tiny - micrometer-sized – thread-like particles.

In addition, we weren't even sure if these fibers were coming from our own ship's wastewater outlets. To test this, we went back to basics: We took a metal bucket and used it to collect water undisturbed by the ship from its bow, before filtering it on a much finer mesh. To our biggest surprise, hundreds of fibers were present in the very first two samples we collected this way.

So, the decision was made: We added this new component to our microplastic project, and started collecting samples throughout the rest of the voyage, and then in many other cruises around the world. In the end, we collected more than 900 samples in six different oceanic basins, including the Southern Ocean, the Atlantic, the Indian Ocean and the Mediterranean Sea. Back in the lab, we counted, isolated and analyzed all the fibers retained on our filters, to determine their composition, abundance and global distribution. We counted more than 23,000 fibers, and analyzed almost two thousand of them using a technique called infrared spectroscopy, to determine their chemical composition.

We found microfibers literally everywhere, with concentrations ranging from 0.02 to 25.8 fibers per liter - about 90,000 to 380,000 tons of fibers floating in the top layer of the Earth's oceans. The highest concentrations were found in the Mediterranean Sea and the lowest in the North Atlantic Ocean. Only three samples didn't contain fibers: one from the North Atlantic and two off the coast of Mozambique in the Indian Ocean.

The most surprising result came from the analysis of the composition of these fibers. To our huge surprise, only a very small proportion (around 8%) of the fibers we analyzed were actually made of plastic (e.g. polyester, nylon or acrylic). The vast majority of oceanic fibers turned out to be made of natural polymers like cotton (which made up 50% of the total), wool (which made up 12%), and others common materials like silk, hemp and linen.

So, we demonstrated that natural cellulose polymers, rather than synthetic fibers, dominate the composition of oceanic fibers worldwide. Surprising, given that currently two-thirds of all human-produced fibers are synthetic. We don't yet know whether these natural fibers pose the same health risks to marine organisms as microplastic fibers. We know even less about the degradation rates of these natural fibers in the marine environment: a crucial factor to understand why these fibers are so abundant. It is likely that dyes and chemical additives used in textile production are playing a role, but it seems that replacing synthetic with natural fibers will not absolve the fashion industry from making radical changes. After having doubled textile production in the last 20 years, soaring to 107 million tons in 2018 alone and rising, the flow of fibers into the ocean seems unstoppable now more than ever.