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DOES ONE STRAW REALLY MATTER?

Plastic is present everywhere. What happens to it and what impact does it have on the world around us?

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Plastics were originally considered to represent a step *towards* greater environmental friendliness. Plastic bags, for instance, were created with the idea of replacing traditional paper bags and so curbing

mass deforestation. Plastics and other artificial polymer materials became so ingrained in people's minds as modern and environmentally friendly products that in the 1970s, an artificial reef was created off the coast of Fort Lauderdale, Florida, made up of over 2 million artificial-rubber tires. Initially, the plan was that it would benefit underwater fauna and flora. However, the project quickly turned out to have disastrous consequences for the entire local aquatic ecosystem. Due to ocean currents, waves, and storms, the artificial rubber in the discarded tires dumped into the ocean caused irreversible damage to coral reefs and other

vulnerable marine ecosystems, which were already contending with the effects of coastal development, intense fishing, climate change, and extreme weather events. It is estimated that, despite many efforts, over 500,000 dumped tires have yet to be retrieved from the ocean floor.

One might think that the slowly-growing realization of the consequences of introducing plastics and other artificial substances into the environment over the past half-century would have led to a gradual decrease in pollution. Nothing could be further from the truth. Since plastics appeared in our daily lives in the 1950s, their production and use have steadily increased. It is estimated that in 2020, plastic production reached 367 million metric tons, a figure that continues to rise. Unfortunately, only about 20 percent of plastic produced currently undergoes recycling. A significant portion of the remainder ends up polluting aquatic environments – the Ellen MacArthur Foundation estimates that by 2050 this could actually lead to there being more plastic than fish in the world's seas. Imagine a region of floating garbage particles three times the size of France drifting in the ocean – and this is not even the final outcome, but rather the stage at which we currently find ourselves. Known as the Great Pacific Garbage Patch, this region is located in the Pacific Ocean and accumulates waste from Asia and North and South America.

From production to degradation

Although some pieces of plastic debris are visible to the naked eye, not all plastic pollutants are easily discernible. This is because plastics degrade into increasingly smaller fragments, often microscopic particles. Such particles are called “secondary microplastics” if they are smaller than 5 mm in diameter, and “nano-plastics” if smaller than 100 nm. Plastics that are intentionally produced in such small sizes, for example, in the cosmetics industry, are called “primary microplastics.” While these classifications are relevant when estimating the quantities of plastic pollutants present in the environment, they are not particularly important to the organisms exposed to plastic waste. Irrespective of their size, microplastics can – like any material in water – become attractive new substrates for various groups of microorganisms, such as bacteria, cyanobacteria, fungi, and algae. These organisms can alter what happens to microplastics in aquatic ecosystems by modifying their physicochemical properties and morphology. In some cases, the colonization of such particles may cause them to sink to the bottom due to increased mass, while in others, it may make them more buoyant, for example, due to gas accumulation. In the former case, the plastic debris together with the colonizing microorganisms becomes more acces-

sible to benthic (bottom-dwelling) organisms, while in the latter case it becomes become more accessible to zooplankton.

It is also worth mentioning that the bacteria colonizing such particles may be pathogenic, possibly posing a real threat to animals further down the food chain – especially to humans at the very end. However, this is not the only danger posed by consuming plastic-contaminated foods. For several years now, scientists have been sounding the alarm, examining the impact of microplastics on living organisms and pointing out their potential to damage or even perforate digestive tracts. By some estimates, humans consume about 5 grams of micro- and nanoplastics per week, equivalent in weight to a credit card or a plastic shopping bag. The smaller these particles are, the greater the potential risk they pose to our health. Research on mice in recent years suggests that if plastic fragments are smaller than one nanometer, they can cross the blood–brain barrier. Given that this is likely to be true for humans, too, we should be all the more concerned about microplastics in our environment.

On the scientific front

This is why plastic pollutants are now the subject of so much research – assessing the scale of the problem itself (examining how microplastics appear in local ecosystems) and analyzing its impact on living organisms, including humans. Unfortunately, most studies indicate that microplastics are quite common and occur even in remote regions of the world, from glaciers and mountain lakes to protected areas



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Even Poland's relatively remote Mazurian Lake District is affected by plastic pollution
Photo 1

Pollution plainly visible in Lake Staw
Photo 2

A sunken boat hull in Lake Staw



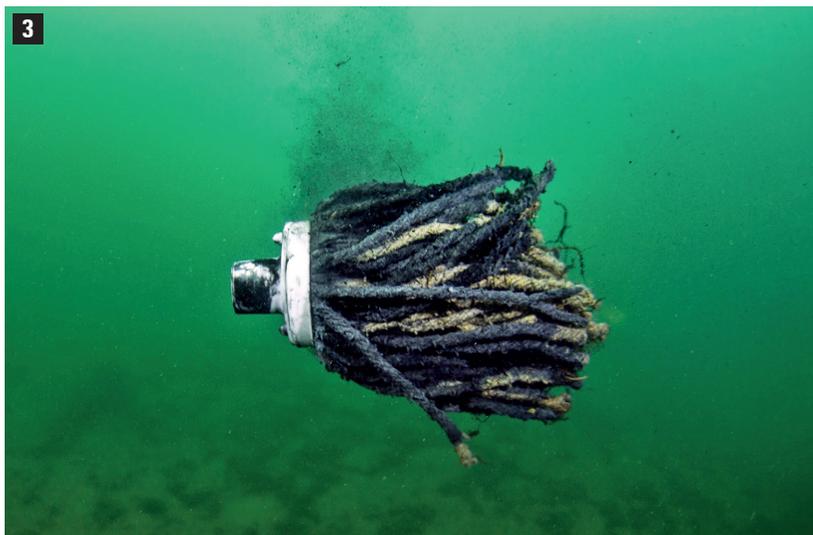


Photo 3
A mop found floating
in Sobolewo Reservoir



Photo 4
A fragment of colored
plastic from the
Czarna Hańcza River

Photo 5
A blue plastic fiber from
the Biała River

or remote from human settlements. A study of the inland waters of northeastern Poland (the Masurian Lake District) found that microplastics were present in all 30 of the lakes tested, with content ranging from 0.27 to 1.57 particles per liter of water. While these results are not as alarming as those recorded in some Asian lakes, which in many cases showed concentrations even as much as ten times higher, the mere fact that plastic is present even in lakes in this area, situated relatively far from any intense human activity, should give us pause.

Another important aspect of current research involves identifying the source of microplastics and analyzing the species that are exposed to direct contact with them. Much research focuses on aquatic organisms – investigating, for example, how different plastics serve as substrates for bacteria, or which species colonize microplastic particles and at what rate. Scientists from around the world are also interested in the further migration of plastics through the food chain. Last year, a study examining the stomach contents of birds in Poland – the common blackbird (*Tur-*

dus merula) and the song thrush (*Turdus philomelos*) – showed that our country's environment is also not free from pollution, and that these species can potentially serve as indicators of microplastic pollution in terrestrial environments. This has also led to other studies aimed at determining the direct impact of plastics on human health. Although such research has only recently gained intensity, the results so far indicate that such large quantities of plastics in our lives can have a significant impact on almost all aspects of how our bodies function: from allergies to cancer.

Our choices

It is crucial to realize that dealing with plastics in the environment is not solely up to scientists. Each and every one of us can contribute to environmental protection in our daily lives by being vigilant and perhaps making a few changes to our none-too-ecofriendly habits. One such change may involve ceasing to use disposable products such as plastic bags, cutlery, plates, straws, or cups. It is also worth paying attention to the packaging of other products, such as beverages – if possible, it is better to choose those sold in glass bottles. Some products, like water, we may not need to buy at all – it is more environmentally friendly to get water from the tap or a well. If there are concerns about water quality, filters or boiling are possible options. When it is not possible to avoid buying products packaged in plastic, it is advisable to opt for one larger package instead of several smaller ones or to use your own containers when buying takeout food. There are many ways to actively support environmental protection, but education is the key (educating both ourselves and others): awareness of what we can do for ourselves and for the sake of environment will pay off in the future. ■

Further reading:

Pol W., Żmijewska A., Stasińska E., Zieliński P., 2022, Spatial-Temporal Distribution of Microplastics in Lowland Rivers Flowing Through Two Cities (NE Poland). <https://doi.org/10.1007/s11270-022-05608-7>

Pol W., Stasińska E., Żmijewska A., Więcko A., Zieliński P., 2023, Litter per liter – Lakes' morphology and shoreline urbanization index as factors of microplastic pollution: Study of 30 lakes in NE Poland. <https://doi.org/10.1016/j.scitotenv.2023.163426>

Deoniziak K., Cichowska A., Niedźwiecki S., Pol W., 2022, Thrushes (Aves: Passeriformes) as indicators of microplastic pollution in terrestrial environments. <https://doi.org/10.1016/j.scitotenv.2022.158621>

