

You are here: [Home](#) > [UFRGS](#) > [News and Information](#) > [Microplastics assume "divine identity" and are omnipresent in the environment](#)

Microplastics assume "divine identity" and are omnipresent in the environment

Research developed at UFRGS, pioneer in Rio Grande do Sul in this area, identified the predominant presence of two polymers in Lake Guaíba's water: polypropylene (55%) and polyethylene (43%)

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By Nicole Trevisol

When the colors, shapes and textures of those small fragments are observed through the microscope, they seem to dance under the water. They shine like precious stones under a beam of light and, to a layman, they may look like diamonds, rubies, emeralds, turquoises, or agates. The microplastics present in Lake Guaíba are abundant and worrying. For the trained eyes of the researchers at the Laboratory of Environmental Processes and Emerging Contaminants (LAPACE, in Portuguese), linked to the UFRGS Chemistry Institute, this material may seem beautiful, but it is a warning sign of its negative interference in the ecosystem.

Present in the air, in the water and even in the salt, microplastics are small particles of plastic that pollute the environment and can measure from 0.001 mm to 5 mm. They are categorized in two sources: of primary origin, in which there is intentional production by the industry; of secondary origin, when production is unintentional and caused, usually, by weathering processes in the environment, such as degradation by sunlight, for example.

"The primaries are those made as microplastics at the source, such as microspheres present in exfoliating soaps. They leave the industry and arrive in nature in this format, or even end up being transformed into nanoplastics. Microplastics of secondary sources, on the other hand, are those that reach the environment in a larger size and, due to solar action and water movement, are fragmented to the point of becoming microplastics," explains [Andreia Neves Fernandes](#), professor at UFRGS and coordinator at LAPACE.

Studies on the presence of microplastics in the ecosystem are recent. They started all around the world in the 2000s. The first article published in Brazil on the subject is from 2009, and, in Porto Alegre, UFRGS is a pioneer in treating the topic in a scientific way. In a literature review carried out by the Laboratory, only 81 publications on microplastics were found in the country. This is alarming, given that Brazil is the fourth largest producer of plastic in the world and recycles only 2% of it. With a precarious selective collection and high production of the material, the large volume of plastic ends up reaching the rivers and, consequently, the oceans.

[Guilherme Tavares Nunes](#), professor at the Interdisciplinary Department at the UFRGS North Coast Campus and researcher at the Center for Coastal, Limnological and Marine Studies (Ceclimar), evaluates the contamination of marine and coastal birds by microplastics on the coast of Rio Grande do Sul. For him, it is important not to demonize this material, since it is present in almost all the utensils we use in a daily basis. "We cannot put this group of materials as the bad guys of the story, because, in doing so, we end up transferring a responsibility that is actually ours, as human species. Plastic alone is not the villain, but our habits, attitudes and the final destination we give to such materials are," says the professor.

Estimates indicate that 60% of the plastic produced in the world so far has been discarded inappropriately in nature. Much of it is considered of single use: used and thrown away, like grocery bags or disposable cups. "I would say that this is the most dramatic portion of contamination of the environment," stresses Guilherme.

One of LAPACE's lines of research seeks, precisely, to verify the presence of plastic materials in Lake Guaíba. The first sample collection of microplastics in the lake was carried out in August 2018, when 9,519 particles were observed in the water. Of this amount, 82% were fragments, 15%, fibers, and 3%, microspheres. As for the colors: 31.4% of the material collected was transparent-white, 25.5%, red, 15.8%, yellow, and 15.6%, blue. In the sample, there were also green (9.4%) and black (2.4%) particles. "When observed through the lens of a microscope, microplastics are beautiful for they shine, but the reality is quite different," says [Crislaine Fabiana Bertoldi](#), PhD student in Chemistry and coordinator of this study.

Crislaine's doctoral thesis aims to determine the presence of microplastics in the water of Porto Alegre's main source of water supply: Lake Guaíba. Interest in the subject is recent, just like the studies on microplastics in the country: it was in 2017, at a congress, that the doctoral student learned more about this 'omnipresent intruder'. From the first sample collection, it can be said that the material pattern found is the one expected. "The predominant polymers in Guaíba's water are polypropylene (55%) and polyethylene (43%), found in practically everything that is plastic: grocery bags, shampoo bottles, cell phones, computers, bags, pens. We also confirmed the presence of polyamide (a polymer used in the production of clothing) and polyurethane (used in the foam of the mattress, for example)," lists the researcher.

According to Andreia, the study's findings corroborate the hypothesis formulated by the researchers: microplastics exist in Guaíba, "but what we did not expect is that we would already see a high concentration of this material in the first sample. Microplastics are omnipresent, they are everywhere and have an impressive dynamics, allowing them to be carried away by the atmospheric environment, by the river drainage. Another interesting point of our findings is that, in regions with large population concentration, there is also a larger quantity of microplastics, that is, we human beings are the main source of this residue in Guaíba," she stresses.

How sample collection is done at Lake Guaíba

From 2018 until now, researchers conducted four collections of surface water at seven points along Guaíba. The first one was at the entrance of the tributaries, and the last one, in Ipanema. In each of these locations, the researchers carry out an entirely manual work. With the aid of a vessel, at each point Crislaine uses a conical net with holes of 60 micrometers to collect the microplastics. For ten minutes, at an average speed of 3 km per hour (1,8 miles per hour), 35 m³ of water are filtered through the net. The small particles collected are stored in a 150 ml (5 oz) beaker attached to the end of the net and taken to the laboratory. According to Andreia, the collection of microplastics can be done with a bucket or a net being dragged by a boat.

The identification of microplastics is an exercise of patience, as the waste may contain leaves, sand, clay, hair, grains. "As microplastics are very small particles, smaller than a grain of rice, we need to take several separation steps to reach our object of study," explains Crislaine.

The raw material goes through a first filter: organic waste such as leaves and branches are removed manually. Then, the researchers separate, sieve and chemically treat the sample to eliminate organic matter, and the plastic is separated from the rest by density. The plastic floats, and other residues are discarded. "After filtering and drying, the material goes to the microscope. There, we make a visual identification of the fragments of microplastics, easily seen because they are dyed," she says.

Exposed on a membrane, the microplastics are taken to the stereomicroscope, and the particles are counted one by one. The equipment, which increases the material size by up to ten times (up to 10 micrometers), helps in the characterization. Larger particles are counted under naked eye, with the help of tweezers. It is possible to identify their shape, type and color.

Following that, a chemical characterization is made to make sure that the collected sample is really microplastic. "Some of them can be taken with tweezers to a device that does the chemical characterization and tells us if it is polyethylene or polypropylene. With the more than 9 thousand microplastics found in the 2018 sample, we randomly picked several particles and took them to the equipment for chemical characterization," points out the doctoral student.

Andreia stresses that the 2018 collection shows the direct influence of the populational density of the place on the concentration of microplastics in the water. "The points of intersection of the Sinos and the Gravataí rivers were those with the highest concentration of microplastics, such as the point near the Port/Gasômetro. There is a dilution in Guaíba, and, in the southernmost region of Porto Alegre and near Ipanema, we have an increase, again, due to the influence of the geological shape and the hydrology of the lake".

The plastic era

We are living in the plastic age. A worrying moment caused by a material made to help us, but which, due to inadequate disposal, has become a problem for all species.

The world production of plastic materials in 2018 was 359 million tons, an amount that is added to the plastics previously and currently produced. It creates a snowball effect. This causes the presence of this material to be noticed everywhere. "If we look around us, everything we see is plastic. It will be difficult to eliminate microplastic from our lives. What we need to do is make people aware of the problem so they use as little as possible of it, choose reusable bags, eliminate the use of straws, use mugs instead of plastic cups, educate children to recycle more," alerts Andreia.

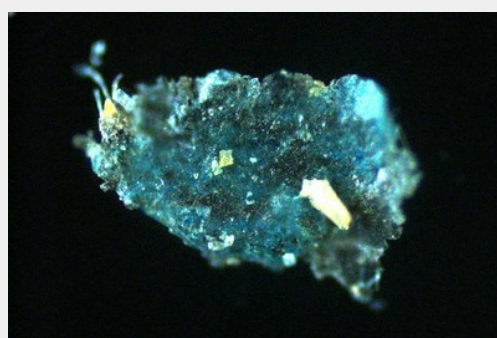
Among the findings of the research on microplastics in Lake Guaíba, one of them reinforces that plastic in contact with the environment does not disappear, but rather accumulates. Crislaine explains that 58% of the identified polymers "had a high degree of aging. This means that these microplastics that we collected had been in Lake Guaíba for a long time. The trend is that the concentration of microplastics will only increase due to the daily arrival of more of this material in the waters".

Therefore, the objective of this research goes beyond analyzing the presence, as it seeks to raise the population's awareness of the contamination of Lake Guaíba and show how it harms the biota, the rivers, the oceans and the human species, especially the latter that uses this source of fresh water as a supply.

For the researchers, the human being is the main responsible for the presence of these microplastics in Guaíba. "We want to show, precisely, the impact that the improper disposal is having on the public water supply in Porto Alegre, where Guaíba is the main source. The population's disregard for the water springs forces us to warn these communities of the dangers this accumulation brings to all species – animal and human," says Crislaine.

Check the full piece of news at <https://www.ufrgs.br/ciencia/microplasticos-assumem-identidade-divina-e-estao-onipresentes-no-meio-ambiente/>.

Translated into English by Marcos Viola Cardoso, under the supervision and translation revision of Elizamari R. Becker (PhD) – IL/UFRGS.



Blue fragments of microplastics. Stereomicroscope image - Photo: Lapace -

