MICROPLASTIC POLLUTION: HOW BAD IS IT AND WHAT CAN WE DO TO SOLVE IT?

BASED AT THE **SKIDAWAY INSTITUTE OF OCEANOGRAPHY** AND THE **UNIVERSITY OF GEORGIA MARINE EXTENSION** IN THE US, **PROFESSOR JAY BRANDES** AND **DODIE SANDERS** ARE INVESTIGATING THE EXTENT OF MICROPLASTICS POLLUTION IN GEORGIA'S COASTAL WATERS – AND THEY ARE ENCOURAGING PEOPLE LIKE YOU TO GET INVOLVED

WE CAN ALL MAKE A DIFFERENCE

It is a common misconception that plastics such as carrier bags or water bottles are only found at the ocean's surface. But, in a recent study, microplastics – tiny fragments of plastic measuring less than 5mm long – have been found 800 metres below the surface of the Pacific Ocean, and organisms are eating them. The Marianas Trench is the deepest part of the ocean —and pieces of plastic have even been found on the bottom there.

It is essential that we all reduce our usage of plastics, particularly single-use plastics. If every individual does their bit, their actions will have significant, positive environmental benefits.

The US National Oceanic and Atmospheric Administration (NOAA) defines microplastics as any type of plastic fragment that measures less than 5mm in length. Plastics have always been notorious for their damaging effect on the environment, not least because of how slowly they degrade, so improving understanding of microplastics pollution in the environment – particularly in aquatic and marine ecosystems – is essential. Given the small size of microplastics, they can be ingested by animals at the bottom of the marine food chain, causing unknown damage to the ecosystems they form part of.

Professor Jay Brandes is a marine chemist based at the University of Georgia's (UGA) Skidaway Institute of Oceanography, and his colleague Dodie Sanders is an environmental educator at the UGA Marine Extension (MAREX) and Georgia Sea Grant in the United States. They are working with a small team of researchers who are trying to ascertain the extent of microplastics pollution in Georgia's coastal waters. Georgia is a US state located in the South East and borders the Atlantic Ocean. Throughout the course of their studies, the scientists have found microplastics in almost every water sample they have taken on the Georgia coast and Jay believes the same or similar results would be seen worldwide. "It is clear from reading the studies published by other scientists that these contaminants are very widespread," he says. "Obviously concentrations vary tremendously by location, but where people have looked for microplastics, they generally have found them. It is very disconcerting."

HOW IS THE AMOUNT OF MICROPLASTICS IN WATER MEASURED?

The UGA Skidaway/MAREX team do all their microplastics work visually, with a microscope. They collect water samples by going to a location, either by boat, or using a dock or a bridge, then use a stainless steel bucket to collect water, which they filter through a series of sieves. The researchers have to be very careful not to contaminate these samples with fibres and other plastics from their own clothes, so they stand downwind of the sample when filtering. They then rinse the sieves off and collect the particles into glass vials that have been carefully cleaned to eliminate contamination. Finally, they bring the vials to the lab, filter them onto another filter, and study this new filter under a microscope.

There are specialised microscopes that look at samples in different ways, such as with infrared light, that can tell you specifically what plastic type you have in your samples. While the team does not have one of these at the moment, they were recently told that a proposal to the National Science Foundation to purchase one of these instruments was approved for funding. So, they are very excited about the possibilities of making more informative studies of their samples in the near future.

HOW DO MICROPLASTICS GET INTO THE WATER SYSTEM?

There are a number of ways. One of the biggest is through the washing of clothing that is made up of plastics-based textiles. Take a look at your clothing labels next time you put them in a washing machine and see how many have polyethylene, spandex, rayon, nylon or other plastics as part of their make-up. Every time these materials are washed some of their plastic fibres detach and are washed away. Those fibres go down the drain, to the sewers, to the wastewater treatment plant and, because they are so tiny, often travel through the treatment plant and into the surrounding environment.

Plastic fibres and other bits of plastic can also shed from our clothing, rugs, food and drink containers, and other sources – and can travel a long way. A recent study found microscopic plastic fibres in the air in the European Alps, miles away from the nearest town. At first, scientists believed that microplastics were

JAY BRANDES

Professor of Marine Chemistry
Skidaway Institute of Oceanography,
University of Georgia, USA

FIELD OF RESEARCH

Marine Chemistry

DODIE SANDERS

Environmental Educator
University of Georgia Marine Extension
(MAREX) and Georgia Sea Grant, USA

RESEARCH PROJECT

Jay and Dodie are part of the UGA Skidaway/MAREX team that collects water samples to analyse the extent of microplastics pollution in Georgia's coastal waters.

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mostly produced by the breakdown of larger pieces of plastic like cups and bags, but their widespread observations of fibres have changed this view somewhat. "We certainly thought that we would mostly see pieces of plastics and maybe microbeads from cosmetics in our samples when we started work in 2016," explains Jay. "However, we have mostly seen fibres!"

IS IT POSSIBLE TO REMOVE MICROPLASTICS ONCE THEY ARE IN THE WATER SYSTEM?

Removing microplastics is a very difficult task once they get out into the environment. While there are effective techniques to trap and remove them in waste-water treatment plants, use of these techniques is not universal nor all that common. Once out in the environment, there is the problem of trying to remove plastics that are the same size as organisms and detritus in the water. The UGA Skidaway/MAREX team filter them out to measure them, but it is impossible to do that with the entire estuary! Not only would it be hugely disruptive, but one would inevitably trap and remove the very organisms the team is trying to protect. Really, the only practical solution is to reduce the sources of plastics and microplastics to the environment and change what we do use to types that break down more easily once they are in the environment.

HOW CAN WE REDUCE THE AMOUNT OF MICROPLASTICS IN THE ENVIRONMENT?

On the one hand, with millions of tons of plastics entering the oceans each year, the problem seems hopeless. But people should keep in mind, the world has created this problem over decades, and it will take time to solve. A first step would be to reduce our usage of plastics, especially single-use plastics, in our every-day lives. This means always using reusable bags when shopping, avoiding buying plastic bottles for drinks, trying to avoid buying pre-made food packaged in plastic bags and containers. Packing a lunch in a lunchbox or paper bag can be cheaper than buying pre-packaged sandwiches, for example, as well as fun when choosing a variety of different things to eat.

Try to choose natural fibre textiles like cotton, linen and bamboo for your clothing and bedding. Recycling is problematic; much of it goes into landfills or is sent to developing countries where it may not be properly disposed of, so reducing your consumption of throwaway plastics is your best choice. Being educated on the issues is also important – often people do not understand why laws like banning disposable plastic bags are good reducing the amount of plastics that make it into the environment.

More importantly, it is vital to not get discouraged at the size of the problem and give up. Every action, no matter how small, helps. "I firmly believe that we will eventually have biodegradable plastics that are cheap and environmentally friendly as replacements for the throwaway, single-use ones we use today," says Jay. "People are working on this and have made excellent progress, but it will still take time."

ABOUT CITIZEN SCIENCE

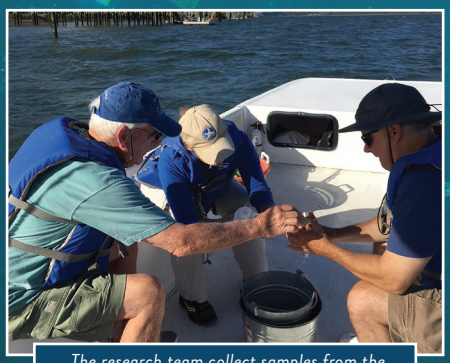
Citizen science is where members of the public help conduct scientific research. This generally happens under the direction of professional scientists and scientific institutions, but this is not always the case. The power of collaborative research is often seen in fields where there are enormous data sets that cannot be managed by scientists alone, and computers are unsuitable for analysing the particular data.

Of course, given the amount of water on Earth, almost anybody – with the right training – can collect, process and analyse environmental microplastic samples. With this in mind, Dodie developed a citizen science programme that has become indispensable to the UGA Skidaway/MAREX research. "Our initial findings left us with many questions and avenues to explore, but how could we accomplish the work with our own small working group; and, how do we best engage, educate and inspire the public about marine pollution like microplastics?" she asks. "Our answer was to develop a microplastics citizen science monitoring programme along the coast to determine distribution and abundance of microplastics."

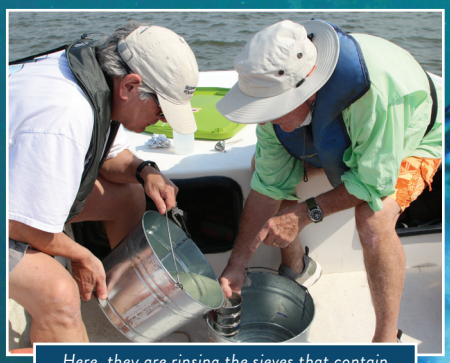
For a year now, Dodie has been working with several environmental groups, called Riverkeepers, in the Satilla, Ogeechee and Altamaha regions. These groups collect samples for microplastics analysis in the course of their regular sampling for other things such as nutrients and environmental toxins. Local citizen scientists round up their samples and bring them back to the research team for processing and analysis. She also has a group of volunteers from the UGA Marine Extension and Georgia Sea Grant who go out each week and collect samples from around the Georgia's coast, bring them to the lab, filter and count the microplastics in each sample, and report the data.

To do all of these activities using traditional academic models with technicians and graduate students would be very expensive, so the help that citizen scientists provide is invaluable for the Skidaway and UGA research, and science as a whole.

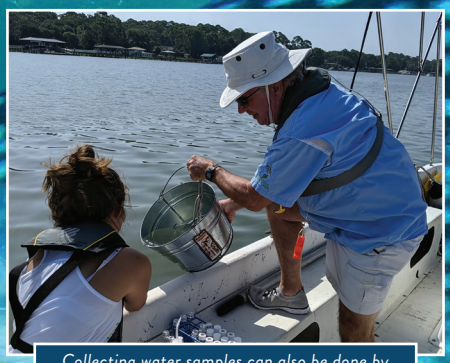
To find out more about how you can get involved in a citizen science project, take a look at The Big Microplastic Survey.



The research team collect samples from the water around Georgia's coast



Here, they are rinsing the sieves that contain water samples



Collecting water samples can also be done by citizen scientists like you

ASK PROF JAY BRANDES AND DODIE SANDERS

JAY, YOUR CAREER HAS ALWAYS BEEN CONCERNED WITH CHEMISTRY AND OCEANOGRAPHY. DID YOUR INTEREST IN THE OCEAN DEVELOP WHEN YOU WERE A CHILD?

I've wanted to be an oceanographer since I was about six years old. I kind of joke about it to my children, who have not had that kind of certainty about what they want to do in life, and are still trying to figure it out (my daughter is 17 and my son is 21). How I came to that conclusion is due to a combination of influences. One was the influence of 'The Undersea World of Jacques Cousteau' on TV when I was a kid. But I think the bigger influence was just visiting the sea in northern California where my grandparents lived and, later on, where I and my family lived. I loved being there, investigating tide pools and scuba diving in the kelp forests. The sea is a beautiful, magical place.

WHO OR WHAT INSPIRED YOU TO STUDY CHEMISTRY?

Very good teachers in college. I was lucky enough to live relatively close to one of the few universities at the time that had an undergraduate degree in oceanography (Humboldt State University, in Arcata, California). As part of the oceanography degree programme, students there had to take classes in the four main research areas in oceanography: biology, chemistry, geology and physics. Only then were you allowed to take more than just the introductory oceanography courses. I found that I enjoyed chemistry more than any of the other fields – much of this was because I was fortunate to have several great teachers in that field, who made their classes interesting. So, I think it was a combination of just being good at it and getting inspired to go into the subject.

DODIE, YOU ARE AN ENVIRONMENTAL EDUCATOR AND HAVE BEEN ENGAGING THE PUBLIC IN OCEANOGRAPHY RESEARCH FOR 30 YEARS. WHY ARE YOU SO PASSIONATE ABOUT CITIZEN SCIENCE?

Citizen science programmes are beneficial to research groups, monitoring agencies and policymakers, and can positively impact communities as citizen scientists become informed and empowered. Microplastics research is a relatively new science, which has caught the interest of the public, and this has led to individuals and environmentally-focused groups wanting to volunteer their time to help. Engaging these citizen scientists creates "force multipliers", meaning greater distances can be covered in shorter timescales. Not only that, but also as citizen scientists become more knowledgeable, their understanding will influence larger decisions about science policy.

DO YOU WORRY ABOUT THE HEALTH OF OUR OCEANS?

Jay and Dodie – Very much so. The oceans are under threat from the changes humans are making. Aside from plastics and microplastics, there are huge problems with overfishing, coral bleaching, acidification, temperature changes, the rise of sea levels, pollution, and so on. The ocean seems endless, but it is being stressed by the impact of so many people and their activities. Coral bleaching has already heavily damaged coral reefs around the world. Future generations will be denied seeing these places in their glory. What do we tell our children when they look at the old photos and movies of these places and ask, what happened?

JAY AND DODIE'S TOP TIPS

01 Know yourself! If working on science that involves both chemistry and the sea is your passion, then great! If you find chemistry boring but love the sea, that isn't enough. Being a successful marine chemist requires both having a passion for it and aptitude for it. There are lots of long hours and frustrating research difficulties to overcome, so you need the drive to keep going!

02 Make sure you get a good background in chemistry as an undergraduate – most of the student applicants we see for our graduate programme do not have a degree in marine science or oceanography. That is ok, if they are good at their chosen specialty.

03 If at all possible, try getting a summer internship at a marine lab or other place that does ocean-related research. This will really help you decide if this is the field for you, will make your graduate school applications stand out, and give you experience in how science is done in this field.

04 Write and write and write! People often neglect the skill and importance of writing. No matter the job, one is constantly evaluated on how proficiently they write – developing strong writing skills and habits will take you a long way.