Microplastic Contamination on Beaches of the Lesser Antilles

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Plastic pollution is one of today's most pressing global challenges. An estimated 4-12 billion kg of plastic enter our oceans annually, where it is broken down into smaller microplastics. Microplastics (pieces of plastics <5mm) are a group of contaminants of emerging concern, which are now ubiquitous in the environment.

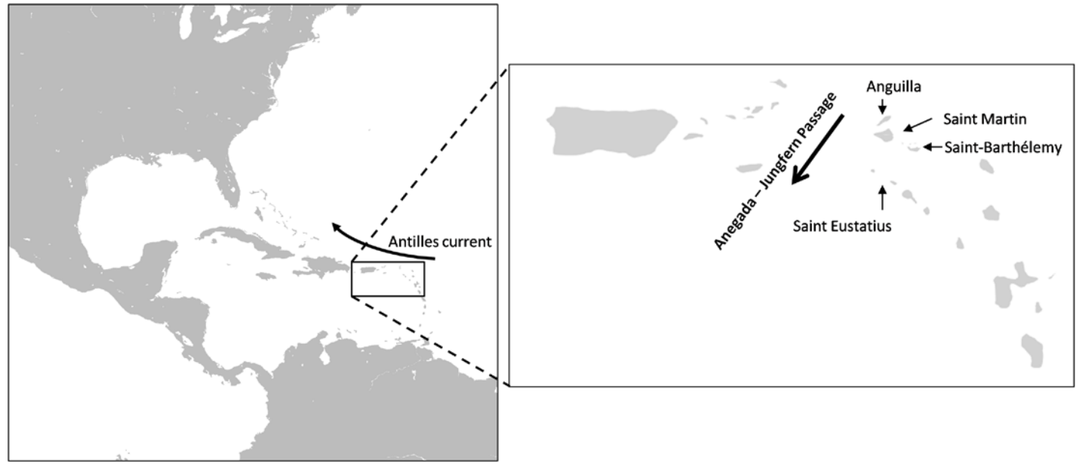
Two types of microplastics are commonly distinguished in the literature: primary and secondary microplastics. Primary microplastics are added to household products (for example cosmetics or body scrubs) or used in industry, and are often uniform in shape. In contrast, secondary microplastics are formed when larger pieces of plastic break down in the environment due to weathering and ultraviolet (UV) exposure. This results in fragmentation into smaller pieces of plastics, with different shapes (e.g., fibers, microspheres, fragments), size ranges (from the nano- to mm-range) and chemical constituents (e.g., polyethylene, polypropylene, polyvinylchloride and polystyrene).

Because of their small size, microplastics are easily ingested by organisms. In addition, laboratory experiments have found adverse impacts of microplastics, including decreased survival, decreased reproductive output, anomalous embryonic development and reduced feeding behavior. This has caused increased concern among scientist and the general public about the long-term impacts of microplastics in the environment.

One area of specific concern are marine environments, which have been identified as a major sink for microplastics. Because of ocean currents microplastics accumulate in certain regions in our oceans. For example, in the North Atlantic subtropical gyre levels of microplastics exceed 100,000 pieces/km^2. The North Atlantic subtropical gyre is located close to the Caribbean region, which is the location for this study. However, to date, very few studies have investigated microplastics in the Caribbean, or on Caribbean beaches.

To address this gap in our knowledge we started a study to increase our understanding on microplastics levels in beach sediment in the Caribbean region. To this end we investigated the level, distribution, and characteristics of microplastics on four Islands of the Lesser Antilles, located in close proximity to the North Atlantic subtropical gyre. In the summer of 2016, three undergraduate students (Lone Mokkenstorm, Lucia Guaita and Froukje Lots), all BSc students at Leiden University College in The Hague conducted a research project in the Lesser Antilles. They were hosted at the Caribbean Netherlands Science Institute (www.cnsi.nl) at St. Eustatius.

Over the summer they samples 14 beaches across four Islands on the Lesser Antilles: Anguilla, St. Barthélemy, St. Eustatius and St. Martin/Maarten. These islands are close to the North Atlantic subtropical gyre (Figure 1 and Figure 2). Beach samples were collected, and brought back to the CNSI for extraction of microplastics using a newly developed, standardized sampling and extraction protocol. After extraction microplastics were analyzed under a microscope and to measure levels at different beaches.



Top, Figure 1:
Figure showing the four Island in the Lesser Antilles region samples, and key current acting in the proximity of the sampling locations. Source: Bosker et al. 2018.
Source: Bosker et al. 2018.

Bottom, Figure 2:
One of the beaches samples during the research project.
Photo by: © Mokkenstrom, Lots and Guiata.

Every sample analyzed in this study contained microplastics. The average number of microplastics across all sampling locations was 261 microplastics/kg dry weight of beach sand. There was a wide range in the levels of microplastic among locations. The total number of microplastics ranged from 68 microplastics/kg at Anse des Sables on St. Martin, to 620 microplastics/kg at Grandes Cayes, also on St. Martin (Figure 3).

When comparing the average levels found on the four different islands, the highest levels of microplastic were found on Anguilla (311 microplastics/kg), followed by St. Martin (269 microplastics/kg), St. Barthélemy (239 microplastics/kg) and St. Eustatius (130 microplastics/kg). No difference in microplastic levels was found between windward and leeward beaches. Of all the microplastics collected, 97% were fibers and the remaining 3% were particles (Figure 4).

It is unclear what caused the difference among locations. One explanation could be the difference in population levels between the islands. St. Eustatius has ~3,500 inhabitants, and had the lowest level of microplastics. For comparison, Anguilla hosts ~15,000 inhabitants, St. Martin ~70,000 inhabitants and St. Barthélemy ~9,300 inhabitants.

Although our study provides important data on the microplastics concentration in Caribbean beach sand, there are several important avenues for future research. Firstly, future work should focus on understanding regional microplastic sources. In our current study we only investigated the microplastic levels on beaches, but a study looking at surface and sediment levels in the region is needed to understand the sources and sinks of microplastics. Secondly, we suggest an investigation of microplastic impacts on local organisms.

The results have been published in the academic journal Marine Pollution Bulletin. Our research provides a detailed study on microplastics on beaches in the Lesser Antilles. These results are important in developing a deeper understanding of the extent of the microplastic challenge within the Caribbean region. This will ultimately increasing our understanding on how to develop optimal coastal management regulations to protect these ecosystems. This is of importance, as this region has an exceptionally rich biodiversity, making it a biodiversity hotspot for both terrestrial and marine ecosystems.

Acknowledgements:
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Additional information:
For more background information on microplastics see: www.lucmicroplastic.wordpress.com

Article:
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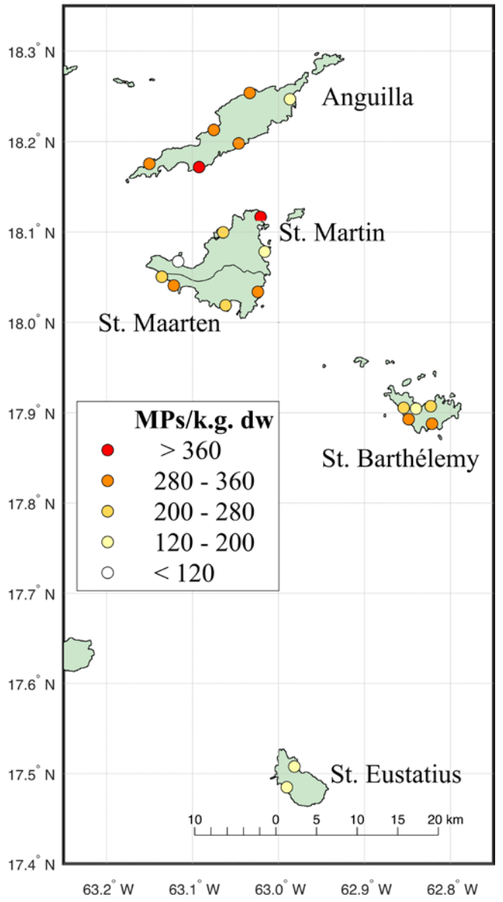

Figure 3:
Microplastic contamination levels across beaches on four islands (Anguilla, St. Barthélemy, St. Eustatius and St. Martin) of the Lesser Antilles. Contamination is reported in number of microplastics per kg of dry sediment. Source: Bosker et al. 2018.

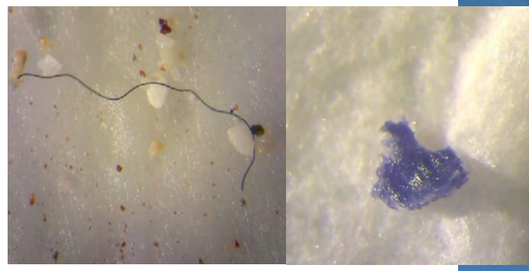

Figure 4:
An example of a microplastic fiber (left) and particle (right) found in the beach sand.
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