

CARIBBEAN RESEARCH PAPER: SUMMARY



The Caribbean is renowned globally for its stunning beaches and crystal clear ocean. However, its islands and the surrounding sea are being contaminated by plastics, posing a potential future threat to its diverse marine life and the tourism industry on which its economy depends.

To date, little work has quantified plastics within the Caribbean marine environment or examined their potential sources. We aimed to address this during eXXpedition Round the World (RTW) by conducting the first holistic assessment of marine and land-based plastic pollution in the Southern Caribbean, alongside scientists at the University of Plymouth in conjunction with the University of Georgia, Plymouth Marine Laboratory and the Technological University of Panama.

This is a summary of the full study. Any questions or inquiries please contact info@exxpedition.com.

CARIBBEAN RESEARCH PAPER

SOURCE, SEA AND SINK - A HOLISTIC APPROACH TO UNDERSTANDING PLASTIC POLLUTION IN THE SOUTHERN CARIBBEAN

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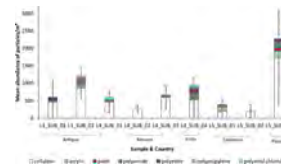
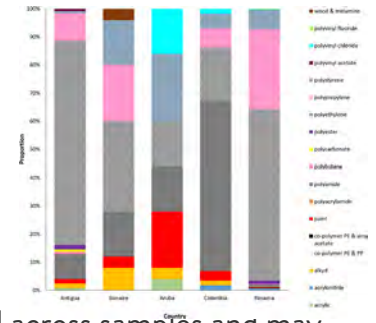
Source, sea and sink—A holistic approach to understanding plastic pollution in the Southern Caribbean Courtene-Jones, W., Maddalene, T., James M. K., Smith, N. S., Youngblood, K., Jambeck, J. R., Earthrowl, S., Delvalle-Borrero, D., Penn, E., Thompson, R. C.

Research locations: Caribbean Sea, Antigua, Bonaire, Aruba, Panama (Colombia at-sea only)

Summary Results: see the full paper for detailed analysis and references.

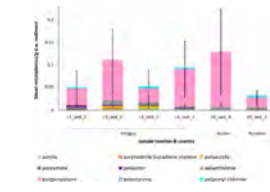


Surface Water Samples: The figure shows the proportion of plastic polymers identified in the surface water of each Caribbean country sampled. The polymer composition varied between geographic regions with Antigua and Panama having the greatest diversity of plastics. Polyethylene was ubiquitous across regions potentially arising from consumer products. Paint flakes and alkyd were identified across samples and may arise from the maritime / tourism industry.

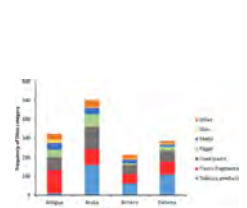


Subsurface Water Samples: The figure shows the abundance and composition of particles identified per m³ of water sampled from a depth of 25m. Cellulose fibres were found in all samples, with polyamide (in the form of fibres) the most common plastic particle.

Sediment Samples: The figure shows the abundance and composition of plastics isolated per gram of dry weight sediment. In contrast to the water samples, polypropylene dominated sediment, this polymer has applications as packaging (e.g films and containers) and in the maritime sector (e.g. ropes).



Land Based Assessments: The figure shows the frequency of litter recorded during land transects. Tobacco products, plastic fragments and food packaging were consistently the top three categories of litter recorded in each country. Food packaging may be a source of polyethylene, polypropylene and polystyrene identified in marine samples.



HOW TO USE THIS RESEARCH TO CREATE CHANGE

The holistic approach of this research and consequent results, highlights the importance and need for more integrated and interdisciplinary studies to better understand and inform on the most effective solutions to the multifaceted issue of plastic pollution.

Until now, evidence of the abundance of plastics within the Caribbean has been lacking. This study presents a snapshot of plastic pollution, and how it differs – in quantity, nature, origin and the policies in place to manage it – across the south of the region. It contributes towards the void of knowledge regarding marine plastic pollution in the Caribbean Sea and highlights the need for international collaborative research and solutions to plastic pollution.

A multidisciplinary need

Off the coast of five Southern Caribbean countries, we identified 18 different polymers of plastic - including synthetic fibres, paint flakes and acrylics. The quantities and polymer types varied between the water surface, subsurface and sediment, as well as between geographic areas.

Just as the types and sources of plastic pollution are many, so too must be the solutions. There's no silver bullet solution, there's not one thing, but there are hundreds of different ways to solve it. As well as more holistic research, what's needed is a multidisciplinary approach to solution finding, which is the same approach we took to collecting the data for this study by involving multidisciplinary women from diverse professional backgrounds, not typically scientists, who made up the eXXpedition crew in the Caribbean.

We hope that the crew's first-hand experience of the real challenge of microplastics gives them the authority, confidence and deep sense of motivation to take action back on land in their areas of expertise. They can't unsee what they've seen, instead they head home and create positive change on the issue whether they're engineers thinking differently about



waste management, chemists looking at ways to reinvent plastic or a biodegradable material, teachers creating educational content or policy makers pioneering strong legislation.

Global solutions, cross-cultural and cross-boundary solution finding

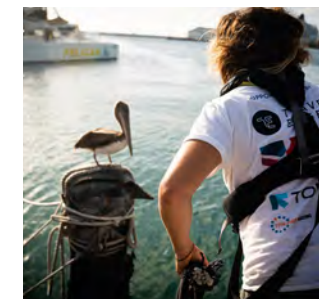
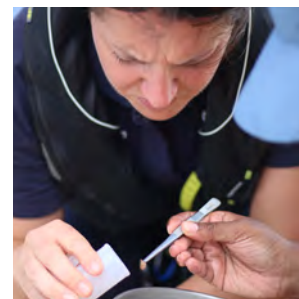
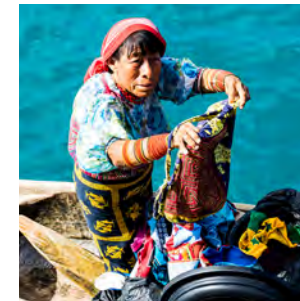
The importance of understanding the transboundary movement of marine litter in the Caribbean, due to the prevailing ocean currents, can not be understated. Such movement can undermine local or national legislation aimed at reducing plastic pollution.

Very few plastic bags or expanded polystyrene foams were found as litter in countries (Antigua, Aruba) which had a ban on these items. However polystyrene foam was identified within surface water samples, suggesting that these may have originated from elsewhere and been carried by ocean currents.

The highest concentrations of plastic (5.09 particles per m³) were located off the San Blas islands in Panama. Detailed ocean modelling and an assessment of regional policies indicated the abundance of microplastics around Panama likely arose from a combination of distant sources, carried by ocean currents, and run-off from mainland Panama, which has some of the highest estimated levels (around 44%) of mismanaged waste in the region.

By comparison, Antigua, Bonaire and Colombia had lower quantities of both terrestrial and marine plastics. The Antiguan samples had a high diversity of polymer types and particle modelling suggests these plastics may have been transported by currents generated in the wider North Atlantic Ocean, even originating from the so-called North Atlantic garbage patch.

Policy works - as seen with the link between plastic bag bans and the lack of plastic bags documented in land-based litter surveys - but it needs to be cross-border and at a global scale.



Further holistic research, such as this study, can help to identify where interventions may be interlinked, resulting in the most significant impact - through regional and international strategies, plastic reduction interventions and policies - to reduce plastic pollution.

Economy and the natural environment

Island nations, such as those in the Caribbean, will be disproportionately affected by increasing plastic pollution due to their ocean-dependent economies and their still developing and vulnerable waste management infrastructure.

Marine plastics are considered to be a major threat to the sustainable use of marine and coastal resources of the Caribbean, on which the region relies heavily for tourism and fishing. However, the research identifies the maritime and tourist industries as contributing towards both terrestrial litter and the microplastics identified in marine samples which represents the complex challenge of managing plastic pollution in the Caribbean region.

Education and problem solving at the source

Tobacco products (primarily cigarette stubs), plastic fragments and food packaging were consistently the top three types of litter found in every land assessment, indicating the contribution from consumer products, and the ability of these to fragment into microplastics when in the environment. This raises the need for public education and awareness about the role of the individual in protecting our ocean from plastic pollution.

However, the most effective place to tackle plastic pollution is at the source. The polymer data collected during eXXpedition Round the World will be made available to industry to identify types of plastic and products that are being mismanaged and ending up in the marine environment - for example, the finding that polyethylene is the prevalent polymer type across our research is an insight that helps industry leaders better understand the negative impacts of their products on our ocean so they can address it. It will also be made available to policy makers and broader stakeholders to

guide and inform Caribbean policy change towards reducing mismanaged waste in the region.

In summary, we set out on eXXpedition Round the World to pinpoint where the solutions to plastic pollution lie on land by better understanding the sources.

The striking thing from our discoveries is the diversity of polymer types which means the pollution has come from many different sources and as a result means the solutions need to be diverse too. Plastic doesn't end up where it starts. We all share one planet and wherever we live the ocean connects us - this study demonstrates why for any game-changing action to tackle ocean plastic pollution all sectors of society must come together in a holistic way across the Caribbean region and beyond.



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eXXpedition emphasized the importance of diversity when it comes to problem solving. Diversity in terms of people, in terms of their ideas, their disciplines and their characters. Perhaps even more important than the science, was realising the importance of an “all hands on deck” approach

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La Daana Kanhai, Trinidad - Leg 4 Crew