



Testimony of Dr. Marcus Eriksen, Co-founder & Researcher, The 5 Gyres Institute

U.S. Senate Committee on Environment & Public Works Hearing: *Evaluating Material Alternatives for Single-Use Plastics*

Washington D.C.

October 26, 2023

Good morning Subcommittee Chair Senator Merkley, Ranking Member Senator Mullin and all committee members. My name is Dr. Marcus Eriksen, co-founder and researcher at The 5 Gyres Institute. Thank you for this opportunity to speak about my experience and observations in researching plastic pollution and allowing me to elevate some potential, science-based solutions.

Fifteen years ago, we began leading research expeditions around the world to answer a few key questions about plastic pollution: how much plastic is in the world's oceans, where is it, and what's the impact on all life? Twenty expeditions and 50,000 nautical miles later, we found answers. Plastic pollution is ubiquitous, impacting habitats and wildlife around the world, our neighborhood streets¹, the air we breathe², and the food we eat^{3 4 5 6 7}.

We published a paper earlier this year revealing more than 170 trillion microplastic particles, weighing 2 million tonnes, are floating on the ocean's surface⁸. An alarming 40-year trend shows a rapid increase in plastic pollution since the turn of the millennium. This is probably a result of some fragmentation of existing pollution, but ultimately, there's too much plastic being produced (see Appendix 1 and 2).

¹ Zhu, X., Munno, K., Grbic, J. et al. Holistic Assessment of Microplastics and Other Anthropogenic Microdebris in an Urban Bay Sheds Light on Their Sources and Fate. *ACS ES&T Water* 1:6, 1401–1410 (2021).

² Allen, S., Allen, D., Phoenix, V.R. et al. Atmospheric transport and deposition of microplastics in a remote mountain catchment. *Nat. Geosci.* 12, 339–344 (2019).

³ Sobhani Z., Lei Y., Tang Y., et al. Microplastics generated when opening plastic packaging. *Scientific Reports* 10: 4841 (2020).

⁴ Karami, A., Golieskardi, A., Choo, C.K., et al. The presence of microplastics in commercial salts from different countries. *Scientific Reports*, 7: 46173 (2017).

⁵ Liebezeit, G. & Liebezeit, E. Synthetic particles as contaminants in German beers. *Food Additives & Contaminants: Part A.* 31(9), 1574-1578 (2014).

⁶ Hernandez, L.M., Xu, E.G., Larsson, H.C.E., et al. Plastic Teabags Release Billions of Microparticles and Nanoparticles into Tea. *Environmental Science & Technology* (2019).

⁷ Ribeiro, F., Okoffo, E.d., O'Brien, J.W., Seafood by Pyrolysis Gas Chromatography Mass Spectrometry. *Environmental Science & Technology* 54: 9408–9417 (2020).

⁸ Eriksen M., Cowger W., Erdle L.M., et al. A growing plastic smog, now estimated to be over 170 trillion plastic particles afloat in the world's oceans—Urgent solutions required. *PLoS ONE* 18:3 (2023).

The plastic on the ocean's surface is really just the tip of the iceberg. We see the impact of plastic on land, in rivers and lakes, and even in deserts. I had the opportunity to return to the Middle East after serving our country in the U.S. Marine Corps in Kuwait 30 years ago during Operation Desert Storm. This time, I was on a different mission as an environmental scientist. I came across the skeletal remains of camels, and discovered masses of densely packed plastic bags inside their stomachs – we estimated there were 2,000 plastic bags inside of one camel⁹. We defined this as a “polybezoar”, a synthetic mass of plastic waste trapped in the stomach or digestive tract of a grazing mammal (see Appendix 3).

I've pulled single-use plastics out of whales and other marine mammals, sea turtles, and seabirds. But plastic isn't just a problem for wildlife. In recent years, plastic has been found in our own bodies, including our lungs¹⁰, heart¹¹, and blood¹². It's an urgent issue that impacts every being on the planet.

Before we talk about solutions, it's important to note that I'm not talking about plastic in cell phones, medical devices, or cars. The problem I'd like to discuss here is single-use plastic. This is the majority of discarded plastic, documented in global cleanups efforts – on land and at sea¹³. When we say single-use plastics, we are referring to items designed to be used once, or for a short period of time, before being thrown away. With production of single-use plastics growing quickly, American people continue to be fooled into inadequate solutions.

Recycling has had 40 years to prove its effectiveness, but these systems have failed for single-use plastics¹⁴. We need to accept that we're not going to recycle our way out of this problem. Fortunately, the private sector is meeting this challenge head on. Successful business models showcasing reusable and refillable packaging are proving that you can do business without causing harm or a waste management burden for taxpayers^{15 16 17}.

However, reuse and refill systems might not work for every sector of plastic use in society¹⁸. In those cases, we can turn to the promising research and innovation that continues to emerge around novel biomaterials. Biomaterials are polymers derived from natural origins, like paper, plant fibers, or a variety of bioplastics like polyhydroxybutyrate (PHB), which is produced by microorganisms.

⁹ Eriksen, M., Lusher, A., Nixon, M., et al. The plight of camels eating plastic waste. *Journal of Arid Environments* 185:104374 (2021).

¹⁰ Jenner, L.C., Rotchell, J.M., Bennett, R.T., et al. Detection of microplastics in human lung tissue using μ FTIR spectroscopy. *Science of The Total Environment* 831: 154907 (2022).

¹¹ Yang, Y., Xie, E., Du, Z. Detection of Various Microplastics in Patients Undergoing Cardiac Surgery. *Environmental Science & Technology* 57:30 10911-10918 (2023).

¹² Leslie, H.A., Martin J.M. Velzen, V., et al. Discovery and quantification of plastic particle pollution in human blood. *Environment International* 163: 107199 (2022).

¹³ Ocean Conservancy. Fighting for Trash Free Seas, Cleanup Reports, The International Coastal Cleanup® <https://oceanconservancy.org/trash-free-seas/international-coastal-cleanup/annual-data-release/>

¹⁴ Greenpeace. Circular Claims Fall Flat Again. Report 2022. <https://www.greenpeace.org/usa/reports/circular-claims-fall-flat-again/>

¹⁵ Klean Kanteen product website <https://www.kleankanteen.com/>

¹⁶ Plain Products product website <https://www.plaineproducts.com/>

¹⁷ ReGrocery product website <https://regrocery.co/>

¹⁸ Erdle, L.M., Eriksen, M. Monitor compartments, mitigate sectors: A framework to deconstruct the complexity of plastic pollution. *Marine Pollution Bulletin* 193:115198 (2023).

5 Gyres recently completed an 18-month field study that measured the fragmentation of bioplastics in different terrestrial and marine settings. We took 22 items, including straws, film, and forks, and put them in real-world environments (ocean, desert, forest, wetlands) across three states. The results showed that when biomaterials end up in realistic environments, some do not last long (see Appendix 4).

Looking at the five types of straws in the study, some of the biomaterials were gone in 16 weeks or less. We found that PHB, which has the functionality of some plastics, degraded as fast as paper, while the polyethylene straw was unchanged. When we look at different types of film, we find the polyhydroxyalkanoates (PHA) is gone at 16 weeks, while polyethylene remains unchanged throughout the study. Likewise, the utensils made of biomaterials largely degraded over the course of 18 months. However, the bamboo utensil did not, and the polystyrene looked as new as day one.

The innovation and entrepreneurship in this space gives me hope for the future. We're seeing new business models emerge across our country, and dozens of biomaterial companies are making tremendous headway in the packaging space. These companies are replacing fossil fuels with regenerative materials, like seaweed, waste methane, and mushrooms^{19 20 21 22}. This offers a new opportunity for significant job creation in industries that don't endanger people's health. The U.S. has an opportunity to lead the way here.

In closing, I want to reiterate that the abundance of micro and nanoplastics in all environments – even our bodies – is increasing at an alarming rate, requiring urgent action. A growing body of research, including our work, shows that biomaterials are a promising solution in many applications as we shift away from fossil-fuel based plastics. I want to thank you again for this opportunity to speak with you today, and I'm happy to answer any questions you may have.

¹⁹ Sway product website. <https://swaythefuture.com/>

²⁰ Notpla product website. <https://www.notpla.com/>

²¹ Mango Materials product website. <https://www.mangomaterials.com/>

²² Ecovative product website. <https://www.ecovative.com/>

APPENDIX

Appendix 1.

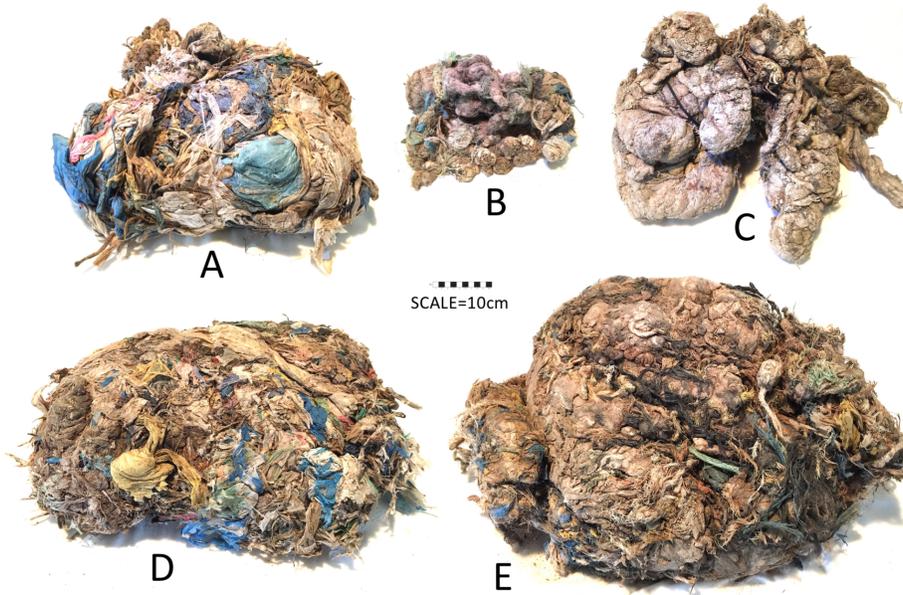


SOUTH PACIFIC GYRE

Appendix 2.



Appendix 3.



Appendix 4.



BETTER ALTERNATIVES 3.0

18-Month Study on Biomaterial Fragmentation in Real Environments

PHA		PLA		PHA	
PLA		PE		PLA	
BAMBOO		PBS		PHB	
PS		PHA		PAPER	
		PHA-PLA W/ METAL BARRIER		PE	
		PBAT-PLA			
California Marine at 64 Weeks		California Marine at 16 Weeks		California Marine at 16 Weeks	