A Product of the Environment: Toxicities of Microplastics and Practice of Laboratory Science

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The positionality of a second year PhD student in an academic space is vulnerable and therefore the language in this talk will be restricted to protect this career position. The content of this section of the panel will be bounded—in a talk that is nonetheless focused on feminist transnationalism—but seeks to still be informative and transgressive in subtle ways. The following theory and methodology portions of this panelwill provide direction and ideas to further the practice of laboratory science in the context of chemical entanglements.

As a scientist within an academic institution there is difficulty in considering oneself a feminist scientist when there is daily complacency to oppressive structures. Pulling from the Research Justice 101: Tools for Feminist Science workshop presented at the Science and Justice Research Center at UC Santa Cruz with the scientist-artist collective Free Radicals, I can attempt to dissect the "work" that the research is doing in feminist contexts. No longer depending on the Scientific Method, which is the framework for nearly every publishable scientific journal, we look towards the Feminist Model of Inquiry which is informed by Sandra Harding's research. Replacing the hypothesis, analysis, and conclusion sections there are the locating your research, defining the purpose, interrogating the hypothesis, and analyzing power dynamics sections of data representation. With this in mind, we delve into the early stages of the distribution and characterization of microplastics in terrestrial environments, which is part of my dissertation research in the Environmental Toxicology Program at UC-Riverside. Ultimately, I hope to disrupt the notion that scientific research was ever or will be objective as is assumed in the Scientific Method.

Beginning with a community, cultural, and historical locatedness we seek to understand the social situation of the microplastics in terrestrial environments research. Recent studies have confirmed that microplastics (MPs) are present in every ecosystem on Earth. Although there is a general understanding of their abundance in marine and aquatic systems, terrestrial ecosystems have yet to be investigated to the same extent. It is estimated that there are 4-23 times more MPs in soil than in oceans and that MPs can make up 0.002%-7% of the soil by abundance[1]. My focus is to characterize MPs entering terrestrial ecosystems via atmospheric deposition and contribute to the understanding of the global cycling of MPs.

Snow environments offer an opportunity to study ambient levels of MPs and easy to work with medium due to the lack of carbon that would need to be separated from the MPs. Alpine environments that have glaciers or permanent snow fields accumulate long-range MPs deposited from the air through storm, wind, and snow events or short-range deposition by human presence on the snow. The global net melting of snow and ice due to climate change could serve as a source of accumulated long-range deposited MPs to downstream environments. With the simultaneous progression of increased snow melt due to climate change and increasing use and disposal of plastics, the accumulation and release of air transported MPs from snow fields to aquatic and terrestrial environments will increase and enter the global water supply. Microplastics could also travel globally via a process called global distillation, just like other persistent organic pollutants like PBDE, PCBS, etc. Global distillation is a thermodynamic

[1] Lozano, Yudi M., and Matthias C. Rillig. "Effects of Microplastic Fibers and Drought on Plant Communities." *Environmental Science & Technology* 54, no. 10 (May 19, 2020): 6166–73. https://doi.org/10.1021/acs.est.0c01051.

phenomenon where persistent organic pollutants will rise with warm air and deposit with cooler temperatures causing them to travel towards the Earth's poles with a "grasshopper" pattern. It is predicted that MPs with lower molecular weights travel with this pattern, like it has been observed with polychlorinated biphenyls, to within the arctic circle. Understanding the travel of MPs at a latitudinal scale is important because of their ability to adsorb heavy metals, hydrophobic/lipophilic POPs, and pathogenic bacteria and fungi. Therefore, studying MPs in snow offers an efficient method of sampling and potential answers to the abundance and types of MPs that are being transported long distances in the MP global cycle.

In looking to describe the purpose of this study we look to toxicological research on microplastics. Studying MP distribution in terrestrial environments is important because it is evident that plastic particles can affect the immune, gastrointestinal, and respiratory systems of living organisms. They cause inflammation of the lungs when inhaled, leach endocrine-disrupting plasticizers, and act as vectors for pathogenic bacteria and fungi. Furthermore, their indestructibility and inability to degrade can cause MPs to adversely affect ecosystems for several generations. To complicate the narrative, they do have a "cleaning effect" or behave as POP sinks. Flame retardant and pesticides will adsorb to their surfaces because of hydrophobic characteristics. Surface area on MPs increases with aging and abrasion so their adsorption of POPs potentially increases. POPs do not tend to desorb from MPs even in the most acidic of environments like guts. Desorption has been observed *in vitro* and at the concentrations of microplastics found in the environment, *in vivo* will unlikely hold significance. Plastic production is predicted to increase in the next decade and thus long-term biomonitoring is also important to the story of MP influx in terrestrial ecosystems. Microplastics are not alone in this trend as persistent organic pollutants also have increasing influx and do not degrade in the environment.

Now we look to interrogate the hypothesis that MPs have patterns of long-range deposition at the local, regional, and global scale. We can look to the history of other persistent organic pollutants. The concept of purity or non-exposure has long been gone. Everything and everyone has been exposed—but the dosage is distributed disproportionately across gender, class, and race[2]. How is it that some of these chemicals which have dose-response curves for multiple species are still used as biopolitical warfare on communities? Public policy aims to provide care for people, possibly even protection from multinational companies entering vulnerable communities. For example, one way in which companies poison beyond their borders is through a loophole that allows United States-based pesticide producers to manufacture non-EPA registered chemicals in the United States as long as they only export them to unregulated markets beyond US markets. Will there be a collaboration that will regulate movement between markets for human and environmental health?

Lastly, we look towards the power dynamics involved in this research. The concept of sampling sites is extractive and has had a horrid history of being violent, especially towards First Nations communities[3]. I will be taking liters of snow from stolen Indigenous lands that are kept by colonial institutions like the US Forest Service and National Park systems[4]. To do so, I write a permit that will be evaluated based on potential sound, soil, and water invasiveness with respect to the local ecosystem[5]. I have received a letter of nominal use that allows me to take my samples in predetermined locations. I don't know if they disrespect sacred sites based on their locations. Ironically, it is well known that

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[2] Barba, Mayra G. Sánchez. "'Keeping Them Down': Neurotoxic Pesticides, Race, and Disabling Biopolitics." *Catalyst: Feminism, Theory, Technoscience* 6, no. 1 (May 15, 2020). https://doi.org/10.28968/cftt.v6i1.32253.

[3] Harding, Sandra. *Whose Science? Whose Knowledge?*. Cornell University Press. 1991.

[4] Varela, J., Amor, B., and Haile R. *Greater Outdoors: Meet the Leaders Making Nature More Accessible*. Bitch Magazine. Fall/Winter 2021 no. 92.

[5] Note that much of Caltech's founders were on the Human Betterment Foundation Board. This institution conducted over 15,000 eugenic sterilizations in California that targeted women of color (not of "aryan" race).

private land or buildings are a means of avoiding permitting because the owner simply needs to give a yes or no. In especially alpine endeavors, there is a warm handshake with systems of scientific domination[6]. The intensely, and ever so toxic!, masculine endeavor of conquering peaks, staking with names to erase, and claim first ascents/descents coincide with first to publish on a topic, become territorial over research subfields, and control the production of data. There is credibility earned in ascending the academic hierarchy, allowing a very elite group of people to publish in paywalled journals (if they are going to be open-source authors will pay the journal a considerable sum of money to keep the article publicly accessible)[7].

On a final note, what is practicing care in microplastics research[8]? It is lonely in the West, where the field is bustling with publications, and I reach out to the Tomsk State University where Dr. Yulia Frank is the director of the Microplastics Siberia Center to mail me samples to use an instrument (FTIR) that I have access to. Involving myself in the research community by being both the mentee and the mentor in academic mentoring programs. Going to high schools in the regions where samples will be taken and asking students for input and what is important to them when it comes to microplastics. Expanding the communication styles of data analysis, working with scientist-artist collectives like Free Radicals (that pays artists!). Ultimately, the goals are to generate non-hierarchical collaborations between scientists, community leaders, and the species that don't have voices. Making sure that *in vitro* is complex and is mimicking the environment with used mixed and aged microplastics that are exposed to UV, saltwater, or biofilms. The politics of caring for people inside the institution will need to develop, to create projects that care for people[9].

Acknowledgements go to Sophie Wang and Alexis Takahashi of Free Radicals, Helen Lamb for editing this piece, Dr. Melina Packer, Dr. Maya Sanchez Barba, and Professor Natalia Duong.

[6] Carey, Mark, M. Jackson, Alessandro Antonello, and Jaclyn Rushing. "Glaciers, Gender, and Science: A Feminist Glaciology Framework for Global Environmental Change Research." *Progress in Human Geography* 40, no. 6 (December 1, 2016): 770–93. https://doi.org/10.1177/0309132515623368.

[7] Rivers, Daniel Lanza. "Cartographies of Feminist Science Studies." *Women's Studies* 48, no. 3 (April 3, 2019): 177–85. https://doi.org/10.1080/00497878.2019.1603980.

[8] Chen, Mel Y. *Animacies: Biopolitics, Racial Mattering, and Queer Affect*. Duke University Press 2012.

[9] Packer, Melina. "Chemical Agents: The Biopolitical Science of Toxicity." *Environment and Society* 12, no. 1 (September 1, 2021): 25–43. https://doi.org/10.3167/ares.2021.120103.