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Title: Microplastic freshwater contamination: an issue advanced by science with public engagement

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Opinion

Plastics are a major source of environmental pollution that has been brought to the fore by the discovery of floating plastic continents in several oceans as well as media images of large plastic pieces wrapped around or ingested by wildlife. The high visibility of macroplastic pollution raise awareness among the general public, however this is not the only plastic-out-of-place. Additionally, both micro- and nanoplastic particles are also being found in marine environments (including deep water environments) and they have different effects and environmental impacts because of their size and composition (Jamieson et al. 2019). While each of the above-mentioned categories of plastics have been found in significant quantities in certain maritime areas, the prevalence and impact of these plastics in freshwater systems, while well researched (Eerkes-Medrano et al. 2015; Li et al. 2018), is much less known to the public. Because of this lack of visibility, there has been little public awareness or discussion of the problem. For policy agendas and civic action, it is necessary that the public be part of the conversation for both more research and for change leading to cleaner freshwater.

A model for this problem is the recent shift of citizen awareness and policy change recommendations in the US with regard to [per- and polyfluoroalkyl substances](#). These substances called PFOA and PFOS, are widely used to make carpets, textiles, food packaging materials, non-stick cookware, and are also common for firefighting at airfields and in other industrial processes. They are persistent synthetic fluorochemicals that do not break down in the environment and have been found in drinking water supplies across the U.S. (Andrews, D 2019). In a short time, with the engagement of scientists, social scientists and the public, the contamination by PFOA and PFOS of drinking water emerged from invisibility to a matter of intense public engagement (Cordner et al. 2019a, b). In the US, while their health consequences were known to both the EPA and industry researchers since the early 1960s, they remained ubiquitous in consumer and industrial products (Richter et al. 2018). Through a variety of public engagement mechanisms, these fluorochemicals, particularly their presence in groundwater and public water supplies has come to the forefront of environmental debates and policy pressure in the US (Bruton and Blum 2017) (<https://www.northeastern.edu/environmentalhealth/about-ssehri/>).

Abstract or potential problems are more difficult for the public to visualize, deliberate about, or mobilize against (Syberg et al. 2018), and outreach education can be a way to engage the public, an important step in bringing about policy change and action. Depending on the body of fresh water, a significant amount of microplastic contamination comes from: a) degradation of disposable plastic, such as packaging materials; b) industrial abrasives; and c) the breakdown of certain synthetic clothing fibers from washing (Dris et al. 2015). Thus, addressing the majority of freshwater microplastic accumulation is not straightforward as it includes the industrial packaging and cleaning sector, the commercial and governmental disposal sector, the garment industry, as well as targeting consumer behavior and choice.

Following the success of PFOA and PFAS awareness in the US, it is our assertion that while furthering the science freshwater plastics contamination is of utmost importance, it is also important to include non-scientists, citizens in the public sphere, regarding the extent of the problem and its potential solutions (Frickel et al. 2010). Strategies to lower the levels of microplastics in freshwater coincide with lowering plastic pollution in general and “range from reuse, green chemistry, designs for recycling, improved waste management, standardized labeling, education, cleaning programs, and sustainable consumption” (Kramm and Völker 2018).

Given the complexity and uncertainty of the science at this time and the number of sectors involved, any public engagement should be for the purposes of education, collaborative discussion, and precautionary policy changes. Citizen science conducted as consensus conferences and deliberative forums, can be catalyst for more public engagement and action. Additionally, public risk perception regarding the accumulations of plastic pollution in the marine environment is relatively well developed and the freshwater contamination problem could potentially build on this. Citizen science, as an inclusive, participatory approach, engenders an atmosphere of transparency and civic agency around emerging environmental issues and can be beneficial for recommending paths forward toward reducing microplastic contamination in freshwater to both scientists and policymakers.

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