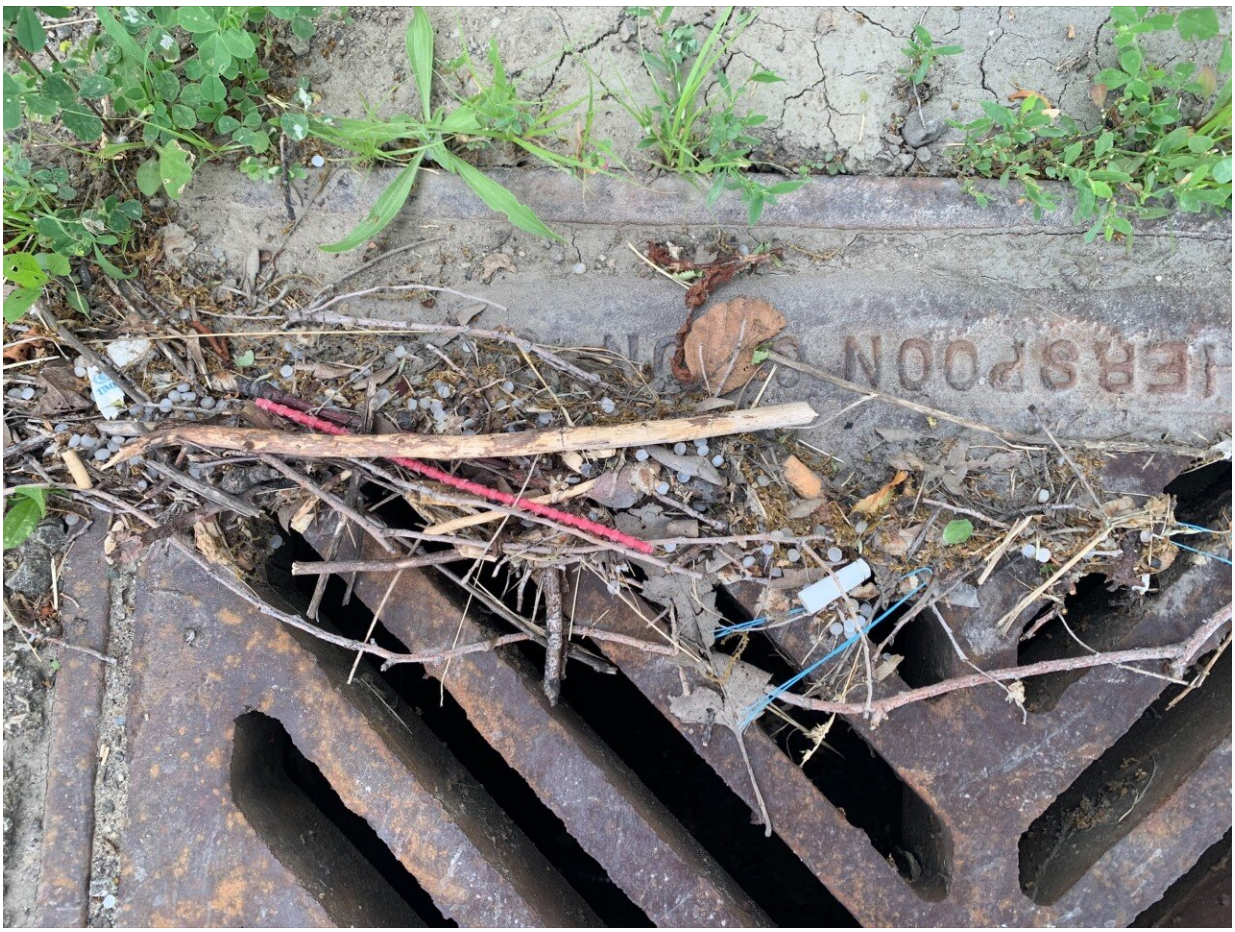
Scientists develop framework to measure plastic emissions and bolster U.N. efforts to reduce pollution

April 16 2024



Mismanaged plastic pellets gather around a storm drain near an industrial plant. Credit: U of T Trash Team

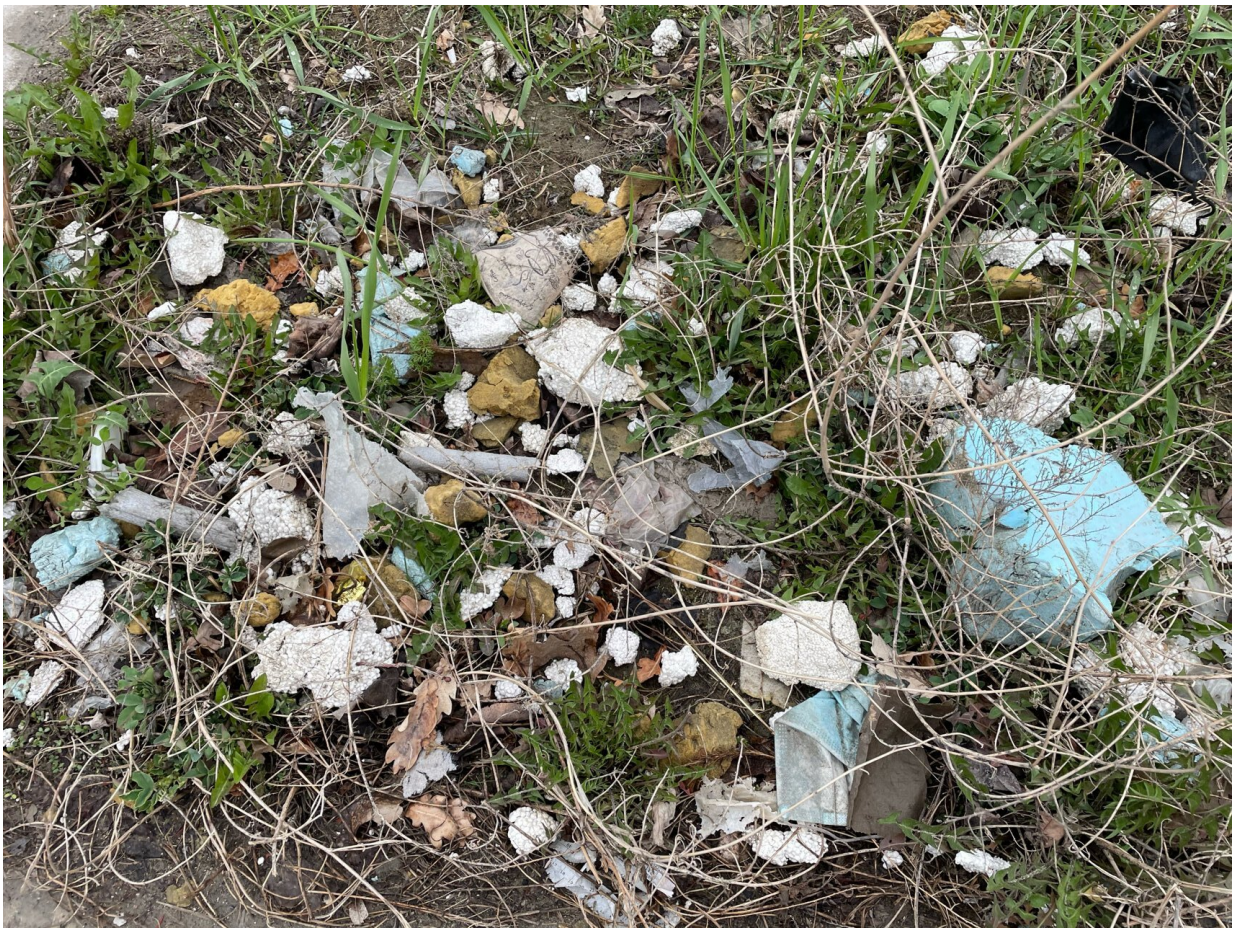
University of Toronto (U of T) scientists have developed a framework for measuring plastic pollution emissions akin to the global standard for measuring greenhouse gas emissions. The researchers say the approach will boost identification of the biggest contributors to plastic pollution from local to national levels and improve strategies in reducing emissions worldwide.

The framework arrives ahead of international discussions in Ottawa from April 23 to 29 led by the United Nations' Intergovernmental Negotiating Committee on Plastic Pollution towards a legally binding global agreement on plastic pollution.

Using Toronto as a model, the researchers developed the first-of-its-kind framework and estimated that in one year alone, Toronto emitted nearly 4,000 tons of plastic pollution.

"That's roughly 400 garbage trucks' worth of plastic that leaks into the environment annually from across the city," said Alice (Xia) Zhu, lead author of a study outlining the method published in *Environmental Science & Technology*. Zhu is a Ph.D. candidate working with Assistant Professor Chelsea Rochman in the Department of Ecology & Evolutionary Biology in the Faculty of Arts & Science at U of T.

"Assigning responsibility for the pollution to a jurisdiction with the ability to enact laws means there is no hiding where the pollution came from. It presents an opportunity to identify major sources of plastic pollution within the area and inform measures to curb these emission," Zhu added.



Mismanaged waste from littering, including fragments of foam packaging, accounted for the greatest share of an estimate of plastic pollution in Toronto in 2020. Credit: U of T Trash Team

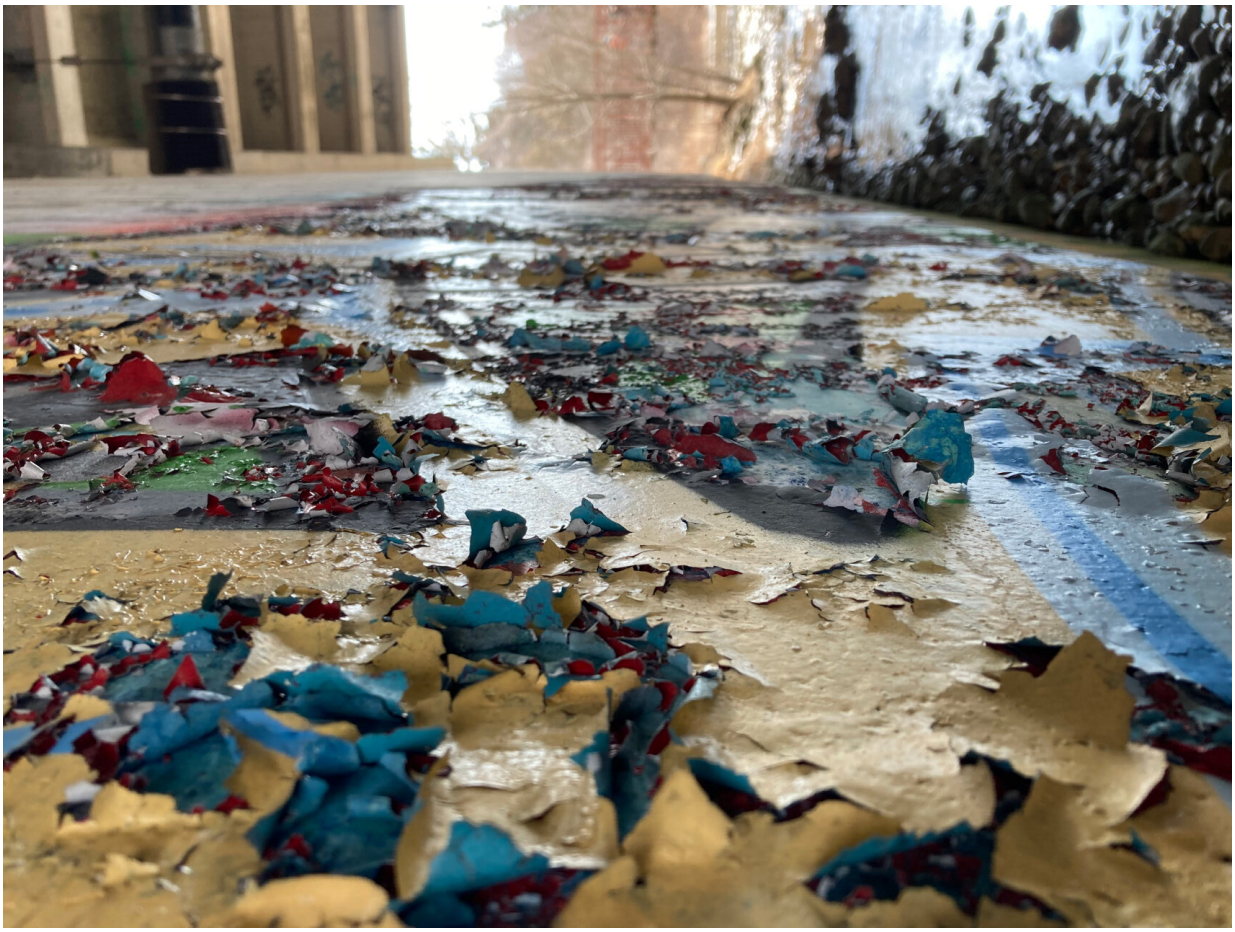
Zhu and colleagues at U of T and the Rochester Institute of Technology took inspiration from guidelines for compiling emissions inventories of greenhouse gases established by the Intergovernmental Panel on Climate Change. Adapting for physical differences between greenhouse gases and solid pieces of plastic, the researchers used a similar methodology of identifying the major pollution-generating activities in a particular area, calculating the amount of pollution generated by each activity within a given period, and accounting for uncertainties associated with each

source of pollution-generating activity.

"Our goal was to develop an accounting mechanism or tool for measuring plastic emissions that any level of government can adopt," said Zhu, who is pursuing a Ph.D. in environmental science in the Department of Physical & Environmental Sciences at the University of Toronto Scarborough. "But most importantly, we hope this tool we have introduced will allow the plastic field to follow in the footsteps of the climate field, where countries submit national emissions inventories to an international body such as the United Nations to track our progress towards reaching a globally defined target." Currently, national emissions inventories of plastic pollution do not exist, nor does a globally defined target for reducing plastic pollution.

To demonstrate the utility of the framework, the researchers built an emissions inventory of plastic pollution for the City of Toronto for the year 2020 drawn from publicly available data gathered through municipal litter audits and other sources. From a list of nine types of sources—including littering, tire dust from airplanes and on-road vehicles, washing machines, and paint from road markings and the exteriors of houses—they estimated between 3,531 and 3,852 tons of plastic pollution were emitted from within the city's boundaries during the period.

Littering made up the largest share at 3,099 tons, while artificial turf was responsible for the most emissions of microplastics—particles less than five millimeters in diameter—at 237 tons.



Paint peeling from structures and road markings is a significant sources of microplastic pollution. Credit: U of T Trash Team

"It is not surprising that larger materials—known as macroplastics, and in this case from mismanaged waste such as littering—made up the majority of the mass. But it overshadows the small stuff, microplastics," said Rochman, a co-author of the study and Zhu's Ph.D. supervisor. "Microplastics tend to be the highest by count in terms of actual pieces. This suggests that policies relevant to microplastics, in addition to macroplastics, are critical to reduce plastic emissions in the City of Toronto."

The researchers selected Toronto to test the framework as it is the largest city in Canada and the fourth-largest city in North America. "It's an urban hub for various activities, and where you have lots of people and activity, you inevitably generate a lot of pollution," said Zhu. "For a successful and informative case study, you want to look at a place with a lot of different sources of pollution. By doing so, you can identify which sources should be prioritized for the reduction of pollution out of all the others, and thereby demonstrate the utility of an emissions inventory for informing local policy."

Zhu said emissions inventories of plastic pollution must be a foundational piece of a successful global treaty on plastic, and that the framework should be applied to other cities, provinces and states, and countries around the world to better understand what kinds of plastic pollution are being released into the environment.

"The guidelines can be applied to regions worldwide, regardless of what kinds of sources are there," Zhu said. "Each geographic region will have different characteristics and the inventory will allow for the development of solutions tailored to that specific region."

More information: Xia Zhu et al, A City-Wide Emissions Inventory of Plastic Pollution, *Environmental Science & Technology* (2024). DOI: 10.1021/acs.est.3c04348

Provided by University of Toronto

https://phys.org/news/2024-04-scientists-framework-plastic-emissions-bolster.html