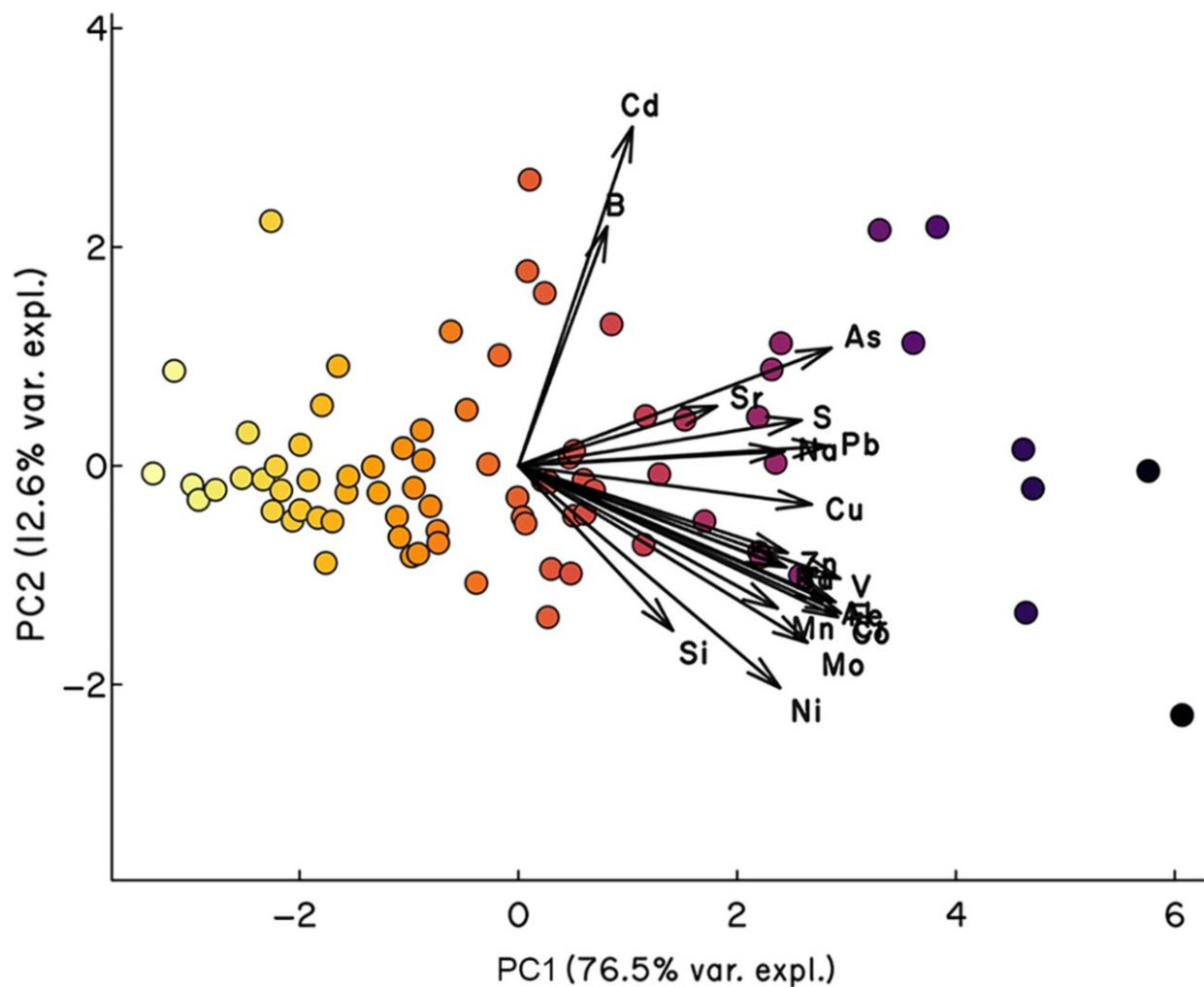


With community at its core, Seattle moss study prompts improvements in two Duwamish Valley neighborhoods

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Biplot of scores from principal component analysis (PCA) of the six priority heavy metals (As, Cd, Cr, Co, Ni, and Pb), with other measured elements shown

as overlays. PCA axis 1 (“PC1”) was the dominant axis of elemental concentration, with nearly all measured elements having strong positive correlations as indicated by direction and length of vector arrows. Each point represents one moss sample site, colored by relative value of PC1 axis scores (yellow = lowest to purple = highest). Concentrations were \log_{10} -transformed to linearize relationships and make highly skewed distributions more symmetrical. Credit: *Ecosphere* (2022). DOI: 10.1002/ecs2.4109

A community science case study mapped heavy metals in moss in two industrial-adjacent neighborhoods in Seattle, Washington, with a history of poor air quality, health outcomes, and racial inequities—yielding findings that have prompted short-term mitigation and follow-up instrumental air quality monitoring. Led by the USDA Forest Service's Pacific Northwest (PNW) Research Station, the study is the first of its kind in which residents, notably local youth, collected and prepared moss samples as part of an environmental justice investigation.

"Mosses absorb pollutants from the air, making them good bioindicators of air quality," said Sarah Jovan, a research ecologist with the PNW Research Station and the study's lead. "Concerned community groups in Seattle's Duwamish Valley engaged the Forest Service to conduct a [moss](#) study there geared towards informing local action because existing air quality information was insufficient for understanding neighborhood-level patterns."

Building off of the approaches and outcomes of the Portland Moss and Air Quality Study, which Jovan co-led, the collaborative Seattle study engaged a diverse partnership of more than 55 people from 9 public and nonprofit organizations. One goal of the study was to determine if community-gathered moss samples and those collected by scientists and other experts indicated similar pollution patterns.

After receiving training, youth with the Duwamish Valley Youth Corps and Duwamish River Community Coalition gathered 79 samples of a common moss species (*Orthotrichum lyellii*) from trees across a sampling grid in the Georgetown and South Park neighborhoods, located in Seattle's industrial core.

To check sampling accuracy, experts resampled a subset of the study grid the youth sampled and analyzed the moss in a laboratory and found sufficient statistical agreement between the two datasets to support the use of the youth's dataset in the study.

Scientists used the youth-gathered dataset to map concentrations of 21 [chemical elements](#) in the moss, including 6 "priority" [heavy metals](#)—arsenic, cadmium, chromium, cobalt, lead, and nickel—that are of particular concern because of their toxicity and potential negative effects on [human health](#) and the environment.

Their findings revealed that local moss in these two neighborhoods had significantly greater concentrations of these priority metals, particularly arsenic and chromium, compared to other [urban studies](#) using the same moss species in other areas of Seattle and in Portland. In addition, and importantly, the results also suggested coarse dust may be an important carrier of heavy metals, which would not be detectable at local instrumental air monitoring sites that focus only on fine particulates.

"Mapping heavy metals in moss gave the community a critical first look, which was very exciting for all of us," said Monika Derrien, a research social scientist with the PNW Research Station and a study co-author.

The study's findings have informed decisions to improve [environmental conditions](#) in the community, with actions ranging from tree-based green infrastructure investments led by the City of Seattle to follow-up instrumental air quality monitoring, which will help translate metals-in-

moss study results to measurable health risks, led by the Puget Sound Clean Air Agency.

"While moss can only be used as a screening tool, the strategic placement of air instruments, which is now underway by regulators, helps close the loop between heavy metals and health concerns," Jovan said.

The research was published in *Ecosphere*.

More information: Sarah E. Jovan et al, Heavy metals in moss guide environmental justice investigation: A case study using community science in Seattle, WA , USA, *Ecosphere* (2022). [DOI: 10.1002/ecs2.4109](https://doi.org/10.1002/ecs2.4109)

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