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have confirmed a tight correlation between cadmium concentrations in moss and cadmium concentrations in the air. As more data comes from the DEQ, she expects to find similar correlations.

By taking leadership from moss, community work to address air pollution is likely to be far less expensive and less time-consuming than it was before. And according to Professor Linda George at Portland State University, personal air quality sensors will also become available in the near future, potentially generating even more public outrage. The only way that state agencies can get ahead of that, she said, is by acting now on what they already know.

What we already know

Previous studies show that Portland has a serious air pollution problem.

USA Today's 2007 report "The Smokestack Effect" showed that Portland students faced some of the worst air quality in the country. Thirty-five Portland schools were ranked in the top 5 percent for the most dangerous outdoor air quality in the country. Overall, Oregon has the third largest population facing an excess risk of cancer due to toxic air pollution, according to the EPA. And according to the Multnomah County Health Department, air pollution contributes to three leading causes of death in the county.

The map of heavy metal hot spots has revealed factories that could have been using equipment to control their emissions years ago – but didn't. It was only after the moss data was revealed to surrounding neighborhoods that companies agreed to use equipment that would reduce human harm. DEQ's belated response to some hot spots suggests that their response to air pollution has prioritized those with the greatest ability to organize, and not necessarily those who are the most at risk.

The sequence of hot spot intervention

In the aftermath of the moss study, DEQ appears to have put most of its air monitoring resources in Southeast Portland, then moved them up to North Portland near Tubman Middle School, and has only now started to deploy them in deep South Portland to address the nickel and arsenic hot spots surrounding Precision Castparts, an aerospace and weapons manufacturer.

As of press time, other hot spots identified by the moss study have not

apparently received agency attention, including the arsenic hot spot in the Cully neighborhood near the Native American Youth and Family Center. The DEQ did not return calls to Street Roots to explain its strategy in addressing these hot spots.

At a community meeting on Feb. 28 at Tubman Middle School, some residents of North Portland expressed deep distrust of DEQ. One woman asked Portland Public Schools officials why students from another school were moved into the Tubman building despite long-standing information (dating back to 2005) that the school was being exposed to high levels of cadmium.

"Why was this site identified as a temporary location spot for Faubian students?" she asked. "So many questions remain unanswered regarding health... and it's not even just about cancer. There are neurological concerns. There are behavioral concerns. It's not just about 'the big cancer,'" she said.

Paul Anthony, a member of the school board, joined PPS facilities manager David Hobbs in claiming that the school had some of the best air in the city due to its state of the art ventilation system. But when Portland Mercury reporter Dan Forbes asked them to respond to Stuart Batterman, a national expert who said such systems provide little protection from metals so far over safe levels, they declined to comment.

The palpable sense of betrayal directed at PPS officials was reinforced by the story of Whitaker Middle School, which other residents shared that evening. Whitaker was demolished in 2007 after students and teachers had spent years suffering from mysterious health problems, and later discovered they had been exposed to high levels of radon – facts that were documented but not shared by school officials. After years of failed attempts to properly ventilate the school, officials decided to close it down instead. A similar problem is shared by residents of the Brentwood-Darlington neighborhood, who were promised full transparency by DEQ officials, but not informed of the moss study

during a meeting in June 2015.

Although some questions have still not been answered, it seems undeniable that moss is delivering better initial results than traditional, mechanical air monitoring and is quickly establishing itself as a key player in the fight against toxic air pollution.

By taking leadership from moss, community work to address air pollution is likely to be far less expensive and less time-consuming than it was before. And according to Professor Linda George at PSU, personal air quality sensors will also become available in the near future, potentially generating even more public outrage. The only way that state agencies can get ahead of that, she says, is by acting now on what they already know.

Jovan and her team have already found an extremely strong correlation between cadmium concentrations in moss and cadmium concentrations in ambient air. New air data from across the city may show similarly strong correlations for other metals, and produce conversion factors that allow moss to become a reliable and low-cost proxy for ambient air concentrations averaged over time. One big unknown is how long these metals in the moss. Jovan said she

suspects the moss concentrations are reflective of air concentrations over the past several months to a year, as her team collected only the upper part of the moss's stem, but that these growth rates are difficult to predict in advance.

Regardless, Jovan said she is grateful to see the growing appreciation for mosses – "the underdogs of the plant world."

Better living with moss

In her award-winning book "Gathering Moss," Robin Wall Kimmerer documents indigenous perspectives and uses of moss, presenting stories from the Potawatomi and other indigenous cultures of North America.

Kimmerer explains that within the indigenous worldview she was raised in, each plant has a particular place, a particular purpose that it fulfills to care for people. The plants, she wrote, still remember their gifts, even when the people have forgotten them.

Many traditional uses of moss centered around its ability to absorb water, which made it an effective tool for smoking camas roots and for cleaning salmon. It also made moss indispensable for the care of children, making it in some ways the first disposable diaper. One species, Sphagnum, carries

astrigent and antiseptic properties that prevent diaper rash, and can absorb up to 40 times its weight in water. For this reason, mosses were also used by women during their menstrual cycles.

Because so much of this sanitary work with moss was the cultural responsibility of women, and related especially to their care of children, much of it was left out of official accounts by the gentlemen anthropologists of the day. "Their notebooks bulged with records of the pursuits of men: hunting, fishing, and making tools. When moss once appeared in a weapon, as wadding behind a harpoon tip, it was described in considerable detail."

In hindsight, the attitude of these anthropologists toward women and their care of children was perhaps a clue to the kind of power- and machine-obsessed culture they were preparing to construct, which would lead directly to colonial resource extraction and eventually to an age "when smoke ran like water."

Later reactions against the excesses of corporate pollution would come primarily from women.

In the early 1900s a women-led "municipal housekeeping" movement attacked the nation's smokestacks and called for the institution of responsible housekeeping over the entire city to stop pollution and disease. Women across the country made successful alliances with engineers, medical professionals, and business leaders, driving in "smoke abatement" ordinances all across the country. Some 75 cities had adopted these laws by 1916.

Much of the activism around air pollution in Portland has, coincidentally, also been led by women and mothers.

The global mining industry to this day maintains deep links to the male-dominated institution of militarism, and both have actively denigrated living organisms while elevating the aesthetic of machines – with smooth operations and cold efficiency.

A former anti-moss billboard in Portland spelled out this logic perfectly, reading simply: "Small, Green, Fuzzy? Kill It!"

Following Kimmerer's line of thinking, it is perhaps the case that moss is still carrying out its traditional role after all, not only by reminding us to respect our plant relations, but by helping us clean up industrial facilities, and their special variety of job-creating' excretions.



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