Winter runoff into streams on par with ocean salinity

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Examining nearby creeks and outflows, Cornell students have found that the amount of road salt in winter and spring runoff that flushes into streams is of near-oceanic salinity levels, according to a new, unpublished report from Cornell's Soil and Water Lab in the Department of Biological and Environmental Engineering.

The students found salt residue lasts all year long in the soils contained in storm-water retention basins and that the high salinity levels appear to be changing the composition of soil microbes.

"Salinity levels in streams across the Northeastern United States have been steadily increasing for several decades, and the culprit is clearly road salt," said Todd Walter, associate professor of biological and environmental engineering, fellow at Cornell's Atkinson Center for a Sustainable Future, and adviser to the students. "There is less information about salt in storm-water systems, like the ones these students monitored," he said.

After winter 2013-14, Cornell undergraduate students measured salt concentrations in water flowing out of storm drains and into Cascadilla Creek near the Synchrotron Drive bridge on campus and at Dryden Road, near Route 366, in Ithaca.

Water samples were checked continually from February to November 2014, and chloride concentrations peaked at 25 grams per liter. The report noted that the average chloride concentration for seawater is 30

grams per liter. Ultimately, summer storms flushed a lot of the salt, and concentrations fell to 0.63 grams per liter; natural levels of chloride in streams are close to 0.001 grams per liter.

Shane DeGaetano '15, Sarah Nadeau '16 and Erin Makarsky '16 conducted the research under Walter, in collaboration with Cornell Facilities Services. DeGaetano presented a poster on the research at the American Geophysical Union meeting last December in San Francisco.

Sampling revealed that road salt never left the local ecosystem completely. "[We learned that] the effects of road salt application last all year long," the report says. "This is an important finding, given that stream flow often reaches its minimum in summer and … is more sensitive to increases in salinity if chloride continues to be discharged from storm water outfalls or groundwater during this time."

Findings like these are not unique to Ithaca. Recent research by the U.S. Geological Survey and others indicates that chloride concentrations – attributed to road salt usage – are rising in streams across the northern United States.

Lauren McPhillips, a Cornell doctoral candidate in the field of biological and environmental engineering, examined detention basins that capture storm runoff from campus parking lots. Winter melt water or storm runoff carry road salt from the parking lots to storm water detention basins, where it accumulates in the soil.

Near two slow-draining basins, McPhillips found levels in soils considered to be "saline." The researchers learned that it took several months for salinity to return to lower baseline levels. McPhillips wondered if these extra-salty parts of campus were uniquely different from other parts of campus. While this research is still in progress, she did discover that some microbial activities were significantly elevated in

the wet, salty detention basins, indicating that soil microbes may be adapting to the saltier conditions.

The most obvious solution is to use less road salt, explained Walter, but this would come at the cost of increased traffic hazards. Walter notes that Cornell Facilities Services has been proactive in experimenting with storm water management strategies and enthusiastic about his students monitoring campus. "The first step to finding better ways to manage our infrastructure is to measure how our activities are impacting the environment," said Walter.

Pete Salino, director of Cornell's grounds department, said that the university uses "cultural and mechanical practices" to decrease salt use on roads, sidewalks and steps. For example, some paths and stairways are not maintained during the winter, and the department uses rate-controlled spreaders. Front-mounted brooms for sidewalk snow-removal equipment rid slush from the walkway without salt.

Quite interested in this research, David Cutter, the university's landscape architect, said this research is useful, as he looks for ways to address water runoff. Cutter hopes to experiment using "bioswales" – ditches with vegetation – to employ plants that may store salt in their tissues in order to remove it from the environment.

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