2016 11 09 -- Water-Wise Landscapes May Harm Water Quality

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Replacing grass with water-wise landscapes may harm water quality

In many water-starved cities, homeowners are being encouraged to replace their lawns to conserve water. But how does this affect soil concentrations of nutrients such as nitrates? Now a team from the US has examined what happens to converted lawns in real homes.

Water-wise landscape

"Despite the potential of water-efficient landscapes to reduce household water consumption and costs, our research shows that large pools of organic matter from former turfgrass are decomposed to a form usable by plants over time," Hannah Heavenrich of Arizona State University, US, told **environmentalresearchweb**. "This leads to an accumulation of mobile nutrients in the plant-rooting zone of the soil, with potentially negative implications for water quality. These results suggest that cities should develop best-management practices to optimize the social–ecological benefits of water-

conserving landscapes while preventing inadvertent pollution of downstream aquatic resources."

Heavenrich and colleague Sharon Hall took samples from the gardens of houses that converted from turfgrass to xeriscapes up to 20 years ago in metropolitan Phoenix, Arizona, where annual precipitation is around 18 cm per year. Also known as water-wise landscapes, rain gardens or natural landscapes, xeriscapes usually contain native or climate-appropriate plants and a mulch groundcover, and may also feature plastic sheeting beneath the surface.

Water-efficient, shrub-dominated residential yards under homeowner management contained higher levels of soil nitrate and higher rates of nutrient mobility through the soil than turfgrass yards, the team found. The largest nitrate pools occurred 9–13 years after turfgrass removal.

"Our study was the first to look at what happens to soil nutrients when you replace a turfgrass lawn with a water-efficient landscape, particularly with respect to the agricultural levels of nutrients that are left behind," said Heavenrich. "We used a novel experimental design by looking at landscape conversion across time. Although it was shown that water-efficient yards save homeowners money on outdoor watering costs, there are few studies that look at other consequences."

Turfgrass lawns tend to grow quickly but, according to Heavenrich and Hall, much like an agricultural crop requires large inputs of water and often fertilizer. This results in a pool of organic nutrients in the soil that cycle from soil to plant and back again.

Sampling soil

"However, when the turfgrass is removed and the cycle interrupted, what happens to all of the nutrients that are left in the soil?" said Heavenrich. "We wanted to know what would happen when a turfgrass lawn is replaced with less productive plants that utilize less water and are spaced more sparsely on the landscape and that cannot utilize the soil nutrients efficiently."

The team focused on nitrate ions, which are highly mobile in soil due to their negative charge and can harm water quality by causing excess growth of algae and toxicity in aquatic environments.

"We hypothesized that water-efficient landscapes that were recently converted from turfgrass would have excess nitrate in the soil and that this nitrate would be more mobile after rainfall or irrigation than in turfgrass yards, creating the potential for negative consequences," said Heavenrich. "As cities expand and are forced to adopt sustainable practices that reduce resource use, we often find a benefit or ecosystem service from new technology or management practice without full investigation of what the best-management practices should be in order to maximize benefits and minimize potential negative outcomes."

In 2015, 77 cities in 16 US states offered financial incentives for homeowners to replace their lawns.

Next, Heavenrich and Hall will continue thinking about how sustainability objectives may have unforeseen consequences, particularly in the urban setting. "For this particular project an important next step would be to perform a similar study in a network of cities across a precipitation and climatic gradient to determine what the management practices should be for the variety of water-efficient yards that exist across the US and across the world," said Heavenrich. "In a city with a very wet climate, nutrient accumulation and mobility that could occur after turfgrass removal may present an even greater risk to water quality than in a semi-arid environment like Phoenix. Significant rainfall inputs could cause faster decomposition of organic matter and larger nutrient pools in a shorter amount of time."

The team reported their findings in **Environmental Research Letters (ERL)**.