Fixed Assets

Aquatic plants sequester toxic compounds in cell tissue, removing contaminants from wetlands.

@ Duckweed, a common aquatic plant, removes many persistent organic compounds that are discharged into natural waters and engineered wetlands, according to a Georgia Tech study.

Research led by Professor of Environmental Engineering Michael Saunders suggests that duckweed is acting as a "sink" for persistent organic compounds.

Researchers have found that a common aquatic plant removes many persistent organic compounds that are discharged into natural waters and engineered wetlands.

Environmental engineers at the Georgia Institute of Technology have found that various chlorinated, fluorinated and mixed chloro-fluoro compounds are taken up and sequestered in the plant tissue of their model plant species — duckweed (*Lemna minor*), a floating aquatic plant. These organic compounds are representative of the pool of persistent compounds discharged into the nation's waters. Sources include agrochemicals, such as pesticides, and pharmaceutical residuals, such as those from antidepressants, which are excreted in human waste.

Though the compounds are sequestered in the plant, there is concern about their ultimate fate in the ecosystem as the plants are eaten by animals, or die

By Jane M. Sanders
Photography by Gary Meek

"Are we taking advantage of duckweed's ability to remove contaminants from the water? The answer is 'yes, but indirectly.'"

— Michael Saunders, professor of environmental engineering

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and decay in wetland sediments, researchers note.

"The compound goes into the plant, and the plant has no choice about the uptake. Whether the compound is water-loving or water-hating does not appear to be a major factor," explains Professor Michael Saunders of the School of Civil and Environmental Engineering. "… And our plants take up this large class of compounds quickly, at rates faster than bacteria would degrade the contaminants."

These findings have implications for both water monitoring regulations and wastewater treatment practices.

Saunders' Ph.D. student Dawn Reinhold presented their research in August 2004 at the 228th national meeting of the American Chemical Society. Reinhold conducted the research, in part, with former Ph.D. student Jacqueline Tront, who graduated in May 2004, and Angela Wrona, also a recent graduate.

This study built upon previous research in Saunders' lab funded by the U.S. Department of Energy.

The research has focused on halogenated phenolic molecules as indicators of chlorinated, fluorinated and mixed chloro-fluoro compounds in natural waters and engineered wetlands. Previously, researchers found that various chlorinated phenols were sequestered in duckweed cell tissue. The current study shows that mono, di and tri fluoro-phenols and mixed chloro-fluoro phenols are also taken up and sequestered at varying rates.

These compounds can be toxic to duckweed, so the plant has evolved a defense mechanism to deal with the threat, Reinhold explains. Duckweed does not degrade the compound, so the plant fixes it inside cell walls and tissue, eliminating the compounds' toxic effect on the plant. She compared this process to human excretion of toxic products. "Plants don't always have the option of excretion, so they package it away into their cell tissue," she explains.

This research has led Saunders and his students to believe duckweed and probably other aquatic plants are acting as "sinks" for persistent organic compounds.

Saunders notes that regulators monitoring contaminants in the water may be missing something by not considering the plant uptake of these compounds — a process that is affecting the overall removal time of the contaminants from the water.

"These types of compounds we have studied are emerging in the regulatory sector as the ones we need to know more about," Saunders says. "They may soon meet with more regulatory control. They are not well regulated now."

Of some concern is the movement of these contaminants up the food chain by ducks that feed on duckweed. Researchers are also interested in what happens to these contaminants when the plants die and decay in wetland sediments. They are likely being degraded by microbes in the sediments, Saunders says.

The researchers' current findings may also have an impact on water treatment and reclamation practices.

"Constructed wetlands are not designed for duckweed and other plants to remove organic contaminants, but it's happening even though it's not generally recognized or included with the design concept…. So here's another tool in the toolbox for getting additional removal of contaminants."

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