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Press Release

Study: source of organic matter affects Bay water quality

By David Malmquist

VIMS post-doctoral researcher Yuehan Lu collects field samples from the Chesapeake Bay watershed. Photo courtesy of Elizabeth Canuel.

Persistence of "urban" organics downstream favors dead-zone formation

(April 23, 2013) Each time it rains, runoff carries an earthy tea steeped from leaf litter, crop residue, soil, and other organic materials into the storm drains and streams that feed Chesapeake Bay.

A new study led by researchers at the Virginia Institute of Marine Science reveals that land use in the watersheds from which this "dissolved organic matter" originates has important implications for Bay water quality, with the organic carbon in runoff from urbanized or heavily farmed landscapes more likely to persist as it is carried downstream, thus contributing energy to fuel low-oxygen "dead zones" in coastal waters.

The study appears in this month's issue of the *Journal of Geophysical Research*, and was highlighted by the journal's publisher, the American Geophysical Union, as an "AGU Research Spotlight" in their print and online channels.

The study was authored by VIMS post-doctoral researcher Dr. Yuehan Lu (now at the University of Alabama), VIMS Professor Elizabeth Canuel, Professor Jim Bauer of Ohio State University, Associate Professor Youhei Yamashita of Hokkaido University in Japan, Professor Randy Chambers of the College of William & Mary, and Professor Rudolf Jaffé of Florida International University.

Low-oxygen dead zones are a growing problem in Chesapeake Bay and coastal ecosystems worldwide. While most management practices focus on reducing inputs of nitrogen and other nutrients known to fuel dead zones, Canuel says "organic matter from the watershed may also contribute. One goal of our study was to examine the quality of organic matter derived from streams and its potential to contribute to dead-zone formation."

As streams and rivers carry dissolved organic matter downstream, bacteria or sunlight can modify it into compounds and forms that are more difficult for organisms to use. While the team's research showed no significant difference in bacterial degradation of organic matter from cleared or forested watersheds, Canuel says it did show that "organic carbon in runoff from watersheds affected by human activity is less susceptible to solar degradation than that from forested watersheds."

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Virginia Institute of Marine Science
School of Marine Science
College of William and Mary
Gloucester Point, VA 23062
(804) 684-7000

"Urban organics" thus remain at higher levels longer, says Canuel, "delivering more organic material to the river mouth and increasing the likelihood that low-oxygen conditions will develop in downstream locations such as estuaries and the coastal ocean."

The research team conducted their study using samples taken from seven small streams that flow into the James and York rivers, major tributaries of Chesapeake Bay. Three of these streams drain forested watersheds, with 87 to 100% tree cover, while the other four drain watersheds largely converted by human activity into pasture, cropland, or pavement and buildings.

The authors aren't yet sure why the organic carbon from the more developed watersheds is less vulnerable to breakdown by sunlight in rivers and streams, but suggest that it might be because it has already been exposed to appreciable sunlight in the less shady urban and agricultural environment.

Says Canuel, "Urban organics may persist downstream because their more photoreactive compounds have already been degraded due to greater light exposure in urban areas, farm fields, and pastures, leaving only the more photo-resistant, refractory compounds to wash into the coastal zone."

The team's findings provide one possible mechanism for an observed increase in the concentration of dissolved organic carbon in the surface waters of North America and Europe during the last few decades, and have implications for management of water quality in coastal zones worldwide.

"Our results show that future studies should assess not only the quantity of dissolved organic carbon entering our rivers and streams, but also its source," says Canuel. "Understanding how organic matter from developed and undeveloped watersheds behaves in the aquatic environment will contribute to the development of more effective watershed management practices and hopefully more successful efforts to reduce the number, extent, and duration of low-oxygen dead zones."