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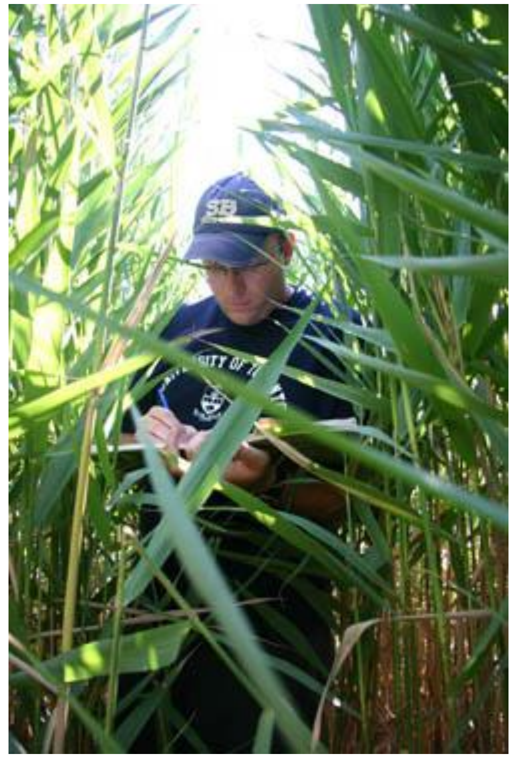
MERCURY HOT SPOTS
What Goes In. . . May come out more toxic.

By Kimbra Cutlip

The wetlands of the world are often referred to as kidneys of the earth, filtering nutrients, sediment and toxins from water as it makes its way into our streams, rivers and oceans.

And like the kidneys in our bodies, wetlands are not merely passive filters. They process, alter and manufacture chemicals that flow into our waterways—some of them not so desirable. Methylmercury is a particularly insidious natural product of bogs and marshes that is often overlooked in wetlands management. But methylmercury production in the marshes is increasing, and it's tied to the acceleration of mercury pollution from such things as mining and the combustion of fossil fuels.

Carl Mitchell, a post doctoral fellow in the microbial ecology lab, recently took a couple of visitors on a tour of his field site where he is trying to determine just how much methyl mercury is produced in the marshes at SERC. Along the way, he explained what scientists know about the role of marshes in methylmercury production.



Carl Mitchell monitors and records information on waterflow through the marsh as part of his research on the pathways mercury travels through the ecosystem.

As he donned a pair of rubber boots, Mitchell cautioned us to walk carefully along the eight-inch planks forming the boardwalk to his site at the headwaters of the Rhode River. Then he disappeared into a thicket of 12-foot tall reeds and we followed his voice into the unknown. The tide was running particularly high, and we felt our way along the boardwalk with our feet as water slapped nearly up to our knees. "In some areas you will sink to your waist in peat if you fall," he called over his shoulder with the authority of someone who knows this first-hand.

One of the most toxic trace metals, inorganic mercury—the slippery quick silver with which we're most familiar—is prevalent almost everywhere. Traces of it occur in sediments and soils laid down over millions of years by volcanic eruptions. More recently, industrialization has rapidly increased the amount of mercury in the environment and new deposition is still occurring.

Inorganic mercury becomes more toxic and accumulates in wildlife and humans when it's converted into organic methylmercury. This is where wetlands come in. They are loaded with naturally occurring microbes that gobble up inorganic mercury and convert it to the organic form. Recently deposited mercury is much more available to those microbes than older mercury, which is tightly bound to the sediments. So, in the marshes, human activity is fueling the engine of methylmercury production.

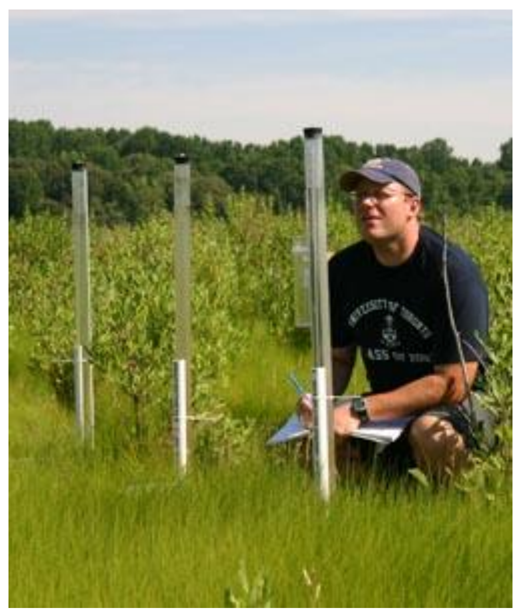
During previous work Mitchell found that the edges of freshwater bogs produce more methylmercury than the center, perhaps because the interior is drier, and methyl mercury-producing microbes are more productive in flooded areas where less oxygen is available. "This presents a 'double whammy' in that the fringe is also where there is more water flow," he says. "Therefore, more of what is produced is delivered to downstream ecosystems, like lakes and bays." From there, methylmercury begins its journey up the aquatic food web.

His new studies introduce the effects of tides. According to Mitchell the ebb and flow of the tides may stimulate more methylmercury production as water pumps in and out the creeks and rivulets. He likens it to a bellows fanning a fire.

After nearly 15 minutes of slogging through the marsh, we arrived at a wooden hut built over a muddy brown stream. Mitchell knelt down and opened his laptop, which had thus far avoided a dunk in the marsh. He asked me to remove a small cap from a grey PVC pipe sticking up through the platform beside me. Inside, I found a port and connected his laptop so he could retrieve data on the flow of water in and out of the creek. Next, Mitchell handed a pair of blue latex gloves to another guest named David. "From now on," he said to David, "you've got the dirty hands. I've got the clean hands." He gave David a zip lock bag containing another zip lock bag with a bottle inside it. Mitchell snapped a pair of gloves on his own hands. He asked David to open the first zip lock bag and reached inside for the second. He then instructed David in the back and forth process by which they would retrieve a pure, uncontaminated sample of water.

Back in the lab, Mitchell will analyze his samples and compare the amount of mercury methylation in the marsh with the amount of methylmercury flowing into the Rhode River. He also compares this information with the overall flow of water in and out of the marsh.

A hydrologist by training, Mitchell wants to know the impact of water flow on the production of methylmercury and its delivery into the Bay. "We're trying to identify the likely places or conditions under which new deposits of inorganic mercury may be more readily methylated," he explains.



MItchell monitors evaporation in the marsh--an important part of understanding the flow of water and materials.

Ultimately, Mitchell's work could lead to the ability to predict methylmercury hot spots and help guide the process of restoring or constructing wetlands without inadvertently creating a new source of methylmercury.

Constructed wetlands are most often focused on removing nutrients and other pollutants from upland water sources, but some of the methods used in the process may actually increase methylmercury coming out of the system. "It's the classic man vs. nature scenario where you try to have control over one thing and something else comes along and bites you in the [backside]," Mitchell says.

That's why Mitchell is trying to get a better handle on the processes governing mercury methylation and movement. If marshes are, in fact, hot spots of methylmercury production as Mitchell and his colleagues in the Microbial ecology lab suspect, and if the lab can identify what governs the process, they may be able to figure out how fast the marshes would respond to reductions in mercury pollution. They also may help managers learn to construct wetlands without increasing methylmercury in the water. That last part may require a balancing act greater than tiptoeing along the boardwalk through the Marshes at SERC. But Mitchell seems up to the task.