Spiders enlisted as pollution sensors
Hunting arachnids give glimpse of chemical threats to food web

BY BETH MOLE

Dangling from riverfront webs, spiders may be watchdogs for waterway pollution. By stockpiling toxic baggage carried by their waterborne prey, these eight-legged monitors can reveal the type, quantity, location and potential biological harm of certain chemicals lurking in water and riverbeds. Spiders may even be better surveyors than some chemical tests, researchers reported November 11.

Along the banks of three rivers around the Great Lakes, scientists collected two types of spiders: long-jawed spiders and orb weavers. Both feast on aquatic insects such as midges that spend their youth in the water, often mucking around in river sediments, where they can pick up industrial chemicals. On the banks, the hungry spiders can build up high levels of chemicals and pass them on to bird predators.

The three rivers tested in the study — the Ottawa, Manistique and Ashtabula — are known to harbor contaminants, mainly polychlorinated biphenyls, or PCBs. A family of more than 200 compounds, PCBs are neurotoxic and disrupt hormone systems in some animals and humans, but they are fairly harmless to the river insects and their arachnid predators. Though PCBs were banned in the United States in 1979, their previous use in hundreds of industrial applications, including production of plastics, electrical transformers and dyes, has left a legacy of pollution. Once sunk in riverbeds, the threat that PCBs pose to animals and humans is tricky to predict from water and sediment samples alone.

“That’s the big challenge,” says environmental engineer Upal Ghosh of the University of Maryland, Baltimore County. The chemicals could stay put in sediments, or some fraction could move into the food web. Using spiders to unravel that threat, he says, is intriguing.

From 2009 to 2013, researchers led by ecologist David Walters of the U.S. Geological Survey in Fort Collins, Colo., collected more than 10,000 spiders living within a meter of the three rivers. By measuring chemicals in five to 20 spiders at each section along contaminated stretches of the rivers, the researchers could gauge which PCBs were seeping out of the waters, what concentrations the pollutants hit, and how dangerous they might be to creatures on land.

“These do pose a risk to wildlife like birds,” Walters said of the PCB levels found. Declines in numbers of songbirds such as swallows could be due in part to eating PCB-laden spiders. And, he said, the levels in spiders mimic those seen in fish, confirming the spiders’ reliability as sensors. All three rivers have fish consumption advisories, he said.

The researchers could even use the spiders’ specific collection of PCBs to pinpoint the source of pollution. For instance, spiders downstream of a paper recycling plant along the Manistique River collected the cocktail of PCBs that had been used in paper recycling.

Walters hopes that the spider monitoring, which is now being used by other researchers, could help keep tabs on polluted sites, track river cleanup methods that can cost millions and identify new hot spots of pollution.