Mercury contamination could do big harm to migrating birds, William and Mary professor finds

W&M Professor Dan Cristol has been studying mercury in wild birds. Photo shows some of the wild Zebra Finch birds inside their aviary at W&M. (Joe Fudge / Daily Press)

By Tamara Dietrich . Contact Reporter
tdietrich@dailypress.com

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Capwell Taylor picked up a pole net, and a gaggle of young zebra finches scattered in a noisy rush of chirping squeals.

Taylor wasn't deterred. A biology major about to graduate, Taylor has worked with birds in the aviary at the College of William and Mary for several years, helping to tease out the harmful effects of methylmercury on birds' ability to reason and remember.

Soon enough, he netted a young male and cupped it carefully in his hands. Like other males, this bird had bright orange cheeks and tell-tale black-and-white striping across its neck and chest.

Not this particular specimen, but others of its kind have just helped researchers discover something new about mercury contamination: It's also damaging to birds when they migrate.

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Specifically, they found that methylmercury concentrations actually intensify in a bird's bloodstream when it undergoes the intense physical rigors of long-distance flight.

"A key thing about migration is the bird doesn't get anything to eat," explained biology professor Dan Cristol, who has studied the effects of mercury on birds for years. "So they metabolize all their fat, and then they start to metabolize all their muscle to get energy."

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Some large birds can lose up to half their body mass during migration, he said, meaning all that mercury that once was stored in organs and muscle gets released in a rush to the blood, where it can damage all the tissues.

"And methylmercury is a neurotoxin," Cristol said. "So we're worried that, during this time of really high stress, when they're migrating and they have to find their way and find food and avoid predators in an unfamiliar area, they're also getting a big surge of mercury into their brain."

Cristol co-authored a report on these findings that just appeared in the journal "Scientific Reports."

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W&M Professor Dan Cristol has been studying mercury in wild birds. Photo shows some of the wild Zebra Finch birds inside their aviary at W&M. W&M student Asst. Capwell Taylor is holding the bird. (Joe Fudge / Daily Press)

The other 'meth'

Methylmercury is a highly toxic organic compound created when mercury interacts with bacteria in the environment. That's the form of mercury most people in the U.S. encounter most frequently, according to the U.S. Environmental Protection Agency.

At one time, mercury entered waterways in industrial waste and in a range of consumer goods, from thermometers to fluorescent light bulbs to novelty jewelry. But today the EPA estimates the single biggest source is coal-burning power plants.

Once it's released in emissions, mercury falls back to Earth, where it's converted to methylmercury and contaminates oceans, waterways and soil.

Eventually, it gets ingested by fish, which get eaten by bigger fish or waterbirds, and so on as it biomagnifies up the food chain.

Cristol's earlier work was among the first to show that birds don't have to be fish-eaters to ingest mercury, though — he found that songbirds also ingest it when they eat land-based spiders and other insects that live near contaminated waterways.

The harmful effects of methylmercury on birds is well-documented, from impairing their motor skills and memory to their ability to reproduce.

But mercury isn't just for the birds.

The EPA says that "almost all people in the world have at least trace amounts of methylmercury in their bodies, reflecting its prevalence in the environment."

For most people, though, the EPA says the levels are believed to be too low to cause health effects.

The study

Cristol and his students ran their study by simulating bird migration using domestic zebra finches in the college aviary in Williamsburg.

Native to Australia, zebra finches are commonly used for laboratory studies, Cristol said, in part because they were the second bird species — after the chicken — to have its entire genome sequenced.

Taylor was hands-on in the study, and said this work and his own research have not only given him a respect for the scientific method, but a newfound appreciation for the subjects.

"I have a whole new appreciation for the birds that fly just out your window in the morning to the birds you see out over the ocean," Taylor said.

For this study, the birds were fed seed laced with mercury over several months until the amount in their blood reached a level comparable to contamination in the wild.

Their fat and lean tissue were measured in a portable MRI machine specially trucked in, then the birds were placed on a 24-hour fast. Some, Cristol said, were even exercised on a sort of hamster wheel to mimic — at least on a small scale — the physical rigors of migration.

The next day, the birds' blood, fat and lean tissue were measured again.

"And what we found was, in just one day of 'migration,' it caused the mercury in their blood to jump more than 10 percent," Cristol said.

One more blow

This finding doesn't bode well for birds undergoing the far more intense physical stress of the real thing.

"What we'd be most worried about is during the migration, because there'd be acute effects on the mental abilities from that surge of mercury," Cristol said.

"So they might not be able to orient properly. When they arrived at a new location, they might have changes in their urge to feed. They might not spend all day feeding and fattening up for the next leg of their migration. The surge in mercury in their blood might affect their hormone levels, and that might affect their behavior."

Most species of migrating birds are already declining in population around the world, he said — some dramatically.

The chief culprit in that decline is habitat destruction — "They have nowhere to migrate to and from," Cristol said.

But a potential surge of neurotoxin to the brain and tissues during migration is just one more blow.

"It could be a nail in the coffin," Cristol said. "Or it could be the last straw."

Co-authors on the report are Chad L. Seewagen, a senior scientist with AKRF Inc., a New York-based environmental, planning and engineering consulting firm, and Alexander R. Gerson of the University of Massachusetts, Amherst.

Dietrich can be reached by phone at 757-247-7892.

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