

Estrogenic Compounds in Waterways

by Deborah Weisberg

Although tournament bass angler Jim Cardillo is environmentally aware, pollution from pharmaceuticals, plastics and personal care products in fisheries is a mystery to him.

A former conservation director of Pennsylvania BASS Federation Nation, Cardillo is well versed in impacts from Marcellus Shale hydrofracturing, mine drainage and invasive species; but those from everyday compounds that appear to be harming fish? “They’re under the radar,” said Cardillo. “It’s an issue you just don’t hear much about.”

Yet, countless products containing chemicals that mimic the female hormone estrogen—from the obvious, such as birth control pills, to pesticides and mouthwash—are flowing into lakes and streams from leaky septic systems, municipal sewers, farms and other sources.

With no water quality standards established for these compounds, federal and state officials who regulate other kinds of pollutants are only beginning to explore their effect on aquatic species and habitats.

Their interest was piqued by the proliferation of intersex fish—males with female characteristics, including eggs in their testes—in Pennsylvania’s waters.

“Ferretting out the culprits is a daunting task, given the huge number of possible suspects in our environment,” said Josh Lookenbill, a water quality specialist with the Pennsylvania Department of Environmental Protection’s monitoring division in Harrisburg.

“Everything we use in everyday life has the potential to be estrogenic or have some other effect,” said Lookenbill, whose agency began monitoring chemicals of emerging concern in 2005.

The more prevalent found in Commonwealth rivers and lakes includes caffeine, followed by acetaminophen (a pain killer), carbamazepine (an anti-convulsant), sulfamethoxazole (an antibiotic) and estrogen, which is a naturally occurring female hormone.

“Some compounds break down and others remain stable when they enter the water,” said Gary Ankley, a research scientist with the Environmental Protection Agency in Duluth, Minnesota. “Even compounds in low concentrations can produce biological effects on wildlife.”

“Trying to identify the most impactful of thousands of compounds, and determining safe concentrations for mussels, fish and other aquatic wildlife is the challenge facing scientists,” said Geoff Smith, Susquehanna River biologist for the Pennsylvania Fish & Boat Commission (PFBC), which is partnering with other agencies on the pollution studies.

“The FDA (Food and Drug Administration) regulates which drugs are out there, but regulatory agencies test for certain things at levels based on human consumption in drinking water,” said Smith.

“Take acetaminophen. The amount in our rivers is minute—a fraction of what would be safe for a person—but we don’t know which concentrations are considered biologically meaningful to aquatic species.”

Other chemicals, including triclosan, an anti-bacterial agent found in scores of common products from toys to trash bags to toothpaste, may be affecting aquatic species in ways scientists haven’t identified, said Smith. “At this point, it’s the elephant in the room... a big unknown.”

About half of the bass sampled in the Delaware River were intersex, compared with 10 percent in the Ohio River drainage. In some parts of the Susquehanna River, where juvenile bass die-off has been a problem in recent years, 100 percent of the smallmouth bass sampled were intersex, according to Vicki Blazer, a research biologist for the United States Geological Survey in Kerneysville, West Virginia.

Considered a leader in estrogenic impact studies, Blazer is focusing her attention on the Susquehanna River because of its high incidence of feminized bass and ongoing problems with juvenile bass mortality.

She is trying to determine if there is a connection between the two and what it means for the future of this and other fisheries.

“Most estrogenic compounds don’t accumulate in fish tissues. That’s good news for people who eat them,” said

photo-Geoff Smith



Dr. Vicki Blazer, United States Geological Survey Leetown Science Center National Fish Health Research Laboratory, takes a blood sample from a male smallmouth bass from the Susquehanna River. The blood will be analyzed for the presence of vitellogenin, an egg-precursor protein. Vitellogenin should not be measurable in male fish, and its presence is evidence of endocrine disruption.



Blazer. “The bad news, for the fish, is they accumulate in the brain, the skin and in the anterior kidney, which is equivalent to bone marrow, where immune response occurs.”

She and colleagues at partner agencies, including the PFBC, suspect immunosuppressed fish are more vulnerable to parasites and bacterial infections.

“We don’t know if certain compounds are affecting fishes’ ability to reproduce, because our focus has been on young-of-year fish that aren’t mature yet,” said Smith. “But, we do believe that it’s causing poor response to environmental factors.”

“In fish, gender differentiation occurs shortly after birth,” said Smith. “One theory is that exposure to the estrogen compounds is occurring at the egg or fry stage, when this gender differentiation occurs, compromising their immune systems as juveniles and manifesting as intersex later in life.”

“In the Susquehanna River, estrogenic compounds from farmland runoff may be packing a double whammy,” said Smith. “It’s likely that run-off is not only contributing to high levels of nutrients to the water but also adding estrogenic compounds contained in fertilizers, cattle feed and other agricultural products.”

Knowledge is power for scientists now piecing together the estrogenic puzzle, but it would take legislative action to reign in compounds that may be determined to be a danger to fisheries.

“In the meantime, individuals can do their part to try to protect water by limiting their use of certain products such as antibacterial soaps and lawn fertilizers,” said Blazer. “Since I got into this area of research, I have changed the products I buy. I avoid things with perfumes and dyes, and I don’t need the perfect lawn.”

Some hospitals, including Geisinger Medical Center, Danville, have launched drug “take-back” initiatives that allow people to properly dispose of medications.

“The public needs to know what it can do now to protect our waterways,” said Cardillo. ☐

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