

River research spawns revelations

by Elizabeth Kumru

Fish in the Elkhorn River are confused about their sex.

Females are becoming defeminized and males are becoming more female.

What is it about this Nebraska river that's causing the fish to undergo a sex change every spring and summer? That's what Alan Kolok, Ph.D., wants to know.

A physiological ecologist and aquatic toxicologist, his research is focused on fish living in contaminated environments and the impact of agricultural contaminants on fish.

"Like the canary in the coal mine, fish are the sentinels for our drinking water," Dr. Kolok said. "What happens to the fish is a cause of concern."

Dr. Kolok is director of the Aquatic Toxicology Laboratory at the University of Nebraska at Omaha (UNO) and interim director of the Center for Environmental Health and Toxicology in UNMC's College of Public Health.

He is interested in biologically active compounds in water and their unusual methods of being toxic to wildlife and humans. Rather than being directly toxic, these compounds hijack cell signaling pathways and lead to irreversible changes at astonishingly low exposure, he said.

"Low levels can have a big effect," said Dr. Kolok, whose research is funded by a National Science Foundation grant. "It's not causing cancer, but it's masquerading as an internal hormone."



Alan Kolok, Ph.D.

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For the past 10 years, he has evaluated the effects of the herbicide atrazine on aquatic life along the Elkhorn River, which flows 290 miles from the eastern Sandhills to join the Platte River just southwest of Omaha. Atrazine is a herbicide commonly used on corn; its environmental and public health impacts are controversial.

Atrazine is one of the three most commonly applied herbicides in the United States with more than 75 million pounds used annually across the country. Nebraska farmers apply considerable amounts of the herbicide each year to their fields. Although this chemical can increase crop yields, large amounts often escape through rainwater runoff and enter the waterways, Dr. Kolok said.

“It’s surprising how little we know about where atrazine goes and what it does over a long period of time,” Dr. Kolok said. “I’d like to know if the fish are breeding during this annual surge.

“If the water is leading to changes in cell signaling in fish, it could lead to reproductive dysfunction in humans,” he said.

With its many tributaries, the Elkhorn watershed encompasses an area of about 7,000 miles.

To perform a large-scale inventory of atrazine in the basin, Dr. Kolok tapped his natural inventive talent and came up with a clever solution. A precise measure of the water costs \$100, but he found a kit, similar

to a pregnancy test, which only costs \$10 and records if atrazine is present above the Environmental Protection Agency’s minimum level allowed for safe drinking water — three parts per billion.

Then he enlisted the help of “citizen scientists” — people interested in the environment such as Boy Scouts, high school students and members of the Audubon Society and Sierra Club.

They took samples at 150 different sites along the river on April 23 and 120 sites on May 21. The results were dramatic.

Once in the water, atrazine is taken up by aquatic life and can have a negative effect on reproductive organs. This phenomenon is commonly known as endocrine disruption.

In April, atrazine was detected in only two sites, both close to Omaha, but in May, atrazine lit up the map south of Norfolk.

“Norfolk became the dividing line,” he said. “Everything northwest of the city, where cattle graze and fields are full of wheat and sorghum, the water had no atrazine. But, south of town, where corn and soybean fields begin, we registered mostly positive.”

Contamination of the water is widespread.

In 2002, the U.S. Geological Society sampled hundreds of surface water sites around the country and found that 80 percent of them had trace contaminants — steroids, pharmaceuticals and personal care

products. The Washington Post reported that an algae bloom created a dead zone in the Gulf of Mexico and the female fish in the area became less feminine

For his river project, Dr. Kolok breeds fathead minnows in his lab at UNO so he can record the gene expression of the fish from birth. “Animals from the wild are different because a number of factors in the environment can affect them,” he said.

The fish are then exposed to the Elkhorn River for seven days — long enough to affect gene expression. Dr. Kolok invented a 40-pound mobile unit that can expose up to 20 fish to a continuous flow of river water.

Soon, his Elkhorn River Research Station (ERRS), an environmental research/education facility, will provide a secure, controlled environment in which students and faculty can conduct experiments. Nine holding tanks will be available at the ERRS to hold fish and other aquatic animals for experimentation. Water from the river will be continuously pumped through the tanks so that animals in the ERRS will be exposed to river water in real time.

“Next year, we’ll continuously expose fish from April through the summer over 10-day periods.

We’ll be able to do a number of different studies, chemical and biological sampling in real time, over the growing season,” Dr. Kolok said.

“I want to know what’s in our water,” he said. 