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Farm chemicals can indirectly hammer frogs

By Janet Raloff

Leopard frogs such as this one have been developing flatworm infections that can sicken or kill them. The larval parasites show up as tiny spots in the frog's internal tissues.N. Halstead, University of South Florida

Ecologists firm up link between agricultural chemicals and potentially devastating flatworm infections

Atrazine, the second-most widely used agricultural herbicide in America, can pose a toxic double whammy to tadpoles. The weed killer not only increases the likelihood that massive concentrations of flatworms will thrive in the amphibians' ponds, a new study reports, but also diminishes the ability of larval frogs to fight infection with these parasites.

Moreover, the new data show, runoff of phosphate fertilizer into pond water can amplify atrazine's toxicity. The fertilizer does this by boosting the production of algae on which snails feed. Those snails serve as a primary, if temporary, host for the parasitic flatworms, which can sicken frogs.

Amphibian populations around the world have been declining in recent decades, with many species on the brink of extinction. Infection with any of several species of tiny flatworms, known as trematodes, can trigger debilitating limb deformities in frogs. Severe infections can kill the amphibians. The question was why high rates of those deformities — and, presumably, trematode infections — began showing up across the nation in the mid-1990s (*SN: 7/12/1997, p. 31*).

A snail releases a cloud of larval trematodes (white dots) into the water. Snails are an early, intermediate host for the young parasitic flatworms that cause problems for frogs.T. Raffel, University of South Florida

The new study suggests that one answer lies in atrazine's quick rise to dominance in U.S. agriculture; for many years the compound has been a — if not the — leading herbicide used by farmers, especially in corn-growing regions.

Val R. Beasley of the University of Illinois at Urbana-Champaign and his colleagues quantified more than 240 separate factors in 18 Minnesota wetlands that might affect amphibian trematode infection rates, including water quality, habitat and resident species. In the Oct. 30 *Nature*, the team now reports that atrazine concentrations stood out as the prime correlate with trematode infection rates in Minnesota's declining northern leopard frog.

The weed killer and its breakdown products accounted for 51 percent of the likelihood these wetland frogs would be sickened by trematode infections. The presence of phosphate fertilizer by itself showed no effect on trematode infection rates. But when atrazine was present, the pair accounted for 74 percent of the probability that area frogs would host trematode infections.

To test whether these chemicals could cause the infections, not just serve as markers of risk factors for infections, the researchers raised young tadpoles for four weeks in 290-gallon cattle tanks that contained snails, leaves, insect larvae and other features of a woodland pond. In some tanks the team added atrazine, phosphate or both — and always at concentrations typical of what Environmental Protection Agency models suggest would be present in rural waters not far from farming.

Encased in protective cysts (yellow ovals), larval flatworm parasites infect frog tissue, causing deformities and even death in the hosts. The toxic parasites must wait for their host to be eaten by a bird or other predator; only then can the flatworms finally reproduce.
S. Sessions, Hartwick College

Where atrazine was present, four times as many snails developed as in water free of the weed killer, reports ecologist Jason Rohr of the University of South Florida in Tampa, who's the study's lead author. These experiments indicate, he says, that as snail populations climbed so did the number of incubating trematodes.

Because these tank studies were conducted in Pennsylvania, where leopard frogs are in serious decline, the researchers substituted related frogs — green and pickerel frogs — for these tests. And among surviving green frogs, trematode infections were significantly higher where atrazine was present. The same was not true for pickerel frogs, but then again this species experienced a high rate of mortality when trace quantities of atrazine laced its water. Frogs that died could not be tested for the infection.

Finally, where atrazine had been present, the young frogs made only one-half to one-seventh as many parasite-clearing immune cells as those in pesticide-free water.

This study “links a couple pieces of the puzzle together,” notes amphibian-disease ecologist Joseph Kiesecker, director of science for the Nature Conservancy in Fort Collins, Colo. Some studies had shown atrazine could impair frog immunity. Other groups, including his, had shown trematode infections could cause limb deformity and lethal illness in frogs. The new study, he says, now shows atrazine can play a major role in both problems.

“What really impressed me about the new work,” adds Tyrone Hayes of the University of California, Berkeley, “is that it looked at a huge number of factors describing a complex environment and asked which of these 240 things contributes [to trematode infections in frogs]. And the most important one turned out to be atrazine.”

Hayes’ work has shown that atrazine can impair reproductive development in frogs. Rohr says his team will be looking at preserved tadpoles from the cattle-tank experiments to see if those tadpoles also exhibit such developmental abnormalities.

Syngenta, which registered atrazine for U.S. use and remains a leading manufacturer, declined to comment for this story.