Research finds that low concentrations of pesticides can become toxic mixture

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Ten of the world's most popular pesticides can decimate amphibian populations when mixed together even if the concentration of the individual chemicals are within limits considered safe, according to University of Pittsburgh research published Nov. 11 in the online edition of *Oecologia*. Such "cocktails of contaminants" are frequently detected in nature, the paper notes, and the Pitt findings offer the first illustration of how a large mixture of pesticides can adversely affect the environment.

Study author Rick Relyea, an associate professor of biological sciences in Pitt's School of Arts and Sciences, exposed gray tree frog and leopard frog tadpoles to small amounts of the 10 pesticides that are widely used throughout the world. Relyea selected five insecticides—carbaryl, chlorpyrifos, diazinon, endosulfan, and malathion—and five herbicides—acetochlor, atrazine, glyphosate, metolachlor, and 2,4-D. He administered the following doses: each of the pesticides alone, the insecticides combined, a mix of the five herbicides, or all 10 of the poisons.

Relyea found that a mixture of all 10 chemicals killed 99 percent of leopard frog tadpoles as did the insecticide-only mixture; the herbicide mixture had no effect on the tadpoles. While leopard frogs perished, gray tree frogs did not succumb to the poisons and instead flourished in the absence of leopard frog competitors.

Relyea also discovered that endosulfan—a neurotoxin banned in several nations but still used extensively in U.S. agriculture—is inordinately

deadly to leopard frog tadpoles. By itself, the chemical caused 84 percent of the leopard frogs to die. This lethality was previously unknown because current regulations from the U.S. Environmental Protection Agency (EPA) do not require amphibian testing, Relyea said. His results showed that endosulfan was not only highly toxic to leopard frogs, but also that it served as the linchpin of the pesticide mixture that eliminated the bulk of leopard frog tadpoles.

"Endosulfan appears to be about 1,000-times more lethal to amphibians than other pesticides that we have examined," Relyea said. "Unfortunately, pesticide regulations do not require amphibian testing, so very little is known about endosulfan's impact on amphibians, despite being sprayed in the environment for more than five decades."

For most of the pesticides, the concentration Relyea administered (2 to 16 parts per billion) was far below the human-lifetime-exposure levels set by the EPA and also fell short of the maximum concentrations detected in natural bodies of water. But the research suggests that these low concentrations—which can travel easily by water and, particularly, wind—can combine into one toxic mixture. In the published paper, Relyea points out that declining amphibian populations have been recorded in pristine areas far downwind from areas of active pesticide use, and he suggests that the chemical cocktail he describes could be a culprit.

The results of this study build on a nine-year effort by Relyea to understand potential links between the global decline in amphibians, routine pesticide use, and the possible threat to humans in the future. Amphibians are considered an environmental indicator species because of their unique sensitivity to pollutants. Their demise from pesticide overexposure could foreshadow the fate of less sensitive animals, Relyea said. Leopard frogs, in particular, are vulnerable to contamination; once plentiful across North America, including Pennsylvania, their population

has declined in recent years as pollution and deforestation have increased.

Source: University of Pittsburgh