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## A New Alarm Sounds for Amphibians

■ Study, called a 'realistic picture,' finds a mix of low-level pesticides like those found on farms may play a role in species' endangerment.

By Marla Cone, Times Staff Writer

Frogs exposed to a mix of pesticides at extremely low concentrations like those widely found around farms suffer deadly infections, suggesting that the chemicals could be a major culprit in the global disappearance of amphibians, UC Berkeley scientists reported Tuesday.

When tadpoles were exposed in laboratory experiments to each pesticide individually, 4% died before they turned into frogs. But when atrazine and eight other pesticides were mixed to replicate a Nebraska cornfield, 35% died.

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The frogs developed an array of health problems, including meningitis, because the chemicals suppressed their immune systems. They also took longer to complete the transformation from tadpole to frog, which reduces their chances of survival.

At least one-third of amphibians worldwide, or 1,856 of the known species of frogs, toads, salamanders and caecilians, are in danger of extinction, according to an international group of conservation biologists.

A variety of factors are thought to be involved, including climate change, ultraviolet radiation, disease, parasites and habitat destruction.

"We demonstrated that a realistic pesticides mixture [based on a mixture applied to an actual field] at low, ecologically relevant concentrations can have dramatic effects on amphibian development and growth and ultimately, we predict, survivorship," Tyrone Hayes, a professor at the university's department of integrative biology, and his

colleagues reported in the online version of the scientific journal Environmental Health Perspectives.

"Given these adverse effects and the continued increase and use of pesticides in agriculture over the past 50 years, it is likely that pesticides have played and will continue to play a role in amphibian declines," they wrote.

Three years ago, Hayes triggered a controversy after reporting that the herbicide atrazine, used in large volumes in the United States primarily on corn, feminizes frogs by mimicking estrogen.

Chemicals that disrupt hormones can have a wide range of seemingly unrelated effects on animals because hormones regulate many bodily functions, including reproduction, immune cells and brain development.

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Syngenta, the manufacturer of atrazine, has criticized Hayes' previous work, saying its own research has been unable to replicate his findings of feminized frogs. Hayes, who formerly worked for a consulting firm hired by Syngenta, has said the company pressures researchers to hide results that link atrazine to ecological effects, which the company denies.

Representatives of CropLife America, a trade group representing pesticide companies, had no comment Tuesday on the new findings. The industry has long said, however, that there is insufficient evidence that pesticides harm frogs.

The Berkeley scientists tested four herbicides, including atrazine and alachlor, three insecticides and two fungicides in combinations used on cornfields. Each was administered to tadpoles at 0.1 part per billion — amounts commonly found in waters near farms but thousands of times lower than the doses in most pesticide experiments — throughout their metamorphosis.

Donald Sparling of the Cooperative Wildlife Research Center at Southern Illinois University said the study attempted to replicate what happened to frogs in their environment, while past studies investigated immediate effects of a few days of exposure to a single chemical.

"Too often and for too long, we've simplified the real-world exposures," said Sparling, an aquatic toxicologist who was not involved in the Hayes research. "With this study by Hayes and other studies going on now, we're finally getting a realistic picture of what's happening in the environment and what amphibians are actually encountering."

Sparling, formerly with the U.S. Geological Survey, previously reported that frogs and toads on the verge of extinction in Yosemite National Park and other parts of the Sierra Nevada encountered large doses of farm pesticides drifting there from the Central Valley.

In the Hayes study, even though all the animals harbored harmful bacteria, none developed deadly infections when exposed to just the individual pesticides. But those exposed to the mixture suffered a variety of symptoms, including an inability to hold its head up, meningitis, septicemia from a water-borne bacteria and smaller size.

The scientists found thymus damage and four times more corticosterone in the blood of exposed frogs, both signs of immune suppression. Corticosterone also slows growth.

"I think pesticides are underlying a lot of these other problems by reducing immune function, which opens them up to more parasites and diseases," Sparling said.

Hayes wrote that the findings raised questions about the way the federal government regulated pesticides because decisions were based on investigations of chemicals one at a time, not combinations, which might "lead to gross underestimations of the role of pesticides in amphibian declines."

In 2003, after reviewing the risks of atrazine, which has been in use for about 50 years, the Environmental Protection Agency decided not to ban it. Instead, the EPA took the unusual step of allowing its use while requiring Syngenta to monitor towns with contaminated drinking water. The agency concluded that there was "not sufficient evidence that atrazine consistently produces effects" in frogs.

Atrazine is found in groundwater, streams and ponds near farms. It is banned in Europe.

In September, a U.S. District Court judge in San Francisco ruled that the EPA had violated the Endangered Species Act by failing to review the effects on the California red-legged frog when it approved pesticides.

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