

New study points to agriculture in frog sexual abnormalities

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A farm irrigation canal would seem a healthier place for toads than a ditch by a supermarket parking lot. But University of Florida scientists have found the opposite is true. In a study with wide implications for a longstanding debate over whether agricultural chemicals pose a threat to amphibians, UF zoologists have found that toads in suburban areas are less likely to suffer from reproductive system abnormalities than toads near farms – where some had both testes and ovaries.

"As you increase agriculture," said Lou Guillette, a distinguished professor of zoology, "you have an increasing number of abnormalities."

Guillette is one of several UF authors of a paper on the research appearing in the online version of the journal *Environmental Health Perspectives*. The lead author is Krista McCoy, who did the work as part of her UF School of Natural Resources and the Environment dissertation.

Several past studies have suggested a link between herbicides commonly used in farming and sexual abnormalities in tadpoles and frogs. Such deformities may be responsible for declines in frogs documented in areas affected by agricultural contaminants, such as Sierra Nevada, Calif., McCoy said. Amphibians are declining worldwide and agricultural chemicals are considered to be one likely cause, she said. Others include pathogenic infections and habitat loss.

Past research has compared frogs collected from natural areas with those

collected from agricultural areas. Other efforts have pointed to specific chemicals, including the herbicide Atrazine, as causing abnormalities. The UF study is the first peer-reviewed study to compare abnormalities in wild toads – toads are a variety of frogs -- from heavily farmed areas with frogs from both partially farmed and completely suburban areas. In so doing, it highlights the difference between the impact of agriculture versus development.

"Our study is the first to explicitly ask, of these two areas of human disturbance, do we see a greater proportion of abnormal animals in one versus another?" Guillette said.

Because the results implicate agriculture, future research can narrow the focus to agricultural chemicals, McCoy said.

"Because we know what chemicals are used at these agricultural sites, we can begin to pin down the chemical cause of these abnormalities by conducting controlled experiments with each chemical alone and in combination," she said.

The researchers gathered giant toads, known scientifically as *Bufo marinus*, from five sites stretching from Lake Worth to Belle Glade and down to Homestead in South Florida. *Bufo marinus* is a very large, exotic, invasive, species known to be deadly to small animals. Guillette said the researchers studied the toad in part because they are easy to catch and their large size ensures enough blood for analysis. Also, he said, "they are common in other agricultural areas around the world," which means they are a good generalist species.

One of the sites consisted almost entirely of land devoted to sugar cane or vegetable farms. The amount of farmland declined in three other sites, with the last being entirely suburban. Researchers calculated the amount of farmland in each site using Google Earth images.

Each site was 2.1 square miles, with the toads collected at the center. That's because the toad's home range is known to be about 1.2 miles, and the researchers sought only those toads living entirely within each site. The researchers collected at least 20 toads from each site in 2005 and 2006.

Examination of the euthanized toads revealed a pattern: The more agricultural the land where they lived, the more sexual organ abnormalities or so-called "intersex" toads -- toads who have both female and male internal reproductive organs, not a normal condition for this and most species of amphibians.

While normal male toads' forelimbs are thicker and stronger than those of their female counterparts, more of the intersex frogs only found in agricultural areas had thin, weak forearms. Also, intersexes had fewer "nuptial pads," areas of scrappy skin on their feet used to grip females during copulation.

Where a sex was clear, the male toads appeared by far the most affected. Normal males are brown, while females are mottled with brown stripes. However, males from agricultural areas were mottled, looking like females.

Internally, the more agricultural the sites, the more feminized the males' reproductive organs. Many had both ovaries and testes. Not only that, both the impacted males and the intersex frogs had less of the male hormone testosterone than normal males, suggesting diminished reproductive capabilities, Guillette said.

Guillette and McCoy said the study's results may have important implications not only for other wild species, but also for people.

"What we are finding in *Bufo marinus* might also occur in other animals,

including other amphibian species and humans," McCoy said. "In fact, reproductive abnormalities are increasing in humans and these increases could partially be due to exposure to pesticides."

Source: University of Florida

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