ScienceWatch – An Uncertain Future for Frogs

"They're not in large numbers—their abundances are low. But we think that as more time goes by, we'll find more species that we thought were lost." – J. Voyles

In a1999 *ScienceWatch* I described the multiple threats faced by frogs worldwide (http://www.hras.org/sw/SW5-24-99Frogs.htm). One such threat* came from an emerging pathogen *Batrachochytrium dendrobatidis* (BD), a chytrid fungus first discovered in 1993 in dead and dying frogs in Queensland, Australia and later found in Panama.

BD is an aggressive pathogen that infects the skin of frogs, causing it to thicken. Frogs need a porous skin for hydration and respiration, so death quickly ensues. The emerging disease, chytridiomycosis, caused massive die-offs wherever it was found and was able spread from one continent to another, probably by the pet trade. By 2004 the fungus had triggered a worldwide epidemic that threatened to wipe out a whole class of amphibians. Recent estimates are that over 200 frog species have gone extinct and hundreds more are endangered.

Emerging pathogens learn new tricks to overcome host defenses but they rarely cause extinction of the host population. Usually they shift from being highly lethal at first to a later period when host and pathogen coexist because host defenses improve and/or the pathogen naturally loses its virulence. The threat of worldwide frog extinctions beginning in 2004 prompted wildlife biologists to conduct captive breeding programs to save the remnants they could find in the wild, hoping to reintroduce them when and if the disease abated.

Now a study in the March 30, 2018 issue of *Science* provides both good and bad news. Some frogs have become naturally resistant to BD, but its virulence has not declined and many other frogs are still dying off.

The lead scientist, Jamie Voyles, studies emerging infectious diseases at the University of Nevada, Reno, NV. Her team looked at nine frog species devastated when BD first appeared in Panama but have since returned to pre-epidemic levels. They tested the possibility that BD was now less deadly due to a decrease in virulence by infecting frogs with fungus collected during the disease outbreak in 2004 and comparing the results with fungus collected from the rebounding frogs. By all measures (growth rate, spore size, severity of infection) both samples were just as virulent.

Next they tested the possibility that rebounding wild populations had become resistant to BD. They took skin secretions, which normally contain antimicrobial peptides, from these frogs and from "naïve" frogs that had been collected before the outbreak and kept in captivity, and compared both for the ability to block the growth of BD in petri dishes. The inhibitory effectiveness of frog secretions from the wild was much greater than that from captive-bred frogs. "We had multiple species that were between two and five-fold different [between wild and captive] in their effectiveness, which is pretty striking'" said Dr. Voyles, who speculated that

mutant frogs with more effective secretions survived the disease outbreak and passed down their resistant genes.

But Karen R. Lips, who studies chytridiomycosis at the University of Maryland, is not convinced that just looking at skin secretions is the answer. She says that to prove skin secretions protect against BD researchers would have to infect frogs to see if stronger secretions keep more frogs alive. Moreover, resistance can also stem from the switching on of genes that make immune-related proteins that thwart infection. It's possible that both factors matter.

Whatever the cause for the rebound there is still no reason to be complacent. The nine recovering species in Panama represent only 12% of those present before the epidemic.

"I want to put out the message that this is still bad," said Dr. Voyles. "The rebound definitely is a glimmer of hope. But it does not mean by any means that everything is back and there is no problem."

Saul Scheinbach

*I also discussed the disruption of frog embryonic development possibly caused by the herbicide atrazine. Subsequently, it was shown that atrazine turns male frogs into females and is linked to cancer in humans. Found at high levels in drinking water, it was banned in Europe but is still the second most widely used herbicide in the US.