

## Context Matters in the Fight to Save Frogs

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As a conservation biologist “Why do frogs matter?” is the question people ask me most frequently, and it is also a deceptively challenging question to answer. It is exasperating, because my personal motivations for working to conserve amphibians aren’t easily classified into a rational human values framework. I often talk about biomedical and ecosystem service values of frogs, but these defensive intellectual justifications seldom generate the emotional response needed to be convincing. I am one of those weird people who gets an endorphin rush from seeing a new amphibian species in the wild for the first time. I get a thrill when I experience a cacophony of a thousand frogs of different shapes and colors yelling above one another in a dark jungle pond. My personal testimony is that when the forest loses its nocturnal soundtrack it becomes a poorer place, but my scientific training makes me deeply uncomfortable with expressing personal feelings. Emotions tend to cloud facts and make it difficult to do good science, which requires objectivity.

Nonetheless, it is important to recognize that conservation is essentially a values-based endeavor and that emotional and moral framing of arguments are more likely to influence people in the competitive marketplace of ideas. For example, the “Save the Whales” movement campaigned very successfully in the 1970’s on the simple notion that whales are good. They framed the whaling debate as a values conflict between heartless whale hunters and those who could see that whales are obviously gentle, sentient beings. This has proven to be a more challenging conundrum for amphibian conservationists who have struggled to get the ‘frogs matter’ message out to the public. Messages that conflict with the “frogs are good” narrative undermine what little incremental progress we have made in this arena, which is why many of us get heartburn discussing exceptions, such as invasive amphibian species.

One classic example of an invasive amphibian species is the Cane Toad, *Rhinella marina*, introduced to Australia in 1945 as a form of biological control for pests

in sugar cane fields. They are highly toxic to predators like snakes, goannas, crocodiles and quolls and they appear to have reduced populations of these species in newly invaded parts of Australia where predators have not yet developed avoidance behaviors. In one area where Cane Toads recently spread to, Australian Freshwater Crocodiles, *Crocodylus johnsoni*, ate Cane Toads causing mass mortalities reducing the crocodile population by 77%. The detrimental consequences of Cane Toad invasions in Australia have raised similar concerns over the potential effects of Asian Toads, *Duttaphrynus melanostictus*, that were first detected in 2014 in Madagascar.

The Coqui, *Eleutherodactylus coqui*, is native to Puerto Rico, where they are a cherished animal and important symbol of place and national identity. In Hawai'i, however, they are an invasive species and in ideal habitats with no native frogs, their populations exploded, forming much higher densities than in Puerto Rico. Homeowners are not enthralled by the choruses of 70–80 decibels keeping them up at night and ecologists worry about the negative ecological effects of these abundant indiscriminate predators of small invertebrates, including endangered snails. Conservationists in Hawaii are therefore working to eradicate coquis using a citric acid spray among other strategies, while back in Puerto Rico the common Coqui is still common, but other Coqui species are in danger of extinction and are the subject of conservation efforts.

In addition to direct impacts of invasive amphibians, some non-native species can have indirect effects on native amphibians by spreading disease. In parts of Korea, invasive North American Bullfrogs, *Lithobates catesbeianus*, have increased prevalence of the amphibian chytrid fungus and reduced populations of endangered Suweon Treefrogs, *Dryophytes suweonensis*, and in Brazil, North American Bullfrogs have been associated with the spread of a deadly global pandemic lineage of the fungus. It is likely that the global trade in amphibians for food or pets has facilitated the spread of the amphibian chytrid fungus, and similar concerns about the potential spread of a newly discovered salamander chytrid fungus have led to an international salamander trade moratorium in the United States. So far, we have not detected the salamander chytrid fungus on any wild or pet salamanders in the U.S., but in Europe the fungus has spread

rapidly, devastating several wild populations of Fire Salamanders, *Salamandra salamandra*.

As with any non-native species, it is not always possible to predict their effects on native wildlife. In some places, habitat modifications in some cases have facilitated their spread. Asian Bullfrogs, *Hoplobatrachus tigrinus*, thrive in rice paddies in Madagascar where they are also hunted for food. In Australia, Green and Golden Bell Frogs, *Litoria aurea*, are highly threatened by mosquito fish introduced from the US. The fish prey on the frogs' eggs, reducing their populations. The frogs, however, thrive in New Zealand farm ponds despite populations having collapsed in their native range. Habitat requirements of green and golden bell frogs are quite different to those of native New Zealand frogs and so they don't harm the native frogs. Some people view the fact that they are doing well there as a good thing, and a review paper on green and golden bell frogs in New Zealand illustrates the amenity values that the researchers themselves place on the frogs:

*"Because these species [green and golden bell frogs] are not protected in New Zealand, field studies can also incorporate experimental manipulations not readily possible in Australia."* (Pike et al. 2002, Royal Zoological Society of NSW).

It is clear that in the fight to save frogs, context matters. The species, its ecology, the value systems of the people living alongside them, and the audience of your message are all critical. In the case of invasive species, pet owners are a critical target audience that should already be on board with the "frogs matter" message. We have many examples of unintended detrimental consequences from invasive amphibian species, so responsible pet owners should never release non-native species into the wild, because frogs *do* matter.