

## Evolution & Behavior

# Snakes in Decline: Not as Good as You May Think

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*Snakes are essential parts of their ecosystem. Even if they are not well-liked, they can indicate what is happening for other species. Amphibian declines have led to a collapse of the ecosystem, using snakes as a model animal. The loss of snakes from nature is far worse for the environment than anticipated and may even encourage people to conserve them.*



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Snakes are incredibly crucial in each ecosystem to which they are native, despite the fact humans often dislike them. Additionally, when conducting community-level studies, snakes can serve as a conservation model for more secretive or rare animals, like some birds and mammals.

In the past couple of decades, amphibians globally have declined from disease, habitat destruction, pollution, introduced species, and combinations of such. Many types of snakes feed on amphibians, and it's expected that they would be affected by the loss of their prey. However, long-term studies with the foresight to collect pre-catastrophic data are incredibly rare and nearly impossible to come by.

Furthermore, it may be challenging to isolate the reason for losing a particular species or group of species in complex ecosystems. Therefore, advances in statistical computation can assist a scientist greatly to form and support their ideas.

We conducted our study at a mid-elevation cloud forest protected area of central Panama. Between 1997 and 2012 data, we were collected data on amphibians and snakes at the site. In late 2004, amphibians declined rapidly at the site because of chytridiomycosis. This disease occurs when a fungus coats amphibians' skin like frogs and toads and results in the quick death of large numbers of individuals and species. In 2006, it was suspected

that the snakes were affected negatively by the rapid decline in their available food. However, tropical snakes are rare and elusive, making any type of biological inference difficult. For this reason, we utilized a class of models that accounts for imperfect species detection, and we focused our analysis on estimating trends rather than absolute values. We also examined structural changes in snake community composition and body condition changes for the most common snake species.

Our results were as expected and matched what was observed in the field. In short, many snakes declined, but there was no clear link between diet and decline. Using the literature, we found that most snakes fed on amphibians. Still, it is unclear to what extent their diets are comprised of amphibians. It might be that snakes that declined may have had difficulty switching their diets as amphibians declined, and prey availability shifted. However, there is one clear example where the loss of amphibians led to the decline of a species. *Sibon argus* has been documented feeding on amphibian eggs more than the three other *Sibon* species encountered at this site, which are primarily molluscivores. *Sibon argus* experienced the most severe declines of its genus despite otherwise similar habitat requirements and behaviors to the other *Sibon* species. Although most snake species declined following the loss of amphibians, a few increased in their occurrence and/or body condition. Therefore, the loss of amphibians indirectly produced many "loser" snake species and

a few "winners," an ecological phenomenon frequently observed after a disturbance.

Ecosystems are very interconnected. One level of a food chain cannot be lost without affecting all of the other species. It is well documented that humans do not like snakes in general. However, snakes are essential predators in any ecosystem. In this case, their dependence on frogs for food led to their decline in a tropical ecosystem. However, snakes are also critical prey for birds and mammals. Additionally, these higher vertebrates also may feed on frogs. Although birds and mammals are more difficult to study, snakes can provide a model. This model suggests that decline impacts will be even more significant for their predators, including animals within humans traditionally associate and appreciate more.

Our study emphasizes the importance of long-term studies. Without persistence in data collection, a complete understanding of what is going on in nature cannot be seen. Premature decisions that do not consider the conservation of the species and habitat are detrimental to our planet's biodiversity.

Additionally, snakes are essential members of their native ecosystem, and the conservation of them as a group is vital. Given their role as both a significant predator and prey, their removal is detrimental to the system. Given the collapse of frog communities worldwide and the dependency of snakes on frogs, a new outlook must aim to protect snakes instead of intentionally removing them.