

# **Instructor's Teaching Guide Outline**

## **Title:**

Cold blood and wet skin in hot and dry secondary forests. How do amphibian traits determine persistence in secondary forests?

## **Authors:**

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## **Summary (of case study):**

Students synthesize information from biological and physiological traits of amphibians and characteristics of secondary forests in the Neotropics to form hypotheses about persistence of amphibians in secondary forests and in response to land-use change.

## **Targeted/Suggested audience:**

Upper level and graduate students in the life sciences.

## **Estimated time:**

1-2 hours

## **Tags:**

amphibian, conservation biology, ectotherm, land use change, life history, physiological ecology, secondary forests, trait-based ecology

## **KEY CONCEPTS**

- Amphibian conservation status is used as the background for introducing the need to understand amphibian persistence in human-modified landscapes

- Secondary forests are described in terms of their characteristics (as they differ from pastures and old-growth forests) as well as in their increasing importance for conservation as deforestation continues.
- Trait-based approaches to understanding amphibian persistence are introduced including the use of intrinsic and extrinsic traits, biological traits, life history, and physiological traits.

## **LEARNING OBJECTIVES/ LEARNING GOALS**

- Describe the biological and physiological traits of amphibians that are important for persistence in modified habitats and secondary forests.
- Differentiate how the characteristics of secondary forests differ from old-growth forests.
- Synthesize information from species traits and secondary forests to form predictive hypotheses of persistence of amphibians in response to land-use change and regrowth of forests.
- Read and interpret published scientific figures to evaluate hypotheses and predictions.

**4DEE Integration statement:** See [4DEE Box folder](#) for 4DEE framework and examples

Core Ecological Concepts: Abiotic and biotic features of different forest types as they move through successional stages, habitat and niche requirements of amphibians as related to biological traits, life history, and physiological traits.

Human–Environment Interactions: Land use change associated with deforestation and secondary forest regeneration and restoration, how human-modified landscapes may allow for persistence of amphibians depending on species traits.

Cross cutting themes: Discuss the importance of amphibian traits (i.e., function) for persistence in secondary forests and human-modified landscapes.

## **PRIOR KNOWLEDGE**

Students should be familiar with:

- The concept of the niche and how it relates to habitat requirements and persistence in modified landscapes.

- Patterns of succession in forest ecosystems and the general differences between areas that are primary forest, secondary forest, deforested, and pasture.
- Reading and interpreting a variety of scientific figures.

## **MATERIALS**

- Required: None.
- Optional: Scientific articles selected from literature cited.

## **PROCEDURE/ TEACHING PLAN** (*OR OTHER SPECIFIC INSTRUCTION FOR TEACHERS TO PREPARE PRIOR TO ACTIVITY*)

This module is designed to be an assignment completed either in class or outside of class and can be completed as individuals or in small groups to allow for collaboration and discussion. There is sufficient background information provided throughout the module that it can be assigned with minimal student preparation or review of concepts.

If assigned outside of class, the module can be assigned as is. If assigned in class, the four practice pages, the final discussion, and the final word can be removed and presented to the class in a different context such as a group discussion, think-pair-share, or short quiz, or other form.

There are many opportunities to expand upon the content of the module using additional readings on amphibian persistence in secondary forests (see suggestions below), ecology of other taxonomic groups in secondary forests, other trait-based approaches to ecology and/or conservation, and ecology of secondary forest regeneration and restoration. Readings can be assigned before or after the module.

The main concepts to enforce are that trait-based approaches can allow for the extrapolation of past studies and data to make predictions about species and groups where data may be lacking. Tropical organisms in general are severely understudied, especially considering the large diversity of species that are located in tropical environments. And yet, deforestation and land-use change continues at alarming rates in the tropics, threatening a large amount of the world's biodiversity. Therefore, being able to make predictions when data may be limited may be important to guide conservation and management decisions, especially when data, time, and funding is limited.

## **ASSESSMENT TYPE**

The module is designed to have formative assessments throughout. However, the module can be changed to remove the four practice pages, the final discussion, and the final word in order to provide those as assessments during in-class activities or as part of summative assessments following the completion of the module.

## **OPTIONAL EXTENSIONS/ ALTERNATIVE CONTEXTS/RESEARCH PROJECTS/DISCUSSION POINTS (OPTIONAL)**

Several articles can be used as accompanying reading for this module to provide examples of peer-reviewed scientific literature, approaches to data analysis, and extensions of the case studies to additional taxa and contexts. These articles can be used either before or after the module is assigned to students depending on class level and desired outcomes.

## **REFERENCES**

- Nowakowski, AJ, Thompson ME, Donnelly MA, and Todd BD. 2017. Amphibian sensitivity to habitat loss is associated with population trends and species traits. *Global Ecology and Biogeography* 26:700-712.
- Taylor EN, Diele-Viegas LM, Gangloff EJ, Hall JM, Halpern B, Massey MD, Rödder D, Rollinson N, Spears S, Sun B, and Telemeco RS. The thermal ecology and physiology of reptiles and amphibians: A user's guide. *Journal of Experimental Zoology*. 2021; 335: 13–44. <https://doi.org/10.1002/jez.2396>
- Thompson, ME, Halstead, BJ, & Donnelly, MA (2022). Riparian buffers provide refugia during secondary forest succession. *Diversity and Distributions*, 28, <https://doi.org/10.1111/ddi.13601>
- Thompson, ME and Donnelly MA. 2018. Effects of Secondary Forest Succession on Amphibians and Reptiles: A Review and Meta-analysis. *Copeia* 106:10-19.
- von May R, Catenazzi A, Corl A, Santa-Cruz R, Carnaval AC, Moritz C. Divergence of thermal physiological traits in terrestrial breeding frogs along a tropical elevational gradient. *Ecology and Evolution*. 2017; 7: 3257–3267. <https://doi.org/10.1002/ece3.2929>

## **CREDITS**

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