



Hydrological Regimes, Pond Morphology, & Habitat Use: Predicting the Impact of a Pathogen

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We are investigating why populations of mountain yellow-legged frog in some parts of the Sierra Nevada are experiencing rapid die-offs as a result of chytridiomycosis, a newly-identified fungal disease of amphibians, while other populations are persisting with the fungus. Mark-recapture field surveys have shown that frogs at the persistent sites can survive with the disease, experiencing only mild infections. Laboratory experiments have revealed that this difference in disease outcome is unlikely to be due to differences in fungal virulence or frog susceptibility between areas.

Declines in amphibian populations have been reported throughout the world in recent years. A number of factors have contributed to these population declines, including disease, introduced species, habitat loss and alteration, and climate change. Chytridiomycosis is a potentially fatal disease of amphibians caused by the chytrid fungus, *Batrachochytrium dendrobatidis*, which has appeared recently in the aquatic habitats of California and throughout the world. In portions of the Sierra Nevada Mountains of California, the disease is causing rapid die-offs of mountain yellow-legged frogs, *Rana muscosa*, a threatened native frog species. In other areas of the Sierra, infected populations of *R. muscosa* appear to be persisting with the fungus. In this study we are investigating why the fungal pathogen is having different outcomes on frog populations in different California watersheds.

Laboratory Experiments: A laboratory experiment conducted this year corroborated our previous years' findings that differences in fungal strain and/or differences in frog susceptibility are not responsible for the different population-level impacts of the disease at the different sites.

In this experiment we exposed subadult *R. muscosa* from either northern (persistent) sites, or southern (die-off) sites to *B. dendrobatidis* strains from each type of site. We found no difference between any of the source frog x source fungus location treatments in (a) the fractions of frog individuals that became infected from a standardized dose of the fungus, or (b) resulting frog mortality due to the fungus.

Field Surveys: During summer of 2006 we continued the field surveys started in the summers of 2004 and 2005 at sites in the Sierra Nevada experiencing *R. muscosa* die-offs due to chytridiomycosis, and sites with *B. dendrobatidis* present with persistent *R. muscosa* populations. We continued to use a non-destructive, quantitative PCR technique to determine the infection status (presence/absence of *B. dendrobatidis*) and infection level (fungal loads) of *R. muscosa* individuals. We marked adult *R. muscosa* and recaptured and re-swabbed the same individual repeatedly. We have found additional evidence that infected frogs at die-off sites carried very high fungal loads, while at persistent sites the infected frogs were experiencing only low to moderate infections. As in the previous year, we found that at the persistent infected sites, some

adult *R. muscosa* lost the infection through time, and many infected individuals survived over the long overwintering period.

Model Development: The results of our laboratory experiments and field surveys have led us to direct our future research efforts towards understanding the fungal load dynamics within individual frogs. We are currently developing mathematical models to investigate the effects of fungal load on population persistence.

Professional Presentations

Briggs, Cheryl, and Lara Rachowicz, Quantifying the *B.d.* transmission function in *Rana muscosa*: An experimental/maximum likelihood approach, Integrative Research Challenges in Environmental Biology grant meeting, Arizona State Univ., Tempe, AZ, November 2005.

Briggs, Cheryl, Jess Morgan, and John Taylor, *B.d.* Population Genetics in the Sierras, Integrative Research Challenges in Environmental Biology grant meeting, Arizona State Univ., Tempe, AZ, November 2005.

Briggs, Cheryl, How do disease processes differ between persistent and non-persistent populations?, Workshop: Restoration Plans for the Mountain Yellow-Legged Frog, Yosemite National Park, CA, January 2006.

Briggs, Cheryl, Using mathematical modeling to understand disease impacts at the local and metapopulation scales, Workshop: Restoration Plans for the Mountain Yellow-Legged Frog, Yosemite National Park, CA, January 2006.

Briggs, Cheryl, Diseases in landscapes: Investigating the population-level consequences of two emerging infectious diseases in California, University of California, Santa Barbara, CA, March 2006.

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