

Pacific Southwest Research Station

Sierra Nevada Research Center

Aseasonal pulsed flow effects on the foothill yellow-legged frog (*Rana boylei*): Integration of empirical, experimental and hydrodynamic modeling approaches

The Research:

This study is a collaborative effort between the USDA Forest Service, Pacific Southwest Research Station, Sierra Nevada Research Center, the University of California, Davis, and an independent scientist. The primary goal of the study is to better understand the effects of pulsed flow releases resulting from hydroelectric power generation on the foothill yellow-legged frog (*Rana boylei*).

The foothill yellow-legged frog is one of a few California amphibians whose complete life cycle is associated with stream environments. The life stages of the foothill yellow-legged frog occur along a mobility continuum from immobile (eggs) to highly mobile (adults) such that adaptations which improve survival rate vary in relation to ontogeny. To avoid disturbance, the timing of this complex life history and set of habitat preferences is synchronized with the seasonality of runoff during the predictable cycle of wet winters and dry summers occurring across the range of the foothill yellow-legged frog. Over the last half century, the foothill yellow-legged frog has declined dramatically, especially in southern California and the southern Sierra Nevada mountains. Dams and reservoirs have been cited as likely factors in this decline because they drastically alter the disturbance regime and sediment budget of rivers in which native species have evolved, resulting in permanent alteration to instream habitats. The ensuing impact on foothill yellow-legged frog survival has been a focus of study over the last decade, but many knowledge gaps remain. Of primary concern in this research are the short-term direct and indirect effects of extreme aseasonal fluctuation in water discharge during the foothill yellow-legged frog's larval rearing season.



Photo: Amy Lind



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Photo: Holly Sanders

Our Mission:

Sierra Nevada Ecosystems are complex and our knowledge of them is incomplete. As a result, the long term outcome of any given land and resource management strategy is uncertain. We will provide assistance to land managers and policy makers by addressing this management dilemma through targeted research, emphasizing an integrated, ecoregional approach to examine particular physical, ecological, and socio-economic issues, across a range of appropriate spatial and temporal scales specific to each issue.

This unit will represent the collective research expertise and interests of scientists located in Fresno, Davis and Albany as well as other scientists within the Pacific Southwest Research Station. With a full spectrum of research, from long term, fundamental research to short-term, tactical applications, this Center is intended to support conservation, restoration, and sustainable utilization of the lands within the Sierra Nevada



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Objectives:

To better understand the effects of pulsed flows on foothill yellow-legged frogs, we are addressing the following objectives in a two phased approach:

Phase I

1. Document relationships between characteristics of pulsed flows (e.g. timing, magnitude in relation to base flow) and survival, reproductive success, and habitat suitability for all life stages of the foothill yellow-legged frog through a review and analysis of existing data and reports.
2. Identify specific knowledge gaps regarding aspects of fluctuating or pulsed flows and their impacts on foothill yellow-legged frog survival rates, reproductive success, and habitat suitability.

Phase II

1. Address specific knowledge gaps identified in Phase I with a series of laboratory and field experiments designed to quantify larval swimming abilities and behavioral responses to changes in shear stress created by manipulations of depth, velocity, and substrate.
2. Develop a model-based methodology to evaluate changes in habitat-scale hydrodynamics from a series of low and high pulse flow scenarios and subsequent changes in habitat availability and heterogeneity.
3. Use results from lab and field manipulations to assess how modeled changes in habitat availability and heterogeneity may influence foothill yellow-legged frog survival and reproductive success. By integrating these two components we will be able to translate model predictions regarding habitat parameters into actual effects on various life stages of the foothill yellow-legged frog.

Application of Research Results:

The integrated results of this work should provide a better understanding of the current impacts of pulsed flows on foothill yellow-legged frogs along with a model-based methodology that could be used to mitigate impacts on various aquatic species in future pulsed flow planning.

Location:

Study sites for field experiments and hydrodynamic modeling are in low-mid elevation streams in the coast range and on the west slope of the Sierra Nevada. Laboratory experiments will be conducted in an artificial stream/laboratory flumes at the USFS PSW Redwood Sciences Laboratory in Arcata, California and at UC Davis.



Photo: Holly Sanders

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