



# Local and Landscape Effects of Introduced Trout on Amphibians in Historically Fishless Watersheds

David S. Pilliod\* and Charles R. Peterson

Department of Biological Sciences, Idaho State University, Pocatello, Idaho 83209-8007, USA

## ABSTRACT

Introduced trout have often been implicated in the decline of high-mountain amphibian populations, but few studies have attempted to understand whether fish stocking also influences the distribution and abundance of amphibians throughout entire mountain basins, including the remaining fishless lakes. We examined this relationship using the relative abundance of long-toed salamanders (*Ambystoma macrodactylum*) and Columbia spotted frogs (*Rana luteiventris*) in fish-containing and fishless lentic sites in basins with varying levels of historic fish stocking. All lentic waters were surveyed for fish and amphibians in 11 high-elevation basins in the Frank Church–River of No Return Wilderness, Idaho, between 1994 and 1999. We found introduced trout (*Oncorhynchus clarki*, *O. mykiss*, *O. m. aguabonita*) in 43 of the 101 sites, representing 90% of the total surface area of lentic water bodies available. At the scale of individual water bodies, after

accounting for differences in habitat characteristics between fish-containing and fishless sites, the abundance of amphibians at all life stages was significantly lower in lakes with fish. At the basin scale, densities of overwintering life stages of amphibians were lower in the fishless sites of basins where more habitat was occupied by trout. Our results suggest that many of the remaining fishless habitats are too shallow to provide suitable breeding or overwintering sites for these amphibians and that current trout distributions may eventually result in the extirpation of amphibian populations from entire landscapes, including sites that remain in a fishless condition.

**Key words:** *Ambystoma macrodactylum*; amphibian; extinction; fish stocking; introduced trout; metapopulation; persistence; *Rana luteiventris*; wilderness.

## INTRODUCTION

For over a century, trout and other sport fishes have been introduced into historically fishless, high-elevation lakes in western North America to provide recreational fisheries for backcountry anglers (Bahls 1992). Recent concern over the decline in amphibian populations has led researchers to assess the role of fish stocking in the loss of amphibian populations from high-elevation watersheds. Although several recent studies have documented the negative effects of introduced trout on amphib-

ians at the scale of individual water bodies (Hayes and Jennings 1986; Bradford 1989; Fisher and Shaffer 1996; Bradford and others 1998), few studies have examined the consequences of introduced fish on amphibian distributions at broader spatial scales (but see Bradford and others 1993; Knapp and Matthews 2000).

Numerous local-scale studies have documented that, in general, amphibians are less likely to exist and to breed successfully in lakes with predatory, nonnative fish (Bradford 1989; Brönmark and Edenhamn 1994; Braña and others 1996; Gamradt and Kats 1996; Hecnar and M'Closkey 1997; Bradford and others 1998; Goodsell and Kats 1999; Knapp and Matthews 2000). In part, amphibian

Received 28 March 2000; Accepted 2 January 2001.  
\*Corresponding author; e-mail: pilldavi@isu.edu