

Category II - Aquatic Ecosystems

Non-native fish in mountain lakes: effects on a declining amphibian and ecosystem subsidy

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EXECUTIVE SUMMARY

Management of high mountain lake areas is a challenge to several State and Federal agencies because of mandates to protect native species and ecosystems, while providing recreational and economic opportunities for the public. Sport fish have been introduced to many formerly fishless lakes and streams in public lands throughout the western USA. The resulting fisheries foster recreation use of wilderness and national forests, however widespread fish introductions have been implicated in the decline of several amphibian species including the Cascades frog (*Rana cascadae*). Non-native trout prey upon larval amphibians and aquatic insects. The adult stages of aquatic insects and amphibians are a major prey item for bats, birds, snakes, and other terrestrial insectivores. The indirect effects of introduced fish on terrestrial wildlife have rarely, if ever, been considered, and there are no experiments testing effects of fish stocking on the Cascades frog (federal and California species of special concern). We will address these critical research needs with an ecosystem-scale study to assess whether changes in fish abundance could aid frog recovery and whether trout predation of larval amphibians and aquatic invertebrates suppresses prey subsidization and, thereby indirectly affects the density of terrestrial predators.

In 2003, with funding from the California Department of Fish and Game (CDFG), we initiated an ecosystem-scale, replicated manipulative experiment in the Trinity Alps Wilderness of northern California, a historically fishless region that now supports trout in approximately 85% of the 100+ lakes > 2 m deep. We identified 16 study basins to make up four replicates of three fish treatments and a control. The lake basins are as similar as possible in terms of physical conditions. Aside from the control basins, the remaining 12 basins were blocked into four groups based on geographic location, and then lakes in each block were randomly chosen as stocking suspension lakes, fish removal lakes, or continue to stock lakes. In the summer of 2003, we collected pre-treatment baseline data at all basins and removed trout from the four fish removal basins in the fall. Over the next two years of this project, we will quantify post-treatment populations of fish, Cascades frogs, emerging aquatic insects, birds, reptiles and bats. Frogs and snakes will be monitored via mark-recapture studies and visual surveys. We will quantify aquatic insect composition and abundance using dip nets, emergence traps and sticky traps. Bats will be monitored via acoustic bat detectors, and we will use point-count surveys to quantify bird abundances.

This project will provide information vital to policy development for protecting and managing the extensive montane wilderness areas in the western United States. Information provided by this project will show whether adjustment of fish stocking practices could create landscapes where fish and frogs can coexist at broad scales. Quantitative information on faunal changes and recovery will be supplied

to agencies for use in landscape-scale management plans. In addition, this project has great relevance to developing ecological theory. Ecologists have recently recognized the importance of 'ecosystem subsidies', which are flows of nutrients and organisms across the borders between adjacent ecosystems, such as water bodies and terrestrial habitats. Ours would be the first experimental study of whether a predator introduced into one community affects the level of subsidy flowing into an adjacent community. Additional benefits of the project include providing field and laboratory research training for Ms. Karen Pope, a Ph. D. student, an undergraduate assistant and volunteers. The study also promotes a research partnership between the University of California, the US Forest Service, and CDFG. Research results will be disseminated broadly using both the basic and applied scientific literature and agency newsletters.