Category II - Aquatic Ecosystems

Restoring Alpine Lake Ecosystems Through Control of Trout Spawning

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Executive Summary:

Non-native trout have been widely introduced into historically fishless lakes in the Sierra Nevada with massive negative ecological effects. There is a growing interest in returning some lakes to a fishless condition, yet progress in this direction is being hampered by lack of information on factors limiting populations of introduced trout in high elevation lakes. There are two primary components to this study.

During the period 1994-1996, stocking was suspended for 5+ years in 33 lakes in the John Muir Wilderness Area.This provided the opportunity to (1) determine what proportion of lakes in the JMW study area contain self-sustaining rainbow trout (*Oncorhynchus mykiss*) or golden trout (*Oncorhynchus mykiss aguabonita*) populations, (2) quantify the effects of halting fish stocking on those trout populations that are self-sustaining, and (3) identify the factors that might influence trout population self-sustainability. At these lakes, we collected trout population data in 2001 and compared the results to those generated from an identical data collection effort conducted at the time of the stocking termination (1995-1996; Knapp, unpublished data). Based on previous research on trout populations in the study area (Knapp, unpublished data), we hypothesized that a majority of currently-stocked trout populations were in fact self-sustaining. For self-sustaining trout populations, we also predicted that halting stocking would have either no effect or a positive effect on fish growth rates. A positive effect on growth rates might occur if halting stocking reduced fish population densities.

This is the first study that addresses the question of what proportion of currently-stocked golden and rainbow trout populations in the alpine Sierra Nevada are self-sustaining. Management of these lakes has historically been predicated on the assumption that few or none of these introduced trout populations are self-sustaining. We found evidence that 79% of the populations in the 33 experimental lakes in this study showed some level of recruitment resulting from natural reproduction. Our conservative definition of population self-sustainability suggested that 64% of the experimental lakes included in this study contained self-sustaining trout populations, while another 15% showed very low recruitment. Trout populations in these latter lakes are unlikely to be self-sustaining over the long term. Our results suggest that many of the golden and rainbow trout populations in the High Sierra are likely self-sustaining. In addition, our results suggest that supplemental stocking of lakes provides no benefit when lakes contain self-sustaining trout populations. Population density and maximum fish size (a measure of individual growth rates) were similar in experimental and control lakes following the 5+ year stocking hiatus. Although no detrimental effects of stocking on recipient trout populations were apparent (e.g., reduced fish sizes resulting from increased population densities), a permanent cessation of stocking in those lakes with low levels of natural reproduction may eventually produce a lower density fish population with higher individual growth rates.

We have collected population data (density, individual sizes, age class distribution) as well as physical measures from (depth, area, elevation, temperature, amount of spawning habitat, and littoral zone substrate) from 70 brook trout lakes in Yosemite National Park to (1) examine the role of spawning habitat in limiting brook trout populations, (2) quantify the influence of lake physical factors (lake elevation, lake area, lake depth, mid-summer water temperature, and conductivity) in influencing brook trout density, and (3) determine what influence climatic variables such as winter precipitation and summer temperatures have on brook trout spawning timing and dynamics. . In addition, we have conducted snorkel surveys in approximately 60 of these lakes in order to identify and quantify the areal extent of spawning habitat. The data will be used at inputs of a matrix population model to determine what factors enable brook trout populations to persist in high elevation lakes in the Sierra Nevada.

Preliminary evidence shows that spawning habitat is a limiting factor in influencing brook trout recruitment. The magnitude of annual recruitment in these populations also appears to be episodic, and is likely influenced by climatic factors such as winter precipitation and summer temperatures. These preliminary results indicate that changing global weather patterns may significantly alter brook trout recruitment in the future.