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Life History Diversity in Klamath River Steelhead

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Abstract

Oncorhynchus mykiss exhibits a vast array of life histories, which increases its likelihood of persistence by spreading risk of extirpation among different pathways. The Klamath River basin (California–Oregon) provides a particularly interesting backdrop for the study of life history diversity in *O. mykiss*, in part because the river is slated for a historic and potentially influential dam removal and habitat recolonization project. We used scale and otolith strontium isotope ($^{87}\text{Sr}/^{86}\text{Sr}$) analyses to characterize life history diversity in wild *O. mykiss* from the lower Klamath River basin. We also determined maternal origin (anadromous or nonanadromous) and migratory history (anadromous or nonanadromous) of *O. mykiss* and compared length and fecundity at age between anadromous (steelhead) and nonanadromous (Rainbow Trout) phenotypes of *O. mykiss*. We identified a total of 38 life history categories at maturity, which differed in duration of freshwater and ocean rearing, age at maturation, and incidence of repeat spawning. Approximately 10% of adult fish sampled were nonanadromous. Rainbow Trout generally grew faster in freshwater than juvenile steelhead; however, ocean growth afforded adult steelhead greater length and fecundity than adult Rainbow Trout. Although 75% of individuals followed the migratory path of their mother, steelhead produced nonanadromous progeny and Rainbow Trout produced anadromous progeny. Overall, we observed a highly diverse array of life histories among Klamath River *O. mykiss*. While this diversity should increase population resilience, recent declines in the abundance of Klamath River steelhead suggest that life history diversity alone is not sufficient to stabilize a population. Our finding that steelhead and Rainbow Trout give rise to progeny of the alternate form (1) suggests that dam removal might lead to a facultatively anadromous *O. mykiss* population in the upper basin and (2) raises the question of whether both forms of *O. mykiss* in the Klamath River should be managed under the same strategy.

Oncorhynchus mykiss displays a vast array of life histories. The species exhibits anadromous (steelhead) and nonanadromous (Rainbow Trout) forms, both of which are capable of spawning

repeatedly in a lifetime (Shapovalov and Taft 1954; Behnke 1992; Busby et al. 1996; Willson 1997). Steelhead and Rainbow Trout can occur in sympatry, with (Seamons et al. 2004; Kuzishchin

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