

ODE Models of Rainbow Trout / Yellowstone Cutthroat Trout Interactions in the Upper South Fork Snake River, Idaho

The displacement of native species by invading nonnative species has caused a decline in biological diversity. One of the few remaining large-river populations of Yellowstone cutthroat trout (YCT) is in the upper South Fork Snake River, Idaho, where they are now being displaced by the nonnative rainbow trout (RBT). Competition for feeding territories among age-0 individuals and hybridization are two known factors contributing to this invasion. However, there is a subpopulation of YCT that spawn in the tributaries rather than in the main river, which provides some protection against the threats of hybridization and competition. Because RBT are actively trapped and removed from the tributaries, tributary-spawning YCT are protected from hybridization. In addition, the offspring are protected from juvenile competition if they remain in the tributaries through their first year before returning to the main river. However, little is known about the early life history of the tributary-spawning subpopulation, although this knowledge is needed to predict future effects of the RBT invasion on the YCT in the South Fork. Several ODE population models of these species' interactions are proposed and analyzed. The first model shows that density-dependent competition alone cannot account for the type of displacement that has been observed. The remaining models incorporate various scenarios of competition in which RBT have an advantage over YCT and of hybridization. Model parameters are determined directly from the demographic data and by using linear and nonlinear regression to minimize mean square error between observed and model-predicted population sizes. Analysis of the regression statistics and the parameter values provides insight into the early life history of the tributary-spawning subpopulation and the relative contributions of competition and hybridization to RBT invasion success.