Title: Yellowstone cutthroat trout conservation in a changing climate

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Abstract:

Yellowstone cutthroat trout (*Oncorhynchus virginalis bouvieri)* is an iconic species in the Greater Yellowstone Area with important ecological, cultural, and socioeconomic significance. However, climate warming and non-native species continue to threaten populations. Yellowstone cutthroat trout conservation planning is focusing on the importance of headwaters, which are anticipated to serve as critical refugia for coldwater-adapted fishes in a warming climate. However, our understanding of the ecology and factors limiting fishes in headwater streams is relatively sparce. To address this need, we initiated long-term mark-recapture studies to investigate the life-histories of Yellowstone cutthroat trout in headwater streams in Montana and Wyoming. Our objectives were to increase our understanding of the abiotic template in headwater riverscapes and quantify how interannual variation in streamflow, temperature, and anomalous climatic years (e.g., droughts) affect vital rates and demographics. Our *in situ* streamflow and temperature data indicated (1) large spatial variation in discharge in headwater streams, suggesting the challenges of using nearby gage data to estimate key streamflow parameters and direct climate vulnerability; (2) enormous (~100x) intra-annual variation in streamflow in headwater streams; and (3) the importance of streamflow in mitigating stressful thermal regimes during the summer. Mark-recapture data suggested wide variation in growth across streams and the importance of growth during the spring. We found high interannual variation in Yellowstone cutthroat trout abundance and recruitment of young-of-year, which was most pronounced when sympatric with non-native brown trout (*Salmo trutta*) and at higher elevation, colder climates. Drought conditions were most evident in impacting brown trout and Yellowstone cutthroat trout sympatric with brown trout. While headwaters can serve as thermal refugia, our research also illustrates the importance of connectivity to larger, more productive stream habitats that foster a diversity of life-histories important for population resilience. Collectively, our results highlight the need to continue to expand our understanding of how climate change and biotic interactions drive the vulnerability and likely persistence of populations in headwater streams to inform effective conservation strategies.