

TEMPERATURE AND COMPETITION BETWEEN BULL TROUT AND BROOK TROUT: A TEST OF THE ELEVATION REFUGE HYPOTHESIS

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We tested the elevation refuge hypothesis that colder temperatures impart a competitive advantage to bull trout (*Salvelinus confluentus*) thus accounting for increased biotic resistance to invasion by brook trout (*Salvelinus fontinalis*) in headwater streams. Growth, survival, and behavior were compared in allopatry and sympatry at temperatures of 8 to 20 °C in the laboratory. In allopatry, bull trout and brook trout grew at similar rates at temperatures of 8.0 to 14.5 °C, but brook trout grew significantly faster at higher temperatures. In sympatry, bull trout grew significantly less than brook trout at all test temperatures, with growth differences increasing linearly with increased temperature. Bull trout feeding and aggression rates were significantly less when sympatric with brook trout at 8 and 16°C whereas bull trout had no effect on feeding and aggression in brook trout. Modeled growth based on tributary temperature data from a high (10 °C mean summer temperature) and low elevation site (14.5 °C) was similar for both species in allopatry. However, brook trout achieved much greater size than bull trout in sympatry, particularly at the warm site where predicted size of brook trout was 21.7 mm (23%) greater in length and 4.9 g (60%) greater in weight. Brook trout have a marked behavioral and physiological advantage over bull trout at warmer temperatures, but the evidence was equivocal for bull trout gaining a similar advantage over brook trout at colder temperatures.