

Effects of water temperature and fish size on predation vulnerability of humpback chub to trout

David Ward and Rylan Morton-Starner
 U.S. Geological Survey, Flagstaff AZ
 dlward@usgs.gov



Rocky Mountain
 Research Station



12 replicate tanks for predation trials

- 4 trout predators per tank
- 12 chub prey per tank (in baskets)
- Allowed to acclimate for 24-h
- Baskets tipped – Live fish counted 24 h later



Summary

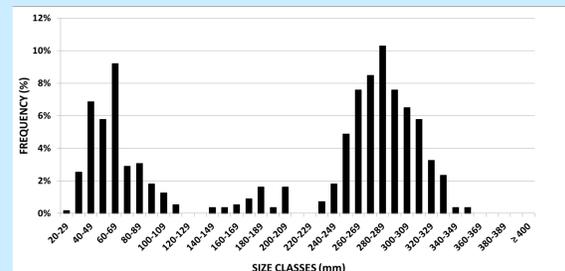
Predation of juvenile native fish by introduced rainbow trout and brown trout is considered a significant threat to the persistence of endangered humpback chub and other native fishes in Grand Canyon. Diet studies of rainbow trout and brown trout in Grand Canyon indicate that these species do eat native fish, but population level impacts are difficult to assess because predation vulnerability changes with fish size, and water temperature. We conducted laboratory experiments to evaluate how short term predation vulnerability of humpback chub changes in response to fish size and water temperature using captive reared bonytail chub, roundtail chub and humpback chub. Juvenile chub 45 to 90 mm TL were exposed to rainbow and brown trout at 10, 15, and 20 °C to measure how predation vulnerability changes as a result of water temperature and fish size. Brown trout were highly piscivorous at all sizes and water temperatures. A 1° C increase in water temperature decreased short term predation vulnerability of humpback chub to rainbow trout by about 5%. Understanding the effects of predation by trout on endangered humpback chub is critical in evaluating management options aimed at preservation of native fishes in Grand Canyon.

	Number of Replicates	Number of Trout	Trout Total Length (mm) Mean (Range)	Prey Species *(All captive reared)	Number of Chub	Chub Total Length (mm) Mean (Range)
Rainbow Trout	12	48	299 (283 - 319)	Bonytail chub	144	77 (70 - 85)
	24	96	275 (261 - 291)	Humpback chub	288	65 (45 - 87)
	12	48	305 (281 - 324)	Roundtail chub	144	63 (47 - 71)
Brown Trout	12	48	246 (230 - 273)	Bonytail chub	144	77 (67 - 90)
	36	144	263 (218 - 341)	Humpback chub	432	70 (45 - 91)
	12	48	231 (214 - 245)	Roundtail chub	144	58 (44 - 67)
Totals	108	384			1296	

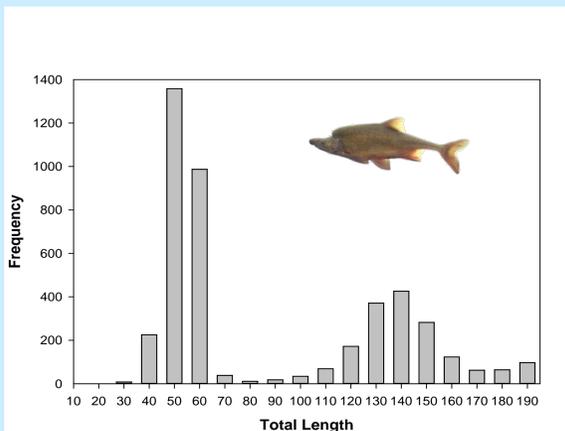
Number and sizes of fish used to evaluate the relationship between water temperature, fish size and predation vulnerability



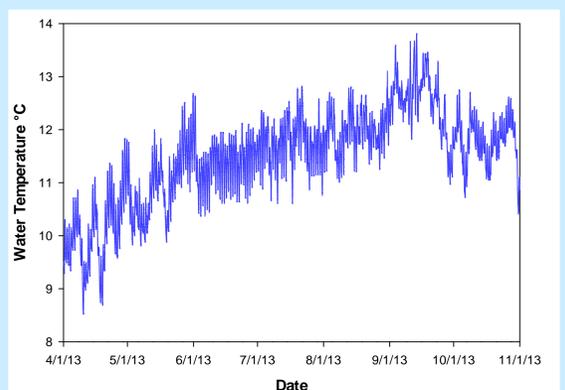
Growth of roundtail chub in the laboratory at three water temperatures for nine months



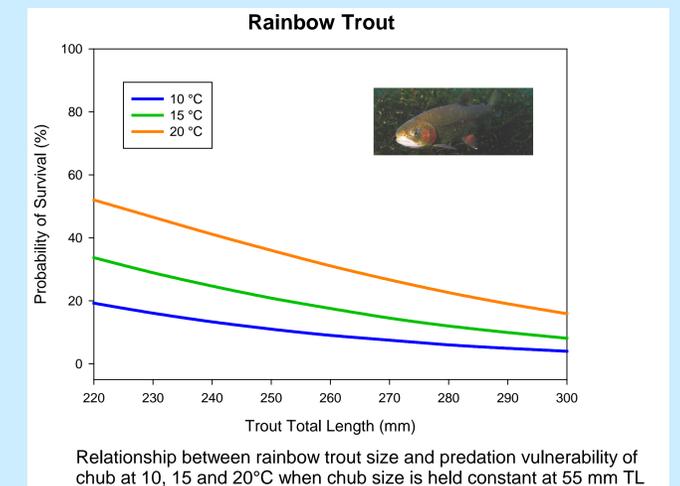
Length frequency histogram of rainbow trout in the Colorado River below the LCR in July 2013



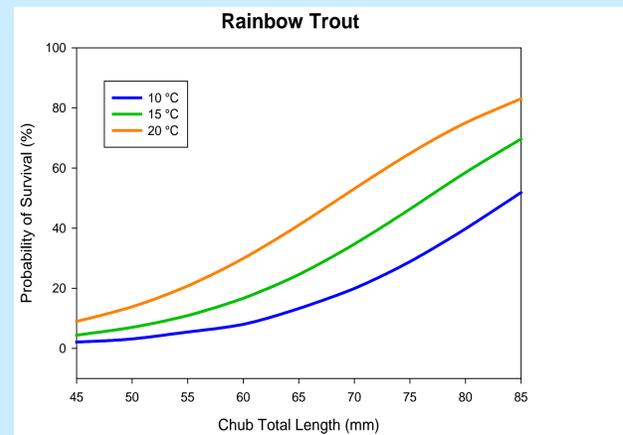
Length frequency histogram for juvenile humpback chub in the Little Colorado River in July 2013



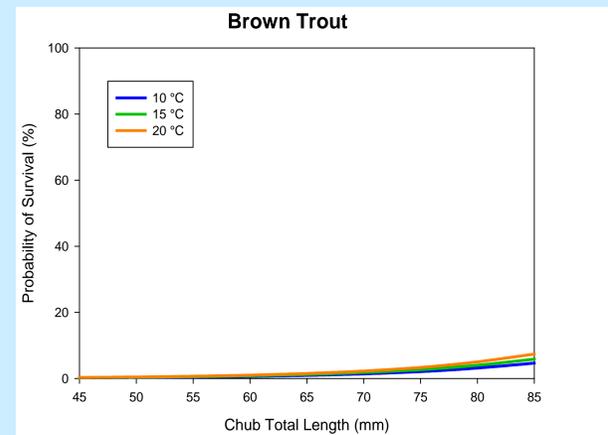
Maintain water temperature above the Little Colorado River in 2013



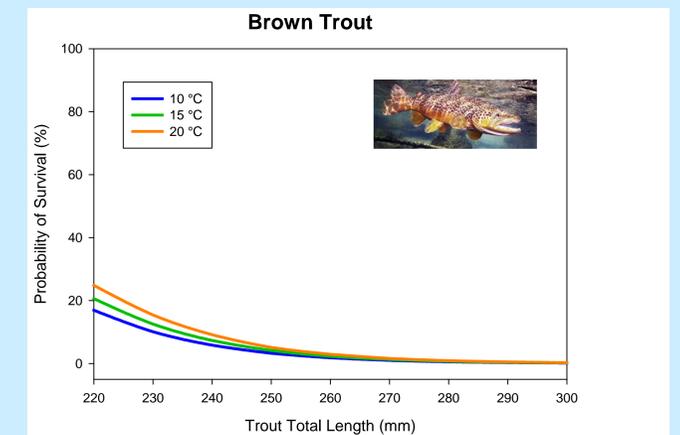
Relationship between rainbow trout size and predation vulnerability of chub at 10, 15 and 20°C when chub size is held constant at 55 mm TL



Relationship between chub size and predation vulnerability at 10, 15 and 20°C when rainbow trout size is held constant at 285 mm TL



Relationship between chub size and predation vulnerability at 10, 15 and 20°C when brown trout size is held constant at 285 mm TL



Relationship between brown trout size and predation vulnerability of chub at 10, 15 and 20°C when chub size is held constant at 55 mm TL