A Map and Database of Westslope Cutthroat Trout Hybridization Throughout Idaho and Montana Streams

Michael Young[1*], Daniel Isaak[2], Kevin McKelvey[1], Taylor Wilcox[1], Kristy Pilgrim[1], Kellie Carim[1], Matt Campbell[3], Matt Corsi[4], Dona Horan[2], Dave Nagel[2], and Michael Schwartz[1]

[1]Rocky Mountain Research Station, National Genomics Center for Wildlife and Fish Conservation, Missoula, MT; [2]Rocky Mountain Research Station, Boise Spatial Streams Group, Boise, ID; [3]Eagle Fish Genetics Laboratory, Idaho Department of Fish and Game, Eagle, ID; [4]Idaho Department of Fish and Game, Coeur d'Alene, ID; *Email: mkyoung@fs.fed.us

Abstract.-Among the many threats posed by invasions of nonnative species is introgressive hybridization, which can lead to the genomic extinction of native taxa. This phenomenon is regarded as common and perhaps inevitable among native cutthroat trout and introduced rainbow trout in western North America, despite that these taxa have naturally co-occurred for thousands of years in some locations. We conducted a synthetic analysis of 13,315 genotyped fish from 558 sites in Idaho and Montana (see map inset) by building logistic regression models using data from geospatial stream databases and from 12 published studies of hybridization to assess whether environmental covariates could explain levels of introgression between westslope cutthroat trout and rainbow trout. A consensus model performed well (AUC, 0.78–0.86; classification success, 72–82%; 10-fold cross validation, 70–82%) and predicted that rainbow trout introgression was positively associated with warmer water temperatures, larger streams, proximity to warmer habitats and to recent sources of rainbow trout propagules, and presence within the historical range of rainbow trout (see graph inset). This poster depicts the probability that westslope cutthroat trout introgression with rainbow trout exceeds 10% in reaches across a 55,234-km stream network during a scenario that represents present climate conditions and rainbow trout distributions. The database for the 558 sites, as well as user-friendly digital maps and ArcGIS shapefiles showing hybridization probabilities for three thresholds (1%, 10%, and 20%) associated with six climate change and rainbow trout invasion scenarios are available at the project website (see References section) to assist managers in conservation planning.

Conclusions

- Headwater streams in many locations are composed largely or entirely of genetically intact populations of westslope cutthroat trout. Locations of hybrid zones between westslope cutthroat trout and rainbow trout are predictably related to environmental conditions such as warmer water, more productive habitats, and sources of rainbow trout propagules.
- Introgression levels are higher where the native ranges of westslope cutthroat trout and rainbow trout overlap (e.g., Clearwater and Salmon river basins). This pattern may be driven by a longer period of co-occurrence or the fecundity subsidy associated with the presence of anadromous steelhead.
- Hybrid zones are often dominated by individuals that represent the parental species. As a result, hybrid swarms characterized by complete admixture between westslope cutthroat trout and rainbow trout are rare. However, hybrid swarms may be common where Yellowstone cutthroat trout have been stocked into the range of westslope cutthroat trout.
- Climate-driven increases in water temperature are expected to slowly shift the position of hybrid zones by 300–500 meters/decade. These shifts can be upstream or downstream, depending on whether rainbow trout are arriving from productive lower-elevation rivers or from high-elevation lakes.
- Many factors influencing hybridization with rainbow trout can be manipulated to foster largely genetically intact populations of westslope cutthroat trout.
- The genomic extinction of westslope cutthroat trout from introductions of rainbow trout seems unlikely, even should the more extreme patterns of introgression inside the native range of rainbow trout be realized elsewhere.
- Results from this research are encapsulated in spatially-explicit databases and ArcGIS shapefiles to assist managers in strategic prioritization of conservation actions.

References:

- Website: https://www.fs.fed.us/rm/boise/AWAE/projects/CutthroatRainbowTrout.html
- McKelvey KS, Young MK, Wilcox TM, Bingham DM, Pilgrim KL, Schwartz MK (2016) Patterns of hybridization among cutthroat trout and rainbow trout in northern Rocky Mountain streams. Ecology and Evolution, 6, 688–706.
- Young MK, Isaak DJ, McKelvey KS, Wilcox TM, Pilgrim KL, Carim KJ, Campbell MR, Corsi MP, Horan DL, Nagel DE, Schwartz MK (2016) Climate, demography, and zoogeography predict introgression thresholds in salmonid hybrid zones in Rocky Mountain streams. PLoS ONE, 11: e0163563. doi:10.1371/journal. pone.0163563

Probability that cutthroat trout hybridization exceeds 10% rainbow trout alleles (PRTA 10%)