Genetic sampling for the conservation of Oncorhynchus clarkii lewisi

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Introduction

Oncorhynchus clarkii lewisi, or the Westslope Cutthroat Trout (WCT), is an at-risk species of fish residing primarily in the Mid and Pacific Northwestern United States. Many conservationist organizations, such as the U.S. Forest Service, the U.S. Bureau of Land Management, and the Montana chapter of the American Fisheries Society, along with the State of Montana, have each outlined WCT as an at-risk species, and this comes with certain allowances and protections to the species (FWP 2022).

As a result of the WCT being extirpated, Montana Fish, Wildlife, and Parks assigned WCT as a species of concern, which sparked the drafting of a Memorandum of Understanding amongst independent conservation organizations, industry organizations, indigenous tribes, and private landowners (FWP 2022, FWP 2019, FWP 2007). This memorandum dictated the desired outcomes of projects designed to swing the status of WCT from a species of concern to a more stable position. These projects and goals apply to Region 3 FWP in Montana, specifically in the Missouri River basin, where the goal is to re-establish the WCT populations to 20% of their previous distribution before it was classified as a species of concern (FWP 2022, FWP 2019).

The specific project at hand was to find and record existing populations in waterways where they had been found previously or in places that had not yet been searched. Given that WCT can breed with invasive species such as Rainbow Trout, it was also necessary to perform genetic testing for the purpose of determining individual genetic purity so that future relocation efforts would not spread invasive traits. Whether or not relocation is a possibility for a population in a select fishery is also assessed during this tracking process, as environmental factors such as accessibility and population size can affect the decision-making when looking at the value of a relocation effort. By limiting the spread of invasive traits and relocating individuals to receptive habitats, WCT will be able to maintain the reproductive patterns and survival techniques that allow it to fulfill its niche and contribute to the biodiversity in Montana’s water systems. This can have positive impacts on the stability and longevity of the stream ecosystems across southern Montana, and it holds certain favorable upshots when considering the ever-enduring fishing industry that helps to support the local economy in places like Bozeman and the surrounding area. This project will span approximately 17,000 square miles, covering 26,000 miles of stream habitat within the nine sub-basins within the Missouri River Basin. This contribution has been done in conjunction with Montana Fish, Wildlife, and Parks and the Hampden-Sydney College Summer Research Program.

Procedure

The sampling process was started with the collection of specimens, which required the fulfillment of three roles: operation of the electrofishing device, capturing the fish with a long-handled net, and the storage and maintenance of the fish as the capturing process went on. The preparation of materials was started by hooking up the output arm to the rear of the electrofishing pack and unwinding the output tail. Next, the pack was calibrated to create the correct amount of power output based on the conductivity of the water, which was measured using an EC reader. 115 ms was the standard output setting for electrofishing, but this was adjusted with a higher output in low conductivity settings and a lower output in higher conductivity settings. Rubber boots were worn by all participants in the procedure, but only the operator wore rubber gloves. The net wielder was positioned next to the pack operator and would ensure the transfer of any fish from water to bucket. The fish were then stored in the bucket until a sample size of 15 individuals had been achieved, with the water being refreshed every five minutes or when the fish had been showing agitation.

After the sample size had been collected, there was a sampling phase that involved the measurement, collection of genetic material, and tagging of each fish. Clove oil was added to the bucket that contained the fish, which made the fish easier to handle and take measurements of. Measurements of length and weight were then taken on a measuring board and scale and recorded. Next, a small portion of each fish’s anal fin was clipped and put into a small, labeled vial of ethanol to be stored and sent for genetic testing. The number on the vial label was recorded. Finally, a PIT tag was injected into each fish behind its dorsal fin and slightly to the right. The tag reader then gave the ID number on the tag, which was recorded to allow for the connection between the vial number and the PIT ID. This was so that the results of genetic tests could be linked to an ID attached to the fish. After this sampling process was completed, the fish were released back into the stream at slightly separate intervals (5 fish per pool) to allow for dispersal.

Results

Genetic diversity is quite variable across the sub basins of the Missouri River basin but high genetic purity is being found in the upper missouri river and the north eastern portion of the big hole river. The Jefferson river has a lot of stream miles occupied by WCT historically but recent testing has been limited.

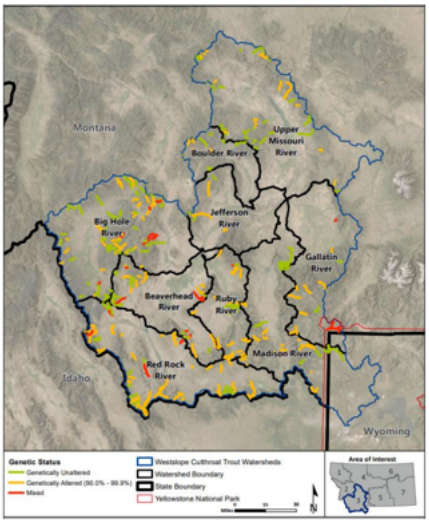

Figure 1. Distribution and genetic class of WCT populations within the nine sub-basins of the Upper Missouri River in southwest Montana (FWP 2022)

Sub-basin	Estimated miles of stream historically occupied by WCT [a]	Estimated miles of stream currently occupied by *genetically unaltered* WCT (% of historic distribution) [b]	Estimated miles of stream currently occupied by *all* identified WCT conservation populations (% of historic distribution)
Beaverhead	828	28.4 (3.4%)	82.2 (9.9%)
Big Hole	2,141	80.1 (3.7%)	220 (10.3%)
Boulder	988	20.0 (2.0%)	27.9 (2.8%)
Gallatin	1,048	25.7 (3.0%)	79.6 (7.6%)
Jefferson	2,176	5.0 (0.2%)	34 (1.6%)
Madison	1,256	131.8 (10.5%)	199.6 (15.9%)
Red Rock	1,638	42.1 (2.6%)	185.3(11.3%)
Ruby	900	31.6 (3.5%)	98 (10.9%)
Upper Missouri	4,764	65 (1.4%)	99.6 (2.1%)
Total	15,739	429.7 (2.7%)	1026.2 (6.5%)

[a] based on, May 2009 Inland Cutthroat Trout Assessment Protocol data
[b] includes genetically unaltered populations, and unaltered segments of populations comprised of unaltered and altered fish (i.e., mixed populations)

Figure 2. Historic and current distribution of WCT in the Missouri River headwaters (FWP 2022)

Sub-basin	Number of Conservation Populations by Genetic Class			
	Genetically Unaltered	Mixed	Genetically Altered	**Total**
Beaverhead	7	1	8	16
Big Hole	25	3	21	49
Boulder	6	0	3	9
Gallatin	3	0	8	11
Jefferson	2	0	2	4
Madison	7	0	13	20
Red Rock	10	0	21	31
Ruby	4	0	11	15
Upper Missouri	23	1	8	32
Total	**87**	**5**	**95**	**187**

Figure 3. Number and genetic class of WCT conservation populations in the assessment area (FWP 2022)

Discussion

To create stable populations of WCT across the Missouri River basin, it is clear that there are areas of high stream mileage that maintain populations of substantial genetic purity. Ultimately, the spread of Rainbow and Brook trout throughout south western Montana has been rapid; thus, continuing to monitor the promising areas such as the Upper Madison, Big Hole, and Jefferson River sections will be important. These areas hold potential for habitat creation that could create the desired population stability, but the strength of these populations could be bolstered by continued relocation efforts. The spreading of invasive species can be limited by the creation of barriers at the base of streams that hold genetically pure WCT, as long as there is at least 5 miles of habitat upstream, so finding viable candidates for new habitats and funding these projects will also be a part of the next steps going forward.

REFERENCES

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