A rangewide genetic assessment of YCT to direct management and conservation strategies to enhance population and species persistence

State(s): Idaho, Montana, Nevada, Utah, Wyoming
Managing Agency/Organization: Wyoming Game and Fish Department
Type of Organization: Government
Project Status: Ongoing
Project type: WNTI Project
Project action(s): Watershed or Population Assessment, Watershed Connectivity, Monitoring. Over 1,000 stream miles assessed, 36 watersheds assessed, 325 populations assessed.
Trout species benefitted: Yellowstone Cutthroat Trout
Population: Yellowstone Cutthroat Trout range-wide (325 populations), 36 watersheds

Project summary:

This is the largest project of this type ever undertaken for an inland fish species.

This project will assess the genetic integrity and relatedness of Yellowstone Cutthroat Trout (Oncorhynchus clarkii bouvieri; YCT) across its historic range in a multiyear project. The project approach is to conduct preliminary analyses (Year 1) to broadly characterize within- and across-population genomic variation across the range of YCT, and then use this information to develop a shared genetic monitoring framework that will have statistical power to cost-effectively understand key population metrics across the entire range of YCT using genetic samples collected by biologists across the species' range. A genetic assessment was deemed particularly important as contemporary populations of YCT occur across a broad range of climatological and topographic ranges and

geographically across Idaho, Montana, Nevada, Utah, and Wyoming. The distribution of YCT suggests that unique genetic lineages are highly likely and important for the long-term health of the species.

Project partners will obtain genetic data from YCT tissue samples using genotyping-by-sequencing methods (GBS). These approaches generate sequence data from tens of thousands of loci across the genome. This level of genomic sampling allows us to discern fine-scale population structure and distinguish genetically admixed populations with high precision. This information will then be used to develop a shared genetic monitoring framework that will have statistical power to cost-effectively understand key population metrics across the entire range of YCT. From these tens of thousands of SNPs, the most informative (200-500 SNPs) can be chosen for inclusion into cost-effective, and high-throughput SNP genotyping panel. Genotyping in Thousands by sequencing (GT-seq) is a high throughput method that uses the same Illumina sequencer equipment to rapidly genotype thousands of individual samples at hundreds of loci. The lab consumable, per sample costs for GT-seq is approximately 1/3 the cost of GBS. This approach will provide managers with a cost effective tool for monitoring YCT populations in the future.

From this information, fisheries managers will be able to better prioritize restoration, habitat enhancement, barrier construction/removal projects and also determine which populations may be at risk of extirpation. Finally, managers will also be able to identify which populations would be suitable for use as source populations for brood development or use for live fish transfer in restoration work. This project will follow an iterative process to ensure the development of long-term, cost-effective approaches to inform YCT management and conservation. Each year, preliminary results will be vetted with the YCT Multistate Work Group to allow managers to be explicitly involved in each step and ensure that the results from this project are meeting the needs of managers.

The objectives of this project are to:: (1) describe genomic variation of YCT throughout their historic range; (2) systematically quantify genetic variation and genetic differentiation of YCT to describe genetic status of extent populations range-wide, and identify potential hatchery introgression from historical stocking; (3) use data from Objective 1 to develop cost-effective genetic marker panels for long-term monitoring of conservation populations; and (4) use genetic results from Objectives 1-3 to inform conservation prioritization, development of application of hatchery brood stock, population translocation, and genetic rescue. Together, this project will develop and implement a consistent strategy for evaluating population and landscape-level genetics of YCT. This project addresses the conservation actions identified in the State Wildlife Action Plans of Montana and Wyoming and the State of Idaho YCT Statewide Management Plan. Furthermore, the framework developed in this project will create a template that allows new data to continually be integrated as they become available, thus allowing for greater capacity of management and conservation applications. This project was ranked as the top priority by the Yellowstone Cutthroat Trout Multistate Work Group. It will lay

the groundwork for similar projects for other species of concern in the intermountain-west. This work will be presented at the YCT Multistate Work Group meetings, local and national Trout Unlimited and American Fisheries Society meetings. It will impact thousands of people across the five state work area.

Problem the Project Addresses:

Like other native salmonids across North America, YCT have experienced substantial declines in distribution and abundance across their historic range. Historical declines in addition to contemporary and future threats (e.g., a changing climate) highlight the need for a coordinated strategy for identifying and prioritizing future management actions to enhance the persistence of extant populations and potentially reintroduce populations.

Recently, the Yellowstone Cutthroat Trout Multistate Work Group, an interagency team focused on the conservation of YCT, identified the lack of a comprehensive genetics assessment as a major factor limiting future YCT management. A genetic assessment was deemed particularly important as contemporary populations of YCT occur across a broad range of climatological and topographic ranges and geographically across Idaho, Montana, Nevada, Utah, and Wyoming. The distribution of YCT suggests that unique genetic lineages are highly likely and important for the long-term health of the species. Concomitantly, there has been extensive stocking of hatchery produced YCT across large portions of the range, presenting unique challenges for management and restoring populations. In addition, many existing populations have been isolated for decades, rendering concerns about the genetic health and the need for management intervention. However, there remains a paucity of information available to describe the genetic differentiation across populations and the health within population—both important aspects in developing a conservation strategy for this species.

The project is a multiyear rangewide genetics assessment of YCT. Our approach looks to conduct preliminary analyses (Year 1) to broadly characterize within- and across-population genomic variation across the range of YCT. This information will then be used to develop a shared genetic monitoring framework that will have statistical power to cost-effectively understand key population metrics across the entire range of YCT using genetic samples from biologists across the range of YCT.

Partners:

- Wyoming Game and Fish Department
- Idaho Fish and Game Department
- Montana Fish Wildlife and Parks
- Western Native Trout Initiative

Project partners include all members of the Yellowstone Cutthroat Trout Multistate Work Group. Idaho Fish and Game Department, Montana Fish Wildlife and Parks, Wyoming Game and Fish Department, National Park Service, and U.S. Forest Service have all played a role in developing this project and the project parameters set forth. Nevada Department of Wildlife and Utah Division of Wildlife Resources will also play a role in the project. All of the groups have been involved in the field sampling. GMU leads and the YCT Multistate Work Group will continue to provide leadership and input throughout the project. All agencies listed have contributed funding for both field and analysis operations and personal to complete the field component of the study. This will be the largest project of this kind ever undertaken.

Project Monitoring:

The project will be assessed after each field season and analysis. Following each seasons collection and analysis, GMU leads and the YCT work group will prioritize sampling for the following field season and propose priority projects based on the years findings. The project will be deemed a success when all of the approximately 325 YCT populations have been assessed and this information is being used to drive future YCT management and conservation projects. The Yellowstone Cutthroat Trout work group will be responsible for maintaining the project and ensuring completion as well as aiding in development of future YCT projects.

Funding Source(s): National Fish Habitat Action Plan
Project cost: \$47,900
Start Date: 06/01/2021 Completion Date: 12/23/2023
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