Project Title
Facilitated passage of Razorback Sucker and Colorado Pikeminnow over the Piute Farms Waterfall

Bureau of Reclamation Agreement Number:

Reclamation Agreement Term

Note: Recovery Program FY23 scopes of work are drafted in May 2022. They often are revised before final Program approval and may subsequently be revised again in response to changing Program needs. Program participants also recognize the need and allow for some flexibility in scopes of work to accommodate new information and changing hydrological conditions.

Lead Agency:
US Fish and Wildlife Service

Principal Investigator:
Benjamin Schleicher
U. S. Fish and Wildlife Service
Grand Junction Fish and Wildlife Conservation Office
445 West Gunnison Avenue, Suite 140
Grand Junction, Colorado 81501
Phone: (970) 628-7205
Email: benjamin_schleicher@fws.gov

Tracy Diver
U.S. Fish and Wildlife Service
New Mexico Fish and Wildlife Conservation Office
3800 Commons Ave. N.E.
Albuquerque, New Mexico 87109
Phone: (505) 342-9900
Email: tracy_diver@fws.gov

Brian Hines
Utah Division of Wildlife Resources
Moab Field Station
1165 S. Hwy 191- Suite 4
Moab, Utah 84532
Phone: (435) 259-3782
Email: bhines@utah.gov

Category:
X Ongoing project
__ Ongoing-revised project
__ Requested new project
__ Unsolicited proposal

Expected Funding Source:
X Annual funds
__ Capital funds
__ Other *[explain]*

Relationship to LRP:
This study is related to the following tasks in the Long-Range Plan:
Task 2.3.1.1 Investigate potential barriers in the mainstem San Juan River and provide and maintain fish passage when needed.
Task 4.4.1.1 Identify and alleviate impediments to specific life and natural-history processes necessary for recovery.
Task 1.2.2.2 Install and maintain remote PIT tag detectors in the river to passively track fish presence/absence and movement.
Task 4.4.3.2 Evaluate effects of management actions (e.g., nonnative fish control) on the distribution, abundance, and demographics (e.g., fish size, age, sexual maturity) of the endangered, native, and nonnative fish populations

Study Background:

Freshwater ecosystems are among the most fragmented environments in the world. The construction of dams and reservoirs has severed system-wide connectivity for many aquatic species (Crook et al. 2000; Silva et al. 2018). For fishes with migratory behaviors, these often-impassable barriers may inhibit individuals from completing certain life history stages (Joy and Death 2001; Cumming 2004). Impediments to spawning, rearing and/or foraging habitats can have severe impacts on the continued persistence of populations. In some circumstances, human-mediated movement around barriers has become a necessary action to help reconnect populations (Minkley 1995; Boothroyd et al. 2017). Translocation, the intentional movement of individuals from one area to another, is a widely applied conservation tool used to increase connectivity between threatened populations (IUCN/SSC 2013; Ranke et al. 2017). Given system-wide impacts to fish movement, translocation has become a valuable management tool for mitigating the effects of artificial barriers.

Razorback Sucker (*Xyrauchen texanus*) were historically found throughout the Colorado River Basin; however, large-scale habitat modifications, such as the construction of dams and reservoirs, led to their decline and extirpation throughout much of their native range (Minckley 1983; Marsh et al. 2015). While augmentation programs have restored extirpated populations throughout the Basin, the majority remain dependent on hatchery augmentation due to the lack of wild recruitment. Given that this long-lived species with known migratory spawning behavior evolved within a historically connected, open network system (Tyus and Karp 1990), unnatural barriers have likely limited their ability to access spawning habitat, interrupting critical aspects of their life history. Consequently, there is active interest in establishing translocation efforts as a management action to mitigate the impact of barriers on spawning and recruitment success for Razorback Sucker (Cathcart et al. 2018).

The San Juan River historically harbored wild Razorback Sucker. Hatchery reintroduction efforts have restored this population, with the lower 180 miles of river designated as Critical Habitat. At the lower end of this designated Critical Habitat (around river mile [RM] 5.0) is the Piute Farms Waterfall (Waterfall), which has been in place since the early 2000s. Long-term regional drought has reduced lake levels and exposed the Waterfall, where it now acts as a barrier for any upstream movement from Lake Powell (Cathcart et al. 2018). While the Waterfall serves as a beneficial barrier for preventing invasion of nonnative predatory fish, such as Walleye and Stripped Bass, it also inhibits movement of native

fishes. For example, the section of the San Juan River downstream of the Waterfall is thought to have historically served as a nursery for endangered Razorback Sucker and Colorado Pikeminnow prior to the construction of Glen Canyon Dam. By blocking upstream movement for these species, they may be unable to complete certain aspects of their life history, such as accessing spawning habitats.

Spawning migrations for Razorback Sucker occur between March and June during the ascending or peak spring flows (Tyus and Karp 1990; Farrington et al. 2014; Clark Barkalow 2020). A large number of Razorback Suckers are found immediately below the Waterfall during this time period (Cathcart et al. 2018, Pennock et al. 2020). This large aggregation of Razorback Suckers suggests that these individuals are trying to move upstream to spawn, with supporting evidence that translocated individuals have been observed near known spawning bars (i.e., Slickhorn Wash; Jackson 2003, Bogaard 2021). While this Waterfall acts as a major barrier to upstream movement, it can be inundated with high lake levels allowing fish passage. The last time the Waterfall was briefly inundated for a two-week period in the summer of 2011, four Razorback Suckers were documented moving upstream from Lake Powell to the San Juan River (Francis et. al 2013), suggesting that fish historically made these migrations when these habitats were connected.

Varying collection efforts have been made to capture Razorback Sucker below the Waterfall and quantify their movements in the San Juan River post-translocation. In 2016, 2017, and 2018, 152, 151, and 202 Razorback Suckers, respectively, were captured using raft-mounted electrofishing and translocated above the Waterfall (Pennock et al 2018); however, encounters detected at the Waterfall using PIT tag antennas suggested that more individuals were attempting to move upstream with 472 and 615 individuals detected in 2016 and 2017 (Cathcart et al. 2018). Resident time and individual movement of these translocated fish varied, with fish traveling between 11 and 116 river miles in the San Juan River; resident time in the system also varied between 13 to 132 days (Pennock et al. 2018). In 2020 and 2021, additional translocation efforts moved 210 and 309 Razorback Sucker and 43 and 31 Colorado Pikeminnow above the waterfall via raft-mounted electrofishing (pers comm. M. Boggard and S. Mussmann). In 2021 a new approach was implemented to evaluate the use of a fyke trap and seining corral to reduce fish exposure to electrofishing. In 2021, only a single Flannelmouth Sucker was collected (Gilbert et al. 2021). Follow up efforts conducted in 2022, failed to capture any Razorback Sucker; although, multiple attempts to move and reset the trap resulted in an increase in Flannelmouth Sucker (n = 185 as of 3/20/2022; sampling in progress at time written) compared to 2021 the trap routinely failed to capture Razorback Sucker or Colorado Pikeminnow. Trap inefficiencies found in both years could be the result of fish behavior (i.e., trap avoidance) or difficult in placement due to rapid scouring in a sandy substrate river and trap design (e.g., ramp height at trap entry requires placement in thalweg).

Despite the increased, broad-scale use of translocation as management action, the effect of this tool is rarely assessed (Fischer and Lindenmayer 2000; Dresser et al. 2017). A successful translocation program may require both the survival of relocated individuals and their reproductive contribution to the next generation. Efforts to evaluate survival of translocated Razorback Sucker show 100% survival (Bogaard per comm). Similarly, genetic parentage analysis of translocated Razorback Sucker and putative offspring (i.e., larval fish) is underway at the Southwestern ARRC. Results for samples collected in 2020 (SOW-41), showed no evidence of in-stream reproduction of Razorback Sucker in the San Juan River (pers. comm. M. Saltzgiver); however, pandemic restrictions severely limited the scale of sampling with only a few hundred larval fish encounter relative to a few thousand collected in previous years. Consequently, it is important to consider the result of multiple years, which are currently underway, before this management action is determined to be successful. Thus, we propose to continue

translocating of both Razorback Sucker and Colorado Pikeminnow upstream of the Waterfall until additional years of parentage assignment has been completed.

Study Goals, Objectives, End Product(s):

The goal of this project is to capture and translocate Razorback Sucker and Colorado Pikeminnow upstream of the Waterfall to provide them the opportunity to contribute to reproduction in the San Juan River. Upstream movement will be tracked via submersible PIT tag antennas and fin clips will be collected for all individuals that were moved. A measure of success for these efforts would be the collection of larval fish, through the standardized larval monitoring, that had parentage of fish translocated through our efforts.

Study Area:

Our proposed study reach for capturing Razorback Suckers and Colorado Pikeminnow will be within one mile downstream of the Waterfall. Captured Razorback Suckers and Colorado Pikeminnow will be translocated up to one mile upstream of the Waterfall and released. PIT tag antennas will be deployed between Mexican Hat, UT (RM 53) to Clay Hills, UT (RM 2.9) to track fish movement.

Study Methods/Approach:

We will collect Razorback Suckers and Colorado Pikeminnow downstream of the Waterfall using an ETS MBS electrofishing unit mounted on a raft. Fish will be collected by long dip nets and transferred into a salted live well. After a sampling pass (no more than one mile) biological data will be collected on each fish: total and standard length (mm), weight (g), scanned for a Passive Integrated Transponder (PIT) tag, given a PIT tag if one is not present. A fin clip will be collected from each translocated individual Razorback Sucker and placed in 95% ethanol (EtOH) for potential parentage assignment. Fish will then be transferred to a boat just upstream of the Waterfall in a 5-gallon bucket where they will be loaded onto a boat containing a large live well and motored upstream at least 0.5 mile prior to release.

Translocation efforts will occur between the second week of March to the early part of April 2023 (three weeks of sampling), as this is the time when the highest number of PIT tagged fish are detected downstream of the Waterfall (Cathcart et. al 2018). These efforts will be consecutive and consist of three person crews sampling for seven days. We will have a three-day effort (all three crews) at the beginning and end of the fieldwork, to set up and take down field equipment and allow field personnel to finalize a sampling plan. Field crews will electrofish for short periods of time (not more than one hour) in both the morning and in the evening to not over pressure migrating fish and to avoid adding unnecessary amounts of electricity to the water.

All translocated fish will have PIT tags prior to their release. Movement from these tagged fish will be detected by strategically placing submersible PIT tag antennas in the lower river below Mexican Hat, UT and one antenna spanning the spawning bar at Slickhorn Wash (RM 18.6). The mobile antennas will be deployed above the Waterfall prior to translocation efforts and retrieved a month later.

Task Description, Deliverables and Schedule:

Data collected during this project will be formatted and submitted to STReaMS no later than December 31, 2023. A draft report will be submitted to the San Juan RIP Program Office to distribute for review by March 31, 2024. Comments will be compiled and responded to accordingly and included in the final report by June 30, 2024.

Budget Summary:

Table 1. Summary of office budgets for Grand Junction FWCO, New Mexico FWCO and Utah DWR for 2023.

Fiscal Year	*Grand Junction FWCO*	*New Mexico FWCO*	*Utah DWR*
2023	$37,878.55	$17,348.12	$49,592
Total	$37,878.55	$17,348.12	$49,592

Reviewers:

References:

Bogaard, Matthew. 2021. Assessing facilitated passage and spawning migration patterns of Razorback Suckers, *Xyrauchen texanus*, in the San Juan River. Master's Thesis, Kansas State University, Manhattan, Kansas.

Boothroyd, M, T. Whillans, and C.C. Wilson. 2017. Translocation as a migration tool: Demographic and genetic analysis of a reintroduced lake sturgeon (*Acipenser fulvescens* Rafinesque, 1817) population. *Journal of Applied Ichthyology* 34(2):348-363.

Cathcart, C.N., C.A. Pennock, C.A. Cheek, M.C. McKinstry, P.D. MacKinnon, M.M. Conner, and K.B. Gido. 2018. Waterfall formation at a desert river–reservoir delta isolates endangered fishes. *River Research and Applications* 34(8):948–956. https:// doi.org/10.1002/rra.3341

Clark Barkalow, S. L., M.A. Brandenburg, and S.P. Platania. 2020. Otoliths reveal spawning ecology and early life history of sympatric catostomids. *North American Journal of Fisheries Management* 40:415–426.

Crook, D.A. and R.R. Whitney. 2000. Fish behavior in relation to passage through hydropower turbines: A review. *Trasactions of the American Fisheries Society* 129:351-380.

Cumming, G.S. 2004. Impact of low-head dams on fish species richness in Wisconsin, USA. *Ecological applications* 14:1495-1506.

Dresser CM, Ogle RM, Fitzpatrick BM. 2017. Genome scale assessment of a species translocation program. *Conservation Genetics* 18(5):1191-9.

Farrington, M.A., R.K. Dudley, J.K. Kennedy, S.P. Platania and G.C. White. 2014. Colorado Pikeminnow and Razorback Sucker larval fish survey in the San Juan River. 2014 INTERIM PROGRESS REPORT (FINAL REPORT) submitted to: United States Bureau of Reclamation and the San Juan River Basin Biology Committee

Fischer J, Lindenmayer DB. 2000. An assessment of the published results of animal relocations. *Biological conservation* 96(1):1-1

Francis, T.A., D.W. Ryden, and B.J. Schleicher. 2013. San Juan River Arm of Lake Powell Razorback Sucker (*Xyrauchen texanus*) Survey: 2011. 44 pp.

Gilbert, E., M. Bogaard, T. Pilger. 2021. Pilot implementation at Piute Farm waterfall of trapping options identified from feasibility study. June 22, 2021.

IUCN/SSC. 2013. Guidelines for reintroductions and other conservation translocations. Version 1.0. Gland, Switzerland. Retrieved from https://portals.iucn.org/library/efiles/documents/2013-009.pdf

Jackson, J. 2003. Nonnative control in the Lower San Juan River 2002. 2002 INTERIM PROGRESS REPORT (FINAL REPORT) submitted to: United States Bureau of Reclamation and the San Juan River Basin Biology Committee.

Joy, M.K. and R.G. Death. 2001. Control of fish and crayfish community structure in Taranaki, New Zealand: Dams, diadromy or habitat structure. *Freshwater Biology* 46:417-429.

Marsh, P.C., T.E. Dowling, B.R. Kesner, T.F. Turner, and W.L. Minckley. 2015. Conservation to stem imminent extinction: The fight to save Razorback Sucker Xyrauchen texanus in Lake Mohave and its implications for species recovery. *Copeia,* 103(1), 141–156. https:// doi.org/10.1643/OT-14-030

Minckley, W.L. 1983. Status of the razorback sucker, Xyrauchen texanus (Abbott), in the lower Colorado River basin. *Southwestern Naturalist,* 28(2), 165–187. https://doi.org/10.2307/3671385

Minckley, W.L. 1995. Translocation as a tool for conserving imperiled fishes: Experiences in Western United States. *Biological Conservation* 72:297-309.

Pennock C.A, M.C. McKinstr, C.N. Cathcart, K.B. Gido, T.A. Francis, B.A. Hines, et al. 2020. Movement ecology of imperiled fish in a novel ecosystem: River-reservoir movements by razorback sucker and translocations to aid conservation. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 30(8):1540–1551. https://doi.org/10. 1002/aqc.3399

Ranke, P.S., S. Skjelseth, H. Pärn, I. Herfindal, Å.A. Pedersen, B.G. Stokke, T. Kvalnes, T.H. Ringsby, B.E. Sæther, and H. Jensen. 2017. Demographic influences of translocated individuals on a resident population of house sparrows. *Oikos* 126(10):1410-8.

Silva, A.T., M.C. Lucas, T. Castro-Santos, C. Katopodis, L.J. Baumgartner, J.D. Thiem, K. Aarestrup K, P.S. Pompeu, G.C. O'Brien, D.C. Braun, and N.J. Burnett NJ. 2018. The future of fish passage science, engineering and practice. *Fish and Fisheries* 19(2):340-362.

Tyus, H.M. and C.A. Karp. 1990. Spawning and movements of razorback sucker, *Xyrauchen texanus*, in the Green River basin of Colorado and Utah. Southwestern Naturalist 35:427-433.