RECOVERY PROGRAM Recovery Program Project Number: FR-165
FY 2020-2021 SCOPE OF WORK for:

Management of Stewart Lake floodplain for use by larval and adult endangered fishes

Reclamation Agreement number: R19AP00059
Reclamation Agreement term: Oct. 1, 2019 – Sept. 30, 2024

Note: Recovery Program FY20-21 scopes of work are drafted in May 2019. 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 (especially in nonnative fish management projects) and changing hydrological conditions.

Lead agency: Utah Division of Wildlife Resources

Submitted by: Michael S. Partlow, Matthew J. Breen, and Garrett T. Tournear
Utah Division of Wildlife Resources
Northeast Regional Office
318 North Vernal Avenue
Vernal, Utah 84078
Phone: 435-781-9453; Fax: 435-789-8343
E-mail: mpartlow@utah.gov

Date Last Modified: 6/14/2019 3:21:00 PM

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

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

I. Title of Proposal: Management of Stewart Lake floodplain for use by larval and adult endangered fishes

II. Relationship to RIPRAP:
GENERAL RECOVERY PROGRAM SUPPORT ACTION PLAN
- II.A. Restore flooded bottomland habitats.
- V. Monitor populations and habitat and conduct research to support recovery actions (research, monitoring, and data management).
- V.A. Measure and document population and habitat parameters to determine status and biological response to recovery actions

GREEN RIVER ACTION PLAN
- I.A.3.d.1. Conduct real-time larval razorback and Colorado pikeminnow sampling to guide Flaming Gorge operations.
- I.D.1. Develop study plan to evaluate flow recommendations.
- I.D.2.a. Evaluate survival of young and movement of sub-adult razorback suckers from floodplains into the mainstem in response to flows.

I.D.2.b.(5)(a). Implement the Larval Trigger Study Plan
I.D.2.d.(1). Conduct annual monitoring of larval razorback suckers and analyze historic monitoring data.
II.A. Restore and manage flooded bottomland habitat.
II.A.5. Manage and/or modify priority floodplain sites for nursery habitat for endangered fish.
II.A.5.a. Stewart Lake.
III. Reduce impacts of nonnative fishes and sportfish management activities.
III.A.4.b. Nonnative cyprinids and centrarchids in nursery habitats.
V. Monitor populations and habitat and conduct research to support recovery actions (research, monitoring, and data management).
V.A. Conduct research to acquire life history information and enhance scientific techniques required to complete recovery actions.
V.D.1. Implement razorback sucker monitoring plan.

III. Study Background/Rationale and Hypotheses:

Floodplain wetlands are recognized as important habitats for early life-stages of razorback sucker (*Xyrauchen texanus*; Wydoski and Wick 1998; Muth et al. 1998; Lentsch et al. 1996; Modde 1996; Tyus and Karp 1990). Reproduction by razorback suckers occurs on the ascending limb of the spring hydrograph, allowing enough time between hatching and swim up for larvae to enter main channel drift when highly productive floodplain habitats are accessible (Muth et al. 1998). Seasonal timing of razorback sucker reproduction indicates a possible adaptation for entrainment and use of floodplain habitats for rearing purposes (Muth et al. 1998). However, limited research has been conducted on how long young razorback sucker stay in floodplains before moving into riverine habitats (Hedrick et al. 2012). In addition, other endangered fishes have been documented using floodplain habitat (Breen 2011; Bestgen et al. 2017).

The Green River Floodplain Management Plan (Valdez and Nelson 2004) identifies the Stewart Lake wetland as a priority habitat for endangered fishes. Stewart Lake is the third largest of 16 identified priority wetlands, thus providing greater area and depth for nursery habitat for larval razorback sucker (i.e., overwinter survival) and other native and endangered fishes. Additionally, it is approximately 11 miles downstream of a known razorback sucker spawning bar, allowing for potential entrainment (Valdez and Nelson 2004). In comparison to other floodplains, Stewart Lake is an ideal study area given that the structural design provides flexibility in water management; this feature allows for: (1) entrainment capabilities during most flow conditions, including dry hydrologic years, (2) management of inlet and outlet structures to maximize entrainment and control floodplain connectivity, (3) timing and control of outlet releases to monitor escapement, and (4) complete drawdown via a graded canal drainage system to control nonnative fish abundance and reset the system any given year. Moreover, supplemental water can be piped into Stewart Lake through the Burns Bench pipeline, managed by the Uintah Water Conservancy District (UWCD), providing the ability to maintain adequate water quality throughout summer months until the wetland is drained in autumn.

A synthesis of data by Bestgen et al. (2011) indicated that further investigations are needed

regarding the timing of Flaming Gorge Dam releases and larval razorback sucker entrainment. Therefore, the Larval Trigger Study Plan (LTSP 2012) was designed to examine larval razorback sucker occurrence in the Green River as a trigger for Flaming Gorge operations. The LTSP identifies several focal wetlands with the ability to entrain larval razorback sucker during a range of flow conditions, specifically three that connect under low, median, and high flow years. Thus, the Stewart Lake wetland, one of the three floodplains that connects at low flows and has the ability to be managed with inlet and outlet control structures, is an ideal setting to conduct a comprehensive study of fishes that immigrate into wetland habitat during floodplain connection, utilize the habitat post-connection, and emigrate from the wetland during drawdown. Using various sampling techniques, during different stages of floodplain use (i.e., entrainment, retention, escapement), we will greatly increase our chances of characterizing the use of floodplain wetlands by wild-spawned razorback sucker, other endangered fishes and nonnatives.

Stewart Lake was one of only two wetlands in the middle Green River to entrain flows in 2012 due to drought conditions. Wild-spawned razorback suckers were successfully entrained by adaptive management of wetland floodgate control structures. However, due to limited flows and high levels of nonnative fishes, water quality and habitat conditions deteriorated quickly preventing the survival of the 2012 cohort (Breen and Skorupski 2012). Therefore, additional techniques were utilized in following years to minimize habitat degradation by loss of water and to limit the influence of nonnatives. Furthermore, information from 2012 demonstrated the ability to entrain larvae under drought conditions and influenced management decisions to improve study design and survival of larval razorback sucker (Skorupski et al. 2013; Schelly et al 2014; Schelly and Breen 2015; Schelly et al. 2016). The relationship between hydrology, magnitude of larval entrainment, and fall razorback recruitment are possible factors where insight can be gained through continued operation of Stewart Lake. In addition, a comprehensive monitoring plan that identifies important research needs for various life stages of razorback sucker has been completed (Bestgen et al. 2012). In relation to this monitoring plan, we have the unique opportunity to examine a variety of research questions in Stewart Lake.

IV. Study Goals, Objectives, End Product(s):

Goal:

Manage a controlled floodplain wetland and characterize use by larval and adult endangered fishes, with an emphasis on recruitment of wild razorback sucker.

Objectives:

1. Monitor entrainment of larval and adult endangered fishes during high-flow connection of riverine and wetland habitats.
2. Examine fish community composition and habitat characteristics in the Stewart Lake wetland following floodplain connection to assess summer survival of wild-spawned and potentially stocked razorback sucker and other endangered fishes.
3. Monitor escapement (fish moving out of the wetland) of native and nonnative fishes entrained in Stewart Lake during a controlled release, through physical capture using a

fixed weir trap.

4. Determine the extent of nonnative fish colonization in wetland habitats.

End Products:

An annual report describing management of the wetland for that year and how Stewart Lake functions as habitat for larval and adult endangered fishes. We will provide information on: (1) larval razorback sucker entrainment, (2) fish community composition, water quality parameters, and wetland habitat characteristics through time following the connection period, and (3) species-specific information on fishes emigrating from the floodplain during the drawdown period. In addition, multiple captures/detections of the same fish from more than one component of our study will allow us to investigate overall use, survival and capture efficiency during the course of a single season of entrainment.

V. Study Area:

Stewart Lake, which is located along the middle Green River at river mile 300, is approximately 570 acres at full capacity (Valdez and Nelson 2004). Low flow connection relative to other wetland habitats allows for research opportunities across a range of flow conditions. Water can be managed through an inlet gate located at the upstream end of the wetland, as well an outlet canal and gate on the downstream end. Timing and extent of floodplain inundation and drawdown can be manipulated via floodgate operations that can be regulated to meet multiple research objectives. For example, the outlet control structure is two feet lower in elevation than the inlet structure and begins flooding at approximately 3,500–4,000 cfs (Schelly, personal observation—March, 2015), thus it can be used to entrain water under low flow scenarios. Once filled to capacity from the outlet structure, the inlet gate can be operated to provide additional water to the wetland given the higher elevation.

VI. Study Methods/Approach:

Topics of interest in the LTSP to assess Flaming Gorge Dam releases will be addressed in accordance with our Stewart Lake study, including razorback sucker larval entrainment and nonnative fish diversity and abundance in floodplain wetlands. In addition to LTSP topics, information on adult endangered species (immigration, entrainment and emigration) using floodplain habitat will be evaluated. Below we have outlined our proposed plans to systematically examine the Stewart Lake wetland and outlet from the point of floodplain connection to draw-down. However, the LTSP highlights that various floodplains could be of high value to razorback sucker under different hydrologic conditions. Thus, under a variety of hydrologic years this project may be modified to focus on other wetlands, depending on Recovery Program guidance. Given that multiple study wetlands are identified in the LTSP, this scope of work will serve a similar function as UCRRP Project #164 and we will share the workload with the U.S. Fish and Wildlife Service, GRBFWCO to adequately accomplish LTSP sampling. We have not specifically identified additional funds in this budget for expansion of this work to other wetlands, but will do so upon further guidance from the Recovery Program in anticipation of higher flow years. In addition, we are currently working with the Bureau of Land Management – Vernal Field Office to conduct a similar project in the Stirrup floodplain pending renovation to function in a similar manner as Stewart Lake.

During the high flow entrainment period, an exclusionary fish screen will be installed at the Stewart Lake outlet structure and we will sample with light traps within the wetland. The fish screen will exclude adult fish from entering the wetland for the entire duration that the floodplain is entraining water and larvae. Previously we used directional traps associated with a weir wall to allow for movement of adult natives into the wetland and exclusion of nonnatives (Skorupski et al. 2013). However, we switched to an exclusionary fish screen due to low capture rates of adult fishes in the inlet trap during filling (i.e., trap avoidance) and because it is too costly to operate a fish trap on a 24-hr basis (Schelly et al. 2014). Alternatively, to monitor adult native fishes attempting to enter the wetland, we now deploy various stationary PIT technologies in the outlet canal for passive detections (Schelly et al. 2016) and fyke nets/boat electrofishing for active sampling/physical capture. Adult endangered species captured in the outlet canal will be moved into Stewart Lake (original intent with trap nets; Breen and Skorupski 2012) as we have determined this is an extremely beneficial procedure (e.g., natural bonytail reproduction; Bestgen et al. 2017). The exclusionary fish screen consists of diamond shaped mesh (3/8" by 7/8"), which will exclude large-bodied fishes (limiting competition and predation on larval native fishes) while allowing larval razorback sucker and small-bodied fishes to move into the wetland freely. During wet hydrologic years when discharge exceeds 18,700 cfs, flows become high enough to overtop two breaches in the Stewart Lake levee road, thus block nets will be installed to exclude adult nonnatives trying to enter the wetland at those locations.

Approximately 20 light traps will be positioned in the inlet and/or outlet canals and in the main body of the wetland at the point of floodplain connection. Daily sampling will initiate following larval detection in the Green River main channel (UCRRP Project #22f), and conclude when the floodplain is disconnected from the main channel or when we have verification that razorback sucker larvae have reached the interior of the wetland in sufficient densities. All larval fish present in light traps will be collected and preserved for later identification by the Larval Fish Lab (costs included in UCRRP Project #15 budget).

We will utilize various sampling techniques to evaluate fish community composition and we will monitor water quality and habitat parameters in the Stewart Lake wetland. Following floodplain inundation and disconnection, the wetland will be systematically sampled to evaluate fish community composition through time (until drained). Once entrainment of larval razorback suckers is confirmed with light traps, we will allow ample growing time and conduct surveys (e.g., fyke nets, seines) as needed to determine growth throughout the summer until draining. Once the wetland is completely drained (see below), we will conduct a final sweep to assess the number of fishes that did not escape during water release. We will also monitor water quality parameters (dissolved oxygen, pH, conductivity and temperature) using a continuous logger, and we will monitor wetland gauge height throughout the summer, requesting supplemental water as needed to maintain a full wetland.

A fish trap will be installed at the outlet gate to monitor escapement of native and nonnative fishes retained in the Stewart Lake wetland following high flow connection. Wetland drawdown (timing and duration of release) will be coordinated with the Utah Division of Wildlife Resources (UDWR) regional habitat manager and the Bureau of Reclamation Provo office in conjunction with selenium management strategies that require a dry period following

flooding to oxidize the chemical (e.g., Naftz et al. 2005). A fish trap will allow us to effectively sample fish leaving the wetland to determine survival and growth of wild-spawned razorback suckers and other native fishes, while allowing us to PIT tag young-of-year razorback sucker to monitor post-emigration survival from the wetland through passive and active sampling associated with other recovery program projects. Following 2016 operation of Stewart Lake it was determined that razorback sucker growth and survival benefitted greatly from an extended inundation period by waiting until mid-September or early-October to initiate drawdown and conducting draining over the course of approximately one month in order to account for all fishes leaving the wetland (i.e., no periods of free release; Schelly et al. 2016). In addition, during the final days of draining we determined that survival increases when a 24-48 hr pulse of supplemental water is provided to improve water quality (Schelly et al. 2016). This strategy was further improved in 2018 when we requested two 24-hr flow pulses of 10 cfs each, separated by 48 hrs (Partlow et al. 2018).

During wet years, as demonstrated in 2014 (Schelly et al. 2014), continuous (24-hr) monitoring of a fish trap during an inundation period spanning more than two weeks poses a staffing challenge. Additionally, our experience suggests that the presence of a structure seems to act as a deterrent to adult native fishes (based on their absence in the in-trap), so an unstaffed exclusionary fish screen is the most feasible approach during inundation. Deployment of stationary PIT antennae in the outlet channel will test whether tagged adult native fishes are exploring the channel and turning back after encountering the weir structure. Reducing the staffing commitment during the period of filling will provide greater flexibility to increase staffing during the multi-week drawdown period, limiting un-sampled free-release periods (e.g., Schelly et al. 2016) and maximizing the sampling of emigrating razorbacks.

Overall, we have learned many important lessons since project implementation began in 2012, each lending to project improvements and increased success. Following several improvements, Stewart Lake operation in 2016 demonstrated what can be accomplished in a priority wetland to assist razorback sucker recruitment if everything goes as planned (Schelly et al. 2016). However, in 2017 we learned that habitat conditions can quickly deteriorate to the point where larval entrainment is a moot point if the wetland is not actively managed (Staffeldt et al. 2017). More specifically, our current protocol (i.e., wetland remains dry for 8-9 months; federal mandate to drain for selenium remediation) creates ideal conditions for the proliferation of cattails (*Typha* spp.). In 2017, cattail densities became such that water could not even flow in through the inlet channel (vital for a complete fill of the wetland) and almost no open water habitat remained in the wetland (i.e., limited fish habitat). One year after our greatest success with this project where we returned over 2,000 wild-spawned razorback sucker to the Green River upon draining (Schelly et al. 2016), only a single age-0 razorback was released back to the Green River during draining in 2017 (Staffeldt et al. 2017), despite even greater densities of drifting larvae in the spring of 2017 compared to 2016 (K. Bestgen, Colorado State University, personal communication). While it is possible that unusual hydrology in 2017, including prolonged cold water releases from Flaming Gorge Dam, may have affected the timing of larval drift and thus Stewart Lake operations, the role of habitat management in ensuring survival of entrained razorback sucker should be prioritized.

Following extensive research and numerous discussions in the fall and winter of 2017–2018, we determined that two major maintenance issues must be addressed in order to maintain

adequate wetland habitat to benefit razorback sucker recruitment at Stewart Lake: (1) a complete prescribed burn performed on an annual basis (late winter/early spring), followed by the immediate release of supplemental water into the wetland to inundate remaining root structures, and (2) dredging of the inlet channel to maintain proper flow. As recommended by Staffeldt et al. 2017, and for the first time since 2012, the entirety of the inlet channel was dredged from November–December 2017 by UDWR's heavy machinery crew (contracted out). Additionally, over the winter of 2017–2018 we worked with the Utah Division of Forestry, Fire, and State Lands to create a long-term prescribed burn plan for Stewart Lake, which last received only a partial fire treatment in the spring of 2013. In April 2018, we conducted a complete burn of the Stewart Lake wetland following approval of the burn plan (Partlow et al. 2018). However, research has shown that prescribed fire alone is only a temporary management tool for controlling cattails; underground rhizomes must be targeted for a complete kill. More specifically, aerenchyma tissue provides air passage from the leaves to the rhizomes in cattails as long as the leaves (alive or dead) penetrate the water column and reach air (Sojda and Solberg 1993). Therefore, interrupting the function of the aerenchyma is the most effective nonchemical means of controlling cattails (Sojda and Solberg 1993), and flooding rhizomes immediately following a complete burn of surface tissues can accomplish this task. Following the burn in 2018, we requested supplemental water from UWCD, but this did not occur immediately (i.e., after the growing season began) and water amounts released (~3 cfs; J. Huntington, UWCD, personal communication) were insufficient to cover the wetland surface, thus we did not observe complete cattail mortality (Partlow et al. 2018). Ideally, future management will entail an earlier prescribed burn followed by an immediate release of supplemental water at a higher rate (10 cfs continuously) to quickly cover rhizomes before any growth occurs, and then we would retain water until just before the ascending limb of the hydrograph arrives.

Weather conditions in the spring of 2019 (i.e., an abundance of low-elevation snowpack that remained until late March) prompted us to identify additional cattail management actions that could compliment or be utilized in place of a prescribed burn. More specifically, weather conditions ultimately determine whether a prescribed burn is possible in a given year, and as timing comes closer to the wetland entrainment period, fire may no longer be an option. Thus, alternative management scenarios must be in place. From our preliminary research, we determined that one of the better tools currently applied by UDWR waterfowl managers is a machine called a "Marsh Master". This machine can effectively mow down and chop up stands of wetland vegetation (targeting root structures) whether the wetland is inundated or not, therefore a perfect tool to use in combination with a prescribed burn to maximize treatment effectiveness, or to use in the place of a prescribed burn.

VII. Task Description and Schedule:

Timeline is subject to change for tasks 1-2 based on the timing and duration of peak flows as well as appropriate weather conditions for a prescribed fire. The timing of task 5 will depend on heavy machinery crew availability (work takes ~2 weeks).

Task 1: Operate and maintain a fish screen at the Stewart Lake outlet gate to entrain water and larval razorback sucker. Conduct an annual prescribed burn to maintain habitat conditions (with possible use of a Marsh Master).

Task 2: Sample the Stewart Lake fish community and monitor post-connection water quality and habitat parameters.

Task 3: Sample fishes exiting the Stewart Lake outlet during drawdown with a fish trap.

Task 4: Data entry, analysis and reporting.

Task 5: Dredge the inlet channel to maintain proper function.

Task	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1		X	X	X	X	X					X	X
2							X	X	X			
3									X	X		
4										X	X	X
5											X	X

VIII. Deliverables, Due Dates, and Budget by Fiscal Year:

FY 2020-2024

Program annual reports due each November.
Project data will be submitted to the Recovery Program Database Manager by January.

IX. Budget Summary:

	UDWR-Vernal
FY 2020	55,364.31
FY 2021	56,451.60
FY 2022	57,560.64
FY 2023	58,691.84
FY 2024	59,845.68
TOTAL	287,914.07

Note: consideration of additional cattail management techniques may increase the cost of this scope of work in future years; see the highlighted portion of the "Study Methods/Approach" section. As of the completion of this scope of work, contracted wetland vegetation management using a "Marsh Master" costs approximately $170/acre treated, which may fluctuate based on habitat conditions.

X. Reviewers:

XI. References:

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