RECOVERY PROGRAM Recovery Program Project Number: FR 165
FY 2018-2019 SCOPE OF WORK for:

Use of Stewart Lake Floodplain by Larval and Adult Endangered Fishes

Reclamation Agreement number: R14AP00007
Reclamation Agreement term: October 1, 2018 – September 30, 2022

Lead agency: Utah Division of Wildlife Resources

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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: Use of Stewart Lake Floodplain by Larval and Adult Endangered Fishes

II. Relationship to RIPRAP:

GENERAL RECOVERY PROGRAM SUPPORT ACTION PLAN

II.A.1. Conduct inventory of flooded bottomlands habitat for potential restoration.
V. Monitor populations and habitat and conduct research to support recovery actions (research, monitoring, and data management).

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.1.a. Evaluate survival of young and movement of sub-adult razorback suckers from floodplains into the mainstem in response to flows.
I.D.1.b.(4)(a) – Implement the Larval Trigger Study Plan
II.A.2. Acquire interest in high-priority flooded bottomland habitats between Ouray NWR and Jensen to benefit endangered fish.
II.A.2.a. Identify and evaluate sites.

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.

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 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 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 (Valdez and Nelson 2004). 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, even dry hydrologic years, (2) management of inlet and outlet structures to maximize entrainment during 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 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 capabilities of maintaining adequate water quality throughout summer months until the wetland is drained in autumn.

Recent findings by Bestgen et al. (2011) indicate 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) was designed to examine larval razorback sucker occurrence in the Green River as a trigger for Flaming Gorge operations (Larval Trigger Study Plan Ad Hoc Committee 2012). The LTSP identifies several wetlands as having the greatest ability to entrain larval razorback sucker during a range of flow conditions, specifically three under low flow years and during all study 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 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 nonnatives, 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). In addition, a comprehensive monitoring plan that identifies important research needs for various life stages of razorback sucker was recently 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, especially questions related to life-stage specific detection and capture efficiencies for razorback sucker.

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

Goal:

Characterize use of a controlled floodplain wetland by larval and adult endangered fishes, emphasizing 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. Examine capture efficiencies of razorback sucker during wetland sampling.
4. 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.
5. Determine the extent of nonnative fish colonization in wetland habitats.

End Products: An annual report describing 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 a single breach inlet located at the upstream end of the wetland, as well a single outlet canal on the downstream end. Timing and extent of floodplain inundation and drawdown can be manipulated via floodgate operations which 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 such as Ouray National Wildlife Refuge floodplains, 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 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, we will install an exclusionary picket weir at the Stewart Lake outlet structure and sample with light traps within the wetland. The weir will exclude adult fish from entering the wetland for the entire duration that the floodplain is breached. Previously we used directional traps associated with the weir to allow for movement of adult natives into the wetland and exclusion of non-natives (Skorupski et al. 2013). However, we switched to an exclusionary weir 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., bonytail reproduction; Bestgen et al. 2017). The exclusionary weir consists of diamond shaped mesh (3/8" by 7/8"), which will exclude large-bodied fishes (limiting competition and predation on larval native fishes), but will allow larval razorback sucker and small-bodied fishes to move into the wetland freely. During wet hydrologic years when discharge exceeds 20,000 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 (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 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 Provo Bureau of Reclamation 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 also providing information on capture probabilities and sampling efficiencies of different gear types within a floodplain from previous sampling. 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 even more when requesting a 24-48 hr pulse of supplemental water 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 two days (Partlow et al. 2018).

The problem of high densities of adult carp causing water quality deterioration and mass mortality was successfully ameliorated in 2013 and beyond by using picket weirs to exclude adult nonnatives during filling (Skorupski and Breen 2013; Schelly et al. 2014; Schelly and Breen 2015; Schelly et al. 2016; Staffeldt et al. 2017; Partlow et al. 2018). A complete fill in 2014 allowed for three months of inundation, resulting in excellent growth of entrained razorbacks. However, the range of sizes after three months of growth was considerable (49-168 mm TL), suggesting that a range of intermediate sizes at drawdown would confound attempts to distinguish multiple cohorts of stocked juvenile razorbacks from wild-spawned fish based on size. Furthermore, when the wetland is completely inundated as in 2014 and 2016, dilution effects across the vast expanse of available habitat make seining capture/recapture rates very low, so that the only feasible opportunity to recapture meaningful numbers of wild or marked fish is during operation of the trap at draining.

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 weir 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 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 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).

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 a kill (Partlow et al. 2018). Ideally, future management will entail an earlier prescribed burn (February or March at the latest), 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.

VII. Task Description and Schedule:

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

Task 1: Install, operate and maintain a picket weir in the Stewart Lake outlet, and conduct an annual prescribed burn to maintain habitat conditions.

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						
2							X	X	X			
3									X	X		
4										X	X	X
5	X	X	X	X							X	X

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

An annual report will be submitted to the Recovery Program in November of each year.

IX. Budget Summary:

For Categorical and Task budget detail refer to Excel document "Project 165 FY19-23 Budget BOR Format.xlsm"

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
	10/1/2018	10/1/2019	10/1/2020	10/1/2021	10/1/2022
	Through	Through	Through	Through	Through
	9/30/2019	9/30/2020	9/30/2021	9/30/2022	9/30/2023
DIRECT LABOR AND FRINGE BENEFIT C(	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**
Direct Labor - Hourly	$ 31,457.80	$ 32,086.96	$ 32,728.70	$ 33,383.27	$ 34,050.93
Fringe Benefits - Hourly	$ 7,978.24	$ 8,137.80	$ 8,300.56	$ 8,466.57	$ 8,635.90
Subtotal of Direct Labor & Fringe Benefits:	**$ 39,436.04**	**$ 40,224.76**	**$ 41,029.26**	**$ 41,849.84**	**$ 42,686.84**
OTHER DIRECT COSTS:	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**
Materials Supplies and Services	$ 12,048.20	$ 12,289.16	$ 12,534.95	$ 12,785.65	$ 13,041.35
Travel Costs	$ 1,813.56	$ 1,849.83	$ 1,886.83	$ 1,924.56	$ 1,963.06
Equipment	$ -	$ -	$ -	$ -	$ -
Contractors	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00
Subtotal of Other Direct Costs:	**$ 14,861.76**	**$ 15,138.99**	**$ 15,421.78**	**$ 15,710.21**	**$ 16,004.41**
GRAND TOTAL:	**$ 54,297.80**	**$ 55,363.75**	**$ 56,451.03**	**$ 57,560.06**	**$ 58,691.24**

FY 2019	$54,298
FY 2020	$55,364
FY 2021	$56,451
FY 2022	$57,560
FY 2023	$58,691
TOTAL	**$282,364**

X. Reviewers:

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