I. Project Title: Use of Stewart Lake floodplain by larval and adult endangered fishes

II. Bureau of Reclamation Agreement Number: R14AP00007

Project/Grant Period: Start date: 05/01/2014
End date: 09/30/2019
Reporting period end date: 09/30/2018
Is this the final report? Yes _____ No __X___

III. Principal Investigators:

Michael S. Partlow, Matthew J. Breen, and Richard R. Staffeldt
Utah Division of Wildlife Resources
Northeast Region
318 North Vernal Ave.
Vernal, Utah 84078
Phone: 435-781-9453; Fax: 435-789-8343
E-mail: mpartlow@utah.gov

IV. Abstract

Razorback sucker (*Xyrauchen texanus*) larval drift coincides with high flows during spring runoff, allowing for entrainment into warm, productive floodplain nursery habitats essential for recruitment. Using flood gates to control flows and weirs to exclude large-bodied nonnative fishes, Stewart Lake was filled to a gauge height of 4.78 ft during the larval drift phase. After a rearing period of 2.5 months ending on 15 August 2018 (abbreviated due to drought conditions), endangered fish production was low with only 10 young-of-year razorback sucker (mean total length = 67.3 mm). Although age-0 razorback sucker recruitment success was limited in 2018 (likely derived from a combination of poor spring hydrology, summer drought conditions, and lack of open water habitat), we learned several valuable lessons to improve operations in the future. More specifically, in future years we hope to complete a prescribed burn treatment, closely followed by sufficient wetland inundation via supplemental water delivery to target rhizome structures in order control cattail densities and maintain adequate habitat conditions for razorback sucker recruitment.

V. Study Schedule: Ongoing.

VI. 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.
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.

VII. Accomplishment of FY 2018 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1: Install, operate and maintain a picket weir in the Stewart Lake outlet

Encroachment of cattails (*Typha* spp.) and bulrush (*Scirpus* spp.) continued to inhibit wetland function and to shrink the amount of open water habitat available for fish production, prompting management actions to help ensure future recovery success at Stewart Lake. During spring runoff in 2017, we discovered that the overgrowth of cattails in the inlet canal prevented the movement of water into the wetland (Staffeldt et al. 2017). Therefore, in December 2017, we contracted the Utah Division of Wildlife Resources (UDWR) heavy machinery crew to dredge the inlet canal to restore proper function (Figure 1). With this operation completed, crews were able to utilize this canal during the end of filling to maximize the amount of water input into Stewart Lake in the spring of 2018. To address the ever-expanding cattail and bulrush community in Stewart Lake wetland (Staffeldt et al. 2017), we conducted extensive research over the fall and winter (2017-2018) to determine appropriate management actions to pursue. Following close collaboration with the Utah Division of Forestry, Fire and State Lands (FFSL), a comprehensive prescribed burn plan was completed and approved for Stewart Lake in February 2018. The main goal of the burn plan is aimed at improving wildlife habitat in the wetland by reducing the amount of surface vegetation, while protecting surrounding residents by reducing existing fuel loads adjacent to numerous properties. Given that cattails will continue to display aggressive growth at Stewart Lake due to federally mandated selenium remediation protocols, which require cycles of filling and draining to oxidize and remove the chemical from soils (Naftz et al. 2005), the burn plan also allows for prescribed fires in subsequent years. More specifically, this long-term burn plan will cover an indefinite number of years until a significant change in Stewart Lake operations occurs and there is need for revision. On 24 March 2018 FFSL in collaboration with UDWR, the Vernal Bureau of Land Management Wildfire Unit, and the Jensen Fire Department successfully completed the burning of Unit 1 in the northeast corner of

Stewart Lake (Figure 2). Given that prevailing winds follow the river corridor from southwest to northeast at this location, this unit was deemed a priority to first create a substantial fire break between the majority of the fuel source located in Unit 2 and adjacent private property (Figure 2). With the bulk of the fuel load, fire intensities were expected to be much greater in Unit 2, thus weather conditions needed to be adequate to initiate burning, ultimately postponing the second burn until 11 April 2018, when a complete burn of this unit was accomplished (Figure 3).

Although goals were achieved for the prescribed burn at Stewart Lake, 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 the Uintah Water Conservancy District (UWCD), but this did not occur immediately (i.e., after the growing season began) and the water delivery rate (~4 cubic feet per second [cfs]; J. Hunting, UWCD, personal communication) was insufficient to cover the wetland surface, thus we did not observe a kill (see below). 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. Then we would retain water until just before the ascending limb of the hydrograph.

Approximately one month after the completion of the prescribed burn at Stewart Lake, followed by minimal ground coverage from supplemental water delivery, vegetation already re-established in the wetland. To help reduce cattail density, UDWR's Habitat Section arranged for treatment with a water-soluble liquid herbicide safe for use with aquatic species. On 8 June 2018 an aerial herbicide application was completed using a fixed wing aircraft, where 170 acres was sprayed with a Round Up Custom formulation to increase open water habitat for waterfowl and fish and reduce cattail cover (M. Hanberg, UDWR, personal communication). Although effects from this treatment were minimal, one week after the application cattails did show signs of stress from the treatment. Cattail management at Stewart Lake will continue to be an ongoing and adaptive management need, and herbicide treatments along with prescribed fires are going to be required. In addition, UDWR is considering a trial of domestic goat grazing to impact cattails in future years (M. Hanberg, UDWR, personal communication).

Under the Larval Trigger Study Plan (LTSP; Larval Trigger Study Plan Ad Hoc Committee 2012), the Bureau of Reclamation (BOR) begins ramping up Flaming Gorge Dam (FGD) releases to help with the entrainment of larval razorback sucker after the first detection of drifting larvae in light traps. In 2018, the first larval razorback sucker was detected at the confluence of the Stewart Lake outlet canal with the middle Green River by the Green River Basin Fish and Wildlife Conservation Office (GRBFWCO) on 17 May 2018 during project # 22f. Typically, the first detection comes at Cliff Creek which sits upstream of the Stewart Lake confluence. The BOR began increasing flows to power

plant capacity ~4,600 cfs on 22 May 2018, but decided to forego full bypass releases for a variety of reasons: the dry hydrology was a large factor combined with diminishing Yampa River flows, as well as the overlap with the Memorial Day weekend. The Flaming Gorge Technical Working Group proposed one final short duration flow spike on the tail end of the declining Yampa hydrology to assist with increasing the potential of entraining larval razorback sucker. Beginning on 29 May 2018, BOR implemented additional releases from a single bypass for a 24 hr duration at 6,600 cfs. In response to FGD operations under the LTSP, the outlet gate was opened on 24 May 2018 and remained open until 31 May 2018 when wetland and river levels reached equilibrium at this location (Figure 4). Immediately upon outlet gate closure, the inlet gate was opened on 31 May 2018 and remained open until 4 June 2018 when river elevation dropped to the point where the inlet canal was disconnected. The maximum water level achieved at Stewart Lake during spring operations in 2018 was 4.78 ft, measured by the gauge located at the outlet canal on 1 June 2018.

A single Biomark 36" remote submersible PIT antenna was deployed on 2 May-13 June 2018 in the outlet channel (~50ft from the weir structure) to detect PIT-tagged fish attempting to enter the wetland. In 2018, we detected 18 unique tags. Tag deployment records from the STReaMS database accounted for 11 razorback sucker, two Colorado pikeminnow (*Ptychocheilus lucius*), one bonytail (*Gila elegans*), and there were four unknown tags. Low water levels in the Green River in 2018 limited the period when the area near the gate structure was inundated and likely accounts for the low detection levels observed compared to previous sampling (e.g., Schelly et al. 2016). Interestingly, of the 18 fish detected in 2018, eight razorback sucker, two Colorado pikeminnow, and one bonytail were detected or captured near the Stewart Lake drain in 2017 or 2016 (Schelly et al 2016; Staffeldt et al 2017). Unfortunately, no razorback sucker released as young-of-year fish from Stewart Lake in previous years were detected or captured in 2018.

To document larval razorback sucker entrainment in Stewart Lake, crews deployed six light traps each day from 24-27 May 2018. All traps were positioned in the wetland, staggered along the dredged channel leading from the outlet gate. On the morning of 25 May 2018, eight larval razorback sucker were collected from three out of six traps (verification by Bruce Haines, GRBFWCO). To limit mortality, once we detected the presence of larval razorback suckers in the wetland, light trapping in Stewart Lake was halted shortly thereafter. Final identification of specimens in 2018 samples will be determined by the Larval Fish Laboratory, Colorado State University.

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

Post-entrainment sampling of the Stewart Lake fish community began on 23 July 2018 after allowing fish time to grow to a catchable size. Since 2015, dense aquatic macrophyte beds have inhibited seining as a sampling technique in Stewart Lake (Schelly and Breen 2015). Several seine hauls were attempted in 2018, but seining progress was difficult due to deep mud and aquatic vegetation. From 24-26 July 2018, a single directional fyke net with ¼" mesh and a 50' central wing was deployed in the dredged outlet channel near the outlet gate structure. Low water levels in Stewart Lake (Figure 5) prohibited sampling outside of the dredged channel, where most habitat was observed to

be less than 0.3 m deep. Minnow traps and hoop nets were not deployed in 2018 due to a lack of inundated habitat and low catch rates in previous years with these gear types (Staffeldt et al. 2017).

Although fish were captured during seining, 78% of total captures (n = 4,054 fish) during post-entrainment monitoring were collected in the fyke net. Native fish captured were limited to two razorback sucker (total length [TL] = 55 and 43 mm) and a single bluehead sucker (*Catostomus discobulus*; TL = 79 mm). Nonnative fishes dominated the catch during post-entrainment sampling (Figure 6). Species included brook stickleback, common carp, creek chub, fathead minnow, green sunfish, Iowa darter, red shiner, sand shiner, and white sucker.

In an attempt to preserve water quality and quantity to aid razorback sucker survival and growth in the wetland, supplemental water delivery was requested on 5 June 2018 from UWCD with confirmed flows from the Burns Bench pipeline on 11 June 2018. Supplemental water was delivered continuously at a rate of 3 cfs until draining commenced on 15 August 2018. Prior to final flushing flows during draining (see below), 762 acre-ft of supplemental water was delivered (J. Hunting, UWCD, personal communication). To monitor water quality during the entrainment period, two mini-DOT (dissolved oxygen and temperature) loggers were deployed in the top third of the water column; one in the dredged channel near the outlet structure and one near the center of the wetland. Subsequently, the mini-DOT set in the outlet channel could not be located and was ultimately discovered buried in benthic sediment after the wetland had been drained. Although it is unknown when the mini-DOT in the dredged channel was dislodged, both units recorded continuous dissolved oxygen levels near 0 mg/L beginning in early July and continuing for the remainder of the entrainment period (Figure 7). Due to concerns about the reliability of measurements obtained from the mini-DOT that was dislodged, Figure 7 is based solely on the mini-DOT deployed near the center of the wetland, where water depths were relatively shallow. Although not certain, low dissolved oxygen levels encountered in 2017 (Staffeldt et al. 2017) and 2018 may be a factor contributing to low razorback sucker production in Stewart Lake during low water years.

Task 3: Sample fishes exiting the Stewart Lake outlet during draw down with a picket weir.

Although additional wetland sampling was scheduled for the beginning of August, deteriorating conditions derived from severe drought throughout the summer were observed upon arrival the morning of 8 August 2018, prompting immediate action to drain the wetland to preclude a likely fish kill. On the same day, we prepared the outlet structure for draining by configuring the fish trap and river-side outlet gate (Staffeldt et al. 2017). Additionally, we requested from UWCD that supplemental water delivery cease as soon as possible. On 15 August 2018, we verified that supplemental water delivery was terminated, lowered the wetland-side gate, and began spilling at 12:00; gauge height was 3.8 ft. before draining commenced. After nearly a full day of spilling, with gate adjustments as needed, we determined that complete drawdown would be quite brief with existing low water levels, thus requested additional pulses of supplemental water from UWCD to improve water quality and fish survival in the latter stages of

draining (Staffeldt et al. 2017). Specially, we requested two 24-hr pulses of 10 cfs separated by a couple of days, which occurred 18-19 and 22-23 August 2018. Water levels in the wetland rose 0.94 ft from 18-19 August and 1.5 ft. from 22-23 August, indicating that supplemental water deliveries of 10 cfs are capable of quickly filling Stewart Lake. In addition to final flow pulses, substantial rainfall the evening of 22-23 August 2018 raised wetland levels and refreshed water quality for the final draining process. After several final flushing attempts (i.e., raised the wetland gate for water to pool, then dropped the gate back down to flush through the fish trap) when only sheet flow was slowly draining out of the Stewart Lake wetland, we discontinued the project at approximately 12:00 on 25 August 2018.

Species composition during the draining phase of Stewart Lake is described in Table 1. Native fishes included 10 age-0 razorback sucker and three speckled dace (*Rhinichthys oculus*), whereas the majority of the species composition was comprised of small-bodied nonnative fishes (99.97%), mainly fathead minnow (*Pimephales promelas*), brook stickleback (*Culaea inconstans*), green sunfish (*Lepomis cyanellus*), Iowa darter (*Etheostoma exile*), and red shiner (*Cyprinella lutrensis*).

Task 4: Data entry, analysis and reporting

Recovery Program annual progress report submitted in December 2018.

VIII. Additional noteworthy observations:

- We learned several valuable lessons during 2018 Stewart Lake operation. Most importantly, cattail management is not easy, but certainly possible if all the correct steps are achieved. Moreover, timing is crucial for each management action to be successful. We suspect that if the timing of each management action outlined in Task 1 is fulfilled, wetland habitat can be successfully restored and maintained to aid in recruitment of wild-spawned razorback sucker at Stewart Lake each year that successful riverine reproduction occurs.

- During the draining phase in 2018, we discovered that gastropods comprised the majority of the aquatic biomass in Stewart Lake; hundreds of thousands, and more likely several million snails were recovered from the fish trap over the course of drawdown. Snails from two different species were observed; a single Lymnaeidae spp. comprised roughly two thirds of total snail biomass and a single Physidae spp. the remainder. Without further research on life-history and other factors, it is unclear why we observed this change in aquatic species composition in 2018, or if they even originate from Stewart Lake. For example, are they entering the wetland from the supplemental water outlet pipes? These snails are unlikely to pose a negative interaction with razorback sucker and could provide a source of forage for larger razorback sucker (T. Jones, USFWS, personal communication), but if large amounts of snails persist in 2019, some investigation of the ecological implications of this change may be warranted.

IX. Recommendations:

- Now that a long-term burn plan has been approved, we need to work with FFSL to coordinate a prescribed burn further in advance of the growing season. Ideally, future management will include a prescribed burn in 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.

- Supplemental water delivery has become a standard operating procedure at Stewart Lake. To confirm water delivery, crews must visually inspect the pipeline, requiring additional site visits during times when other recovery program projects make such trips difficult to schedule. We recommend that the Recovery Program fund the installation of a digital flow gauge at the outlet pipes to allow UDWR and associated partners to access supplemental water delivery parameters remotely. Consultation with a hydrologist or similar person with applicable expertise would help determine the best possible approach and assistance from the Recovery Program would help to this end.

- Continue with two 24-hr flow pulse events (separated by two days) near the conclusion of draining to improve water quality and native fish survival during the final stages of wetland drawdown. However, we recommend duplicating 2018 efforts with a release rate of 10 cfs if our remaining supplemental water allotment allows for it.

- Review all previously PIT-tagged age-0 fish released from Stewart Lake during drawdown in all years of this project for a comprehensive assessment of potential recruitment into larger juvenile size classes. Specifically, UDWR will query the STReaMS database on an annual basis to look for basin-wide encounters of PIT-tagged fish that have previously been released from Stewart Lake. In 2017, 118 age-1 razorback sucker released from Stewart Lake in 2016 (Schelly et al. 2016) were encountered, but we have yet to document survival into the age-2 class. Considering the overall goal of recruiting wild-spawned razorback sucker into the population of breeding adults, analysis of subsequent encounters, and possibly survival, of razorback sucker reared in Stewart Lake should be included in annual reports and may warrant an additional task under the scope of work.

X. Project Status: On track and ongoing.

XI. FY 2018 Budget Status

A. Funds Provided: $58,898
B. Funds Expended: $58,898
C. Difference: $0
D. Percent of the FY 2018 work completed, and projected costs to complete: 100%
E. Recovery Program funds spent for publication charges: $0

XII. Status of Data Submission:

We will submit our data to the Recovery Program database manager by January 2019.

XIII. Signed: *Michael S. Partlow* 12/07/18
Principal Investigator Date

XIV. References:

Larval Trigger Study Plan Ad Hoc Committee. 2012. Study plan to examine the effects of using larval sucker occurrence in the Green River as a Trigger for Flaming Gorge Dam. Final Report to the Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

Naftz, D.L., J. Yahnke, J. Miller, and S. Noyes. 2005. Selenium mobilization during a flood experiment in a contaminated wetland: Stewart Lake Waterfowl Management Area, Utah. Applied Geochemistry 20:569-585.

Schelly, R.C. and M.J. Breen. 2015. Use of Stewart Lake floodplain by larval and adult endangered fishes. Annual Report of Utah Division of Wildlife Resources to the Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

Schelly, R.C., Staffeldt, R.S., and M.J. Breen. 2016. Use of Stewart Lake floodplain by larval and adult endangered fishes. Annual Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

Sojda, R.S. and K.L. Solberg. 1993. 13.4.13. Management and control of cattails. Waterfowl Management Handbook. 33. U.S. Fish and Wildlife Service, Washington, D.C. http://digitalcommons.unl.edu/icwdmwfm/33

Staffeldt, R.R., M.S. Partlow, B.R. Anderson, and M.J. Breen. 2017. Use of Stewart Lake floodplain by larval and adult endangered fishes. Annual Report of Utah Division of Wildlife Resources to the Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

Table 1. Percent composition of various species and their total lengths (TL) collected in 2018 during the draining phase at Stewart Lake.

Species	Total	% Composition	Avg. TL (mm)	Range
Black bullhead	141	0.14	53	19-187
Brook stickleback	11,466	11.36	44	24-59
Common carp	137	0.14	121	51-174
Creek chub	1	0.01	–	85
Fathead minnow	82,576	81.79	47	18-73
Green sunfish	4,516	4.47	54	28-134
Iowa darter	1,067	1.06	47	35-68
Razorback sucker	10	0.01	67.3	46-94
Red shiner	993	0.98	59	36-84
Sand shiner	27	0.03	108	39-59
Speckled dace	3	0.00	80.3	70-86
White sucker	23	0.02	118	45-184
TOTAL	100,960			

Figure 1. The Stewart Lake inland canal before (left panel) and after (right panel) dredging occurred in December 2018 to restore functionality.

Figure 2. Prescribed fire operations at Stewart Lake that occurred from March–April 2018. The prescribed burn included two units that were ignited separately to ensure local resident safety.

Figure 3. Complete burn of Stewart Lake Unit 2 on 11 April 2018; top picture shows the prescribed burn, bottom picture was taken a few hours after the fire extinguished.

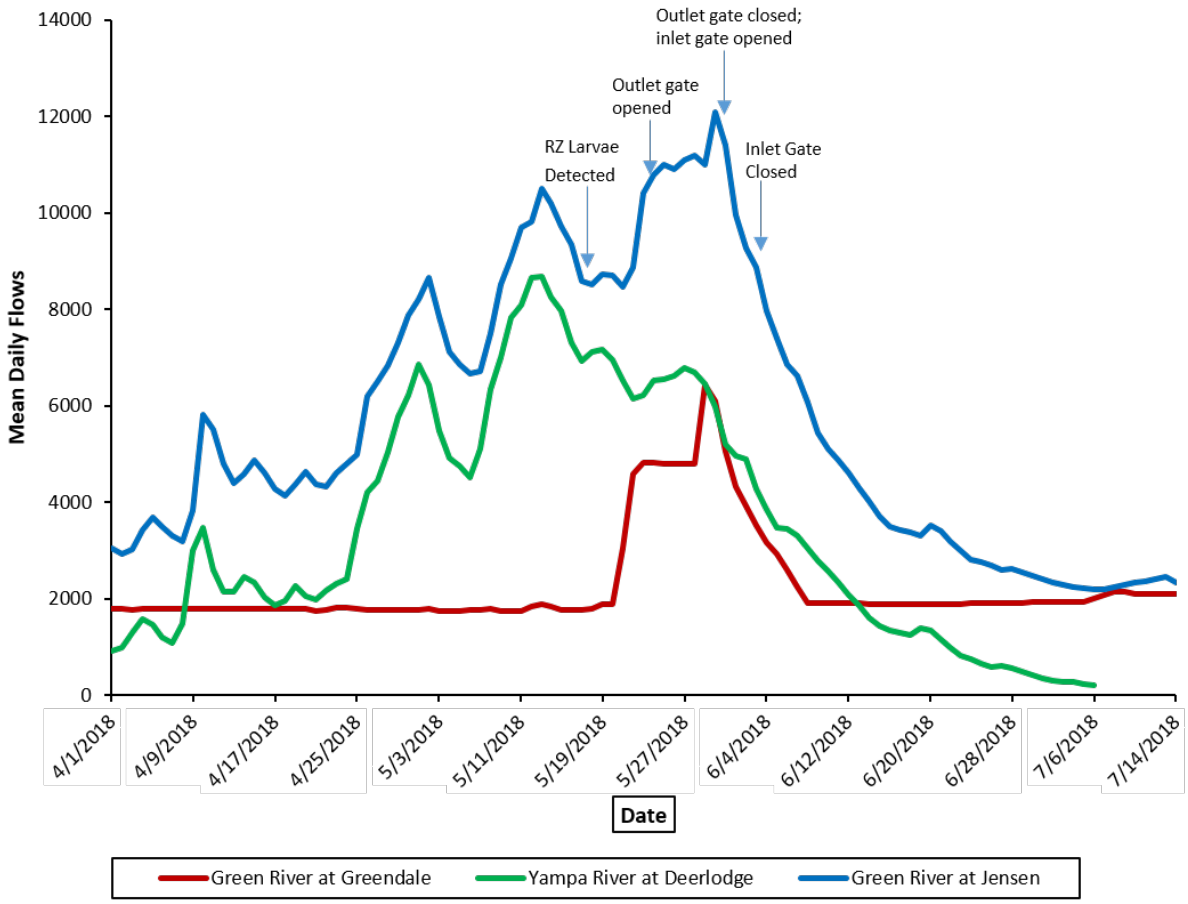

Figure 4. Hydrograph of 2018 spring flows under the Larval Trigger Study Plan, with first detection of larval razorback sucker and Stewart Lake filling periods highlighted. Flow data originates from USGS gages #09261000 (Jensen, UT), #09260050 (Deerlodge Park, CO), and #09234500 (Greendale, UT). Note that USGS discharge data used to create this figure was provisional.

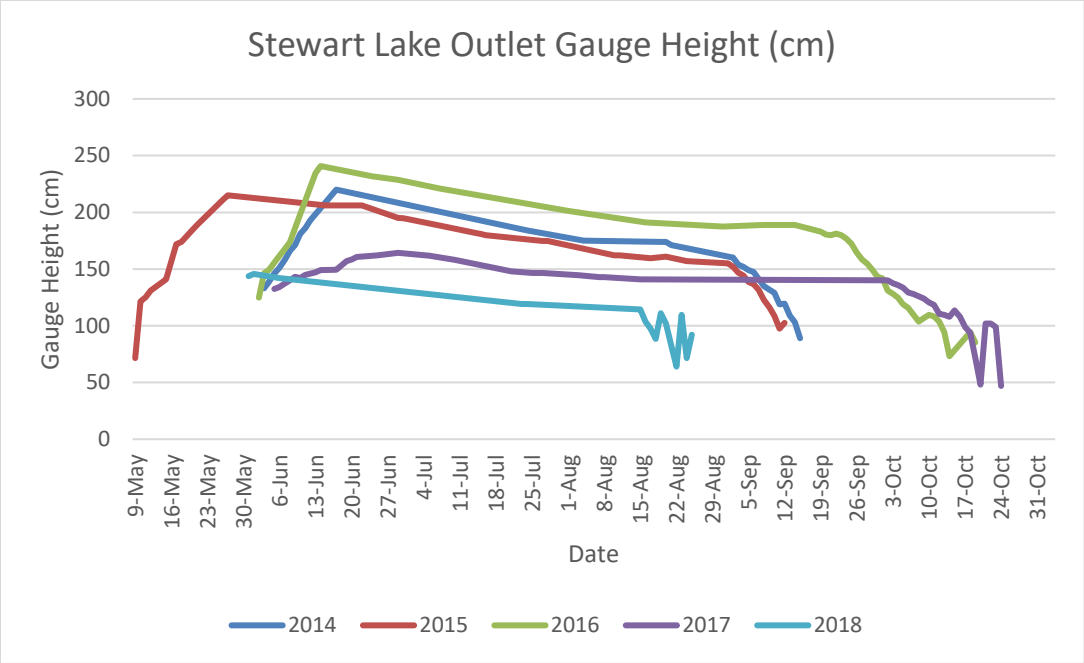

Figure 5. Depth measurements from the gauge at the Stewart Lake outlet structure during the periods of filling, inundation, and draining in 2014–2018.

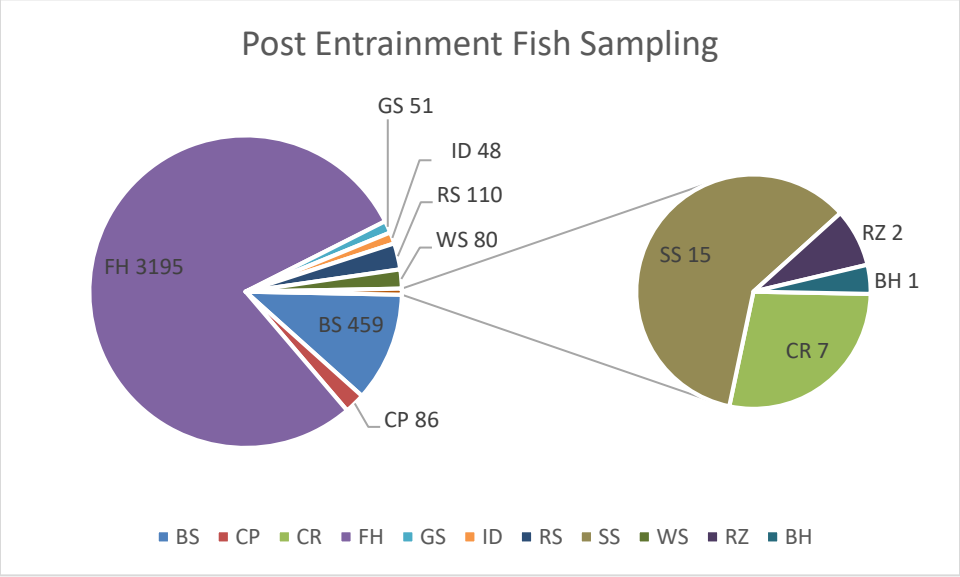

Figure 6. Fish collected in the Stewart Lake wetland during post-entrainment sampling in 2018. Species include: bluehead sucker (BH), brook stickleback (BS), creek chub (CR), common carp (CP), fathead minnow (FH), green sunfish (GS), Iowa darter (ID), red shiner (RS), razorback sucker (RZ), sand shiner (SS), and white sucker (WS).

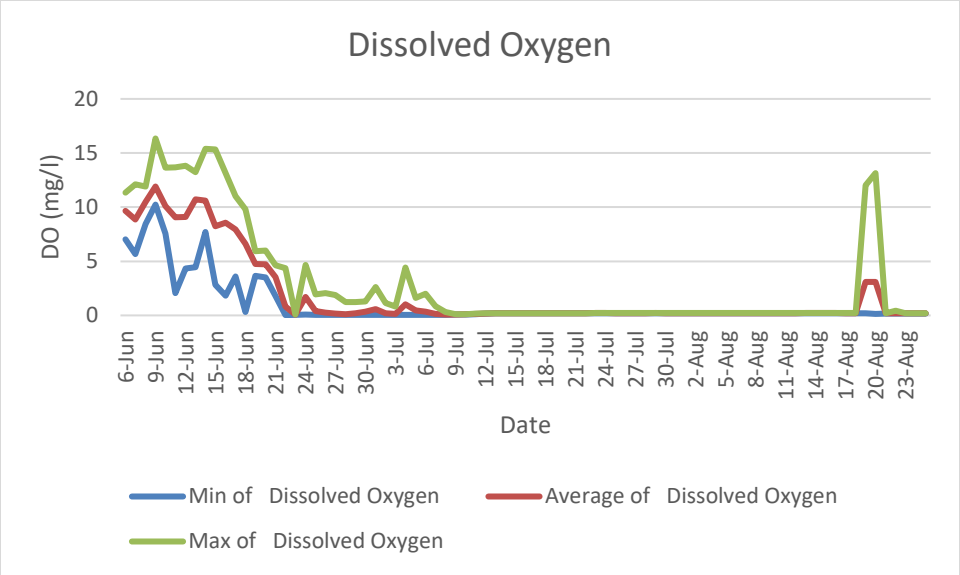

Figure 7. Continuous dissolved oxygen (DO) readings taken in the Stewart Lake wetland for the duration of the entrainment period.