COLORADO RIVER RECOVERY PROGRAM
FY 2019 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: FR-165

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

II. Bureau of Reclamation Agreement Number: R19AP00059

Project/Grant Period: Start date: 10/01/2018
End date: 09/30/2023
Reporting period end date: 09/30/2019
Is this the final report? Yes _____ No __X___

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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 capacity, with a gauge height of 229 cm (7.5 ft) during the larval drift period. After an inundation period of four months, 417 young-of-year razorback sucker, two presumptive young-of-year bonytail, and six adult bonytail were encountered while draining, and an unknown number of fish were released into the Green River in an uncontrolled discharge of water and fish from the wetland. Despite habitat concerns stemming from a near complete loss of open water habitat from encroaching cattails, 2019 has been a successful year for wild-spawned razorback sucker at Stewart Lake. Active management at Stewart Lake under the Larval Trigger Study Plan continues to play a key role in the recovery of the razorback sucker, and results suggest an off-channel wetland component in the life history of the bonytail. A review of encounter histories of razorback sucker previously released from Stewart Lake has revealed the first documented recruitment of wild spawned razorback sucker to age-2 and age-3 in the upper Colorado River Basin.

V. Study Schedule: Ongoing

VI. Relationship to RIPRAP:

GREEN RIVER ACTION PLAN

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
II.A.	Restore and manage flooded bottomland habitat.

II.A.3.d.1.	Conduct real-time larval razorback and Colorado pikeminnow sampling to guide Flaming Gorge operations.
II.A.5.	Manage and/or modify priority floodplain sites for nursery habitat for endangered fish (as identified in Floodplain Synthesis, LTSP, etc.)
II.A.5.a.	Stewart Lake

VII. Accomplishment of FY 2019 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

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

Encroachment of cattails *Typha spp.* and bulrush *Scirpus spp.* has become a persistent problem at Stewart Lake and has reduced the area of open water to 4.65 acres as measured with a handheld GPS on 04 September 2019 (Figures 1 and 2). A planned prescribed burn was not undertaken in the spring of 2019 because of persistent wet weather and snow cover late into the season. A successful burn was completed in 2018, but cattail shoots reemerged, providing oxygen to unground rhizomes, when we were unable to adequately inundate the wetland prior to the growing season. Thus, plant mortality was not achieved (Partlow et al. 2018).

While prescribed fire may be an efficient means of vegetation removal, stalk removal represents only a portion of a cattail removal strategy that targets carbohydrate stores retained in underground rhizomes while plants are dormant. Specifically, aerenchyma tissue that provides air passage from leaves to rhizomes must be destroyed and rhizomes must be flooded prior to the next growing season (Sojda and Solberg 1993). In an attempt to ensure that all phases of our strategy (aerenchyma disruption and inundation) are accomplished before the 2020 growing season, we made a special one-time funding request from the Recovery Program for treatment of cattail stalks using specialized mechanical equipment (Marsh Master; Coast Machinery LLC., Baton Rouge, LA) designed for use in wetlands. Additional funds from this request are specified for early operation of the Burns Bench pipeline to provide supplemental water prior to the growing season. The combination of mechanical stalk disruption (scheduled for December 2019) and early delivery of supplemental water should allow us to complete both aspects of our strategy with fewer dependencies on weather conditions. Moreover, the observed level of effectiveness of the strategy we have outlined above may help guide the Recovery Program's operation and maintenance of other high priority wetlands in the upper Colorado River basin.

We utilized an exclusionary weir constructed of 1/8" expanded aluminum with 1/4" by 7/8" diamond shaped openings at the outlet gate to allow larval fish to enter the wetland while excluding large-bodied nonnative fishes. This weir was first installed in 2017 (Staffeldt et al. 2017) and has remained effective with relatively little effort required to reinstall before filling begins. At the inlet gate, an aluminum picket weir was utilized to exclude nonnative fishes during the final stages of filling. In anticipation of high spring flows, block nets were installed at two levee breaches to exclude nonnative fishes at those

locations

Under the Larval Trigger Study Plan (Larval Trigger Study Plan Ad Hoc Committee 2012), the Bureau of Reclamation (BOR) begins ramping up Flaming Gorge Dam releases to help with the entrainment of larval razorback sucker after the first detection of drifting larvae in light traps. In 2019, the Green River Basin Fish and Wildlife Conservation Office (GRBFWCO) detected the first two larval razorback sucker at Cliff Creek (RM 302.8), approximately four miles upstream of the Stewart Lake outlet, on 21 May 2019. Although releases typically occur soon after the first larval detection, relatively low larval detections in the Green River coupled with forecasted cold temperatures and a lack of cumulative degree days used to predict larval emergence (K. Bestgen, Colorado State University Larval fish Lab, personal communication), initiation of spring releases was postponed until 03 June 2019. BOR attempted to manage Flaming Gorge releases to target a peak flow of 18,600 cfs at Jensen, without exacerbating flooding at a flow above 22,000 cfs. As a result, bypass releases were variable depending on Yampa River flow forecasts. Full bypass (8,600 cfs) occurred on 05 June 2019 and continued until a spike in Yampa River flows led BOR to reduce flows by a single bypass tube (~2,000 cfs) on 07 June 2019. Dam releases returned to full bypass on 10 June 2019 and continued until 17 June 2019. The 2019 peak discharge for the Green River at Jensen was 21,000 cfs on 11 June 2019. Mean daily discharge at Jensen was above 18,000 cfs for 12 consecutive days (7-18 June 2019) and returned to this level for an additional day on 23 June 2019 (Figure 3).

To confirm the presence of razorback sucker *Xyrauchen texanus* on the river side of the outlet gate, we deployed two light traps outside the wetland by the outlet gate beginning on 22 May 2019. Larval razorback sucker (n=2) were captured in these traps on 29 May 2019 and the outlet gate was opened when sufficient water became available on 04 June 2019 (Figure 3). Increasing flows began spilling over the lowest elevation levee breach on 06 June 2019. At 10:20 on the morning of 11 June 2019, which was during Green River peak discharge, a block net positioned at the lowest elevation levee breach was discovered folded over and the higher elevation levee was in danger of being compromised as well (Figure 1). Personnel that collected light traps around 07:00 that morning reported that they had cleaned debris from the block nets and both were still up at that time, indicating that the wetland was accessible to large bodied-fishes for three hours or less. Both block nets were raised and reinforced by adding additional t-posts and ropes. We observed numerous adult common carp *Cyprinus carpio* on the river side of the block net attempting to enter the wetland shortly after the net was repositioned. Based on observations from 2019, water begins flowing over the lower elevation levee breech when flows at the Jensen gauge approach 17,800 cfs. With projected declines in Green River flows, on 17 June 2019 (gauge height=204 cm [6.7 ft]), the inlet gate was opened to ensure a complete fill (229 cm [7.5 ft]; Figure 3). Equilibrium between the river elevation and the wetland elevation at the outlet occurred on 19 June 2019 and the outlet gate was closed to retain water in the wetland (Figure 3). Filling from the inlet gate continued until 28 June 2019, when declining Green River flows coincided with a maximum wetland elevation of 229 cm (7.5 ft; Figure 3). At this point, the wetland was level with the lowest elevation levee breach but not overtopping.

To document entrainment of larval razorback sucker in Stewart Lake, we deployed three to four light traps staggered along the dredged channel leading from the outlet gate and a single light trap west of the lowest elevation levee breach (Figure 1). Despite captures of larval razorback sucker outside of and in close proximity to the outlet gate, captures within the wetland were low with a single razorback sucker collected on 10 June 2019 and two collected on 13 June 2019. Although light traps were situated along the edges of the open water canal, it was difficult to find zero-velocity habitats outside of the thick cattail stands where traps could be placed.

A single Biomark 36" remote submersible PIT antenna was deployed on 01 May-28 June 2019 in the outlet channel (~50 ft from the weir structure) to detect PIT-tagged fish attempting to enter the wetland. In 2019, we detected 57 unique tags. Tag deployment records indicate we detected 33 bonytail *Gila elegans,* 23 razorback sucker*,* and one unidentified tag. All bonytail detected were stocked in June 2019 or August 2018 (STReaMS 2019). In an exciting turn of events, a razorback sucker (PIT tag 3DD.003BCC9418) was detected on 18 June 2019. This razorback sucker was captured and tagged while emigrating from Stewart Lake on 08 October 2016 (total length [TL]=94 mm) and represents one of the first documented age-3 recruits of a wild-spawned razorback sucker in the upper Colorado River basin since the inception of the Recovery Program (see Task 4 below).

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

Sampling of the fish community in Stewart Lake typically occurs after enough time has passed to allow razorback sucker to grow to a catchable size. However, in 2019, we observed adult common carp in Stewart Lake on 24 June 2019, four days before filling was complete. In an attempt to remove some of these adult carp and assess what other fishes may have accessed the wetland during the brief period it was breached as described above, we deployed three 50 ft trammel nets on 25-27 June 2019. The first overnight set yielded two common carp (459 and 469 mm TL), one green sunfish (*Lepomis cyanellus*; 141 mm TL), and eight adult bonytail (280-304 mm TL). Crew members failed to bring a PIT scanner and did not gather tag data for these bonytail. The second overnight set (26-27 June 2019) yielded seven white sucker *Catostomus commersonii* (106-112 mm TL), six green sunfish (97-111 mm TL), two black bullhead *Ameiurus melas* (175 and 185 mm TL), two razorback sucker (211 and 253 mm TL), and six bonytail (range = 265-310 mm TL). Stocking records (STReaMS, 2019) indicate that two of these bonytail were stocked on 14 June 2019 at Cliff Creek and four were stocked at Walker Hollow (RM 294.0) on 17 June 2019. The stocking dates for these bonytail rule out the possibility that they entered the wetland through the levee breech when peak flows briefly overwhelmed block nets on 11 June 2019. Therefore, the most likely way that they entered the wetland was by jumping over the picket weir in the inlet canal. The two razorback sucker were recaptures from classroom-raised fish consisting of 17 razorback sucker and six bonytail stocked into Stewart Lake from 14 May-02 June 2019 (Tildon Jones, USFWS, personal communication).

Midsummer sampling of Stewart Lake took place on 13-14 August 2019. A single

directional fyke net with 1/4" mesh and a 50' central wing extending from the middle of the trap mouth was set for one night where two sections of dredged channel converge near the center of the wetland. Sampling resulted in the capture of 16 young-of-year (YOY) razorback sucker (mean = 67.5 mm TL; range = 62-105 mm TL), including three mortalities. Nonnative fishes captured during midsummer sampling included common carp (n=162), green sunfish (n=52), brook stickleback *Culaea inconstans* (n=8), fathead minnow *Pimephales promelas* (n=367), and white sucker (n=2). No additional sampling was performed to prevent further mortalities of YOY razorback sucker.

To maintain desired water quality and quantity, we requested supplemental water deliveries from the UWCD during a 16 July 2019 conference call and deliveries began on 18 July 2019. Supplemental water flows were continuous until 24 September 2019, just prior to the onset of draining. To monitor water quality, we deployed four mini-DOT (dissolved oxygen and temperature) loggers at two locations within the wetland. For two consecutive years, loggers have recorded extended periods of very low dissolved oxygen and upon retrieval seem to have come loose from their mounting stakes and fallen into benthic sediments. In an attempt to avoid this fate, in 2019 we suspended the loggers from floats at depths of one foot or three feet. Nonetheless, each logger recorded similar patterns of very low dissolved oxygen in the late summer with moderate increases before draining (Figure 4).

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

The fall draining process utilized the same trap structure, constructed of expanded aluminum, used for the previous two years (Staffeldt et al. 2017; Partlow et al, 2018). On 30 September 2019, three months after filling was completed, we began draining the Stewart Lake wetland through the outlet gate. Draining and twice-daily trap checks occurred continuously until 29 October 2019 except for two days on 19-20 October 2019 when the gate was closed. The draining process at Stewart Lake often results in poor water quality due to ground water inflows and mobilization of benthic sediment. To maintain water quality and avoid fish mortality, in the final stages we typically request one or two pulse flows of supplemental water (Schelly et al. 2016; Staffeldt et al. 2017; Partlow et al. 2018). However, in 2019 abnormally cold temperatures necessitated draining of the Burns Bench pipeline several weeks before pulse flows were needed (J. Hunting, UWCD, personal communication). As a result, supplemental water was not available during wetland draining. On 27-29 October, a series of events led to concern that a large fish kill could be imminent: single digit temperatures (°F) coincided with the wetland reaching a level (105 cm [3.5 ft]) where fish were concentrated in a relatively small area just above the outlet gate and fish trap. On the morning of 29 October 2019, we observed large numbers of fish in distress under ice (Figure 5). With temperatures forecasted near zero degrees for at least one additional night, we decided to accelerate draining in an attempt to process as many fish as possible before an uncontrolled release might become necessary to avoid a fish kill. As we increased flow through the fish trap, crews immediately encountered large numbers of nonnatives, as well as YOY razorback sucker and several adult bonytail. After hours of fish processing (including assistance from (GRBFWCO and Recovery Program employees) the aluminum trap door on the fish

trap failed under the increased head placed on it by the accelerated draining rate and by fish plugging up holes in the mesh. This uncontrolled release sent a swirling mix of fish and water down the outlet canal to the Green River, but also stranded thousands of fish inside the wetland and along the outlet canal after flow subsided. While mostly common carp, YOY razorback sucker were also observed among stranded fish. While crews salvaged stranded razorback sucker in buckets of water and placed them into flowing water towards the Green River, the outlet gate was raised to allow water to build back up so a pulse of water could flush stranded fish to the river. After two such pulses, the number of stranded fish was reduced. The following day (30 October 2019) while retrieving dissolved oxygen loggers within the drained wetland, we discovered 15 razorback sucker stranded in isolated pools. While the total number of endangered fish released into the Green River during this event is not known, based on numbers of razorback sucker encountered prior to trap failure and the presence of stranded razorback sucker, we estimate that at least several hundred untagged YOY razorback sucker were released. In 2017, numerous 2016 age-class razorback sucker were encountered in the Stewart Lake drain, Ashley Creek, and the Green River during nonnative removal work. If 2019 year-class razorback sucker are encountered next spring, an opportunity may exist to estimate the total number of razorback sucker released this year using the ratio of tagged to untagged individuals captured.

Prior to the uncontrolled release, we measured and scanned all endangered fish encountered in the fish trap for a PIT tag. Untagged razorback sucker ≥ 80 mm TL were implanted with a PIT tag, and all endangered fish were released into the Green River either downstream of the outlet canal or downstream of the inlet canal. In total, 417 YOY razorback sucker were captured in the fish trap during draining in 2019, of which 356 were implanted with a PIT tag. Mean total length of the 2019 cohort was 101.9 mm (range = 60-185 mm; Figure 6). Two presumptive YOY bonytail (Bestgen et al. 2017) were captured as well as six adult bonytail. None of the six bonytail were recaptures from early season trammel netting, but four were from the same two stocking events on 14 June and 17 June 2019, and two were classroom-raised fish (see above). We estimated nonnative fish total abundance by filling a one-gallon bucket of fish from large coolers used to process fish coming from the trap (thoroughly mixed), identifying and counting all species within this subsample bucket and then enumerating the total volume of fish processed and multiplying the subsample by total gallons removed. Additionally, approximately 20 individuals of each species were measured during each sampling event to determine size distribution of nonnative species and to reduce the likelihood of less common species being unaccounted for in subsamples. All nonnative fish encountered prior to the uncontrolled release were removed, but an unknown number of nonnatives were released into the Green River when the trap door failed.

Species composition during the draining phase of Stewart Lake is described in Table 1. The dominant species encountered was green sunfish, which accounted for 63.2% of the catch. While YOY common carp accounted for a smaller proportion of the total catch (13.6%), they likely represented a similar proportion of total biomass as green sunfish, due to their larger body size. The remainder of the nonnative catch included fathead minnow, brook stickleback, Iowa darter *Etheostoma exile*, redside shiner *Richardsonius balteatus,* red shiner *Cyprinella lutrensis*, sand shiner *Notropis stramineus*, and white

sucker. Additional native fish included 10 speckled dace *Rhinichthys oculus.*

Task 4: Data entry, analysis and reporting

We performed a query of the STReaMS database on 11 November 2019 to assess the recruitment of previously tagged age-0 razorback sucker from Stewart Lake into larger juvenile and adult size classes. In 2018, a similar query was performed but only searched for tags associated with the large cohort produced in 2016 (Shelly et al. 2016) and not for tags deployed before 2016. Prior to our most recent search, we discovered encounters of age-1 razorback sucker from Stewart Lake, but no instances of older fish (Schelly et al. 2015; Partlow et al. 2018). This year we discovered four instances of 2014 year-class razorback sucker that reentered and were tagged in Stewart Lake in 2015 (Schelly et al. 2015) and were later encountered as age-2 or age-3 fish. In 2015, aluminum picket weirs were used to exclude large bodied fish and it was assumed that age-1 razorback sucker jumped over the picket weir at the outlet gate before a height extension was added (Schelly et al. 2015). A list of these fish and their encounters follows:

3D9.1C2C2D451D

- Tagged during midsummer sampling at Stewart Lake on 28 July 2015 (281 mm TL; age-1).
- Recaptured during midsummer sampling on 12 August 2015 (281 mm TL).
- Recaptured during draining on 06 September 2015 (312 mm TL).
- Detected as an age-3 on an antenna in the Stewart Lake drain on 24 April 2017.
- Recaptured in a fyke net in the Stewart Lake drain on 03 May 2017 (358 mm TL; age-3).

3DD.003BCC9121

- Tagged during draining on 10 September 2015 (315 mm TL; age-1).
- Recaptured during tributary electrofishing in the Stewart Lake drain on 20 May 2016 as an age-2 (324 mm TL).

3DD003BCC915F

- Tagged during draining on 03 September 2015 (266 mm TL; age-1).
- Detected on an antenna in Stewart Lake drain from 23-27 June 2017 (age-3).

3DD.003BCC915E

- Tagged during draining on 02 September 2015 (277 mm TL; age-1).
- Recaptured in a fyke net at RM 299.9 on 29 March 2017 (315 mm TL; age-3).

These fish, in addition to the 2016 year-class razorback sucker detected on our antenna in 2019 (see above), represent the first evidence of recruitment beyond age-1 of wild spawned razorback sucker in the upper Colorado River basin, a milestone in razorback sucker recovery.

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

The inlet canal was dredged in December 2017 (Partlow et al. 2018) and has functioned well since. No dredging was performed in 2019.

VIII. Additional noteworthy observations

IX. Recommendations:

- Trammell netting after the filling phase was intended to remove common carp, but also provided insight on what species were able to circumvent our attempts to exclude large-bodied fishes. Adult green sunfish and common carp were both present in these nets and also comprised large portions of the total biomass drained from the wetland. We can assume that many of the green sunfish and common carp encountered during draining were offspring of fish that entered the wetland either through the levee breach, when the block net briefly failed, or through (or over) the inlet weir. We have made steady improvements to our exclusionary structures and correcting the final weaknesses could have a drastic effect on the fish assemblage of Stewart Lake if we could completely exclude reproducing green sunfish and common carp from the wetland. It should be recognized, however, that nonnative fish larvae might still be entrained along with razorback sucker larvae if those species are spawning nearby. Additionally, we plan to place semi-permanent fish barriers across the levee breaches by installing treated fence posts with a steel hardware cloth screen with 1/2" x 1/2" square openings.

- The capture of two presumptive YOY bonytail suggests that bonytail once again reproduced in Stewart Lake in 2019. An unintended consequence of improvements to our exclusionary structures could be a loss of access to the wetland for bonytail. The Recovery Program should consider stocking small numbers of bonytail directly into the wetland so that we may continue to learn how these endangered fish use wetlands for reproduction.

- Large numbers of common carp were observed spawning in the Stewart Lake drain prior to filling and suspected larval carp were captured in light traps just outside the outlet gate. In 2018, crews performing nonnative removal under Recovery Program Project 123b removed 85 adult carp from the drain to help avoid entraining large numbers of larval carp into the wetland. In future years, crews that will already be performing nonnative removal targeting northern pike and white sucker in the Stewart Lake drain should actively remove carp in the weeks leading up to the filling of Stewart Lake to reduce the number of larval and adult common carp that enter the wetland.

- An unknown number of YOY razorback sucker were released into the Green River in an uncontrolled release at the end of draining in 2019. If juvenile razorback sucker are collected during other projects next spring in the Stewart Lake drain and Ashley Creek areas, we should document the ratio of tagged and untagged fish. Then simple mark-recapture principles can be applied to estimate the actual number of razorback sucker produced in 2019.

- For several years dissolved oxygen loggers have recorded long periods of very low dissolved oxygen, yet the fish community is able to survive these conditions if enough

water volume is present. We should consider the necessity of continuing to deploy miniDOT loggers in Stewart Lake and consider instead exploring the wetland with a handheld dissolved oxygen meter in late August or early September to determine if higher oxygen refuges occur and, if so, what relationship they may have with vegetation and depth.

- Of the five razorback sucker that we have documented as age-2 or age-3 recruits, four are fish that accessed Stewart Lake at age-1 in 2015. This suggests that juvenile razorback sucker that spend an additional growing season in Stewart Lake may have a higher rate of survival. We recommend moving some age-1 razorback sucker from the Stewart Lake drain into the wetland in future years if the opportunity arises.

X. Project Status: On track and ongoing.

XI. FY 2019 Budget Status
- A. Funds Provided: $54,298
- B. Funds Expended: $54,298
- C. Difference: $0
- D. Percent of the FY 2019 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 2020.

XIII. Signed: *Michael S. Partlow* 11/13/19
Principal Investigator Date

XIV. References:

Bestgen, K.R., R.C. Schelly, R.R. Staffeldt, M.J. Breen, D.E. Snyder and M.T. Jones. 2017. First reproduction by stocked Bonytail in the upper Colorado River basin. North American Journal of Fisheries Management 37(2):445-455.

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.

Partlow, M.S., M.J. Breen., and R.R. Staffeldt. 2018. 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. 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

Species Tagging, Research and Monitoring System (STReaMS). 2019. Accessed via the internet at https://streamsystem.org on 11/11/2019.

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 2019 during the draining phase at Stewart Lake.

Species	Total	% Composition	Avg. TL (mm)	TL Range
Brook stickleback	11,040	3.5	68.2	39-83
Bonytail	8	<0.1	216.9	60-352
Common carp	42,859	13.6	114.1	47-604
Fathead minnow	60,029	19.0	61.2	32-80
Green sunfish	198,900	63.2	69.8	34-168
Iowa darter	188	<0.1	56.5	47-75
Razorback sucker	417	0.1	101.9	60-186
Red shiner	568	0.2	61.0	36-85
Redside shiner	3	<0.1	74.7	69-84
Sand shiner	24	<0.1	56.0	45-65
Speckled dace	10	<0.1	54.1	40-65
White sucker	342	0.1	146.4	59-215
White sucker X flannelmouth sucker	1	<0.1	-	174
TOTAL	314,388			

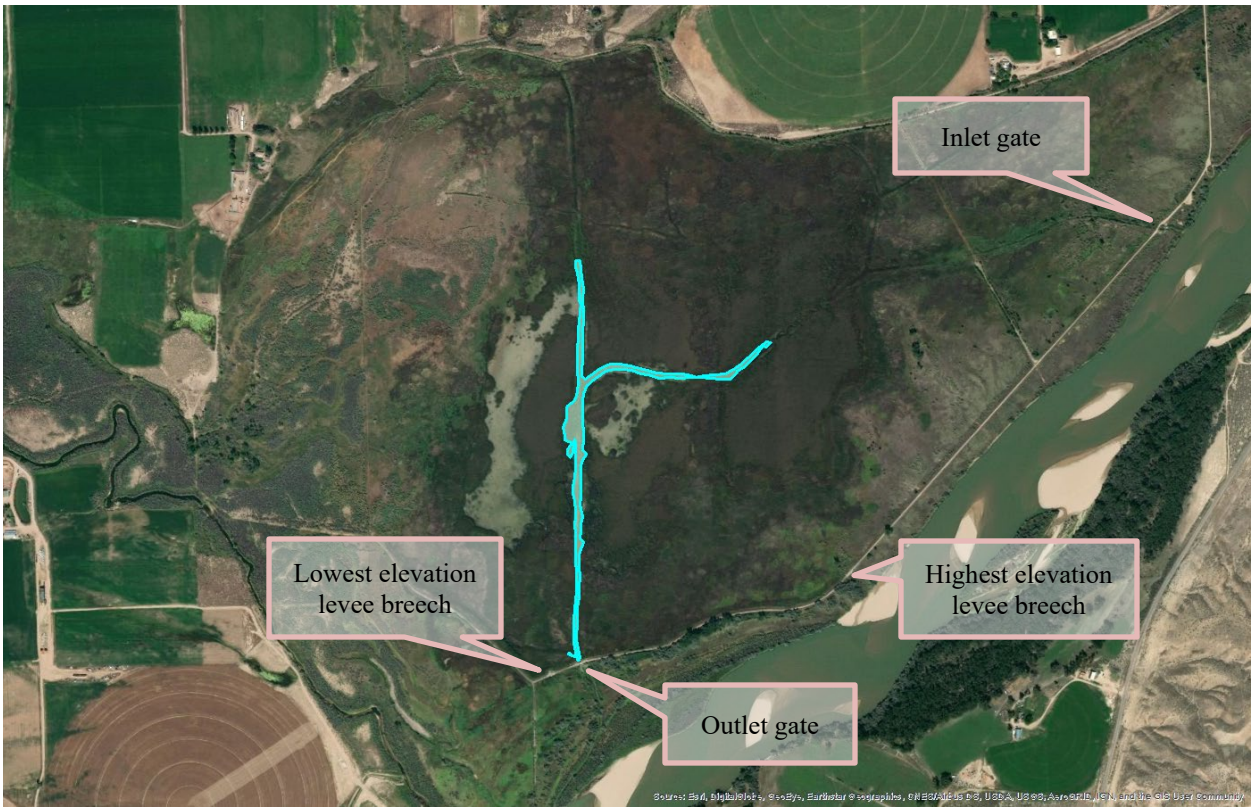

Figure 1. Open water habitat in Stewart Lake as measured with a handheld GPS on 04 September 2019 (light blue polygon) and water control features. Area of open water = 4.65 acres.

Figure 2. View of Stewart Lake wetland from the outlet gate on 04 September 2019, detailing the lack of open water habitat.

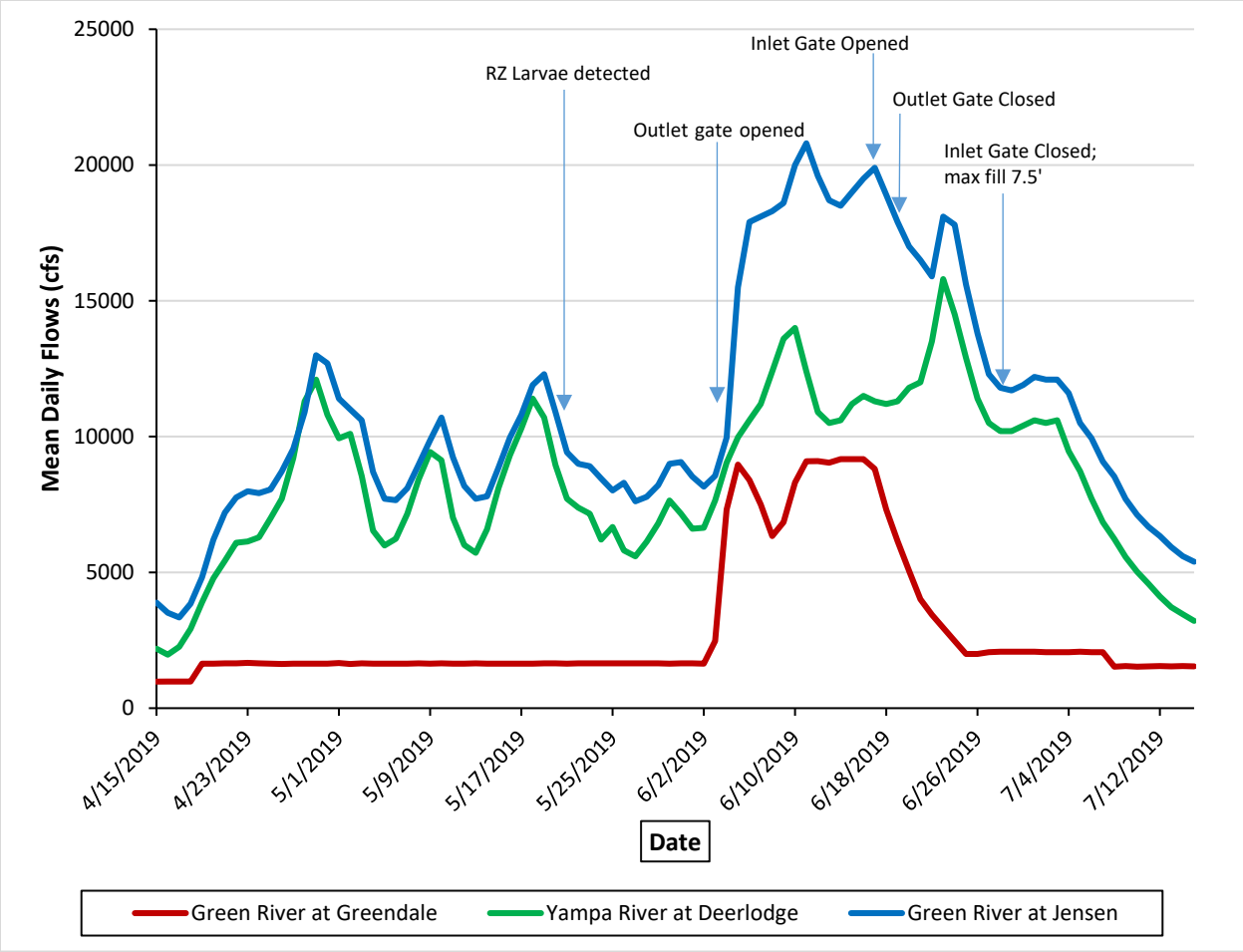

Figure 3. Hydrograph of 2019 spring flows under the Larval Trigger Study Plan, with first detection of larval razorback sucker and Stewart Lake filling periods highlighted. Flow data originates from USGS gages #09261000 (Jensen, UT), #09260050 (Deerlodge Park, CO), and #09234500 (Greendale, UT).

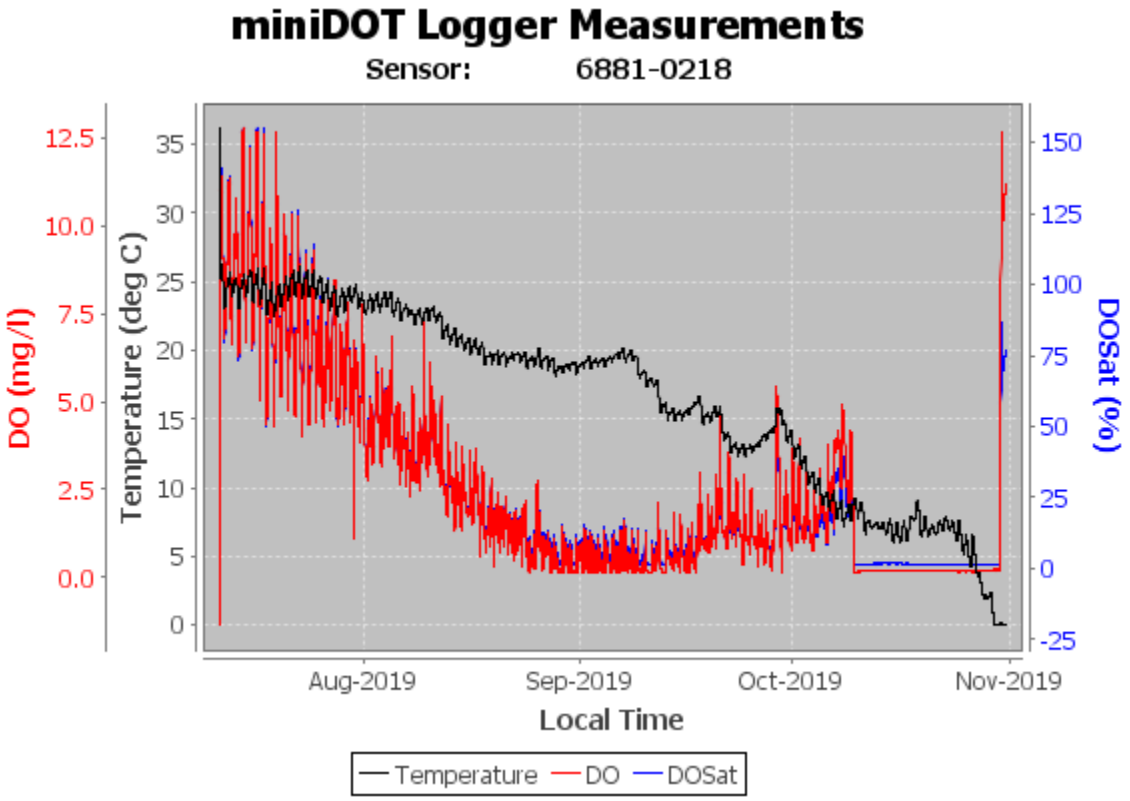

Figure 4. Dissolved oxygen (DO) and temperature measurements at Stewart Lake, 11 July to 30 October 2019.

Figure 5. Distressed fish under ice on 29 October 2019 in Stewart Lake.

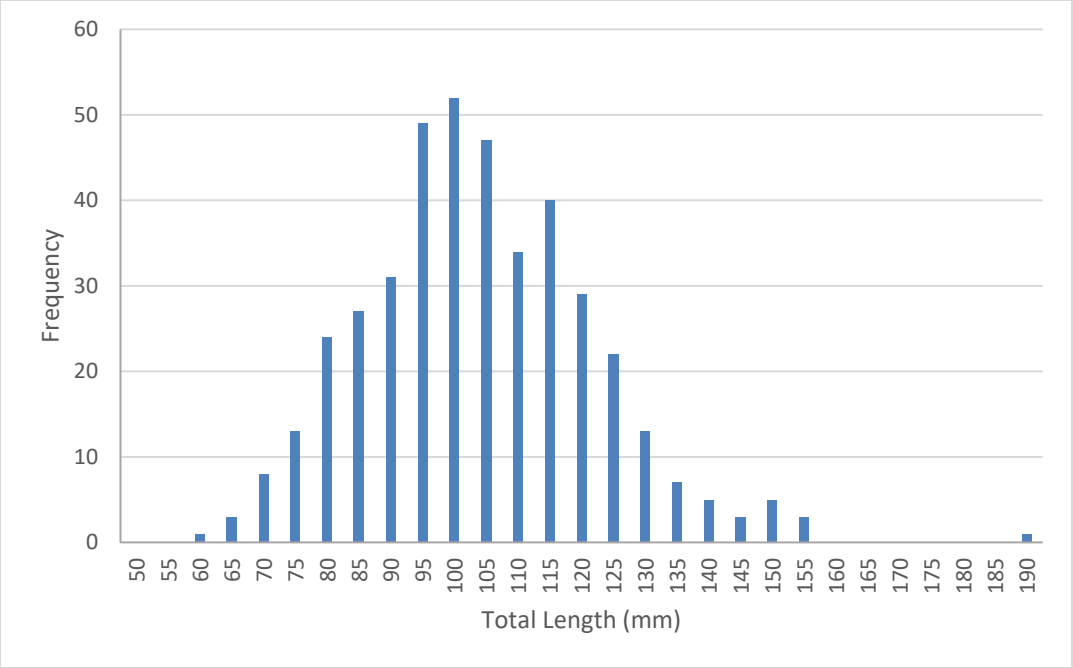

Figure 6. Length frequency histogram of razorback sucker sampled during draining of Stewart Lake, 30 September-29 October 2019.