COLORADO RIVER RECOVERY PROGRAM
FY 2012 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: FR165

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

II. Bureau of Reclamation Agreement Number(s): #R12AP40033

Project/Grant Period:
Start date (Mo/Day/Yr): 9/13/2012
End date: (Mo/Day/Yr): 11/30/13
Reporting period end date: 9/30/12
Is this the final report? Yes _____ No __X__

III. Principal Investigator(s):

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IV. Abstract:

Reproduction by razorback sucker (*Xyrauchen texanus*) occurs on the ascending limb of the spring hydrograph as an adaptation for entrainment of larvae into highly productive floodplain habitats. Stewart Lake has been identified as a priority floodplain because of its large size, location relative to razorback spawning bars, and functionality under a variety of flow scenarios. Stewart Lake was one of only two wetlands in the Ouray reach of the Green River to entrain flows in 2012 due to drought conditions. Wild-spawned razorback suckers were successfully entrained via adaptive management of wetland floodgate structures. Flow entrainment was quite limited, preventing successful recruitment of this cohort, but we also provide extensive documentation of wetland conditions prevailing from mainstem flows with a limited peak and duration.

V. Study Schedule: FY2012–FY2013

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 2012 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1: Install, operate and maintain stationary PIT-tag antennas and reader in the Stewart Lake inlet

Maintenance and repair of our stationary PIT-tag antenna equipment occurred following the conclusion of the Stirrup floodplain project (RZ-RECR). This system is fully operational and ready for future use for this task and task 3. As noted in our scope of work, operation of the stationary equipment at the Stewart Lake inlet is not scheduled until 2013.

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

Five 4 mm light traps were set for 10–24 hours at the Stewart Lake inlet structure to monitor larval razorback sucker entrainment beginning on 7 May 2012. They were set to determine initial occurrence of larvae at the inlet structure. Larvae were detected by USFWS on 16 May in the Jensen area, which prompted the Bureau of Reclamation to increase flow releases to powerplant capacity on 19 May 2012. Flaming Gorge releases eventually peaked at 7,790cfs on May 23. Native sucker larvae were first detected at the Stewart Lake inlet structure on the 18 May, but were present in low abundance, whereas USFW was capturing high abundance of larval sucker in the Stewart Lake outlet. Larval abundance at this time potentially consisted of the highest concentrations of larval sucker ever observed during light trap sampling (Bruce Haines, FWS-UCRFP, personal communication). Light trapping continued at the inlet until 21 May at which time we modified our traps to have 2 mm openings to increase their effectiveness by excluding cyprinids; however, there was still no indication of successful capture of native larval suckers. Discharge and depth were monitored from 20–24 May, indicating no flow with a slight increase in depth (Figure 1). The inlet channel was failing to entrain water and larvae up to this point (Figure 1). Therefore, this prompted the opening of the Stewart Lake outlet gate in order to entrain water and larval suckers; the outlet was opened on 21 May. On 22 May, light trapping continued in the inlet and began in Stewart Lake by the outlet gate. Four light traps were set in Stewart Lake near the outlet structure to determine if larval suckers were being entrained. It was verified larvae were present in Stewart Lake, thus prompting light trapping to end at the inlet structure to focus in Stewart Lake while it was inundating water at the outlet. In total 90 light trap samples were taken at the inlet structure from 7 May–22 May 2012. On 23 and 24 May, 20 and 19 light traps, (respectively) were set for approximately 24 hours in Stewart Lake extending from the outlet gate structure to the far extent of the lake (Figure 2). From 22 -25 May, discharge was monitored at the outlet structure to determine when Stewart Lake was no longer inundating water (Figure 3). In the morning of 25 May, we determined that discharge and depth had equalized allowing the maximum amount of water in the lake, which prompted the closing of the outlet structure. Based on our samples, larval suckers appeared to be distributed throughout Stewart Lake, thus light trapping was discontinued. At this time, flows in the Green River began to decrease (Figure 4). The lake was revisited on 21 June to determine if larval suckers were still present in Stewart Lake. We used a canoe to set light traps to minimize disturbance to the system and efficiently sample the channel. At this time, the majority of larval light traps were dominated by age-0 carp. Additionally, we observed several complete kills within light trap samples, especially in traps set near the outlet structure.

We determined overall area of the wetland following closure of the Stewart Lake outlet structure. To accomplish this, we gathered 75 UTM coordinates along the perimeter of the wetland, which we then plotted using ArcMap v.10 to create polygon shape files for a map of the inundated area (Figure 2). With limited flow entrainment, Stewart Lake did not reach full capacity, instead filling along a series of main channels (maximum depth ~1 m) with some spill over into other areas (maximum depth <20 cm). Within a couple of weeks, water was only present in main channel areas (Figure 2). Using the X-Tools Pro Package v.9.1, we calculated overall area of the polygon shape files. The initial area that flooded was a total of 70.5 acres, which is approximately 12.4% of capacity (570 acres; Valdez and Nelson 2004), and the channels that remained at the end of the study covered a total area of 9.2 acres (Figure 2).

To determine the fish community composition of juvenile and adult fish entrained in the wetland, we set 11 fyke nets on 20 June 2012. Fyke nets were evenly distributed throughout the main channel of Stewart Lake and fished for 24 hours. With the exception of two nets that were placed near the outlet structure, nets were placed perpendicular to shore so that net leads crossed the entire channel. We collected a total of two black bullheads (TL = 118, 195 mm), 20 channel catfish (Mean TL = 438.9 ± 16.4 mm; Range = 215–584 mm), 357 common carp, one fathead minnow, 16 northern pike, and two red shiners. Northern pike (Mean TL= 503.2 ± 29.5 mm; Range = 265–885 mm) consisted of four males and 12 females, all of which were reproductively spent prior to capture. Common carp only consisted of large adults (Mean TL= 550.3 ± 6.5 mm; Range = 420–710 mm), which were so abundant that several individuals were captured by their dorsal spines in net leads and we were physically rowing our canoe over aggregations of carp while retrieving nets. A significant amount of biomass was removed during this single netting effort, where we completely filled a 17 foot canoe two times with adult carp. All fish were alive upon capture, with the exception of one net that was placed closet to the outlet structure in which every single fish deceased prior to pulling the net. At the time, we did not observe any dead fish along the banks, but we did observe high concentrations of carp mouthing at the surface near the outlet structure.

Water quality was continuously monitored in Stewart Lake from 4-29 June 2012. We used two miniDOT Loggers (PME Inc., Vista, CA) set to record data at 30-minute intervals, which we then averaged for each day to monitor changes in temperature and dissolved oxygen concentrations through time (Figures 5 and 6). One unit was placed near the outlet gate, which was the area of greatest depth, and the second was placed near the end of the bottom left channel (Figure 2). Due to decreasing water levels, the second logger was moved to the confluence of upper channels on 21 June 2012 (Figure 2). Temperatures were similar among sites, whereas we observed drastic differences in dissolved oxygen (Figures 5 and 6). Although daily fluctuations occurred, it appears that sufficient dissolved oxygen concentrations were present near channel extremities (Figure 6). However, dissolved oxygen was quickly depleted near the outlet gate, reaching anoxic conditions on 8 June (Figure 5). It is important to note that extensive vegetative uptake of floodplain water from monotypic stands of cattails (e.g., Figure 7c), in combination with drought-related evaporation, quickly decreased the overall size of the wetland (Figure 2). In addition, high densities of large adult fishes quickly depleted dissolved oxygen concentrations causing the wetland to become anoxic leading to a complete fish kill (Figure 7c-d). Although different in magnitude, we observed similar drops in dissolved oxygen among data logger locations. Specifically, dissolved oxygen initially dropped after 7 June, then went back up after 21 June, only to plummet once again on 22 June (Figures 5 and 6). At the second site, we observed peaks in dissolved oxygen concentrations that were not observed near the outlet gate, which may be explained by primary productivity in the absence of higher densities of fish (Figure 6). Near the outlet gate water remained anoxic until 21-22 June (Figure 5), which can explain the 100% mortality of fish collected in light traps and the fyke net placed in the area the night of 21 June. We suspect that a large fish kill event occurred right after our site visit on 21 June because dissolved oxygen increased, especially near the outlet (Figure 5), which may be explained by a lack of fish consuming oxygen. This secondary increase in dissolved oxygen followed by a sharp decrease on 23-24 June (Figure 5) suggests that decomposition of carcasses began to take place, consuming the remaining oxygen.

When we revisited the site on 28 June, only a few carp and bullheads were observed mouthing near the surface, while hundreds to thousands of dead fish were present along all shorelines. On 29 June, we opened the outlet gate to drain the remaining water and potentially allow any remaining natives to get back to the Green River, which was extremely unlikely given the complete lack of water in the outlet channel at the time. Given the poor water quality conditions that rapidly developed from a limited amount of flow entrainment, and abundance of adult nonnative fishes, it is clear that 10,300 cfs (> 10,000 cfs for 2 days; Figure 4) is insufficient for entrainment and survival of larval and adult endangered fishes.

To monitor PIT-tagged fished possibly entrained in the wetland, both during and after it was drained, we used two different techniques for tracking PIT tags. First, a flat plate antenna (27"x13") attached to a FS2001F-ISO reader (Biomark Inc., Boise ID) was placed approximately 150 m from the outlet gate (center of the channel). Unfortunately, we did not detect any fish with this antenna from 21 June to 29 June when the wetland was drained. Given that tasks 3-4 (below) were not possible due the fish kill, we conducted a salvage operation to assess overall entrainment and escapement of PIT-tagged native fishes. The structure of the floodplain following decreased water levels (i.e., a single channel remaining; Figure 2) created a focused search area allowing for the use of a portable antenna to scan for PIT tags. We used a RM310 reader (Biomark Inc., Boise ID) attached to a portable wand with an extendable handle to scan the dried surface of the floodplain channel and outlet channel on 3 October 2012. Approximately six hours of effort was necessary to scan the entire surface that previously contained water in the wetland. Although no PIT tags were found in the outlet channel, a single PIT tag was found approximately 100 m from the outlet gate in the wetland. This tag belonged to a 2006 age class bonytail (233 mm TL when released) that was originally stocked in the Green River at the Split Mountain boat ramp on 17 November 2008. Without the presence of a carcass to verify that this fish was entrained in 2012, we can only speculate, but we do know that this bonytail did in fact enter Stewart Lake at some point.

Task 3: Install, operate and maintain stationary PIT-tag antennas and reader in the Stewart Lake drain

Due to a large-scale fish kill as noted in task two, we did not conduct this task in 2012 given that fish escapement was a moot point.

Task 4: Sample the fish community in the Stewart Lake drain during the draw-down

Due to a large-scale fish kill as noted in task two, we did not conduct this task in 2012. However, as mentioned under task two we did scan the outlet channel for potential PIT-tagged fish that were released from the floodplain during final draw down. No native fish were found during this effort.

Task 5: Data entry, analysis and reporting

Recovery Program annual progress report submitted in November 2012.

VIII. Recommendations:

- Through our fish community monitoring, measurement of environmental variables, and extensive habitat measurements following entrainment, we have clearly shown that floodplains are valuable for native fishes, but with inadequate spring peak flows sustained quality habitat is limited. We were successful at entraining wild-spawned larval razorback suckers, which is a primary objective of the Larval Trigger Study Plan. Unfortunately, wetland conditions following floodplain connection did not allow for survival of entrained fishes or the recruitment of this cohort. We recommend that the Recovery Program strive for Reach 2 flows >>10,300 cfs for a longer duration than maintained in 2012 in order to successfully entrain and rear larval razorback sucker at Stewart Lake. An additional benefit would be to draw from Red Fleet Reservoir (up to 1,000 acre feet available) as needed to augment summer lake levels to improve rearing habitat conditions in the summer.

- Despite an insufficient flow entrainment period due to a limited peak of short duration, high densities of nonnative fishes were entrained in Stewart Lake. In less than one month, we observed a substantial fish kill of entrained fishes, mainly adult carp. Thus, we recommend that in low flow years (when supplemental Red Fleet Reservoir releases are not available) Stewart Lake be used as a management option for controlling problematic nonnative species.

- Given that the inlet structure was ineffective at filling the wetland in 2012, we recommend that the inlet channel be leveled annually to eliminate sediment build up that prevents adequate function. We recommend that dredging needs to occur around the inlet structure and throughout the entire inlet canal following high flows each year. These activities would be especially important during high flow years such as 2011 that substantially altered the dynamics of the inlet canal.

- Develop and implement a caging study (hatchery and/or wild produced razorbacks) which will answer two questions: (1) how will larval razorback sucker larvae survival rates be affected when predator nonnatives (e.g., cyprinids) are excluded and (2) how does selenium uptake from Stewart Lake sediments occur in early life history stages of razorback sucker. In combination with a 2011 sediment analysis (if not significantly different from previous years), answers to these questions may allow us to move forward with long-term inundation of Stewart Lake which would aid in multiple objectives including the recovery of native fishes, providing valuable research options in this important floodplain habitat, and providing waterfowl/habitat management options.

IX. Project Status: On track and ongoing

X. FY 2012 Budget Status

A. Funds Provided: $46,177
B. Funds Expended: $46,177
C. Difference: $0
D. Percent of the FY 2012 work completed, and projected costs to complete: 100%
E. Recovery Program funds spent for publication charges: $0

XI. Status of Data Submission (Where applicable):

Data will be submitted to the database manager in December 2012.

We will submit our data to the Recovery Program database manager in December 2012.

XII. Signed: *Matthew J. Breen* 11/9/12
Principal Investigator Date

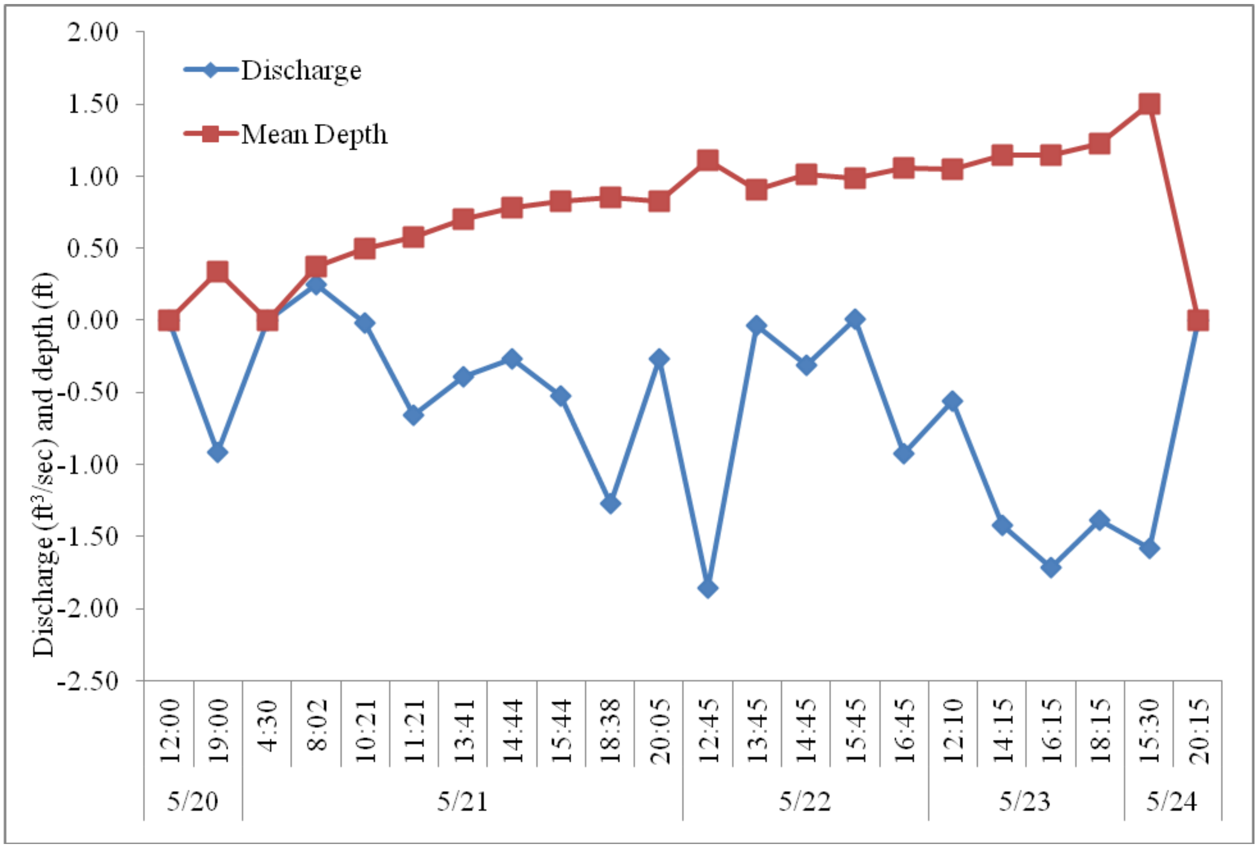

Figure 1. Mean depth and discharge measured at the Stewart Lake inlet structure on several dates and times during 2012 peak flow.

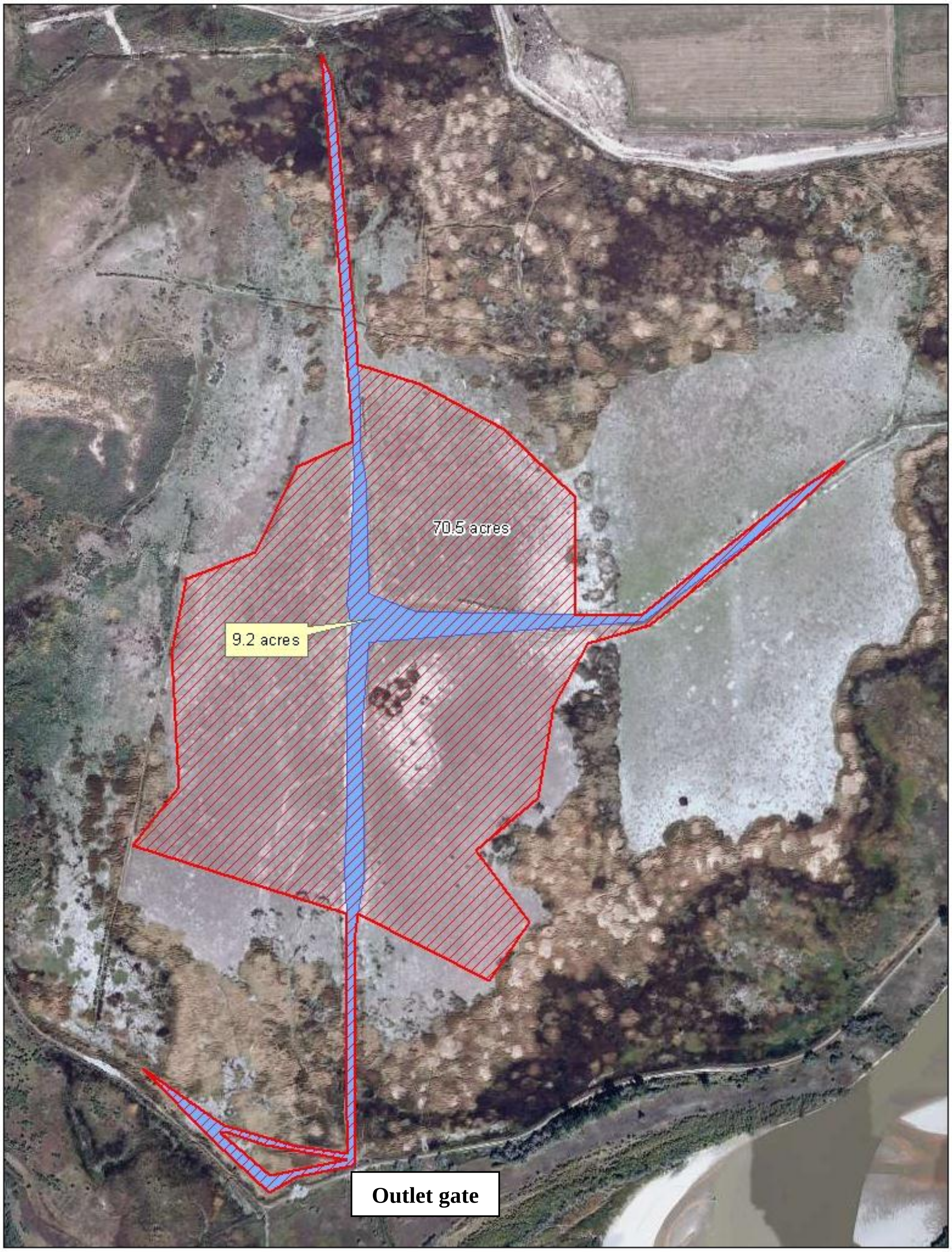

Figure 2. The Stewart lake floodplain following entrainment of Green River flows in May 2012. Red hash marks indicate the total area that was initially inundated and the underlying blue outline indicates the remaining channelized area following extensive drought-related evaporation and vegetative uptake of entrained water.

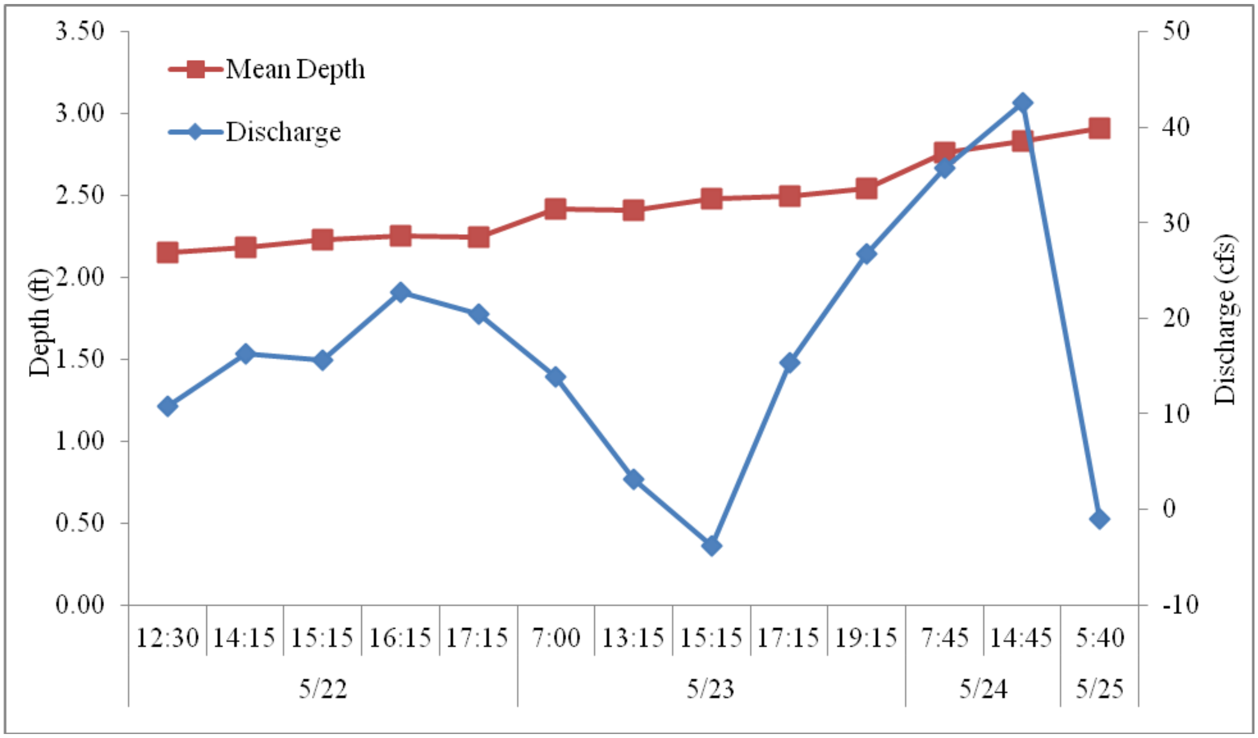

Figure 3. Mean depth and discharge measured at the Stewart Lake outlet structure on several dates and times during 2012 peak flow.

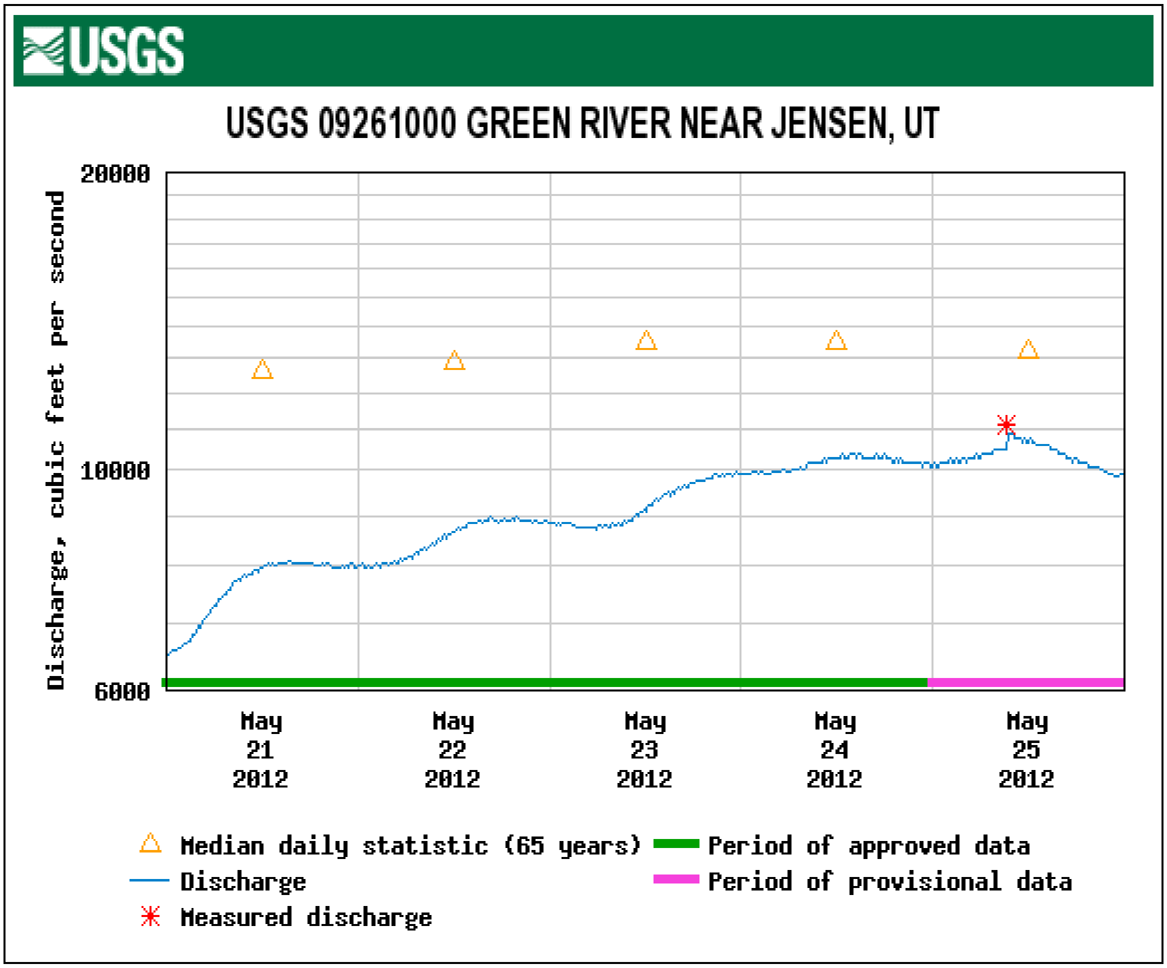

Figure 4. Green River daily discharge recorded at the USGS Jensen gauge.

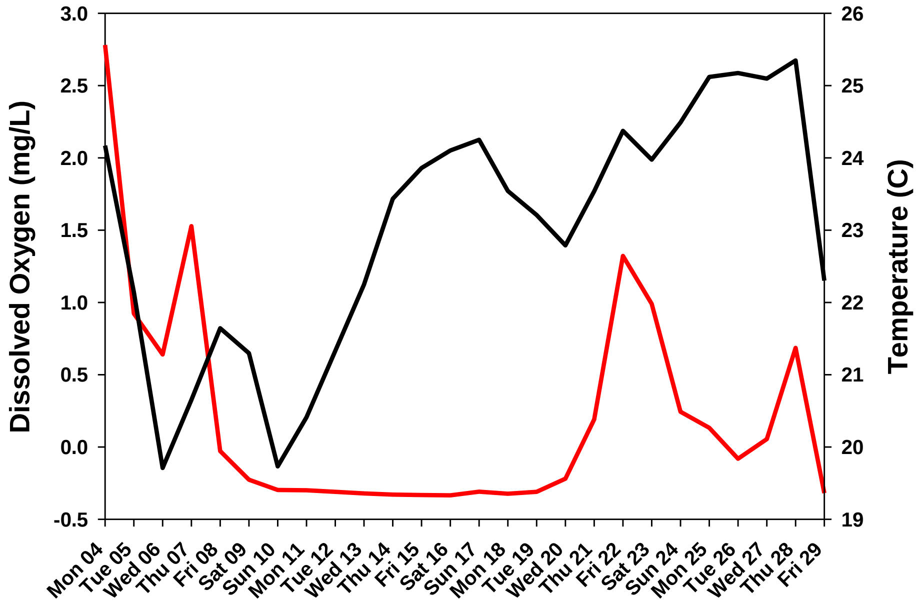

Figure 5. Mean daily dissolved oxygen concentrations (red line) and temperature (black line) recorded from a data logger placed in Stewart Lake near the outlet gate from 4-29 June 2012.

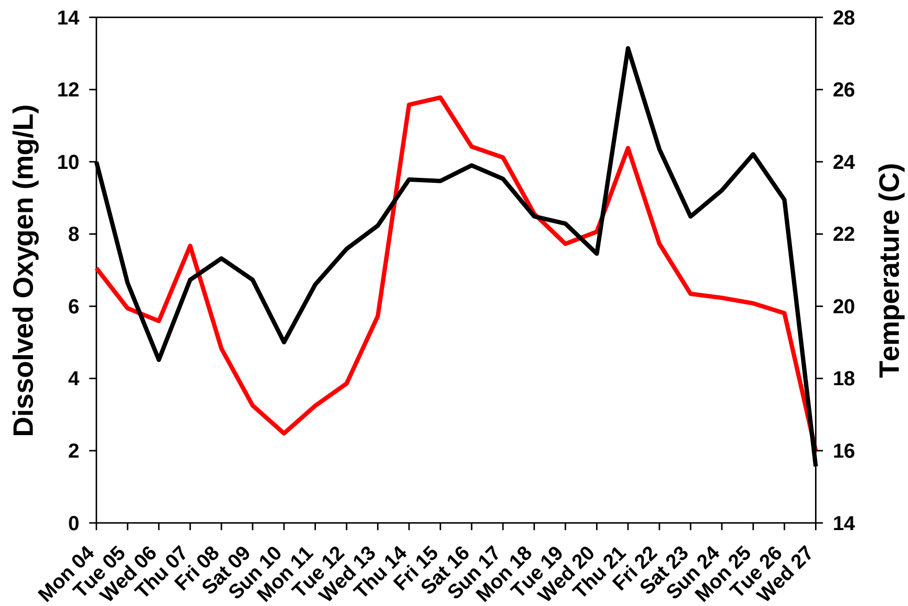

Figure 6. Mean daily dissolved oxygen concentrations (red line) and temperature (black line) recorded from a data logger placed in the Stewart Lake channel, several hundred meters from the outlet gate from 4-27 June 2012.

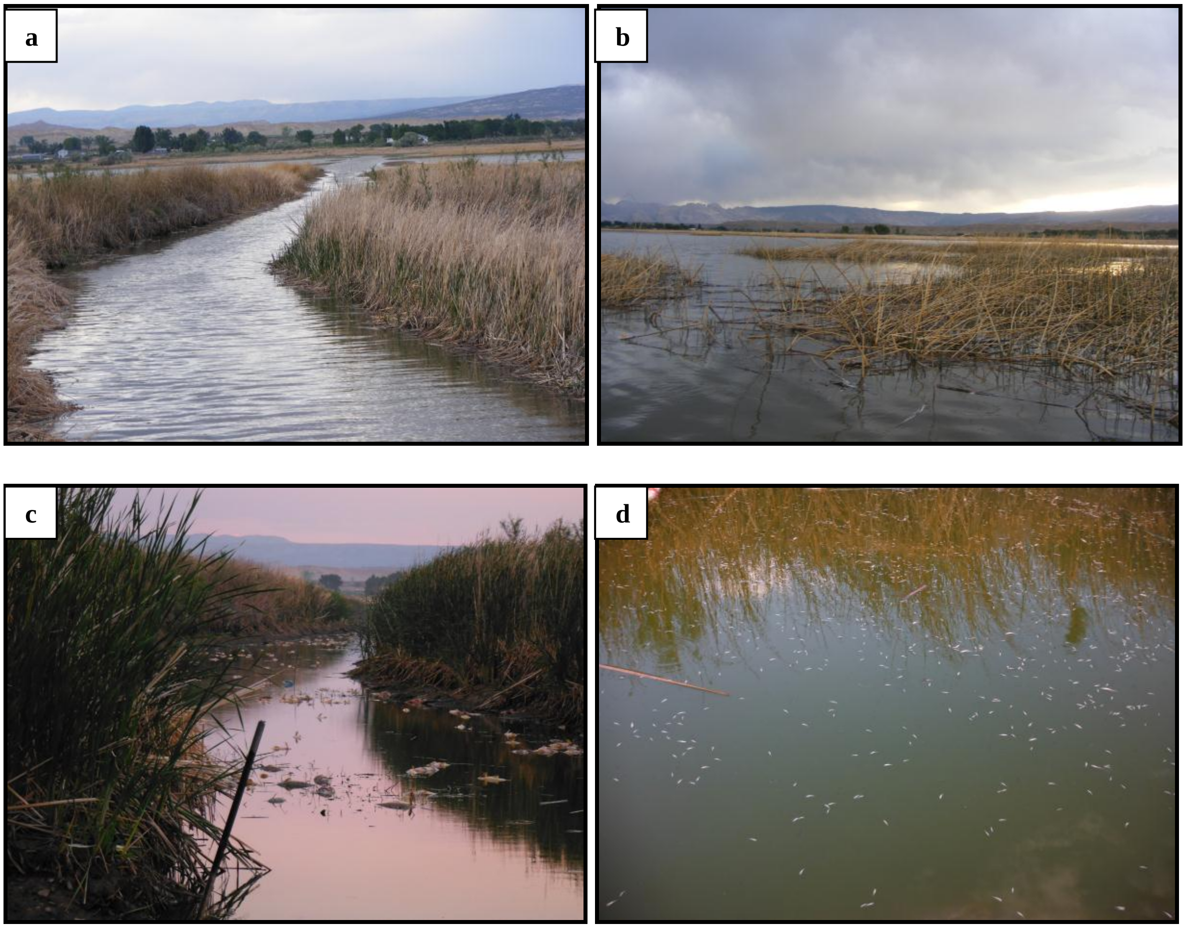

Figure 7. The Stewart Lake floodplain following initial entrainment of Green River flows on 25 May 2012 (a-b). A widespread fish kill was observed following diminished water quality conditions that affected both adult (c) and larval fishes (d).