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

II. Bureau of Reclamation Agreement Number(s): #R14AP00007

Project/Grant Period: Start date (Mo/Day/Yr): 05/01/2014
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Reporting period end date: 09/30/2015
Is this the final report? Yes _____ No __X__

III. Principal Investigator(s): Robert C. Schelly and Matthew J. Breen
Utah Division of Wildlife Resources
Northeast Regional Office
318 North Vernal Ave.
Vernal, Utah 84078
Phone: 435-219-4910; Fax: 435-789-8343
E-mail: rschelly@utah.gov

IV. Abstract:

Razorback Sucker (*Xyrauchen texanus*) larval drift coincides with high flows during spring runoff, allowing for entrainment in warm, productive floodplain nursery habitats essential for recruitment. Using floodgate structures to control flows and picket weirs to exclude large-bodied nonnative fishes, Stewart Lake was nearly filled to capacity in 2015 during the larval drift period. After entrainment for almost four months, 97 Razorback Suckers were sampled returning to the Green River during drawdown of the wetland. Under an increasing number of hydrologic scenarios, Stewart Lake continues to highlight the potential of managed wetlands for Razorback Sucker recovery under the Larval Trigger Study Plan.

V. Study Schedule: FY2012–FY2018

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 2015 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1: Install, operate and maintain a picket weir in the Stewart Lake outlet: May 8—May 28, 2014

Due to an unseasonably warm period in February of 2015, Green River flows at Jensen reached a high enough level (peaking at just over 3,500 cubic feet per second (cfs), reached in the early morning hours of 9 February) to allow inflow into Stewart Lake, where the outlet gate had been left open. Water was observed to have inundated the deepest channels, and small nonnative cyprinids were visible. At a point approaching the daily minimum Green River flow when a visible outflow was observed at the outlet gate, the gate was closed on 12 February at 16:45. It was opened again on 23 February to further drain any remaining water, and closed on 24 February around 09:45, coinciding with the Green River daily minimum flow of approximately 2,600 cfs. The gate was reopened on 26 February and 9 March to drain water pooled behind the outlet gate (on the latter date, a considerable pool had formed due to snow melt). As a result, Stewart Lake was fully drained and free of nonnative fishes by March, ahead of picket weir installation and filling in May.

Light trapping for Razorback Sucker larvae in the middle Green River by Vernal-CRFP (Project #22f) detected the first larvae on 8 May 2015—the earliest first appearance of larval razorbacks yet documented. Upon confirmation of larval drift as per the Larval Trigger Study Plan (LTSP; Larval Trigger Study Plan Ad Hoc Committee 2012), and operating under presumption of a dry hydrologic classification at this point in May (later revised due to spring precipitation), the Bureau of Reclamation began stepping up releases from Flaming Gorge Dam on 11 May 2015, culminating in a peak release of approximately 8,000 cfs (as measured at the USGS Greendale gage: 09234500) on 14 May 2014 (Figure 1). The peak flow target at Jensen was set at 14,000 cfs, which was ultimately exceeded. Maximum releases were maintained for 7 days, with step-down releases beginning on 21 May 2015. An unexpected, prolonged surge in Yampa River flows following an initial peak led to a Green River spring peak flow of 15,800 cfs (provisional), recorded early on the evening of 21 May at Jensen (USGS gage: 09261000).

Complementary to the Green River light trapping by Vernal-CRFP, we (UDWR) began deploying light traps in Stewart Lake to document larval entrainment beginning on 9 May 2015 and continuing through 29 May 2015. Trapping locations included the outlet

channel adjacent to the wetland, and ultimately the entire length of the deep channel inside Stewart Lake, as well as locations around the periphery of the open water portion of the wetland and the inlet channel. As filling of the wetland progressed, up to 14 light traps were deployed every night. Presumptive Razorback Suckers were identified among these samples, though possibly at lower densities than in 2014 (this observation is presently anecdotal). High turbidity during a substantial portion of the filling phase, both inside the wetland and in the Green River, may have diminished the effectiveness of light traps due to reduced visibility. A full analysis of 2015 light trapping results, however, including comparisons with catch rates in previous seasons, awaits identification of Razorback Sucker larvae in these samples by the Larval Fish Laboratory (Colorado State University).

Filling of Stewart Lake began at 10:15 on 9 May 2015 with the opening of the outlet gate (see Figure 1). At 15:00, two Biomark 27" x 13" O.D. flat plate antennas wired to Biomark FS2001F-ISO PIT-tag readers were deployed in the outlet channel (approximately 50 feet from the picket weir) were activated to detect any PIT-tagged fishes attempting to enter the wetland during filling. The purpose of this deployment was to test whether low catch rates of adult endangered fishes in the trap during filling in 2013 and 2014 (Skorupski et al. 2013, Schelly et al. 2014) were an artifact of trap avoidance, or an accurate reflection of limited attempts by large bodied native fishes to enter the wetland during filling. On account of these negligible catch rates of endangered fishes, no in-trap was deployed in 2015: an exclusionary picket weir alone (Figure 2) was used to exclude all large-bodied fishes that would otherwise invade the wetland in large numbers (see Breen and Skorupski 2012). Anticipating a short duration of sufficiently high Green River flows to maintain connection with Stewart Lake during filling, the inlet gate, also outfitted with an exclusionary picket weir (Figure 3), was opened at 16:15 in the hope of achieving maximum possible fill. As Yampa River flows declined prior to the arrival of increased Flaming Gorge releases at Jensen, the Green River dropped below the equilibrium level of Stewart Lake at 19:00 on 10 May 2015, and the outlet gate was closed. The outlet gate was reopened at 10:00 on 11 May 2015, closed again at 10:00 on 12 May 2015 upon return to equilibrium, and then opened again at 08:15 on 14 May 2015 as the arrival of increased Flaming Gorge releases at Jensen compensated for declining Yampa River flows. From this point on until 20 May 2015, rising Green River levels allowed for continuous filling of Stewart Lake using both inlet and outlet gates, making occasional adjustments at each gate so that flows would not threaten the integrity of weir structures. At 10:22 on 20 May 2015, the outlet gate was closed as equilibrium was reached, and the (higher elevation) inlet gate was opened further to achieve maximum fill in the wetland. With unexpectedly increasing Yampa flows fueling a late pulse in the Green River, the outlet gate was reopened at 16:30 on 21 May 2015 and finally closed at 08:55 on 22 May 2015. Bolstered by Yampa River flows compensating for declining Flaming Gorge releases, Green River levels remained high enough to continue filling via the Stewart Lake inlet gate for another six days, until 07:55 on 28 May 2015. Careful management of inlet and outlet gates allowed us to fill Stewart Lake to within about 10 cm of the maximum fill achieved in 2014, despite a considerably lower Green River spring peak (Figure 4).

During the 11 days of filling through the outlet channel, the flat plate antennas logged 28 unique PIT tag detections, mainly Razorback Sucker, that had navigated up the Stewart

lake outlet channel to approach the picket weir (Table 1). This confirmed our earlier hypothesis that low catch rates at in-traps used during filling were due to trap avoidance. Although some PIT tag histories are yet to be determined, we detected a Razorback Sucker from the 1995 year class, and another individual that was last encountered in 2006. The best represented year class (n = 8) was 2008 (stocked in 2009). Eight fish were detected on multiple days during the period of filling, with two individuals detected repeatedly over a period of eight and nine days, respectively. Evidently, if a more suitable fish trap could be designed for use during filling, numerous adult Razorback Suckers would make use of available wetland habitat during inundation.

Despite approximately 1.5 feet of emergent picket weir posts above the water level, Common Carp were observed jumping over the weir to enter Stewart Lake on 17 May 2015. Extensions made of wire mesh and seine nets were added to prevent further incursion by jumping adult nonnative fishes. Nevertheless, scores of adult carp and at least one adult Northern Pike were later determined to have entered the wetland.

Task 2: Sample the fish community in the Stewart Lake wetland and monitor post-connection water quality and habitat parameters: May 11—August 25, 2014

Having observed one adult Northern Pike and numerous adult Common Carp in Stewart Lake after jumping the picket weir, and not yet aware of large-bodied natives, an assortment of fyke, trammel, and gill nets were set overnight on 26 May near the outlet gate and in the deep main channel. (Age-0 Razorbacks were assumed to be too small for capture by these methods.) Five carp were captured in gill nets on 28 May, and seven carp in trammel and gill nets on the 29 May. Another overnight trammel net set on 5-6 July caught an additional 14 adult carp, and surprisingly caught four hatchery-raised Bonytail, only one of which survived. Upon realization that some adult endangered fishes had breached the exclusionary weir during filling (probably also by jumping), all subsequent gill and trammel netting was suspended.

Sampling for Razorbacks began with seining--an effective sampling method in 2014--from 29 June - 1 July (after allowing approximately one month of undisturbed growth in the wetland). Seining was abandoned as ineffective after the first week (due to high densities of submergent aquatic macrophytes impeding pulling ability), but sampling with fyke and hoop nets continued on a bi-weekly basis (14-16 July; 27-28 July; 10-11 August; 24-25 August) until draining began on 1 September. During the 14-16 July sampling period four hoop nets (baited with dog food) were deployed along with a single directional fyke net. On 27 July, two directional fyke nets (each with a 50' central wing extending from the middle of the net mouth and another 50' wing extending from one or the other side) and two standard fyke nets (with only a central wing, up to ~30' long, extending from the middle of the net mouth) were deployed. As only the large directional fyke nets were successful at capturing small numbers of Razorbacks, those two nets alone were deployed during the remaining two August sampling periods. A map of these sampling sites is provided in Figure 5. Throughout this sampling phase, capture rates were low, resulting in only 20 total captures of age-0 Razorbacks (see Table 2). Directional fyke nets did reveal the presence of age-1 Razorbacks in the wetland (with nine total captures), which along with the Bonytail were assumed to have jumped the picket weir before a height extension was added during filling.

To help maintain inundated habitat and prevent deterioration of water quality, two cfs of supplemental water, delivered through the Burns Bench intake structure, was requested from the Uintah Water Conservancy District on 1 June 2015, with a request for an increase to 5 cfs on 29 June 2015. Delivery of supplemental water continued, with occasional interruptions during periods of high demand within the system, until the end of August. Throughout the period of inundation, up to five mini-DOT (dissolved oxygen and temperature) loggers were deployed at multiple depths in the water column at numerous points within the wetland to monitor water quality. Continuous loggers revealed dissolved oxygen levels consistently in the range of 6-9 mg/L in open water near the surface and in the middle of the water column, with low dissolved oxygen zones (below 1 mg/L) near the benthos or in dense vegetation. Temperatures ranged from 14-22 °C, and were typically on the upper end of this range in the upper portion of the water column during the latter period of inundation, importantly for higher growth rates in Razorback Suckers (Bestgen 2008).

Task 3: Sample fishes exiting the Stewart Lake outlet during draw down with a picket weir: September 1—September 14

A picket weir and trap box (with ~¼ inch wire mesh panels and seine attachments to prevent escapement) was installed in the outlet channel to capture exiting fishes (Figure 6), and the Stewart Lake outlet gate was opened for draining on 1 September 2015. Draining was completed on 13 September 2015. Whereas in 2014, fish sampling alternated with periods of unsampled free releases (Schelly et al. 2014), this year sampling continued without interruption even in the absence of 24/7 staffing. The removable trap door remained closed for the duration of draining, with the exception of daily cleaning periods--lasting only a few minutes--when it was pulled out to scrape off accumulated debris, including small dead nonnative fishes stuck in the mesh. During these brief cleanings, the outlet gate was closed and flows were reduced to a trickle. Sampling of larger fishes emigrating from the wetland was thus considered to be comprehensive, not just an incomplete snapshot. Regular netting sweeps of the trap were performed during peak fish emigration periods (morning and afternoon/evening), and flows were slightly reduced overnight to prevent fish mortality in the trap while it was left unstaffed. The accumulated overnight catch was then netted during morning shifts.

Sampling and handling protocols were similar to those employed in 2014. With each net sweep of the trap, native species were segregated out and kept in buckets of fresh water, while nonnative species were collected in coolers. Native fishes of larger sizes were scanned for PIT tags and measured (TL), and untagged Razorback Suckers deemed large enough were implanted with PIT tags (63 fish total, see Table 3). All native fishes were released into the outlet channel downstream of the fish trap and weir. Nonnative fishes were subsampled by volume to estimate total numbers, then disposed of in a pit. After thoroughly mixing the sample, a plastic container was used to scoop a consistent volume of fish from the cooler, and the number of scoops was enumerated. One scoop was poured out and every fish was identified and counted, and the counts from that subsample scoop were multiplied by the total number of scoops taken from the cooler to arrive at an estimate of total fish numbers. In addition, series of at least 20 individuals of each species were measured (TL) during each netting shift.

With uninterrupted sampling in 2015, the total estimated number of fishes trapped during 13 days of draining was 371,990 (comprising 371,866 nonnatives and 124 natives; Table 2; Figures 7 and 8). Notably, the relative species composition of the nonnative component shifted dramatically this year compared to 2014. This was mainly a result of an explosion of Green Sunfish in 2015, constituting 33% of the total fishes processed at draining (n = 121,501). In striking contrast, Green Sunfish were a negligible component of the 2014 Stewart Lake sample (n = 329; Schelly et al. 2014).

Curiously, fewer (n = 87) age-0 Razorback Suckers were sampled during the draining of Stewart Lake in 2015 than in previous years (n = 729 in 2014, n = 579 in 2013). Some possible explanations include reduced densities of drifting larvae related to the record-breaking early date of larval first appearance, or increased predation on larval Razorbacks early in the inundation phase by the extremely high numbers of Green Sunfish documented in the system this year. The first possibility can be explored following analysis of 2015 samples by the Larval Fish Lab; the second calls for further investigation. Despite the smaller sample size, the mean total length of the 2015 Stewart Lake Razorback class at draining was 107 mm, 10 mm longer than the mean total length in 2014 (Figure 9), demonstrating the benefit of even a few extra weeks of entrainment for maximizing growth.

Of the five age-1 Razorbacks that circumvented the picket weir to enter Stewart Lake and were PIT-tagged during fyke net sampling (3D9.1C2C2D8F8D, 3D9.1C2C2D451D, 3D9.1C2C2D89B5, 3D9.1C2C2DA787, 3D9.1C2C2DE0D5), only two were recaptured amongst the nine age-1 fish handled during draining (see Table 3), leaving three individuals unaccounted for. Possible explanations include mortality, either prior to draining or resulting from failure to emigrate from the wetland during draining, avoidance of capture during draining via escape through the weir and fish trap structure, or shedding of the implanted tag. Additionally, at least five Bonytail also found their way through or over the weir and into Stewart Lake. Three of these (3DD.003BC1AB40, 3DD.003BC1A5D1, 3DD.003BC1A8DE) suffered mortalities in trammel nets set to target adult carp on 6 July 2015, and two were sampled and released alive during draining (3DD.003BC1B0CD, 3DD.003BC1ABE6). One of these Bonytail was detected by the flat plate antenna during filling (see Table 1).

Task 4: Data entry, analysis and reporting

Recovery Program annual progress report submitted in November 2015.

VIII. Additional noteworthy observations:

- The combined evidence from the flat plate antenna and the captures of large-bodied Razorbacks and Bonytail that evidently jumped the picket weir to enter Stewart Lake supports the notion that off-channel wetland habitats are important throughout the lives of these species.
- Early in the spring, age-1 Razorbacks were repeatedly captured while electrofishing in Stewart Drain, but they were not sampled in the main channel later in the season during Smallmouth Bass removal. Consistent with the above, this suggests the importance of

off-channel wetland habitats to Razorbacks even in their second year and beyond (e.g., Hedrick et al. 2012) .

- Supplemental water delivery into late August may have helped prevent water quality deterioration in the final hours of draining, as no fish die-off was observed this year, in contrast to 2014.

IX. Recommendations:

- With the controlled-wetland model now successfully in operation at both Stewart Lake and Johnson Bottom, continue to investigate the potential for installation and operation of gated control at additional wetlands (i.e. Stirrup).
- Explore new, low-cost fish trap designs that address the problem of avoidance by large native fishes attempting to enter Stewart Lake during filling, so that native species could be selectively allowed to enter the wetland.
- Extend height of picket weirs to prevent jumping by adult nonnatives, including Common Carp and Northern Pike. This modification would incur additional expenses for materials and equipment.
- Investigate further the problem of Green Sunfish proliferation and its possible relationship to suppression of Razorback numbers, considering both in the context of annual environmental conditions including flows and winter temperatures, and research possible Green Sunfish control measures.
- Investigate the potential for nonnative fishes (specifically Green Sunfish) to enter Stewart Lake through the supplemental water delivery system, and consider screening options if necessary.
- Measure turbidity during light trapping to assess effects of reduced visibility on capture rates.
- With the increase in mean length of the 2015 Stewart Lake Razorback class after several additional weeks of entrainment, we continue to recommend prolonging entrainment as long as possible, within the constraints of selenium remediation protocols, to maximize Razorback growth.
- One of our older model Biomark FS2001F-ISO PIT tag readers failed to detect a tag immediately after implantation in an age-1 Razorback during fyke netting, leading us to suspect that the tag had been lost. During draining, this tag was successfully detected in the fish upon recapture. Given the potential for double-tagging fish with some of our older PIT tag reading equipment (this not being an isolated event), an upgrade would be advisable.

X. Project Status:

On track and ongoing.

XI. FY 2015 Budget Status

A. Funds Provided: $45,178
B. Funds Expended: $45,178
D. Percent of the FY 2015 work completed, and projected costs to complete: 100%
E. Recovery Program funds spent for publication charges: $0

XII. Status of Data Submission (Where applicable):

We will submit our data to the Recovery Program database manager in December 2015.

XIII. Signed: *Robert C. Schelly* 11/12/15
Principal Investigator Date

XIV. References:

Bestgen, K.R. 2008. Effects of water temperature on growth of razorback sucker larvae. *Western North American Naturalist* 68(1): 15-20.

Breen, M.J. and J.A. Skorupski Jr. 2012. Use of the 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.

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

Hedrick, T.N., A.R. Breton, and S.P. Keddy. 2012. Razorback sucker survival and emigration from the Stirrup floodplain, middle Green River, Utah 2007-2010. Publication Number 12-10. Final report submitted to the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Denver, CO.

Schelly, R.C., J.T. Herdmann, and M.J. Breen. 2014. 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.

Skorupski, J.A., Jr., I. Harding, and M.J. Breen. 2013. 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.

400 kHz tag	134 kHz tag	Species	Year Class	Last Encounter: Type	Year	River
423E413E55	3D91BF18E2716	*Xyrauchen texanus*		Capture	4/3/2006	Green River
44750A6B3C	3D91BF1FF5A8A	*Xyrauchen texanus*		Capture	6/3/2008	Green River
7F7D78363E	3D91BF24CC146	*Xyrauchen texanus*	1995	Capture	5/5/2011	Green River
	3D91C2C2D77DE	*Xyrauchen texanus*		Capture	9/28/2009	Green River
	3D91C2C2D9A5D	*Xyrauchen texanus*	2006	Capture	5/23/2011	Green River
	3D91C2C2DB4BB	*Xyrauchen texanus*	2007	Stocking	9/23/2008	Green River
	3D91C2C2DE437	*Xyrauchen texanus*	2007	Capture	5/23/2011	Green River
	3D91C2C2DE5A1	*Xyrauchen texanus*	2007	Capture	4/14/2012	Green River
	3D91C2C3EF277	*Xyrauchen texanus*	2008	Stocking	9/15/2009	Green River
	3D91C2C3F05F7	*Xyrauchen texanus*	2008	Stocking	9/23/2009	Green River
	3D91C2C3F08E7	*Xyrauchen texanus*	2008	Stocking	9/23/2009	Green River
	3D91C2C444E7D	*Xyrauchen texanus*	2008	Stocking	10/2/2009	Green River
	3D91C2C445040	*Xyrauchen texanus*	2008	Stocking	9/30/2009	Green River
	3D91C2C53973B	*Xyrauchen texanus*	2008	Stocking	9/15/2009	Green River
	3D91C2C53B2AB	*Xyrauchen texanus*	2008	Stocking	9/15/2009	Green River
	3D91C2D5A9192	*Xyrauchen texanus*	2008	Stocking	10/5/2009	Green River
	3D91C2D5B39BE	*Xyrauchen texanus*	2009	Stocking	9/13/2010	Green River
	3D91C2D9A2C40	*Xyrauchen texanus*	2009	Capture	8/15/2013	Green River
	3D91C2D9A87A0	*Xyrauchen texanus*	2009	Capture	4/12/2011	Green River
	3D91C2D9B0302	*Xyrauchen texanus*	2010	Capture	4/11/2012	Green River
	3D91C2DD8F5C6	*Xyrauchen texanus*	2011	Stocking	9/11/2012	Green River
	3D91C2C2D421D	?				
	3D91C2C2D52F3	?				
	3D91C2C2D5B6B	?				
	3DD003BC1AAB8	?				
	3DD003BC1AB40	*Gila elegans*		Capture	7/6/2015	Stewart Lake
	3DD003BC1AE3B	?				
	3DD003BC1B389	?				

Table 1. PIT-tags detected by flat-plate antennae deployed in channel leading to the Stewart Lake outlet gate during filling of Stewart Lake (5- 22 May 2015). Data (for all but *Gila elegans*) retrieved on 11 September 2015 from STReaMS (Species Tagging, Research and Monitoring System) at *https://streamsystem.org/*.

Species	Seining / Fyke netting				Draining			
	# Sampled	% Comp.	TL (mm) Mean ± SD	TL (mm) Range	# Sampled	% Comp.	TL (mm) Mean ± SD	TL (mm) Range
Black Bullhead	888	2.66	57.4 ± 20.3	37-222	1039	0.28	66.9 ± 12.7	42-130
Brook Stickleback	49	0.15	41.0 ± 2.7	39-45	489	0.13	50.3 ± 4.8	42-61
Bonytail	3	0.0090	276.7 ± 22.0	262-302	2	0.0005	327 ± 2.89	325-329
Catostomus sp. (native)	1	0.0030	50	-	6	0.0016	78.7 ± 10.3	63-94
Channel Catfish	-	-	-	-	5	0.0013	405.6 ± 173.4	103-540
Common Carp	13246	39.73	58.1 ± 18.7	19-183	98071	26.36	64.8 ± 16.1	47-183
Creek Chub	1	0.0030	125	-	1	0.0003	139	-
Fathead Minnow	7980	23.94	47.8 ± 10.1	18-70	146244	39.31	51.0 ± 7.6	32-85
Gila sp.	-	-	-	-	19	0.0051	49.7 ± 6.8	37-64
Green Sunfish	9876	29.62	47.2 ± 22.4	17-145	121501	32.66	59.9 ± 19.5	35-151
Iowa Darter	-	-	-	-	1	0.0003	49	-
Northern Pike	-	-	-	-	1	0.0003	700	-
Razorback Sucker (age-0)	20	0.060	78.9 ± 16.1	54-109	87	0.0234	107.4 ± 16.4	75-152
Razorback Sucker (age-1)	9	0.027	252.2 ± 28.1	195-282	10	0.0027	277.9 ± 25.0	245-315
Red Shiner	1089	3.26	56.6 ± 11.0	30-81	4161	1.12	55.4 ± 10.4	30-86
Redside Shiner	-	-	-	-	8	0.002	64.4 ± 2.8	61-70
Sand Shiner	138	0.42	49.7 ± 9.8	34-75	169	0.045	51.9 ± 4.7	42-61
White Sucker	8	0.024	185.1 ± 58.4	121-273	175	0.047	119 ± 45.3	56-260
White Sucker X Flannelmouth	-	-	-	-	1	0.0003	67	-
TOTAL	33305				371990			

Table 2. Percent composition of various species and their size ranges during the two 2015 Stewart Lake sampling phases: seining / fyke-netting and draining. (Does not include adult Common Carp targeted early in the entrainment period or stranded at the conclusion of draining, totaling approximately 40 individuals.)

PIT tag #	Date	TL (mm)	Year class	PIT tag #	Date	TL (mm)	Year class
3DD.003BCC915E	9/2/2015	277	2014 (age-1)	3DD.003BCC915D	9/12/2015	96	2015 (age-0)
3DD.003BCC915F	9/3/2015	266	2014 (age-1)	3DD.003BCC9134	9/12/2015	98	2015 (age-0)
3DD.003BCC9159	9/3/2015	298	2014 (age-1)	3DD.003BCC9104	9/12/2015	100	2015 (age-0)
3D9.1C2C2D451D	9/6/2015[1]	312	2014 (age-1)	3DD.003BCC911C	9/12/2015	100	2015 (age-0)
3DD.003BCC9160	9/7/2015	119	2015 (age-0)	3DD.003BCC9130	9/12/2015	100	2015 (age-0)
3DD.003BCC9163	9/7/2015	245	2014 (age-1)	3DD.003BCC9145	9/12/2015	102	2015 (age-0)
3DD.003BCC9149	9/7/2015	290	2014 (age-1)	3DD.003BCC914D	9/12/2015	102	2015 (age-0)
3DD.003BCC9140	9/8/2015	115	2015 (age-0)	3DD.003BCC912A	9/12/2015	105	2015 (age-0)
3DD.003BCC9164	9/8/2015	120	2015 (age-0)	3DD.003BCC9161	9/12/2015	106	2015 (age-0)
3DD.003BCC9135	9/8/2015	130	2015 (age-0)	3DD.003BCC9122	9/12/2015	110	2015 (age-0)
3DD.003BCC9128	9/8/2015	268	2014 (age-1)	3DD.003BCC910D	9/12/2015	111	2015 (age-0)
3DD.003BCC915B	9/9/2015	118	2015 (age-0)	3DD.003BCC914F	9/12/2015	116	2015 (age-0)
3DD.003BCC913F	9/9/2015	122	2015 (age-0)	3DD.003BCC9144	9/12/2015	120	2015 (age-0)
3DD.003BCC915C	9/9/2015	248	2014 (age-1)	3DD.003BCC913D	9/12/2015	121	2015 (age-0)
3DD.003BCC9136	9/10/2015	99	2015 (age-0)	3DD.003BCC9111	9/12/2015	123	2015 (age-0)
3DD.003BCC9120	9/10/2015	101	2015 (age-0)	3DD.003BCC9166	9/12/2015	123	2015 (age-0)
3DD.003BCC914C	9/10/2015	103	2015 (age-0)	3DD.003BCC9153	9/12/2015	126	2015 (age-0)
3DD.003BCC915A	9/10/2015	107	2015 (age-0)	3DD.003BCC9135	9/12/2015[2]	130	2015 (age-0)
3DD.003BCC912B	9/10/2015	108	2015 (age-0)	3DD.003BCC9151	9/12/2015	131	2015 (age-0)
3DD.003BCC9125	9/10/2015	115	2015 (age-0)	3DD.003BCC911E	9/12/2015	132	2015 (age-0)
3DD.003BCC9139	9/10/2015	115	2015 (age-0)	3DD.003BCC9167	9/12/2015	133	2015 (age-0)
3DD.003BCC9141	9/10/2015	122	2015 (age-0)	3DD.003BCC9112	9/12/2015	146	2015 (age-0)
3DD.003BCC9154	9/10/2015	138	2015 (age-0)	3DD.003BCC9162	9/12/2015	152	2015 (age-0)
3DD.003BCC9121	9/10/2015	315	2014 (age-1)	3D9.1C2C2DE0D5	9/12/2015[3]	260	2014 (age-1)
3DD.003BCC9138	9/11/2015	104	2015 (age-0)	3DD.003BCC911A	9/13/2015	92	2015 (age-0)
3DD.003BCC9142	9/11/2015	107	2015 (age-0)	3DD.003BCC9106	9/13/2015	97	2015 (age-0)
3DD.003BCC914B	9/11/2015	107	2015 (age-0)	3DD.003BCC9132	9/13/2015	100	2015 (age-0)
3DD.003BCC9158	9/11/2015	107	2015 (age-0)	3DD.003BCC912E	9/13/2015	109	2015 (age-0)
3DD.003BCC914E	9/11/2015	116	2015 (age-0)	3DD.003BCC9116	9/13/2015	110	2015 (age-0)
3DD.003BCC9152	9/11/2015	119	2015 (age-0)	3DD.003BCC9155	9/13/2015	113	2015 (age-0)
3DD.003BCC9126	9/11/2015	132	2015 (age-0)	3DD.003BCC9148	9/13/2015	118	2015 (age-0)
3DD.003BCC9150	9/12/2015	84	2015 (age-0)	3DD.003BCC9123	9/13/2015	120	2015 (age-0)
3DD.003BCC913E	9/12/2015	90	2015 (age-0)	3DD.003BCC9115	9/13/2015	121	2015 (age-0)

Table 3. Razorback Suckers PIT-tagged during the 2015 draining of Stewart Lake.

[1]Second recapture; tagged 7/28/15 during fyke netting, recaptured 8/12/15 during fyke netting.
[2]Recapture; tagged 9/8/15 during draining, somehow navigated back above fish trap.
[3]Recapture; tagged 8/25/15 during fyke netting.

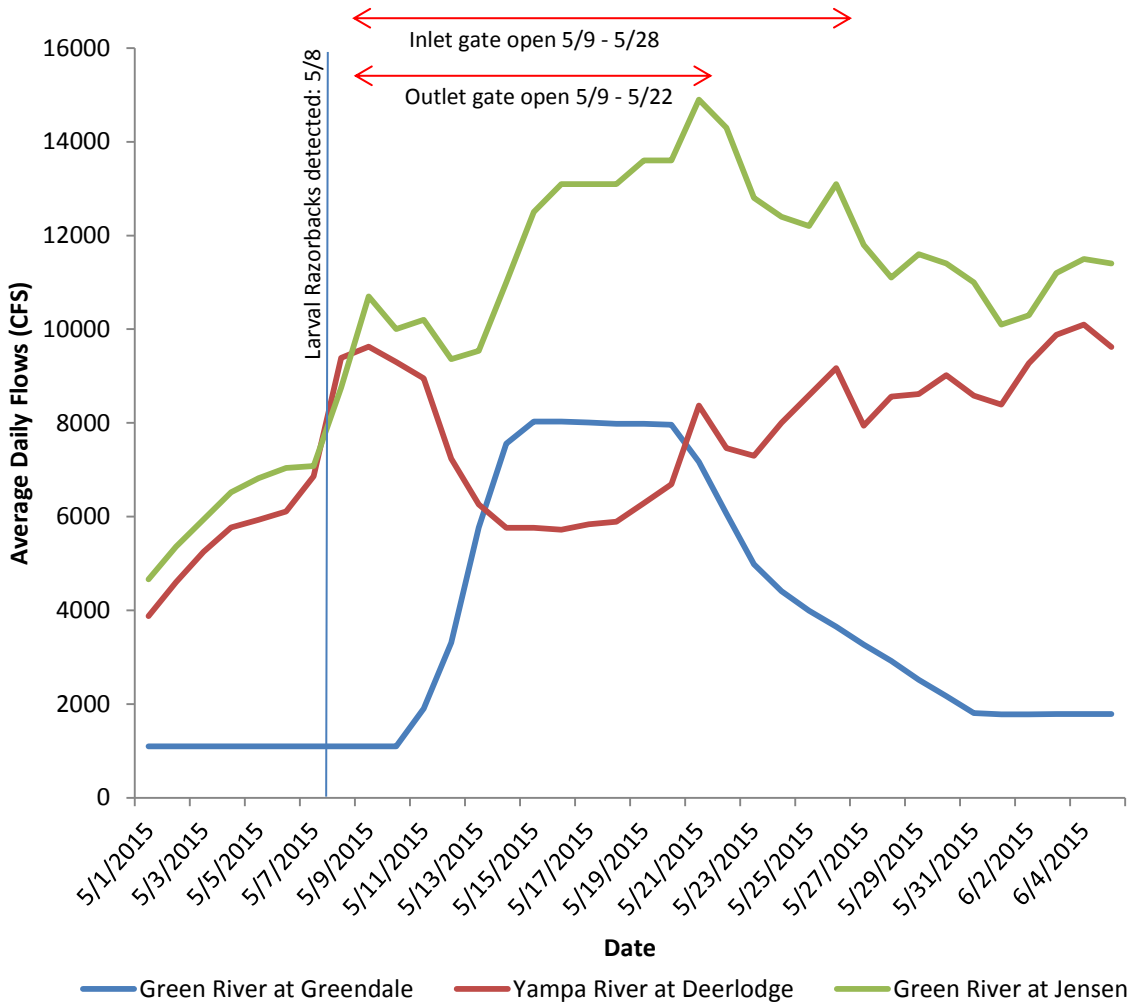

Figure 1. Hydrograph of 2015 spring flows under the Larval Trigger Study Plan, with first detection of drifting Razorback Sucker larvae and the Stewart Lake filling period highlighted. Flow data originates from USGS gages 09261000 (Jensen), 09260050 (Deerlodge), and 09234500 (Greendale).

Figure 2. Configuration of picket weir (located at the outlet structure), showing seine nets attached to extend weir height and flat plate antenna control box visible in the outlet channel, during the 2015 filling of Stewart Lake.

Figure 3. Picket weir installed at the Stewart Lake inlet gate.

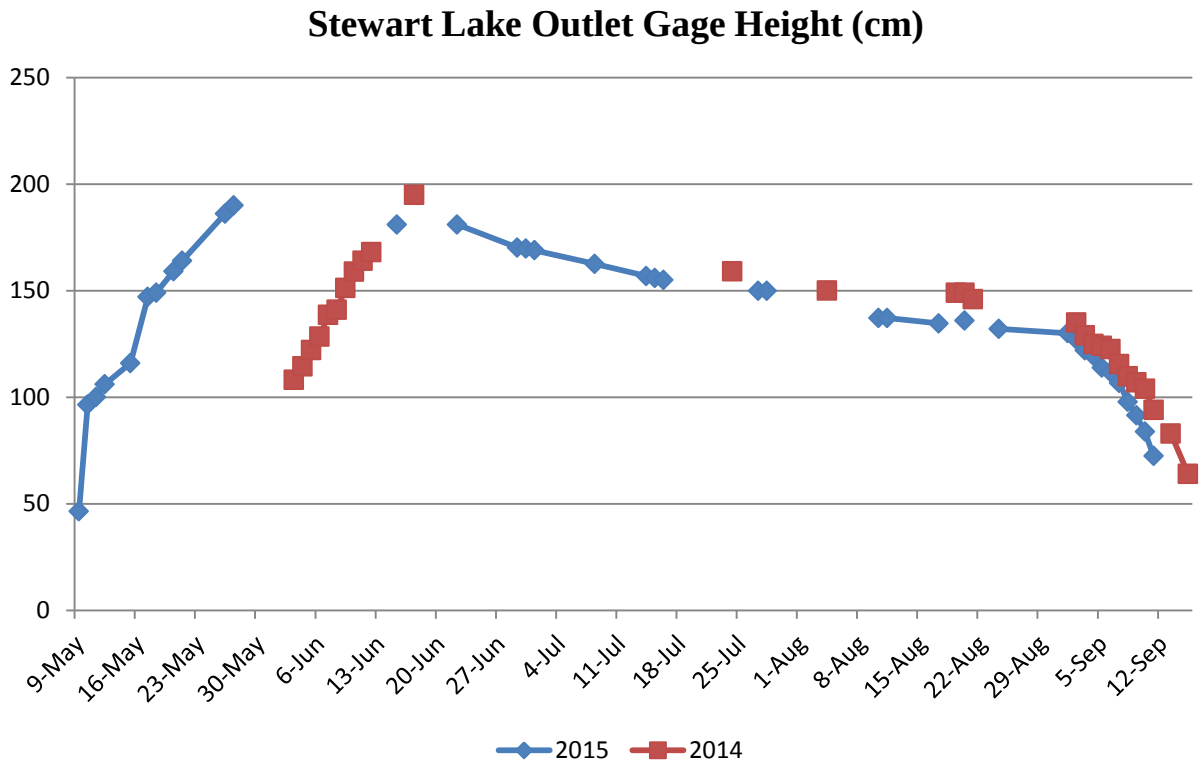

Figure 4. Depth measurements at the Stewart Lake outlet structure during the periods of filling, inundation, and draining in 2014 and 2015.

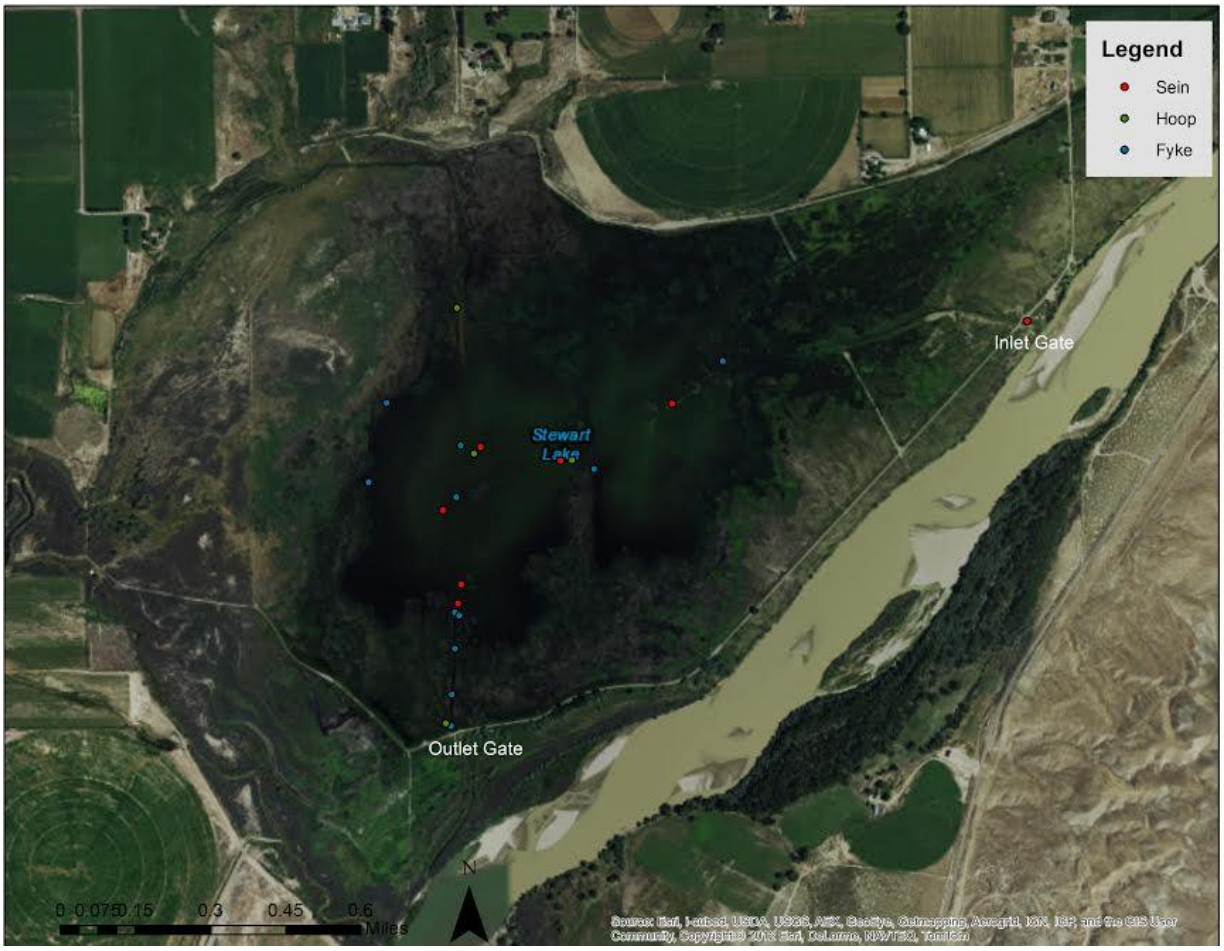

Figure 5. Map of Stewart Lake wetland showing inlet and outlet gates and seining, hoop netting, and fyke netting localities.

Figure 6. Fish trap and picket weir used to sample fishes at the outlet gate during Stewart Lake draining.

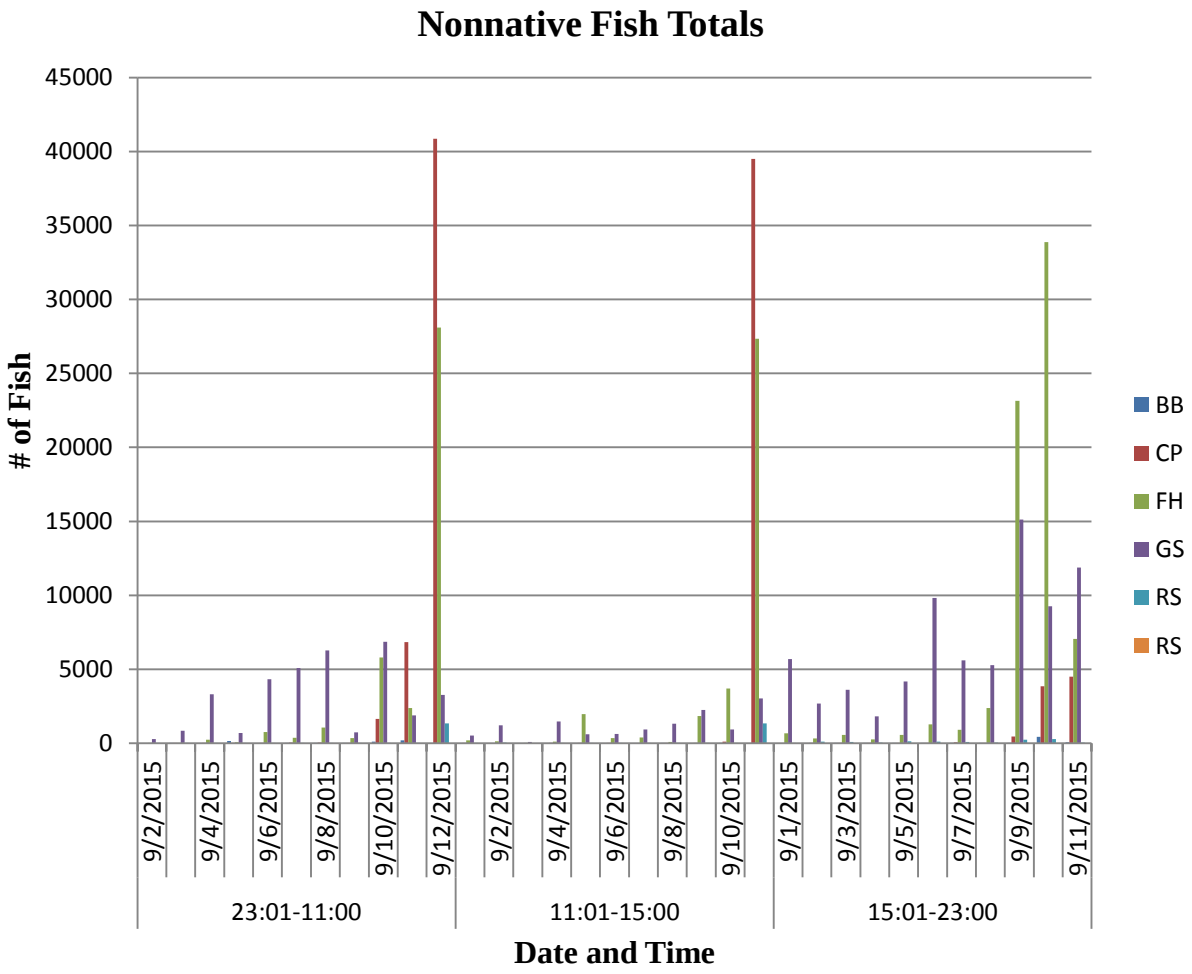

Figure 7. Nonnative emigration trends through 2015 Stewart Lake draining illustrated by total numbers sampled of predominant species through time.

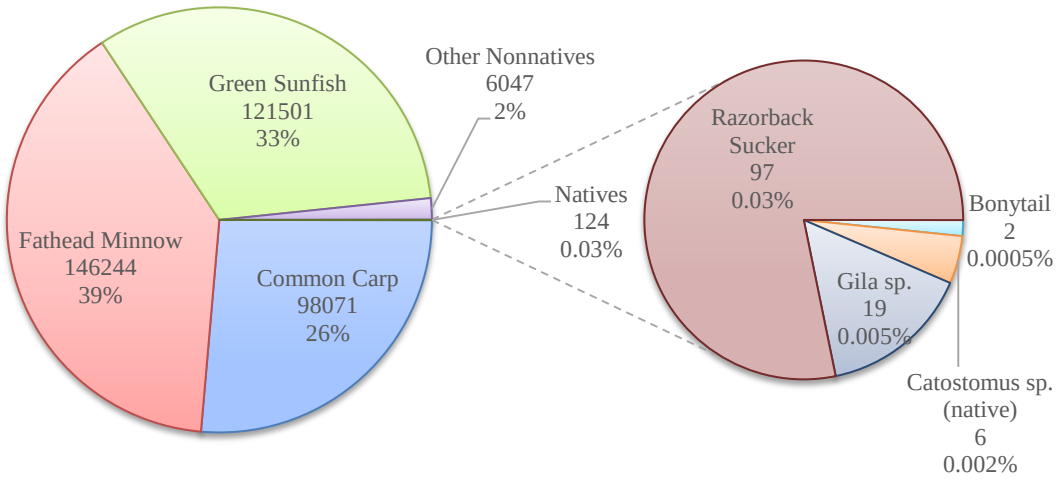

Figure 8. Relative species composition during 2015 Stewart Lake draining for all species (left), with relative composition of native species detailed in the smaller pie (right).

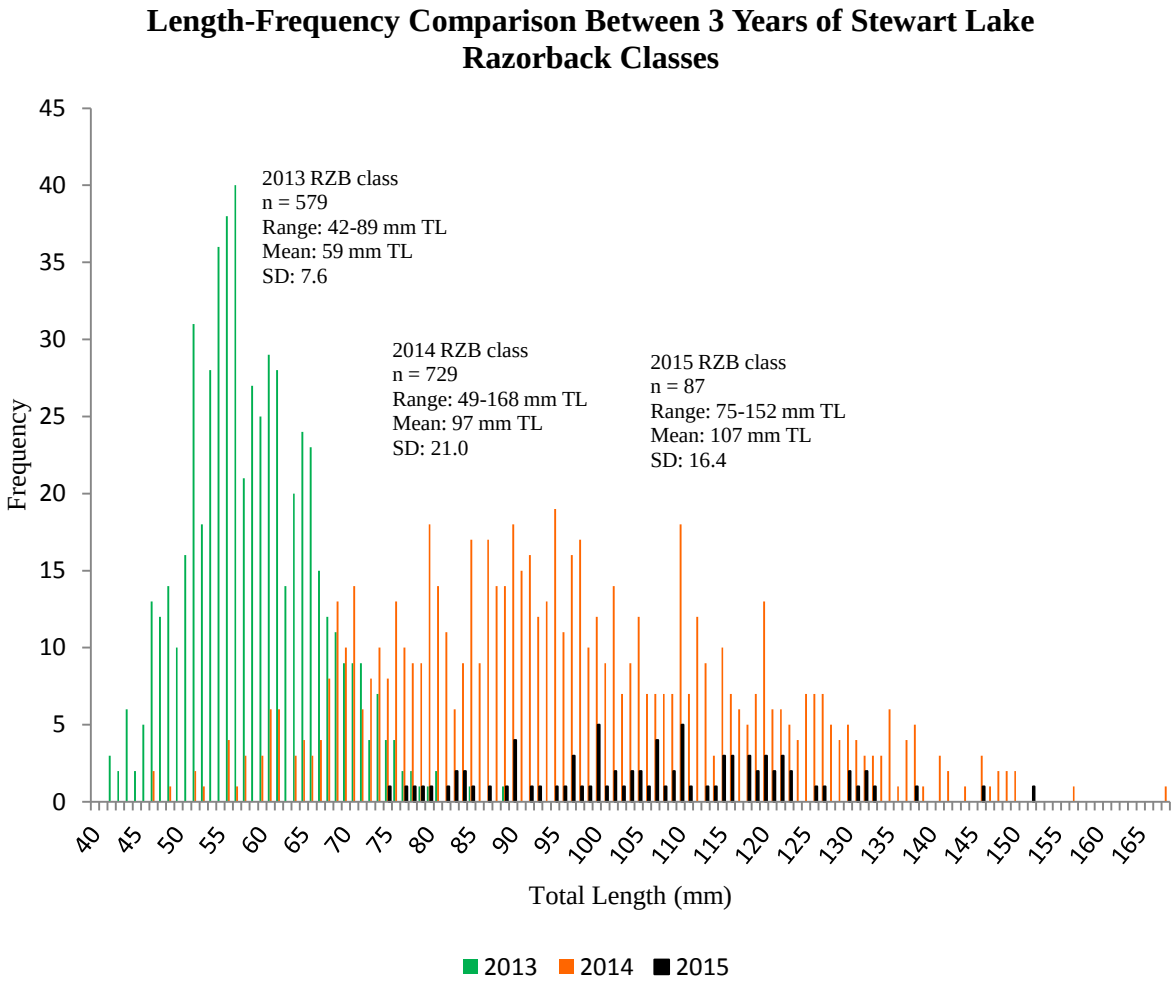

Figure 9. Comparative histogram of Razorback Sucker size classes sampled during Stewart Lake draining in 2013, 2014, and 2015. Note that only age-0 fish are included here; the 10 age-1 Razorbacks sampled in 2015 are not shown.

Wild-spawned Razorback Suckers (age-1 top, age-0 bottom) from 2015 Stewart Lake draining