COLORADO RIVER RECOVERY PROGRAM
FY 2016 ANNUAL PROJECT REPORT

RECOVERY PROGRAM
PROJECT NUMBER: 169

I. Project Title: Detecting endangered fishes using PIT tag antenna technology in the Upper Colorado River Basin

II. Bureau of Reclamation Agreement Number: R15PG00083

Project/Grant Period: Start date: 10/01/2014
End date: 09/30/2019
Reporting period end date: 09/30/2016
Is this the final report? Yes _____ No _X__

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IV. Abstract:

Portable PIT tag antennas allow researchers to detect PIT-tagged fish in remote locations with minimal infrastructure, labor, or maintenance. During 2016, the Green River Basin Fish and Wildlife Conservation Office deployed portable antennas at three known spawning locations in the Green and Yampa Rivers in Dinosaur National Monument (Figure 1) with the intention of detecting as many endangered razorback sucker, Colorado pikeminnow, and bonytail as possible. Out of 3,388 detections, we were able to identify 1,080 individual or unique tags. These unique tags represented 973 razorback sucker, 45 Colorado pikeminnow, 17 bonytail, 15 roundtail chub, 19 flannelmouth sucker, four bluehead sucker, and one razorback x flannelmouth sucker hybrid (Figure 2).

V. Study Schedule: 2012-ongoing.

VI. Relationship to RIPRAP**:**
General Recovery Program Support Action Plan
V.A.1.a.(2). Investigate improving recapture rates through passive PIT tag monitoring, nets, etc. to improve population abundance estimates.
Green River Action Plan**:** Mainstem
V.D.1. Implement razorback sucker monitoring plan.

VII. Accomplishment of FY 2016 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Razorback Bar

Five stand alone or "submersible" antennas were deployed on 8 April at Razorback Bar on the Green River, where the majority of PIT tag detections in this study have occurred (Figure 2, Smith et al. 2015 Figure 2). Two antennas were moved to Echo Park Bar on the Yampa River on 14 April, and the other three remained at Razorback Bar until 9-June, 14 days after razorback sucker larvae were first detected in the mouth of Cliff-Creek (Jones et al. 2016).

Razorback sucker

Razorback sucker detections increased in 2016 compared to 2012 through 2015, with the majority (N = 586) of the 959 unique detections occurring during the first week of sampling. Most of these fish were stocked from 2009 to 2012 as 1+ year olds. Additionally, razorback suckers that have been at large longer than 4.5 years comprised a larger proportion (47%) of detections than in years past (Figure 3) and would presumably be sexually mature. The earliest stocking date of any fish detected was 9-April 2004, although it is not likely older tagged fish would be detected by these antennas. This is because the submersible antennas only read 134 kilohertz (kHz) tags which have only been in use by the hatcheries since 2004.

Sixty razorback suckers detected at Razorback Bar in 2015, 33 individuals in 2014, 44 in 2013, and 2 in 2012 were detected again in 2016. There were also six razorback suckers detected at Razorback Bar in three different years including 2016 and one individual that has been detected every year except 2015 since 2012.

Ouray National Fish Hatchery (ONFH) stocked all razorback suckers detected at Razorback Bar except for two fish that were tagged in the field by the Utah Division of-Wildlife Resources Vernal (UDWR Vernal) and two stocked at Green River, Utah by the Grand Valley Unit of ONFH. All razorback suckers were stocked in the Green River between the Split Mountain boat ramp and Green River, Utah.

Webber and Beers (2014) found that the majority (93%) of razorback sucker detected at Razorback Bar in 2012-2013 had not been previously captured during active river sampling. Similarly, 87% of razorback suckers detected in 2016 had not been captured since stocking and 80% had neither been captured nor previously detected by antennas.

In addition to increased detections, 2016 marked the first time razorback suckers that have ventured outside of the Green River Basin were observed at this spawning site. Individual movements associated with these detections involved one-way distances up to 381.5 miles from Razorback Bar (Figure 4). These detections include two razorback-suckers that were stocked at Ouray National Wildlife Refuge (ONWR) and one at Green River, Utah that were last encountered in Lake Powell in 2014 and 2015. Additionally, three razorbacks that were captured in the Colorado River in Canyonlands-National Park in 2013 and 2015 were detected at Razorback Bar in April 2016. These

detections hint at a more extensive exchange between razorback suckers in the Green and Colorado Rivers, and perhaps Lake Powell, than previously thought. Along with the recent documentation of successful spawning in Lake Powell (T. Francis, Grand Junction FWCO, personal communication), known wild recruitment in Lake Mead, and observed upstream migration into lower Grand Canyon (Albrecht et al. 2014), these records suggest that reservoirs may be more important habitat for various life stages of the species than previously thought.

Prior to the 2016 launch of STReaMS, the Recovery Program's online database, these encounter histories would have been more easily overlooked. The accessibility of this database combined with the extensive field sampling and the increasing use of PIT tag antennas throughout the Upper Colorado River Basin will likely reveal trans basin movements such as these more frequently in the future.

Other Species

Six Colorado pikeminnow were detected at Razorback Bar in 2016 which had all been previously encountered in the middle Green River or the Green River within Dinosaur-National Monument. Unlike 2015, none of the Colorado pikeminnow detected at Razorback Bar were detected at Echo Park Bar or Cleopatra's Couch bar.

We also detected bonytail stocked in 2015 by ONFH (N=3) and Colorado Parks and Wildlife (N=4), demonstrating overwinter survival, which was also observed in 2015. Three bonytail stocked by the UDWR Wahweap State Fish Hatchery at the Highway 40 bridge in Jensen (9 river miles/RM downstream), Utah in May 2016 were detected the same month at Razorback Bar.

Razorback Bar antennas also detected tags from 11 flannelmouth sucker, one bluehead sucker, one roundtail chub, and one flannelmouth x razorback sucker hybrid. All were PIT-tagged by UDWR Vernal.

Spawning Bars on the Yampa River

Using the same approach as Razorback Bar on the Green River, this project was expanded in 2015 to two locations on the Yampa River in Dinosaur National Monument by setting submersible PIT tag antennas at known spawning bars. Unlike Razorback Bar, the new sites are located within river stretches that are managed as wilderness by the National-Park Service and receive a high amount of recreational river use. The less obtrusive nature of the submersible antennas in comparison to other PIAs, which require more surface infrastructure (batteries, solar panels, etc.) to operate, allowed us to monitor native and endangered fish presence without compromising wilderness qualities, impacting user experience, or risking the chance of vandalism or tampering.

Echo Park Bar

The spawning bar that we refer to as "Echo Park Bar" is located 0.3 miles upstream from the Green-Yampa River Confluence and two submersible antennas were set at this location from 14 April - 24 June. Although rare, the majority of razorback sucker

captures on the Yampa River in recent years have occurred at or near this gravel bar, and researchers documented spawning at this site prior to the razorback sucker's listing under the Endangered Species Act (Tyus and Karp 1990). In total, 51identifiable unique tags were detected at Echo Park Bar, consisting of 12 razorback sucker, 14 Colorado-pikeminnow, 7 bonytail, 7 roundtail chub, 8 flannelmouth sucker, and 3 bluehead sucker (Table 2). All razorback suckers detected were stocked by ONFH between 2009 and 2013. Two of these fish were stocked in Green River, Utah (225 RM downstream), two at the Split Mountain boat ramp (27 RM downstream), and the remainder at ONWR (84 to 91 RM downstream). Although detections at Echo Park Bar were not as numerous as at Razorback Bar in 2016, more razorback suckers were documented by these antennas than have been caught in the Yampa River in the past 20 years. Of the 14 Colorado-pikeminnow detected at Echo Park Bar in 2016, 11 were PIT-tagged in the Green River and the remaining three individuals in the Yampa River. Six of the Colorado pikeminnow detected have been encountered since they were PIT-tagged, of which 5 of these fish were also detected at Echo Park Bar in 2015. All bonytail detected at Echo Park Bar in 2016 were stocked in the Green River approximately one mile downstream in Echo Park on 11-August 2015.

Cleopatra's Couch Bar

Cleopatra's Couch Bar is located at Yampa River mile 16.5 and is one of two gravel bars in the Upper Green River Basin that have been extensively documented as Colorado-pikeminnow spawning locations. Three submersible antennas were deployed at or near this spawning bar on 23 June and retrieved on 16 July. We were able to locate codes for 34 individual fish, which consisted of 25 Colorado pikeminnow, 2 razorback sucker, and 7 roundtail chub (Table 3). Data retrieval and maintenance of these antennas was conducted concurrently with Project 110 (Lower Yampa Nonnative Management). These antennas allowed the collection of presence-absence information pertaining to Colorado-pikeminnow at this spawning bar that otherwise would not have occurred because of the potential for electrofishing- induced spawning disruption.

A smaller proportion of the 25 Colorado pikeminnow detected at Cleopatra's Couch Bar in 2016 were PIT-tagged in the Yampa River than in 2015. However, Yampa- tagged fish represented a larger portion of Cleopatra's Couch Bar detections than Echo Park Bar detections (39% versus 28.6%, respectively). Six of the Colorado pikeminnow detected in 2016 were also detected at this site in 2015, and three were recorded at Echo Park Bar six to eight weeks before detection at Cleopatra's Couch. Time at large without capture ranged from two days for an individual tagged approximately five miles downstream of Cleopatra's Couch Bar to ten years.

Roundtail chub detections decreased from 2015, possibly the result of deploying the downstream antenna further upstream and away from a site where roundtail chub spawning aggregations have been observed in the past. All roundtail chub detected had been tagged in the Yampa River within five miles of the study area except for one that had been tagged roughly 25 miles upstream. The detection of two razorback suckers at Cleopatra's Couch Bar in 2016 further displays the utility of these antennas: razorback sucker sightings in the Yampa River are infrequent at best. These razorbacks were stocked at ONWR (98 to 114 RM downstream), and neither fish had been encountered

since stocking in 2011 and 2014.

Shortcomings

Submersible antennas in the Yampa River and at Razorback Bar produced more PIT tag detections in 2016 than in previous years. The majority of detections at Razorback Bar occurred during the first week of sampling, so it seems likely that even more tags would have been detected if the antennas would have been deployed earlier. Fewer detections at Cleopatra's Couch Bar compared to 2015 in part resulted from problems with a battery on one of the antennas, which could not be diagnosed and changed until the next Project 110 electrofishing trip passed by Cleopatra's Couch. While submersible antennas are easier to deploy, have a larger read range than flat plate antennas, require less maintenance, and are less prone to being swept away by rapid increases in flow, they do not record 400 kHz PIT tags. Although these tags haven't been inserted into fish in over ten years, razorback suckers and Colorado pikeminnow that only carry these older PIT tags are still caught every year by field crews. Lastly, by the end of the sampling season we could not download in house the data stored on any of the five antennas used in 2016. Fortunately the antenna manufacturer was able to retrieve the data at their facility as well as replace the data loggers with an updated version.

VIII. Additional noteworthy observations:

IX. Recommendations:

- Continue using PIT tag antennas to monitor fish at Razorback Bar, Echo Park Bar, and Cleopatra's Couch Bar. The congregation of fish in these locations for spawning increases the chances for detection of individuals that may otherwise be spread over large distances. Furthermore, PIT tag antennas provide an unobtrusive method of monitoring endangered fishes at spawning locations as opposed to electrofishing, which can disrupt spawning behavior and egg viability.

- Continuing the use of these antennas during years where razorback sucker are collected during field work could allow for better survival estimates, and perhaps derived population estimates.

- Compare dates of high razorback sucker detections to back-calculated age for larvae collected. This may allow us to determine if these tag detections can be used as a relative index of spawning activity. It would also increase our confidence that fish detected at this location are likely engaging in spawning activity.

- Given similar hydrologic conditions, commence sampling at Razorback Bar one to two weeks earlier than 2016.

- Deploy flat plate antennas along with submersible antennas at Razorback Bar so that fish carrying only 400 kHz tags can be recorded.

X. Project Status: This project is on track and ongoing

XI. FY 2016 Budget Status

A. Funds Provided: $18,358.00
B. Funds Expended: $18,358.00
C. Difference: -0-
D. Percent of the FY 2016 work completed: 100%
E. Recovery Program funds spent for publication charges: -0-

XII. Status of Data Submission: Data was submitted to the database manager on 1 February 2017

XIII. Signed: Christian Smith 2/28/2017
Principal Investigator Date

Literature Cited

Albrecht, B., R. Kegerries, J.M. Barkstedt, W.H. Brandenburg, A.L. Barkalow, S.P. Platania, M. McKinstry, B. Healy, J. Stolberg, and Z. Shattuck. 2014. Razorback Sucker *Xyrauchen texanus* Research and monitoring in the Colorado River inflow area of Lake Mead and the lower Grand Canyon, Arizona and Nevada. Final report prepared by BIO-WEST, Inc., for U.S. Bureau of Reclamation, Upper Colorado Region, Salt Lake City, UT.

Jones, M.T., C.T. Smith, and D. Beers. 2016. Middle Green River Floodplain Sampling. Annual Report to the Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

Tyus, H.M. and C.A. Karp. 1990. Spawning and Movements of Razorback Sucker, Xyrauchen texanus, in the Green River Basin of Colorado and Utah. The Southwestern Naturalist 35 (4): 427-433.

Webber, P.A. and D. Beers. 2014. Detecting razorback suckers using passive integrated transponder tag antennas in the Green River, Utah. Journal of Fish and Wildlife Management 5: 191-196. Figure 1. Year of stocking for razorback sucker detected with the PIT antennas in 2014.

Table 1. PIT tag antenna detections of unique codes per species at Razorback Bar, UT in 2016.

Species	Number of Unique Tags Detected
Razorback sucker	959
Colorado pikeminnow	6
Bonytail	10
Flannelmouth sucker	11
Bluehead sucker	1
Flannelmouth x razorback sucker	1
Roundtail chub	1
Total	989

Table 2. PIT tag antenna detections unique codes per species at Echo Park Bar, CO in 2016.

Species	Number of Unique Tags Detected
Razorback sucker	12
Colorado pikeminnow	14
Bonytail	7
Roundtail chub	7
Flannelmouth sucker	8
Bluehead sucker	3
Total	51

Table 3. PIT tag antenna detections of unique codes per species at Cleopatra's Couch-Bar, CO in 2016.

Species	Number of Unique Tags Detected
Razorback sucker	2
Colorado pikeminnow	25
Roundtail chub	7
Total	34

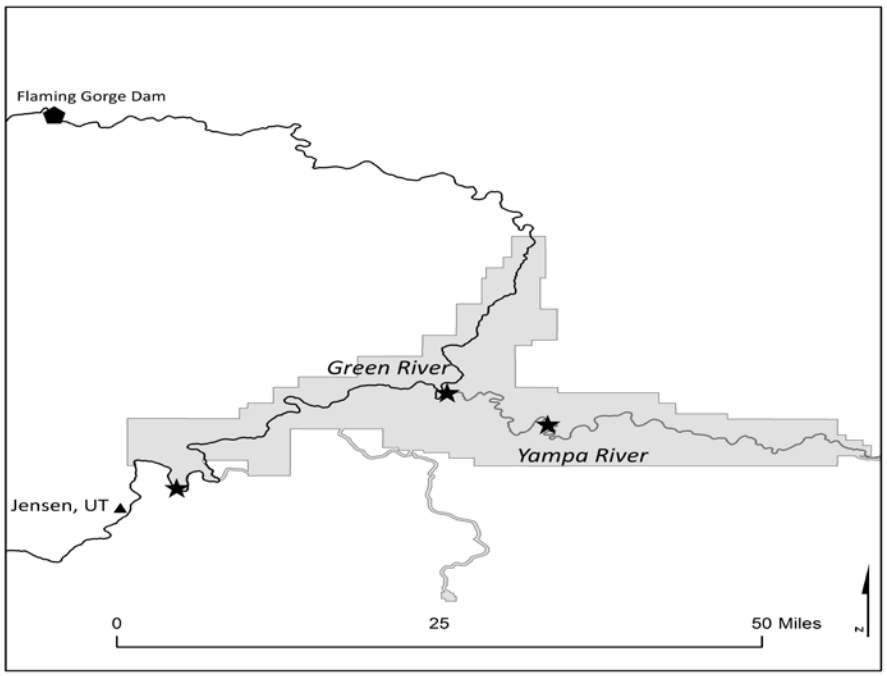

Figure 1. Locations of PIT tag antenna arrays set by Green River Basin FWCO in 2016 are indicated by stars. The shaded polygon shows the extent of Dinosaur-National Monument.

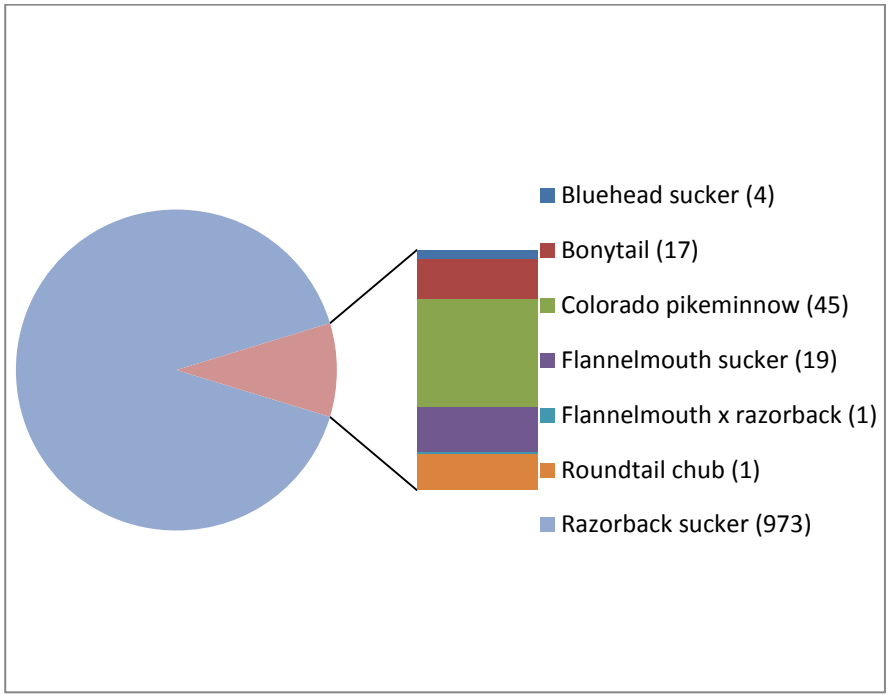

Figure 2. Relative proportion of PIT-tagged fish detected at Passive Interrogation-Arrays (PIAs) set at Razorback Bar on the Green River, Echo Park Bar on the Yampa River, and Cleopatra's Couch Bar on the Yampa River in 2016.

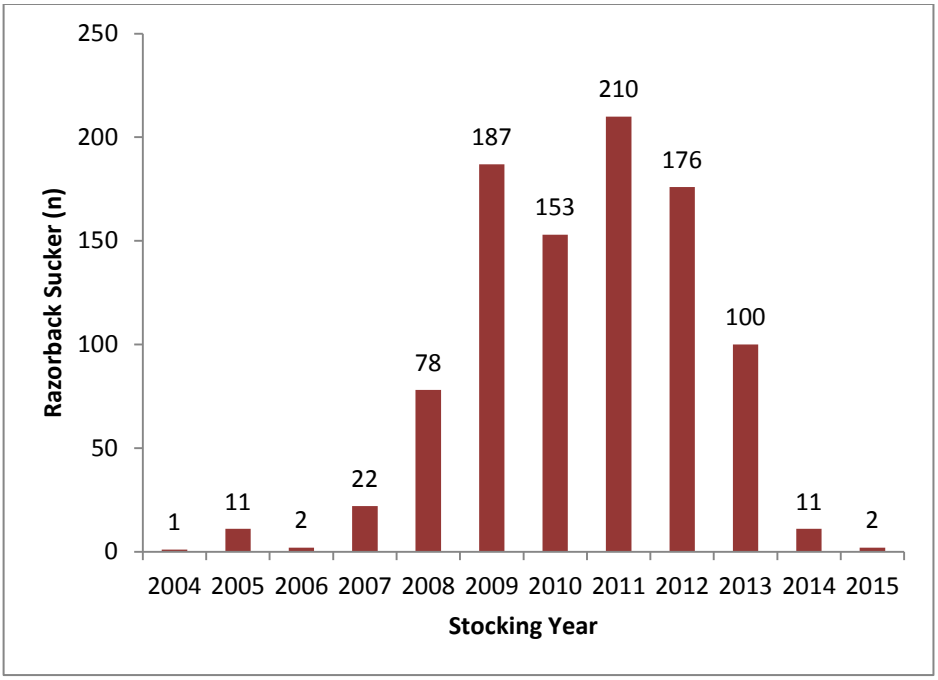

Figure 3. Year of stocking for razorback sucker detected at Razorback Bar PIT tag-antennas in 2016.

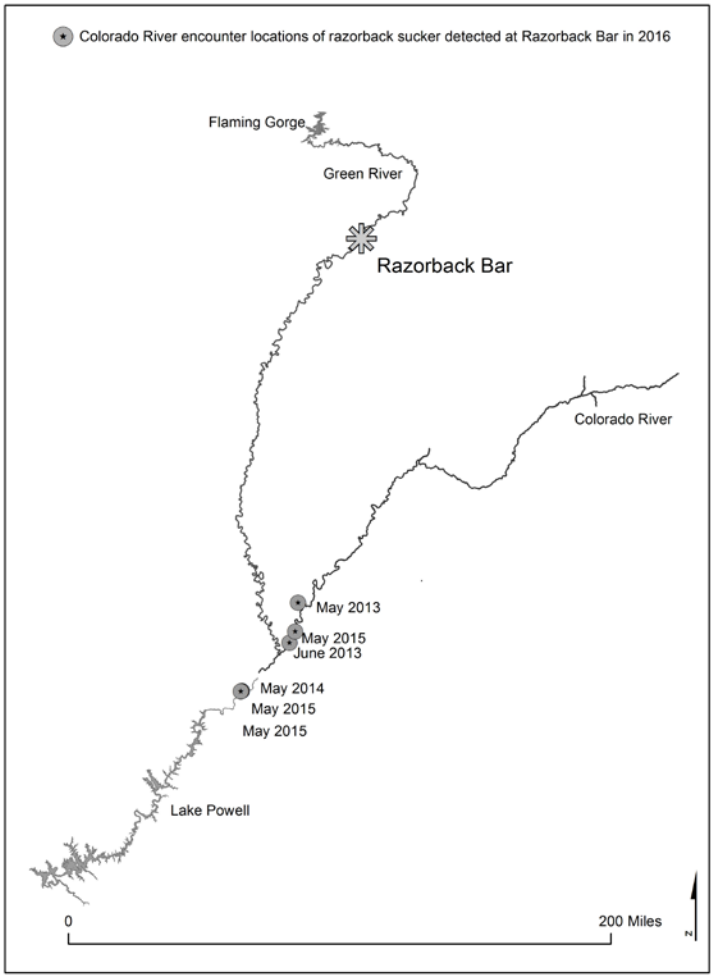

Figure 4. Lake Powell and Colorado River encounter locations of razorback sucker detected at Razorback Bar in 2016.