

COLORADO RIVER RECOVERY PROGRAM
FY 2017 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: 09/30/2017
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 2017, 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 5,715 detections, we were able to identify 1,826 individual or unique tags. These unique tags represented 1,657 razorback sucker, 55 Colorado pikeminnow, 30 bonytail, 13 roundtail chub, 63 flannelmouth sucker, four bluehead sucker, and four razorback x flannelmouth sucker hybrids (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 2017 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Razorback Bar

The Green River Basin Fish and Wildlife Conservation Office (GRB FWCO) deployed five stand alone or “submersible” antennas on 24 March 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 and 2016 Figure 2). Two additional antennas were set on 5 April and moved to Echo Park Bar on the Yampa River on 26 April. Two of the remaining five antennas were removed on 29 May, and the other three remained at Razorback Bar until 10 July. The last detection at Razorback Bar occurred on 20 June, but it is not certain whether this end date resulted from lack of fish presence or dead antenna batteries.

Razorback sucker

Razorback sucker detections increased in 2017 compared to 2012 through 2016, with the majority (N = 1,176) of the 1,656 unique razorback sucker detections occurring from mid-April to mid-May. Most of the razorback sucker detected were stocked from 2009 to 2012 as 1+ year olds (Figure 3) and would presumably be sexually mature. The earliest stocking date of any fish detected was 5 May 2005. It is possible that older fish carrying only 400 kilohertz (kHz) tags were present but not detected at Razorback Bar because submersible antennas do not detect these older tags, which the Recovery Program replaced with 134 kHz tags in 2004.

Sixty-five razorback suckers detected at Razorback Bar in 2016, 106 individuals in 2015, 41 in 2014, 48 in 2013, and 55 in 2012 were detected again in 2017. There were also 24 razorback suckers detected at Razorback Bar in three different years including 2017. In total, 14.4 percent (N = 238) of the razorback sucker detected at Razorback Bar in 2017 had been previously detected by antennas at this spawning location at least once since 2012. 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, 87.5 percent of razorback suckers detected in 2017 had not been captured since stocking and 73 percent had neither been captured nor previously detected by antennas.

Ouray National Fish Hatchery (ONFH) stocked 98 percent (N=1,628) of the razorback suckers detected at Razorback Bar. An additional five razorbacks were stocked at Green River, Utah by the Grand Valley Unit of ONFH and 22 fish (1.3%) likely lost their hatchery tags were tagged by field crews (Utah Division of Wildlife Resources [UDWR] Vernal and GRB FWCO). Lastly, one individual raised by a fourth grade class at Davis Elementary in Jensen, Utah and stocked at the Split Mountain boat ramp in April 2017 was detected at Razorback Bar ten days post stocking. This represents the first river encounter with a “Razorbacks in the Classroom” fish from Utah. All razorback suckers were stocked in the Green River between the Split Mountain boat ramp and Green River, Utah.

In addition to increased detections, 2017 was the second year in a row that 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 373.5 miles from Razorback Bar (Figure 4). These detections include two razorback suckers that were stocked at Ouray National Wildlife Refuge (ONWR) that were last encountered in Lake Powell in 2013 and one stocked at Green River, Utah that was caught at Colorado river mile [RM] 4 in 2016. Additionally, one razorback sucker that was detected at Razorback Bar in April and May 2017 was caught during humpback chub population estimate work in Cataract Canyon (Colorado RM -9.1) in October, 2017. Combined with the six individuals detected at this site in 2016 that had previously been caught in the Colorado River, 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 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 (www.streamsystem.org), 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

Twenty Colorado pikeminnow were detected at Razorback Bar in 2017 compared to six in 2016. Unlike razorback sucker, Colorado pikeminnow in the Upper Green River Basin are reared in the wild and tagged by field crews. Excluding three fish missing PIT tag deployment records, the majority (N = 14) of Colorado pikeminnow detected at this site in 2017 were tagged in the Green River between RM 30.8 and RM 327.6. The remaining three traceable individuals were tagged in the Yampa River between RM 5 and RM 73.2. Among the pikeminnow detected that were lacking initial tagging information was one individual that was captured by Grand Junction FWCO field crews at Colorado River RM 106.8 in October 2015 and Colorado River RM 3.6 in June 2015, then captured by a UDWR Vernal field crew at Green River RM 319.1 in April 2016.

A total of twenty PIT tags associated with bonytail were detected at Razorback Bar in 2017. Most of these fish were stocked by ONFH in the Green River at Rainbow Park (RM 327.8) in September 2016 (N=9) or the Stewart Lake outlet channel (RM 299.2) in May 2017 (N=3), and one individual that was stocked at Rainbow Park in 2014 that is the first record of bonytail surviving three winters collected in this study. Other detected bonytail stocked in September 2016 include three fish that were stocked at Yampa River RM 11.8 by Colorado Parks and Wildlife, which further demonstrate overwinter survival by the most imperiled of the four Colorado River endangered fish species.

Lastly, four bonytail stocked by the UDWR Wahweap State Fish Hatchery at the Escalante Ranch in April 2017 were detected in May and June 2017 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, allow 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 26 April to 8 June and 20 June; one antenna was removed later because it required additional effort to free it from a submerged sandbar. The actual date range of detection possibility is not certain because the batteries on both antennas were dead upon retrieval; the last detection date was 29 May.

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 Federal listing under the Endangered Species Act in 1991 (Tyus and Karp 1990). In total, 43 identifiable unique tags were detected at Echo Park Bar, consisting of one razorback sucker, 14 Colorado pikeminnow, 10 bonytail, 5 roundtail chub, 11 flannelmouth sucker, and 2 bluehead sucker (Table 2).

Of the 14 Colorado pikeminnow detected at Echo Park Bar in 2017, 11 were PIT-tagged in the Green River (RM 82.6 – RM 358) and the remaining three individuals in the Yampa River (RM 25.2 – RM 49.9). Nine of the 14 Colorado pikeminnow detected at Echo Park Bar in 2017 have not been captured since they were PIT-tagged, yet five had been detected by antennas prior to 2017. Additionally, three of these Colorado pikeminnow were detected in early May before they were detected at Cleopatra's Couch in June 2017. Finally, the last Colorado pikeminnow detected at Echo Park Bar in 2017 on 31 May was also detected at Razorback Bar on 20 April 2017.

Bonytail detected at Echo Park Bar in 2017 include three fish that were stocked in the Green River approximately one mile downstream in Echo Park on 11 August 2015 and seven individuals that were stocked at Yampa River RM 11.8 on 7 September 2016. Those stocked in Echo Park overwintered two years and included one fish that was

detected on the same antenna in May 2016; the Yampa River-stocked bonytail exhibited one year of overwinter survival.

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. Two submersible antennas were deployed at or near this spawning bar on 8 June and a third was deployed on 15 June. All were retrieved on 29 July due to dropping flows on the Yampa River. Deployment, 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 GRB FWCO field crews do not shock this reach due to the potential for electrofishing- induced spawning disruption.

In total, we were able to locate codes for 28 individual fish, which consisted of 21 Colorado pikeminnow and 7 roundtail chub (Table 3). Among the roundtail chub detected, five had been tagged in the Yampa River between RM 14 – RM 34 during Project 110 fish community monitoring passes, and the other two were tagged by the Colorado State University Larval Fish Lab (LFL) as part of Project FR-115. None of the roundtail chub detected at this site in 2017 had been encountered since they were tagged.

A smaller proportion of the 25 Colorado pikeminnow detected at Cleopatra's Couch Bar in 2016 were PIT-tagged in the Yampa River than those detected in 2015, and again an even smaller proportion (19% or 4 individuals) were detected in 2017. Five of the Colorado pikeminnow detected in 2017 were also detected at this site in 2016, and three were recorded at Echo Park Bar six weeks before detection at Cleopatra's Couch. Time at large without capture ranged from thirteen days for an individual (name= Steve [Ed Kluender personal comm.]) tagged by LFL in Vermillion Creek (Green River RM 366.7) to 11 years for a fish tagged by UDWR Moab at Green River RM 75.5.

A notable number of Colorado pikeminnow detected at Cleopatra's Couch this year (N=9) were also detected by LFL antennas in Vermillion Creek, a tributary to the Green River, 11 – 36 days before they were detected at Cleopatra's Couch (Ed Kluender, personal comm.). One of these fish was detected in the Green River 21 days later at the Tusher Diversion Dam (RM 129.3). This male Colorado pikeminnow would have at least passed by the other well-documented Colorado pikeminnow spawning area in the Green River Basin at Three Fords (Green River RM 155.5) during the descending limb of the hydrograph.

PIT tag antenna data collected from antennas placed in locations throughout the Green River Basin combined with other encounter history data sourced from STReaMS (www.streamsystem.org), the Recovery Program's online database, can reveal Colorado pikeminnow movements not previously documented. Although this species is known to be highly migratory, this relatively new technology and data accessibility contributes important life history information that would otherwise require additional expense and

time (i.e. radio telemetry). Beyond providing new and important life history information and increased individual detections that could contribute to more robust survival estimates, PIT tag antenna data can help guide hatchery management by providing metrics such as the relative strength of stocking year classes.

Shortcomings

Submersible antennas at Razorback Bar produced more PIT tag detections in 2017 than in previous years. Despite unusually high and extended releases from Flaming Gorge Dam in the Green River, the hydrology in the Yampa River was such that our sampling window of opportunity at Cleopatra's Couch was shorter in 2017 than 2016. This resulted in fewer detections at Cleopatra's Couch Bar compared to 2016. Deployment of Echo Park Bar antennas in 2017 was delayed because access was limited by extreme snowpack.

Although we were able to determine the species and encounter histories associated with 1,826 tags directly through STReAMS or by contacting PIT tag lot recipients, 52 PIT tags detected in this project in 2017 remain unidentified. Some of the unidentified tags associated with Ouray National Fish Hatchery have prompted discussion about introducing fail-safes to hatchery data collection which include the use of PIT tag antennas during fish tagging, transfer, and/or stocking events.

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.

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

XI. FY 2017 Budget Status

- A. Funds Provided: \$30,754.00
- B. Funds Expended: \$30,754.00
- C. Difference: -0-
- D. Percent of the FY 2017 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 5 September 2017.

XIII. Signed: Christian Smith 1/12/2018
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 2017.

Species	Number of Unique Tags Detected
Razorback sucker	1,656
Flannelmouth sucker	52
Bonytail	20
Colorado pikeminnow	20
Flannelmouth x razorback sucker	4
Bluehead sucker	2
Roundtail chub	1
Total	1,755

Table 2. PIT tag antenna detections unique codes per species at Echo Park Bar, CO in 2017.

Species	Number of Unique Tags Detected
Colorado pikeminnow	14
Flannelmouth sucker	11
Bonytail	10
Roundtail chub	5
Bluehead sucker	2
Razorback sucker	1
Total	43

Table 3. PIT tag antenna detections of unique codes per species at Cleopatra's Couch-Bar, CO in 2017.

Species	Number of Unique Tags Detected
Colorado pikeminnow	21
Roundtail chub	7
Total	28

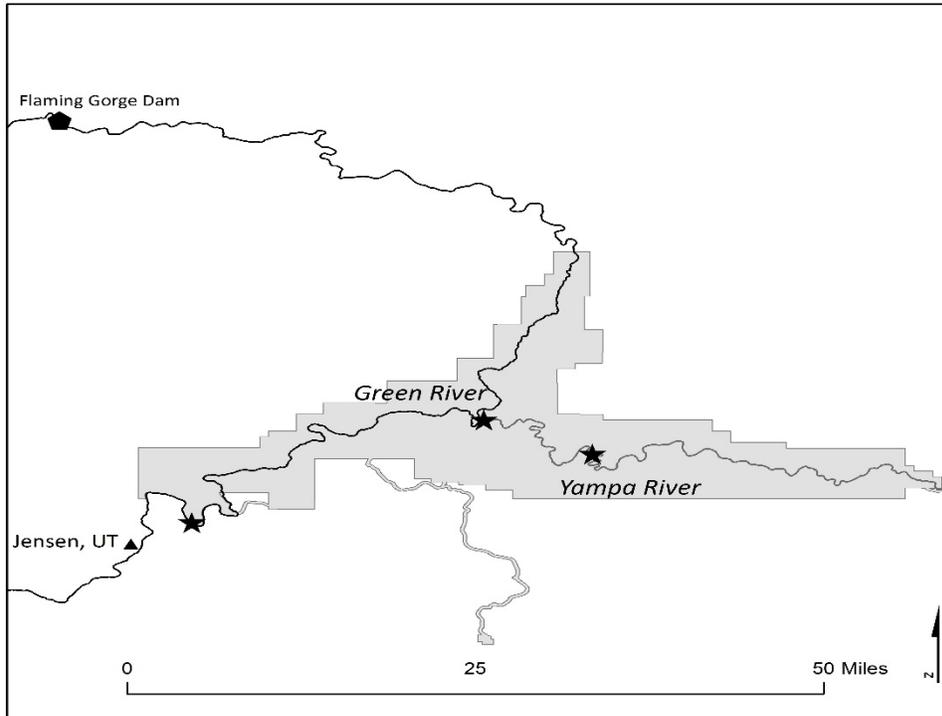


Figure 1. Locations of PIT tag antenna arrays set by Green River Basin FWCO in 2017 are indicated by stars. The shaded polygon shows the extent of Dinosaur National Monument.

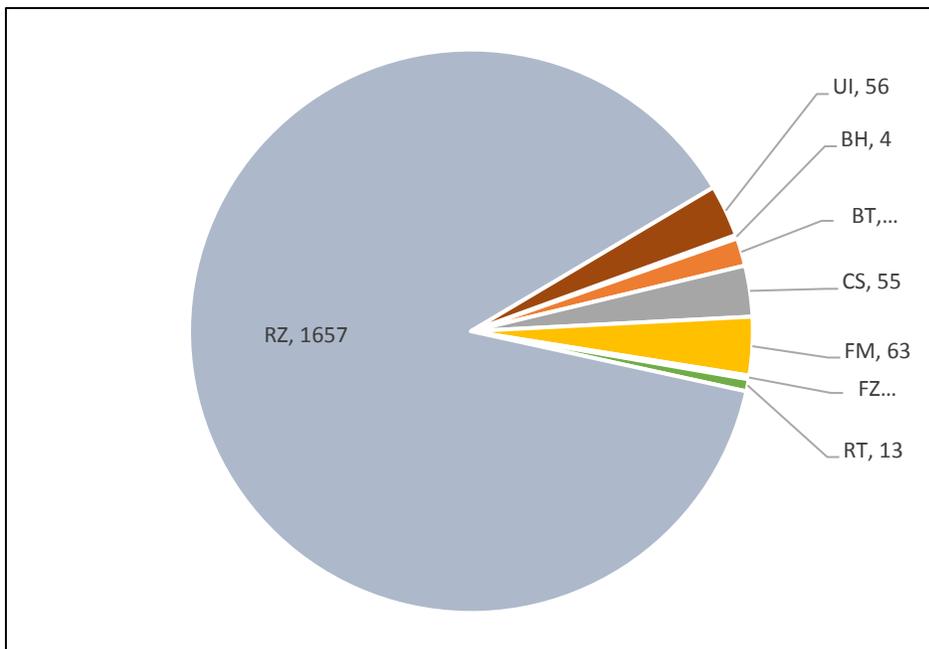


Figure 2. Relative proportion of PIT-tagged fish detected at Passive Interrogation Arrays (PIAs) set at Razorback Bar on the Green River, Echo Park Bar on the Yampa River, and Cleopatra's Couch Bar on the Yampa River in 2017.

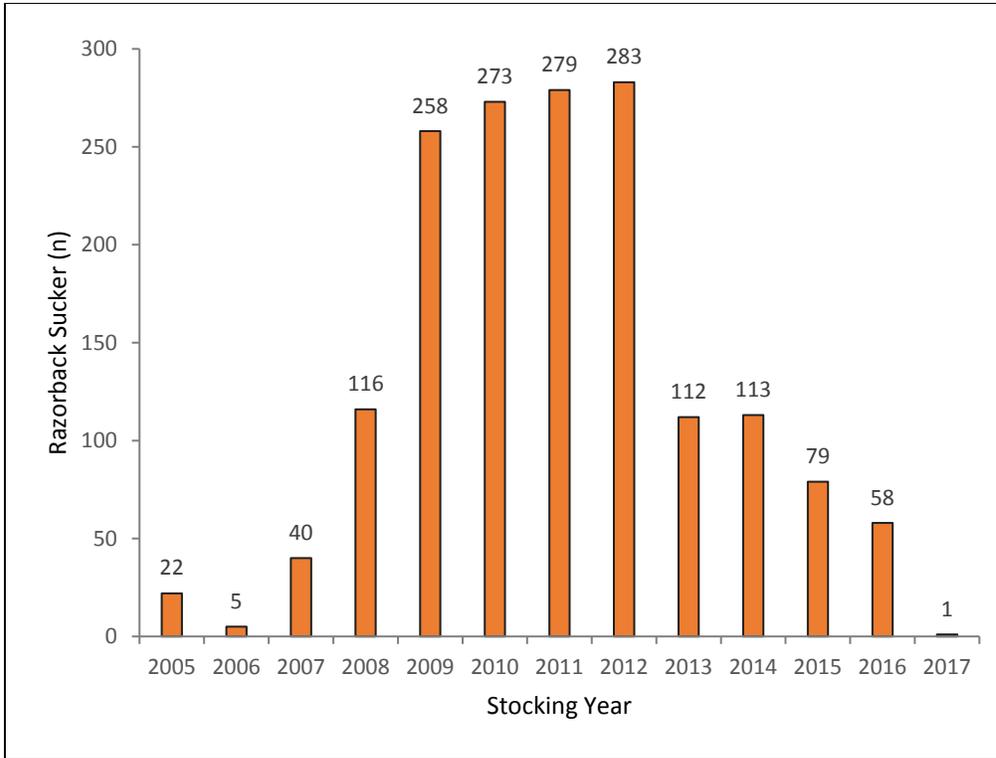


Figure 3. Year of stocking for razorback sucker detected at Razorback Bar PIT tag antennas in 2017.

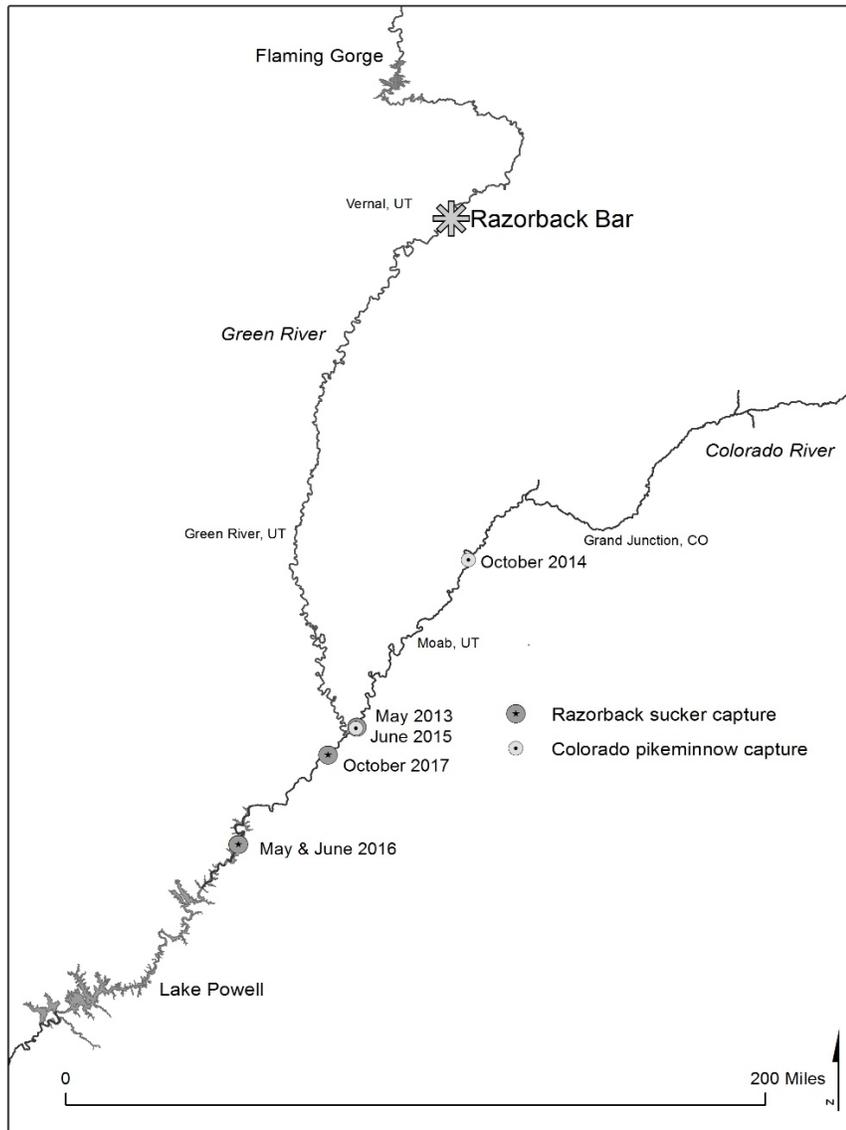


Figure 4. Colorado River and Lake Powell capture location and date of Colorado-pikeminnow and razorback sucker detected at Razorback Bar, UT in 2017.