

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

FY 2023 ANNUAL REPORT

PROJECT: 169

Project Title

Monitoring Spawning Aggregations on the Green and Yampa Rivers with Antennas.

Bureau of Reclamation Agreement Number:

R20PG00024

Project/Grant Period:

Start date: 10/1/2019

End date: 9/30/2024

Reporting period end date: 9/30/2023

Is this the final report? Yes No

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Abstract:

Portable passive integrative transponder (PIT) tag antennas allow researchers to detect PIT-tagged fish in remote locations with minimal infrastructure, labor, or maintenance. Furthermore, data collected by antennas provides vital evidence of endangered fish survival and movement. The Green River Basin Fish and Wildlife Conservation Office deployed portable antennas at four locations in the Green and Yampa rivers in 2023 with the goal to detect as many tagged endangered razorback sucker, Colorado pikeminnow, and bonytail as possible. Out of 4,311 detections, we were able to identify 2,571 individual or unique tags. These unique tags represented 2,363 razorback sucker, 83 Colorado pikeminnow, 72 bonytail, 7 roundtail chub, 33 flannelmouth sucker, 8 bluehead sucker, and 4 flannelmouth x razorback sucker hybrids.

Study Schedule:

2012-Ongoing

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

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V.D.1. Implement Razorback sucker monitoring plan.

Accomplishment of FY 2023 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Razorback Bar PIT tag antenna monitoring

The Green River Basin Fish and Wildlife Conservation Office (GRB FWCO) deployed six stand-alone or “submersible” antennas on 11 April 2023 at Razorback Bar on the Green River (~ river mile [RM] 312.9) where the majority of passive integrated transponder (PIT) tag detections in this study have occurred (Figure 1, Smith et al. 2016-2018 and 2021, Smith and Beers 2019, 2020, and 2022). Rising discharge prompted the removal of one antenna on 26 April. Although the 5 remaining antennas were pulled on 10 August, one had been buried under sand since 26 April. We detected unique PIT-tag codes associated with 1,113 razorback sucker *Xyrauchen texanus*, 33 Colorado pikeminnow *Ptychocheilus lucius*, 72 bonytail *Gila elegans*, 13 flannelmouth sucker *Catostomus latipinnis*, 4 bluehead sucker *Catostomus discobolus*, and 1 flannelmouth x razorback sucker hybrid *Catostomus latipinnis x Xyrauchen texanus* during this period in 10,080.2 hours of total effort (Table 1).

Razorback sucker

The number of unique razorback sucker (RZ) detections per day exceeded 100 beginning 27 April and decreased after 30 April (Figure 2). In comparison, unique detections per day at this site exceeded 100 for over three weeks in 2022. This disparity in daily detections could be attributed to higher runoff in 2023 compared to 2022 and its effect on decreasing detection efficiency.

Numerous RZ detected at Razorback Bar in past years were detected again in 2023 (Figure 3). Over one third (37.2%; N = 413) of the RZ detected at Razorback Bar in 2023 were previously detected by antennas at this known spawning location at least once since 2015. Webber and Beers (2014) found that the majority (93%) of RZ detected at Razorback Bar in 2012-2013 had not been previously captured during active river sampling. The majority (84.7%) of RZ detected in 2023 had not been captured since stocking, and 50 percent had neither been captured nor previously detected by PIT tag antennas. The latter proportion decreased markedly from 73 percent in 2017. This decrease is possibly the effect of more extensive PIT tag antenna coverage at Razorback Bar and throughout the Green River Basin in the last six years.

The Ouray National Fish Hatchery (ONFH) – Randlett unit stocked 97.4 percent of the RZ detected at Razorback Bar in 2023. All these fish were stocked into the Green River between Rainbow Park (RM 329.5) and Green River, Utah (RM 120.1). In addition, 10 RZ (0.9 percent) were tagged by Utah Division of Wildlife Resources (UDWR) Vernal field crews after being captured in the field. Although 7 of these were adult fish that presumably lost their hatchery tags, three were wild RZ produced in and released from Stewart Lake in October 2022. Razorback sucker stocked between 2017 and 2019 yielded more detections than other stocking cohorts and the oldest RZ detected, that we can determine, was stocked in 2004 (Figure 4).

As of 2023, the detection of RZ that have ventured outside of the Green River Basin has occurred on antennas at Razorback Bar during seven separate years. Four RZ were detected this year that have also

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been encountered in the Colorado River ($n=1$) or Lake Powell ($n=3$). Among those was one individual that was stocked at Green River State Park (Green River RM 120.1) in 2012, captured in Lake Powell (Colorado RM -70.5) in 2015, detected at Razorback Bar (Green RM 312.9) in May 2019, detected again in Lake Powell (Colorado RM -62.5) in June 2021, and finally detected at Razorback Bar (RM 313.0) in May 2023. This individual has travelled at least 1,324.8 river miles since stocking.

Colorado pikeminnow

Thirty-three Colorado pikeminnow (CPM) were detected at Razorback Bar in 2023 compared to 70 in 2022. Unlike most RZ, all CPM in the Upper Green River Basin are wild fish PIT-tagged by field crews. The CPM detected at Razorback Bar this year were PIT-tagged between 2005 and 2020. The majority ($n = 28$) of CPM detected at this site in 2023 were tagged in the Green River (RM 30.8-RM 345). Two of the remaining fish were PIT-tagged in the Yampa River (RM 10.6 and RM 42.2), two in the White River (RM 36.1 and RM 73.7), and one in the mouth of Vermillion Creek adjacent to the Green River (Green River RM 368.9). Two CPM detected at Razorback Bar were detected between 14 to 38 days later at Echo Park Bar. These individuals may have been migrating upstream to spawn in the Yampa River.

Bonytail

Razorback Bar antennas detected tags from 72 bonytail in 2023 compared to 28 in 2022. Fifty-seven of these fish were stocked by ONFH-Randlett at the Stewart Lake outlet (Green River RM 300.9) on 15 May 2023 and the other 15 were stocked at Walker Hollow (Green River RM 295.8) the following day. Bonytail detection dates at Razorback Bar ranged from 27 May to 5 August.

Echo Park Bar PIT tag antenna monitoring

The spawning bar that we refer to as Echo Park Bar is in the Yampa River, 0.3 miles upstream from the Green River confluence. Two submersible antennas were set at this location on 12 June and a third on 30 June. All three antennas were retrieved on 21 July (1,775.1 hours of total effort). The late antenna deployment date in 2023 resulted from the road into Echo Park being closed until June due to snow. Outside of visiting this site via raft on Project 110 electrofishing passes, access entails a one mile walk from the Echo Park road. When access was achieved by foot, a pack raft is used to deploy and maintain an antenna set off the north bank of the Yampa River. In total, 19 traceable unique tags were detected at Echo Park Bar in 2023, consisting of 15 CPM, 2 roundtail chub, and 2 bluehead sucker (Table 2).

Colorado pikeminnow

Of the 15 CPM detected at Echo Park Bar in 2023, 11 were PIT-tagged in the Green River (RM 45.3–345) and one in the Yampa River (RM 9.8). These fish were PIT-tagged between 2007 and 2023. Deployment records were not available for the three remaining PIT tag codes. Three of the 12 CPM with PIT tag deployment records detected at Echo Park Bar in 2023 have not been captured since they were PIT-tagged, yet all of these fish had been detected by antennas prior to 2023.

Razorback sucker

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Echo Park antennas did not detect any razorback sucker PIT tags in 2023. Although rare, the majority of RZ 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 RZ's federal listing under the Endangered Species Act in 1991 (Tyus and Karp 1990). We are hopeful that a significant effort conducted by the National Park Service in September 2023 wherein all tamarisk trees were removed from the island at this spawning location will promote future sand erosion and improve the viability of this important habitat.

Roundtail chub

The two roundtail chub detected at Echo Park this year were PIT-tagged at or within 3.5 river miles of the 2023 array. Neither of these fish had not been captured since they were PIT-tagged in 2010 or 2011 yet they have both been detected by antennas at this site in multiple years.

Cleopatra's Couch Bar PIT tag antenna monitoring

Cleopatra's Couch Bar is located on the Yampa River, 16.5 river miles upstream of the Green River confluence, and is one of two gravel bar complexes in the Green River Basin that have been extensively documented as CPM spawning locations (Tyus and McAda 1984, Irving and Modde 2000).

Three submersible antennas were deployed at or near this spawning bar on 29 June 2023 and were retrieved on 11 (n=1) and 20 July 2023 (1,316.4 hours of total effort) because of dropping flows on the Yampa River. Most of the 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 CPM at this spawning bar that otherwise would not have occurred because GRB FWCO field crews do not electrofish this reach due to the potential for spawning disruption.

We were able to locate tag information for 24 fishes, which consisted of 20 CPM and 4 roundtail chub (Table 3).

Colorado pikeminnow

The majority (64.7%, $n = 11$) of the 17 CPM with tag deployment records detected at Cleopatra's Couch in 2023 were first encountered and PIT-tagged in the Green River (RM 18 – 347.5). The remainder consisted of 4 individuals that were tagged in the Yampa River (RM 5.0 – 49.9), one in the White River (RM 65), and another in Vermillion Creek (CM 0/Green RM 368.9). Thirteen of the 20 total CPM detected this year were also detected at this site between 2015 and 2022. One fish had been detected in 6 different years, another in 4, and 2 individuals were detected in 3 separate years. Among the CPM detected at Cleopatra's Couch this year was a fish that was recorded at Razorback Bar in late April of 2023. However, neither this fish nor any other CPM detected at Cleopatra's Couch were detected by Echo Park antennas this year. The maximum time at large without capture for a CPM detected at Cleopatra's Couch in 2023 was over 12 years for a fish that was last physically captured at Green RM 287 on 11 May 2011.

Roundtail chub

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The 4 roundtail chub detected at Cleopatra's Couch this year were tagged in the Yampa River during Project 110 between 2009 and 2020.

White-Green River confluence PIT tag antenna monitoring

Portable PIT-tag antennas were deployed in the White River within 0.5 RM's of the White-Green River confluence (Green River RM 246.8) for the first time in 2023. The primary intention of these antennas was to detect Colorado pikeminnow PIT-tags during 2023 CPM abundance estimate sampling (Project 128a) and use the data to improve the estimate's precision. In addition, electrofishing catch rates for RZ near this confluence are often relatively high, so it was expected that detection rates on antennas would be as well.

A total of 1,292 traceable PIT tags were detected between 28 April and 26 July 2023 (3,745.1 hours of total effort) among four antennas. These tags were associated with 15 CPM, 1,250 RZ, 1 bonytail, 1 roundtail chub, 3 flannelmouth x razorback sucker, 20 flannelmouth sucker, and 2 bluehead sucker (Table 4).

Colorado pikeminnow

The initial capture and PIT-tagging of the CPM detected at the White-Green River confluence occurred for 7 individuals in the Green River (RM 71 – RM 233.7) between 2016 and 2023, 5 CPM in the White River (RM 7 – RM 73.7) between 2019 and 2022, and two fish in the Yampa River (RM 15.8 and RM 23.4) in 2017 and 2021. Two fish captured in the Green River (RM 230.8 and RM 317.5) during Project 128 sampling in 2023 were detected at this site. However, none of the CPM captured during the White River component of Project 128 were detected by these antennas nor were any of the antennae CPM captured.

Razorback sucker

Of the 1,202 RZ detected at the White-Green River confluence with traceable stocking records, all but two were stocked in the Green River (RM 120.1-329.5) by ONFH between 2003 and 2022. The other individuals were stocked by ONFH at the Enron boat ramp on the White River (RM 24) in 2018 and in the Stirrup wetland (Green RM 276) in 2009. Prior to 2022, 247 (20.5%) of these RZ had been captured since stocking and 310 (25.8%) had been detected by PIT tag antennas in the Green River including those at the Tusher Diversion Dam and Razorback Bar.

An additional 12 RZ's were detected at this site that received PIT-tags from UDWR Vernal or GRB FWCO field crews. Five of these fish were of confirmed wild origin and transferred from the Stewart Lake (n=4) and Old Charley (n=1) wetlands to the mainstem Green River during the fall of 2022. The remaining fish were captured and PIT-tagged in the Green River (n=6; RM 208.7 – RM 315.2) and White River (RM 5.2).

Shortcomings

Perhaps the result of the long duration of moderately high runoff in 2023, five antennas were buried for extended periods. One of the 6 antennas deployed at Razorback Bar was deeply buried throughout the

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sampling season but fortunately retrievable in July. Similarly, 3 of the 4 White-Green River confluence antennas were buried deeply enough in mid-May to prevent changing batteries. Consequently, detection effort was diminished.

Although reduced since the earliest years of this project, PIT tag codes lacking some or all tagging information exist. Although we were able to determine species and encounter histories for the majority of codes detected, 117 PIT tag codes or 4.3 percent of the codes detected by our antennas in 2023 do not currently contain information within the STReAMS database.

Clarity of understanding what questions of interest related to endangered fish recovery that antenna data could answer is greatly lacking. PIT tag antennas have clearly expanded encounters with PIT-tagged fishes, especially at known spawning locations such as Razorback Bar. However, our examination of antenna data has been limited to select sites and mostly on an annual basis, which has provided an incomplete picture of how listed species use the Upper Colorado River Basin.

Recommendations:

1. PIT tag antenna data has been collected throughout the Upper Colorado River Basin since 2012 but has yet to be holistically examined. Framing questions that could be answered with detection data is the first step in leveraging the potential of permanent and portable antennas and applying this technology to improve and expand upon future recovery actions. These questions could pertain to endangered fish spawning or other seasonal movements, spawning and production potential, and basin-wide survival. Investigating all antenna data collected to date is the first step in framing these questions and would likely improve current and future antenna monitoring strategies.
2. Continue using PIT tag antennas to monitor fish at Razorback Bar, Echo Park Bar, Cleopatra's Couch Bar, and the White-Green River confluence. The congregation of fish in these locations 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.
3. PIT tag antennas should be deployed in monitoring reaches to collect detection data during years when razorback sucker and Colorado pikeminnow are physically captured for abundance estimation projects. Such data could allow for more accurate survival estimates, and perhaps more precise population estimates if detections overlap the physical sampling period.
4. 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.

Project Status:

On track and ongoing.

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FY 2023 Budget Status

Funds Provided: \$30,065

Funds Expended: \$30,065

Difference: \$0

Percent of the FY 2023 work completed, and projected costs to complete: 100%, \$0

Recovery Program funds spent for publication charges: \$0

Status of Data Submission

Data was submitted to the STReAMS database manager on 10/31/2023

Signed:

Chris Smith

Dave Beers

9 November 2023

References

Irving, D.B. and T. Modde. 2000. Home-range fidelity and use of historical habitat by adult Colorado squawfish (*Ptychocheilus lucius*) in the White River, Colorado and Utah. *Western North American Naturalist*, 60: 16-25.

Smith, C.T., M.T. Jones, and D. Beers. 2016. Detecting endangered fishes using PIT tag antenna technology in the Upper Colorado River Basin. Annual Report to the Upper Colorado River Endangered Fish Recovery Program. Denver, CO.

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Smith, C.T. and D. Beers. 2022. Detecting endangered fishes using PIT tag antenna technology in the Upper Colorado River Basin. 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.

Tyus, H.M. and C.W. McAda. 1984. Migration, movements, and habitat preferences of Colorado squawfish, *Ptychocheilus lucius*, in the Green, White, and Yampa rivers, Colorado and Utah. Southwestern Naturalist, 29: 289-299.

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.

Zelasko, K. A., and K. R. Bestgen. 2022. Obstacles to abundance estimation for razorback suckers *Xyrauchen texanus* in the Green River, 2016–2018. Final report to the Upper Colorado River Endangered Fish Recovery Program. Denver, Colorado. Larval Fish Laboratory Contribution 229.

Table 1. PIT tag antenna detections of unique codes per species at Razorback Bar, UT in 2023.

Species	Number of Unique Tags Detected
Razorback sucker	1,113
Colorado pikeminnow	33
Bonytail	72
Flannelmouth sucker x razorback sucker	1
Flannelmouth sucker	13
Bluehead sucker	4
Total	1,236

Table 2. PIT tag antenna detections of unique codes per species at Echo Park Bar, CO in 2023.

Species	Number of Unique Tags Detected
Colorado pikeminnow	15
Roundtail chub	2
Bluehead sucker	2
Total	19

Table 3. PIT tag antenna detections of unique codes per species at Cleopatra’s Couch Bar, CO in 2023.

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Species	Number of Unique Tags Detected
Colorado pikeminnow	20
Roundtail chub	4
Total	24

Table 4. PIT tag antenna detections of unique codes per species at White-Green River confluence, UT in 2023.

Species	Number of Unique Tags Detected
Razorback sucker	1,250
Colorado pikeminnow	15
Bonytail	1
Roundtail chub	1
Flannelmouth sucker x razorback sucker	3
Flannelmouth sucker	20
Bluehead sucker	2
Total	1,292

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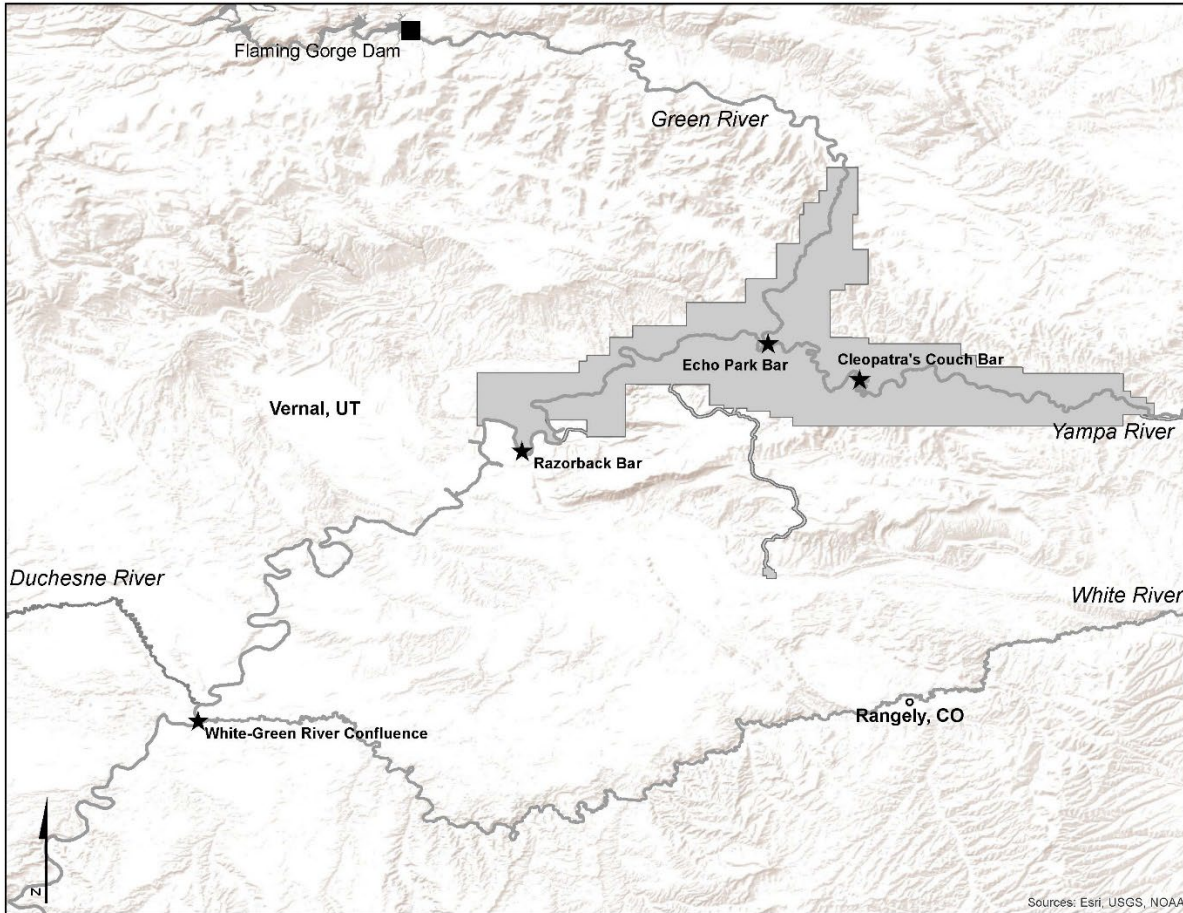


Figure 1. Locations of PIT tag antenna arrays set by Green River Basin FWCO in Dinosaur National Monument in 2023 are indicated by stars. The shaded polygon shows the extent of Dinosaur National Monument.

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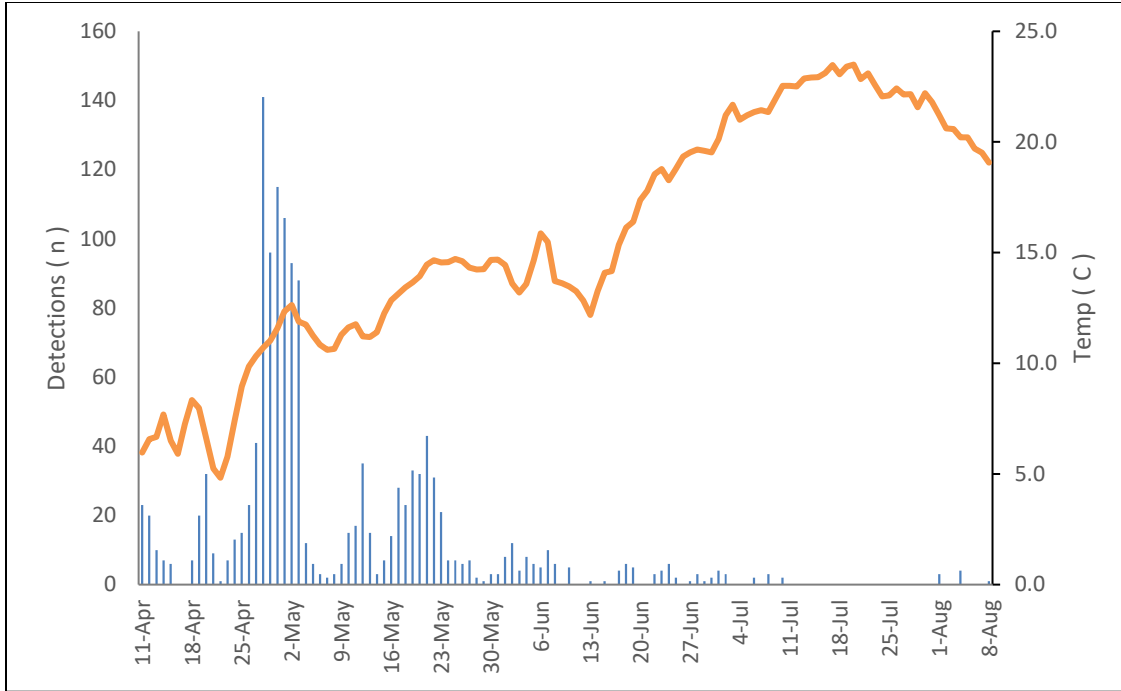


Figure 2. Number of individual or unique razorback sucker PIT tags detected each day (blue bars) and daily mean temperature (orange line; USGS gauge 09261000, located near Jensen, UT) during the 2023 sampling season at Razorback Bar, UT

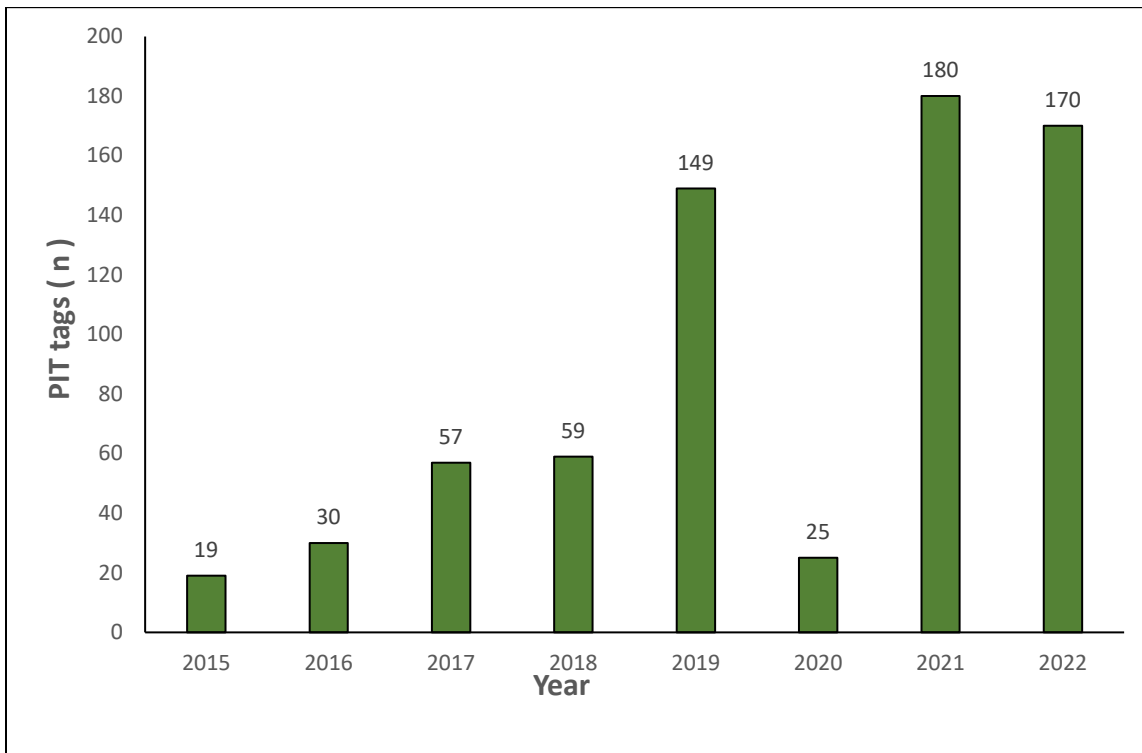


Figure 3. Number of razorback sucker PIT tags detected at Razorback Bar in 2023 that have been detected at this site in other years. Fewer PIT tags were detected at this site in 2020 than

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in any other year because the COVID 19 pandemic delayed the start of our field season and antennas were not deployed until May 22.

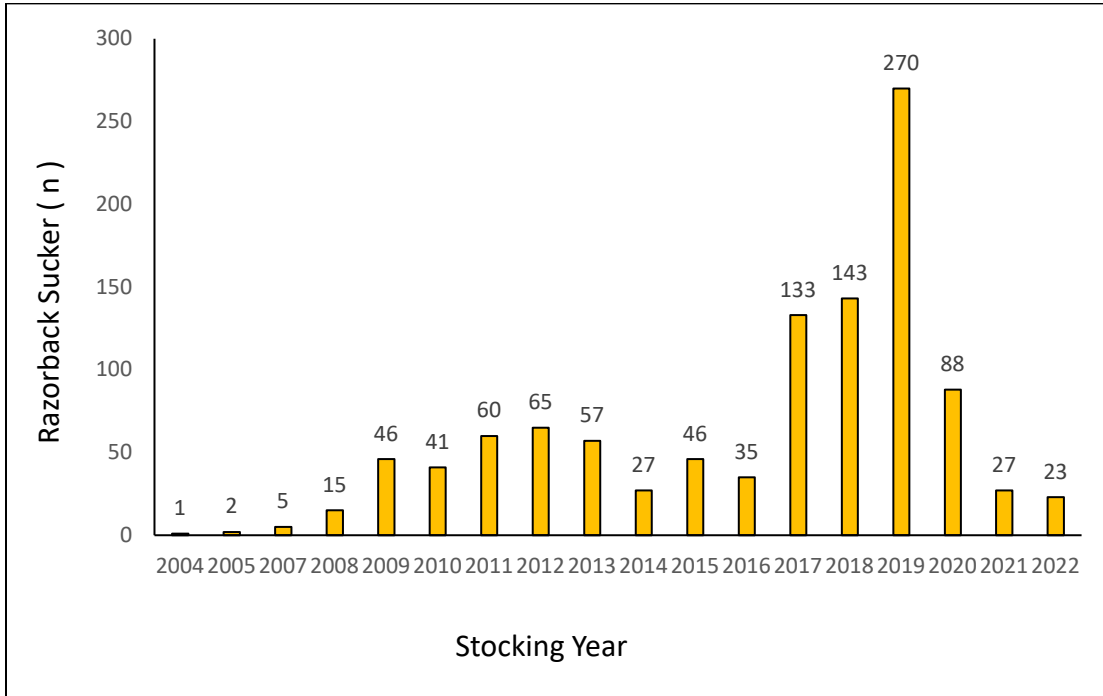


Figure 4. Stocking year and number of unique detections for razorback sucker detected by Razorback Bar PIT tag antennas in 2023. Incomplete stocking records reduced stocking year determination to 1,084 of the 1,113 total number of unique tags detected.