

# UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

FY 2023 ANNUAL REPORT

PROJECT: C-28a

## **Project Title**

Stationary PIT detection system in the Green River Canal, Green River, UT

## **Bureau of Reclamation Agreement Number:**

R19AC00153

## **Project/Grant Period:**

Start date: 09/16/2019

End date: 09/30/2024

Reporting period end date: 12/01/2023

Is this the final report? Yes

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## **Abstract:**

The goal of this project is to evaluate entrainment of PIT-tagged endangered fish in the Green River Canal (near Green River, Utah) using passive interrogation arrays (PIAs). Entrainment at this facility has been monitored in this fashion since 2013 and observed entrainment rates of endangered fish since that time have been considerable owing to a lack of fish-excluding structure at the canal intake. In FY 2019, a combination weir wall and fish screen were installed at the top of the Green River Canal along with several PIT antenna loops to detect its efficacy. Whereas endangered fish entrainment rates in the unscreened canal varied during 2013-2019 from 118 to 695 fish per irrigation season (in 2018 and 2013, respectively), total entrainment of PIT tagged fish in the screened canal (i.e., post 2019) was limited to 3 fish. Between December 1, 2022 and Nov 28, 2023, a total of 1,241 fish were detected in the vicinity of the fish screen, including 33 bonytail, two Colorado pikeminnow, two flannelmouth sucker, one bluehead sucker, 757 razorback sucker, and 446 unidentified fish. About 98% of unidentified fish are presumed to be stocked bonytail. No fish were detected in the canal downstream from the fish screen. Entrainment rates since completion of the screen in 2019 continue to be drastically lower than those observed prior to screen construction.

# UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

## **Study Schedule:**

April 2013—December 2023

## **Relationship to RIPRAP:**

Green River Action Plan

II: Restore habitat.

II.2.B: Screen Tusher Wash Diversion (aka Green River Canal) to prevent endangered fish entrainment, if warranted

II.2.B.b: Design.

II.2.B.c: Construct.

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

Task 1: Operate and maintain PIA system; perform diagnostics, repair system if necessary.

The goal of this project is to evaluate entrainment of PIT-tagged endangered fish in the Green River Canal (near Green River, Utah) using PIAs before and after construction of a fish-excluding weir wall and screen structure at the top of the canal. Canal entrainment at this facility has been monitored in this fashion since 2013. Observed entrainment rates of endangered fish during 2013 - 2018 were considerable owing to a lack of fish excluding structures at the canal intake (Table 1). In 2019, the top of the Green River Canal was reconfigured to include an innovative fish exclusion structure comprised of a weir wall with horizontal, fine-aperture screens at its crest (Figure 1) which diverts entrained fish back to the Green River while also delivering the canal's full capacity (ca. 85 cfs) to water users downstream. The screen was fitted with several PIT detection antennas and are configured as follows (Figure 2):

- a) Intake: Loops one (1; upstream) and two (2; downstream of 1): Weir and screen intake area just upstream of the trash rack.
- b) Return channel: Loops three (3; upstream) and four (4; downstream of 3): Fish return channel flowing to the Green River.
- c) Canal: Loops five (5) and six (6; downstream of 5): Below horizontal screen in the Green River Canal.

In 2023, the Green River Canal started flowing in early April, continued through Nov 17, and averaged about 56 cfs during that period (preliminary data, Utah Division of Water Rights; <https://www.waterrights.utah.gov/cgi-bin/dvrtview.exe>). Antenna arrays are continually operational and thus were working in advance of the canal start date.

Task 2: December: Annual report (current document).

During the 2023 irrigation season<sup>1</sup>, a total of 1,241 PIT-tagged fish was detected on the Green River Canal fish screen antenna loops, indicating continued fish visitation of the facility (Table 2).

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<sup>1</sup> represented in this report by data collected during December 1, 2022 through November 28, 2023 (downloaded from STReaMS November 28, 2023; <https://streamsystem.org>).

## UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

Detected fish included 757 razorback sucker *Xyrauchen texanus* (61% of total), 446 unidentified fish (36%), 33 bonytail *Gila elegans* (3%), two Colorado pikeminnow *Ptychocheilus lucius* (<1%), 2 flannelmouth sucker *Catostomus latipinnis* (<1%) and one bluehead sucker *C. discobolus* (<1%). About 98% of unidentified fish (438) are most likely stocked bonytail from Wahweap State Fish Hatchery, with the remainder mostly a mix of stocked razorback and bonytail from Ouray National Fish Hatchery (Randlett Unit). These are the most likely explanations because detected tag numbers had been assigned to specific hatcheries for the purposes of tagging fish to be stocked (bonytail or razorback sucker), but stocking information hadn't been uploaded to STReaMS at the time this report was written.

About 49% of all fish were detected only on return channel antennas loops, which is due to introduction of tagged razorback sucker directly into the return channel (either directly or through the screen return) by Colorado State University (CSU) in April 2023. The purpose of this experiment was to evaluate physical condition of fish passing through the facility via the return channel. Investigators introduced 838 tagged razorback sucker into the Green River Canal, including 689 razorback sucker for evaluation of condition and an additional 149 for evaluation of fish behavior in the channel above the screen. Results specific to these experiments are forthcoming.

Of the 689 fish which were introduced for the condition analysis, 474 were detected in the return channel antennas (3 and 4 combined) for a putative detection rate of about 69%. Of the 474 detections, 447 or 94% were detected only on antenna 3, indicating that antenna 4 isn't detecting or recording fish most of the time.

About 33% of all fish were detected both on the intake and return channel loops, which is consistent with results from 2019 (34%) and 2022 (35%). The relatively low fraction of fish detected on the intake antenna loops in 2023 (19%) could be due to proximity of intake antennas to nearby steel trash racks, which could be interacting with the electromagnetic field of the antenna and reducing efficiency.

No fish were detected in the Green River Canal below the fish screen in 2023, indicating high effectiveness of the structure. Whereas endangered fish entrainment rates in the canal varied during 2013-2018 from 118 to 695 fish per irrigation season (Table 1), entrainment rates since construction of the fish screen in 2019 have been markedly reduced. Two PIT-tagged bonytail were detected in the canal (downstream of the screen) during the 2020 irrigation season, and a single bonytail was detected there in 2021; no fish were detected in the canal during 2019, 2022 and 2023.

While the Green River Canal fish screen has proven to be effective at reducing canal entrainment of large-bodied fish almost completely, nothing is known about its ability to prevent entrainment of fish larvae. Additionally, while effects of return channel hydraulics on condition of large-bodied razorback sucker are currently being investigated, effects on condition of bonytail (a frequent visitor to the facility) are an open question. These two areas of inquiry should be considered by the Biology Committee for potential funding opportunities.

Since antenna systems are known to have detection efficiencies which are less than 100% under

## UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

most conditions, we cannot rule out the possibility that additional entrainment didn't occur with the presence of the canal screen. Despite these caveats, the difference in entrainment rates before and after screen construction indicates that entrainment rates are now markedly reduced over pre-screen levels observed in 2013 through 2018. While the current configuration of the fish screen functions to markedly reduce entrainment from historical levels, it obviously doesn't eliminate it. Exactly how a few fish have bypassed the screen is unknown, but it appears that a fish jumping at the correct angle could conceivably enter the canal through the gap at the bottom of the screen (Figure 1), which is probably less than a meter above the flowing water. The situation could be remedied by affixing a wood or fiberglass panel across the gap to prevent jumping fish from entering the canal.

As a term and condition in the 2017 Biological Opinion on the Green River Canal fish screen, the Fish and Wildlife Service required Reclamation to conduct annual monitoring of fish entrainment in the canal "for at least five years" after construction. This report marks the fifth annual report of such monitoring efforts. Monitoring and annual evaluation of fish use of the screen facility and entrainment should continue indefinitely, but annual reporting will cease after this year.

### **Recommendations:**

- Continue to operate and maintain the Green River Canal fish screen and PIAs
- Evaluate signal strength and overall performance of antennas 1 and 2 in the screen intake area for potential interference by the steel trash rack.
- Evaluate functionality and performance of antenna 4 (return channel) and perform repairs as needed.
- Discuss modifications of the facility with Reclamation facility managers and the Green River Canal Company to keep fish from jumping the gap above the downstream end of the fish screen.
- Consider evaluating ability of the fish screen to prevent entrainment of early life stages of fish (i.e., larvae) and perhaps other species of fishes (e.g. bonytail)

### **Project Status:**

Ongoing.

### **FY 2023 Budget Status**

Funds Provided: see project 179 annual report.

Funds Expended: n/a

Difference: n / a

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

Recovery Program funds spent for publication charges: \$0

# UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

## **Status of Data Submission**

Data are automatically uploaded into STReaMS.

## **Signed:**

/s/Dave Speas

Principal Investigator

Date: Dec 12, 2023

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

Table 1. Detections of PIT-tagged fish in the Green River Canal near Green River, UT during 2013 through 2022. Asterisk (\*) reflects data collected after screen installation in 2019 and indicates fish detected near the fish screen but not entrained in the canal; (\*\*) indicates fish were entrained in the canal that year (see text).

Species	2013	2014	2015	2016	2017	2018	2019*	2020*	2021*	2022*	Total
Flannelmouth sucker	7	6	4	0	4	2	2	5	25	9	54
Bluehead sucker	0	0	0	0	0	1	0	0	0	0	1
FMS x RZB	1	1	0	1	0	0	0	0	4	0	7
Humpback chub	1	1	1	2	0	2	2	2	1	0	12
Bonytail	8	27	77	57	42	20	900	840**	1,187**	35	2353
Colorado pikeminnow	105	22	21	25	24	15	17	36	40	18	323
Razorback sucker	531	304	182	136	174	58	134	99	385	139	2142
Unidentified	42	55	20	19	34	20	22	21	82	272	587
Total	695	416	305	240	278	118	1,077	1,003	1,724	473	6,329

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

Table 2. Detections of PIT-tagged fish in the Green River Canal near Green River, UT during Dec 1, 2022 through Nov 28, 2023 (accessed Nov 28, 2023; <https://streamsystem.org>). See figures 1 and 2 for antenna locations.

	Intake only (antennas 1 and 2)	Return only (antennas 3 and 4)	Intake and return	Canal (antennas 5 and 6)	Total individual fish
Bluehead sucker	0	0	1	0	1
Bonytail	13	4	16	0	33
Colorado pikeminnow	2	0	0	0	2
Flannelmouth sucker	1	0	1	0	2
Razorback sucker	96	533	128	0	757
Unidentified	127	67	252	0	446
Total	239	604	398	0	1,241

# UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM



Figure 1. Green River Canal fish screen in operation, looking downstream. Water flows left to right over the screen (foreground right). Screened water drops into the canal entrance while fish and unscreened water is collected and diverted back to the Green River. Note the gap above downstream end of screen, which could allow jumping fish a means enter the canal. Photo: Ryan Christianson

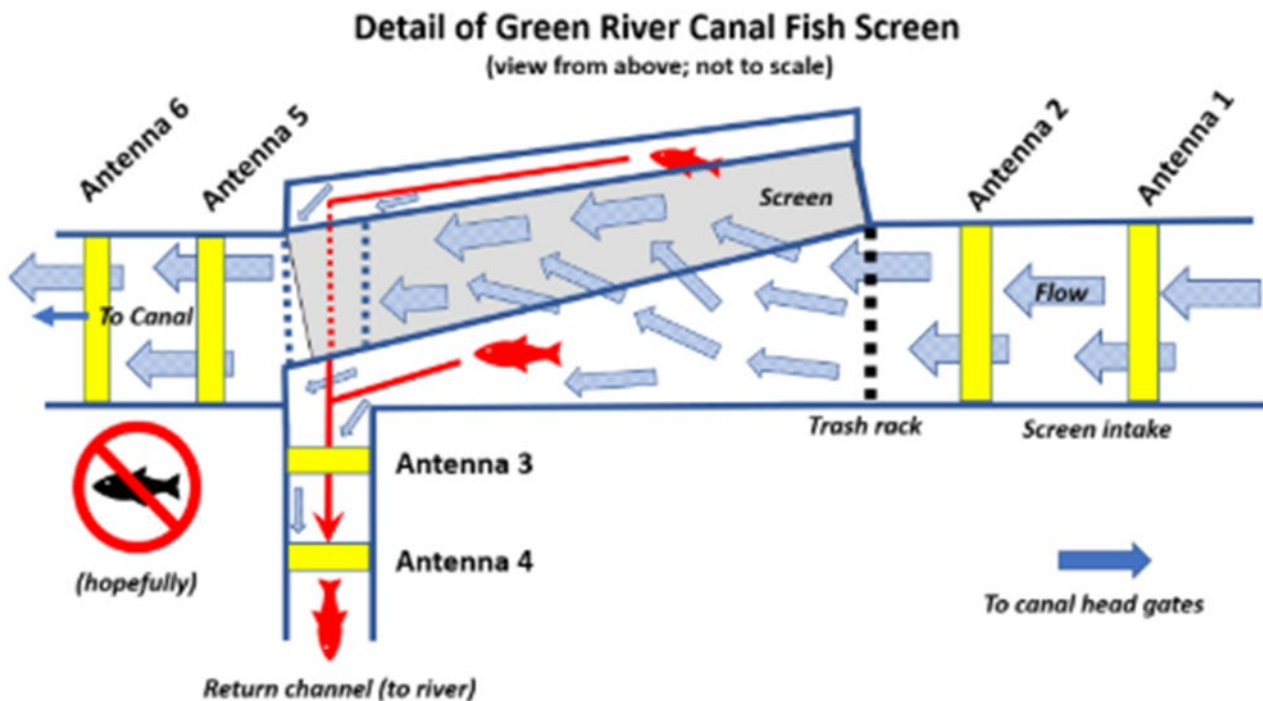


Figure 2. Schematic of the Green River Canal fish screen as viewed from above showing direction of flow (right to left) and location of PIT antennas.