

I. Project Title: **Annual Operation and Maintenance of the Fish Passage Structure at the Government Highline Diversion Dam on the Upper Colorado River and Price Stubb Fish Passage**

II. Bureau of Reclamation Agreement Number: R15PG00083

Project/Grant Period: Start date: 10/1/2014
End date: 9/30/2019
Reporting period end date: 9/30/2019
Is this the final report? Yes _____ No X

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IV. Abstract: The purpose of this project is to collect and summarize annual data on the overall number of large-bodied fish, number of different fish species, and seasonal distribution of fish use at the fish passageway at the Government Highline diversion dam (aka Grand Valley Water Users [GVWU] dam) on the upper Colorado River in Debeque Canyon. This fish passage structure has been operated during 13 of the last 15 years, since construction was completed in August 2004.

In 2019, GVWU Fish Passage was operational from 30 April through 8 July and 10 July through 25 September. The shutdown period was to facilitate sediment removal via trackhoe at the upstream end of the facility near the fish return tube. A total of 11,862 fish used the fish passage over a 146-day period in 2019. One endangered Colorado pikeminnow (*Ptychocheilus lucius*), 16 bonytail (*Gila elegans*), 29 razorback sucker (*Xyrauchen texanus*) and two humpback chub (*Gila cypha*) made passage.

V. Study Schedule: 2004-Ongoing

VI. Relationship to RIPRAP:
Colorado River Action Plan

- II.B. Restore native fish passage at instream barriers.
- II.B2. Restore fish passage at Price Stubb
 - II.B.2.a.(4) Operate and maintain
 - II.B.2.a.(5) Monitor and evaluate success
- II.B.3. Restore fish passage at Government Highline (aka Grand Valley Water

Users).

II.B.3.a.(3). Operate and maintain

VII. Accomplishment of FY 2019 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

GVWU Fish Passage

1. In 2019, 16 bonytail were collected in the GVWU fish trap (Tables 1, 2, and 3). The fish ranged in total length from 215 to 420 mm with a mean of 283 mm. The largest fish did not have a PIT tag when collected. A PIT tag was inserted in this fish prior to release. The remaining 15 bonytail were all stocked in July 2019.
2. In 2019, one Colorado pikeminnow made passage at the GVWU passage. This fish (627 mm TL) did not have a PIT tag when collected. A PIT tag was inserted in this fish prior to release. This is the sixth Colorado pikeminnow to make passage at this facility (Tables 1, 2, and 3).
3. Four humpback chub (*Gila cypha*) also made passage at GVWU passage in 2019 (bringing the total to eleven since this passage began operation). Total lengths ranged from 167 to 220 mm, and all four had PIT tags implanted prior to being released (Tables 1, 2, and 3).
4. In 2019, 29 razorback sucker were collected in the GVWU fish trap (Tables 1, 2 and 3). These fish ranged in total length from 340 to 495 mm with a mean of 447 mm. Ten of these fish have become frequent users of this facility, having made passage in prior years.
5. A total of 11,862 fish were collected in the trap of the GVWU Dam fish passage from 30 April through the 25 September 2019. The highest total ever collected in the trap was in 2014 (24,670) and the second highest total (18,390) was in 2010 (Table 4). This is the thirteenth year of operation since the structure was completed. This facility has been operated for different lengths of time during various times of year, since 2004, thus making specific year-to-year comparisons about yearly catch totals and species composition should be discouraged.

Native fishes (and their hybrid forms) accounted for 78.7% (n = 11,862) of the total catch in 2019 (Table 4). Nonnative fishes (and native by nonnative hybrid fish) accounted for 21.3% (n = 2,523) of the total catch in 2019. Flannelmouth sucker (*Catostomus latipinnis*) accounted for 42.3% (n = 5,013) of the total catch, and bluehead sucker (*Catostomus discobolus*) accounted for 24.8% (n = 2,942) of the total catch during 2019 (Table 1). These two native species have dominated the total catch since the ladder began operation. Roundtail chub (*Gila robusta*) accounted for 10.7% (n = 1,267) of the total catch during 2019. The most prevalent nonnative fish found in the fish trap from 2013 to 2019 was white sucker (*Catostomus commersoni*; 13.8% of total catch, n = 1,641 in 2019; 4.8% of total catch, n = 479 in 2018; 4.8% of total catch, n = 657 in 2017; 4.8% of total catch, n = 756 in 2016; 7.5% of total catch, n = 1,075 in 2015; 22.9% of total catch, n = 5,637 in 2014; 14.9% of total catch, n = 1,999 in 2013). Channel catfish (*Ictalurus punctatus*), which were not

found between GVWU and Price-Stubb dams prior to completion of the non-selective fish passage at Price-Stubb dam in April 2008, were once again collected in the GVWU fish passage during 2019 (n = 61).

6. Thirty-one largemouth bass (*Micropterus salmoides*; largest annual catch; total lengths ranged from 108 to 359 mm with a mean of 242 mm) and 10 smallmouth bass (*Micropterus dolomieu*; second largest annual catch; total lengths ranged from 196 to 295 mm with a mean of 254 mm) were also collected and removed in 2019. No gizzard shad (*Dorosoma cepedianum*) were collected in 2019.
7. All fish found in the fish trap were counted and sorted by species. All native fish, as well as nonnative rainbow (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) were released upstream of GVWU diversion dam. All channel catfish were returned alive immediately downstream from the dam. All other nonnative fish, including native X nonnative hybrid suckers were removed.
8. In 2019, 15 roundtail chub (*Gila robusta*) were collected, euthanized and shipped to USFWS Bozeman Fish Technology Center (lab) to perform health condition profiles for comparison with captive bonytail health condition profiles prior to their stocking. These roundtail chubs' total lengths ranged from 225 to 370 mm with a mean total length of 315 mm. None of these fish had a PIT tag prior to being euthanized.

Price-Stubb Antenna

The Price-Stubb PIT tag antennas (5 miles downstream of GVWU) produced multiple hits on 1,135 unique PIT tags (FY record) during FY 2019 (Table 5); many of these tags were detected on multiple days (n = 2-15). We reported in 2010 (first year of operation) that the close placement of these four antennas in relation to one another (~10 inches apart) complicated determining directionality of fish movements (upstream vs. downstream). In late June of 2011, Audrey Hopkins of Biomark adjusted some of the settings at the unit. She changed the antenna sequence (AS) from 1,2,3,4,0,0,0,0,0,0,0 to 1,3,1,3,1,3,2,4,2,4,2,4 and adjusted the delay time from 100mS to 45mS. These adjustments have provided more resolution for determining directionality of fish movements from detections. Some unknown directions of fish passage still remain, however not as many as were previously encountered. In FY 2019 there were 1,219 daily detections, and 74% (n=899) of those fish passed the antenna heading upstream, 12% (n=151) in an undetermined direction, and 14% (n=169) in a downstream direction. A recurring and problematic issue is that data on many PIT-tagged fish are still not being submitted to STReaMS: 16% (n=178) of the individual tags detected on this antenna array were unknown fish. Bluehead sucker (n=137, *Catostomus discobolus*), bonytail (n=176, *Gila elegans*), Colorado pikeminnow (n=5, *Ptychocheilus lucius*), flannelmouth sucker (n=328, *Catostomus latipinnis*), razorback sucker (n=278, *Xyrauchen texanus*), roundtail chub (n=28, *Gila robusta*), and flannelmouth sucker X bluehead sucker hybrids (n=4) make up the individual PIT tag detections that could be found in STReaMS (many were detected on multiple dates) during FY 2019. Table 5 gives a detailed breakdown of the fish that were detected by the antenna by month, and Table 6 gives annual totals by

species.

Operation and Maintenance

1. In 2015, BOR and GVWU employees used a trackhoe to remove a portion of the river left bank and sediment bar that had deposited over numerous years in front of the upstream fish ladder entrance and fish return tube. However, a prolonged spring runoff combined with multiple spring rainstorm spikes in 2015 re-deposited large amounts of sediment and the upstream sediment bar returned, causing the fish return tube to become unusable during low summer and fall flow periods. In spring 2016 through 2019, GVWU opened the roller closest to the fish passage for several weeks during high spring flows to help sluice away the sediment bar. This worked well for about a month after base flows were reached. Unfortunately, multiple rainstorm spikes combined with deposition of sediment due to low, slow flows on the inside bend of the river in summer 2016 and 2017 again re-deposited large amounts of sediment and by late summer 2016 and 2017, the upstream sediment bar had returned. This once again caused the fish return tube to become unusable during low summer base flow periods, due to fish stranding and or impingement issues. Therefore, our employees moved common native fishes (in a stocking truck) approximately 30 yards downstream, releasing them near the opening for the attraction flow gate (downstream of the terminal end of the sediment bar, but closer to the roller dam) for safe release back to the river for most of the 2015 through 2018 field seasons.

In 2019, GVWU employees used a trackhoe to remove approximately 25 dump-truck loads of river-borne sediment in front of the attraction flow, fish ladder entrances, and fish return tube on 9-10 July. The sediment was hauled to an upland terrestrial site within the fish-way project area for disposal and/or storage. This 'cleanout' was very much needed, and 2019 was the first year since 2015 that the facility operated as it was designed to.

2. Weeds were sprayed and removed from the property throughout 2019.
3. Accumulated debris and trash were manually, and with the use of a trackhoe, removed from the Price-Stubb non-selective fish passage facility 5 miles downstream of the GVWU Fish Passage on 20 August, 2019.

VIII. Additional noteworthy observations:

- a. Ben Schleicher, the San Juan River biologist from our office, wanted to investigate passage use by available PIT tagged fish by deploying submersible PIT antenna (PIA) at the bottom of the GVWU Fish Ladder: one in the middle, and one just before the fish trap at the top end of the ladder. Utilizing this same methodology, researchers working with the San Juan River Basin Recovery Implementation Program determined that the Public Service Company of New Mexico (PNM) Fish Passage Facility was only passing a small percentage of available PIT tagged fish. However, there were no other studies on other fish passage facilities to compare passage rates and determine if there is a design flaw at the San Juan Facility or if there are spatial or

temporal explanations for their results. Unfortunately, there were gear limitations realized through this experiment. The PIAs deployed have a three meter diameter and a read range of about 30 inches in a “noise” free environment (free of metals that disrupt the antenna’s ability to energize the passive tag for reading). These dimensions do not allow for complete coverage of the ladder. In addition, GVWU Fish Passage’s structure is constructed of concrete reinforced with steel rebar, and all of the baffles and additional equipment are made of aluminum and/or stainless steel which create a “noisy” environment (= a reduction in read range) for PIT tag detection. Therefore, the results from this “extra” research are inconclusive. No fish made it to the trap and made passage without being detected by any PIA, however, fish were detected that did not make passage. All three PIAs were up and operational from the 24th of July to the 25th of September and detected 11 unique bluehead sucker, 128 bonytail, 1 Colorado pikeminnow, 8 flannelmouth sucker, 137 razorback sucker, 14 roundtail chub, and 10 unidentifiable tags. Of the 10 unidentifiable tags, 2 tags were distributed to Ouray National Fish Hatchery Grand Valley Unit, 2 tags were distributed to GJ FWCO, and the other 6 tags were not distributed to the program. Sixty-seven (21.7%) of these tags were detected on all three PIA (and were not collected in the trap). For a breakdown of which antenna detected what tags see Table 7.

- b. In a continuation of sampling in 2018, we left the lower PIA in place after shutting the fish passage down last year, to determine how many PIT tagged fish may have been available to passage had we left the passage open over winter. From the 5th of September 2018 (last date reported for FY 18) to 30th of April 2019, we had 3,070 detections on 466 individual PIT tags. These tags belonged to 116 bonytail, 64 flannelmouth sucker, 252 razorback sucker, 3 roundtail chub, 2 tags distributed to Colorado Parks and Wildlife, and 23 tags that were not distributed by the program.

High water during spring runoff this year made it impossible to change batteries and download data from the beginning of May to the middle of July on the lower two PIAs. This intermittent data was not included in the analysis/report as no comparison would be available with the upper antenna. Individual detections for all three antennas are available in STReAMS for this intermittent period. Similar to FY 2018, we have left the lower antenna operational to document how many PIT tagged fish would have potentially used the GVWU fish ladder when it was not operational.

IX. Recommendations:

- a. Biological:
 - i. Continue to collect information on the number of fish, by species, in the fish trap of the GVWU fish passageway in 2020 starting about mid-April and running through mid-October. These tentative dates may need to be adjusted, based upon the ability of the adjacent Grand Valley Water Users canal, as well as the ability of downstream diversions structures to get sufficient quantities of water to fill their canals.
 - ii. Continue collecting data from Price-Stubb antenna.
- b. Operation and Maintenance:
 - i. After successful trackhoe sediment removal in 2019, a similar effort may

not be needed in 2020. Unfortunately, the vegetated bank on river left will eventually reform (as it did in one year following the 2015 sediment removal), as the fish ladder is located on the inside bend of the river, across the river from the GVWU canal head gates, which means that this location will naturally sediment in over time, and manual sediment removal will have to be repeated at some point.

During the spring high flow periods of 2014-2019, GVWU opened the roller closest to the fish passage. The natural sluicing action that this action causes is very effective at removing large amounts of sediment from in front of the fish passage in a very short period of time. Unfortunately, the length of time that the fish passage realizes the benefits from this action can be highly variable, depending upon 1) how low summer base flows are, and 2) how many summer rainstorm events we have. Both circumstances quickly act to re-deposit the sediment bar in front of the fish ladder entrance and return tube. At a bare minimum though, we feel that having GVWU continue to sluice during spring high flow periods by raising the roller closest to the fish passage is highly beneficial.

Because of its physical location, on the inside bend of a very wide and slow section of the Colorado River, the area directly in front of the GVWU fish passage is very susceptible to sedimentation. It is our recommendation that some combination of the two actions specified above be available every spring to help control sedimentation issues. But at the very minimum, we believe the sluicing operations are vital to our ability to continue to successfully operate this structure from mid-April through mid-October each year.

X. Project Status: On track and ongoing

XI. FY 2019 Budget Status

- A. Funds Provided: \$66,078
- B. Funds Expended: \$66,078
- C. Difference: -0-
- D. Percent of the FY 2019 work completed, and projected costs to complete: 100%
- E. Recovery Program funds spent for publication charges: -0-

XII. Status of Data Submission (Where applicable): Data will be uploaded into STReAMS by the end of November, 2019.

XIII. Signed: Travis Francis 10/30/2019
Principal Investigator Date

Table 1. Total number of juvenile and adult fish captured in the fish trap of the passageway at the Grand Valley Water Users Diversion Dam during 2019.

Common Name	Number of Fish	Percent of Total Fish
NATIVE FISH		
bluehead sucker	2,942	24.80
bonytail	16	0.13
Colorado pikeminnow	1	0.01
Colorado cutthroat	0	0.00
flannelmouth sucker	5,013	42.26
humpback chub	4	0.03
mottled sculpin	1	0.01
mountain whitefish	33	0.28
razorback sucker	29	0.24
roundtail chub	1,267	10.68
speckled dace	13	0.11
TOTAL	9,319	78.56
NONNATIVE FISH		
black bullhead	4	0.03
black crappie	0	0.00
bluegill	5	0.04
brook trout	0	0.00
brown trout	73	0.62
channel catfish	61	0.51
common carp	50	0.42
fathead minnow	0	0.00
green sunfish	19	0.16
gizzard shad	0	0.00
lake trout	1	0.01
largemouth bass	31	0.26
longnose sucker	39	0.33
northern pike	0	0.00
rainbow trout	32	0.27
red shiner	4	0.03
smallmouth bass	10	0.08
splake	0	0.00
white sucker	1,641	13.83
TOTAL	1970	16.61
HYBRID FISHES		
Native X Native Hybrids:		
razorback X flannelmouth sucker	0	0.00
bluehead X flannelmouth sucker	20	0.17
Native X Nonnative Hybrids:		
bluegill X green sunfish	1	0.01
bluehead X white sucker	163	1.37
bluehead X flannelmouth X white sucker	1	0.01
Colorado cutthroat X rainbow trout	1	0.01
flannelmouth X white sucker	387	3.26
bluehead X longnose sucker	0	0.00
flannelmouth X longnose sucker	0	0.00
white X longnose sucker	0	0.00
ALL TOTALS	11,862	100.00

Table 2. 2019 GVWU PIT tagged fish histories.

Month of Passage	Species	PIT Tag Histories
May-19	razorback sucker (<i>Xyrauchen texanus</i>) N=2	N=1 stocked 9/8/2016 in Rifle at CO RMI 240.7; detected at Price Stubb April 2019 N=1 PIT tag reader was not working
July-19	bonytail (<i>Gila elegans</i>) N=3	N=2 stocked July 2019 in Rifle at CO RMI 240.7 N=1 tagged July 2019 at GVWU Ladder
	razorback sucker (<i>Xyrauchen texanus</i>) N=3	N=1 stocked 8/31/2016 in Rifle at CO RMI 240.7 N=1 stocked 9/8/2016 in Rifle at CO RMI 240.7; made passage May 2017 at GVWU Ladder and detected at GVWU Ladder August 2018 N=1 stocked 9/12/2018 in Rifle at CO RMI 240.7
August-19	bonytail (<i>Gila elegans</i>) N=7	N=6 stocked 7/16/19 in Palisade at CO RMI 187.7; two were detected August 2019 at Price Stubb CO RMI 188.3 N=1 stocked 7/17/2019 in Rifle at CO RMI 240.7
	Colorado pikeminnow (<i>Ptychocheilus lucius</i>) N=1	N=1 tagged August 2019 at GVWU Ladder
	humpback chub (<i>Gila cypha</i>) N=2	N=2 tagged August 2019 at GVWU Ladder
	razorback sucker (<i>Xyrauchen texanus</i>) N=22	N=1 stocked 10/18/2011 near Rullison at CO RMI 227.6; made passage 2014-2016 at GVWU Ladder and detected at GVWU Ladder July-August 2018 N=2 stocked 10/16/2014 in Rifle at CO RMI 240.7; one made passage July 2017 at GVWU Ladder and detected at GVWU Ladder May-June 2018; one was captured August 2015 at CO RMI 182.3 N=1 tag distributed to ONFH Grand Valley in 2016 N=13 stocked August-September 2016 in Rifle at CO RMI 240.7; one detected April 2019 at Price Stubb CO RMI 188.3; three made passage July-August 2017 at GVWU Ladder; one made passage June 2017 at GVWU Ladder and was detected August 2018 at GVWU Ladder PIA N=1 tagged 7/13/2017 at GVWU Ladder; detected June-August 2018 at GVWU Ladder N=2 stocked 8/29/2017 in Rifle at CO RMI 240.7 N=1 tagged August 2019 at GVWU Ladder N=1 original encounter not found in STReAMS; detected April 2019 at Price Stubb CO RMI 188.3
	roundtail chub (<i>Gila robusta</i>) N=1	N=1 tagged August 2019 at GVWU Ladder for tour demonstration
September-19	bonytail (<i>Gila elegans</i>) N=6	N=1 stocked 7/17/2019 in Fruita at CO RMI 157.1 N=5 stocked 7/16/19 in Palisade at CO RMI 187.7
	humpback chub (<i>Gila cypha</i>) N=2	N=2 tagged September 2019 at GVWU Ladder
	razorback sucker (<i>Xyrauchen texanus</i>) N=2	N=1 stocked 10/16/2014 in Rifle at CO RMI 240.7; one made passage May 2015 at GVWU Ladder N=1 stocked August-September 2016 in Rifle at CO RMI 240.7; one made passage April 2017 at GVWU Ladder and was detected June-July 2018 at GVWU Ladder PIA

Table 3. Number of Colorado pikeminnow, razorback sucker, bonytail and humpback chub captured in the fish trap of the Grand Valley Water User’s passageway from 2005 through 2019.

Year	Colorado pikeminnow	razorback sucker	bonytail	humpback chub
2005	0	1	0	1
2006	0	0	0	0
2007	Fish Passage not operated due to insufficient flows			
2008	0	1	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	22	2
2012	Fish Passage not operated due to insufficient flows			
2013	0	2	0	0
2014	1	25	14	0
2015	1	52	10	0
2016	1	36	44	0
2017	2	130	12	2
2018	0	4	0	2
2019	1	29	16	4
Totals	6	280	118	11

Table 4. Comparison of the total number of fish, total native vs. nonnative fishes, and percent composition of native and nonnative fish captured in the fish trap of the Grand Valley Water User’s passageway between 2005 and 2019.

Year	Total Number of Fish	Total		Percent Composition	
		Native	Nonnative	Native Fishes	Nonnative Fishes
2004	fish passageway & fish trap not run due to insufficient flows				
2005	4,638 ^a	2,867	1,771	61.8	38.2
2006	11,978 ^b	10,747	1,231		
2007	fish passageway run for sediment maintenance only (fish trap not run)				
2008	10,788 ^c	9,663	1,125	89.6	10.4
2009	12,402 ^d	11,286	1,116	91.0	9.0
2010	18,390 ^e	16,358	2,032	89	11
2011	8,875 ^f	6,870	2,005	77.4	22.6
2012	fish passageway & fish trap not run due to insufficient flows				
2013	13,401 ^g	10,702	2,699	79.9	20.1
2014	24,670 ^h	17,253	7,417	69.9	30.1
2015	14,248 ⁱ	12,094	2,154	84.9	15.1
2016	15,889 ^j	13,754	2,135	86.6	13.4

2017	13,581 ^k	11,352	2,229	83.6	16.4
2018	10,210 ^L	9,058	1,152	88.7	11.3
2019	11,862 ^m	9,339	2,523	78.7	21.3
Totals	170,932	141,343	29,589	82.7	17.3
^a Fish trap operated for 12 days (June and September).					
^b Fish trap operated for 41 days (five, 2-week periods).					
^c Fish trap operated continuously from 2 May to 15 October.					
^d Fish trap operated continuously from 20 April to 15 October.					
^e Fish trap operated continuously from 16 April to 15 October.					
^f Fish trap operated continuously from 19 April 19 to 14 October.					
^g Fish trap operated for 49 days (continuously from 17 May to 5 July).					
^h Fish trap operated for 177 days (continuously from 22 April to 16 October).					
ⁱ Fish Trap operated 140 days (continuously from 1 May to 12 August, and again from 9 September to 16 October)					
^j Fish Trap operated 136 days (continuously from 25 April to 13 May, again from 16 May to 8 June, again from 9 June to 28 July, and again from 11 August to 14 October)					
^k Fish Trap operated continuously from 20 April to 20 October					
^L Fish Trap operated for 58 days (continuously from 1 May to 28 June)					
^m Fish Trap operated for 146 days (continuously from 30 April to 8 July, and again 10 July to 25 September)					

Table 5. Price-Stubb PIT Antenna Detections

Month of Detection	Direction	Species	Number of Fish	History
October 2018	Upstream	BT	0	N=5 stocked June 2018 at CO RMI 240.7 N=1 stocked September 2018 at CO RMI 208.5
	Unknown		3	
	Downstream		3	
	Upstream	CS	0	N=1 tagged by USFWS GJ 5/3/2017 detected by PIA at GVWU in June and July 2018
	Unknown		0	
	Downstream		1	
	Upstream	RZ	6	N=1 stocked September 2013 at CO RMI 240.7; captured August 2017 at CO RMI 177.4; detected at Price Stubb August 2017; detected by PIA at GVWU August 2018 N=1 stocked October 2014 at CO RMI 240.7; detected August 2018 at Price Stubb N=1 stocked April 2016 from CDOT at CO RMI 204.5; detected August 2017 at Price Stubb
	Unknown		10	
	Downstream			
			30	

Month of Detection	Direction	Species	Number of Fish	History
				N=1 stocked September 2016 at CO RMI 185.4; captured July 2017 at CO RMI 189.8; detected July 2017 at Price Stubb N=42 stocked September 2018 at CO RMI 240.7
	Upstream	Unidentified	0	N=1 Not distributed by Recovery Programs
	Unknown		0	
	Downstream		1	
	Unknown		1	
	Downstream		1	
November 2018 through February 2019	Upstream	BT	0	N=7 stocked June 2018 at CO RMI 240.7 N=20 stocked September 2018 at CO RMI 208.5
	Unknown		10	
	Downstream		17	
	Upstream	RZ	0	N=2 stocked September 2018 at CO RMI 240.7
	Unknown		0	
	Downstream		2	
	Upstream	Unidentified	0	N=1 Not distributed by Recovery Programs
	Unknown		0	
Downstream	1			
March 2019	Upstream	BH	23	N=17 tagged by CPW for 3 Spp. work in Oct. 2014-2015 between CO RMI 175.3 and 177.7 many were detected multiple times 2014-2018 N=7 tagged by CPW for 3 Spp. work in October 2018
	Unknown		1	
	Downstream		0	
	Upstream	BT	0	N=2 stocked June 2018 at CO RMI 240.7
	Unknown		1	
	Downstream		1	
	Upstream	FM	67	N=15 tagged by CPW for 3 Spp. work in Oct. 2014-2015 between CO RMI 175.3 and 177.7 many were detected multiple times 2014-2018 N=54 tagged by CPW for 3 Spp. work in October 2018
	Unknown		1	
	Downstream		1	
	Upstream	RT	1	N=1 tagged October 2017 in Black Rocks CO RMI 136; detected April 2018 at Price Stubb
	Unknown		0	
	Downstream		0	
	Upstream	RZ	8	N=1 stocked September 2013 at CO RMI 240.7; captured September 2013 at CO RMI 184.6; captured May 2015 at CO RMI 176.9 N=4 stocked October 2014 at CO RMI 240.7 N=2 stocked October 2014 at CO RMI 183.6;
	Unknown		2	
Downstream	6			

Month of Detection	Direction	Species	Number of Fish	History
				one captured October 2014 at CO RMI 177.4 N=4 stocked August-October 2016 at CO RMI 240.7; one detected April 2017 at Price Stubb and two made passage at GVWU Ladder May 2017 N=5 stocked September 2018 at CO RMI 240.7
	Upstream	Unidentified	24	N=24 Not distributed by Recovery Programs many were detected multiple times at Price Stubb 2017-2018
	Unknown		0	
	Downstream		0	
April 2019	Upstream	BH	46	N=30 tagged by CPW for 3 Spp. work in Oct. 2014-2015 between CO RMI 175.3 and 177.7 many were detected multiple times 2014-2018 N=19 tagged by CPW for 3 Spp. work in October 2018
	Unknown		2	
	Downstream		1	
	Upstream	BT	1	N=4 stocked June 2018 at CO RMI 240.7 N=1 stocked September 2018 at CO RMI 208.5
	Unknown		2	
	Downstream		2	
	Upstream	FM	169	N=1 tagged by CPW for 3 Spp. work November 2003 detected at Price Stubb in 2011 and 2016-2018 N=50 tagged by CPW for 3 Spp. work in Oct. 2014-2015 between CO RMI 175.3 and 177.7 many were detected multiple times 2014-2018 N=129 tagged by CPW for 3 Spp. work in October 2018
	Unknown		5	
	Downstream		6	
	Upstream	FXB	1	N=1 tagged by CPW 3 Spp. work October 2018
	Unknown			
	Downstream			
	Upstream	RT	10	N=1 tagged October 2011 in Black Rocks CO RMI 136; detected at Price Stubb many times each year 2012-2018 N=1 tagged September 2016 in Black Rocks CO RMI 136 N=1 tagged September 2016 in WW at CO RMI 121.7 detected at both Price Stubb and GVWU in May-July 2018 N=6 tagged October 2017 in Black Rocks CO RMI 136 and four detected at both Price Stubb and GVWU in May-July 2018 N=1 tagged October 2017 by CPW for 3 Spp. work at CO RMI 219; detected May-July 2018 at GVWU PIA N=1 tagged October 2018 by CPW for 3 Spp. work
	Unknown			
	Downstream		1	
	Upstream	Unidentified	91	N=93 Not distributed by Recovery Programs

Month of Detection	Direction	Species	Number of Fish	History
	Unknown		6	many were detected multiple times at Price Stubb 2017-2018 N=4 distributed to Jenn Logan 2013-2014 N=1 distributed to Mike Gross 2014
	Downstream		1	
April 2019 Continued	Upstream	RZ	56	N=1 stocked September 2011 at GR RMI 255.4 N=3 stocked September 2013 at CO RMI 157.1; one captured April 2014 at CO RMI 166.4 and detected May 2017 at Price Stubb; one captured March 2014 at CO RMI 147.3 N=2 stocked September 2013 at CO RMI 240.7; one captured July 2014 at CO RMI 168.4 N=1 tagged March 2014 at CO RMI 190.8; detected September 2018 at Price Stubb N=7 stocked October 2014 at CO RMI 183.6; one captured August 2017 at CO RMI 126; one captured 2015 and 2017 CO RMI 103-109; one captured May 2015 at CO RMI 162.7; one captured August 2016 at CO RMI 174.7 and detected May 2018 at Price Stubb; one captured October 2014 at CO RMI 167.9; one detected September 2017 on PIA at CO RMI 135.7 N=17 stocked October 2014 at CO RMI 240.7; one captured July 2016 at CO RMI 179; one captured May 2015 at CO RMI 183; one captured September 2015 at CO RMI 193.2; one was salvaged from the canal in 2016 and captured September 2017 at CO RMI 166; four were detected May 2018 at Price Stubb; one captured April 2015 at CO RMI 186; one captured April 2015 at CO RMI 185.7 and detected May 2018 at Price Stubb; one was captured July 2015 at CO RMI 156.6 and September 2015 at CO RMI 183.6 and was detected August 2016 at Price Stubb N=1 tagged May 2015 at CO RMI 91.5; detected May 2018 at Price Stubb N=2 stocked May 2015 at CO RMI 166.7; one captured June 2015 at CO RMI 155.4 N=1 stocked August 2016 at GU RMI 57.1 N=13 stocked September 2016 at CO RMI 185.4; one captured July 2017 at CO RMI 189.8 and detected July 2017 and October 2018 at Price Stubb; one detected August 2018 at Price Stubb N=10 stocked August-September 2016 at CO RMI 240.7; one made passage at GVWU July 2017 and was detected at both Price Stubb
	Unknown		7	
	Downstream		3	

Month of Detection	Direction	Species	Number of Fish	History
				and GVWU July-September 2018 N=1 stocked August 2017 at CO RMI 240.7 N=1 stocked September 2017 at CO RMI 183.6 N=1 stocked April 2018 at CO RMI 204.5 N=5 stocked September 2018 at CO RMI 240.7
May 2019	Upstream	BH	50	N=21 tagged by CPW for 3 Spp. work in Oct. 2014-2015 between CO RMI 175.3 and 177.7 many were detected multiple times 2014-2018 N=36 tagged by CPW for 3 Spp. work in October 2018
	Unknown		5	
	Downstream		2	
	Upstream	CS	2	N=1 tagged June 2010 at CO RMI 15.5; captured May 2013 at CO RMI 179.2 and detected May 2017 and 2018 at Price Stubb N=1 tagged June 2015 at CO RMI 99; detected in May 2017 and 2018 at Price Stubb N=1 tagged August 2017 at GVWU Passage CO RMI 193.7; detected May 2018 at Price Stubb
	Unknown		1	
	Downstream		0	
	Upstream	FM	70	N=27 tagged by CPW for 3 Spp. work in Oct. 2014-2015 between CO RMI 175.3 and 177.7 many were detected multiple times 2014-2018 N=55 tagged by CPW for 3 Spp. work in October 2018
	Unknown		8	
	Downstream		4	
	Upstream	FXB	2	N=2 tagged by CPW 3 Spp. work October 2018
	Unknown		0	
	Downstream		0	
	Upstream	RT	2	N=1 tagged October 2012 at Black Rocks CO RMI 136; detected May 2013 and May 2015-2018 and July 2018 at Price Stubb N=1 tagged October 2016 at Black Rocks CO RMI 136; detected and captured in Black Rocks October 2017 N=1 tagged October 2017 at Black Rocks CO RMI 136; detected May-July 2018 on GVWU PIA and Price Stubb
	Unknown		1	
Downstream	0			
Upstream	Unidenti fied	44	N=48 Not distributed by Recovery Programs many were detected multiple times at Price Stubb 2017-2018 N=1 distributed to Jenn Logan 2013-2014 N=1 distributed to Mike Gross 2018	
Unknown		4		
Downstream		2		
May 2019 Continued	Upstream	RZ	58	N=1 stocked October 2010 at CO RMI 227.6; detected March and May 2015 and May
	Unknown		22	

Month of Detection	Direction	Species	Number of Fish	History
	Downstream		9	<p>2017 at Price Stubb N=1 stocked September 2011 at CO RMI 184.7 N=1 tagged September 2011 at CO RMI 182; captured April 2014 at CO RMI 183.1, detected June 2014 at Price Stubb and capture July 2014 at CO RMI 183.1 N=1 stocked August 2012 at GR RMI 120 N=1 stocked October 2012 at CO RMI 240.7 N=1 tagged June 2013 at CO RMI 175.9 N=1 tagged June 2013 at CO RMI 161.9; captured September 2013 at CO RMI 153.3 and September 2016 at CO RMI 152.6 N=1 stocked October 2014 at GU RMI 57.1; captured August 2015 at CO RMI 124.8 N=21 stocked October 2014 at CO RMI 183.6; one captured May 2015 at CO RMI 162.7; one captured August 2016 at CO RMI 174.7; one captured October 2014 at CO RMI 177.7 and April 2015 at CO RMI 163.1; one captured June 2015 at CO RMI 177.5, July 2016 at CO RMI 173.3, detected May 2017 at Price Stubb and captured August 2017 at CO RMI 174.6; one captured April 2015 at CO RMI 161.9; one detected May 2017 and 2018 at Price Stubb; one captured October 2014 at CO RMI 177.7 and captured July 2017 at CO RMI 112.1 N=14 stocked October 2014 at CO RMI 240.7; one captured August 2018 at CO RMI 163.4; one captured August 2018 at CO RMI 169; one captured April 2015 at CO RMI 154.7 and captured July 2017 at CO RMI 177.4; one captured June 2015 at CO RMI 155.8 N=1 stocked April 2015 at GU RMI 57.1 N=4 stocked May 2015 at CO RMI 166.7; one captured July 2016 at CO RMI 154.2 N=1 stocked June 2016 at CO RMI 204.5 N=1 tagged August 2016 at CO RMI 171.9 N=10 stocked September 2016 at CO RMI 185.4; one captured August 2018 at CO RMI 156.9; one detected April 2017 at Price Stubb; one captured July 2017 at CO RMI 163.6; one captured July 2017 at CO RMI 184.2 N=1 stocked September 2016 at CO RMI 157.1 N=11 stocked August-September 2016 at CO RMI 240.7; one detected September 2016 at</p>

Month of Detection	Direction	Species	Number of Fish	History
				Price Stubb; one detected November 2016 at Price Stubb; one made passage at GVWU Ladder August 2017; one made passage at GVWU Ladder May 2017 N=3 stocked September 2017 at CO RMI 183.6 N=14 stocked September 2018 at CO RMI 240.7
June 2019	Upstream	BH	0	N=3 tagged by CPW for 3 Spp. work in Oct. 2014-2015 between CO RMI 175.3 and 177.7 many were detected multiple times 2014-2018
	Unknown		0	
	Downstream		3	
	Upstream	BT	0	N=2 stocked September 2015 at CO RMI 195
	Unknown		1	
	Downstream		1	
	Upstream	CS	1	N=1 tagged June 2016 at CO RMI 51.9; detected August-September 2016 at Tusher Diversion GR RMI 128.3
	Unknown		0	
	Downstream		0	
	Upstream	FM	2	N=9 tagged by CPW for 3 Spp. work in Oct. 2014-2015 between CO RMI 175.3 and 177.7 many were detected multiple times 2014-2018 N=4 tagged by CPW for 3 Spp. work in October 2018
	Unknown		5	
	Downstream		6	
	Upstream	FXB	1	N=1 tagged by CPW 3 Spp. work October 2018
	Unknown		0	
	Downstream		0	
	Upstream	RZ	0	N=1 stocked April 2015 at CO RMI 240.7 N=2 stocked August-September 2016 at CO RMI 240.7; one was captured twice in July-August 2017 near CO RMI 190 and was detected at both Price Stubb and GVWU Ladder PIA June-July 2018 N=1 stocked August 2017 at CO RMI 240.7 N=6 stocked September 2018 at CO RMI 240.7
	Unknown		8	
Downstream	2			
Upstream	Unidentified	3	N=10 Not distributed by Recovery Programs many were detected multiple times at Price Stubb 2017-2018	
Unknown		2		
Downstream		5		
July 2019	Upstream	BH	6	N=1 tagged by CPW for 3 Spp. work in Oct. 2014-2015 between CO RMI 175.3 and 177.7 many were detected multiple times 2014-2018 N=7 tagged by CPW for 3 Spp. work in October 2018
	Unknown		2	
	Downstream		0	
	Upstream	BT	4	N=1 stocked June 2018 at CO RMI 183.6 N=1 stocked June 2018 at CO RMI 240.7 N=1 stocked July 2019 at CO RMI 187.7 N=8 stocked July 2019 at CO RMI 240.7
	Unknown		1	
	Downstream		6	

Month of Detection	Direction	Species	Number of Fish	History	
	Upstream	FM	0	N=2 tagged by CPW for 3 Spp. work in October 2018	
	Unknown		1		
	Downstream		1		
	Upstream	RT	8	N=1 tagged September 2008 in WW at CO RMI 120; detected July 2011 at Price Stubb, captured September 2011 in WW CO RMI 119.8, detected many times 2012-2016 at Price Stubb, detected twice September-October 2017 in Black Rocks CO RMI 136 on PIA and detected May 2018 at Price Stubb N=2 tagged September 2016 in Black Rocks CO RMI 136 N=2 tagged October 2017 in WW at CO RMI 120-123.5; one detected June-July at GVWU Ladder PIA N=4 tagged October 2017 in Black Rocks CO RMI 136; one detected May-June 2018 at Price Stubb and GVWU Ladder PIA; one detected May 2018 at Price Stubb N=2 tagged by CPW for 3 Spp. work in October 2018	
	Unknown		2		
	Downstream		1		
	Upstream	RZ	0	N=1 stocked September 2018 at CO RMI 240.7	
	Unknown		1		
	Downstream		0		
	Upstream	Unidentified	2	N=2 Not distributed by Recovery Programs many were detected multiple times at Price Stubb 2017-2018	
Unknown	0				
Downstream	0				
August 2019	Upstream	BH	0	N=1 tagged by CPW for 3 Spp. work in Oct. 2014-2015 between CO RMI 175.3 and 177.7 many were detected multiple times 2014-2018	
	Unknown		1		
	Downstream		0		
	Upstream	BT	40	N=2 stocked June 2018 at CO RMI 240.7 N=4 stocked July 2019 at CO RMI 157.1 N=38 stocked July 2019 at CO RMI 187.7 N=3 stocked July 2019 at CO RMI 240.7	
	Unknown		4		
	Downstream		3		
	Upstream	RT	0	N=1 tagged October 2017 in Black Rocks CO RMI 136; one detected May and July 2018 at Price Stubb	
	Unknown		0		
	Downstream		1		
	Upstream	RZ	1	N=1 stocked August 2016 at CO RMI 240.7	
	Unknown		0		
	Downstream		0		
Upstream	Unidentified	0	N=1 distributed to Mike Gross 2018		
Unknown		0			
Downstream		1			
September 2019	Upstream	BH	0	N=1 tagged by CPW for 3 Spp. work in October 2018	
	Unknown		0		

Month of Detection	Direction	Species	Number of Fish	History
	Downstream		1	
	Upstream	BT	66	N=9 stocked July 2019 at CO RMI 157.1 N=67 stocked July 2019 at CO RMI 187.7 N=3 stocked July 2019 at CO RMI 240.7
	Unknown		11	
	Downstream		2	
	Upstream	RT	1	N=1 tagged by CPW for 3 Spp. work in Oct. 2014-2015 between CO RMI 175.3 and 177.7 N=2 tagged October 2017 in Black Rocks at CO RMI 136; one detected May 2018 at Price Stubb; one detected May-July 2018 at both Price Stubb and GVWU Ladder PIA
	Unknown		0	
	Downstream		2	
	Upstream	RZ	8	N=1 stocked October 2014 at CO RMI 240.7; detected August 2018 at Price Stubb N=4 stocked August-September 2016 at CO RMI 240.7; one made passage at GVWU Passage July 2017 and was detected by PIA at the same location in June 2018; one was detected June 2018 at Price Stubb and GVWU Ladder PIA N=1 stocked August 2017 at CO RMI 240.7 N=1 stocked September 2018 at CO RMI 240.7 N=49 stocked September 2019 at CO RMI 240.7
	Unknown		15	
	Downstream		33	
	Upstream	Unidentified	6	N=2 Not distributed by Recovery Programs many were detected multiple times at Price Stubb 2017-2018 N=7 distributed to Mike Gross 2018-2019
	Unknown		1	
	Downstream		2	

Table 6 Price Stubb Fiscal Year PIT Antenna Detections

Species	BH	BT	CS	FXB	FM	HB	RT	RZ
# of Individuals FY2010***	0	0	2	0	0	0	6	0
# of Individuals FY2011**	0	16	1	0	1	0	19	83
# of Individuals FY2012**	0	88	8	0	3	1	36	135
# of Individuals FY2013**	0	138	2	0	1	0	79	239
# of Individuals FY2014**	0	114	3	0	1	0	29	69
# of Individuals FY2015**	106	22	4	0	251	0	19	19
# of Individuals FY2016**	67	126	13	0	245	0	21	36
# of Individuals FY2017**	88	66	21	0	103	0	16	140
# of Individuals FY2018**	70	71	11	0	73	0	29	81
# of Individuals FY2019**	137	176	5	4	328	0	28	278
Grand total¹	468	817	70	4	1,006	1	282	1,080
	¹ Many of these fish were detected at Price Stubb in multiple years							
	* Antenna was only in operation for 1.5 months during FY 2010							
	** Some of these fish were detected in more than one month during the fiscal year							

Table 7. 2019 GVWU Portable Submersible PIT Antenna Detections

	bluehead sucker	bonytail	Colorado pikeminnow	flannelmouth sucker	razorback sucker	roundtail chub	UNIDENTIFIED *	INDIVIDUAL TOTAL	PERCENT OF TOTAL
LOWER ONLY	2	42	1	4	74	6	4	133	43.0420712
MIDDLE ONLY	0	0	0	0	1	0	0	1	0.323624595
UPPER ONLY	0	1	0	0	0	0	0	1	0.323624595
TRAP ONLY	0	0	0	0	0	0	0	0	0
LOWER + MIDDLE	3	9	0	3	23	4	4	46	14.88673139
LOWER + UPPER	1	15	0	0	1	1	0	18	5.825242718
LOWER + TRAP	0	0	0	0	6	0	0	6	1.941747573
LOWER + MIDDLE + UPPER	4	44	0	1	13	3	2	67	21.6828479
LOWER + MIDDLE + TRAP	0	1	0	0	15	0	0	16	5.177993528
LOWER + UPPER + TRAP	0	2	0	0	0	0	0	2	0.647249191
ALL 4	0	6	0	0	2	0	0	8	2.588996764
MIDDLE + UPPER	1	4	0	0	0	0	0	5	1.618122977
MIDDLE + TRAP	0	0	0	0	2	0	0	2	0.647249191
MIDDLE + UPPER + TRAP	0	3	0	0	0	0	0	3	0.970873786
UPPER + TRAP	0	1	0	0	0	0	0	1	0.323624595
INDIVIDUAL TOTAL	11	128	1	8	137	14	10	309	
PERCENT OF TOTAL	3.55987055	41.42394822	0.323624595	2.588996764	44.33656958	4.530744337	3.236245955		
* Most of these fish are flannelmouth and bluehead sucker that would not be checked for a PIT tag in the fish trap									