

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(s): R15PG00083

Project/Grant Period: Start date (Mo/Day/Yr): 10/1/2014  
End date: (Mo/Day/Yr): 9/30/2019  
Reporting period end date: 9/30/2018  
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 number of large-bodied fish, fish species, and seasonal distribution of fish that use 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 12 of the last 14 years (construction was completed in August 2004).

In 2018, GVWU Fish Passage was operational from 1 May through 28 June when the structure was closed because of low base flows in the river. A total of 10,210 fish used the fish passage over a 58-day period in 2018. This is a high total number of fish considering the short period that the facility was operated. Four endangered razorback sucker (*Xyrauchen texanus*) and two humpback chub (*Gila cypha*; bringing the total to seven since the passage began operation) made passage.

V. Study Schedule: 2004-Ongoing

VI. Relationship to RIPRAP:  
Colorado River Action Plan  
Colorado River

II.B.3.a (4). Operate, monitor, and evaluate the success of fish passage at Government Highline Diversion Dam.

VII. Accomplishment of FY 2018 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

## GVWU Fish Passage

1. In 2018, four razorback sucker were collected in the Government Highline fish trap (Appendix; Tables 1, 2 and 3). The fish ranged in total length from 367 to 444 mm with a mean of 403 mm. Two of the fish have become frequent users of this facility making passage in prior years.
2. Two humpback chub (*Gila cypha*) also made passage at GVWU passage in 2018 (bringing the total to seven since the passage began operation). Total lengths were 196 and 184 mm and both were tagged on this encounter. The first humpback chub to make passage occurred the first year of passage operation (2005), two made passage in 2011, and two more made passage in 2017.
3. A total of 10,210 fish were collected in the trap of the Government Highline Diversion Dam fish passage from 1 May through the 28 June 2018. The highest total ever collected in the trap was in 2014 (24,670) and the second highest total was in 2010 (18,390) (Appendix; Table 4). The facility was only operated for 58 days (2018) because spring run-off was short in duration and in magnitude leading to below average base flows. In this hydrologic scenario all of the available water to operate the ladder is called for by downstream water users; therefore, the ladder is shut down. This is the twelfth 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, and we suggest that making specific year-to-year comparisons about yearly catch totals and species composition should be discouraged.

Native fishes (and their hybrid forms) accounted for 88.7% (9,058) of the total catch in 2018 (Appendix; Table 4). Nonnative fishes (and native by nonnative hybrid fish) accounted for 11.3% (1,152) of the total catch in 2018. Bluehead sucker (*Catostomus discobolus*) accounted for 38.1% (3,888) of the total catch and flannelmouth sucker (*Catostomus latipinnis*) accounted for 32.3% (3,299) of the total catch during 2018 (Appendix; Table 1). These two native species have dominated the total catch since the ladder began operation. Roundtail chub (*Gila robusta*) accounted for 17.2% (n = 1,760) of the total catch during 2018. The most prevalent nonnative fish found in the fish trap from 2013 to 2018 was white sucker (*Catostomus commersoni*; 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 Government Highline 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 Government Highline fish passage during 2018 (n = 32).

4. One gizzard shad (*Dorosoma cepedianum*), 2 largemouth bass (*Micropterus salmoides*), and 3 smallmouth bass (*Micropterus dolomieu*) were also collected and removed in 2018.
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 Government Highline 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.

### Price-Stubb Antenna

The Price-Stubb PIT tag antennas produced multiple hits on 664 unique PIT tags during FY 2018 (Table 5), many of these tags were detected on multiple days (n = 2-5). 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. The direction of movement of some fish through the passage still remain unknown, however not as many as were previously encountered. In FY 2018; there were 765 daily detections and 69% (n=525) of those fish passed the antenna heading upstream, 13% (n=102) in an undetermined direction, and 18% (n=138) in a downstream direction. A recurring and problematic issue is that data on many PIT-tagged fish are still not being submitted to STReaMS, 49.5% (n=329) of the individual tags detected on this antenna array were unknown fish. Bluehead sucker (n=70, *Catostomus discobolus*), bonytail (n=71, *Gila elegans*), Colorado pikeminnow (n=11, *Ptychocheilus lucius*), flannelmouth sucker (n=73, *Catostomus latipinnis*), razorback sucker (n=81, *Xyrauchen texanus*), and roundtail chub (n=29, *Gila robusta*), make up the individual PIT tag detections that could be found in STReaMS (many were detected on multiple dates) during FY 2018. 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 and 2017, 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 employee's 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 contrast, endangered fishes were transported upstream several hundred yards (again in a stocking truck) where they were released upstream of the sediment bar. This required transferring endangered fish from the stocking truck to the river in hand-held nets through fairly thick vegetation, one at a time, to the river's edge where they could be safely released.

2. Weeds were sprayed and removed from the property throughout 2018.
3. Accumulated debris and trash were manually removed from the Price-Stubbs non-selective fish passage facility 5 miles downstream of the Government Highline Fish Passage in early July 2018.

VIII. Additional noteworthy observations:

- A. Ben Schleicher, a San Juan Biologist in our office, wanted to investigate passage use by available PIT tagged fish by deploying submersible PIT antenna (PIA) at the bottom of the Government Highline Fish Ladder, one in the middle, and one just before the fish trap at the top end of the ladder. Researchers working with the San Juan River Basin Recovery Implementation Program determined that the Public Service Company of New Mexico Fish Passage Facility was only passing a small percentage of available PIT tagged fish utilizing this same methodology. 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 PIA 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, Government Highline Fish Passage's structure is constructed of concrete reinforced with steel rebar and all of the baffles and additional equipment is made of aluminum and/or stainless steel all of which create a "noisy" environment (a reduction in read range) for PIT tag detection. Therefore, the results from this "extra" research are inconclusive. Fish made it to the trap and made passage that were not detected by any PIA (two razorback sucker), and fish were detected that may not have made passage. The PIA were deployed from the 25<sup>th</sup> of May to the 28<sup>th</sup> of June and detected sixteen unique roundtail chub, one bonytail, three Colorado pikeminnow, 53 razorback sucker, four bluehead sucker, two flannelmouth sucker, one tag that was distributed to Ouray National Fish Hatchery Grand Valley Unit, two tags that were distributed to Brian Hines with Utah Division of Wildlife Resources Moab, three tags that were distributed to Jenn Logan with Colorado Parks and Wildlife, one tag that was distributed to G.J. FWCO, and 26 tags that were not distributed by the program. Only seven (6%) 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. We left the lower PIA in place, after shutting the fish passage down, to determine

how many PIT tagged fish may have been available to passage had we left the passage open. From the 29<sup>th</sup> of June to 5<sup>th</sup> of September, 126 individual PIT tags were detected. These tags belonged to one bonytail, three Colorado pikeminnow, six roundtail chub, 89 razorback sucker, eighteen tags distributed to Ouray National Fish Hatchery Grand Valley Unit, one tag that was distributed to Brian Hines with Utah Division of Wildlife Resources Moab, and eight tags that were not distributed by the program.

IX. Recommendations:

A. Biological:

1. Continue to collect information on the number of fish, by species, in the fish trap of the Government Highline fish passageway in 2019 starting about 15 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.
2. Continue collecting data from Price-Stubbs antenna.

B. Operation and Maintenance:

1. In past years it has been stated in this section of our annual report that “to maintain optimum performance of the fish passageway, sediment maintenance should be performed on as needed basis to remove sediment and debris from the forebay of the fishway and attraction flow intakes to prevent buildup and compaction of sediment.”

It is our opinion that the large, heavily-vegetated portion of the riverbank on river left immediately upstream of and adjacent to the upstream fish ladder openings should at some point be further removed (a much larger section than was removed during the 2015 removal effort) during early spring 2019, just prior to high flows. This heavily-vegetated portion of the river bank now redirects a significant amount of the river flow away from the upstream fish ladder openings and leads to heavy sedimentation in front of the upstream portions of the fish passage. The upstream fish return tube (a 12-inch pipe, immediately adjacent to the entrance of the fish ladder) has become almost impossible to use (even after trackhoe removal in 2015) during low flow periods due to the massive sediment peninsula that keeps rebuilding in front of it.

During low flow periods from 2016 through 2018, native and endangered fish being returned upstream had to be loaded by hand from the concrete fish sorting tanks at the fish ladder into a stock tank

in the back of a pickup truck, then driven downstream (to the attraction flow head gate) or upstream of the sediment bar (endangered fish only) in order to prevent the fish stranding and/or impingement resulting in probable death that would have resulted had the fish return tube been used on those occasions. Unfortunately, this release site is ~30 yards closer to the dam, increasing the likelihood of fish being swept back downstream. This was stressful on both the fish and the biologists, especially on several days when total numbers of fish being handled in the ladder exceeded 1,000 individuals and ambient air temperatures exceeded 95 degrees.

Having been on-site when similar (smaller volume) sediment removal work was done in 2015 leads us to believe that further vegetation and sediment removal along the heavily-vegetated riverbank could be done from the river left shoreline using a long-reach trackhoe. It's our opinion that such a maintenance activity would help reduce sedimentation problems which occur annually in front of the upstream fish passage opening, fish return tube, and attraction flow opening. Unfortunately, even if this maintenance action is done, 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 overtime and manual sediment removal will have to be repeated at some point.

During the spring 2014, 2016, 2017 and 2018 high flow periods, 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 critical.

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 Government Highline fish passage is very susceptible to sedimentation. It is our recommendation that some combination of the two actions specified above take place 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 2018 Budget Status

A. Funds Provided: \$64,775

B. Funds Expended: \$64,775

C. Difference: -0-

D. Percent of the FY 2018 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 has been uploaded into STReaMS.

XIII. Signed: Travis Francis 10/16/2018  
Principal Investigator Date

APPENDIX:

**Table 1.** Total number of juvenile and adult fish captured in the fish trap of the passageway at the Government Highline Diversion Dam during 2018.

<b>Common Name</b>	<b>Number of Fish</b>	<b>Percent of Total Fish</b>
<b>NATIVE FISH</b>		
bluehead sucker	3,888	38.08
bonytail	0	0.00
Colorado pikeminnow	0	0.00
Colorado cutthroat	0	0.00
flannelmouth sucker	3,299	32.31
humpback chub	2	0.02
mountain whitefish	61	0.60
razorback sucker	3	0.03
roundtail chub	1,760	17.24
speckled dace	20	0.20
<b>TOTAL</b>	<b>9,033</b>	<b>88.47</b>
<b>NONNATIVE FISH</b>		
black bullhead	24	0.24
black crappie	0	0.00
blue gill	0	0.00
brook trout	0	0.00
brown trout	55	0.54
channel catfish	32	0.31
common carp	26	0.25
fathead minnow	0	0.00
green sunfish	2	0.02
gizzard shad	1	0.01
largemouth bass	2	0.02
longnose sucker	34	0.33
northern pike	0	0.00
rainbow trout	38	0.37
red shiner	0	0.00
smallmouth bass	3	0.03
splake	0	0.00
white sucker	479	4.69
<b>TOTAL</b>	<b>696</b>	<b>6.82</b>
<b>HYBRID FISHES</b>		
<u>Native X Native Hybrids:</u>		
razorback X flannelmouth sucker	0	0.00
bluehead X flannelmouth sucker	25	0.24
<u>Native X Nonnative Hybrids:</u>		
bluehead X white sucker	161	1.58
bluehead X flannelmouth X white sucker	1	0.01
Colorado cutthroat X rainbow trout	0	0.00
flannelmouth X white sucker	294	2.88
bluehead X longnose sucker	0	0.00
flannelmouth X longnose sucker	0	0.00
white X longnose sucker	0	0.00
<b>ALL TOTALS</b>	<b>10,210</b>	<b>100.00</b>

**Table 2.** 2018 GVWU PIT tagged fish histories.

Month of Passage	Species	PIT Tag Histories
May-18	humpback chub ( <i>Gila cypha</i> ) N=2	N=2 tagged GVWU passage in 2018
	razorback sucker ( <i>Xyrauchen texanus</i> ) N=1	N=1 stocked 10/16/2014 in Rifle at CO RMI 240.7, 7/25/2016 made passage at GVWU dam (CO RMI 193.7)
Jun-18	razorback sucker ( <i>Xyrauchen texanus</i> ) N=3	N=1 tagged at GVWU passage in 2018 N=1 stocked 8/31/2016 in Rifle at CO RMI 240.7, 6/30/2017 made passage at GVWU dam (CO RMI 193.7)

**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 2018.

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
<b>Totals</b>	<b>5</b>	<b>251</b>	<b>102</b>	<b>7</b>

**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 2018.

<b>Year</b>	<b>Total Number of Fish</b>	<b>Total Native</b>	<b>Total Nonnative</b>	<b>Percent Composition</b>	
				<b>Native Fishes</b>	<b>Nonnative Fishes</b>
2004	fish passageway & fish trap not run due to insufficient flows				
2005	4,638 <sup>a</sup>	2,867	1,771	61.8	38.2
2006	11,978 <sup>b</sup>	10,747	1,231	89.7	10.3
2007	fish passageway run for sediment maintenance only (fish trap not run)				
2008	10,788 <sup>c</sup>	9,663	1,125	89.6	10.4
2009	12,402 <sup>d</sup>	11,286	1,116	91.0	9.0
2010	18,390 <sup>e</sup>	16,358	2,032	89.0	11.0
2011	8,875 <sup>f</sup>	6,870	2,005	77.4	22.6
2012	fish passageway & fish trap not run due to insufficient flows				
2013	13,401 <sup>g</sup>	10,702	2,699	79.9	20.1
2014	24,670 <sup>h</sup>	17,253	7,417	69.9	30.1
2015	14,248 <sup>i</sup>	12,094	2,154	84.9	15.1
2016	15,889 <sup>j</sup>	13,754	2,135	86.6	13.4
2017	13,581 <sup>k</sup>	11,352	2,229	83.6	16.4
2018	10,210 <sup>L</sup>	9,058	1,152	88.7	11.3
<b>Totals</b>	<b>159,070</b>	<b>132,004</b>	<b>27,066</b>	<b>83.0</b>	<b>17.0</b>

<sup>a</sup> Fish trap operated for 12 days (June and September).

<sup>b</sup> Fish trap operated for 41 days (five, 2-week periods).

<sup>c</sup> Fish trap operated continuously from 2 May to 15 October.

<sup>d</sup> Fish trap operated continuously from 20 April to 15 October.

<sup>e</sup> Fish trap operated continuously from 16 April to 15 October.

<sup>f</sup> Fish trap operated continuously from 19 April 19 to 14 October.

<sup>g</sup> Fish trap operated for 49 days (continuously from 17 May to 5 July).

<sup>h</sup> Fish trap operated for 177 days (continuously from 22 April to 16 October).

<sup>i</sup> Fish Trap operated 140 days (continuously from 1 May to 12 August, and again from 9 September to 16 October)

<sup>j</sup> 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)

<sup>k</sup> Fish Trap operated continuously from 20 April to 20 October

<sup>L</sup> Fish Trap operated for 58 days (continuously from 1 May to 28 June)

**Table 5 Price Stubb PIT Antenna Detections**

Month of Detection	Direction	Species	Number of Fish	History
October 2017	Upstream	BH	0	N=2 tagged by CPW for 3 Spp. work in Oct. 2014 at CO RMI 175.3
	Unknown		0	
	Downstream		0	
	Upstream	BT	2	N=1 stocked 7/20/2017 at CO RMI 166.7 N=1 stocked 7/12/2017 at CO RMI 183.6 N=2 stocked 9/6/2017 at CO RMI 208.5
	Unknown		1	
	Downstream		1	
	Upstream	FM	1	N=1 tagged by CPW for 3 Spp. work in Oct. 2014 at CO RMI 177.7; detected at Price Stubb April 2015, and May 2017
	Unknown		0	
	Downstream		0	
	Upstream	RZ	0	N=1 stocked August 2017 at CO RMI 240.7
	Unknown		1	
	Downstream		0	
	Upstream	RT	1	N=1 Tagged 10/11/2011 at Black Rocks CO RMI 136; detected at Price Stubb multiple times in 2014, 2015, 2016 and 2017 N=1 tagged 9/9/2016 at Black Rocks CO RMI 136 detected at Price Stubb in 2017
	Unknown		0	
Downstream	1			
November and December 2017	Upstream	BT	1	N=45 stocked 9/6/2017 at CO RMI 208.5 N=1 stocked 7/18/2017 at CO RMI 183.6
	Unknown		18	
	Downstream		27	
	Upstream	FM	0	N=1 tagged by CPW for 3 Spp. work in Oct. 2014 at CO RMI 177.7; detected at Price Stubb March 2015
	Unknown		1	
	Downstream		0	
	Upstream	RZ	1	N=2 stocked 8/29/2017 at CO RMI 240.7 N=1 stocked 8/31/2016 at CO RMI 240.7
	Unknown		0	
	Downstream		2	
	Upstream	Unidentified	0	N=1 Not distributed by Recovery Programs
Unknown	0			
Downstream	1			
January and February 2018	Upstream	BT	0	N=13 stocked 9/6/2017 at CO RMI 208.5
	Unknown		6	
	Downstream		7	
	Upstream	RZ	0	N=11 stocked August 2017 at CO RMI 240.7
	Unknown		6	
	Downstream		5	
	Upstream	Unidentified	0	N=2 Not distributed by Recovery Programs
	Unknown		1	
Downstream	1			

**Table 5 cont.**

Month of Detection	Direction	Species	Number of Fish	History
March 2018	Upstream	BH	9	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
	Unknown		0	
	Downstream		0	
	Upstream	BT	0	N=2 stocked 9/6/2017 at CO RMI 208.5
	Unknown		1	
	Downstream		1	
	Upstream	FM	4	N=4 tagged by CPW for 3 Spp. work in Oct. 2014 between CO RMI 175.3 and 177.7 many were detected multiple times 2014-2018
	Unknown		0	
	Downstream		0	
	Upstream	RZ	1	N=1 stocked 10/16/2014 at CO RMI 240.7, was detected at Price Stubb August 2016 and recaptured 8/30/2017 at CO RMI 175.6 N=2 stocked 9/8/2016 at CO RMI 240.7
	Unknown		0	
	Downstream		0	
	Upstream	Unidentified	22	N=16 Not distributed by Recovery Programs; many detected multiple times at Price Stubb 2015-2018 N=7 distributed to Jenn Logan CPW in 2013 or 2014 for 3 Spp. Work; many detected multiple times at Price Stubb 2014-2018
	Unknown		0	
	Downstream		1	

**Table 5 cont.**

Month of Detection	Direction	Species	Number of Fish	History
April 2018	Upstream	BH	14	N=16 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		1	
	Upstream	FM	15	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
	Unknown		2	
	Downstream		4	
	Upstream	RT	2	N=1 tagged 10/11/2011 at Black Rocks CO RMI 136, detected at Price Stubb each year 2014-2018 N=1 tagged 10/18/2017 at Black Rocks CO RMI 136
	Unknown		0	
	Downstream		0	
	Upstream	RZ	4	N=1 stocked 8/29/2013 at CO RMI 240.7 made passage at GVWU Fish Ladder CO RMI 193.7 each year 2014-2017 N=1 stocked 10/3/2014 at CO RMI 183.6 N=1 stocked 10/16/2014 at CO RMI 240.7 N=1 stocked 9/8/2016 at CO RMI 240.7 N=4 stocked August 2017 at CO RMI 240.7
	Unknown		2	
	Downstream		2	
	Upstream	Unidentified	52	N=41 Not distributed by Recovery Programs; many detected multiple times at Price Stubb 2015-2018 N=23 distributed to Jenn Logan CPW in 2013 or 2014 for 3 Spp. Work; many detected multiple times at Price Stubb 2014-2018
	Unknown		5	
	Downstream		7	



**Table 5 cont.**

Month of Detection	Direction	Species	Number of Fish	History
May 2018	Upstream	BH	40	N=44 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		2	
	Downstream		2	
	Upstream	BT	0	N=2 stocked June or July 2017 at CO RMI 183.6
	Unknown		2	
	Downstream		0	
	Upstream	CS	3	N=1 tagged 6/2/2010 at CO RMI 15.5, recaptured 5/21/2013 at CO RMI 179.2 and detected 5/31/2017 at Price Stubb N=1 tagged 5/17/2013 at CO RMI 58.2, recaptured 4/9/2015 at CO RMI 55.7 and detected 5/7/2017 at Price Stubb N=1 tagged 7/23/2013 at CO RMI 103.1, detected 10/20/2016 at CO RMI 135.7 N=1 tagged 6/19/2015 at CO RMI 99, detected 5/29/2017 at Price Stubb N=1 tagged 8/3/2017 at GVWU Passage CO RMI 193.7
	Unknown		2	
	Downstream		0	
	Upstream		42	
	Unknown		2	
	Downstream	FM	4	N=47 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=1 tagged 7/17/2014 by CPW for 3 Spp. work at Roubideau Creek

**Table 5 cont.**

Month of Detection	Direction	Species	Number of Fish	History
May 2018 Cont.	Upstream	RT	19	<p>N=1 tagged 9/29/2008 at Black Rocks CO RMI 136, detected 2011-2014 and 2016 at Price Stubb and recaptured 9/30/2011 in Westwater CO RMI 119.8 and detected in September and October 2017 in Black Rocks</p> <p>N=1 tagged 10/27/2011 at Black Rocks CO RMI 136, detected 2013, 2016 and 2017 at Price Stubb</p> <p>N=2 tagged October 2012 at Black Rocks RMI 136; one detected each year 2013-2016 at Price Stubb</p> <p>N=1 tagged October 2014 at Black Rocks CO RMI 136, detected 2016 and 2017 at Price Stubb</p> <p>N=3 tagged September 2016 at Black Rocks CO RMI 136, three detected at Price Stubb in 2017</p> <p>N=13 tagged October 2017 at Black Rocks CO RMI 136</p>
	Unknown		1	
	Downstream		1	
	Upstream	Unidentified	166	
	Unknown		8	
	Downstream		13	

**Table 5 cont.**

Month of Detection	Direction	Species	Number of Fish	History
May 2018 Cont.	Upstream	RZ	22	<p>N=1 stocked 9/11/2013 at CO RMI 240.7, recaptured 7/7/2017 at CO RMI 191.5</p> <p>N=1 stocked 6/6/2014 at CO RMI 204.5, recaptured twice July 2014 ~ CO RMI 183.0</p> <p>N=4 stocked 10/3/2014 at CO RMI 183.6; one detected 5/26/2017 at Price Stubb</p> <p>N=9 stocked 10/16/2014 at CO RMI 240.7; one was recaptured 4/3/2015 at CO RMI 185.7, one was recaptured 6/16/2015 at CO RMI 169.9, one was recaptured 8/29/2016 at CO RMI 174.7, one made passage at GVWU Ladder 8/8/2016 and 7/27/2017 CO RMI 193.7 and was recaptured 7/21/2017 at CO RMI 190.5, one recaptured 10/21/2015 at CO RMI 178.1</p> <p>N=1 tagged in the field 5/13/2015 at CO RMI 91.5</p> <p>N=4 stocked 5/12/2015 at CO RMI 166.7; one recaptured 8/4/2017 at CO RMI 154.8, one recaptured 6/30/2015 at CO RMI 154 and detected 9/27/2017 at Price Stubb</p> <p>N=2 stocked 4/27/2016 at CO RMI 204.5; one detected 6/3/2016 at Price Stubb and made passage twice 2016 and 2017 at GVWU Passage CO RMI 193.7</p> <p>N=5 stocked August or September 2016 at CO RMI 240.7; one made passage at GVWU Ladder 7/13/2017 at CO RMI 193.7, two were detected July or August 2017 at Price Stubb</p> <p>N=1 stocked 9/14/2016 at CO RMI 185.4</p> <p>N=1 stocked 5/30/2017 at CO RMI 204.5</p> <p>N=6 stocked August 2017 at CO RMI 240.7</p> <p>N=1 stocked 4/25/2018 at CO RMI 204.5</p>
	Unknown		6	
	Downstream		7	

**Table 5 cont.**

Month of Detection	Direction	Species	Number of Fish	History
June 2018	Upstream	BH	3	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		0	
	Upstream	BT	1	N=2 stocked 7/12/2017 at CO RMI 183.6
	Unknown		1	
	Downstream		0	
	Upstream	CS	2	N=1 tagged 5/1/2000 at CO RMI 183.3, recaptured 2000, 2003, twice in 2005, 2008-2010 (each year) and 2014 within 10 miles of tagging location N=1 tagged 5/1/2003 at CO RMI 58.3, recaptured 2004 and 2005 near same location, recaptured 2009, twice in 2013 and once in 2016 CO RMI 169-180 N=2 tagged 6/23/2016 at CO RMI 48.9 and 52
	Unknown		0	
	Downstream		2	
	Upstream	RT	5	N=1 tagged 10/18/2014 at Black Rocks CO RMI 136 N=1 tagged 10/12/2016 in Westwater at CO RMI 123.5, recaptured 10/17/2017 at Black Rocks CO RMI 136 N=4 tagged October 2017 at Black Rocks CO RMI 136
	Unknown		0	
	Downstream		1	

**Table 5 cont.**

Month of Detection	Direction	Species	Number of Fish	History	
June 2018 Cont.	Upstream	RZ	6	N=1 stocked 10/3/2014 at CO RMI 183.6 N=1 stocked 10/16/2014 at CO RMI 240.7 N=1 stocked 4/27/2016 at CO RMI 204.5, made passage at Price Stubb July 2017 and GVWU Ladder 8/4/2017 CO RMI 193.7 N=3 stocked August or September 2016 at CO RMI 240.7; one recaptured 7/21/2017 at CO RMI 189.8 and mad passage 8/7/2017 at GVWU Ladder CO RMI 193.7, one detected August 2017 at Price Stubb and made passage 8/2/2017 at GVWU Ladder CO RMI 193.7 N=1 stocked 9/14/2016 at CO RMI 185.4 N=1 stocked 6/2/2017 at CO RMI 204.5, made passage 7/13/2017 at GVWU Ladder at CO RMI 193.7 N=1 stocked 8/29/2017 at CO RMI 240.7	
	Unknown		3		
	Downstream		0		
	Upstream	Unidentified	11		N=11 Not distributed by Recovery Programs; many detected multiple times at Price Stubb 2015-2018 N=4 distributed to Jenn Logan CPW in 2013 or 2014 for 3 Spp. Work; many detected multiple times at Price Stubb 2014-2018 N=1 distributed 1/10/2017 to Brian Hine UDWR Moab N=3 distributed to ONFH GV 2/16/2018
	Unknown		5		
	Downstream		3		

**Table 5 cont.**

Month of Detection	Direction	Species	Number of Fish	History
July 2018	Upstream	BH	1	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		0	
	Downstream		0	
	Upstream	BT	0	N=1 stocked 7/6/2016 at CO RMI 183.6
	Unknown		0	
	Downstream		1	
	Upstream	CS	0	N=1 tagged 5/1/2003 at CO RMI 58.3, recaptured 2004 and 2005 near same location, recaptured 2009, twice in 2013 and once in 2016 CO RMI 169-180
	Unknown		0	
	Downstream		1	
	Upstream	RT	1	N=1 tagged 10/11/2011 at Black Rocks CO RMI 136, detected each year 2014-2017 at Price Stubb N=1 tagged 10/11/2012 at Black Rocks CO RMI 136, detected 2013 and 2015-2017 (each year) at Price Stubb N=2 tagged September 2016 at Black Rocks CO RMI 136, both detected 2017 at Price Stubb N=2 tagged October 2016 in Westwater at CO RMI 120-124; one recaptured 10/17/2017 at Black Rocks CO RMI 136 N=6 tagged October 2017 at Black Rocks CO RMI 136
	Unknown		3	
	Downstream		8	
	Upstream		2	
	Unknown		0	
	Downstream	RZ	0	N=1 stocked 10/16/2014 at CO RMI 240.7, recaptured 7/12/2017 at CO RMI 186.2 N=1 stocked 8/31/2016 at CO RMI 240.7, made passage 7/10/2017 at GVWU Ladder CO RMI 193.7
Upstream	10			
Unknown	0			
Downstream	Unidentified	2	N=2 Not distributed by Recovery Programs; many detected multiple times at Price Stubb 2015-2018 N=10 distributed to ONFH GV 2/16/2018	
Upstream		0		
Downstream		2		

**Table 5 cont.**

Month of Detection	Direction	Species	Number of Fish	History
August 2018	Upstream	CS	1	N=1 tagged 7/28/2016 at Redlands Fish Ladder GU RMI 3.0 translocated same day to Escalante GU RMI 42.7
	Unknown		0	
	Downstream		0	
	Upstream	FM	1	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		0	
	Downstream		0	
	Upstream	RZ	6	N=3 stocked 10/16/2014 at CO RMI 240.7; one recaptured 5/4/2015 at CO RMI 183 N=1 stocked 9/14/2016 at CO RMI 185.4 N=1 stocked 4/28/2017 at CO RMI 204.5 N=1 stocked 8/29/2017 at CO RMI 240.7 N=1 stocked 4/25/2018 at CO RMI 204.5
	Unknown		0	
	Downstream		1	
	Upstream	Unidentified	6	N=3 Not distributed by Recovery Programs; many detected multiple times at Price Stubb 2015-2018 N=1 distributed to Jenn Logan CPW in 2013 or 2014 for 3 Spp. Work; many detected multiple times at Price Stubb 2014-2018 N=3 distributed to ONFH GV 2/16/2018 N=1 distributed to GJ FWCO 4/1/2013
	Unknown		0	
	Downstream		2	

**Table 5 cont.**

Month of Detection	Direction	Species	Number of Fish	History
September 2018	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		0	
	Downstream		1	
	Upstream	CS	0	N=1 tagged 4/9/2015 at CO RMI 61.3
	Unknown		0	
	Downstream		1	
	Upstream	RZ	2	N=1 tagged in the field 3/28/2014 at CO RMI 190.8 N=1 stocked 9/16/2014 at CO RMI 240.7 N=1 stocked 5/30/2017 at CO RMI 204.5 N=1 stocked 8/29/2017 at CO RMI 240.7
	Unknown		1	
	Downstream		1	
	Upstream	Unidentified	4	N=1 Not distributed by Recovery Programs; many detected multiple times at Price Stubb 2015-2018 N=44 distributed to ONFH GV 2/16/2018
	Unknown		17	
	Downstream		24	

**Table 6 Price Stubb Fiscal Year Monthly PIT Antenna Detections**

Species	BH	BT	CS	FM	HB	RT	RZ
# of Individuals FY2010***	0	0	2	0	0	6	0
# of Individuals FY2011**	0	16	1	1	0	19	83
# of Individuals FY2012**	0	88	8	3	1	36	135
# of Individuals FY2013**	0	138	2	1	0	79	239
# of Individuals FY2014**	0	114	3	1	0	29	69
# of Individuals FY2015**	106	22	4	251	0	19	19
# of Individuals FY2016**	67	126	13	245	0	21	36
# of Individuals FY2017**	88	66	21	103	0	16	140
# of Individuals FY2018**	70	71	11	73	0	29	81
<b>Grand total<sup>1</sup></b>	331	641	65	678	1	254	802
<sup>1</sup> 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.** 2018 GVWU Portable Submersible PIT Antenna Detections

	Bluehead Sucker*	Bonytail	Colorado Pikeminnow	Flannelmouth Sucker*	Roundtail Chub	Razorback Sucker	Unidentified*	Individual Total	Percent of Total
Lower Antenna Only	2	0	2	1	5	40	10	60	53.57142857
Middle Antenna Only	0	0	1	0	0	2	2	5	4.464285714
Upper Antenna Only	0	0	0	0	0	0	1	1	0.892857143
Fish Trap Only	0	0	0	0	0	2	0	2	1.785714286
Lower + Middle	2	1	0	0	9	7	15	34	30.35714286
Lower + Upper	0	0	0	1	0	0	0	1	0.892857143
Lower + Trap	0	0	0	0	0	1	0	1	0.892857143
Lower + Middle + Upper	0	0	0	0	2	0	5	7	6.25
Lower + Middle + Trap	0	0	0	0	0	1	0	1	0.892857143
Lower + Upper + Trap	0	0	0	0	0	0	0	0	0
All - Lower + Middle + Upper + Trap	0	0	0	0	0	0	0	0	0
Middle + Upper	0	0	0	0	0	0	0	0	0
Middle + Trap	0	0	0	0	0	0	0	0	0
Upper + Trap	0	0	0	0	0	0	0	0	0
Individual Total	4	1	3	2	16	53	33	<b>112</b>	
Percent of Total	3.571428571	0.892857143	2.678571429	1.785714286	14.28571429	47.32142857	29.46428571		

\* Most of these fish are Flannelmouth and Bluehead Sucker that would not be checked for a PIT tag in the fish trap