

## BLUE RIVER BARRIER MONITORING, 2017



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## Background

Native fishes are declining throughout Arizona, primarily due to deleterious interactions with nonnative aquatic species. One tool used to curtail the decline is the construction of stream barriers to impede upstream migration of nonnative fish species. The Bureau of Reclamation (Reclamation) has constructed several barriers on stream sites to protect and conserve endangered and candidate/proposed species including: Loach Minnow *Tiaroga cobitis*, Spikedace *Meda fulgida*, Roundtail Chub *Gila Robusta*, and Gila Chub *Gila Intermedia* (undergoing taxonomic review/revision), and other aquatic wildlife including amphibians and reptiles. Reclamation is committed to monitoring stream barriers constructed in accordance with requirements related to the Central Arizona Project for a minimum of five years post-construction. The primary purpose of the monitoring is to evaluate the effectiveness of the barriers. Secondarily, monitoring will also provide information on the fish/aquatic community of each stream. Funding was provided to the Arizona Fish and Wildlife Conservation Office to monitor barrier effectiveness over a five year period.

This report details the fourth year of monitoring on the Blue River, including barrier monitoring and sampling and data collection consistent with Arizona Game and Fish Department's annual monitoring efforts on Blue River as a whole. The Blue River is a tributary to the San Francisco River and the much larger Gila River Basin. Native fish historically present in the stream were longfin dace *Agosia chrysogaster*, speckled dace *Rhinichthys osculus*, loach minnow, Sonora sucker *Catostomus insignis*, and desert sucker *Pantosteus clarki* (Minckley & Marsh 2009). Spikedace and Roundtail chub were introduced in 2012 to expand their current population. Constructed in 2012, the barrier on the Blue River is located 0.8 kilometers above its confluence with the San Francisco River. The purpose of the barrier is to provide nonnative free habitat for endangered Loach Minnow and Spikedace, Roundtail Chub, and other native species (Reclamation 2013).

## Methodology

### *Barrier Monitoring*

Sampling was conducted with a Smith-Root type 24A backpack electrofisher to monitor upstream and downstream of the barrier. Methods roughly followed Marsh (2014), in which 200 meters (m) of stream was sampled below the barrier and 200 m above the barrier with a single pass of backpack electrofishing. Mesohabitat (number of pools, riffles, and runs) were quantified for each sampling reach. All fish were measured (in millimeters [mm]) and nonnative fish found above barriers were enumerated and euthanized. Presence of other native aquatic wildlife such as Lowland Leopard Frog *Lithobates yavapaiensis* or Narrow-headed Garter Snake *Thamnophis rufipunctatus* were also noted. Target nonnative species (those species large enough to insert a PIT tag) below barriers were tagged with 134 kHz PIT tags, and 0.91 m x 0.61 m remote PIT scanners will be deployed above barriers in subsequent years to detect upstream movement of fish past the barrier.

### *Blue River Monitoring*

In addition to barrier monitoring, AZFWCO conducted annual monitoring of Reach 1 in the Blue River which stretches from the barrier upstream to the Pat Mesa Tributary. Annual monitoring in Blue River

followed protocols detailed in the Blue River Monitoring Plan (AZGFD et. al. 2012). Arizona Game and Fish Department divided Reach 1 of the Blue River into 24-200 m backpack electrofishing transects and labeled 22 pools deemed too deep to effectively backpack electrofish (AZGFD et. al. 2012). AZFWCO randomly selected 3-200 meter transects for backpack electrofishing and seven pools for deployment of hoop nets (Table 2; Figure 1).

Transects were delineated by mesohabitat types (run, riffle, pool, and cascade) and electrofishing occurred upstream with one electrofisher and two netters. At the end of each mesohabitat within the transect, fish were identified to species, total length (TL) was measured (millimeters [mm]) and electrofishing seconds (sec) and distance (meters [m]) were recorded before sampling the next mesohabitat. Electrofishing ceased at the end of the 200 m transect. Hoop nets (50-60 cm diameter, 100 cm long, a single 10 cm throat, 6 mm nylon mesh netting) were baited with dog food and deployed with the throat of the hoop net facing downstream at the seven randomly selected pools in the afternoon and retrieved the next day.

## Results

We visited the Blue River on November 14 and 15, 2017. The weather was characterized by warm sunny days. The USGS stream gauge at the Juan Miller Crossing USGS recorded a discharge of 4.5 cubic feet per second (cfs) and water was clear with great visibility for backpack electrofishing.

### *Barrier Monitoring*

Macro-habitat for the 200 m downstream transect was predominately comprised of riffle habitat with the exception of a 10 m pool at the beginning of the transect and a pool that comprised the final five meters up to the base of the barrier. A total of 71 individuals, four native and four nonnative species, were captured in 923 sec of electrofishing including: native Longfin Dace, Sonora Sucker, Desert Sucker, and Speckled Dace and nonnative Red Shiner *Cyprinella lutrensis*, Channel Catfish *Ictalurus punctatus*, Green Sunfish *Lepomis Cyanellus*, and Fathead Minnow *Pimephales promelas* (Table 2). The majority of the fish captured were native Longfin Dace and nonnative Red Shiner with low catch rates of the other six species (Table 2). There were two large Channel Catfish present in the pool directly below the barrier which may be concerning in high flow events in which upstream movement may be possible. All Channel Catfish and the single Green Sunfish were PIT tagged and released downstream of the barrier (Appendix).

Macro-habitat 200 m upstream of the barrier was comprised of run-pool habitat with some undercut banks in the upper 50 m of the transect. A total of 70 individuals, five native species and no nonnative species, were collected in 976 sec of electrofishing including: Longfin Dace, Sonora Sucker, Roundtail Chub, Desert Sucker, and Speckled Dace. The majority of fish captured were Longfin Dace with moderate numbers of Roundtail Chub and Speckled Dace and low numbers of Sonora and Desert Sucker (Table 2).

### *Randomly Selected Transects*

The furthest downstream transect was comprised of three mesohabitats: 131 m of riffle habitat, 52 m of run habitat, and 23 m of pool habitat (Table 3). A total of 146 fish, including six native species, were captured in 1049 sec of electrofishing. The majority of fish captured were Speckled Dace and Desert Sucker, with moderate numbers of Longfin dace, Sonora Sucker, and Roundtail chub, and eight Spikedace (Table 4).



**Photo. Two endangered fish, Loach Minnow (top) and Spikedace (bottom) captured in the Blue River, AZ.**

The middle transect was comprised of four mesohabitats: 100 m of pool habitat, 76 m of run habitat, 26 m of riffle habitat, and eight meters of cascade habitat (Table 3). A total of 46 fish, including six native species, were captured in 736 sec of electrofishing. The majority of fish captured were Sonora Sucker and Roundtail Chub, with low numbers of Longfin Dace, Desert Sucker, and Speckled Dace, and one Spikedace (Table 4).

The furthest upstream transect was comprised of three habitats: 108 m of riffle habitat, 58 meter of pool/run habitat, and 37 meter of pool habitat (Table 3). A total of 88 fish, including seven native species, were captured in 847 sec of electrofishing. The majority of fish captured were Longfin Dace, Speckled Dace, and Desert Sucker, with moderate numbers of Longfin Dace, Sonora Sucker, and Spikedace, and one Loach Minnow (Table 4).

### *Hoop Netting*

A total of seven hoop nets were placed in seven randomly selected pools. Hoop nets captured a total of 133 fish and four species including: 31 Sonora Sucker, 96 Roundtail Chub, four Spikedace, and two Desert Sucker. Overall, hoop nets were more effective at collecting larger Roundtail Chub which was most evident in pools 16 and 17, the two most upstream net sets. They each collected four chub over 200 mm in total length.

### *Population Structure*

When combining all sampling, Roundtail Chub encompassed the majority of the catch (Table 6). Longfin Dace, Sonora Sucker, Desert Sucker, and Speckled Dace had almost identical catch numbers. Of the two endangered fish there were a total of 26 Spikedace and one Loach Minnow captured. The large-bodied fish (i.e. Sonora Sucker, Desert Sucker and Roundtail Chub) were mostly comprised of small young-of-year and sub-adult fish (Table 6; Figure 1). The majority of Roundtail Chub were less than 100 mm with

the only fish greater than 100 mm being captured in hoop nets (Table 5; Figure 1). This suggests that Roundtail Chub have successfully reproduced and recruited since the species was stocked in the Blue River in 2012. The other stocked fish, Spikedace, has also shown signs of recruitment with individuals measured as small as 32 mm.

## **Discussion**

Although direct comparisons with previous sampling events lack statistical power, inferences can be made. In 2012, the first year of monitoring, the only native fish encountered was Longfin Dace. In subsequent years, diversity increased, particularly after stocking of Roundtail Chub, Spikedace, and Loach Minnow. Roundtail Chub catch per unit effort (CPUE) increased on an order of magnitude and the latter two were detected for the first time this year in the four years of monitoring. Catch ratio of natives to nonnatives also increased dramatically with the catch ratio being less than 1:1 in the first year after barrier construction and is now 10:1 with native fish dominating the fish community (Table 7). Additionally, no nonnatives were captured above the barrier as observed in previous years, indicating abundance may be decreasing and suggests that the barrier is functioning as intended.

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**Table 1. Locations of randomly selected transects and pools for backpack electrofishing and deployment of hoop nets, respectively.**

	<b>Sampling Site</b>	<b>Easting</b>	<b>Northing</b>
<b>Transect</b>	5	667861	3677151
	15	668158	3678338
	19	668538	3678309
<b>Pool</b>	1	668199	3676758
	7	667488	3677713
	11	668246	3678210
	14	668473	3678133
	15	668458	3678216
	16	668562	3678324
	17	668572	3678386

**Table 2. Summary of fish captured in barrier monitoring efforts on the Blue River, AZ. Site refers to downstream and upstream of the barrier. CPUE refers to catch per second of electrofishing effort for 923 sec of backpack electrofishing downstream and 976 sec of backpack electrofishing upstream of the barrier. \*Denotes native species.**

<b>Site</b>	<b>Species</b>	<b>Number Collected</b>	<b>CPUE</b>	<b>Mean TL (Range [mm])</b>
<b>Downstream</b>	Longfin Dace*	27	0.029	60 (28-76)
	Sonora Sucker*	3	0.003	73 (58-89)
	Red Shiner	26	0.028	44 (34-66)
	Channel Catfish	5	0.005	402 (105-630)
	Green Sunfish	1	0.001	130 (130-130)
	Desert Sucker*	6	0.007	55 (24-69)
	Fathead Minnow	1	0.001	49 (49-49)
	Speckled Dace*	2	0.002	50 (41-59)
	<b>TOTAL</b>	<b>71</b>	<b>0.077</b>	<b>-</b>
<b>Upstream</b>	Longfin Dace*	27	0.028	55 (31-73)
	Sonora Sucker*	8	0.008	104 (68-283)
	Roundtail Chub*	12	0.012	61 (47-71)
	Desert Sucker*	5	0.005	75 (71-79)
	Speckled Dace*	18	0.018	50 (36-66)
	<b>TOTAL</b>	<b>70</b>	<b>0.071</b>	<b>-</b>

**Table 3. Summary of backpack electrofishing effort and mesohabitat at three randomly selected transects Reach 1 of the Blue River, AZ.**

<b>Transect</b>	<b>Habitat</b>	<b>Seconds</b>	<b>Distance Sampled (m)</b>
5	Riffle	211	48
	Run	232	33
	Riffle	157	35
	Pool	126	23
	Riffle	90	17
	Run	94	19
	Riffle	139	31
15	Pool	332	82
	Run	115	23
	Cascade	60	8
	Run	128	53
	Riffle	35	26
	Pool	66	18
19	Pool	175	37
	Riffle	89	17
	Pool/Run	230	58
	Riffle	353	91

**Table 4. Summary of fish collected with backpack electrofishing at three randomly selected transects on Reach 1 of the Blue River, AZ. CPUE refers to Catch Per Second of Electrofishing in 1049, 736, and 847 seconds for transects 5, 15, and 19 respectively.**

<b>Transect</b>	<b>Species</b>	<b>Number Collected</b>	<b>CPUE</b>	<b>Mean TL (range [mm])</b>
<b>5</b>	Longfin Dace	12	0.011	43 (29-64)
	Sonora Sucker	23	0.021	99 (71-360)
	Roundtail Chub	12	0.011	58 (48-75)
	Spikedace	8	0.008	52 (42-65)
	Desert Sucker	43	0.040	94 (38-205)
	Speckled Dace	48	0.046	40 (29-72)
	Total	146	0.139	-
<b>15</b>	Longfin Dace	5	0.007	55 (47-68)
	Sonora Sucker	15	0.020	73 (48-88)
	Roundtail Chub	16	0.021	54 (44-65)
	Spikedace	1	0.001	32 (32-32)
	Desert Sucker	8	0.011	98 (65-135)
	Speckled Dace	1	0.001	45 (45-45)
	Total	46	0.063	-
<b>19</b>	Longfin Dace	19	0.022	56 (31-68)
	Sonora Sucker	9	0.011	164 (67-331)
	Roundtail Chub	6	0.007	56 (44-78)
	Spikedace	13	0.015	56 (41-72)
	Desert Sucker	23	0.027	90 (61-145)
	Speckled Dace	17	0.020	49 (31-81)
	Loach Minnow	1	0.001	51 (51-51)
Total	88	0.104	-	

**Table 5. Summary of fish collected in hoop nets at seven randomly selected pools in Reach 1 of the Blue River, AZ.**

<b>Pool</b>	<b>Species</b>	<b>Number Collected</b>	<b>Mean TL (range [mm])</b>
<b>1</b>	Sonora Sucker	5	91 (70-141)
	Roundtail Chub	1	70 (70-70)
	Desert Sucker	2	81 (70-91)
<b>7</b>	Sonora Sucker	7	73 (65-92)
	Roundtail Chub	18	59 (50-82)
<b>11</b>	Sonora Sucker	1	241 (241-241)
	Roundtail Chub	2	138 (134-141)
<b>14</b>	Sonora Sucker	6	176 (140-248)
	Roundtail Chub	15	67 (48-170)
<b>15</b>	Sonora Sucker	5	84 (74-89)
	Roundtail Chub	54	54 (42-75)
	Spikedace	4	52 (51-54)
<b>16</b>	Sonora Sucker	2	104 (83-125)
	Roundtail Chub	4	230 (215-267)
<b>17</b>	Sonora Sucker	5	170 (75-221)
	Roundtail Chub	2	268 (262-273)

**Table 6. Summary of native fish captured across all sampling conducted in Reach 1 of the Blue River, AZ.**

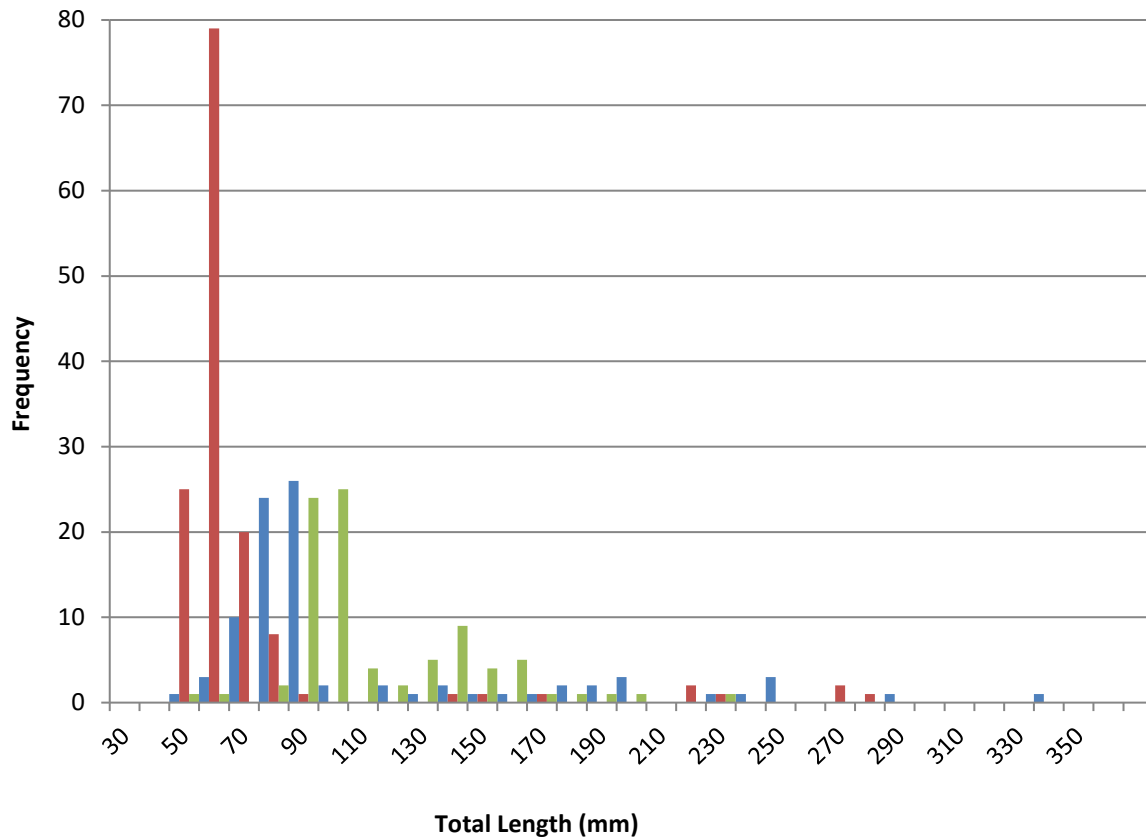
<b>Species</b>	<b>Number Collected</b>	<b>Relative Abundance</b>	<b>Mean TL (mm)</b>	<b>Minimum TL (mm)</b>	<b>Maximum TL (mm)</b>
<b>Longfin Dace</b>	90	0.16	55.24	28	76
<b>Sonora Sucker</b>	89	0.16	108.44	48	360
<b>Roundtail Chub</b>	142	0.26	66.08	42	273
<b>Spikedace</b>	26	0.05	53.08	32	72
<b>Desert Sucker</b>	87	0.16	89.13	24	205
<b>Speckled Dace</b>	86	0.16	44.44	29	81
<b>Loach Minnow</b>	1	0.00	51.00	51	51
<b>TOTAL</b>	554				

**Table 7. Summary of catch data collected on the Blue River barrier over four years. Data for 2012, 2013, and 2014 were derived from Marsh et. al. (2012), Marsh et. al. (2013), and Marsh et. al. (2014) respectively. CPUE refers to Catch Per Second of Electrofishing. Catch Ratio is the number of natives to nonnatives captured with the assumption that higher numbers means more natives were present. \*Denotes a native species.**

	Species	2012		2013		2014		2017	
		Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE
<b>Upstream</b>	Fathead Minnow	28	0.238	10	0.013	22	0.022		
	Green Sunfish	11	0.019	1	0.001				
	Red Shiner					2	0.002		
	Longfin Dace*	21	0.032	150	0.193	237	0.261	64	0.069
	Speckled Dace*							84	0.085
	Spikedace*							22	0.024
	Loach Minnow*							1	0.001
	Sonora Sucker*			3	0.003	8	0.009	55	0.06
	Desert Sucker*					31	0.035	79	0.083
	Roundtail Chub*					4	0.005	46	0.051
<b>Downstream</b>	Red Shiner					1	0.002	26	0.028
	Channel Catfish					2	0.004	5	0.005
	Yellow Bullhead	3	0.031			3	0.006		
	Fathead Minnow	13	0.133					1	0.001
	Green Sunfish	5	0.036					1	0.001
	Western Mosquitofish	12	0.077						
	Longfin Dace*	2	0.02	11	0.014	23	0.048	27	0.029
	Speckled Dace*			6	0.008			2	0.002
	Desert Sucker*					1	0.002	6	0.007
	Sonora Sucker*							3	0.003
<b>TOTAL</b>		<b>95</b>	<b>0.586</b>	<b>181</b>	<b>0.232</b>	<b>334</b>	<b>0.396</b>	<b>422</b>	<b>0.449</b>
<b>Catch Ratio</b>		<b>0.32</b>		<b>15.45</b>		<b>10.13</b>		<b>11.79</b>	



Figure 1. Map of the sampling area with sampling sites marked as yellow for electrofishing transects and red for hoop net deployments in the Blue River, AZ.



**Figure 2. Length-frequency histogram of the three large bodied species, Roundtail Chub (Red), Sonora Sucker (Blue), and Desert Sucker (Green), captured in the Blue River, AZ.**

**Appendix. List of PIT Tags inserted into nonnative fish below the Blue River Barrier.**

<b>Species</b>	<b>TL</b>	<b>PIT tags</b>
Channel Catfish	570	003C0228E3
Channel Catfish	602	003C0228C0
Channel Catfish	630	003C0228C8
Channel Catfish	105	003C0228BF
Channel Catfish	105	003C02288F
Green Sunfish	130	003C0228B3