Bonita Creek Fish Monitoring
May 29 – June 1, 2018

Jacob J. Rennert, Taylor F. Haas, and Benjamin J. Miller

Marsh & Associates, LLC
5016 S. Ash Avenue, Suite 108
Tempe, Arizona 85282

Final Report Submitted to

Bureau of Land Management
Safford, Arizona

August 30, 2018

BONITA CREEK FISH MONITORING
May 29 – June 1, 2018

Marsh & Associates (M&A) with assistance from Bureau of Land Management (BLM) visited lower Bonita Creek, Graham Co., Arizona to sample fishes from May 29 to June 1, 2018. This monitoring is part of a long-term program initiated by BLM to evaluate relationships between populations of native and non-native fishes in this stream.

Methods

Collections were made by hoop net (0.66 m diameter, 1.2 m long, two-hoop, single throat, 0.6 cm mesh), minnow trap (standard "Gee," 25 cm diameter, 47 cm long, double throat, 0.6 or 0.3 cm mesh; or collapsible "Promar" traps, 0.3 m diameter, 0.6 and 0.9 m long, double throat, 1.2 cm mesh). Traps were set with an air pocket to prevent inadvertent drowning of non-target air-breathing animals. Gee and Promar traps were set in pairs with enough space in between to not interfere with another nets ability to catch fish. Netting effort during this trip was distributed throughout Zone 1 (between 1st and 2nd road crossings), Zone 2 (between 2nd and 3rd road crossings), Zone 3 (between 3rd and 4th road crossings), Zone 4 (between 4th and 5th road crossings), and Zone 5 (between 5th and 6th road crossings). The order of habitats from upstream to downstream is as follows:

- Zone 5: Remaining habitats
- Zone 5: Across from city campground
- Zone 4: Close to city campground
- Zone 4: Along canyon wall closer to road crossing 4
- Zone 3: Main pool closer to road crossing 4
- Zone 3: Pool above canyon wall pool
- Zone 3: Canyon wall pool
- Zone 2: Upper pool closer to road crossing 3
- Zone 2: 12S 0641085E 3642688.8N - 12S 0641053E 3642731.3N
- Zone 2: Above downed cottonwood
- Zone 2: Leveler pool to downed cottonwood
- Zone 2: River left of leveler pool
- Zone 2: Canyon wall pool
- Zone 2: Uppermost pool
- Zone 2: 2nd uppermost pool
- Zone 2: Pool below 2nd uppermost pool
- Zone 2: Below leveler pool
- Zone 2: 2nd pool below leveler
- Zone 2: Pool close to road crossing 2 and below
- Zone 1: Above riffle/fall
- Zone 1: Above downed cottonwood to riffle/fall
- Zone 1: Deergrass stretch up to downed cottonwood

- Zone 1: Pool adjacent to canyon wall pool
- Zone 1: Canyon wall pool
- Zone 1: Above road crossing 1 in cattail stretch

Approximate times of deployment and retrieval for nets and minnow traps were recorded, but effort was summarized as number of overnight sets regardless of actual time fished. All species were identified and enumerated; non-native yellow bullhead *Ameiurus natalis*, fathead minnow *Pimephales promelas*, and western mosquitofish *Gambusia affinis*, and native Gila topminnow *Poeciliopsis occidentalis*, Sonora sucker *Catostomus insignis*, Gila chub *Gila intermedia*, and Sonora mud turtle *Kinosternon sonoriense*. Species that attain relatively larger body size were further separated into size (age) classes, age-0 for primarily young-of-year smaller than about 5 cm total length, and age-1+ for sub-adults and adults longer than 5 cm (adult size limitations were species specific). All non-native fishes were removed from the stream; native species were returned near the point of capture. The non-native bullfrog *Lithobates catesbeianus* adults and tadpoles were assessed for presence/absence. Other by-catch of aquatic invertebrates (e.g., giant waterbug *Lethocerus* sp.) were not quantified.

Results

Total effort for Promar, Gee, and hoop net sets was 372, 372, and 2 respectively. Total catch comprised of 1,062 Gila chub, 122 Sonora sucker, 2 Gila topminnow, 7 Sonora mud turtles, 128 yellow bullhead (Figure 1), 225 fathead minnow, and 1,173 western mosquitofish. A summary of catch by age group and gear type is provided in Table 1. Bullfrogs were not quantitively sampled, however they were observed in every zone but not every site. Presence and absence of bullfrogs were included in daily tables for each site. Total catch per unit effort (CPUE) for fishes was 3.64 per net set. CPUE for native fish species (Gila chub, Sonora sucker, and Gila topminnow) was 1.59 per net set and non-native fish species (yellow bullhead) had a CPUE of 0.17 per net set; non-native green sunfish were not detected on this trip. Total non-native CPUE (yellow bullhead, fathead minnow, and western mosquitofish) was 2.05 per net set. All traps remained at least partially submerged when worked and most gears held fish unharmed until removal.

Table 1. Catch (number) by species, age class, and sex (only Sonora mud turtle) from all capture methods for Bonita Creek, Graham County, Arizona, May 29 – June 1, 2018. GIIN (Gila chub); CAIN (Sonora sucker); POOC (Gila topminnow); KISO (Sonora mud turtle); AMNA (yellow bullhead); PIPR (fathead minnow); and GAAF (western mosquitofish).

Gear	GIIN		CAIN		POOC	KISO		AMNA		PIPR	GAAF
Age Class	0	1+	0	1+	N/A	F	M	0	1+	N/A	N/A
Hoop	11	2	0	0	0	0	0	0	0	4	4
Gee	610	172	47	1	2	0	0	1	1	217	1059
Promar	114	153	4	70	0	4	3	44	82	4	110
Total	735	327	51	71	2	4	3	45	83	225	1173

Daily Sampling Summary

On May 29, 2018, a total of 125 Promar and 125 Gee minnow traps were set between 13:21 and 16:35 in Zones 1 and 2 in the following pools from upstream to downstream:

- 28 Gee and 28 Promar below leveler pool;
- 4 Gee and 4 Promar in second pool below leveler pool;
- 18 Gee and 18 Promar in pool closer to road crossing 2 below canyon wall pool;
- 6 Gee and 6 Promar above riffle/fall;
- 9 Gee and 9 Promar above downed cottonwood to riffle/fall;
- 30 Gee and 30 Promar in deergrass stretch up to downed cottonwood;
- 18 Gee and 18 Promar in pool adjacent to canyon wall pool;
- 2 Gee and 2 Promar in canyon wall pool; and
- 10 Gee and 10 Promar above road crossing 1 in cattail stretch.

Traps were cleared of all animals on May 30, 2018 between 07:03 and 11:23 (Table 2).

Table 2. Total catch of fishes and bullfrogs from Promar and Gee nets in Bonita Creek, Graham County, Arizona on May 29 - May 30, 2018. GIIN (Gila chub); CAIN (Sonora sucker); POOC (Gila topminnow); KISO (Sonora mud turtle); AMNA (yellow bullhead); PIPR (fathead minnow); GAAF (western mosquitofish) and LICA (bullfrog).

	Total Catch per Species							
Site (pool)	GIIN	CAIN	POOC	KISO	AMNA	PIPR	GAAF	LICA
Zone 2: Below Leveler pool	22	5	0	1	1	11	79	Present
Zone 2: 2nd pool below leveler	0	3	0	0	2	1	2	Absent
Zone 2: Pool close to Road crossing 2 and below	5	3	0	0	7	7	198	Present
Zone 1: Above riffle/fall	4	1	0	0	8	0	0	Absent
Zone 1: Above downed cottonwood to riffle/fall	3	1	0	0	11	24	2	Absent
Zone 1: Deergrass stretch up to downed cottonwood	6	2	0	0	16	31	48	Present
Zone 1: Pool adjacent to canyon wall pool	29	2	0	0	2	31	34	Present
Zone 1: Canyon wall pool	0	0	0	0	2	0	2	Absent
Zone 1: Above road crossing 1 in cattail stretch	7	1	0	0	6	16	78	Absent
Total	76	18	0	1	55	121	443	

On May 30, 2018 a total of 2 hoop nets, 125 Promar and 125 Gee minnow traps were set between 12:57 and 16:47 in Zone 2 in the following pools from upstream to downstream:

- 15 Gee and 15 Promar in uppermost pool;
- 5 Gee and 5 Promar in 2nd uppermost pool;
- 3 Gee and 3 Promar in pool below 2nd uppermost pool;
- 10 Gee and 10 Promar from 12S 0641085E 3642688.8N - 12S 0641053E 3642731.3N;
- 42 Gee and 42 Promar above downed cottonwood;
- 14 Gee, 14 Promar, and 1 hoop net in leveler pool up to downed cottonwood;

- 8 Gee and 8 Promar river left of the leveler pool; and
- 28 Gee, 28 Promar, and 1 hoop net in canyon wall pool.

Traps were cleared of all animals on May 31, 2018 between 07:09 and 12:10 (Table 3).

Table 3. Total catch of fishes and bullfrogs from Promar and Gee nets in Bonita Creek, Graham County, Arizona on May 30 - May 31, 2018. GIIN (Gila chub); CAIN (Sonora sucker); POOC (Gila topminnow); KISO (Sonora mud turtle); AMNA (yellow bullhead); PIPR (fathead minnow); GAAF (western mosquitofish) and LICA (bullfrog).

	Total Catch per Species							
Site (pool)	GIIN	CAIN	POOC	KISO	AMNA	PIPR	GAAF	LICA
Zone 2: Uppermost pool	63	2	1	0	1	13	6	Absent
Zone 2: 2nd uppermost pool	12	1	0	0	1	8	8	Absent
Zone 2: Pool below 2nd uppermost pool	27	0	0	0	2	0	0	Absent
Zone 2: 12S 0641085E 3642688.8N	10	5	0	0	1	1	44	Present
Zone 2: Above downed cottonwood	53	16	1	1	5	50	375	Present
Zone 2: Leveler pool to downed cottonwood	22	2	0	0	5	8	136	Present
Zone 2: River left of leveler pool	0	1	0	0	1	0	59	Present
Zone 2: Canyon wall pool	31	9	0	2	4	6	100	Present
Total	218	36	2	3	20	86	728	

On May 31, 2018 a total 122 Promar and 122 Gee minnow traps were set between 13:02 and 16:12 in Zones 2, 3, 4, and 5 in the following pools from upstream to downstream:

- 29 Gee and 29 Promar in remaining habitats;
- 14 Gee and 14 Promar directly across from city campground;
- 7 Gee and 7 Promar in small pools closer to city campground;
- 16 Gee and 16 Promar in pool along canyon wall;
- 21 Gee and 21 Promar in main pool closer to road crossing 4;
- 5 Gee and 5 Promar in pool above canyon wall;
- 10 Gee and 10 Promar in canyon wall pool; and
- 20 Gee and 20 Promar in upper pool closer to road crossing 3.

Traps were cleared of all animals on June 1, 2018 between 06:53 and 10:48 (Table 4).

Table 4. Total catch of fishes and bullfrogs from Promar and Gee nets in Bonita Creek, Graham County, Arizona on May 31 – June 1, 2018. GIIN (Gila chub); CAIN (Sonora sucker); POOC (Gila topminnow); KISO (Sonora mud turtle); AMNA (yellow bullhead); PIPR (fathead minnow); GAAF (western mosquitofish); and LICA (bullfrog).

	Total Catch per Species							
Site (pool)	GIIN	CAIN	POOC	KISO	AMNA	PIPR	GAAF	RACA
Zone 5: Remaining habitats	274	27	0	0	19	7	0	Present
Zone 5: Across from city campground	120	13	0	2	7	1	0	Present
Zone 4: Close to city campground	24	6	0	0	0	0	0	Present
Zone 4: Along canyon wall	60	3	0	0	2	4	0	Present
Zone 3: Main pool closer to road 4 crossing	41	8	0	0	6	0	1	Present
Zone 3: Pool above canyon wall pool	15	0	0	0	0	0	0	Present
Zone 3: Canyon wall pool	78	5	0	0	11	5	0	Present
Zone 2: Upper pool closer to road crossing 3	156	6	0	1	8	1	1	Present
Total	768	68	0	3	53	18	2	

Conclusions and Recommendations

There were five target species (Gila chub, Sonora sucker, Gila topminnow, green sunfish, and yellow bullhead) in this sampling effort; green sunfish was not encountered. In May 2017 sampling effort CPUE for target non-native species (green sunfish and yellow bullhead) was 0.06 compared to CPUE of 0.17 during this trip. Percentage of non-native species increased from 1.14% to 4.72%. This increase in target non-native species is due to the increase in yellow bullhead catch, which had a 161% increase in catch compared to the previous year (49 in May 2017 and 128 May 2018), despite having less sampling effort in 2018. Numbers of target native species has increased in samples over the past year. Target native species accounted for 43.7% of overall catches, increasing from 25.5% for 2017. CPUE for target native fish species was 1.59 per net set, which was an increase from 2017 CPUE of 1.35 per net set. Presence of parasites was also noted throughout this sampling trip. Anchor worm (*Lernaea*) was most prevalent among parasites with a recorded observation (e.g., cyst, bloating, anchor worm attached) for 16% of total native fish captures. Presence of parasites should be continually monitored due to potential negative health effects.

Absence of green sunfish in this sampling effort indicates that mechanical removal of these fish has been effective. Although M&A biologists have contributed to that effort with three to four trips per year for the last six years, the total amount of effort required to reach this point has been at least an order of magnitude higher. Focused effort during M&A assisted trips combined with constant routine removal conducted by BLM employees and volunteers has resulted in a collapse of the green sunfish population. Despite continued absence of green sunfish captures, it is possible that there are still green sunfish persisting in small numbers. However, persistence also is possible after implementation of any fish removal technique (e.g., rotenone), and continued lack of detection is an indicator that mechanical removal is at least as effective as other techniques.

Mechanical removal via traps has had no observable impact on yellow bullhead abundance. Yellow bullhead numbers increased from 2017 to 2018. As BLM and M&A continue occasional netting trips to deter reestablishment of green sunfish, different sampling techniques should be applied in an effort

to find an effective means of removing all ages of yellow bullhead. Yellow bullhead may not need to be completely removed for Gila chub and Sonora sucker to maintain viable populations, but a decline in yellow bullhead abundance likely would result in greater native fish abundance. Electrofishing was found to be less effective than trapping for green sunfish removal. However, it should be revisited with the specific intent of removing yellow bullhead.

We continue to recommend that effort be restricted at any given location to no more than three consecutive nights to not overly impact resident native fishes by repeated sampling. Care should be taken to avoid temporal overlap in areas sampled by different entities (i.e., BLM and M&A). Small pools, runs, stagnant ponded areas, and isolated off-channel pools should not be overlooked because data indicate these habitats have potential to hold a great number of invasive fish. However, nets set in any stagnant or off-channel ponds should be checked regularly (e.g., every 2-4 hours) to limit potential fish stress and mortality due to low dissolved oxygen levels. During summer months when high water temperature and low dissolved oxygen may contribute to stressful conditions even in larger, regularly sampled pools, technicians may consider setting nets in early evening to avoid trapping native species in potentially hypoxic conditions of the afternoon.

Acknowledgements
The authors (M&A), Heidi Blasius (BLM), and Eric Wallace participated in field work. This program was initiated and supported by BLM and US Bureau of Reclamation. Collections were authorized by permits issued by Arizona Game and Fish Department and US Fish and Wildlife Service.

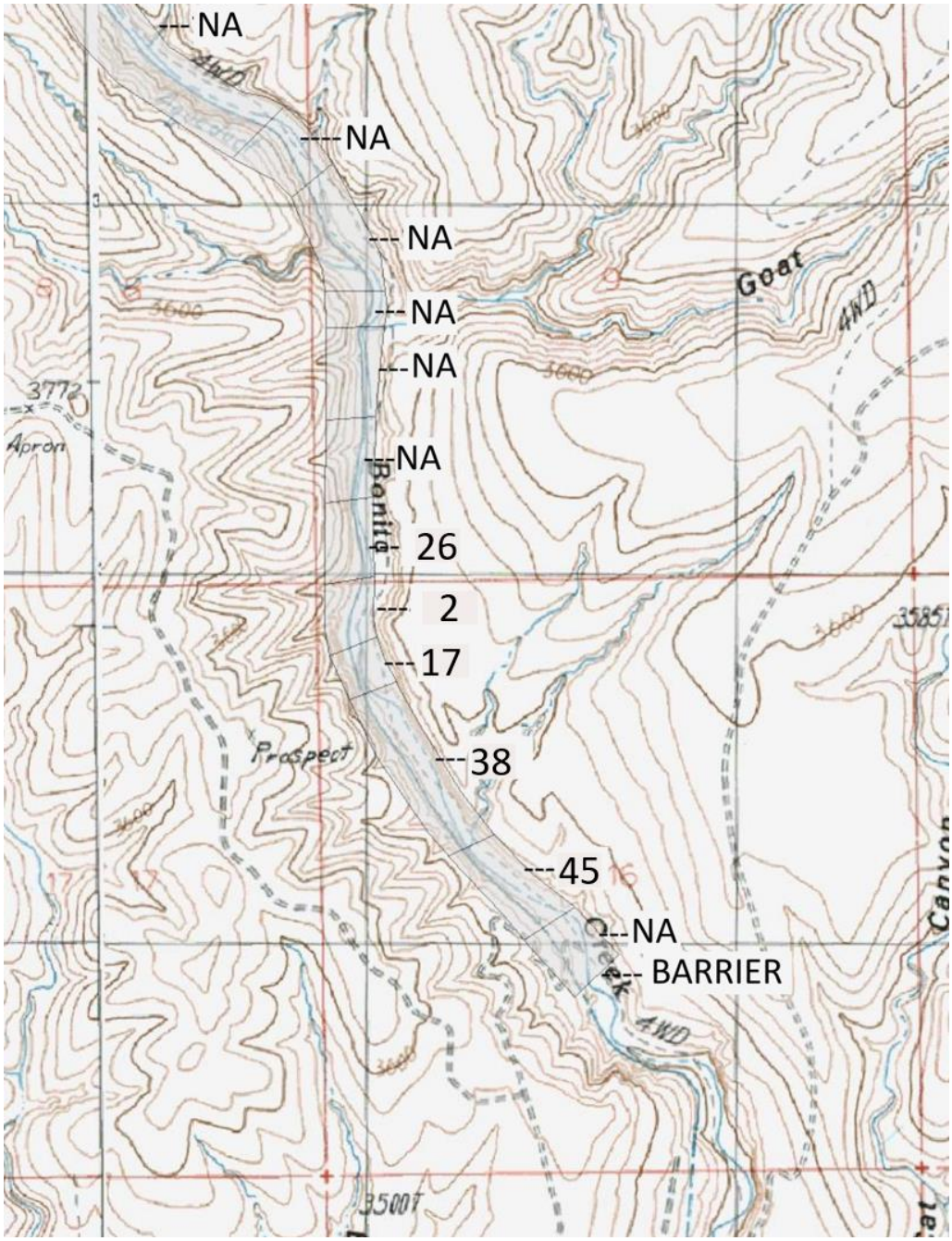

Figure 1. Yellow bullhead captures for Bonita Creek, Graham Co., Arizona, sampling May 29-June 1, 2018. Totals were divided among stream reaches bounded by road crossings between the fish barrier (BARRIER) and the known upper extent of yellow bullhead occupancy. Reaches without effort during this sample period are labeled 'NA.'