Bonita Creek Fish Monitoring
September 29 – October 2, 2015

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Marsh & Associates (M&A) with assistance from Bureau of Land Management (BLM) visited lower Bonita Creek, Graham Co., Arizona to sample fishes September 29, 2015 to October 2, 2015. This monitoring is part of a long-term program initiated by BLM to evaluate relationships between populations of native and non-native fishes.

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," 0.3 m diameter, 0.6 and 0.9 m long, double throat, 1.2 cm mesh), or seine (2.4 m length, 0.6 cm mesh). Traps were set with an air pocket to prevent inadvertent drowning of non-target air-breathing animals. Netting effort during this trip was distributed throughout Zone 1 (between the 1st and 2nd road crossings), Zone 2 (between the 2nd and 3rd road crossings), Zone 3 (between the 3rd and 4th road crossings), Zone 5 (between the 5th and 6th road crossings), Zone 6 (between the 6th and 7th road crossings), and Zone 11 (between the 11th and 12th road crossings) (Figures 1 & 2).

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*, green sunfish *Lepomis cyanellus*, fathead minnow *Pimephales promelas*, western mosquitofish *Gambusia affinis*, and Northern crayfish *Orconectes virilis* and native Sonora sucker *Catostomus insignis*, Gila chub *Gila intermedia*, and Sonora mud turtle *Kinosternon sonoriense*. Species that attain relatively larger body size (all but fathead minnow and poeciliids) 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. All non-native fishes were removed from the stream; native species were returned near the point of capture. By-catch of aquatic invertebrates (e.g., giant waterbug *Lethocerus* sp.) and non-native bullfrog *Lithobates catesbeianus* adults and tadpoles were not quantified.

Summary of results. Total effort was 373, 373, and 20 overnight sets for Gee, Promar, and hoop nets, respectively. Total catch (all netting methods combined) was 896 fathead minnow, 775 western mosquitofish, 172 Gila chub, 162 yellow bullhead, 94 green sunfish, 20 Sonora sucker, 3 Sonora mud turtle, and 1 Northern crayfish. Total catch per unit effort (CPUE) was 2.77 fish per net set. Catch per unit effort for combined native fish species (Sonora sucker and Gila chub) was 0.25 per net set and CPUE for targeted non-native fish species (yellow bullhead and green sunfish) was 0.33 fish per net set.

No traps were removed from catch per unit effort (CPUE) calculations and all traps remained at least partially submerged when run and most gears held fish unharmed until removal. To avoid potentially trapping species in warm hypoxic waters, technicians did not alter beaver dams to lower water levels in target pools. A summary of catch by age group and gear type is included in Table 4.

Narrative accounts of sampling and other activities. Beginning at 7:19 on September 29, 2015, a series of 9 Gee and 9 Promar nets were set in the 1st pool (cattail pool), 21 Gee and 21 Promar nets were set in the 2nd pool, and 45 Gee and 45 Promar nets were set in the 3rd pool (long pool) upstream of the first crossing in Zone 1. A combined total of 28 Gee, 28 Promar nets and 2 hoop nets were set in the 2nd (leveler pool) and 3rd pool (cattails) upstream of the second crossing in Zone 2 at 8:47. Twenty Gee, 20 Promar, and 3 hoop nets were set in the lower half of the 4th pool (big dam pool) above the second crossing in Zone 2 at 13:55. All nets and traps were cleared of fishes between 7:20 and 10:50 on September 30, 2015 (Table 1).

Table 1. Total catch from all methods, Bonita Creek, Graham Co., Arizona, September 29 to 30, 2015. CAIN (Sonora sucker); GIIN (Gila chub); AMNA (yellow bullhead); LECY (green sunfish); PIPR (fathead minnow); GAAF (western mosquitofish); KISO (Sonora mud turtle); ORVI (Northern crayfish).

	Total Catch per Species							
Site (pool)	CAIN	GIIN	AMNA	LECY	PIPR	GAAF	KISO	ORVI
Zone 1: 1st pool (cattail pool) upstream of 1st crossing	0	7	1	0	4	17	0	0
Zone 1: 2nd pool upstream of 1st crossing	2	3	18	0	8	18	1	1
Zone 1: 3rd pool (long pool) upstream of 1st crossing	4	1	10	0	141	48	0	0
Zone 2: 2nd (leveler) and 3rd (cattails) pool upstream of 2nd crossing	0	0	20	5	110	103	0	0
Zone 2: 4th pool (big dam pool) upstream of 2nd crossing lower half	1	11	8	10	24	55	2	0
Total	7	22	57	15	287	241	3	1

On September 30, 2015, a set of 10 Gee and 10 Promar nets were each deployed in the 2nd pool above the first crossing of Zone 1 at 8:02. The 3rd pool (long pool) above the second crossing of Zone 2 was populated with 20 Gee and 20 Promar nets at 8:15. Thirty Gee, 30 Promar, and 2 hoop nets were collectively set at 10:15 in the 2nd (leveler pool) and 3rd (cattails) pools upstream of the second crossing in Zone 2. At 11:05, the lower half of the 4th pool (big dam pool) upstream of the second crossing was populated with 30 Gee, 30 Promar, and 1 hoop nets. The upper half of the 4th pool was populated with 35 Gee, 35 Promar, and 3 hoop nets at 13:05. Additionally, two hoop nets were set in each of the following locations at 14:30; the 2nd and 3rd pool upstream of the third crossing in Zone 3, the 2nd pool upstream of the fifth crossing in Zone 5, the pumping station pool downstream from the seventh crossing in Zone 6, and just upstream of the 11th crossing in Zone 11. All nets and traps were cleared of fishes between 7:30 and 12:00 on October 1, 2015 (Table 2).

Table 2. Total catch from all methods, Bonita Creek, Graham Co., Arizona, September 30 to October 1, 2015. See Table 1 for abbreviations.

	Total Catch per Species							
Site (pool)	CAIN	GIIN	AMNA	LECY	PIPR	GAAF	KISO	ORVI
Zone 1: 2nd pool upstream of 1st crossing	0	2	4	0	0	7	0	0
Zone 1: 3rd pool (long pool) upstream of 1st crossing	1	5	14	0	84	35	0	0
Zone 2: 2nd (leveler) and 3rd (cattail) pool upstream of 2nd crossing	0	2	14	4	91	58	0	0
Zone 2: 4th pool (big damn pool) upstream of 2nd crossing lower half	1	8	2	13	42	61	0	0
Zone 2: 4th pool (big dam pool) upstream of 2nd crossing upper half	0	4	30	33	4	151	0	0
Zone 3: 2nd and 3rd pool upstream of 3rd crossing	0	3	0	0	0	0	0	0
Zone 5: 2nd pool upstream of 5th crossing	0	0	0	0	0	0	0	0
Zone 6: pumping station pool downstream from 7th crossing	0	37	0	0	0	0	0	0
Zone 11: just upstream of 11th crossing	0	11	0	0	0	0	0	0
Total	2	72	64	50	221	312	0	0

Beginning at 8:50 on October 1, 2015 upstream of the second crossing in Zone 2, 20 Gee and 20 Promar nets were set in the 3rd pool (cattails); 30 Gee and 30 Promar nets were set in the lower half of the 4th pool (big dam pool); and 35 Gee, 35 Promar, and 2 hoop nets were set in the upper half of the 4th pool (big dam pool). Additionally in Zone 2 downstream from the third crossing at 12:00, 10 Gee and 10 Promar nets were set in the 4th pool, 23 Gee and 23 Promar nets were set in the 3rd pool, and 7 Gee and 7 Promar nets were set in the 2nd pool. All traps and nets were removed from the creek on Friday, October 2, 2015 between 7:25 and 10:15 (Table 3).

Table 3. Total catch from all methods, Bonita Creek, Graham Co., Arizona, October 1 to 2, 2015. See Table 1 for abbreviations.

	Total Catch per Species							
Site (pool)	CAIN	GIIN	AMNA	LECY	PIPR	GAAF	KISO	ORVI
Zone 2: 3rd pool (cattails) upstream of 2nd crossing	0	0	14	2	17	21	0	0
Zone 2: 4th pool (big dam pool) upstream of 2nd crossing lower half	2	5	6	7	60	50	0	0
Zone 2: 4th pool (big dam pool) upstream of 2nd crossing upper half	0	1	8	14	66	126	0	0
Zone 2: 2nd pool downstream from 3rd crossing	5	13	6	5	47	4	0	0
Zone 2: 3rd pool downstream from 3rd crossing	2	33	5	1	117	5	0	0
Zone 2: 4th pool downstream from 3rd crossing	2	26	2	0	81	16	0	0
Total	11	78	41	29	388	222	0	0

Conclusions and Recommendations. During the September/October 2015 sampling trip, catch of target non-native species (green sunfish and yellow bullhead) was slightly higher (CPUE=0.33) than the catch of the two most common native species (Gila chub and Sonora sucker) (CPUE=0.25). In June, catch per unit effort for target groups was 0.82 for non-native species and 0.72 for natives. The CPUE between native and non-native species for both trips is markedly different than the nearly order of magnitude

difference for the same area in June 2014 (2.09 and 0.22 for target non-native and native species respectively).

Sampling effort for the last two years has focused in Zone 2, where previous sampling reported higher densities of target non-native species. Total number of green sunfish captured in Zone 2 this trip was lower than at the beginning of this year, though greater than values during summer sampling. This suggests that green sunfish abundance has been negatively impacted by the consistent effort. However, catches from the current sampling trip may underrepresent populations due to relatively higher water levels in target pools as a result of intact beaver dams. Catch of green sunfish in Zone 1 as well as upper reaches continue to be depressed relative to previous samples. No green sunfish were caught in Zone 1 by Gee and Promar nets or above Zone 2 by hoop netting efforts, indicating that sampling effort over the past few years has been effective in keeping non-native fish numbers manageable at these locations. We suggest that additional sampling efforts this year continue to focus on lower zones of Bonita Creek (Zones 1-3), though efforts in other zones should not be abandoned.

Total length used as a reference for age class indicates that catch of age-1+ adult green sunfish was 14% of total green sunfish count (Table 4). Sampling trips earlier this year differ from these data, showing greater catches of age-1+ compared to age-0 green sunfish. Previous autumn sampling in 2011, 2012, and 2013 however, were more similar to the current 2015 September/October sampling, showing greater proportions of age-0 compared to age-1+ green sunfish. The throat diameter difference between Gee and Promar traps imparts some size selectivity to the gear and thus can also be used to select size classes of fishes. Consistent with total length data, a greater number of green sunfish was captured in smaller diameter Gee traps (80) compared to larger diameter Promar traps (3).

The total catch for age-0, young-of-year yellow bullhead was greater than that of age-1+ adults, contrasting data from within the past year, 102 and 60, respectively. Promar traps continue to prove more effective capturing yellow bullhead (154) compared to Gee traps (8). The use of multiple sampling techniques may still be beneficial in targeting different non-native species.

This month, size ratios of green sunfish have shifted toward smaller fish. Fecundity generally decreases with size (Bagenal and Braum, 1971) so reducing the size of non-native species may reduce total reproductive output and subsequent recruitment. Continued use of a total length reference measurement for target species and net throat diameter classification will provide data that can be used to support a future quantitative analysis of this shift.

We continue to recommend that effort be restricted at any given location to no more than three consecutive nights so as to not overly impact resident native fishes by repeated sampling. For the same reason, 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 (i.e., 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.

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Table 4. Catch (number) by species and age from all capture methods for Bonita Creek, Graham Co., Arizona, September 29 to October 2, 2015.

	Sonora sucker		Gila chub		Yellow bullhead		Green sunfish		Fathead minnow	Western mosquitofish	Sonora mud turtle	Northern crayfish
Gear Type	0	1+	0	1+	0	1+	0	1+				
Hoop	0	0	6	51	0	0	4	7	0	1	0	0
Gee	0	0	33	47	8	0	76	4	888	768	0	0
Promar	0	20	2	33	94	60	1	2	8	6	3	1
Total	0	20	41	131	102	60	81	13	896	775	3	1

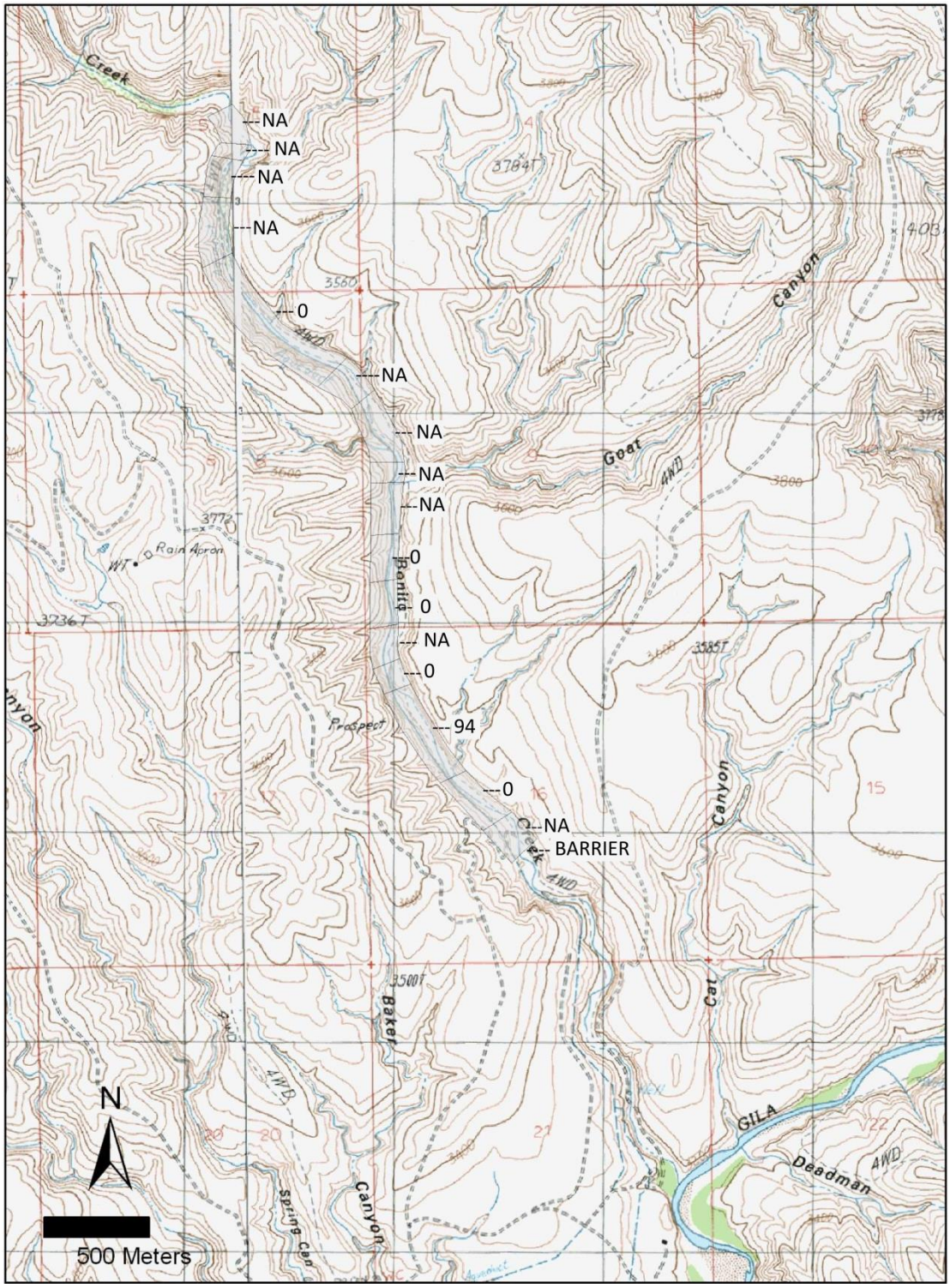

Figure 1. Green sunfish captures for Bonita Creek, Graham Co., Arizona, sampling September 29 to October 2, 2015. Totals were divided among stream reaches bounded by road crossings between the fish barrier (BARRIER) and the known upper extent of green sunfish occupancy. Reaches without effort during this sample period are labeled 'NA.'

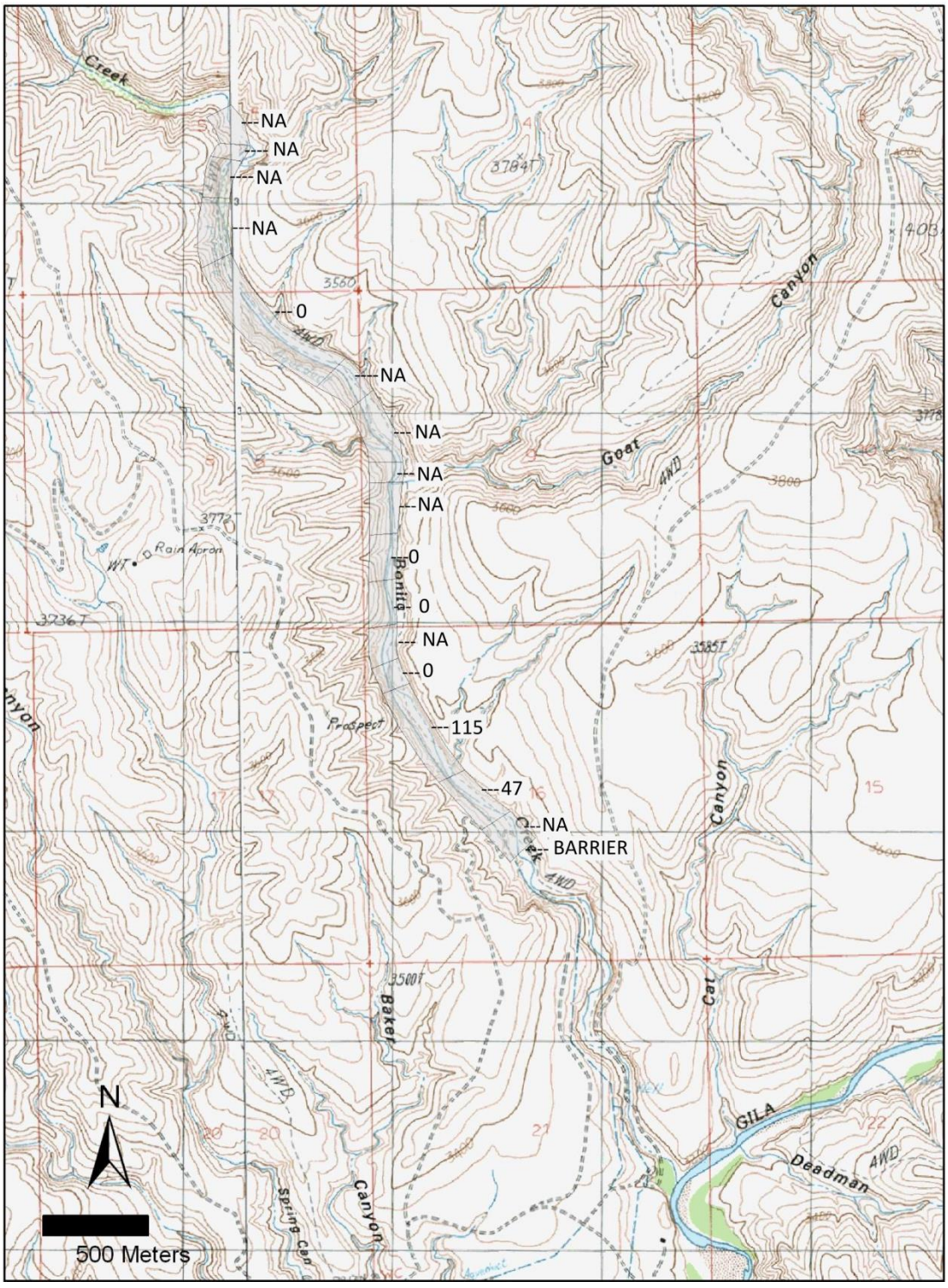

Figure 2. Yellow bullhead captures for Bonita Creek, Graham Co., Arizona, sampling September 29 to October 2, 2015. Totals were divided among stream reaches bounded by road crossings between the fish barrier (BARRIER) and the known upper extent of yellow bullhead occupancy. Reaches without effort during this sample period are labeled 'NA.'