Bonita Creek Fish Monitoring
June 23 – 26, 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 June 23 – 26, 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 6 (between the 6th and 7th road crossings), Zone 10 (between the 10th and 11th road crossing), and Zone 11 (between the 11th and 12th road crossing) (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 300, 300, and 28 overnight sets for Gee, Promar, and hoop nets, respectively and 10 seine hauls. Total catch (all netting methods combined) was 1235 western mosquitofish, 380 yellow bullhead, 343 Gila chub, 341 fathead minnow, 137 green sunfish, 108 Sonora sucker, 12 Sonora mud turtle, and 1 Northern crayfish. Total catch per unit effort (CPUE) was 4.1 fish per net set. Catch per unit effort for combined native fish species (Sonora sucker and Gila chub) was 0.7 per net set and CPUE for targeted non-native fish species (yellow bullhead and green sunfish) was 0.8 fish per net set. Supplemental seine catch was 49 fathead minnow, 33 western mosquitofish, 28 Gila chub, and 4 Sonora sucker.

One Promar trap was removed from catch per unit effort (CPUE) calculations due to predator behavior that resulted in a large hole in the trap. Though beaver activity and rain created fluctuating water levels

in target pools, all nets were still at least partially submerged when run. A summary of catch by age group and gear type is included in Table 4.

Narrative accounts of sampling and other activities. Beginning at 12:20 on June 23, 2015, a series of 10 Gee and 10 Promar nets were set in the 1st pool (cattail pool), 10 Gee and 10 Promar nets were set in the 2nd pool, and 25 Gee and 25 Promar nets were set in the 3rd pool (long pool) upstream of the first crossing in Zone 1. Gear was set into the first pool (cliff wall) upstream of the second crossing in Zone 2 with 5 Gee and 5 Promar nets and into the second and third pools combined with 25 Gee and 25 Promar nets at 13:30. Twenty-five Gee, 25 Promar, and 3 hoop nets were set in the lower half of the fourth pool (big dam pool) above the second crossing in Zone 2 at 14:00 while 25 Gee and 25 Promar nets were set in the upper half of the same pool at 14:30. The first and second pools downstream from the third crossing in Zone 2 were populated with 4 hoop nets each at 15:25. All nets and traps were cleared of fishes between 7:30 and 13:00 on June 24, 2015 (Table 1).

Table 1. Total catch from all methods, Bonita Creek, Graham Co., Arizona, June 23 – 24, 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	4	7	9	6	22	152	0	0
Zone 1: 2nd pool upstream of 1st crossing	1	1	6	8	17	199	1	0
Zone 1: 3rd pool (long pool) upstream of 1st crossing	10	0	54	37	29	9	1	0
Zone 2: 2nd and 3rd pool upstream of 2nd crossing	1	0	63	3	12	111	2	0
Zone 2: 1st pool (cliff wall) upstream of 2nd crossing	0	0	3	0	1	32	0	0
Zone 2: 4th pool (big dam pool) upstream of 2nd crossing- lower	10	4	39	20	11	93	2	0
Zone 2: 4th pool (big dam pool) upstream of 2nd crossing- upper	20	44	65	19	43	171	0	0
Zone 2: 1st pool downstream from 3rd crossing	2	43	0	0	9	0	0	0
Zone 2: 2nd pool downstream from 3rd crossing	0	2	0	9	0	1	0	0
Total	48	101	239	102	144	768	6	0

On June 24, 2015, a set of 10 Gee and 10 Promar nets were each deployed in the first (cattail pool) and second pools above the first crossing of Zone 2 at 7:40 and 7:50, respectively. The third pool (long pool) above the first crossing of Zone 2 was populated with 25 Gee and 25 Promar nets at 8:10. Twenty-five Gee and 25 Promar nets were set at 9:05 in the third pool upstream of the second crossing in Zone 2. At 13:40, downstream of the third crossing in Zone 2, the second pool was populated with 5 Gee, 5 Promar, and 4 hoop nets, the third pool was populated with 10 Gee, 10 Promar, and 1 hoop net, the 4th pool (cattails) was populated with 5 Gee and 5 Promar nets, and the fifth pool was populated with 10 Gee and 10 Promar nets. Additionally, 2 hoop nets were set at 14:51 in the pumping station pool downstream from the seventh crossing in Zone 6. All nets and traps were cleared of fishes between 8:39 and 10:31 on June 25, 2015 (Table 2).

Table 2. Total catch from all methods, Bonita Creek, Graham Co., Arizona, June 24 – 25, 2015. See Table 1 for abbreviations.

Site (Pool)	*Total Catch Per Species*							
	CAIN	GIIN	AMNA	LECY	PIPR	GAAF	KISO	ORVI
Zone 1: 1st pool (cattail pool) upstream of 1st crossing	1	4	4	3	22	85	0	0
Zone 1: 2nd pool upstream of 1st crossing	1	1	6	2	25	103	1	0
Zone 1: 3rd pool (long pool) upstream of 1st crossing	2	2	35	2	35	7	0	0
Zone 2: 3rd pool upstream of 2nd crossing	0	0	61	0	5	138	1	0
Zone 2: 2nd pool downstream from 3rd crossing	2	1	7	7	1	4	0	0
Zone 2: 3rd pool downstream from 3rd crossing	3	20	1	0	14	0	0	0
Zone 2: 4th pool (cattails) downstream from 3rd crossing	0	0	0	0	2	0	0	0
Zone 2: 5th pool downstream from 3rd crossing	8	13	3	1	4	6	1	0
Zone 6: Pumping station pool downstream from 7th crossing	7	71	0	1	0	0	0	0
Total	24	112	117	16	108	343	3	0

Beginning at 7:54 on June 25, 2015 downstream from the third crossing in Zone 2, 4 hoop nets were set in the second pool, 15 Gee, 15 Promar, and 1 hoop net was set in the third pool, 2 Gee and 2 Promar nets were set in the fourth (cattails) pool, and 13 Gee and 13 Promar nets were set in the fifth pool. Additionally, 2 seine hauls were performed in the second pool, 1 seine haul was conducted in the third pool, and 2 seine hauls were completed in the fifth pool downstream from the third crossing in Zone 2 beginning at 13:58. Upstream of the first crossing in Zone 1, the first (cattail pool) and second pools were populated with 10 Gee and 10 Promar nets each at 8:45 and 8:50, respectively. The third pool (long pool) upstream of the first crossing in Zone 1 was populated with 25 Gee and 25 Promar nets at 9:20. Three hoop nets were set in the pumping station pool downstream from the seventh crossing in Zone 6 at 10:38 and 2 hoop nets were set in the first pool (fallen tree) downstream from the twelfth crossing in Zone 11 at 12:50. At 13:03, 5 seine hauls were completed in the deer grass pool downstream from the eleventh crossing in Zone 10. All traps and nets were removed from the creek on Friday, June 26, 2015 between 8:30 and 9:53 (Table 3).

Table 3. Total catch from all methods, Bonita Creek, Graham Co., Arizona, June 25 – 26, 2015. See Table 1 for abbreviations.

Site (Pool)	*Total Catch Per Species*							
	CAIN	GIIN	AMNA	LECY	PIPR	GAAF	KISO	ORVI
Zone 2: 2nd pool downstream from 3rd crossing	0	13	0	6	22	3	0	0
Zone 2: 3rd pool downstream from 3rd crossing	5	32	0	0	26	1	0	0
Zone 2: 4th pool (cattails) downstream from 3rd crossing	0	4	0	2	22	0	0	0
Zone 2: 5th pool downstream from 3rd crossing	6	10	1	5	30	13	0	0
Zone 1: 1st pool (cattail pool) upstream of 1st crossing	0	3	1	0	8	41	0	0
Zone 1: 2nd pool upstream of 1st crossing	1	8	2	1	8	56	3	1
Zone 1: 3rd pool (long pool) upstream of 1st crossing	1	0	20	4	19	11	0	0

Zone 6: Pumping station pool downstream from 7th crossing	18	60	0	1	0	0	0	0
Zone 11: 1st pool (fallen tree) downstream from 12th crossing	8	16	0	0	0	0	0	0
Zone 10: Deer grass pool downstream from 11th crossing	1	12	0	0	3	32	0	0
Total	40	158	24	19	138	157	3	1

Conclusions and Recommendations. During the June 2015 sampling trip, catch of target non-native species (green sunfish and yellow bullhead) was similar to catch of the two most common native species (Gila chub and Sonora sucker), which differed from the June 2014 sampling trip when catch of non-native species was an order of magnitude greater than catch of the two most common native species. This largely was due to almost 90% lower total catches of green sunfish in June 2015 (137, CPUE=0.2) compared to June 2014 (1354, CPUE=1.9), as well as higher total catch of Gila chub in June 2015 (371, CPUE=0.6) compared to June 2014 (124, CPUE=0.2). Mechanical removal efforts over the past year may have contributed to a shift in native to non-native ratios that favor native species.

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 the lowest recorded since effort was redirected to this zone, and was more than an order of magnitude less than catches in June 2014. This suggests that green sunfish abundance has been negatively impacted by the consistent effort. Catch of green sunfish in upper reaches continues to be depressed relative to previous samples (2 green sunfish in overnight net sets in Zone 6, 0 green sunfish in overnight net sets in Zone 10 and 11) 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 yet be abandoned.

Total length used as a reference for age class indicates that catch of age-0, young-of-year green sunfish was approximately 25% of that for age-1+ adult green sunfish (Table 4). Sampling trips earlier this year compliment these data, showing greater catches 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. In contrast to previous sampling trips in 2014, a greater number of green sunfish was captured in larger diameter Promar traps (77) compared to smaller diameter Gee traps (32).

Though not markedly different, 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. Promar traps continue to prove more effective capturing yellow bullhead (253) compared to Gee traps (116), though the catch ratio between gear types is less than recorded from sampling trips within the past year. This may be in part due to the large number of young-of-year yellow bullhead less than 2 cm total length captured in Gee traps this June, which has not previously been observed. In this instance it is likely that sampling occurred shortly after a yellow bullhead spawn. Use of multiple sampling techniques may still be beneficial in targeting different non-native species.

This month, size ratios of green sunfish have continued to shift toward larger fish while yellow bullhead size ratios have shifted toward larger catches of smaller fish compared to previous sampling events. 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.

Supplemental seining efforts were successful in catching target native species but did not catch target non-native species. Because of typical behavior of yellow bullhead, seining is not an efficient method of capture for this species. Green sunfish were not expected to be present in upper zones and did not contribute to seine catch totals in Zone 10. The presence of green sunfish in Zone 2 was confirmed by their capture in traps. Their absence in seine hauls within the same zone was likely due to ineffective seining caused by depth (greater than 2 meters).

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, June 23 – 26, 2015.

Gear	Sonora sucker		Gila chub		Yellow bullhead		Green sunfish		Fathead minnow	Western Mosquitofish	Sonora mud turtle	Northern crayfish
Type	0	1+	0	1+	0	1+	0	1+				
Hoop	2	41	69	156	0	11	6	22	17	12	0	0
Gee	21	0	39	9	115	1	14	18	310	1171	0	1
Promar	1	43	19	51	80	173	9	68	14	52	12	0
Seine	1	3	26	2	0	0	0	0	49	33	0	0
Total	25	87	153	218	195	185	29	108	390	1268	12	1

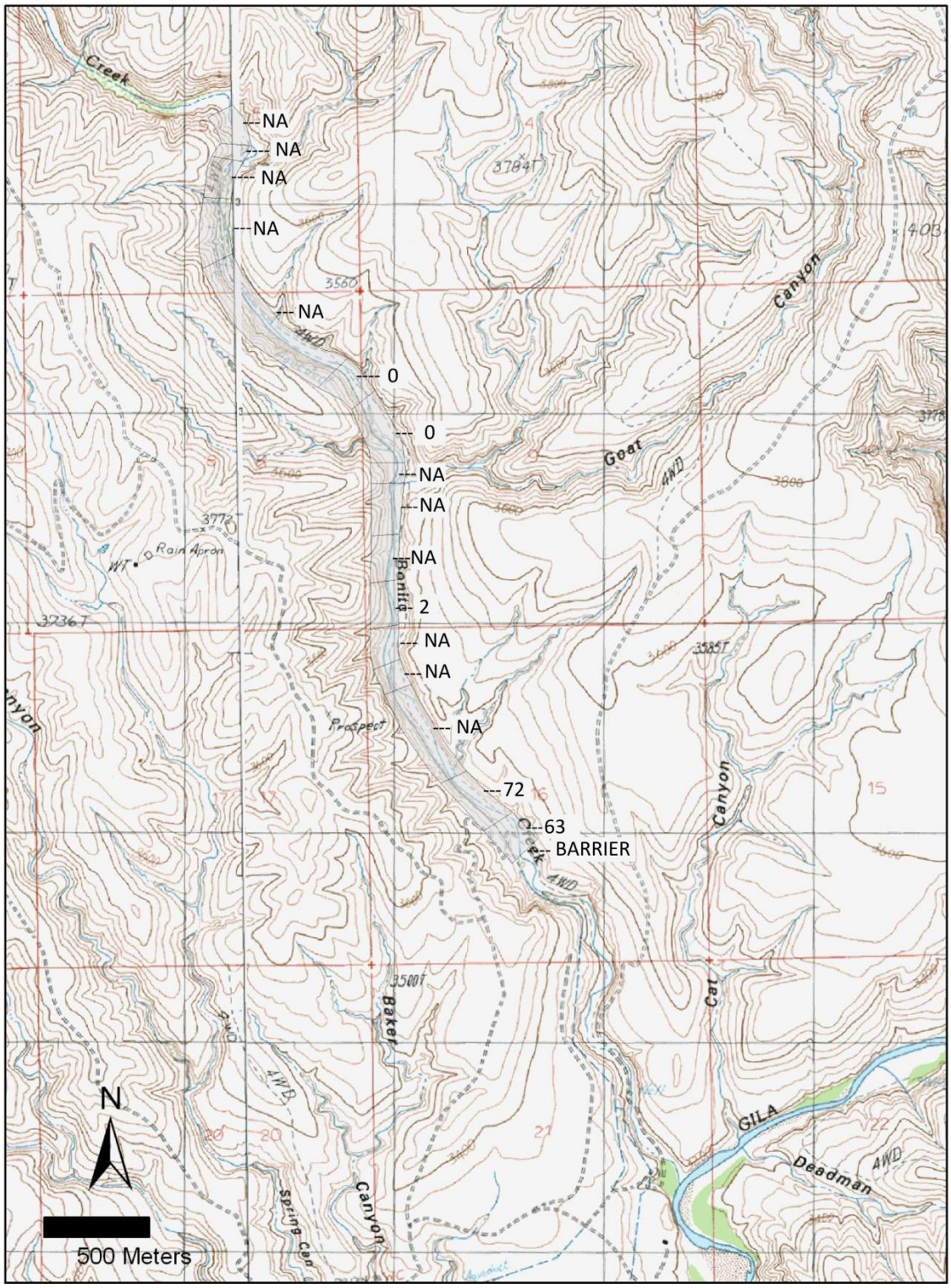

Figure 1. Green sunfish captures for Bonita Creek, Graham Co., Arizona, sampling June 23 – 26, 2015. Totals were divided among stream reaches bounded by road crossings between the fish barrier (BARRIER) and the known upper extent of green sunfish occupancy. Reaches without effort during this sample period are labeled 'NA.'

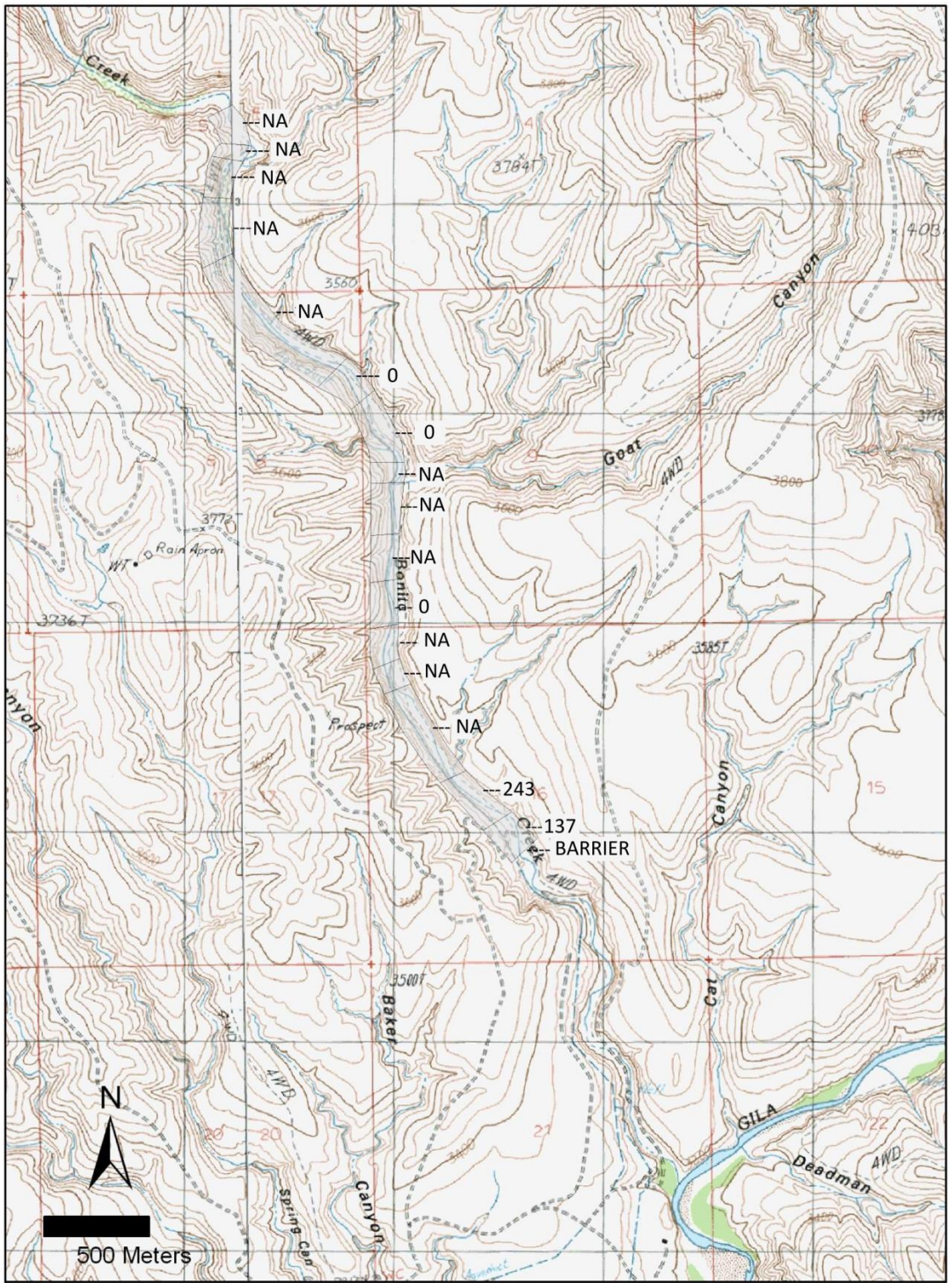

Figure 2. Yellow bullhead captures for Bonita Creek, Graham Co., Arizona, sampling June 23 – 26, 2015. Totals were divided among stream reaches bounded by road crossings between the fish barrier (BARRIER) and the known upper extent of yellow bullhead occupancy. Reaches without effort during this sample period are labeled 'NA.'