Nonnative Fish Removal from Aravaipa and Bonita Creeks 2022 Annual Report

Interagency Agreement (R17PG00018 and R18PG00115) Between Bureau of Reclamation
And
Bureau of Land Management, Safford Field Office

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Project Title: Nonnative fish removal from Bonita and Aravaipa Creeks (Task ID: AZ-2009-1).

Strategic Plan Goals for Bonita and Aravaipa Creeks:

Preventing Extinction and Managing Toward Recovery

Goal 4. Remove nonnative aquatic species threats.

Goal 9. Monitor to quantitatively measure and evaluate project success in improving the status of target species and their habitats.

BONITA CREEK ANNUAL REPORT

Recovery Goals/Objectives for Bonita Creek Fish:

Nonnative fish removal from Bonita Creek will help secure populations of Gila Chub (*Gila intermedia*) and Gila Topminnow (P*oeciliopsis o. occidentalis*) and address the following recovery goals identified for each species in their respective recovery plans.

Recovery Objectives for Gila Chub:

Gila Chub draft recovery plan (2015)

Task 1. Protect and manage remnant populations and their habitats.

Gila Chub draft 2015 recovery plan objective 1.3.1 - Eliminate or control problematic nonnative aquatic organisms.

Task 7. Use adaptive management practices to guide future recovery actions where uncertainty exists.

Gila Chub draft 2015 recovery plan objective 7 - Monitor remnant, repatriated, and refuge populations to inform adaptive management strategies.

Recovery Objectives for Gila Topminnow:

Gila Topminnow draft recovery plan (1999)

Task 1. Prevent extinction by protecting remaining natural and long-lived reestablished populations.

Gila Topminnow 1999 draft revised recovery plan objective 1.5 - Protect remaining natural and long-lived reestablished populations from invasion by detrimental nonnative aquatic species.

Task 2. Reestablish and protect populations throughout historic range.

Gila Topminnow 1999 draft revised recovery plan objective 2.4 - Protect habitats of reestablished or potential populations from detrimental nonnative aquatic species.

Task 3. Monitor natural and reestablished populations and their habitats.
Gila Topminnow 1999 draft revised recovery plan objective 3 - Monitor natural and reestablished populations and their habitats.

Geographical Area: Bonita Creek originates in the Gila Mountains on the San Carlos Apache Indian Reservation and flows southeasterly from its headwaters approximately 46 miles to its confluence with the Gila River. The Bonita Creek watershed drains approximately 370 square miles and is a mixture of federal, city, tribal, and private lands. From the reservation boundary downstream, BLM, SFO manages approximately 92% of the lands and the remaining 8% are City of Safford and private holdings. The two managers/landowners, Bureau of Land Management (BLM), Safford Field Office (SFO), and City of Safford are supportive of the project.

Background for Bonita Creek: In 2008, Bureau of Reclamation (BOR) through the Gila River Basin Native Fishes Conservation Program, constructed a fish barrier across lower Bonita Creek to prevent upstream incursion of nonnative aquatic species from the Gila River into lower and upper segments of Bonita Creek as part of a multi-agency native fish restoration project to protect the extant fish fauna including endangered Gila Chub, Longfin Dace (*Agosia chrysogaster*), Speckled Dace (*Rhinichthys osculus*), Sonora Sucker (*Catostomus insignis*), and Desert Sucker (*Pantosteus clarkii*) and to secure habitat for the repatriation of other imperiled Gila basin fish (Figure 1). Additionally, the reach of Bonita Creek between the City of Safford infiltration gallery dike and the fish exclusion barrier was chemically renovated with the piscicide rotenone to eliminate nonnative fishes. Shortly after the chemical treatment, nonnative fishes, including Western Mosquitofish (*Gambusia affinis*) and Green Sunfish (*Lepomis cyanellus*) in 2009, Fathead Minnow (*Pimephales promelas*) in 2010, and Yellow Bullhead (*Ameiurus natalis*) in 2011 were discovered in the renovated portion of Bonita Creek. With the discovery of Green Sunfish in 2009, Bureau of Land Management (BLM), Safford Field Office (SFO) initiated mechanical removal since retreatment of the stream with piscicides was deemed not feasible due to habitat complexity (which is likely the reason the first treatment failed), public perception, and permitting requirements.

Removal effort of Green Sunfish varied over the years and was largely dependent on funding and personnel availability. In 2016, increased funding from the BLM Washington Office and the Bureau of Reclamation's Gila River Basin Native Fishes Conservation Program provided for the hiring of a dedicated removal crew that was able to more than double our overall effort in 2016 from 2015. This increased effort reduced Green Sunfish numbers to a point that recruitment was effectively eliminated and by September 2018 they were no longer detectable. A total of 23,282 Green Sunfish were removed from a 1.9-mile reach of lower Bonita Creek (Table 1). Removal efforts are now targeting Yellow Bullhead.

The results for Bonita Creek suggest that in systems that are isolated either naturally or with a barrier, nonnative mechanical removal can be effective in either eliminating or reducing the numbers of nonnative fish species. The importance of timing the removal effort to reduce the number of spawning adults is equally as important as the amount of effort expended. Underestimating the effort needed, funding constraints, and lack of personnel are the primary reasons it took nine years to eliminate Green Sunfish from Bonita Creek.

Methods for Bonita Creek: Approximately 1.9 miles of lower Bonita Creek were divided into 16 zones based on low-water road crossings from the constructed fish barrier (Zone 0, 641579E,

3642074N) upstream to the City of Safford's infiltration gallery (Zone 16, 640173E, 3645545N) (Figure 1). These zones were used to separate effort for data recording and analysis.

A variety of gear types, including collapsible Promar traps (0.3 m diameter, 0.6 and 0.9 m long, double throat, 1.2 cm mesh), Gee metal minnow traps (25 cm diameter, 47 cm long, double throat, 0.6 or 0.3 cm mesh), and hoop nets (0.7 m diameter, 1.2 m long, two-hoop, single throat, 0.6 cm mesh) have been used to optimize removal efforts. Gee metal minnow traps and hoop nets were eliminated in February 2021, as they are ineffective in catching Yellow Bullhead. A new trap, Krey Trap™ (0.3 m high, 0.5 m long, 0.95 m across, 8 sided with 6 holes, 0.3 x 0.3 cm mesh), was assessed during the July 2021 removals for its effectiveness in catching Yellow Bullhead. The Krey trap may be used on occasion as it did capture Yellow Bullhead, however, the holes made it easy for fish to slip through and the traps are unwieldy when compared to Promar traps. Backpack electrofishing has also been used intermittently at Bonita Creek; however, the presence of large and deep beaver dam pools makes it somewhat ineffective. Monsoonal flooding in 2022 reduced the number of beaver dam pools allowing us to effectively electrofish segments of the creek.

Promar traps were baited with wet and dry dog food to attract and increase catch. Traps were set in daytime and fished overnight. Time of deployment and retrieval of traps were recorded, but effort was summarized as trap sets regardless of the actual time fished. Traps were set with air-pockets to prevent non-targeted animals from drowning.

All species captured were identified, classified as either juvenile or adult, and enumerated. Native species captured included Gila Chub, Longfin Dace, Speckled Dace, Gila Topminnow, Sonora Sucker, Desert Sucker, and Sonora mud turtle (*Kinosternon sonoriense*). Nonnative species encountered included fathead minnow (*Pimephales promelas*), Western Mosquitofish (*Gambusia affinis*), and Yellow Bullhead (*Ameiurus natalis*). American Bullfrog (*Rana catesbeianus*) was recorded as present or absent. Total length (TL) measurements in millimeters (mm) were recorded for Yellow Bullhead. Yellow Bullhead ≥140 mm TL was classified as adult or if <140 TL was classified as juvenile.

All nonnative fish species were placed in a bucket and euthanized with an overdose of tricane methanesulfonate (MS-222) and discreetly placed away from the creek and visitors in a debris pile or buried. Non-targeted native species were returned to the water immediately at or near the point of capture to minimize impacts to them.

Results for Bonita Creek: Ten removal trips were conducted from January through November 2022 and 814 Yellow Bullhead were removed (Table 2). An additional 30 Yellow Bullhead were removed during annual fish monitoring in March-April and are not included in table 2. Two were collected below the fish barrier and 28 above. A length-frequency histogram of Yellow Bullhead removed from Bonita Creek in 2022, except two juveniles that were not measured, depicts at least three age classes of Yellow Bullhead including juveniles between 50-139 mm TL and adults 140-250 mm TL, and 251-280 mm TL (Figure 2).

Recommendations for Bonita Creek: Yellow Bullhead removal will continue in 2023. The number of removal trips will be increased due to additional funding from the BLM Washington Office and from a National Fish and Wildlife Foundation grant. Additional funding will allow for

monthly removal trips that will focus on the upper reaches, which support fewer Yellow Bullhead than lower reaches, and will continue downstream as CPUE approaches zero and areas are cleared. Movement of Yellow Bullhead from downstream into upstream removal reaches is difficult, if not impossible, due to beaver dams that act as barriers to upstream fish movement.

Recovery Goals/Objectives for Aravaipa Creek Fish: Nonnative fish removal of piscivorous Yellow Bullhead from Aravaipa Creek will help protect and secure genetic lineages of two of the rarest endemic fishes of the Gila River basin, Loach Minnow (*Tiaroga cobitis*) and Spikedace (*Meda fulgida*) and address the following recovery goals identified for each species in their respective recovery plans.

Recovery Objectives for Loach Minnow:

Loach Minnow and Spikedace recovery plans (1991)

Task 5. Enhance or restore habitats occupied by depleted populations.

Loach Minnow recovery objective 5.1 Identify target areas amenable to management.

Loach Minnow recovery objective 5.2 Determine necessary habitat and landscape improvements. This includes removal or other control of nonnative fishes, where they are problematic.

Loach Minnow recovery objective 5.3 Implement habitat improvement. This includes repeated management to remove nonnatives.

Task 6. Reintroduce populations to selected streams within historic range.

Loach Minnow recovery objective 6.2.2 Enhance habitat, as necessary.

Loach Minnow recovery objective 6.2.3 Assess status of nonnative fishes in watershed.

Loach Minnow recovery objective 6.2.5 Reclaim as necessary to remove non-native fishes.

Recovery Objectives for Spikedace:

Loach Minnow and Spikedace recovery plans (1991)

Task 5. Enhance or restore habitats occupied by depleted populations.

Spikedace recovery objective 5.1 - Identify target areas amenable to management.

Spikedace recovery objective 5.2 - Determine necessary habitat and landscape improvements. This includes depletion or removal of nonnative fishes, if identified as significant deterrents to survival or enhancement of Spikedace.

Spikedace recovery objective 5.3 - Implement habitat improvement. This includes repeated management to remove nonnatives.

Task 6. Reintroduce populations to selected streams within historic range.

Spikedace recovery objective 6.2.3 - Assess status of non-native fishes in the watershed.

Spikedace recovery objective 6.2.5 - Reclaim as necessary to remove non-native fishes.

Geographical Area: Aravaipa Creek is a tributary to the San Pero River and is located in southeastern Arizona about 50 miles west of Safford, Arizona, along the border of Graham and Pinal counties (Figure 3). The creek becomes perennial at Aravaipa Spring near Stowe Gulch on lands owned and managed by The Nature Conservancy and flows west to the San Pedro River approximately 22-miles. The watershed covers 558 square miles and includes multiple tributaries, some which contribute flow to the mainstem. Landownership is comingled with private, federal, and tribal inholdings. The two primary managers/landowners, BLM and The Nature Conservancy are supportive of the project. Permission to remove Yellow Bullhead from private lands on the west end is ongoing with permission granted so far from 18 of the 19 landowners contacted.

Background for Aravaipa Creek: Considered one of the premiere native fish assemblages in the state, Aravaipa Creek (Figure 3) supports **s**even populations of native fish species, including Loach Minnow, Spikedace, Roundtail Chub (*Gila robusta*), Speckled Dace, Longfin Dace, Sonora Sucker, and Desert Sucker. Additionally, nonnative predatory and competitive fishes, including Yellow Bullhead and Red Shiner (*Cyprinella lutrensis*) inhabit the mainstem of Aravaipa Creek and threaten the native fishes. A third nonnative fish species, Green Sunfish, was successfully removed from Horse Camp Canyon, a tributary to Aravaipa Creek, by BLM, SFO and partners using a variety of gear types, including Promar nets, Gee metal minnow traps, dipnets, seines, and backpack electrofishers from 2010 to 2015. With the elimination of the source population of Green Sunfish from Horse Camp Canyon, the BLM, SFO and partners-initiated removal of Yellow Bullhead and any remaining Green Sunfish from Aravaipa Creek in 2017 as nonnative fish are the greatest threat to the native fish community in this system. Future invasions of nonnative fishes from the San Pedro River are unlikely due to paired fish barriers that were constructed in 2001 by BOR.

The purpose of this task is to remove nonnative fishes, Yellow Bullhead and Red Shiner from Aravaipa Creek to protect the extant native fish community. Although all species prey upon and compete with the native species, removal efforts will focus primarily on habitats occupied by Yellow Bullhead, which includes pools, backwaters, and streambank margins. By focusing on these habitats, impacts to federally endangered Loach Minnow and Spikedace will be minimal. Red Shiner will not be targeted directly since their habitat preferences tend to overlap with both Loach Minnow and Spikedace.

Methods for Aravaipa Creek: Aravaipa Creek was divided into 79, 500-meter (m) segments starting from the lower constructed fish barrier (S001, UTM 534676E, 3634081N) upstream to Stowe Gulch (S079, UTM 559509E, 3636784N). These segments were used to separate effort for data recording and analysis. One or two teams consisting of a backpack electrofisher (Smith-Root model LR-24 or 20B) and one or two dip netters collected fishes by shocking along both banks for the days sampled. Electrofishing effort (seconds [s]) was recorded for each segment sampled. All likely Yellow Bullhead habitat was sampled and included slow-moving pools, woody debris, vegetation, and undercut banks. When a Yellow Bullhead was encountered, the location was repeatedly sampled with the electrofisher until no additional individuals were captured. We stopped recording capture locality for each yellow bullhead in 2021 to expedite the removal process. Pool and backwater habitats were sampled with a backpack electrofisher, seine, or both and occasionally

with traps. When traps were used, their location was marked with a UTM coordinate or conspicuously identified if no GPS signal was available. They were baited with wet and/or dry dog food and set for a maximum of two hours. Nonnative fish were placed in a bucket, euthanized with MS-222, enumerated, and measured (TL in mm). Non-targeted native species, including Lowland Leopard Frog were returned to the water immediately at or near the point of capture to minimize impacts to them.

Results for Aravaipa Creek: The BLM, SFO and partners conducted three removal trips (i.e., seven days) in 2022. Forty-four stream segments, totaling approximately 23.5 river kilometers were sampled in 2022. A total of 929 Yellow Bullhead were removed by electrofishing and 11 by seining. Juveniles comprised 39.2% (n=369), and adults comprised 60.7% (n=571) (Table 3). An additional three Yellow Bullhead, two juveniles and one adult, were removed during the spring 2022 bi-annual fish monitoring for a total of 943 Yellow Bullhead (Table 4).

A length-frequency histogram of Yellow Bullhead removed (excluding those collected during fish monitoring) from Aravaipa Creek in 2022 depict juveniles from 50-139 mm TL, and several age classes of adult fish greater than 140 mm TL (Figure 4).

It is still too early to draw any conclusions on the effect that Yellow Bullhead removal efforts are having ass preliminary analysis of Catch-Per-Unit-Effort (CPUE) for number and biomass of AMNA removed showed CPUE (fish/per minute) decreasing from 0.86 in 2020 to 0.57 in 2021 and increasing to 0.97 in 2022. Additionally, CPUE for biomass (grams/per minute) showed the same trend with a slight decrease from 28.0 in 2020 to 23.0 in 2021 and an increase to 52.61 in 2022 (Table 5).

Lack of flooding in 2020 and 2021 and low flows allowed for nonnative watercress (*Nasturtium officinale*) to increase in both width and length along both streambanks providing ideal and difficult habitat to remove Yellow Bullhead from. Flooding in 2022, temporarily removed the watercress, deposited large woody debris, and filled some smaller pool habitats. Current discharge (January 11, 2023) at Aravaipa Creek based on the Mammoth, Arizona stream gauge is 33 cubic feet per second (cfs) and streamflow levels are 84.0% above average for this time of year. Daily maximum mean discharge from 2015 through 2022 is shown in Figure 5.

Recommendations for Aravaipa Creek: Yellow Bullhead removal will continue in 2023. The number of removal trips will be increased due to additional funding from the BLM Washington Office and from a National Fish and Wildlife Foundation grant. Additional funding will allow for bimonthly removal trips that will be split between the east and west ends. Removal trips will focus on habitats in the wilderness and with an upstream to downstream approach. Backpack electrofishing will be the primary gear type used due to its proven effectiveness at Aravaipa Creek. Additionally, overnight sets for Promar traps may be attempted in habitats adjacent or nearby campsites.

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Literature Cited

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U.S. Fish and Wildlife Service. 1991b. Loach Minnow Recovery Plan. Albuquerque, New Mexico. 38 pp.

U.S. Fish and Wildlife Service. 2015. Gila chub (Gila intermedia) Draft Recovery Plan. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, New Mexico. 118 pp. + Appendices A-C.

Weedman, D. A. 1999. Gila topminnow, *Poeciliopsis occidentalis occidentalis,* revised recovery plan. Draft. August 1999. U.S. Fish and Wildlife Service, Phoenix, AZ.

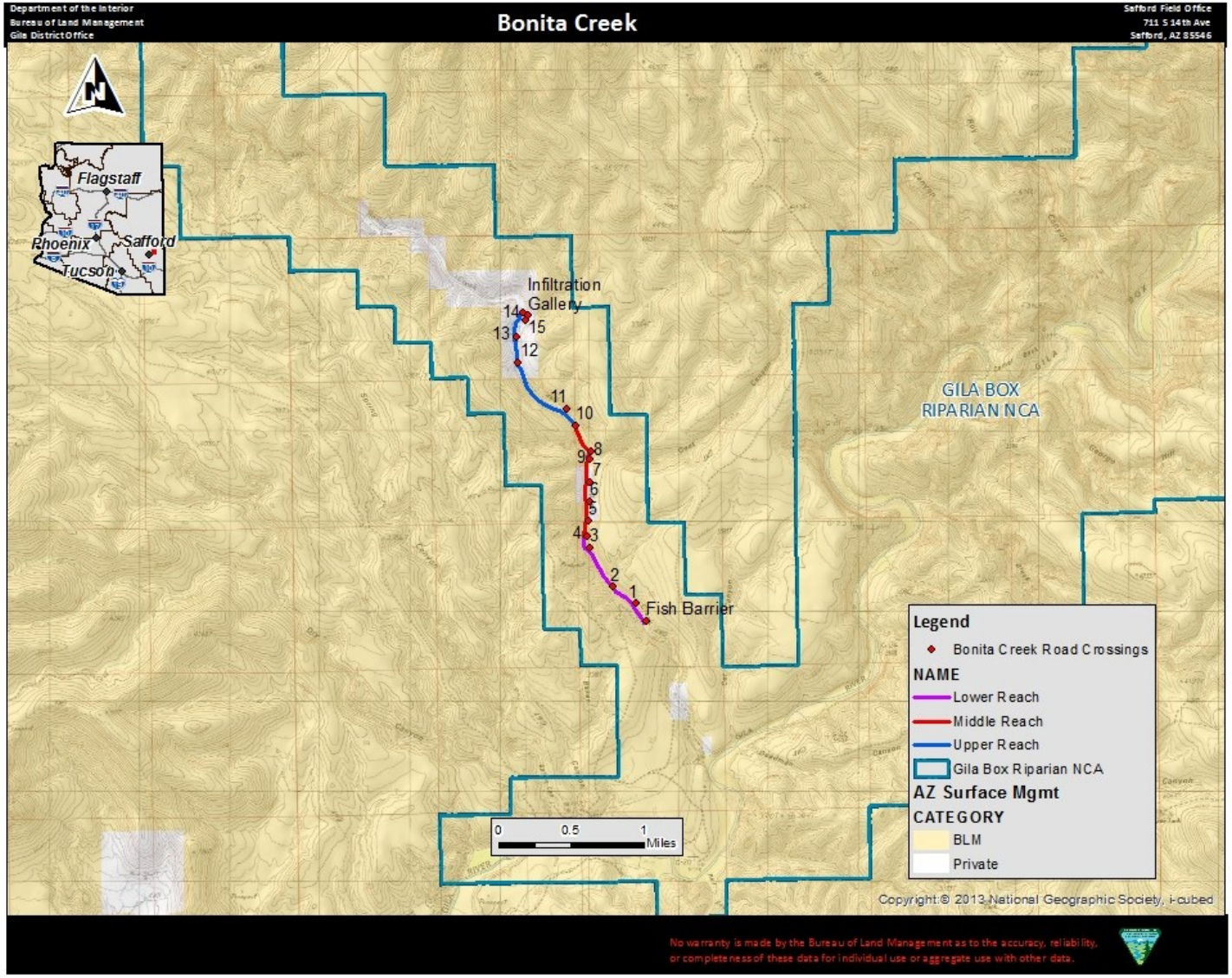

Figure 1. Project area showing fish barrier, low water road crossings, City of Safford infiltration gallery, and stream reaches of Bonita Creek.

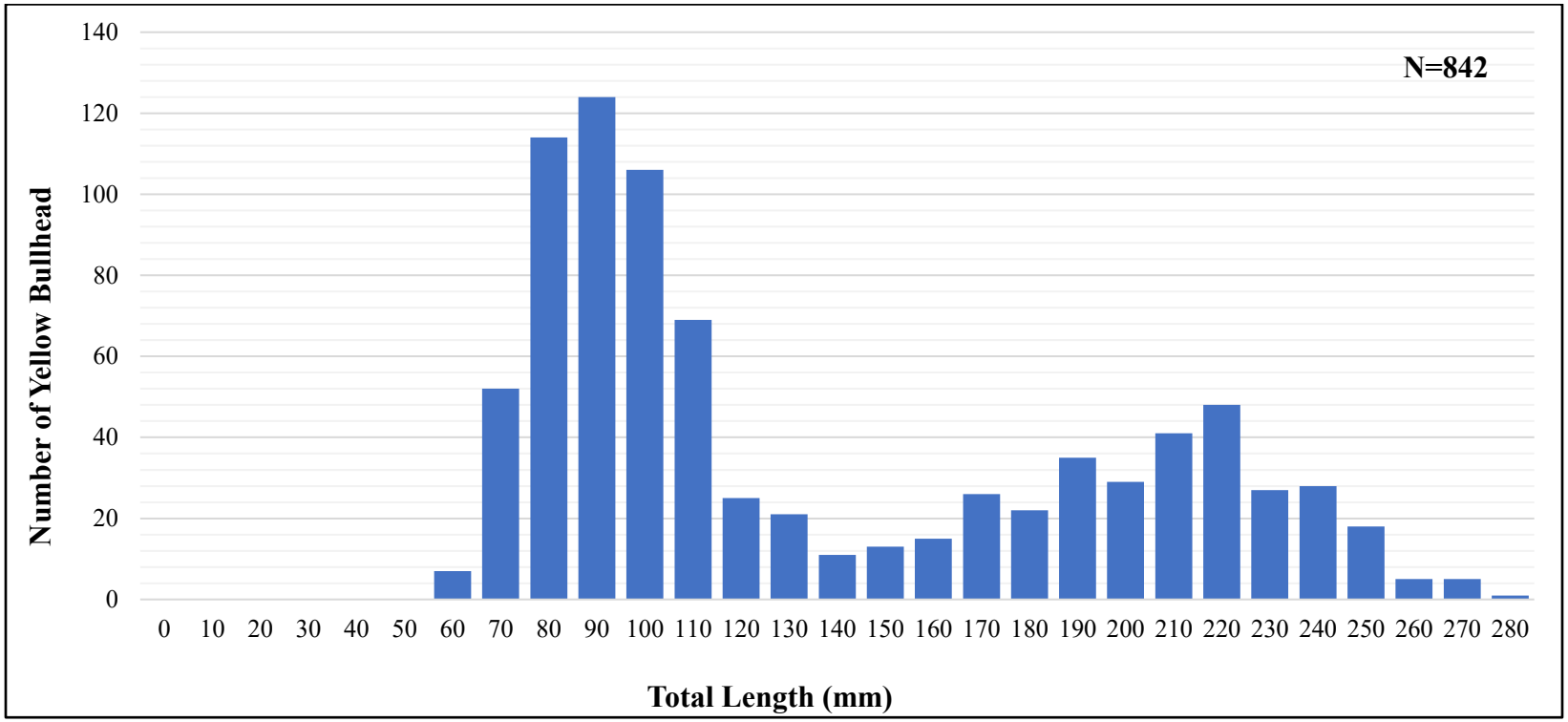

Figure 2. Length frequency histogram of Yellow Bullhead catch in Bonita Creek, January-November 2022.

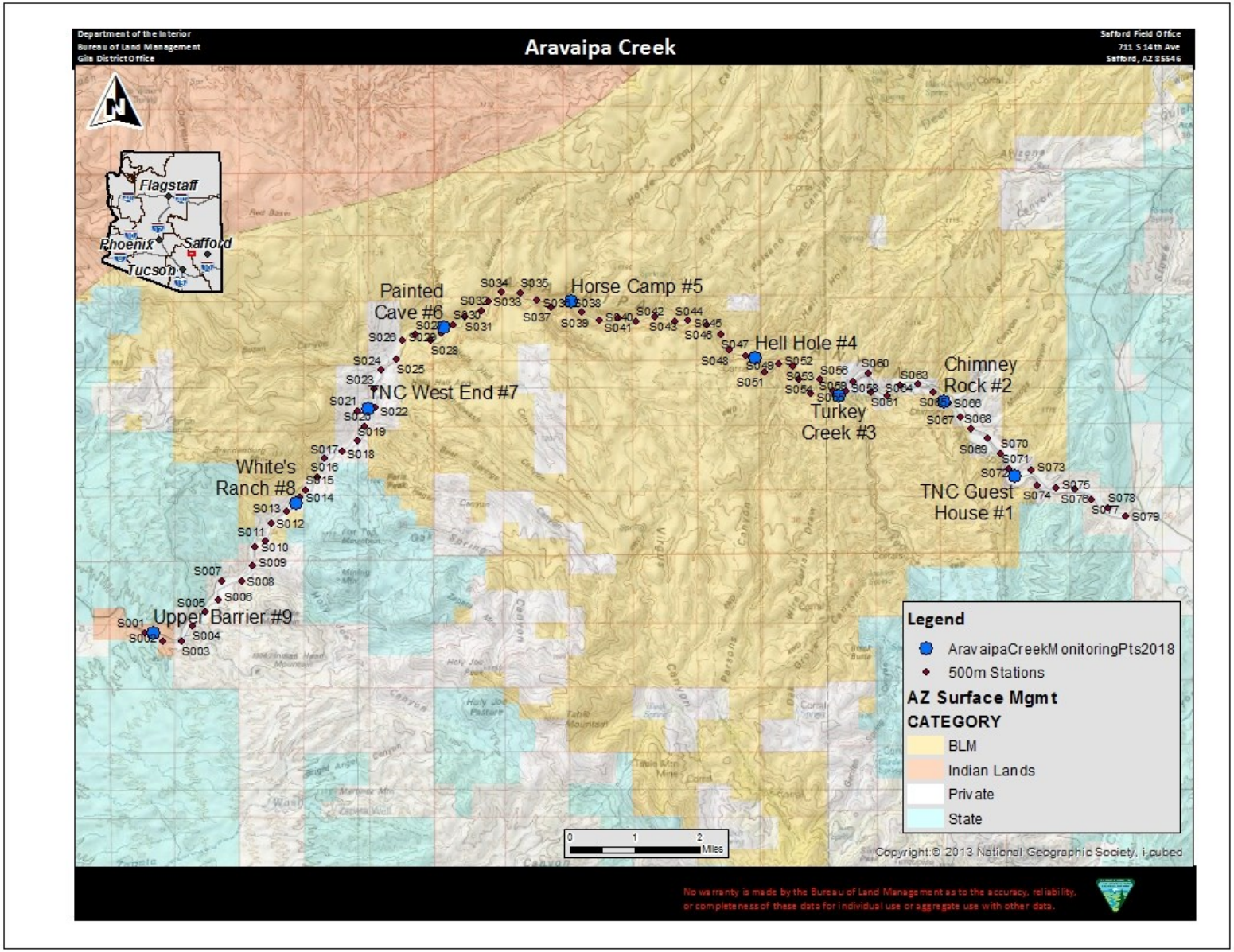

Figure 3. Project area showing 500-meter reaches and permanent fish monitoring sites of Aravaipa Creek.

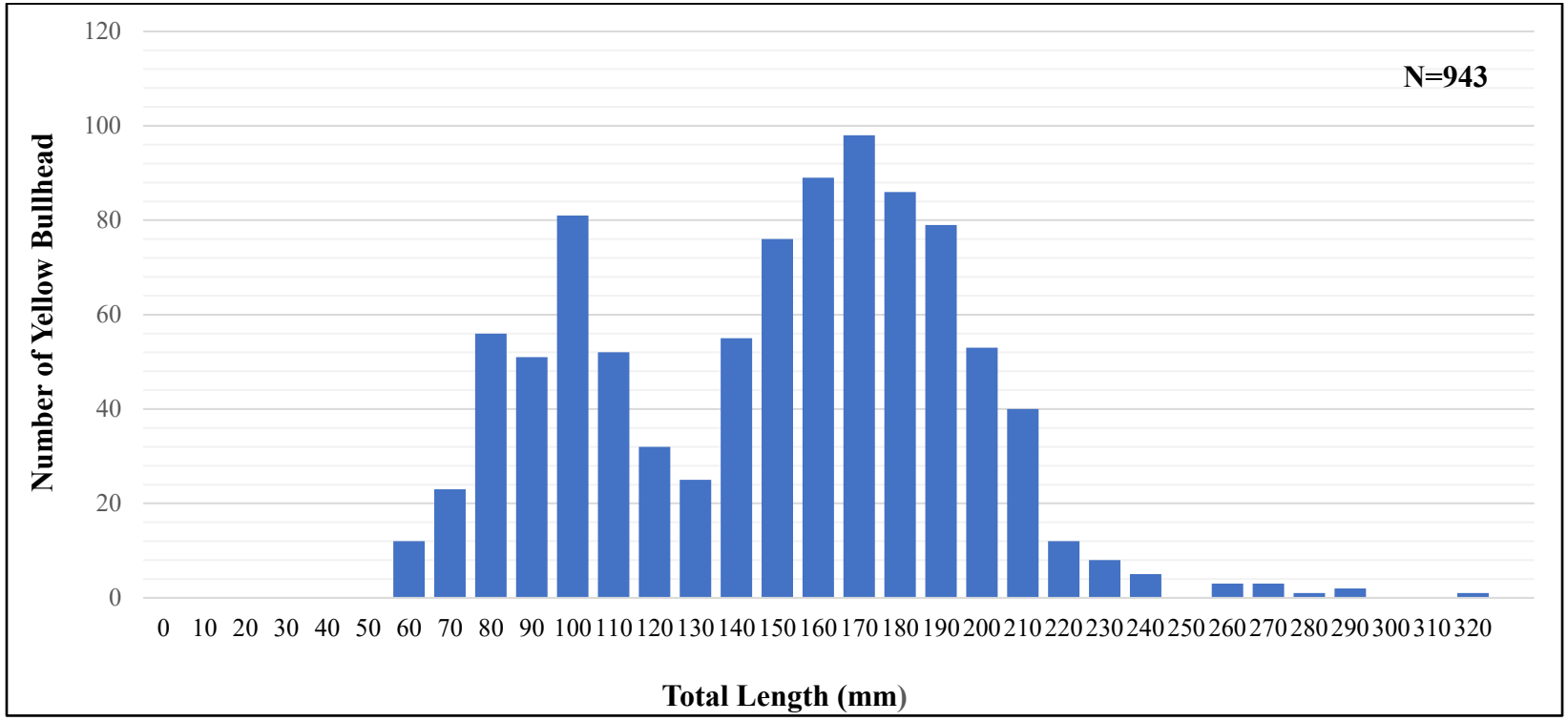

Figure 4. Length frequency histogram of Yellow Bullhead catch in Aravaipa Creek, April-August 2022.

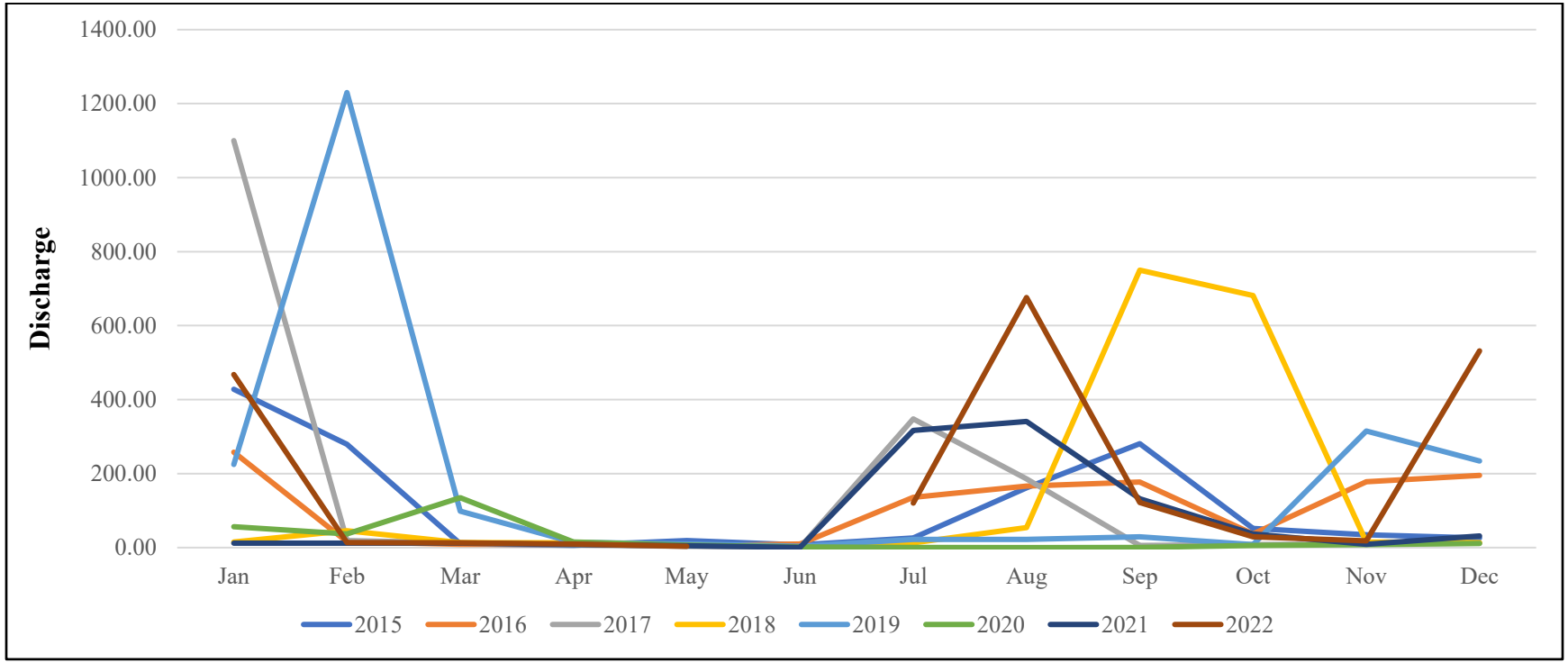

Figure 5. Daily maximum mean discharge in cubic feet per second in Aravaipa Creek (Mammoth, AZ stream gage) from 2015 through 2022.

Table 1. Gear type and total number of Green Sunfish removed from Bonita Creek, 2009-2022.

Gear Type	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018-2022	Total
Gee Minnow Trap	137	1,647	2,323	3,701	1,152	2,278	1,329	2,815	2		15,384
Promar Net	155	471	820	1,623	857	521	574	576	5		5,602
Hoop Net			76	224	148	198	204	126			976
Gee and Promar - Combined			756								756
Seine	173				186			12			371
Dip Net					93						93
Red Promar	7				4			42			53
Backpack Electrofisher	10	8	10			2					30
Tote Barge Shocker						7					7
Custom Trap						8	1				9
Crab Trap					1						1
Total	**482**	**2,126**	**3,985**	**5,548**	**2,441**	**3,014**	**2,108**	**3,571**	**7**	**0**	**23,282**

Table 2. Summary of Yellow Bullhead removal from Bonita Creek in 2022.

Removal Date	Zones	Promar® Effort (net night)	Electrofishing Seconds	Number of Yellow Bullhead Captured by Net and CPUE			
				Backpack Shocker	CPUE	Promar®	CPUE
1/24-25/2022	3-5	60		0		15	0.25
2/2-3/2022	5-7	75		0		17	0.23
3/2-3/2022	5-6	50		0		5	.010
04/20-21/2022	12-16	55		0		33	0.60
8/2-3/2022	3-6	50		0		92	1.84
10/24-25/2022	11-12	168		0		145	0.86
10/25-26/2022	11-12	168		0		59	0.35
10/25/2022	12-13		1,694	13	0.01		
10/31/2022	0-3		5,920	103	0.02		
11/01/2022	2-11		13,292	243	0.02		
11/02/2022	0-2; 6-7; 11-15		8,093	89	0.01		
Total				**448**		**366**	

Table 3. Yellow Bullhead effort, catch, and biomass per segment by electrofishing in Aravaipa Creek, 2022.

Date	Segment	Effort(s)	Catch	Estimated Biomass (g)*
4/9/2022	S038	57-seine hauls	1	22
4/9/2022	S029	40-seine hauls	1	19
4/9/2022	S013	87-seine hauls	1	54
4/26/2022	S049	985	22	1524
4/26/2022	S050	1075	39	1863
4/26/2022	S051	934	15	718
4/26/2022	S052	1132	16	518
4/26/2022	S053	1173	14	668
4/26/2022	S054	973	12	593
4/26/2022	S055	752	9	580
4/26/2022	S056	1190	8	282
4/26/2022	S038	1596	37	2709
4/26/2022	S039	852	18	726
4/26/2022	S040	1056	34	1922
4/26/2022	S041	814	14	731
4/27/2022	S042	1271	18	956
4/27/2022	S043	1340	17	824
4/27/2022	S044	909	7	321
4/27/2022	S045	1319	18	779
4/27/2022	S046	1403	17	717
4/27/2022	S047	2202	22	728
4/27/2022	S048	1295	8	341
4/27/2022	S056	8-Seine hauls	11	1053
4/27/2022	S057	1473	10	631
4/27/2022	S058	1106	3	224
4/28/2022	S059	1866	6	427
4/28/2022	S060	1374	9	682

4/28/2022	S061	718	4	217
4/28/2022	S062	832	5	324
7/1/2022	S022	2379	32	1978
7/1/2022	S023	1740	37	2380
8/29/2022	S025	931	30	1565
8/29/2022	S026	1932	44	1930
8/29/2022	S027	1217	23	1274
8/29/2022	S028	1668	38	1562
8/30/2022	S034	1818	49	2999
8/30/2022	S035	1836	27	1363
8/30/2022	S036	1021	16	1056
8/30/2022	S037	1628	23	1340
8/31/2022	S029	1326	30	2249
8/31/2022	S030	2003	37	1355
8/31/2022	S031	1636	29	1322
8/31/2022	S032	2015	21	1245
8/31/2022	S033	1001	24	1449
9/1/2022	S022	1306	18	900
9/1/2022	S023	1175	28	1089
9/1/2022	S024	1024	41	2034
Totals:			**943**	**50,243**

*Biomass of yellow bullhead removed was calculated using the length to weight formula from (Schneider et al., 2000).

Table 4. Summary of Yellow Bullhead removal from Aravaipa Creek from April through November 2022.

Removal Date	Location	Distance Covered (river kilometers)	Effort (Seconds)	Number of Yellow Bullhead Removed	Comments
04/09/2022	West & East Ends	1.5		3	Spring fish monitoring - Seine
04/26-28/2022	East-end	13.0	29,640	382	
04/27/2022	East-end	----		11	Seine
07/01/2022	West-end	1.0	4,119	69	
08/29-09/1/2022	West-end	8.0	23,537	478	
Total		**23.5**	**57,296**	**943**	

Table 5. Summary of Yellow Bullhead removal from Aravaipa Creek from 2018 through 2022.

Year	Age Class	Count	Minutes	Biomass (g)	CPUE (#AMNA/Minutes)	CPUE (grams/per minute)
2018	J	117	650.533	2,356	0.18	3.62
2018	A	116	650.533	14,043	0.18	21.59
2019	J	75	508.383	1,132	0.15	2.23
2019	A	43	508.383	4,888	0.08	9.61
2020	J	2048	3224.13	22,167	0.64	6.88
2020	A	733	3224.13	67,449	0.23	20.92
2021	J	2628	6990.98	39,716	0.38	5.68
2021	A	1389	6990.98	121,117	0.20	17.32
2022	J	371	954.93	5,683	0.39	5.95
2022	A	572	954.93	44,559	0.59	46.66