



Nonnative Fish Removal from Aravaipa and Bonita Creeks 2023 Annual Report

Interagency Agreement (R22PG00016) 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 (*Poeciliopsis 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 24,107 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. Hoop nets were removed from use in February 2021, as they are somewhat ineffective in catching Yellow Bullhead, possibly due to their positioning above the streambed to create an air pocket to prevent nontargeted wildlife from drowning. 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; but was ineffective due to the presence of large and deep beaver dam pools. However, monsoonal flooding in 2022 reduced the number of beaver dam pools allowing us to effectively electrofish segments of the creek that previously were inaccessible. Additionally, the reduction in beaver dam pools and potentially other factors is resulting in habitat drying throughout Bonita 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: Nine removal trips, totaling 24-days, were conducted from March through October 2023. A total of 2,713 Yellow Bullhead were removed (Table 2). Backpack electrofishing captured 2,099 Yellow Bullhead (Table 3), whereas Promar and Gee metal minnow traps captured 578 and 36, respectively (Tables 4 and 5). Of the Yellow Bullhead removed, adults (n=875) comprised 32.25% and juveniles (n=1,838) comprised 67.75%. An additional 28 Yellow Bullhead were removed during annual fish monitoring in April and June and are not included in table 2; eighteen were collected below the fish barrier and 10 above. Length-frequency histograms

of Yellow Bullhead removed from Bonita Creek in 2023, from Gee metal minnow traps, Promar traps, and backpack electrofisher show multiple age classes of Yellow Bullhead (Figure 2).

Recommendations for Bonita Creek: Yellow Bullhead removal will continue in 2024. The number of removal trips will be increased due to additional funding from the Bipartisan Infrastructure Law. Additional funding will allow for multiple 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.

ARAVAIPA CREEK ANNUAL REPORT

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 Pedro River and is located in southeastern Arizona about 50 miles west of Safford, Arizona, along the border of Graham and Pinal counties. The creek becomes perennial at Aravaipa Spring near Stowe Gulch on lands owned and managed by The Nature Conservancy (TNC) 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 supports seven populations of native fish species, including Loach Minnow, Spikedace, Roundtail Chub (*Gila robusta*), Speckled Dace, Longfin Dace, Sonora Sucker, and Desert Sucker. The Arizona Game and Fish Department recently stocked Gila Topminnow on TNC land in 2022. It is too early to determine if they will persist and establish a population.

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) (Figure 3). 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 and Discussion for Aravaipa Creek: In 2023, 20 removal trips that spanned 42-days and covered 151 stream segments (*i.e.*, 75.5 river kilometers) were conducted at Aravaipa Creek (Table 6). Total electrofishing effort was 241,750 seconds (4,092 minutes), resulting in the capture of 7,592 Yellow Bullhead. Dipnet sweeps along the streambank vegetation captured an additional 980 Yellow Bullhead for a total of 8,572. Estimated Yellow Bullhead biomass removed totaled 111,091 grams (g) (Table 7). An additional 50 Yellow Bullhead not included in table 7 were removed during the spring and fall fish monitoring and four were captured for an internal outreach event for a total of 8,626. Of the 8,626 Yellow Bullhead captured, juveniles comprised 93.64% (n=8,077), and adults comprised 6.36% (n=549) of total catch.

Catch per unit effort (CPUE) was calculated for both the number of Yellow Bullhead captured and their estimated biomass. The number of Yellow Bullhead removed nearly doubled from 2022 to 2023, likely a reflection of increased fishing effort leading to higher capture numbers; whereas the Yellow Bullhead biomass removed showed a decline from 53 g per minute in 2022 to 27 g per minute in 2023, despite a significant 705% increase in the number of Yellow Bullhead removed during this period (Table 8).

A length-frequency histogram of Yellow Bullhead removed in 2023 from Aravaipa Creek, excluding those collected during fish monitoring, illustrates multiple ages classes with juvenile Yellow Bullhead being the highest proportion (Figure 4).

It is anticipated that the substantial removal of juvenile fish in 2023 will reduce the overall reproductive capacity of the population and as the removal efforts continue in 2024, the skewed age distribution is expected to contribute to a decline in Yellow Bullhead.

The absence of flooding from 2020 through 2023, coupled with low flows, facilitated the growth of nonnative watercress (*Nasturtium officinale*) in the creek, creating pockets of ideal habitat for juvenile Yellow Bullhead. The daily maximum mean discharge from 2015 through 2023 is illustrated in Figure 5.

Recommendations for Aravaipa Creek: Yellow Bullhead removal will continue in 2024. The number of removal trips will be increased due to additional funding from the Bipartisan Infrastructure Law. 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 of Promar traps may be attempted in habitats adjacent or nearby campsites.

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

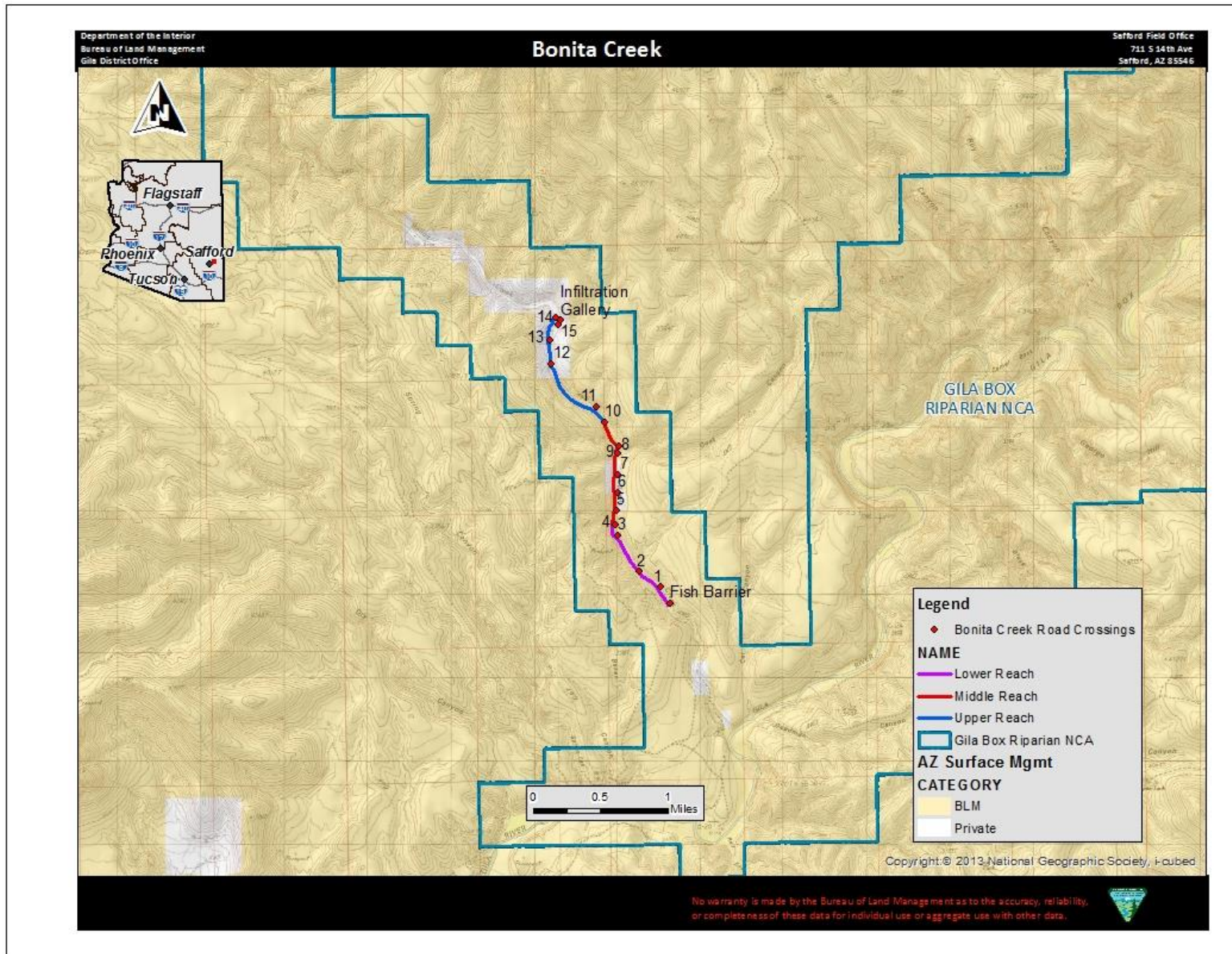


Figure 1. Project area showing fish barrier, low water road crossings, City of Safford infiltration gallery, and stream reaches of Bonita Creek.

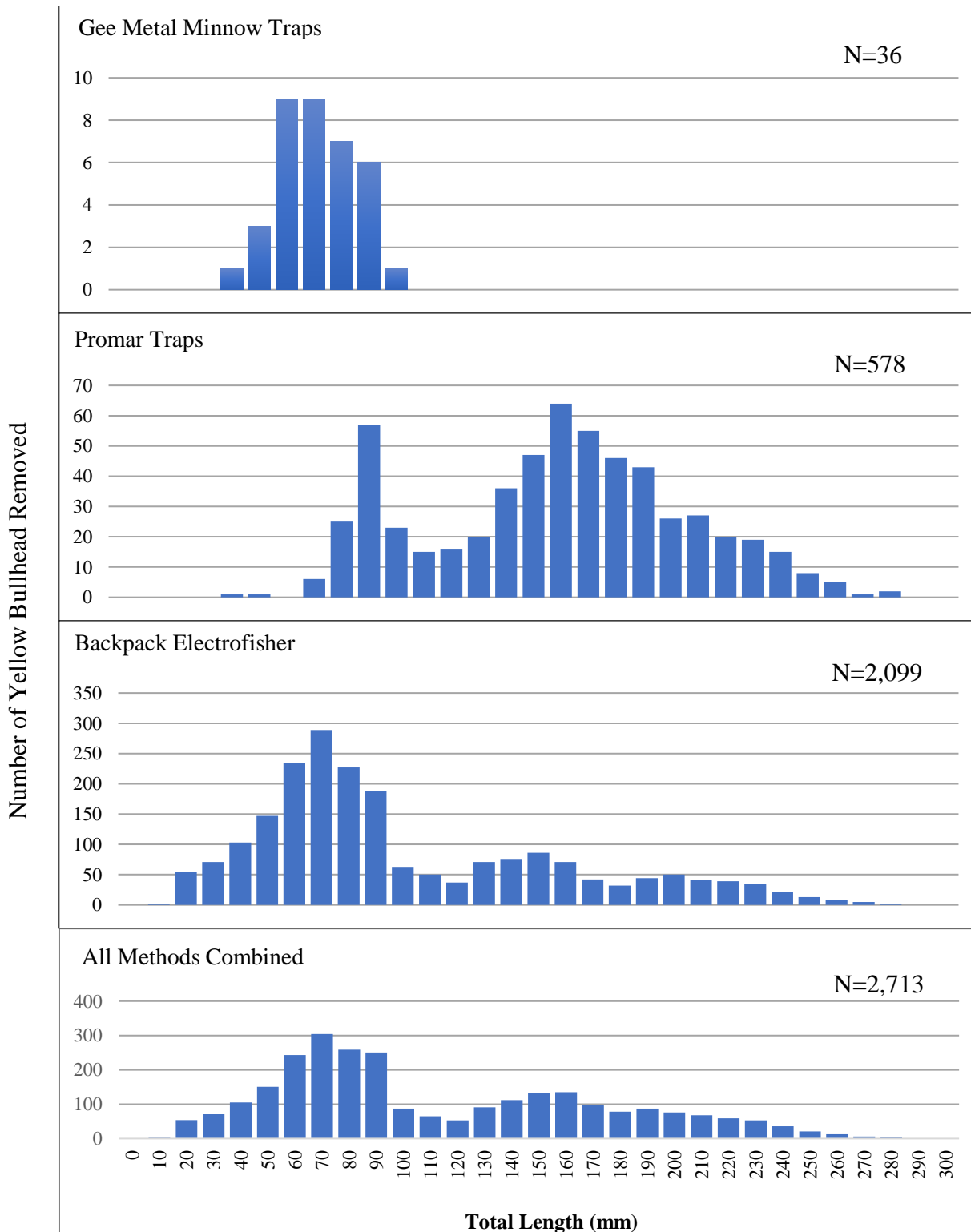


Figure 2. Length frequency histograms of Yellow Bullhead removed from Bonita Creek using Gee metal minnow traps, Promar traps, backpack electrofisher, and all methods combined in 2023.

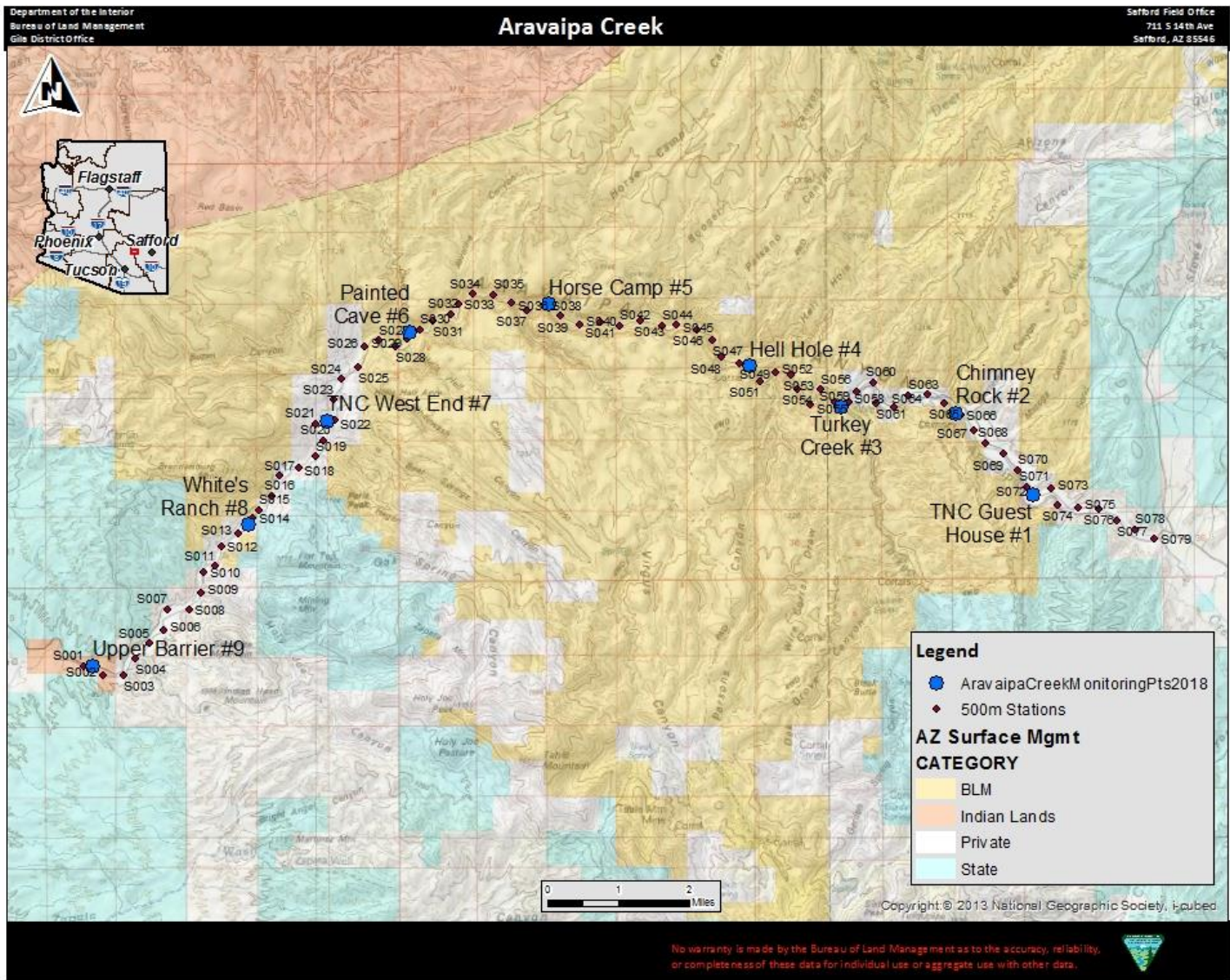


Figure 3. Project area showing the 79, 500-meter reaches and permanent fish monitoring sites of Aravaipa Creek.

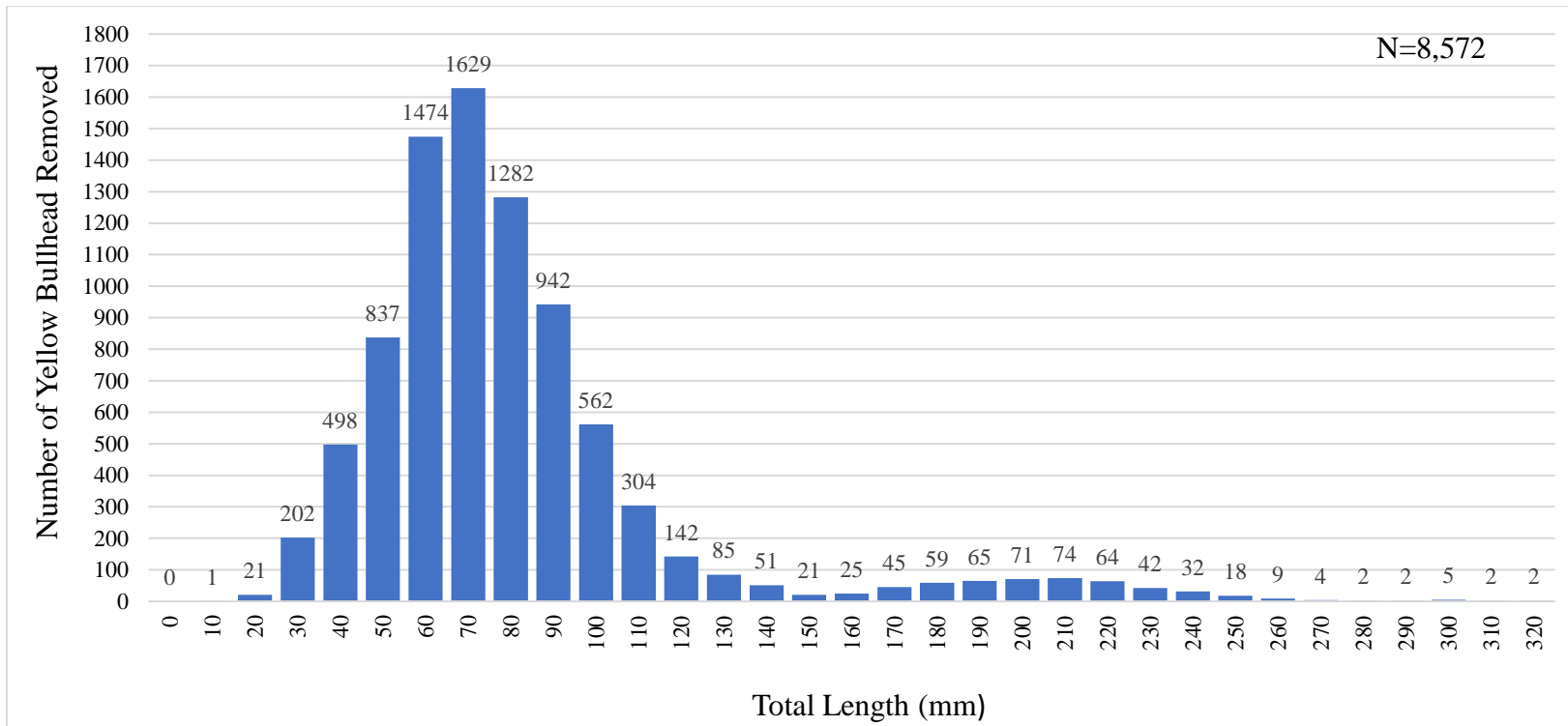


Figure 4. Length frequency histogram of Yellow Bullhead catch from Aravaipa Creek, February-December 2023.

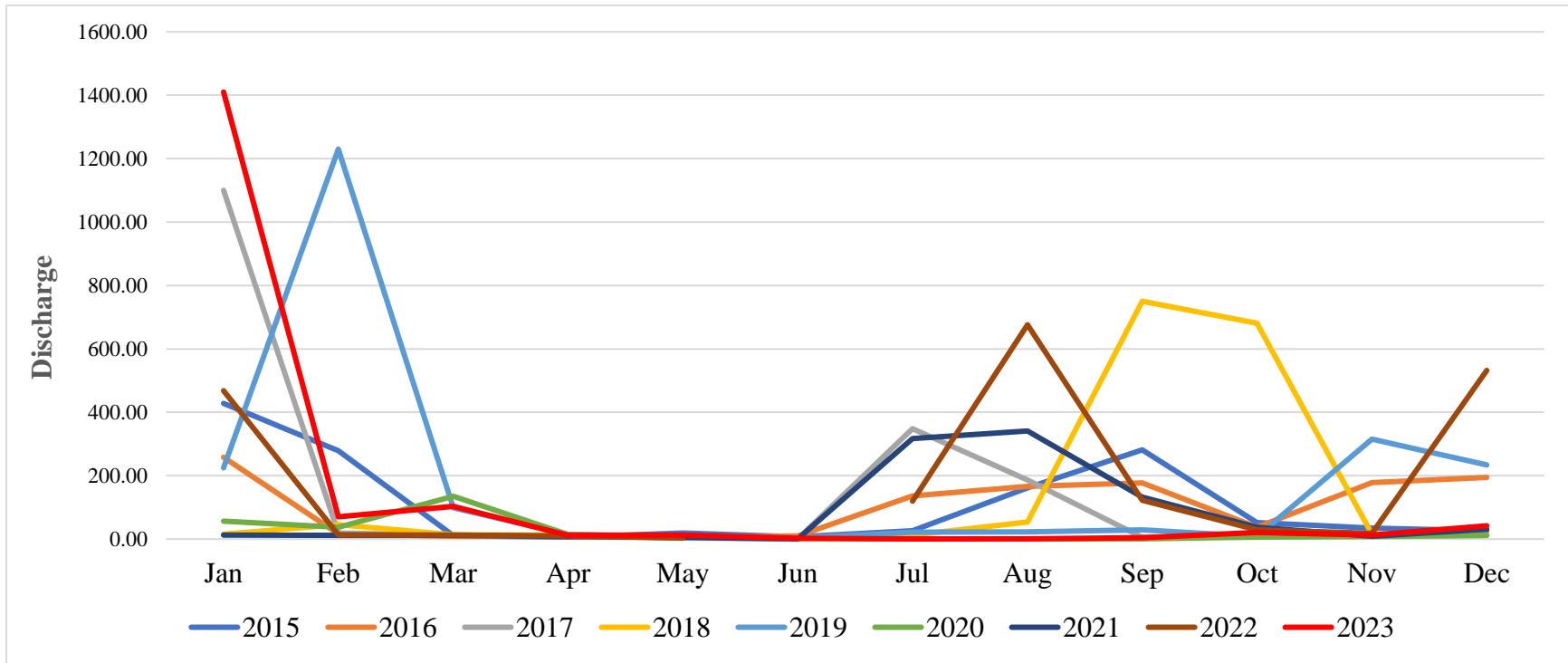


Figure 5. Daily maximum mean discharge in cubic feet per second in Aravaipa Creek (Mammoth, AZ stream gage) from 2015 through 2023. Please note that the US Geological Survey station at Aravaipa Creek is missing data in June and July.

Table 1. Catch summary of Green Sunfish removed from Bonita Creek by gear type, 2009-2023.

Gear Type	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018-2023	Total
Gee Minnow Trap	350	1,688	2,324	3,701	1,152	2,278	1,329	2,815	2		15,639
Promar Net	614	566	832	1,623	857	521	574	576	5		6,168
Hoop Net			76	224	148	198	204	126			976
Gee and Promar - Combined			756								756
Straight Seine					186			12			198
Seines/Dipnets	173										173
Dip Net					93						93
Red Promar	11				4			42			57
Backpack Electrofisher	10	8	10			2					30
Tote Barge Shocker						7					7
Custom Trap						8	1				9
Crab Trap					1						1
Total	1,158	2,262	3,998	5,548	2,441	3,014	2,108	3,571	7	0	24,107

Table 2. Summary of Yellow Bullhead removed from Bonita Creek in 2023 using a variety of methods.

Zone ID	Number of Yellow Bullhead Removed		
	Metal	Promar	BPS
Between Fish Barrier and 1st Road Crossing	34	179	381
Road Crossing 1-2		49	519
Road Crossing 2-3	2	89	538
Road Crossing 3-4		17	27
Road Crossing 4-5		8	22
Road Crossing 5-6		33	53
Road Crossing 6-7		16	31
Road Crossing 7-8		45	35
Road Crossing 8-9	Dry		
Road Crossing 9-10	Dry		
Road Crossing 10-11			
Road Crossing 11-12		114	445
Road Crossing 12-13		13	40
Road Crossing 13-14		15	8
Total by Method	36	578	2,099
Total All Methods Combined	2,713		

Table 3. Summary of Yellow Bullhead removal by backpack electrofisher from Bonita Creek in 2023.

Removal Date	Location-Road Crossings	Effort Minutes	Number of Yellow Bullhead Removed	CPUE
3/16/2023	3-4	27.17	3	0.11
3/16/2023	4-5	20.38	7	0.34
3/16/2023	5-6	27.92	10	0.36
4/6/2023	5-6	24.05	5	0.21
4/6/2023	6-7	9.12	1	0.11
6/5/2023	0-1	45.38	34	0.75
6/5/2023	1-2	86.93	110	1.27
6/6/2023	2-3	85.67	77	0.90
6/6/2023	3-4	19.62	6	0.31
6/6/2023	4-5	17.85	3	0.17
6/6/2023	5-6	27.43	7	0.26
6/6/2023	6-7	20.15	8	0.40
6/7/2023	7-8	35.52	7	0.20
6/7/2023	10-11	4.02	0	0.00
6/7/2023	11-12	112.15	135	1.20
6/7/2023	12-13	28.72	15	0.52
6/7/2023	13-14	13.68	6	0.44
6/8/2023	1-2	57.70	39	0.68
7/15/2023	0-1	97.45	65	0.67
7/15/2023	1-2	98.68	62	0.63
7/15/2023	2-3	76.12	47	0.62
7/31/2023	0-1	86.70	135	1.56
7/31/2023	1-2	48.33	37	0.77
7/31/2023	2-3	34.72	41	1.18
8/1/2023	2-3	65.97	26	0.39
8/1/2023	3-4	21.37	4	0.19
8/1/2023	4-5	18.37	7	0.38
8/1/2023	5-6	27.28	9	0.33
8/1/2023	6-7	20.37	8	0.39
8/1/2023	7-8	22.12	6	0.27
8/2/2023	11-12	103.25	116	1.12
8/2/2023	12-13	36.83	13	0.35
8/2/2023	13-14	15.70	1	0.06
8/3/2023	14-15	1.58	0	0.00
8/14/2023	0-1	68.47	56	0.82
8/14/2023	1-2	89.25	56	0.63
8/14/2023	2-3	114.55	126	1.10
8/14/2023	4-5	32.00	1	0.03
8/14/2023	5-6	36.80	5	0.14
8/14/2023	6-7	28.15	6	0.21

Table 3. Continued.

8/14/2023	7-8	16.62	4	0.24
8/14/2023	11-12	88.97	77	0.87
8/14/2023	12-13	28.28	4	0.14
8/14/2023	13-14	15.03	0	0.00
8/15/2023	0-1	101.52	44	0.43
8/15/2023	1-2	105.40	50	0.47
8/15/2023	2-3	142.72	57	0.40
8/15/2023	3-4	22.48	4	0.18
8/15/2023	4-5	17.87	1	0.06
8/15/2023	5-6	29.43	3	0.10
8/15/2023	6-7	18.27	4	0.22
8/15/2023	7-8	15.43	6	0.39
8/15/2023	11-12	132.13	38	0.29
8/15/2023	12-13	39.80	8	0.20
8/15/2023	13-14	18.60	0	0.00
8/16/2023	0-1	110.15	33	0.30
8/16/2023	1-2	54.58	23	0.42
8/16/2023	2-3	152.32	67	0.44
8/16/2023	3-4	17.50	2	0.11
8/16/2023	4-5	24.83	0	0.00
8/16/2023	5-6	34.92	2	0.06
8/16/2023	6-7	18.98	0	0.00
8/16/2023	7-8	14.85	3	0.20
8/16/2023	11-12	67.70	1	0.01
8/16/2023	12-13	23.67	0	0.00
8/16/2023	13-14	12.97	1	0.08
8/17/2023	0-1	39.95	8	0.20
8/17/2023	1-2	69.65	43	0.62
8/17/2023	2-3	74.13	44	0.59
8/17/2023	3-4	11.62	0	0.00
8/17/2023	4-5	14.58	1	0.07
8/17/2023	5-6	26.37	1	0.04
8/17/2023	6-7	16.40	1	0.06
8/17/2023	7-8	13.03	5	0.38
8/17/2023	11-12	68.57	19	0.28
8/17/2023	12-13	17.08	0	0.00
8/17/2023	13-14	8.32	0	0.00
10/2/2023	0-1	31.60	6	0.19
10/2/2023	1-2	76.13	65	0.85
10/3/2023	2-3	62.60	46	0.73
10/3/2023	3-4	18.15	8	0.44
10/3/2023	4-5	11.52	2	0.17
10/3/2023	5-6	24.95	11	0.44

Table 3. Continued.

10/4/2023	6-7	19.20	3	0.16
10/4/2023	7-8	20.43	4	0.20
10/4/2023	11-12	102.27	59	0.58
10/4/2023	12-13	21.72	0	0.00
10/4/2023	13-14	9.63	0	0.00
10/5/2023	1-2	42.40	34	0.80
10/5/2023	2-3	25.72	7	0.27
Total		3,959	2,099	

Table 4. Summary of Yellow Bullhead removal by Promar Traps from Bonita Creek in 2023.

Removal Date	Location-Road Crossings	Effort (NN)	Number of Yellow Bullhead Removed	CPUE
6/5-6/2023	0-1	25	54	2.16
6/6-7/2023	0-1	25	17	0.68
6/7-8/2023	11-12	10	19	1.90
8/1-2/2023	0-1	25	48	1.92
8/1-2/2023	1-2	5	12	2.40
8/1-2/2023	2-3	15	43	2.87
8/2-3/2023	0-1	25	20	0.80
8/2-3/2023	1-2	16	37	2.31
8/14-15/2023	0-1	25	11	0.44
8/14-15/2023	4-5	10	5	0.50
8/14-15/2023	5-6	7	8	1.14
8/14-15/2023	6-7	4	5	1.25
8/14-15/2023	11-12	25	18	0.72
8/15-16/2023	0-1	25	8	0.32
8/15-16/2023	3-4	16	8	0.50
8/15-16/2023	5-6	10	5	0.50
8/15-16/2023	6-7	8	4	0.50
8/15-16/2023	7-8	13	32	2.46
8/16-17/2023	0-1	35	21	0.60
8/16-17/2023	2-3	29	46	1.59
8/16-17/2023	3-4	4	8	2.00
8/16-17/2023	5-6	31	15	0.48
8/16-17/2023	6-7	3	3	1.00
8/16-17/2023	7-8	7	6	0.86
8/16-17/2023	11-12	10	34	3.40
8/17-18/2023	3-4	4	1	0.25
8/17-18/2023	4-5	5	3	0.60
8/17-18/2023	5-6	25	5	0.20
8/17-18/2023	6-7	3	4	1.33
8/17-18/2023	7-8	7	7	1.00
8/17-18/2023	11-12	5	3	0.60
8/17-18/2023	12-13	5	10	2.00
8/28-29/2023	12-13	18	3	0.17
8/28-29/2023	13-14	16	15	0.94
9/19-20/2023	11-12	25	22	0.88
10/2-3/2023	11-12	15	8	0.53
10/2-3/2023	12-13	10	0	0.00
10/3-4/2023	11-12	25	6	0.24
10/4-5/2023	11-12	25	4	0.16
Total		596	578	

Table 5. Summary of Yellow Bullhead removal by Gee Metal Traps from Bonita Creek in 2023.

Removal Date	Location-Road Crossings	Effort (NN)	Number of Yellow Bullhead Removed	CPUE
8/14-15/2023	0-1	24	15	0.63
8/15-16/2023	0-1	24	9	0.38
8/16-17/2023	0-1	24	10	0.42
8/16-17/2023	2-3	10	2	0.20
8/16-17/2023	5-6	25	0	0.00
8/17-18/2023	5-6	25	0	0.00
Total		132	36	

Table 6. Summary table of Yellow Bullhead removal from Aravaipa Creek in 2023.

Removal Date	Location	Distance Covered (river kilometers)	Effort (Seconds)	Number of Yellow Bullhead Removed	Comments
2/8/2023	West-end			4	T&E leads visit
2/21/2023	East-end	2	2,698	1	
3/27-29/2023	West-end	6.5	14,356	50	
4/1/2023	East-end			2	Spring fish monitoring - Dipnet
4/12-14/2023	East-end	8	13,833	93	
5/8-10/2023	West-end	8.5	11,861	44	
5/15-16/2023	East-end	4.5	7,746	47	
6/20-22/2023	West-end	5	20,818	186	
7/5-6/2023	West-end	2.5	25,491	566	
7/17/2023	East-end	1	5,141	15	
8/5/2023	West-end	1		80	Dipnet Sweeps
8/12/2023	West-end	2.5		346	Dipnet Sweeps
8/26/2023	West-end	3		319	Dipnet Sweeps
8/28-31/2023	East-end	5.5	33,127	2260	
9/2/2023	West-end	1.5		67	Dipnet Sweeps
9/10/2023	West-end	0.5		19	Dipnet Sweeps
9/16/2023	West-end	1.5		119	Dipnet Sweeps
9/26-29/2023	West-end	4.5	30,332	1930	
10/6-7/2023	West & East Ends			48	Fall fish monitoring - Seine
10/23-26/2023	East-end	9	29,602	361	
10/30-11/2/2023	West-end	5.5	36,011	1982	
11/11/2023	West-end	1		30	Dipnet Sweeps
12/9/2023	West-end	2	10,734	57	
Total		75.5	241,750	8,626	

Table 7. Yellow Bullhead catch, effort and biomass per creek segment by electrofishing at Aravaipa Creek in 2023.

Stream Segment and Date	Number of Yellow Bullhead Removed	Effort by Segment Electrofishing (Minutes)	Biomass by Segment
S021			
5/10/2023	4	848	302
9/10/2023	19	*	155
9/16/2023	53	*	241
11/11/2023	26	*	120
12/9/2023	5	2678	23
S022			
5/10/2023	4	704	417
7/6/2023	11	2860	300
8/12/2023	8	*	17
8/26/2023	30	*	97
9/2/2023	41	*	139
9/16/2023	31	*	145
11/11/2023	4	*	29
11/2/2023	197	3320	1825
12/9/2023	9	2201	42
S023			
5/10/2023	3	628	318
7/6/2023	60	4129	602
8/12/2023	36	*	88
8/26/2023	37	*	134
9/16/2023	35	*	206
9/29/2023	159	3617	1620
11/2/2023	140	3920	1112
12/9/2023	30	2953	201
S024			
5/10/2023	4	929	361
7/6/2023	294	5397	1551
8/5/2023	58	*	145
8/12/2023	109	*	242
8/26/2023	82	*	222
9/29/2023	56	1872	992
12/9/2023	13	2902	286
S025			
3/27/2023	9	1793	615
5/10/2023	3	643	345
8/12/2023	100	*	337
8/26/2023	49	*	160

Table 7. Continued.

Stream Segment and Date	Number of Yellow Bullhead Removed	Effort by Segment Electrofishing (Minutes)	Biomass by Segment
S026			
3/27/2023	9	1775	609
5/10/23	2	736	164
6/22/2023	29	3657	2402
8/5/2023	22	*	62
8/12/2023	93	*	278
8/26/2023	65	*	242
S027			
3/27/2023	2	1143	193
5/10/23	5	714	356
6/22/2023	11	1513	701
8/26/2023	56	*	142
9/26/2023	179	4119	1659
10/30/2023	159	3472	1861
S028			
3/27/2023	5	1609	431
5/8/2023	0	774	0
6/22/2023	12	1687	1013
7/5/2023	126	7822	197
9/26/2023	325	4658	2831
10/30/2023	201	3671	1750
S029			
3/29/2023	1	1198	68
5/8/2023	4	1135	623
7/5/2023	75	5283	953
9/28/2023	222	3688	1974
10/30/2023	65	2641	767
S030			
3/29/2023	4	995	205
5/8/2023	5	684	324
9/12/2023	4	*	11
9/28/2023	254	2789	3158
11/1/2023	183	3325	1881
S031			
3/29/2023	0	1020	0
5/8/2023	1	645	133
6/21/2023	11	2209	807
11/1/2023	228	3029	2157

Table 7. Continued.

Stream Segment and Date	Number of Yellow Bullhead Removed	Effort by Segment Electrofishing (Minutes)	Biomass by Segment
S032			
3/29/2023	8	1218	1032
5/8/2023	3	609	503
6/21/2023	8	1614	911
9/2/2023	22	*	60
11/1/2023	321	4342	2845
S033			
3/29/2023	4	992	403
5/9/2023	2	762	213
6/21/2023	64	3162	643
S034			
3/28/2023	1	1122	13
5/9/2023	0	492	0
6/20/2023	23	2709	3149
9/27/2023	256	3813	3005
S035			
3/28/2023	3	550	387
5/9/2023	1	429	63
6/20/2023	11	1609	1013
9/27/2023	276	3397	2547
10/31/2023	182	3043	1525
S036			
3/28/2023	1	599	17
5/9/2023	2	602	223
6/20/2023	1	205	89
6/21/2023	16	2453	906
9/27/2023	203	2379	1784
10/31/2023	154	2752	2693
S037			
3/28/2023	3	342	279
5/9/2023	1	527	55
10/31/2023	152	2496	1099
S038			
4/12/2023	12	1496	962
5/16/2023	7	821	760
8/29/2023	291	3856	2530
S039			
4/12/2023	3	919	349
5/16/2023	7	843	538
8/29/2023	255	3169	2346

Table 7. Continued.

Stream Segment and Date	Number of Yellow Bullhead Removed	Effort by Segment Electrofishing (Minutes)	Biomass by Segment
S040			
4/12/2023	2	813	196
5/16/2023	1	621	64
8/29/2023	190	2202	1345
S041			
4/12/2023	0	895	0
5/16/2023	3	782	213
S042			
4/12/2023	17	1109	1761
5/16/2023	16	957	1624
S043			
4/13/2023	5	1090	527
5/16/2023	5	945	244
8/28/2023	256	5409	2130
S044			
4/13/2023	9	812	831
5/15/2023	6	1149	418
S045			
4/13/2023	11	1022	960
5/15/2023	2	916	103
S046			
4/13/2023	5	680	651
5/15/2023	0	712	0
S047			
4/13/2023	0	519	0
S048			
4/13/2023	7	692	738
7/17/2023	3	2335	262
8/30/2023	190	2516	1164
S049			
4/13/2023	3	784	335
7/17/2023	12	2806	280
8/30/2023	351	3506	3249
S050			
4/13/2023	4	619	268
8/30/2023	514	4327	5634
S051			
4/14/2023	3	879	309
8/30/2023	112	2817	1775

Table 7. Continued.

Stream Segment and Date	Number of Yellow Bullhead Removed	Effort by Segment Electrofishing (Minutes)	Biomass by Segment
S052			
4/14/2023	6	695	343
S053			
4/14/2023	6	809	358
S055			
2/21/2023	1	827	102
S056			
2/21/2023	0	713	0
8/31/2023	52	2146	2071
S057			
2/21/2023	0	563	0
8/31/2023	36	1622	2096
10/23/2023	78	4183	545
S058			
2/21/2023	0	595	0
8/31/2023	13	1557	383
10/23/2023	23	2753	871
S059			
10/23/2023	26	2146	555
S060			
10/24/2023	49	1925	459
S061			
10/24/2023	85	2247	1161
S062			
10/24/2023	61	2280	614
S063			
10/24/2023	10	1135	596
S064			
10/24/2023	3	1218	507
S065			
10/25/2023	19	2285	874
S066			
10/25/2023	0	889	0
S068			
10/25/2023	1	1413	10
S069			
10/25/2023	0	1064	0
S070			
10/25/2023	5	1442	29

Table 7. Continued.

Stream Segment and Date	Number of Yellow Bullhead Removed	Effort by Segment Electrofishing (Minutes)	Biomass by Segment
S071			
10/25/2023	0	1237	0
S072			
10/26/2023	1	1261	148
S073			
10/26/2023	0	1144	0
S074			
10/26/2023	0	478	0
S075			
10/26/2023	0	502	0
Total	8,572	241,750	111,091

*Biomass of yellow bullhead removed was calculated using the length to weight formula from (Schneider et al., 2000). *Effort was not captured for dipnet sweeps.

Table 8. Summary of Yellow Bullhead catch per unit effort by number per minute and by biomass per minute for juveniles and adults from Aravaipa Creek by backpack electrofisher from 2018 through 2023.

Year	Age Class	Count	Minutes	Biomass (g)	CPUE (#AMNA/minute)	CPUE (grams/minute)
2018	J	117	650.53	2,356	0.18	3.62
2018	A	116	650.53	14,043	0.18	21.59
2019	J	75	508.38	1,132	0.15	2.23
2019	A	43	508.38	4,888	0.08	9.61
2020	J	2,048	3224.13	22,167	0.64	6.88
2020	A	733	3224.13	67,449	0.23	20.92
2021	J	2,628	6990.98	39,716	0.38	5.68
2021	A	1,389	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
2023	J	7,048	4029.17	45,790	1.75	11.36
2023	A	544	4029.17	62,027	0.14	15.39