Gila River Basin Native Fish Monitoring

2022 Annual Report

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Submitted to

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In behalf of Reclamation Contract No. 140R3022F0030

April 2023

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Introduction

Long-term monitoring at multiple spatial scales through time (i.e., temporal) provides important insight on distribution, abundance, and dynamics of stream fish communities. In 1994, a long-term monitoring program was initiated by Bureau of Reclamation (Reclamation) as a requirement imposed by Fish and Wildlife Service (FWS) to monitor fish populations in selected waters of the Gila River basin due to impacts of the Central Arizona Project (CAP) on federally listed fishes (FWS 1994, 2001, 2008). FWS determined that the canal and its interconnected channels had potential to degrade fish habitat as the CAP provided a mechanism for dispersal of non-native fishes into surrounding aquatic systems. The initial monitoring program objective was to provide baseline data on distribution and abundance of non-native fishes in the CAP canal system and its primary connected waters. In 2012, Reclamation and FWS in collaboration with Arizona Game and Fish Department (AZGFD) and New Mexico Department of Game and Fish (NMDGF) shifted focus further upstream of the CAP canal system to gather information on status of wild populations of federal-listed and candidate fishes.

The primary objective of the current monitoring program is to identify the presence and distribution of each target species in the streams being monitored. Secondarily, evaluate fish community structure to determine relative abundance of focal species within the community of co-occurring fishes. Moving forward, the program goal will be to better assess conservation status of federally listed focal species by calculating population size indices, determining fish assemblage structure including non-natives, documenting reproduction and recruitment, and determining geographic extent for each focal species (Mosher et al. 2020). Species specific objectives and standardized protocols will assist with meeting this goal.

This report summarizes monitoring activities conducted by Marsh & Associates, LLC (M&A) during calendar year 2022 for the Gila River Basin Native Fish Monitoring Project (GRBMP). Here, detailed trip summaries with catch data are reported, results are summarized across sub-basins, sampling gears are qualitatively evaluated, and trends of recruitment and size-structure are examined where possible.

Surveys were conducted in selected streams of major drainages throughout the Gila River basin (Figure 1) that were not being surveyed by others (e.g., agencies, institutions, and private contractors). The focal species in each stream is one or more of four native species currently listed as threatened or endangered: Gila Chub *Gila intermedia,* Spikedace *Meda fulgida*, Loach Minnow *Tiaroga cobitis*, and Gila Topminnow *Poeciliopsis occidentalis.*

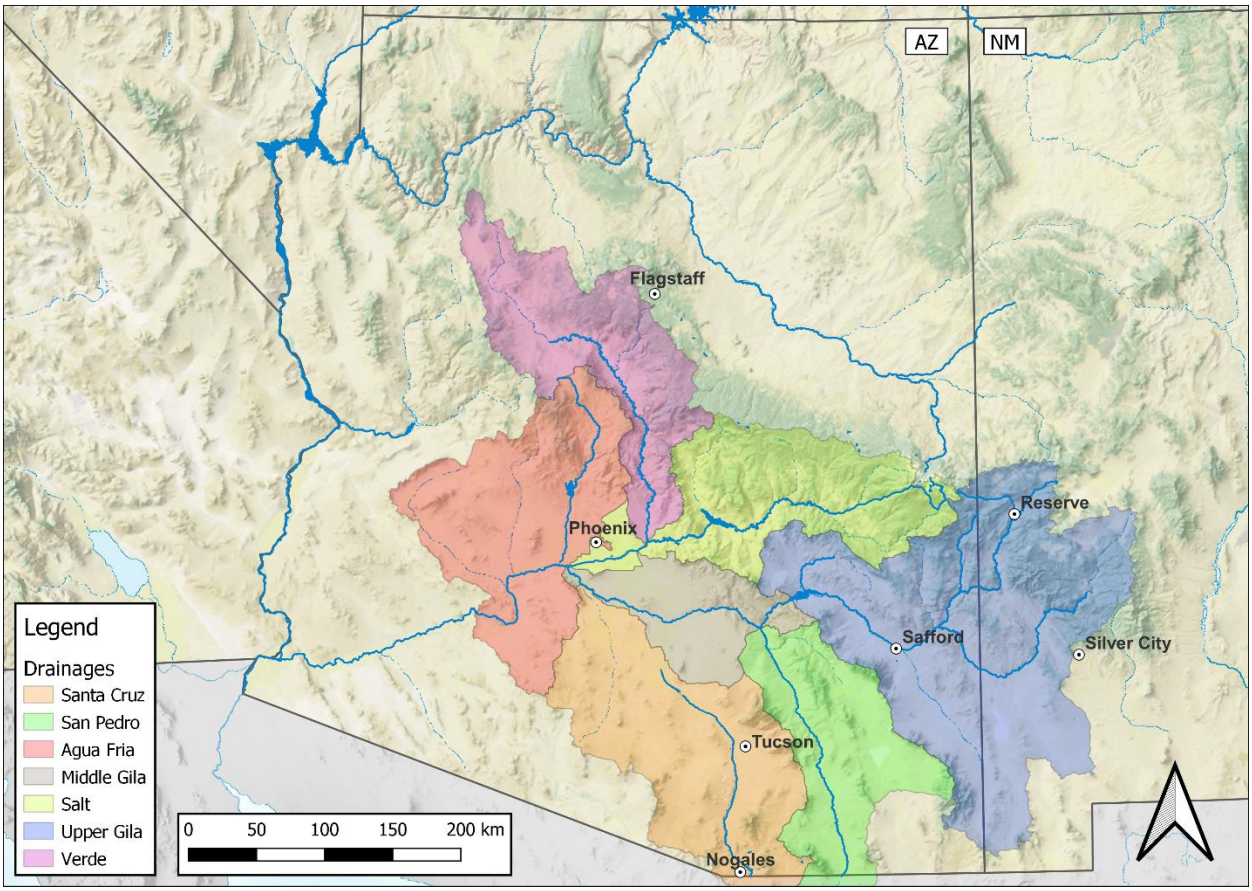

Figure 1. Major drainages of the Gila River basin, Arizona and New Mexico, where stream surveys were conducted in 2022.

Methods

A new, generalized sampling design and methodology, including site-specific monitoring protocols, was implemented in 2021 and utilized again in 2022. Sampling methodologies followed Mosher et al. (2020) and any deviations are reported in the trip summaries section below. These methods will help improve consistency regarding survey timing, effort, and sampling locations moving forward. Standardized methods allow for more informative comparisons across years. Primary methods of sampling were backpack electrofishing ([BPEF]; Smith-Root LR-20B Electrofisher), large hoop nets (29 in x 24 in, ¼ in mesh), Promar collapsible mini-hoop nets (hereafter mini-hoop nets; 12 in x 24 and 36 in, ½ in mesh), Gee-style minnow traps (hereafter minnow traps; 10 in x 18 in, 1/8 in mesh), dip nets (1.16 ft x 1 ft, 1/8 in mesh), and seine (12 ft x 4 ft, 0.118 in mesh). In New Mexico, BPEF was used in combination with kick seining at several sites that contained broad shallow runs with smooth substrate.

Site-specific monitoring protocols were established for each stream (Mosher et al. 2020); generally, gear selection was determined by focal species and habitat type. In addition, protocols differed slightly for Arizona versus New Mexico streams because of differing data preferences of the fish management agencies in the two states. In New Mexico, all survey stations were 200-meters (m) in length compared to 100-m in Arizona (except for the lower Blue River which has 200-m survey stations). Regardless, total length of stream sampled during a given study year is enough to cover at least 20% of available habitat at

a site. Sites typically consisted of at least one fixed station and remaining stations were randomly selected, 100-m or 200-m intervals that were generated using QGIS software. Potential survey stations were numbered beginning at 01 for the most upstream station and continuing downstream. A random number generator was used to assign random stations to be sampled for each monitoring extent.

Survey stations were broken up into major habitat types (Riffle, Run, Pool) and efforts were recorded individually for each type within a site. For example, at the end of each habitat break during an electrofishing survey, electrofishing seconds were recorded, all fishes captured were processed, and information such as habitat type, length, width, depth (if a pool) were recorded. Catch totals and effort were recorded individually for each mini-hoop net or minnow trap set, dip net sweep, and seine haul.

At each processing point, fishes were identified to species (Table 1), and counted. All Spikedace, Loach Minnow, Gila Chub, and non-native piscivores captured were measured for total length (TL, in millimeters [mm]). In addition, Gila Chub were weighed to the nearest gram. Lengths of other species were categorized into general size classes: ≤20 mm and >20 mm for Gila Topminnow and Western Mosquitofish *Gambusia affinis*, ≤40 mm and >40 mm for small-bodied fishes (e.g., Speckled Dace *Rhinichthys osculus* and Longfin Dace *Agosia chrysogaster*, and ≤50, 51-100 and >100 mm for large-bodied fishes (e.g., Desert Sucker *Pantosteus clarkii* and Sonora Sucker *Catostomus insignis*).

Station lengths were measured in the field using a Garmin 66i GPS unit. UTM coordinates of upper and lower boundaries of each reach were recorded in NAD83 datum. Habitat photographs were taken at each random station as were specimen photos of species of interest. At fixed stations, photographs were taken at upper and lower boundaries of both upstream and downstream views. Water physico-chemical parameters (temperature, dissolved oxygen [DO], pH, and conductivity) were measured at fixed stations. At stream sites, discharge was measured at fixed stations across 10 intervals using a HACH® FH950. Discharge protocol was a modified version of that developed by U.S. Environmental Protection Agency (Lazorchak et al. 1998).

Table 1. List of species encountered during surveys throughout the Gila River Basin in 2022.

Common name	Code	Scientific Name
Brook Stickleback	CUIN	*Culaea inconstans*
Channel Catfish	ICPU	*Ictalurus punctatus*
Common Carp	CYCA	*Cyprinus carpio*
Desert Sucker	PACL	*Pantosteus clarkii*
Fathead Minnow	PIPR	*Pimephales promelas*
Flathead Catfish	PYOL	*Pylodictis olivaris*
Gila Chub	GIIN	*Gila intermedia*
Gila Topminnow	POOC	*Poeciliopsis occidentalis*
Green Sunfish	LECY	*Lepomis cyanellus*
Largemouth Bass	MISA	*Micropterus salmoides*
Loach Minnow	TICO	*Tiaroga cobitis*
Longfin Dace	AGCH	*Agosia chrysogaster*
Western Mosquitofish	GAAF	*Gambusia affinis*

Rainbow Trout	ONMY	*Oncorhynchus mykiss*
Red Shiner	CYLU	*Cyprinella lutrensis*
Sonora Sucker	CAIN	*Catostomus insignis*
Speckled Dace	RHOS	*Rhinichthys osculus*
Spikedace	MEFU	*Meda fulgida*
Yellow Bullhead	AMNA	*Ameiurus natalis*
American Bullfrog	RACA	*Rana catesbeiana*
Canyon Treefrog	HYAR	*Hyla arenicolor*
Lowland Leopard Frog	RAYA	*Rana yavapaiensis*
Northern Crayfish	ORVI	*Orconectes virilis*
Sonora Mud Turtle	KISO	*Kinosternon sonoriense*

Data summary and analyses

Fish capture data were summarized and compiled in tabular form, separately for each stream, that provides numerical, catch-per-unit effort (CPUE), and relative abundance for each species and each age (size) class. Length-frequency histograms are included where possible to evaluate size-structure and reproduction. Also, a narrative text summarized trip details and fish community composition. Status of focal species was assessed in contexts of physical habitat conditions, local fish community, proximate or perceived threats, and other relevant conservation concerns. Solutions implemented (or recommended) to remedy any problems were described, and additional recommendations were offered that might contribute to program improvement. Station maps were constructed in QGIS (QGIS Development Team 2021).

Comparisons are made with previous surveys completed under this monitoring program in situations where adequate data exist. Monitoring data from 2013 – 2020 were downloaded using Microsoft Access. GRBMP surveys completed before 2021 utilized a different sampling protocol, therefore CPUE comparisons were not possible in some instances. TL was not typically recorded during these years so size-structure comparisons are limited. Population size and recruitment trends will be better examined in future years as the current sampling protocol is maintained. Raw data from 2012-2019 were provided for Hot Springs Canyon and lower Blue River by Reclamation which enabled a rolling 10-year CPUE trend analysis. CPUE for these surveys were calculated per station and then summarized for each year.

Results

A total of 90 sampling stations were completed across 19 streams. Gila Chub were detected at 16 of 18 stations (4 of 4 streams) where they were a focal species, Gila Topminnow were detected at 19 of 47 stations (8 of 11 streams), Loach Minnow were detected at 5 of 37 stations (2 of 5 streams), and Spikedace were detected at 3 of 32 stations (1 of 3 streams) where they were a focal species.

Across all streams, a total of 11,973 individuals across 17 fish species (8 native and 9 non-native) were captured (Table 2). No new taxa were detected for the Gila River basin. However, a notable discovery in 2022 was the first detection of Green Sunfish in Fresno Canyon since the site was treated with rotenone in 2007. Native taxa accounted for 91.34% of total catch. BPEF was the primary sampling gear and was used at 42 sampling stations. BPEF was effective at capturing both large and small-bodied fishes and accounted for 19.29% (n=2,310) of total catch. However, BPEF was not effective in stream reaches with

deep pools or high turbidity. Minnow traps were employed at 21 stations to target Gila Topminnow and young-of-year Gila Chub in pools. Minnow traps were the most productive sampling gear, accounting for 45.29% (n=5,423) of total catch. Seining was employed at 21 stations in deeper pools and flowing habitat with smooth substrate and accounted for 28.79% (n=3,447) of total catch. Other gears were used less frequently, such as dip-net sweeps that were utilized to target Gila Topminnow in shallow, vegetated stream margins at 13 stations and accounted for 3.27% (n=391) of total catch. Mini-hoop nets were employed to target adult Gila Chub in springs and deep pools at five different stations and accounted for 3.36% (n=402) of total catch.

Increased monsoonal activity in 2021 and 2022 appeared to have both positive and negative impacts on streams throughout the Gila River basin. Spring based sites, such as Coal Mine Canyon, Fresno Canyon, and Cottonwood Spring saw increased catch and improved habitat conditions. Evidence of large flood events were clearly visible in most flowing systems, which likely contributed to low numbers (or lack of detection) of Gila Topminnow at sites such as Cienega Creek and Spring Creek. Frequency of rain events also led to higher flows and increased turbidity in larger systems such as San Francisco River. Flows remained too high to sample during the recommended time-frame for both Gila River (Upper Box) and San Francisco (AZ) monitoring reaches and these sites were unable to be surveyed in 2022. Three stations were attempted at San Francisco (AZ), but efforts were ultimately abandoned due to ineffective sampling and unsafe wading conditions. High flows and turbidity led to less-than-ideal conditions for sampling in San Francisco River (NM) and lower Blue River and may have led to reduced catch.

Table 2. Summary of fish species captured by stream, Gila River basin, Arizona and New Mexico, 2022. Focal species for each stream are highlighted in yellow. Streams listed in alphabetic order; species codes are in Table 1.

Stream	AGCH	CAIN	CUIN	CYCA	CYLU	GAAF	GIIN	ICPU	LECY	MEFU	MISA	ONMY	PACL	PIPR	POOC	PYOL	RHOS	TICO
Cienega Creek	653	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-
Coal Mine Canyon	13	-	-	-	-	-	-	-	-	-	-	-	-	-	880	-	-	-
Cottonwood Spring	-	-	-	-	-	-	-	-	-	-	-	-	-	-	292	-	-	-
Fresno Canyon	194	-	-	-	-	-	-	-	1	-	-	-	-	-	853	-	-	-
Hot Springs Canyon	176	13	-	-	-	-	86	-	-	-	-	-	35	-	-	-	204	21
Lime Creek	545	-	-	-	-	-	-	-	-	-	-	-	-	-	131	-	-	-
Lower Blue River	207	38	-	-	-	-	-	-	-	4	-	-	218	-	-	-	24	-
Monkey Spring	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	-	-	-
Negrito Creek, NM	46	23	-	-	-	-	-	-	-	-	-	-	29	-	-	-	92	-
O'Donnell Creek	-	2	-	-	-	9	314	-	-	-	-	-	-	-	-	-	-	-
Parker Canyon	1	-	-	-	-	250	-	-	26	-	7	-	-	-	-	-	-	-
Redfield Canyon	69	36	-	-	-	-	59	-	9	-	-	-	-	-	14	-	-	-
San Francisco River, NM	354	48	-	2	3	1	-	1	-	-	-	1	78	14	-	7	130	17
Sheehy Spring	-	-	-	-	-	1	54	-	-	-	-	-	-	-	-	-	-	-
Sheepshead Canyon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	359	-	-	-
Sonoita Creek	1549	-	-	-	-	665	-	-	-	-	13	-	534	-	-	-	167	-
Spring Creek	122	-	-	-	-	-	472	-	-	2	-	-	-	-	-	-	82	-
Swamp Springs Canyon	823	-	-	-	-	-	-	-	-	-	-	-	-	-	409	-	-	-
Tularosa Creek, NM	173	8	5	-	-	8	-	-	6	-	-	-	10	7	-	-	43	-

Trip Summaries

San Pedro River Basin

O'Donnell Creek August 2 & 3, 2022

Station		Lower Boundary	Upper Boundary
OD06 (Fixed)	12R NAD83	544872E, 3492308N	544833E, 3492189N
OD08		544977E, 3492468N	544954E, 3492393N

O'Donnell Creek (Santa Cruz Co., AZ) is a tributary to Babocomari River and located on Canelo Hills Cienega Reserve managed by The Nature Conservancy (TNC) (Figure 4). The focal species at O'Donnell Canyon is Gila Chub. The 1.1 km monitoring reach is located within Canelo Hills Cienega Preserve and access was coordinated with TNC personnel. O'Donnell Creek was last surveyed for this monitoring program in 2019 and resulted in capture of 182 Gila Chub (Shollenberger et al. 2020)

M&A and TNC personnel completed the sampling of O'Donnell Creek on August 2 & 3, 2022. Two (1 fixed, 1 random), 100-m stations were surveyed. Sampling was conducted with mini-hoop nets that were set overnight. Totals of 314 Gila Chub, 2 Sonora Sucker, 9 Western Mosquitofish, 55 Northern Crayfish, and 4 Sonora Mud Turtles were captured across all stations and gear types.

The fixed station, OD06, began immediately below an erosion control dam. Ten mini-hoop nets were set within the 100-m station for a total of 218 trap hours. Species captured were Gila Chub (n=212; 82.82%), Sonora Sucker (n=1; 0.39%), Northern Crayfish (n=41; 16.02%), and Sonora Mud Turtle (n=2; 0.78%). To confirm the presence of Western Mosquitofish and to better capture smaller bodied fish, two minnow traps were set along the vegetated margins of the pool below the barrier. These additional efforts resulted in capture of nine Western Mosquitofish and two Gila Chub.

The random station, OD08, began 200-m downstream from the fixed station. Ten mini-hoop nets were set within the random station for a total of 203 trap hours. Species captured were Gila Chub (n=100; 85.47%), Sonora Sucker (n=1; 0.85%), Northern Crayfish (n=14; 11.97%), and Sonora Mud Turtle (n=2; 1.71%). Catch and effort totals for all surveyed stations are summarized in Table 3.

Mesohabitat was primarily comprised of pools less than 1 m deep connected by short cascades. The reach had dense, woody riparian vegetation throughout, forming a thick canopy of branches that shaded the stream and covered most of the water surface, except for the lowermost pool in the fixed station. Given the high density of streamside vegetation, it should be considered to remove some of it to decrease cover and increase sun exposure for increased primary productivity (algae and macrophytes) and secondary production (invertebrates). Previous efforts utilized a different monitoring protocol, so comparisons to previous GRBMP surveys are limited, however mean CPUE of Gila Chub has steadily increased since 2013 (Figure 2).

Water temperature, DO, pH, and conductivity at fixed station OD06 were recorded at 18.7 °C, 8.4 mg/L, 8.1, and 570 µS, respectively. Stream discharge measured immediately above the dam was calculated to be 0.03 m^3/s (1.13 cfs). A length-frequency histogram for all Gila Chub captured at O'Donnell Creek is included below (Figure 3). Photographs of upper and lower extents of the fixed station are provided below (Figures 5-8).

Table 3. Summary of catch by mini-hoop net at two stations at O'Donnell Creek, Arizona, surveyed on August 2 & 3, 2022. Total effort was 420.09 hours.

Stations	Statistic	GIIN (51-100)	GIIN (>100)	CAIN	KISO	ORVI	Totals
OD06* (217.59 hrs)	Count	92	120	1	2	41	256
	% total catch	35.94%	46.88%	0.39%	0.78%	16.02%	100%
	CPUE (ind/net hr)	0.42	0.55	0.00	0.01	0.19	1.18
OD08 (202.50 hrs)	Count	64	36	1	2	14	117
	% total catch	54.70%	30.77%	0.85%	1.71%	11.97%	100%
	CPUE (ind/net hr)	0.32	0.18	0.00	0.01	0.07	0.58
Total	Count	156	156	2	4	55	373
	% total catch	41.82%	41.82%	0.54%	1.07%	14.75%	100%
	CPUE (ind/net hr)	0.37	0.37	0.00	0.01	0.13	0.89

*Denotes fixed station

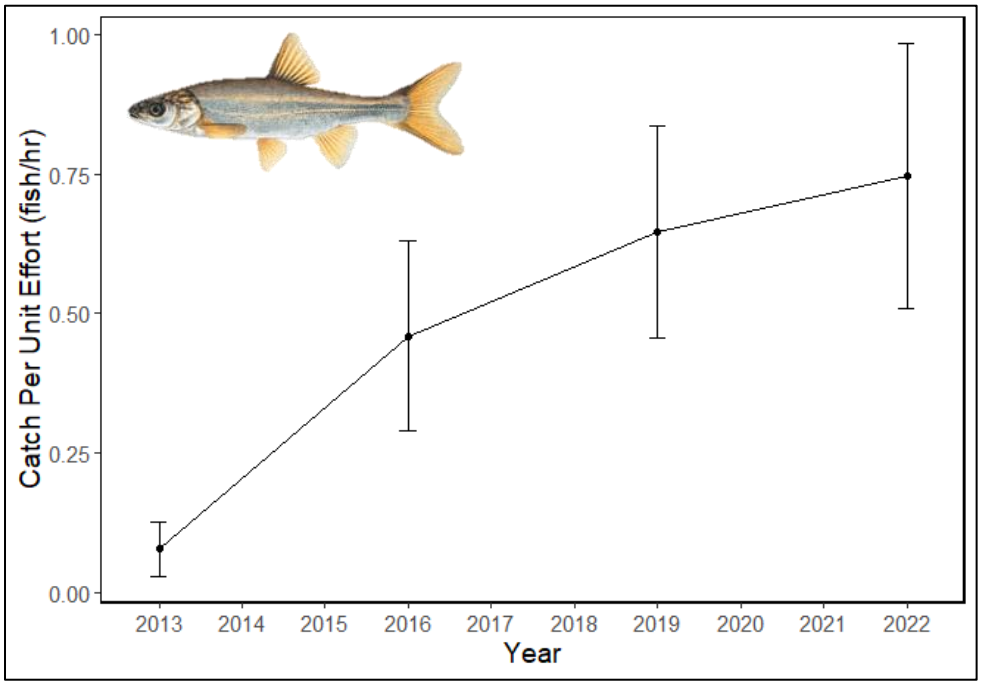

Figure 2. Mean CPUE for Gila Chub in O'Donnell Creek, Arizona, since 2013 under GRBMP.

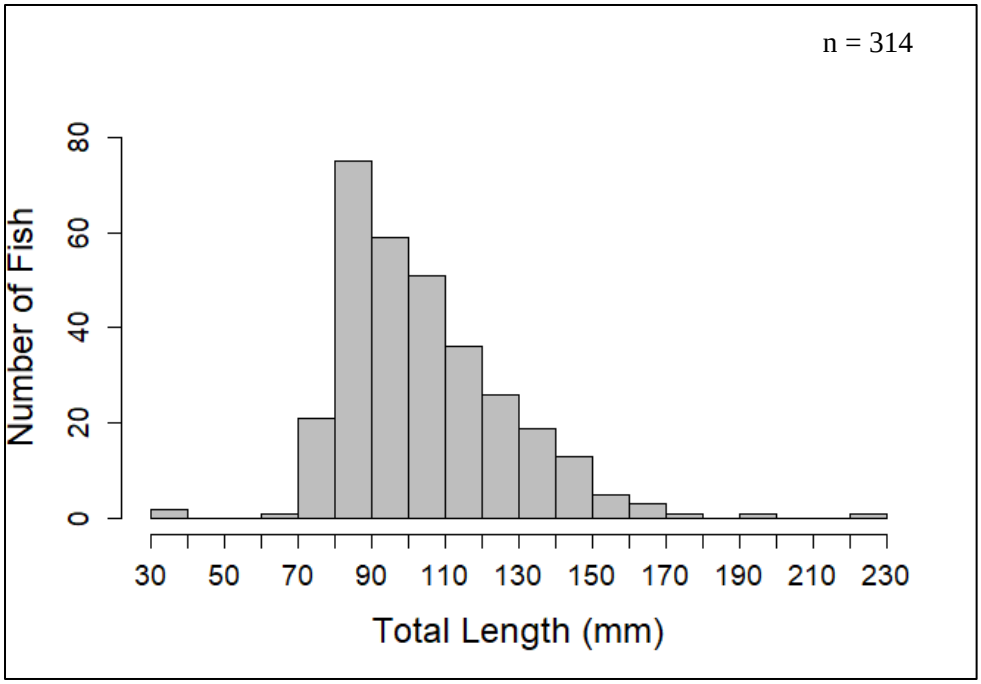

Figure 3. Length-frequency distribution for Gila Chub captured at O'Donnell Creek, Arizona, sampled on August 2 & 3, 2022.

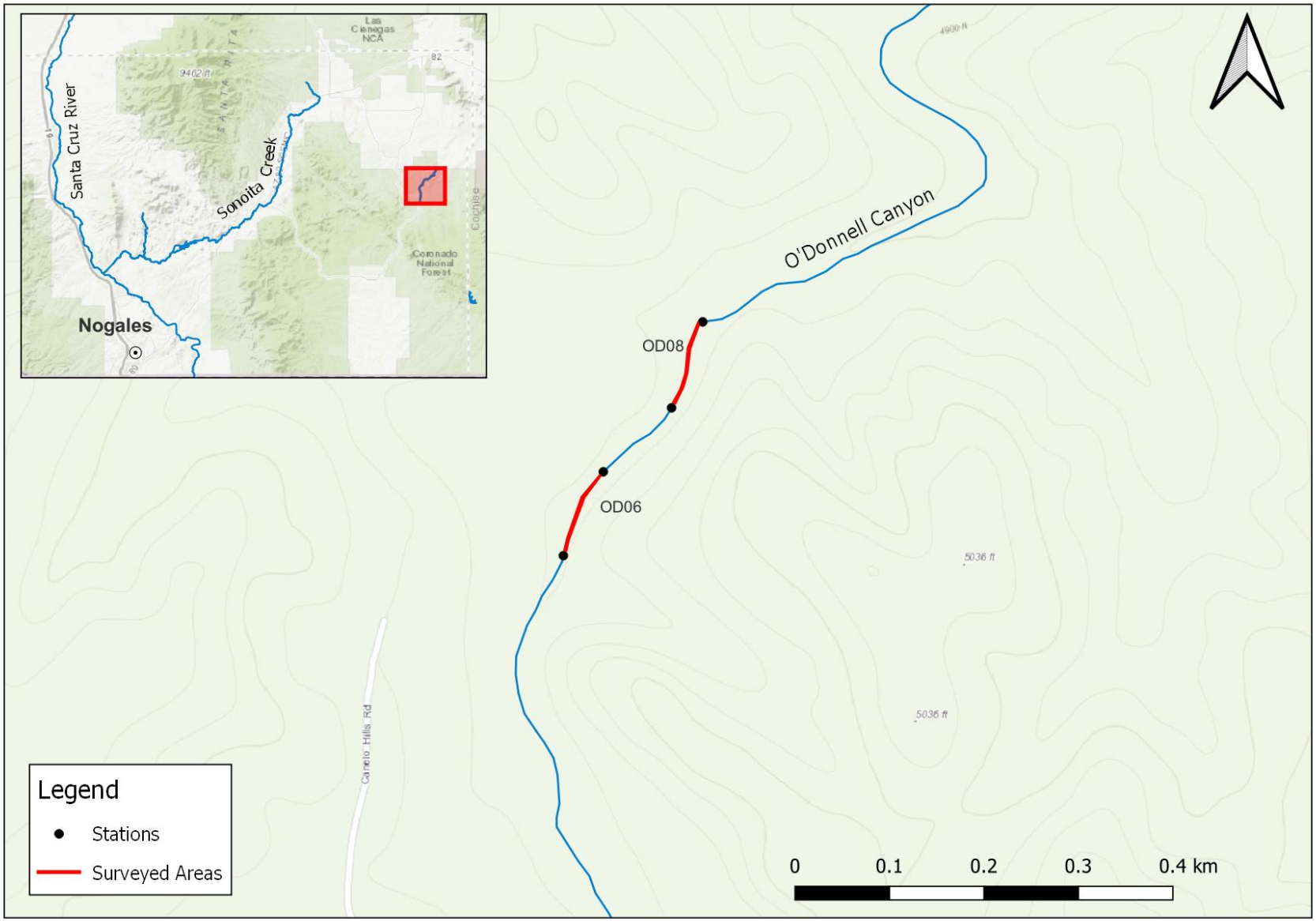

Figure 4. Location of sampling stations in O'Donnell Creek, Arizona, sampled on August 2 and 3, 2022.

Figure 5. Downstream to downstream view of fixed station OD06 in O'Donnell Creek, Arizona.

Figure 6. Downstream to upstream view of fixed station OD06 in O'Donnell Creek, Arizona.

Figure 7. Upstream to downstream view of fixed station OD06 in O'Donnell Creek, Arizona.

Figure 8. Upstream to upstream view of fixed station OD06 in O'Donnell Creek, Arizona.

Hot Springs Canyon September 6 & 7, 2022

Reach	Station		Lower Boundary	Upper Boundary
1	HS03	12S NAD83	569571E, 3579904N	569637E, 3579833N
1	HS06 (Fixed)		569355E, 3579960N	569454E, 3579939N
1	HS08		569202E, 3580084N	569282E, 3580028N
2	HS16		568563E, 3579976N	568661E, 3579958N
2	HS20		568335E, 3580079N	568396E, 3580152N
2	HS23 (Fixed)		568059E, 3580026N	568142E, 3580080N
3	HS27		567955E, 3580038N	567961E, 3579943N
3	HS28		567900E, 3580118N	567953E, 3580038N
3	HS32 (Fixed)		567616E, 3580040N	567732E, 3580049N

Hot Springs Canyon (Cochise County, AZ) originates from western slopes of Winchester Mountains and is a tributary to San Pedro River. A 3.4 km section of perennial stream is located within TNC's Muleshoe Ranch property. Hot Springs Canyon is protected from invasion by non-native species by a concrete fish barrier located 9 km upstream from the San Pedro confluence. Loach Minnow and Spikedace were stocked into Hot Springs Canyon every year from 2007-2011. Loach Minnow is considered established in Hot Springs Canyon as evidence of recruitment has been found every year since the last stocking. It is unclear if Spikedace was established as annual monitoring efforts have noted a steady decrease in numbers since 2012 and recruitment has not been detected every year. These populations were augmented with 300 Loach Minnow and 333 Spikedace in May 2020 near the confluence with Wildcat Canyon (Hickerson et al. 2021). Loach Minnow, Spikedace, and Gila Chub are the target species for Hot Springs Canyon. Hot Springs Canyon monitoring efforts have been conducted annually since 2011, 182 Gila Chub, 17 Loach Minnow, and 0 Spikedace were captured in 2021 (Shollenberger et al. 2022).

M&A and Reclamation personnel completed the sampling of Hot Springs Canyon on September 6 and 7, 2022. Sampling was completed by BPEF. Nine, 100-m stations were sampled throughout reaches 1-3 in Hot Springs Canyon (Figure 11). One fixed and two randomly selected stations were sampled in each reach. Stations were accessed by hiking downstream from Muleshoe Ranch Headquarters.

Totals of 21 Loach Minnow, 86 Gila Chub, 204 Speckled Dace, 176 Longfin Dace, 35 Desert Sucker, and 13 Sonora Sucker were captured across all nine stations. Catch and effort totals are summarized by reach below (Table 4). No non-native species were captured or observed. Loach Minnow were detected at three of nine stations and were most abundant near the confluence with Wildcat Canyon. Gila Chub were detected at all nine stations. Spikedace were not captured during annual monitoring for the third year in a row. Spikedace were last detected during autumn monitoring in 2019 when two individuals were captured (Hickerson et al. 2020). Loach Minnow catch was similar to last year, however overall catch numbers were approximately 50% lower than last year, likely due to monsoon floods. Major flood debris was evident throughout the monitoring reach. Gila Topminnow were detected in Hot Springs Canyon 2.5 km upstream from the monitoring reach near Secret Spring (12S 571310/3578433). Flowing surface water was found in the canyon well beyond the typical perennial stretch this year. Length-frequency histograms for all Gila Chub and Loach Minnow captured at Hot Springs Canyon between 2020 and 2022

are included below (Figure 9). CPUE trends for each focal species across a 10-year period are included in Figure 10. Data from 2012-2019 were collected by AZGFD and provided by Reclamation.

Average stream discharge across three fixed stations was calculated to be 0.11 m^3/s (3.88 cfs). Average water temperature, DO, pH, and conductivity across three fixed stations were 22.3 °C, 8.23 mg/L, 7.98, and 431 µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 12-23).

Table 4. Summary of catch at all stations at Hot Springs Canyon, Arizona, by BPEF. Total effort was 5,458 seconds.

Reach	Stations	Statistic	AGCH	CAIN	GIIN	PACL	TICO	RHOS	Totals
1 (1,368 sec)	HS03 HS06* HS08	Count	126	7	28	12	17	124	314
		% total catch	40.13%	2.23%	8.92%	3.82%	5.41%	39.49%	100%
		CPUE (ind/hr)	331.58	18.42	73.68	31.58	44.74	326.32	826.32
2 (1,943 sec)	HS16 HS20 HS23*	Count	35	3	31	21	4	54	148
		% total catch	23.65%	2.03%	20.95%	14.19%	2.70%	36.49%	100%
		CPUE (ind/hr)	64.85	5.56	57.44	38.91	7.41	100.05	274.22
3 (2,147 sec)	HS27 HS28 HS32*	Count	15	3	27	2	0	26	73
		% total catch	20.55%	4.11%	36.99%	2.74%	0.00%	35.62%	100%
		CPUE (ind/hr)	25.15	5.03	45.27	3.35	0.00	43.60	122.40
Total		Count	176	13	86	35	21	204	535
		% total catch	32.90%	2.43%	16.07%	6.54%	3.93%	38.13%	100%
		CPUE (ind/hr)	116.09	8.57	56.72	23.09	13.85	134.55	352.88

*Denotes fixed station

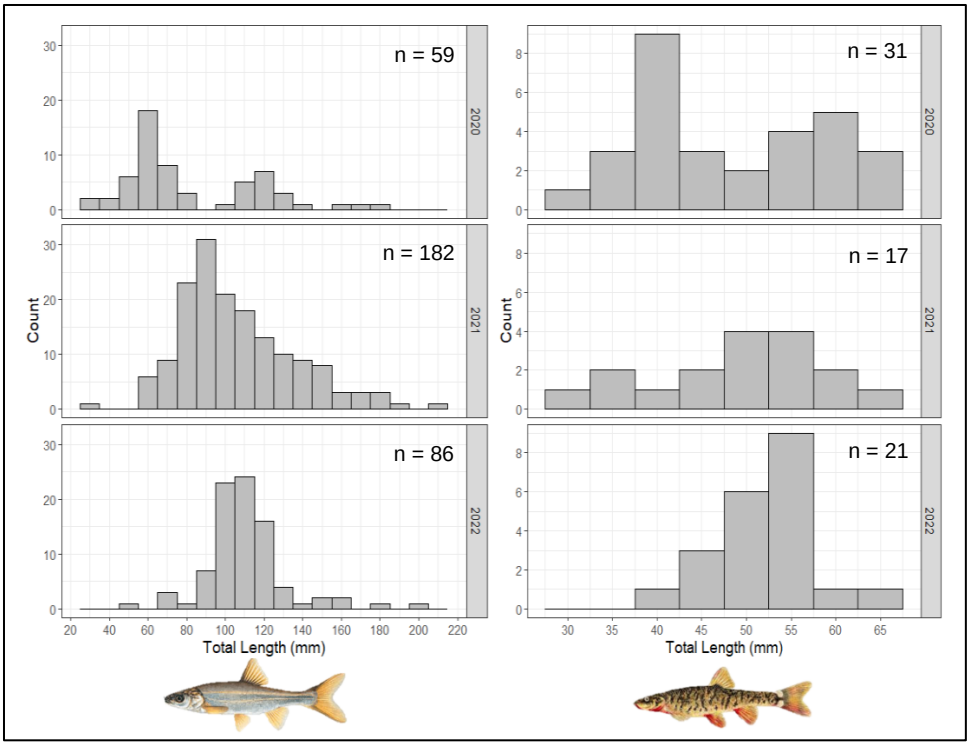

Figure 9. Length-frequency distribution plots for Gila Chub (left) and Loach Minnow (right) captured at Hot Springs Canyon, Arizona, from 2020-2022.

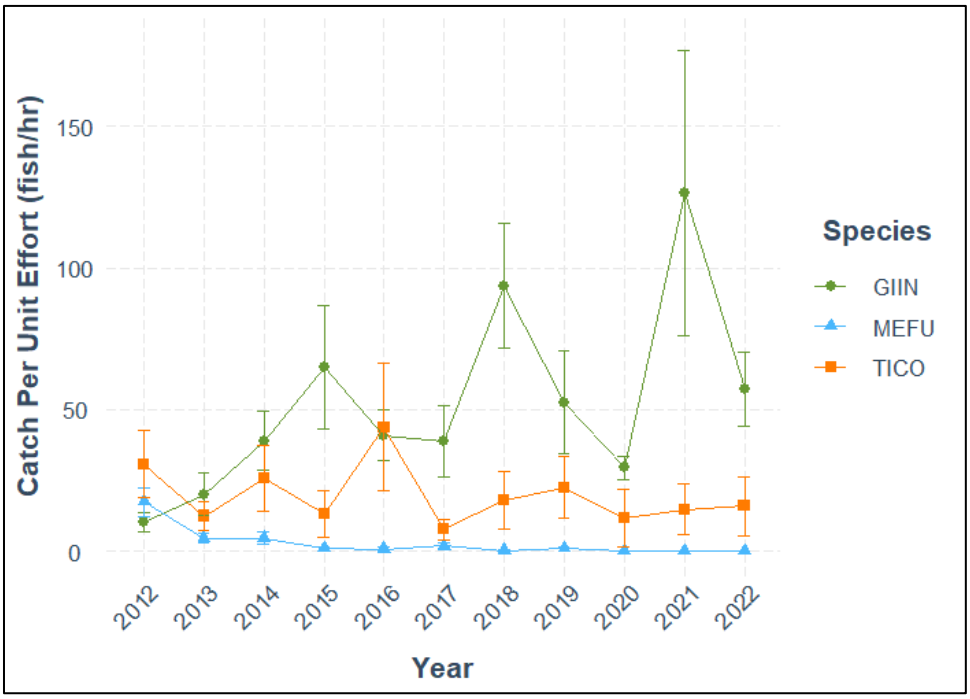

Figure 10. Mean CPUE for all focal species from annual monitoring since 2012 at Hot Springs Canyon.

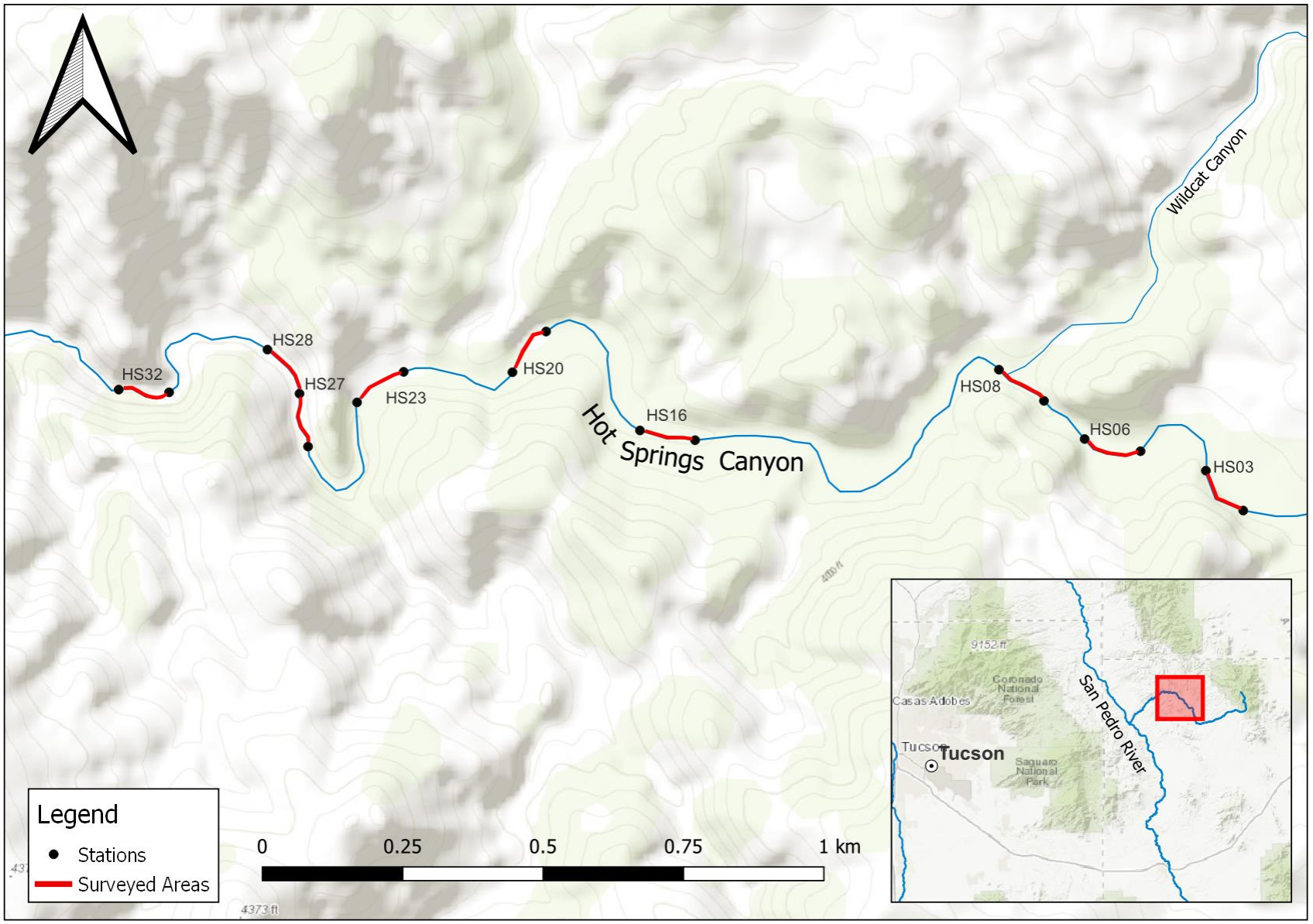

Figure 11. Location of sampling stations in Hot Springs Canyon, Arizona, surveyed on September 6 & 7, 2022.

Figure 12. Downstream to downstream view of fixed station HS06 in Hot Springs Canyon, Arizona.

Figure 13. Downstream to upstream view of fixed station HS06 in Hot Springs Canyon, Arizona.

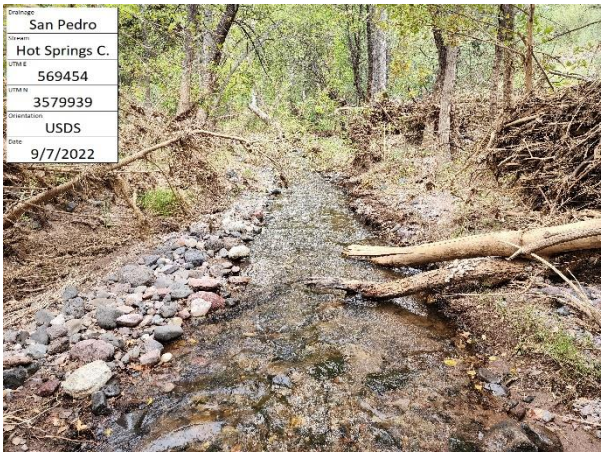

Figure 14. Upstream to downstream view of fixed station HS06 in Hot Springs Canyon, Arizona.

Figure 15. Upstream to upstream view of fixed station HS06 in Hot Springs Canyon, Arizona.

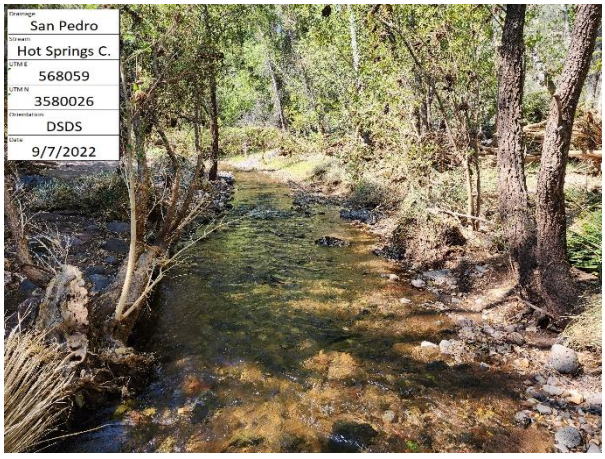

Figure 16. Downstream to downstream view of fixed station HS23 in Hot Springs Canyon, Arizona.

Figure 17. Downstream to upstream view of fixed station HS23 in Hot Springs Canyon, Arizona.

Figure 18. Upstream to downstream view of fixed station HS23 in Hot Springs Canyon, Arizona.

Figure 19. Upstream to upstream view of fixed station HS23 in Hot Springs Canyon, Arizona.

Figure 20. Downstream to downstream view of fixed station HS32 in Hot Springs Canyon, Arizona.

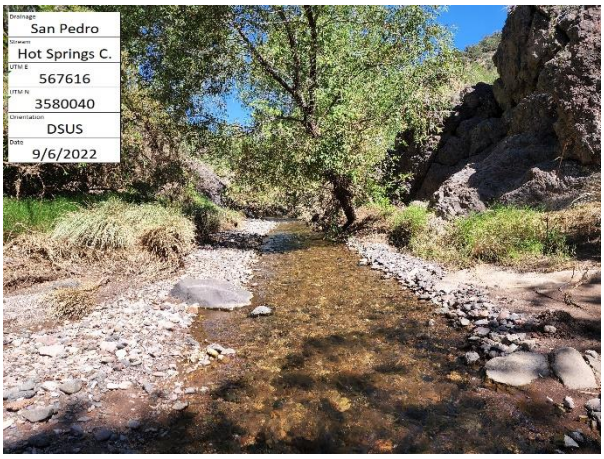

Figure 21. Downstream to upstream view of fixed station HS32 in Hot Springs Canyon, Arizona.

Figure 22. Upstream to downstream view of fixed station HS32 in Hot Springs Canyon, Arizona.

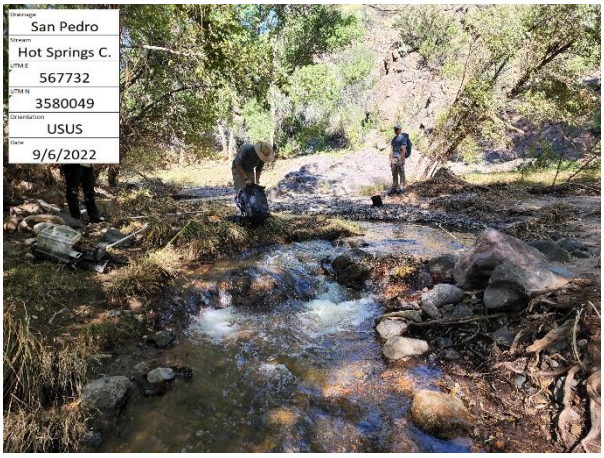

Figure 23. Upstream to upstream view of fixed station HS32 in Hot Springs Canyon, Arizona.

Swamp Springs Canyon September 8, 2022

Station		Lower Boundary	Upper Boundary
SW03 (Fixed)	12S NAD83	566501E, 3589048N	566595E, 3589069N
SW05		566307E, 3589145N	566398E, 3589078N
SW08		566096E, 3589018N	566121E, 3589116N
SW16		564238E, 3589509N	564349E, 3589490N

Swamp Springs Canyon (Graham County, AZ) is a tributary to Redfield Canyon in San Pedro River drainage. The canyon is situated within Muleshoe Ranch Conservation Management Area and Redfield Canyon Wilderness (Figure 25). Gila Topminnow were introduced to Swamp Springs Canyon in 2007 and 2008 (AZGFD 2018) and are the focal species at this site. Swamp Springs was last surveyed for this monitoring program in 2019, which resulted in capture of 332 Gila Topminnow.

M&A and Reclamation personnel completed the sampling at Swamp Springs Canyon on September 8, 2022. Sampling at Swamp Springs Canyon was completed with minnow traps. Four, 100-m stations were surveyed across two separate reaches. Ten minnow traps were deployed within each station and were set for a minimum of 2 hours. Monitoring reaches were accessed by hiking down canyon from Forest Road (FR) 691. Flowing surface water was present throughout the majority of our hike downstream, however fish were not observed until reaching the upper extent of the monitoring reach. Totals of 823 Longfin Dace and 409 Gila Topminnow were captured across all four stations.

The upper monitoring reach is 1.4 km long and characterized by surface flow over bedrock and is surrounded by forested riparian vegetation such as cottonwood, sycamore, alder, and willow. Each sample reach included both run and pool mesohabitat, with the majority consisting of a series of pools separated by a trickle of water. Three stations were sampled throughout the upstream reach. Fixed station SW03 is located near the upstream end of the perennial water in this reach. This station was formerly the only station monitored during past GRBMP surveys. Gila Topminnow (n=253; 31.74%) and Longfin Dace (n=544; 68.26%) were captured in the fixed station. An additional 112 Gila Topminnow and 211 Longfin Dace were captured in the two randomly selected stations in the upper reach.

The lower reach is located 1.7 km downstream and is 300-m in length. A single, 100-m station (SW16) was surveyed in this reach and resulted in capture of Gila Topminnow (n=44; 39.29%) and Longfin Dace (n=68; 60.71%). Gila Topminnow and Longfin Dace were observed throughout and in-between both monitoring reaches. Water levels dropped significantly from the beginning of the survey to when traps were pulled. A fully submerged trap in station SW05 was in shallow puddle at the time of retrieval and this pool was completely dry one hour later. Numerous Longfin Dace and Gila Topminnow were salvaged from dry land and moved into deeper pools immediately upstream. Catch and effort totals for all surveyed stations are summarized in Table 5.

Total Gila Topminnow captured increased from the previous survey, however only a single 100-m station was assessed in 2019. Mean CPUE has decreased steadily over the past three monitoring events (Figure 24).

Water temperature, DO, pH, and conductivity at fixed station SW03 were recorded at 23.2 °C, 6.5 mg/L, 7.85, and 414 µS, respectively. Stream discharge measurements were attempted at the downstream boundary of the fixed station, however there was insufficient flowing water to effectively measure. Photographs of upper and lower extents of fixed station SS03 are provided below (Figures 26-29).

Table 5. Summary of catch at four stations at Swamp Springs Canyon, Arizona, by minnow trap. Total effort was 92.37 hours.

Stations	Statistic	AGCH (<40)	AGCH (>=40)	POOC (<20)	POOC (>=20)	Totals
SS03* (27.75 hrs)	Count	186	358	53	200	797
	% total catch	23.34%	44.92%	6.65%	25.09%	100%
	CPUE (ind/net hr)	6.70	12.90	1.91	7.21	28.72
SS05 (24.38 hrs)	Count	47	149	25	45	266
	% total catch	17.67%	56.02%	9.40%	16.92%	100%
	CPUE (ind/net hr)	1.93	6.11	1.03	1.85	10.91
SS08 (22.18 hrs)	Count	10	5	35	7	57
	% total catch	17.54%	8.77%	61.40%	12.28%	100%
	CPUE (ind/net hr)	0.45	0.23	1.58	0.32	2.57
SS16 (20.47 hrs)	Count	0	68	2	42	112
	% total catch	0.00%	60.71%	1.79%	37.50%	100%
	CPUE (ind/net hr)	0.00	3.32	0.10	2.05	5.47
Total	Count	243	580	115	294	1232
	% total catch	19.72%	47.08%	9.33%	23.86%	100%
	CPUE (ind/net hr)	2.56	6.12	1.21	3.10	13.00

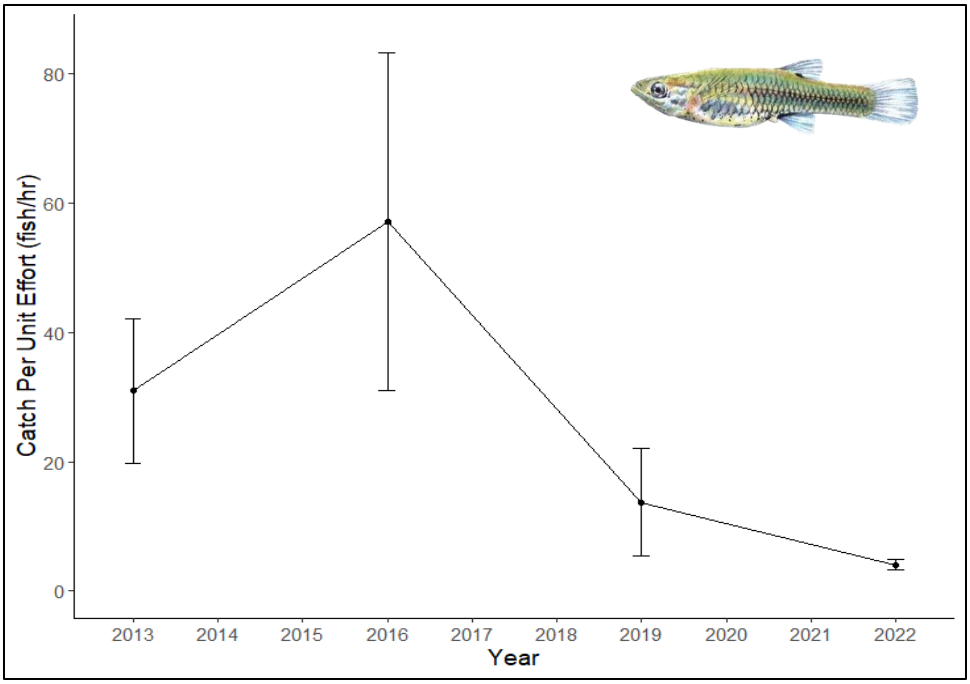

Figure 24. Mean CPUE for Gila Topminnow in Swamp Springs Canyon, Arizona, since 2013 under GRBMP.

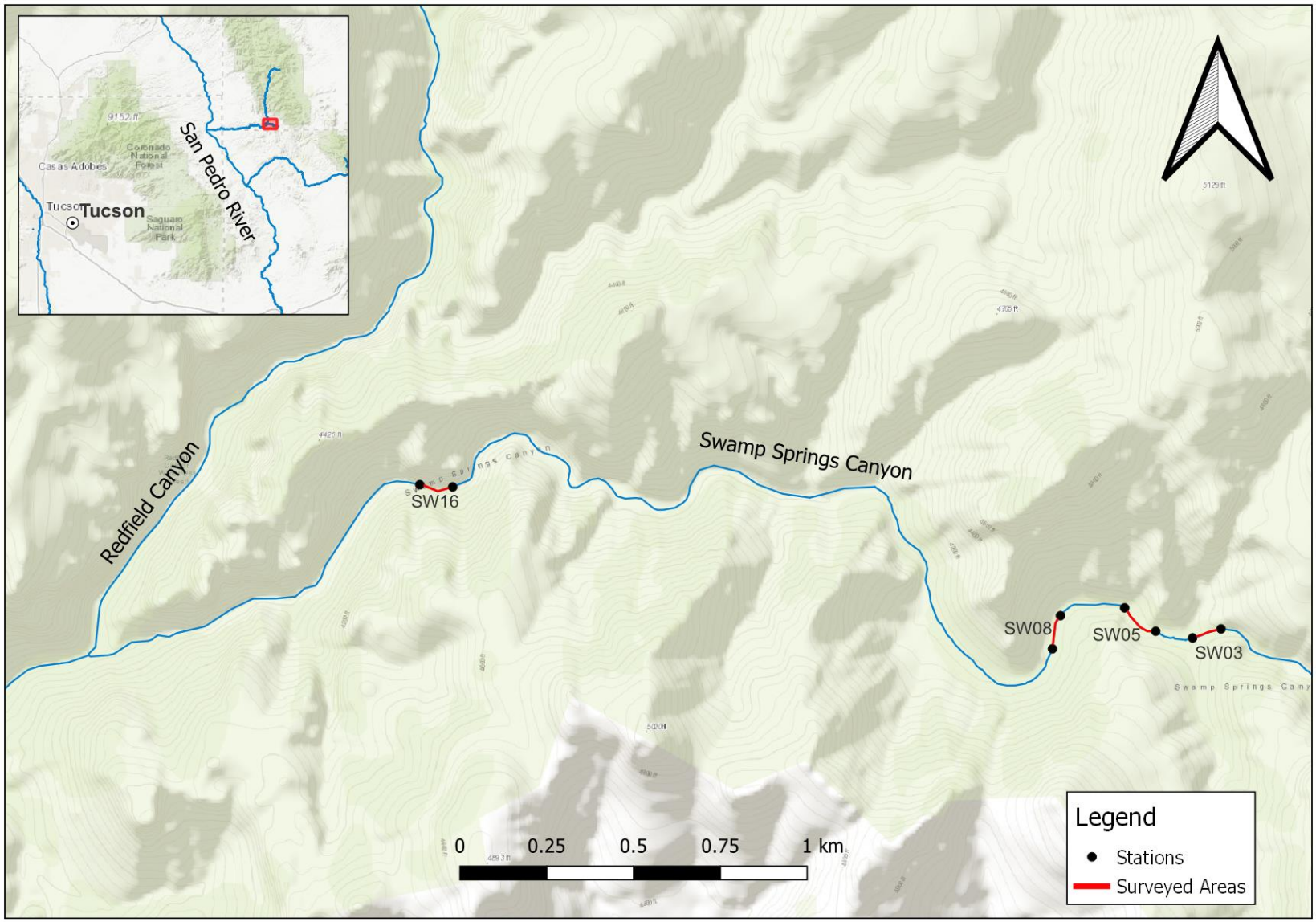

Figure 25. Location of sampling stations in Swamp Springs Canyon, Arizona, sampled on September 8, 2022.

Figure 26. Downstream to downstream view of fixed station SW03 in Swamp Springs Canyon, Arizona.

Figure 27. Downstream to upstream view of fixed station SW03 in Swamp Springs Canyon, Arizona.

Figure 28. Upstream to downstream view of fixed station SW03 in Swamp Springs Canyon, Arizona.

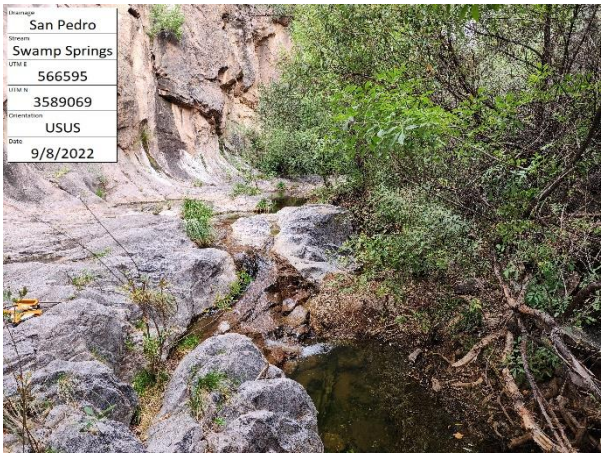

Figure 29. Upstream to upstream view of fixed station SW03 in Swamp Springs Canyon, Arizona.

Redfield Canyon October 19 & 20, 2022

Station		Lower Boundary	Upper Boundary
RD06	12S NAD83	563721E, 3589703N	563786E, 3589715N
RD11		563434E, 3589269N	563499E, 3589346N
RD13 (Fixed)		563346E, 3589095N	563369E, 3589177N
RD16		563084E, 3588911N	563165E, 3588970N
RD19 (Fixed)		559668E, 3589031N	559764E, 3589033N

Redfield Canyon (Graham County, AZ) is a tributary to San Pedro River and is located within Muleshoe Ranch Conservation Management Area, Redfield Canyon Wilderness, and Galiuro Wilderness (Figure 30). The perennial portion of the canyon flows for approximately 12 km. Gila Topminnow and Gila Chub are the focal species. Gila Topminnow were first detected in Redfield Canyon in 2009. It is likely these fish dispersed downstream from Swamp Springs Canyon (AZGFD 2018). Non-native Green Sunfish are present in Redfield Canyon and removal efforts have been ongoing since 2007 (Hickerson et al. 2022). Redfield canyon has not been surveyed previously for this monitoring program.

M&A personnel completed sampling of Redfield Canyon on October 19 & 20, 2022. Five, 100-m stations (2 fixed, 3 random) were surveyed across two distinct reaches. Monitoring reaches were accessed via Redfield Canyon Trailhead. BPEF was conducted at all five stations to target Gila Chub. Minnow traps were set at three stations to target Gila Topminnow after electrofishing was completed. Totals of 69 Longfin Dace, 59 Gila Chub, 36 Sonora Sucker, 14 Gila Topminnow, 9 Green Sunfish, and 69 unidentified Cyprinids were captured across all stations and gear types.

The downstream fixed station was located near the western wilderness boundary just upstream from a large pool. This was the only station in the downstream reach. The electrofishing survey captured Gila Topminnow (n=7; 70%) and Green Sunfish (n=3; 30%). Ten minnow traps were set after the electrofishing survey for approximately 2 hours and captured Green Sunfish (n=4; 80%) and Gila Topminnow (n=1; 20%). All sunfish were <50mm and were removed from the stream. Gila Chub were not detected at this station. Opportunistic BPEF sampling was conducted around the edges of the large pool near the beginning of the station and resulted in capture of two Sonora Suckers and five YOY Green Sunfish. Larger fish (potentially chub) were observed in the pool but could not be captured.

The remaining stations were in the upper reach which is located near the confluence with Swamp Springs Canyon. BPEF surveys captured Gila Chub (n=59; 32.42%), Gila Topminnow (n=2; 1.10%), Longfin Dace (n=69; 37.91%), Sonora Sucker (n=36; 19.78%), unidentifiable (<15mm) Cyprinids (n=14; 7.69%), and Green Sunfish (n=2; 1.10%). Ten minnow traps were set at the lower two of the four stations in this reach and resulted in capture of Gila Topminnow (n=4; 6.78%) and an unidentified Cyprinid species (n=55; 93.22%). Both sunfish caught in this reach were >100mm. Lowland Leopard Frogs *Rana yavapaiensis*, Canyon Tree Frogs *Hyla arenicolor*, a Sonoran Lyresnake *Trimorphodon lambda*, and a Black-tailed Rattlesnake *Crotalus molossus* were observed within the canyon. Catch and effort totals for all surveyed stations are summarized in Tables 6 and 7.

Stream discharge measured at the upstream extent of fixed station RD13 was 0.01 m^3/s (0.45 cfs). There was insufficient flowing water at fixed station to RD19 to calculate an accurate discharge. Average water temperature, DO, pH, and conductivity across both fixed stations were 18.0 °C, 7.3 mg/L, 7.85, and 426

µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 31-38).

Table 6. Summary of catch at three stations at Redfield Canyon, Arizona, by minnow trap. Total effort was 75.26 hours.

Station	Statistic	LECY	POOC	CYPRINIDAE SPP	Totals
RD13* (19.83 hrs)	Count	0	0	38	38
	% total catch	0.00%	0.00%	100.00%	100%
	CPUE (ind/net hr)	0	0	1.92	1.92
RD16 (35.28 hrs)	Count	0	4	17	21
	% total catch	0.00%	19.05%	80.95%	100%
	CPUE (ind/net hr)	0.00	0.11	0.48	0.60
RD19* (20.15 hrs)	Count	4	1	0	5
	% total catch	80.00%	20.00%	0.00%	100%
	CPUE (ind/net hr)	0.20	0.05	0.00	0.25
Total		4	5	55	64
		6.25%	7.81%	85.94%	100%
		0.05	0.07	0.73	0.85

*Denotes fixed station

Table 7. Summary of catch at five stations at Redfield Canyon, Arizona, by BPEF. Total effort was 2,572 seconds.

Stations	Statistic	AGCH	CAIN	GIIN	POOC	LECY	CYPRINIDAE SPP	Totals
RD06 (581 sec)	Count	1	18	17	0	0	0	36
	% total catch	2.78%	50.00%	47.22%	0.00%	0.00%	0.00%	100%
	CPUE (ind/hr)	6.20	111.53	105.34	0.00	0.00	0.00	6.20
RD11 (491 sec)	Count	3	13	19	0	2	5	42
	% total catch	7.14%	30.95%	45.24%	0.00%	4.76%	11.90%	100%
	CPUE (ind/hr)	22.00	95.32	139.31	0.00	14.66	36.66	307.94
RD13* (419 sec)	Count	0	4	18	0	0	9	31
	% total catch	0.00%	12.90%	58.06%	0.00%	0.00%	29.03%	100%
	CPUE (ind/hr)	0.00	34.37	154.65	0.00	0.00	77.33	266.35
RD16 (496 sec)	Count	65	1	5	2	0	0	73
	% total catch	89.04%	1.37%	6.85%	2.74%	0.00%	0.00%	100%
	CPUE (ind/hr)	471.77	7.26	36.29	14.52	0.00	0.00	529.84
RD19* (585 sec)	Count	0	0	0	7	3	0	10
	% total catch	0.00%	0.00%	0.00%	70.00%	30.00%	0.00%	100%
	CPUE (ind/hr)	0.00	0.00	0.00	43.08	18.46	0.00	61.54
	Count	69	36	59	9	5	14	192
	% total catch	35.94%	18.75%	30.73%	4.69%	2.60%	7.29%	100%

	CPUE (ind/hr)	96.58	50.39	82.58	12.60	7.00	19.60	268.74

*Denotes fixed station

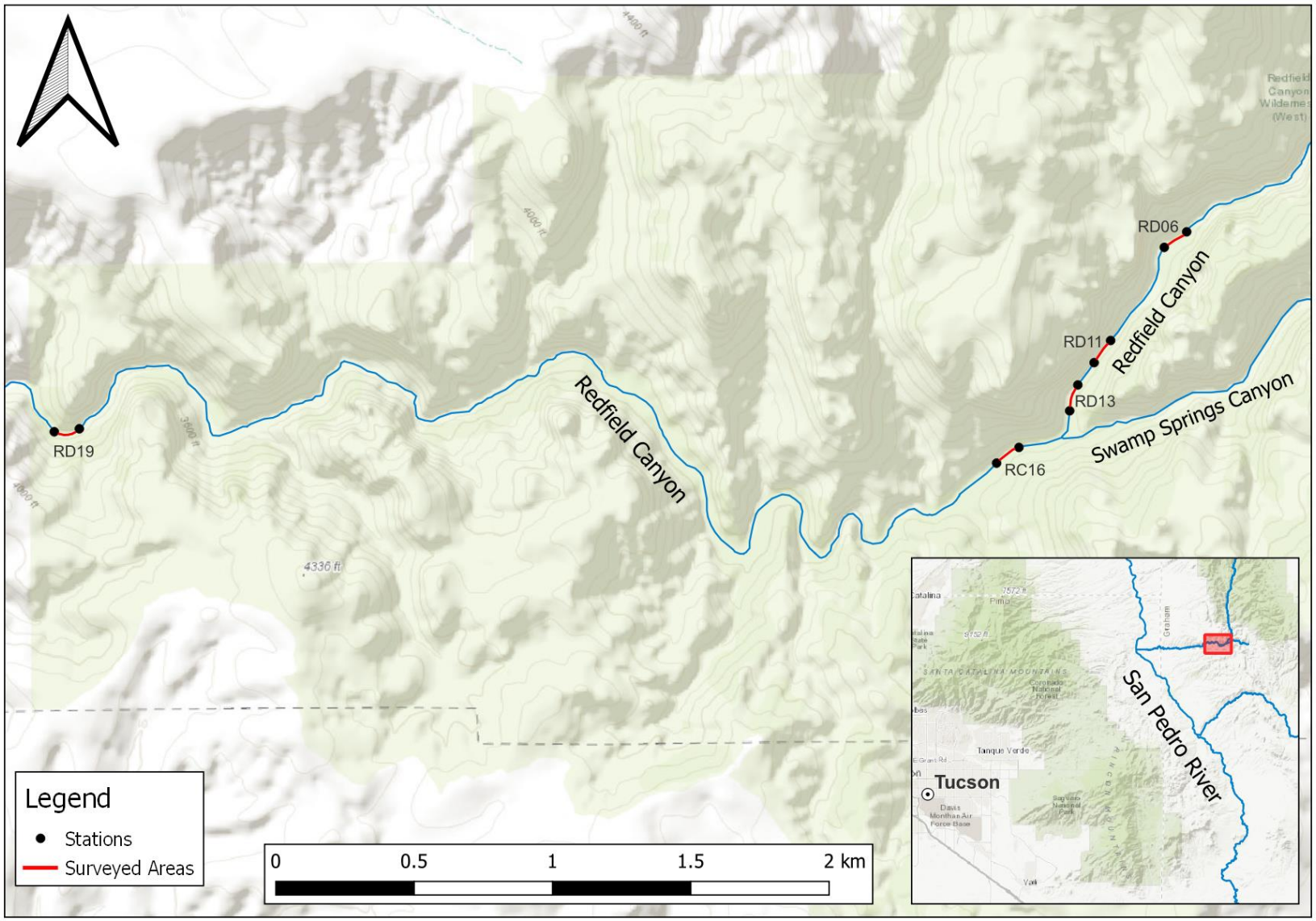

Figure 30. Location of sampling stations in Redfield Canyon, Arizona, sampled on October 19-20, 2022.

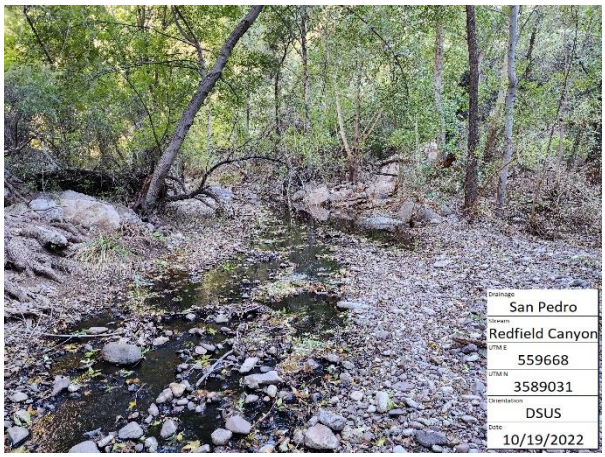

Figure 31. Downstream to upstream view of fixed station RD19 in Redfield Canyon, Arizona.

Figure 32. Downstream to downstream view of fixed station RD19 in Redfield Canyon, Arizona.

Figure 33. Upstream to upstream view of fixed station RD19 in Redfield Canyon, Arizona.

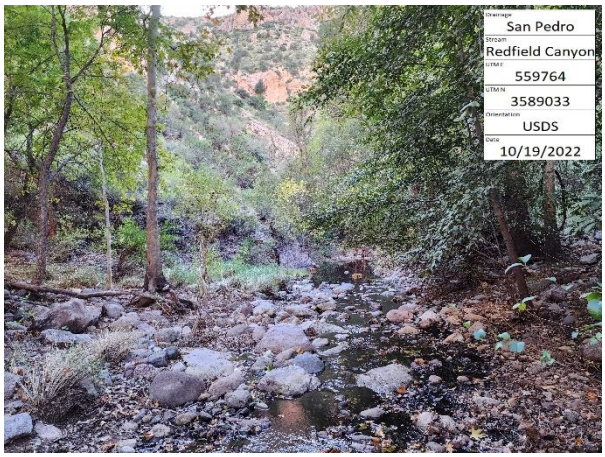

Figure 34. Upstream to downstream view of fixed station RD19 in Redfield Canyon, Arizona.

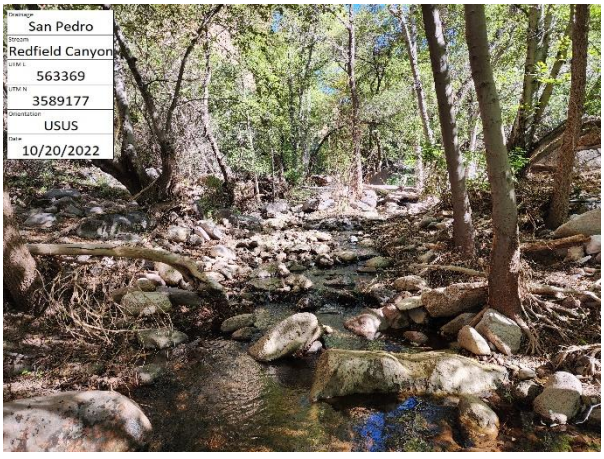

Figure 35. Upstream to upstream view of fixed station RD13 in Redfield Canyon, Arizona.

Figure 36. Upstream to downstream view of fixed station RD13 in Redfield Canyon, Arizona.

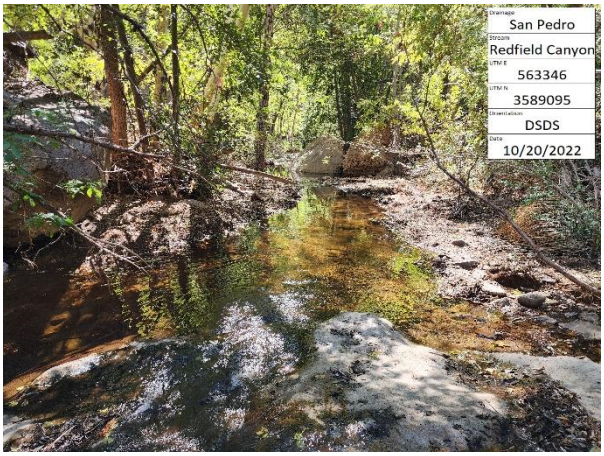

Figure 37. Downstream to downstream view of fixed station RD13 in Redfield Canyon, Arizona.

Figure 38. Downstream to upstream view of fixed station RD13 in Redfield Canyon, Arizona.

Santa Cruz River Basin

Sonoita Creek May 23 – 25, 2022

Station		Lower Boundary	Upper Boundary
SN17	12R NAD83	521765E, 3487983N	521875E, 3487994N
SN26		521094E, 3487806N	521156E, 3487868N
SN33		516218E, 3485491N	516287E, 3485416N
SN37		515848E, 3485467N	515934E, 3485478N
SN53		514620E, 3484856N	514678E, 3484940N
SN63		511621E, 3483985N	511626E, 3484067N
SN68		511443E, 3483553N	511493E, 3483644N
SN74		511123E, 3483128N	511128E, 3483225N
SN80		510748E, 3482727N	510825E, 3482809N
SN90		509966E, 3482351N	510067E, 3482367N
SN96		509640E, 3482099N	509742E, 3482137N
SN125		507350E, 3482910N	507456E, 3482868N

Sonoita Creek (Santa Cruz County, AZ) flows through the town of Patagonia and is tributary to Santa Cruz River near Rio Rico, AZ. The section of creek upstream of Patagonia Lake includes 11 km of perennial water. This section was surveyed annually within TNC's Patagonia Preserve from 1989 to 2005. Gila Topminnow is the target species for Sonoita Creek. Gila Topminnow were last detected upstream from Patagonia Lake in 2005. There is no barrier preventing nonnative fish from moving upstream out of Patagonia Lake. The section of creek downstream of the lake is fed by discharge and seepage from the lake, and there is about 5 km of perennial water in this section. Gila Topminnow were last detected downstream of the lake in 2001. During periods of heavy precipitation and flow, Gila Topminnow may disperse downstream to lower Sonoita Creek from Fresno Canyon but may not survive due to the abundance of nonnative fish (AZGFD 2018). Sonoita Creek was last surveyed for this monitoring program in 2014.

M&A personnel completed the sampling of Sonoita Creek from May 23 to 25, 2022. Three distinct reaches of the creek were surveyed, including immediately downstream and upstream from the lake, and within Patagonia Preserve (Figure 39). A total of 12, 100-m stations were completed. All sampling was conducted using seine hauls. Totals of 1,549 Longfin Dace, 534 Desert Sucker, 167 Speckled Dace, 651 Western Mosquitofish, and 13 Largemouth Bass were captured across all 12 stations.

The most upstream monitoring reach located within TNC’s Patagonia-Sonoita Creek Preserve was completed May 23. Two (1 fixed, 1 random) sampling stations were completed. Ten seine hauls were completed within each station. Species captured include Longfin Dace (n=367; 71.40%), Speckled Dace (n=123; 23.93%), and Desert Sucker (n=24; 4.67%). Gila Topminnow were not detected. No non-native fish species were detected.

Seven randomly selected stations were surveyed throughout a 7.4 km reach of Sonoita Creek immediately downstream from Patagonia Lake on May 24th. Surface water was intermittent throughout this reach, however only station SN80 was entirely dry. Ten seine hauls were completed at each station where possible. Due to limited habitat at stations SN96 and SN68, only three and seven hauls were completed,

respectively. Species captured included Longfin Dace (n=394; 37.24%), Western Mosquitofish (n=651; 61.53%), and Largemouth Bass (n=13; 1.23%). An opportunistic seine haul also was completed within a disconnected pool outside of the selected stations that resulted in capture of eight Largemouth Bass, one Green Sunfish, one Bluegill, and one American Bullfrog. Additional *Lepomis* spp. were observed throughout the monitoring reach but could not be captured via seine. Gila Topminnow were not detected.

Three randomly selected stations were surveyed throughout a 2.7 km reach of Sonoita Creek beginning immediately upstream from Patagonia Lake on May 25. Ten seine hauls were completed within each station. Species captured included Longfin Dace (n=788; 58.11%), Desert Sucker (n=510; 37.61%), Speckled Dace (n=44; 3.24%), and Western Mosquitofish (n=14; 1.03%). Gila Topminnow were not detected. Catch and effort totals for all surveyed stations are summarized in Table 8.

Water temperature, DO, pH, and conductivity at fixed station SN26 were recorded at 21.2 °C, 8.2 mg/L, 8.21, and 994 µS, respectively. Stream discharge was measured at the upper extent of SN26 and was calculated to be 0.09 m^3/s (3.03 cfs). Photographs of upper and lower extents of the fixed station are provided below (Figures 40-43).

Table 8. Summary of catch at 12 stations throughout Sonoita Creek, Arizona, by seine. Total effort was 100, 1-m hauls.

Reach (Effort)	**Stations**	**Statistic**	**AGCH**	**RHOS**	**PACL**	**MISA**	**GAAF**	**Totals**
TNC (73.15 m²)	SN17 SN26*	Count	367	123	24	0	0	514
		% total catch	71.40%	23.93%	4.67%	0.00%	0.00%	100%
		CPUE (ind/m²)	5.02	1.68	0.33	0.00	0.00	7.03
Above Lake (109.73 m²)	SN33 SN37 SN53	Count	788	44	510	0	14	1356
		% total catch	58.11%	3.24%	37.61%	0.00%	1.03%	100%
		CPUE (ind/m²)	7.18	0.40	4.65	0.00	0.13	12.36
Below Lake (256.03 m²)	SN63 SN68 SN74 SN90 SN96 SN125	Count	394	0	0	13	651	1058
		% total catch	37.24%	0.00%	0.00%	1.23%	61.53%	100%
		CPUE (ind/m²)	1.80	0.00	0.00	0.06	2.97	4.82
Total		Count	1549	167	534	13	665	2928
		% total catch	52.90%	5.70%	18.24%	0.44%	22.71%	100%
		CPUE (ind/ m²)	3.85	0.42	1.33	0.03	1.65	7.28

*Denotes fixed station

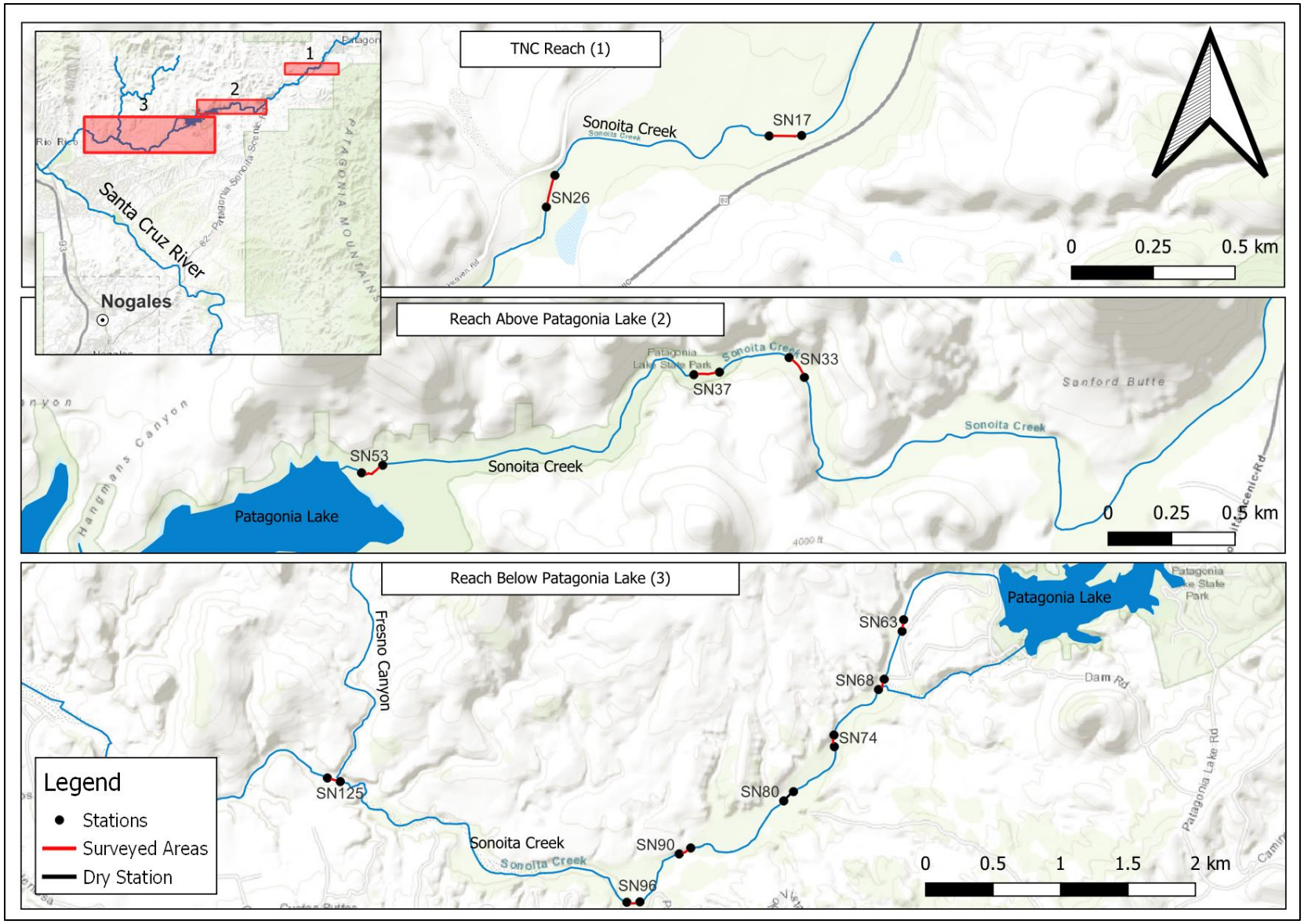

Figure 39. Location of sampling stations in Sonoita Creek, Arizona, sampled on May 23-25, 2022.

Figure 40. Downstream to downstream view of fixed station SN26 in Sonoita Creek, Arizona.

Figure 41. Downstream to upstream view of fixed station SN26 in Sonoita Creek, Arizona.

Figure 42. Upstream to upstream view of fixed station SN26 in Sonoita Creek, Arizona.

Figure 43. Upstream to downstream view of fixed station SN26 in Sonoita Creek, Arizona.

Monkey Spring May 23, 2022

Station		Lower Boundary	Upper Boundary
MS01 (Fixed)	12R NAD83	528085E, 3499695N	528070E, 3499792N

Monkey Spring (Santa Cruz County, AZ) is a tributary to Sonoita Creek near Patagonia, AZ (Figure 45). The focal species at Monkey Spring is Gila Topminnow. Monkey Spring has long been recognized as a unique habitat. The natural population of Gila Topminnow here has been the source of many wild replicate stockings around the state (Weedman 1999). It also was occupied historically by Santa Cruz (Monkey Spring) Pupfish (*Cyprinodon arcuatus*) and a morphologically distinct form of Gila Chub, both of which are extirpated from this site; the pupfish is extinct. This site is surveyed annually for GRBMP and 284 Gila Topminnow were captured in 2021 (Shollenberger et al. 2022).

M&A personnel completed sampling of Monkey Spring on May 23, 2022. Sampling was completed by seine hauls. Monkey Spring was accessed via the Rail X Ranch just off SR-82. This site is on private property and landowner permission is required to access this sampling location.

One fixed sampling station, MS01, was surveyed. This station encompasses the entirety of the pipe rail-enclosed spring and 56-m of the cement flume immediately downstream of the spring. Ten, 1-m seine hauls were completed, five within the flume and five in the enclosed spring. A total of 225 Gila Topminnow was captured (100%). No other fish species were detected. A Sonora Mud Turtle was captured within the enclosed spring. Catch and effort totals for MS01 are summarized in Table 9. The majority (78.22%) of Gila Topminnow were captured in the cement canal below the enclosed spring. There was no surface water present outside of the cement canal and enclosed spring.

Overall CPUE was similar to the previous surveys (Figure 44), but there was a notable decrease in number of juvenile topminnow (<20mm) captured during 2022. Water temperature, DO, pH, and conductivity at the fixed station were recorded at 27.4 ℃, 4.1 mg/L, 7.33, and 1,364 µS, respectively. Photographs of upper and lower extents of the fixed station are provided below (Figures 46-49).

Table 9. Summary of catch at fixed station MS01 at Monkey Spring, Arizona, by seine. Total effort was 10, 1-m hauls.

Station	Statistic	POOC (<20)	POOC (>=20)	KISO	Total
MS01* (36.58 m²)	Count	14	211	1	226
	% total catch	6.19%	93.36%	0.44%	100.00%
	CPUE (ind/net hr)	0.38	5.77	0.03	6.18

*Denotes fixed station

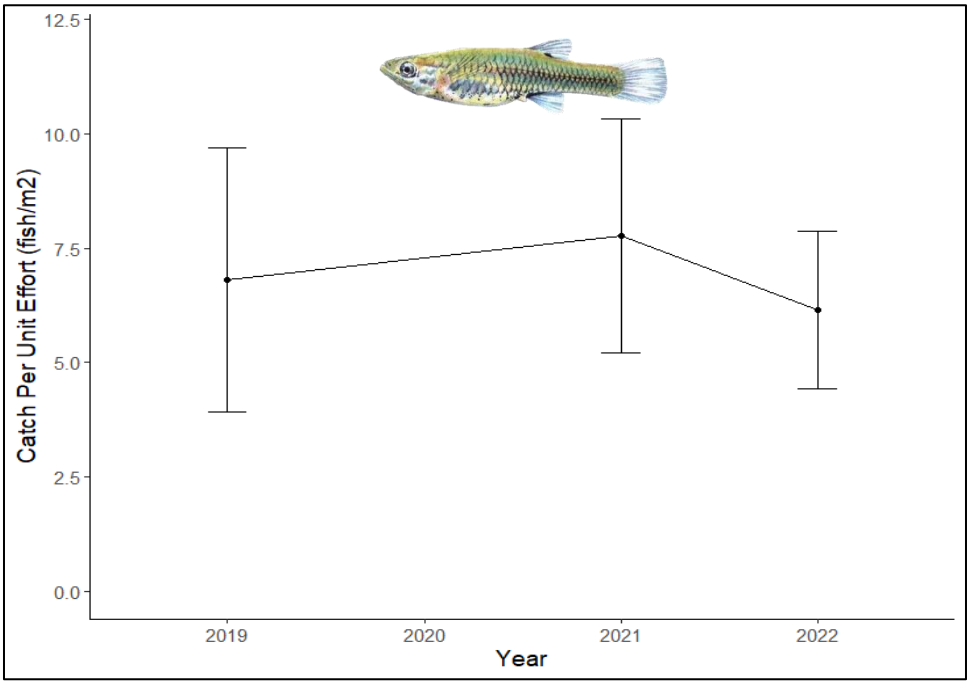

Figure 44. Mean CPUE for Gila Topminnow captured in Monkey Spring, Arizona, since 2019 under GRBMP

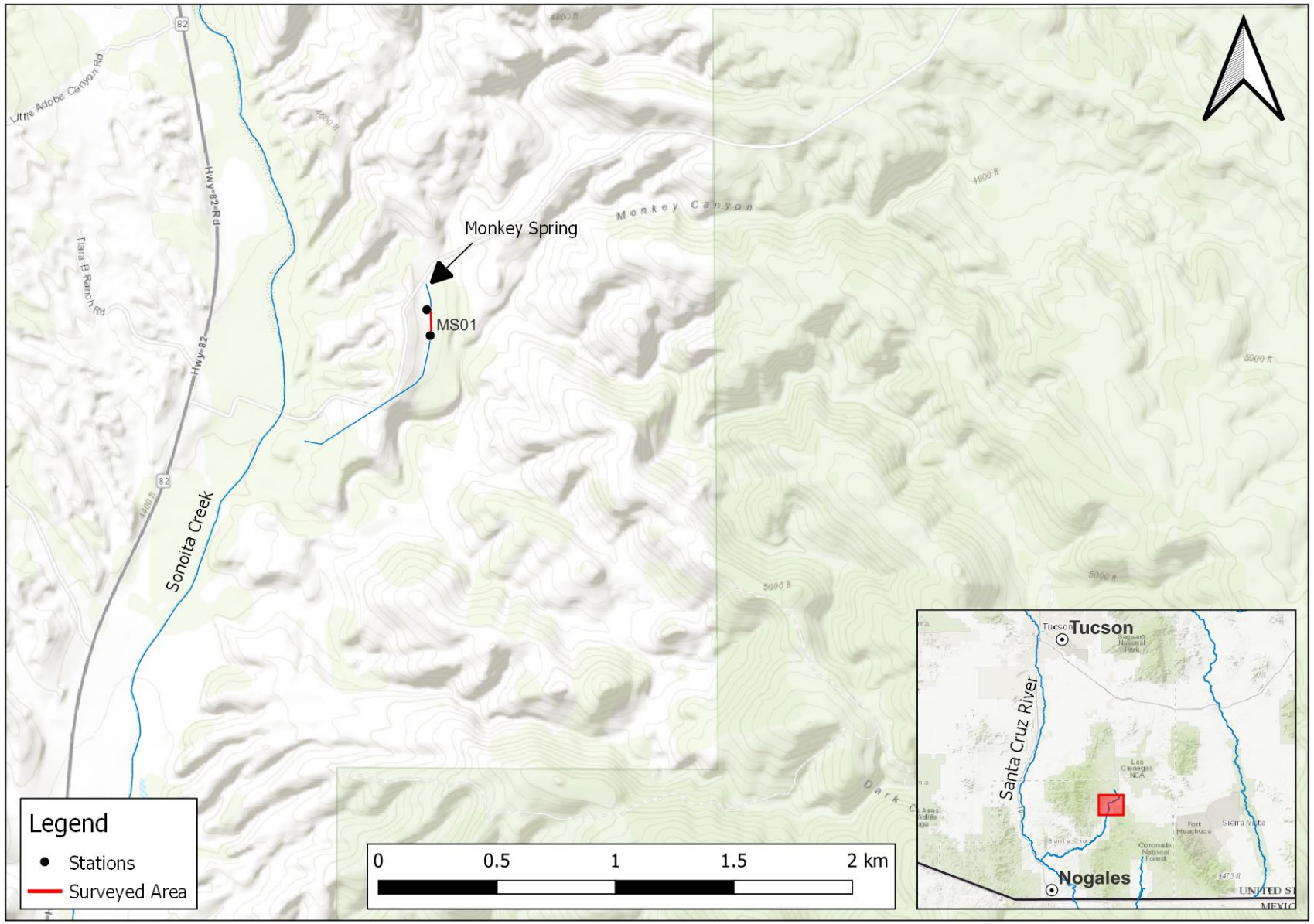

Figure 45. Location of fixed sampling station MS01 at Monkey Spring, Arizona, surveyed on May 23, 2022.

Figure 46. Downstream to downstream view of fixed station MS01 at Monkey Spring, Arizona.

Figure 47. Downstream to upstream view of fixed station MS01 at Monkey Spring, Arizona.

Figure 48. Upstream to downstream view of fixed station MS01 at Monkey Spring, Arizona.

Figure 49. Upstream to upstream view of fixed station MS01 at Monkey Spring, Arizona.

Cottonwood Spring May 25, 2022

Station		Lower Boundary	Upper Boundary
CT01 (Fixed)	12R NAD83	527486E, 3502129N	527556E, 3502058N

Cottonwood Spring (Santa Cruz County, AZ) is a tributary to Sonoita Creek located between the towns of Patagonia and Sonoita. The entire length of stream is approximately 100-m, however the majority of water is diverted into a pipe 60-m downstream of the spring and the remainder flows 40-m in a ditch that empties into Sonoita Creek. The focal species for this site is Gila Topminnow. A small but stable natural population of Gila Topminnow is present in Cottonwood Spring and sometimes occupies pools in Sonoita Creek when habitat is available (Weedman 1999). Cottonwood Spring was last surveyed for this monitoring program in 2021, resulting in capture of 155 Gila Topminnow (Shollenberger et al. 2022).

M&A personnel completed sampling of Cottonwood Spring on May 25, 2022. Sampling was completed by dip net sweeps. The spring was accessed via a short hike from HWY 82. Cottonwood Spring is located on private land and permission from the landowner is required to access this site.

One fixed station, CS01, was surveyed beginning at the springhead and ending below the diversion ditch (Figure 51). A total of 292 Gila Topminnow (100%) were captured. Total effort was 25, 1-m dip net sweeps. All fish were captured in the approximately 60-m long reach between the diversion box and the springhead. The remainder of the 100-m site below the diversion was dry. No other fish species were detected within Cottonwood Spring, however five Longfin Dace were captured in a small, isolated pool in Sonoita Creek just upstream from the confluence with Cottonwood Spring. Overall CPUE increased this year by 15.49 individuals per m^2 compared to the 2021 survey (Figure 50). Catch and effort totals for CS01 are summarized in Table 10.

There was much more aquatic vegetation present within the spring channel compared to 2021 which reduced water velocity in the channel and appeared to provide excellent nursery habitat (Figure 55). Water temperature, DO, pH, and conductivity were measured at the springhead and recorded 27.1 °C, 3.8 mg/L, 7.26, and 1,757 µS, respectively. Photographs of upper and lower extents of the fixed station are provided below (Figures 52-55).

Table 10. Summary of catch at fixed station CT01 at Cottonwood Spring, Arizona, by dip net. Total effort was 25, 1-m sweeps.

Station	Statistic	POOC (<20)	POOC (>=20)	Total
CS01* (8.84 m^2)	Count	176	116	292
	% total catch	60.27%	39.73%	100%
	CPUE (ind/m^2)	19.91	13.12	33.03

*Denotes fixed station

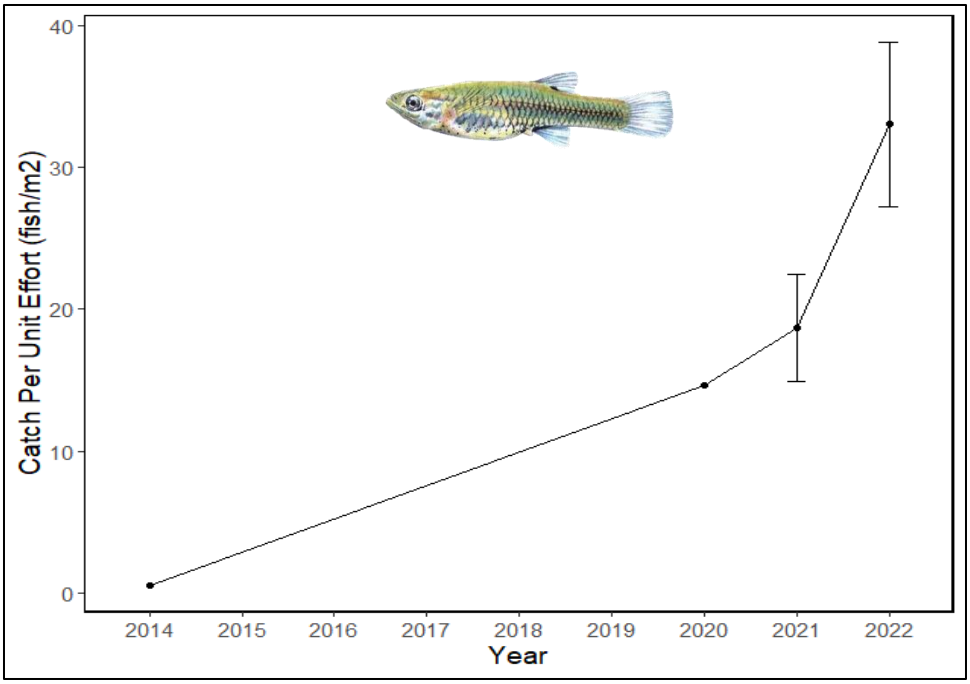

Figure 50. Mean CPUE for Gila Topminnow in Cottonwood Spring, Arizona, since 2014 under GRBMP.

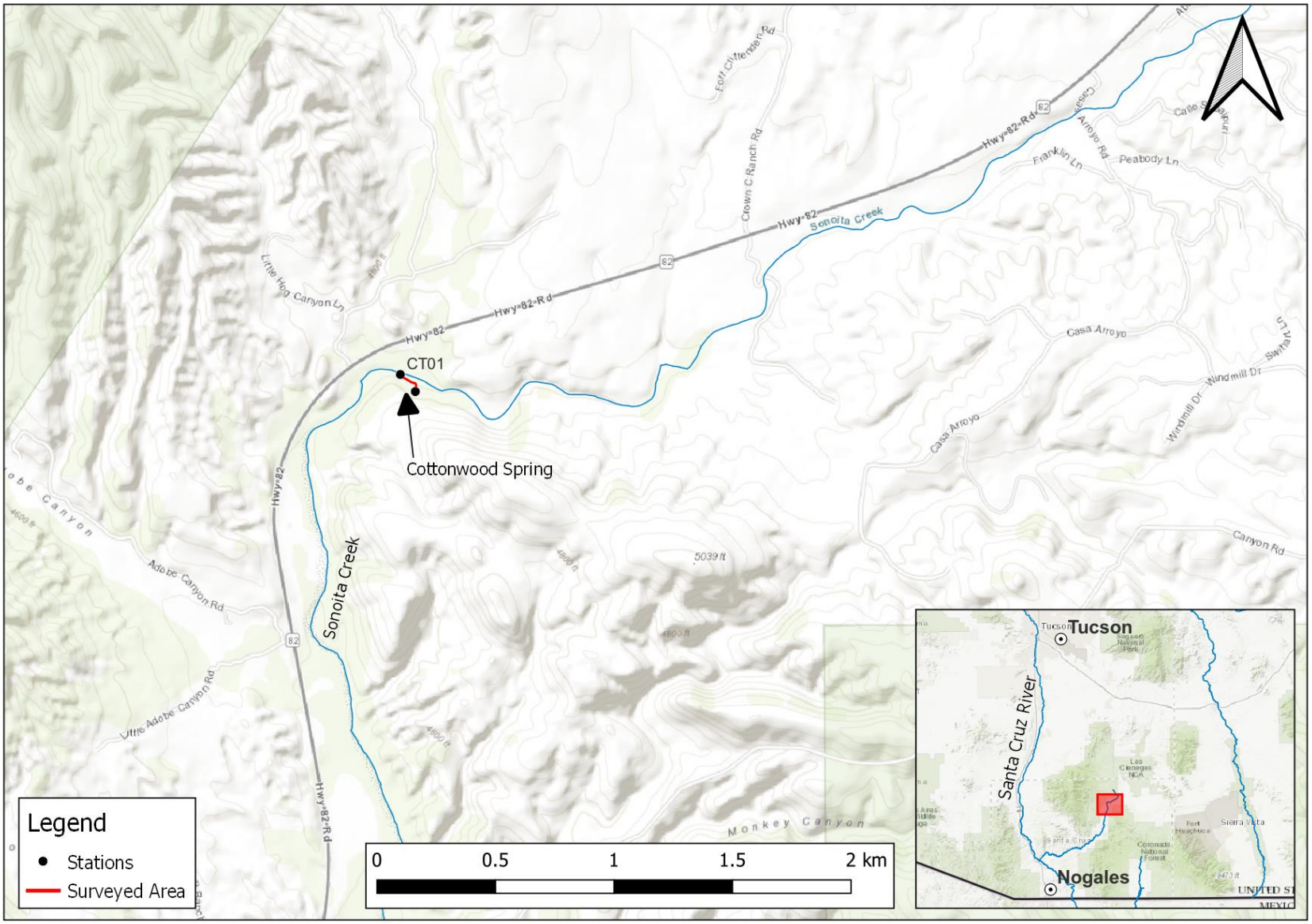

Figure 51. Location of fixed sampling station CT01 at Cottonwood Spring, Arizona, surveyed on May 25, 2022

Figure 52. Downstream to downstream view of fixed station CT01 at Cottonwood Spring, Arizona.

Figure 53. Downstream to upstream view of fixed station CT01 at Cottonwood Spring, Arizona.

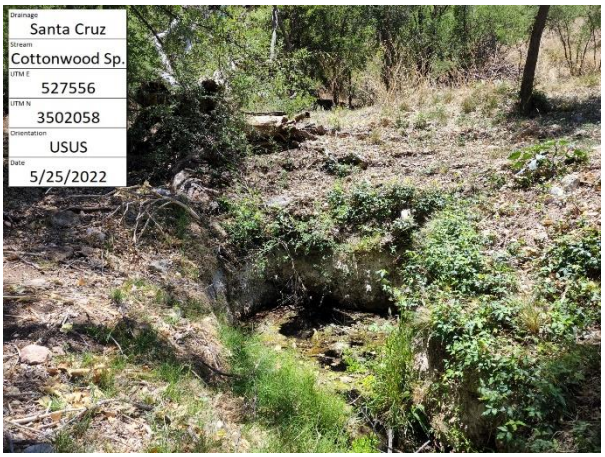

Figure 54. Upstream to upstream view of fixed station CT01 at Cottonwood Spring, Arizona.

Figure 55. Upstream to downstream view of fixed station CT01 at Cottonwood Spring, Arizona.

Figure 56. Looking downstream towards diversion box at Cottonwood Spring, Arizona, in 2021 (Left) and 2022 (Right).

Coal Mine Canyon June 8, 2022

Station		Lower Boundary	Upper Boundary
CM01 (Fixed)	12R NAD83	510442E, 3487940N	510499E, 3488022N
CM02 (Fixed)		510048E, 3487024N	510030E, 3487115N

Coal Mine Canyon (Cochise County, AZ) is a tributary to Fresno Canyon in Sonoita Creek drainage and is located north of Patagonia Lake State Park. Gila Topminnow is the focal species at Coal Mine Canyon. A natural population of Gila Topminnow was first discovered in Coal Mine Canyon in 1996 (Weedman 1999). Surface water is absent throughout most of Coal Mine Canyon aside from two perennial pools associated with springs. This site is surveyed annually for GRBMP and 506 Gila Topminnow were captured in 2021 (Shollenberger et al. 2022).

M&A personnel surveyed Coal Mine Canyon on June 8, 2022. This site was accessed via Blue Haven Road in Patagonia, AZ, which was followed to Solero Ranch Road, and then Montezuma Well Road was taken to the fenced Coal Mine Spring where the vehicle was parked. A private landowner gate is present near the start of Montezuma Well Road and requires a gate code to proceed on the road. Access to this location also requires coordination with Arizona State Parks to acquire a permit to conduct scientific sampling in this area. Montezuma Well Road is extremely rough and a UTV or ATV is recommended for this road; however, it is possible to travel this road with a 4X4 truck, but the drive is slow going and tough on vehicles. Two, 100-m fixed stations were surveyed, with each station encompassing one of the perennial pools (Figure 58). Totals of 880 Gila Topminnow and 13 Longfin Dace were captured across both stations.

The upstream station, CM01, was located at the large, fenced spring pool. This pool contained the only available surface water within the 100-m station and was approximately 11-m long and 12-m wide. Water levels were slightly higher compared to the bleak conditions in 2021. Seven minnow traps were set within this station, which resulted in capture of Gila Topminnow (n=241; 84.86%) and Northern Crayfish (n=43; 15.14%).

The second station, CM02, was located approximately 1 km downstream from CM01. This station consisted of a single pool about 22-m in length, 8-m wide, and 1.7 m deep. Ten minnow traps were set, which resulted in capture of Gila Topminnow (n=639; 84.86%) and Northern Crayfish (n=97; 12.95%). Catch and effort totals for both stations are summarized in Table 11.

The improved conditions in Coal Mine Canyon led to approximately double the mean CPUE for topminnow at this site compared to last year (Figure 57). Longfin Dace were detected here for the first time since 2012, indicating the species has persisted in Coal Mine Canyon since its introduction in 2007.

Average water temperature, DO, pH, and conductivity across the two fixed stations were recorded at 28.1 °C, 9.5 mg/L, 8.81, and 408 µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 59-66).

Table 11. Summary of catch at two fixed stations at Coal Mine Canyon, Arizona, by minnow trap. Total effort was 36.93 hours.

Station	Statistic	AGCH	POOC (<20)	POOC (≥20)	ORVI	Total
CM01* (15.13 hrs)	Count	0	54	187	43	284
	% total catch	0.00%	19.01%	65.85%	15.14%	100%
	CPUE (ind/net hr)	0.00	3.57	12.36	2.84	18.77
CM02* (21.80 hrs)	Count	12	1	638	97	749
	% total catch	1.73%	0.13%	85.18%	12.95%	100%
	CPUE (ind/net hr)	0.60	0.05	29.27	4.45	34.36
Total	Count	12	55	825	140	1033
	% total catch	1.26%	5.32%	79.86%	13.55%	100%
	CPUE (ind/net hr)	0.35	1.49	22.34	3.79	27.97

*Denotes fixed station

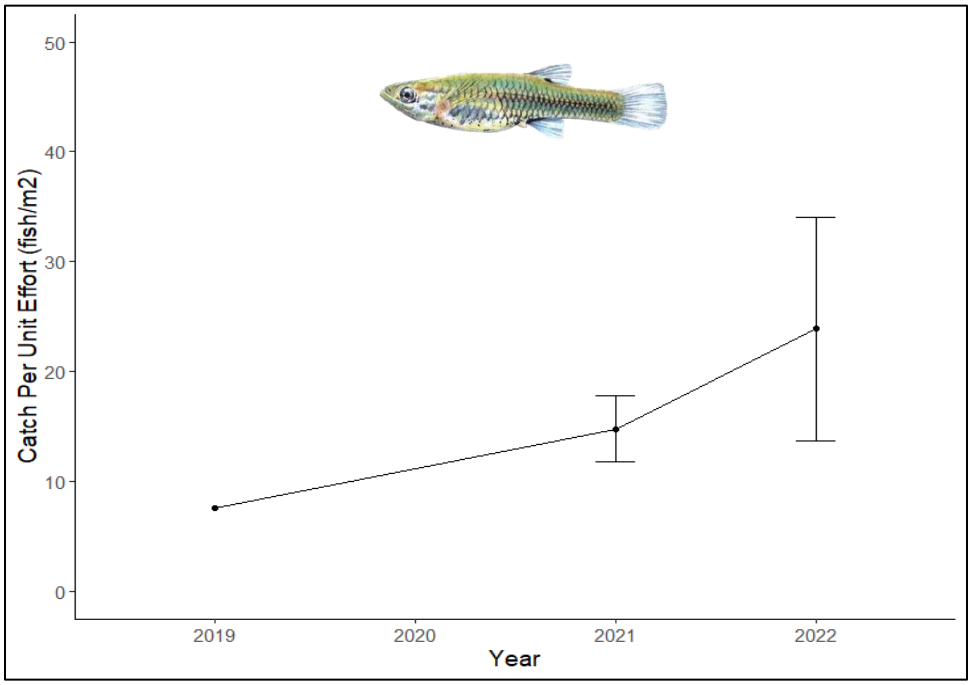

Figure 57. Mean CPUE for Gila Topminnow in Coal Mine Canyon, Arizona, since 2019 under GRBMP.

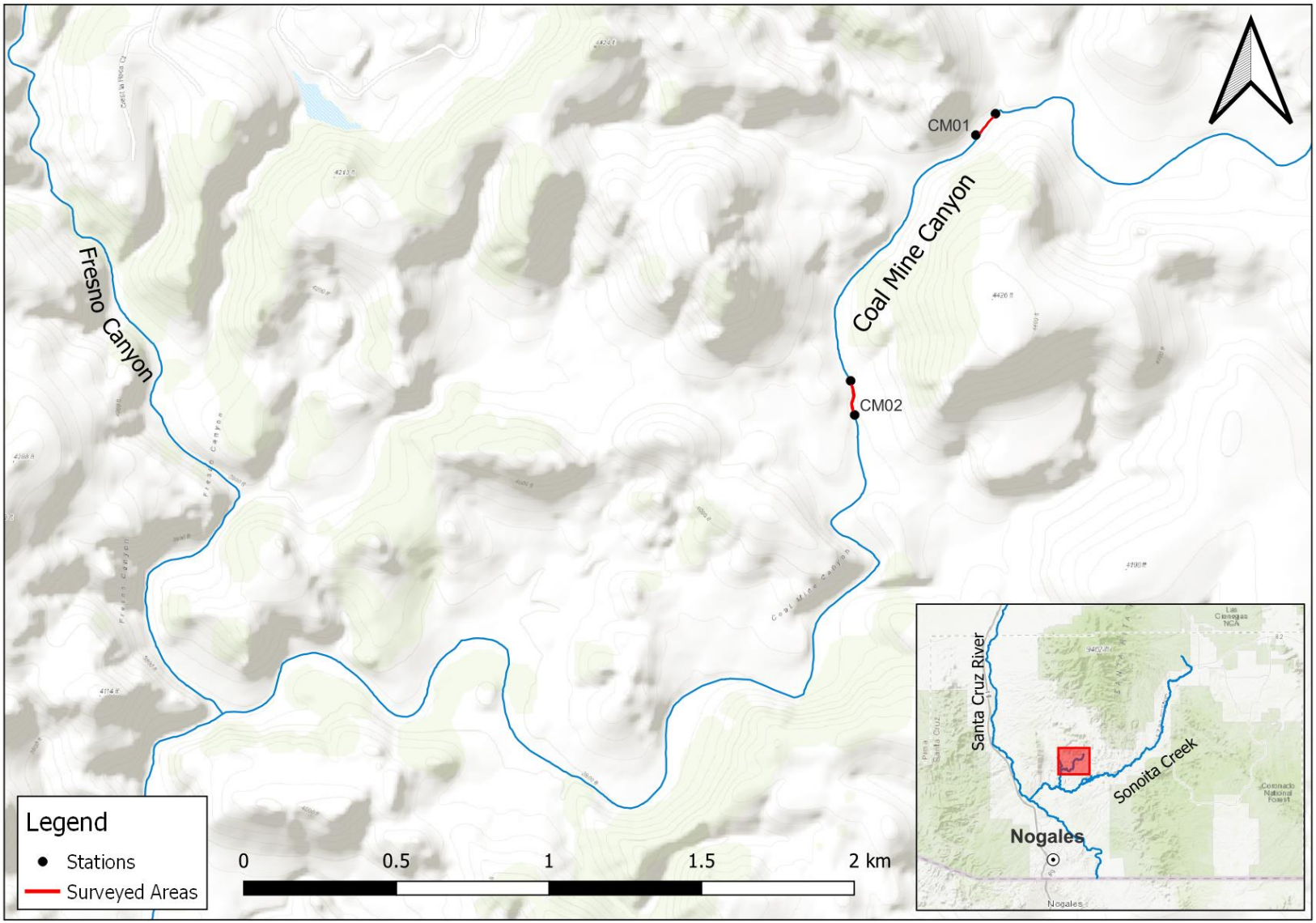

Figure 58. Location of fixed sampling stations at Coal Mine Canyon, Arizona, surveyed on June 8, 2022.

Figure 59. Downstream to downstream view of fixed station CM01 at Coal Mine Canyon, Arizona.

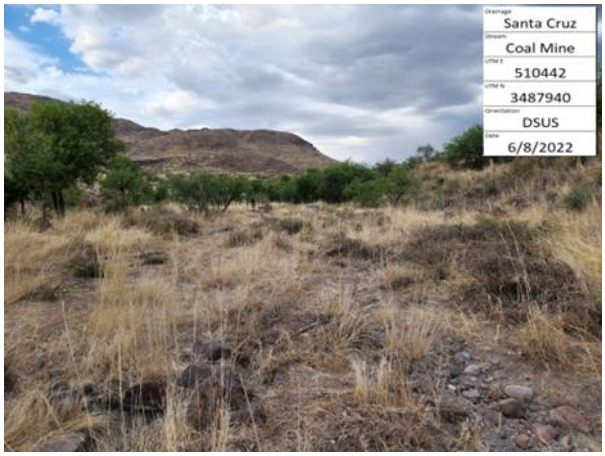

Figure 60. Downstream to upstream view of fixed station CM01 at Coal Mine Canyon, Arizona.

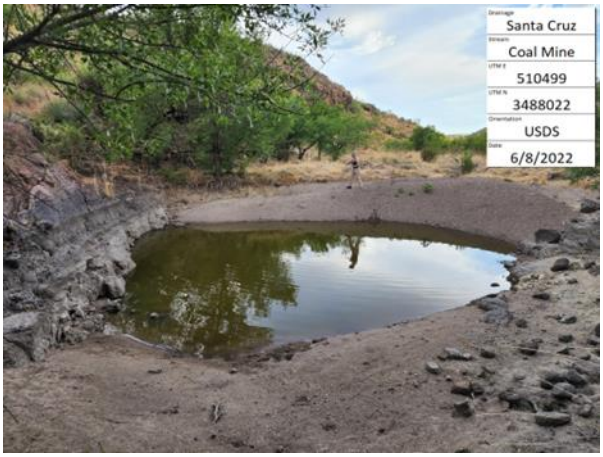

Figure 61. Upstream to downstream view of fixed station CM01 at Coal Mine Canyon, Arizona.

Figure 62. Upstream to upstream view of fixed station CM01 at Coal Mine Canyon, Arizona.

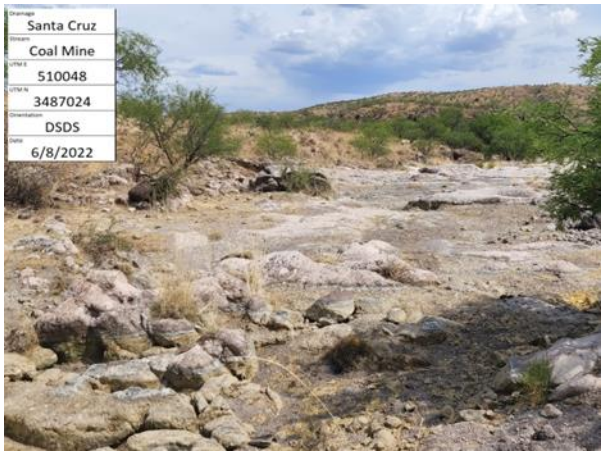

Figure 63. Downstream to downstream view of fixed station CM02 at Coal Mine Canyon, Arizona.

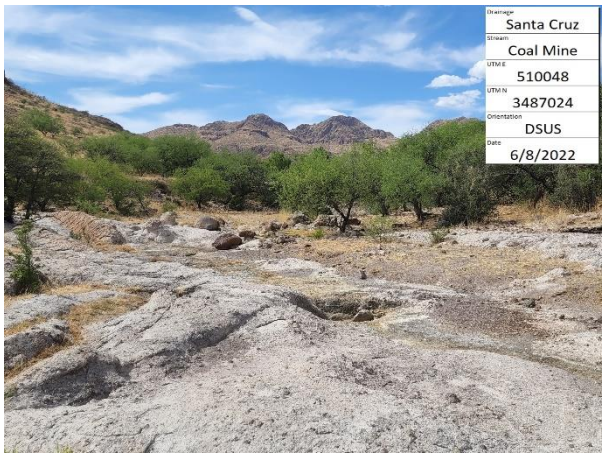

Figure 64. Downstream to upstream view of fixed station CM02 at Coal Mine Canyon, Arizona.

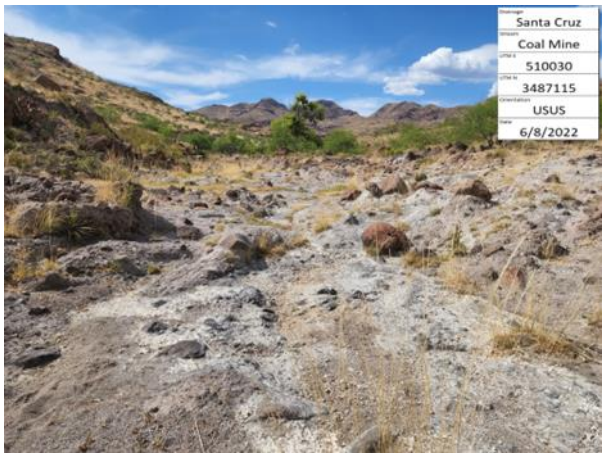

Figure 65. Upstream to upstream view of fixed station CM02 at Coal Mine Canyon, Arizona.

Figure 66. Upstream to downstream view of fixed station CM02 at Coal Mine Canyon, Arizona.

Fresno Canyon June 9, 2022

Station		Lower Boundary	Upper Boundary
FC01 (Fixed)	12R NAD83	507749E, 3485964N	507848E, 3485986N
FC02 (Fixed)		507729E, 3485860N	507749E, 3485959N
FC03 (Fixed)		507745E, 3485724N	507727E, 3485857N

Fresno Canyon (Santa Cruz County, AZ) is a tributary to Sonoita Creek downstream of Patagonia Lake in Santa Cruz sub-basin. Gila Topminnow is the focal species at Fresno Canyon. A natural population of Gila Topminnow was discovered in Fresno Canyon in 1992 (Weedman, 1999). Due to the presence of predatory non-natives such as Green Sunfish, Fresno Canyon was treated with rotenone in 2007. Prior to renovation, approximately 1,200 Gila Topminnow were salvaged from Fresno Canyon and transported 3 miles to Coal Mine Spring (Mitchell 2007). In 2008, 1,000 Gila Topminnow and 75 Longfin Dace from Coal Mine Canyon were translocated into Fresno Canyon (AZGFD 2018). This site is surveyed annually for GRBMP and 24 Gila Topminnow were captured in 2021 (Shollenberger et al. 2022).

M&A personnel surveyed Fresno Canyon on June 9, 2022. Fresno Canyon was accessed by hiking from the end of Montezuma Well Road (reference the Coal Mine Canyon trip summary above for specific driving directions and coordination for this site). Three consecutive, 100-m fixed stations were surveyed (Figure 68). Ten minnow traps were set within each station for approximately 2 hours. Conditions have improved since the previous survey. Surface water was higher compared to 2021 and duckweed *Lemna* sp. was far less prevalent throughout the monitoring reach. Still, there was little flowing water and mesohabitat consisted of mostly disconnected pools. Totals of 853 Gila Topminnow, 194 Longfin Dace, and one Green Sunfish were captured across all stations.

Efforts in the upper station captured Gila Topminnow (n=347; 72.0%), Longfin Dace (n=135; 28.0%). The fence near the upper portion of this perennial stretch is still damaged and cattle impacts were readily apparent, and several cows were observed within the monitoring reach. Efforts in the middle station captured Gila Topminnow (n=440; 75.6%), Longfin Dace (n=14; 2.41%), and Northern Crayfish (n=128; 21.99%). Efforts within the downstream station captured Gila Topminnow (n=66; 37.08%), Longfin Dace (n=45; 25.28%), Green Sunfish (n=1; 0.05%) and Northern Crayfish (n=66; 37.04%). Catch and effort totals for all stations are summarized in Tables 12.

The Gila Topminnow population in Fresno Canyon has seemingly rebounded from last year with the improved conditions. Mean CPUE was the highest it has ever been under this monitoring program (Figure 67). The Green Sunfish (75 mm TL) was captured within the most downstream station. The sunfish was not released back into the stream. This is the first Green Sunfish captured in Fresno Canyon since it was chemically treated with Rotenone in 2007 and its appearance suggests the species persists somewhere within the drainage. It is recommended that extensive and intensive surveys be initiated to locate and eliminate any Green Sunfish within the Fresno Canyon system.

Stream discharge measurements were not taken as there was no flowing water. Average water temperature, DO, pH, and conductivity across the three fixed stations were recorded at 25.7 °C, 8.16 mg/L, 8.26, and 514 µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 69-80).

Table 12. Summary of catch at three fixed stations at Fresno Canyon, Arizona, by minnow trap. Total effort was 74.9 hours.

Station	Statistic	POOC (<20)	POOC (>=20)	AGCH	LECY	ORVI	Total
FC01* (28.37 hrs)	Count	77	270	135	0	0	482
	% total catch	15.98%	56.02%	28.01%	0.00%	0.00%	100%
	CPUE (ind/net hr)	2.71	9.52	4.37	0.00	0.00	16.99
FC02* (24.83 hrs)	Count	148	292	14	0	128	582
	% total catch	25.43%	50.17%	2.41%	0.00%	21.99%	100%
	CPUE (ind/net hr)	5.96	11.76	0.56	0.00	5.16	23.44
FC03* (21.70 hrs)	Count	2	64	45	1	66	178
	% total catch	1.12%	35.96%	25.28%	0.56%	37.08%	100%
	CPUE (ind/net hr)	0.09	2.95	2.03	0.05	3.04	8.20
Total	Count	227	626	194	1	194	1242
	% total catch	18.28%	50.40%	15.62%	0.08%	15.62%	100%
	CPUE (ind/net hr)	3.03	8.36	2.43	0.01	2.59	16.58

*Denotes fixed station

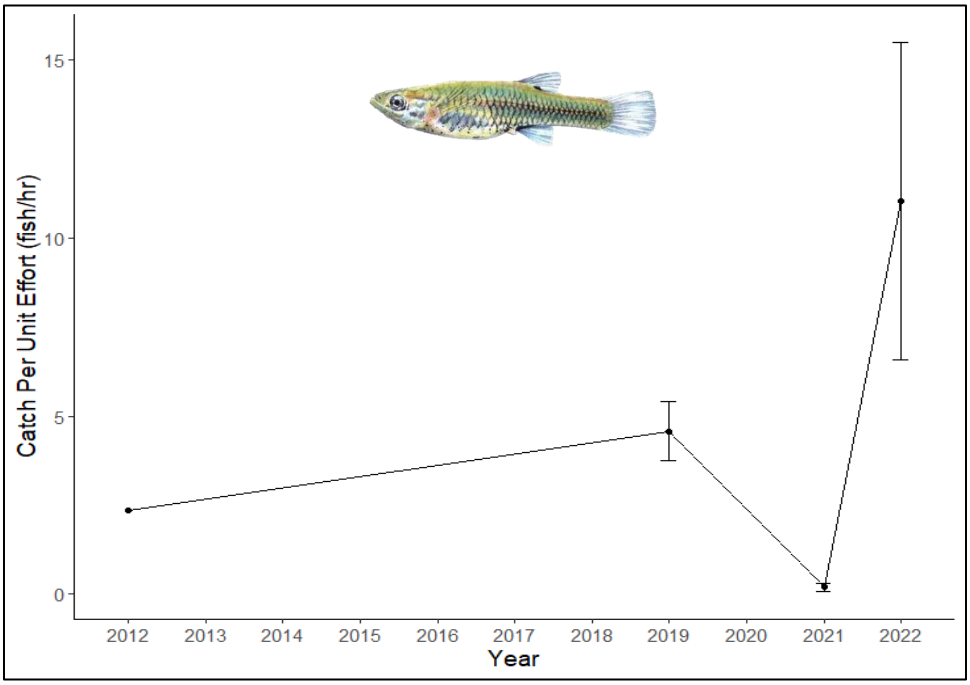

Figure 67. Mean CPUE for Gila Topminnow in Fresno Canyon, Arizona, since 2012 under GRBMP.

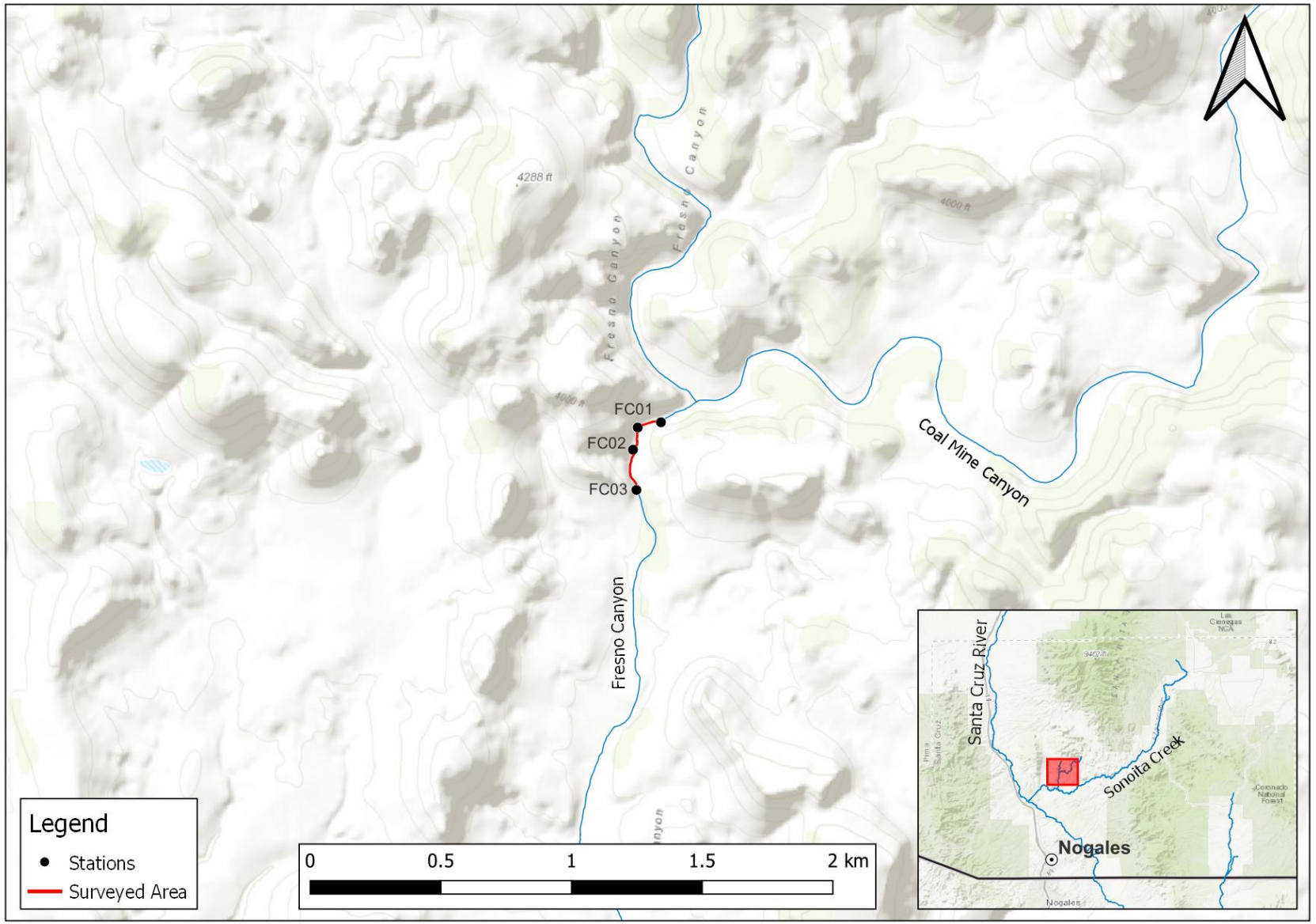

Figure 68. Location of fixed sampling stations at Fresno Canyon, Arizona, surveyed on June 6, 2022.

Figure 69. Downstream to downstream view of fixed station FC01 at Fresno Canyon, Arizona.

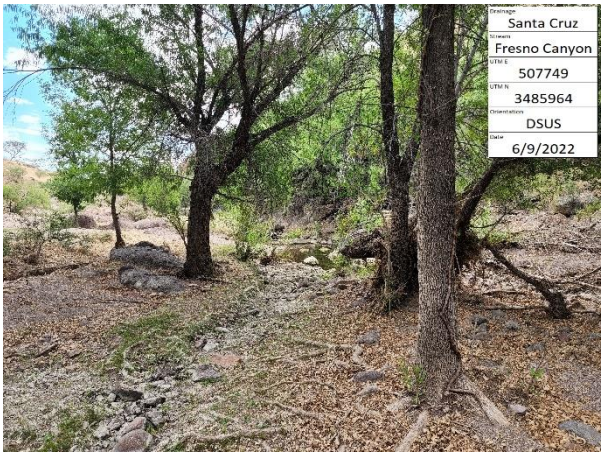

Figure 70. Downstream to upstream view of fixed station FC01 at Fresno Canyon, Arizona.

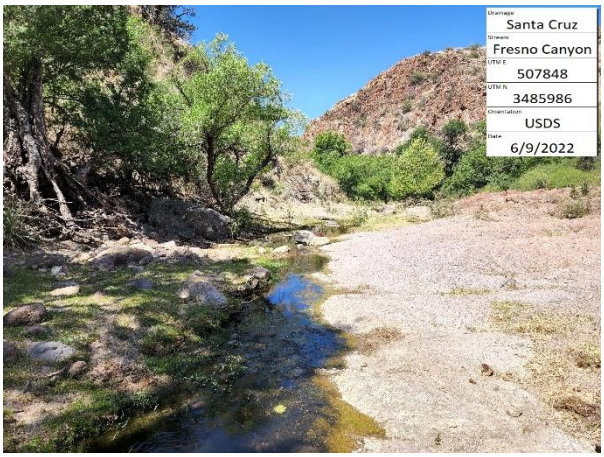

Figure 71. Upstream to downstream view of fixed station FC01 at Fresno Canyon, Arizona.

Figure 72. Upstream to upstream view of fixed station FC01 at Fresno Canyon, Arizona.

Figure 74. Downstream to downstream view of fixed station FC02 at Fresno Canyon, Arizona.

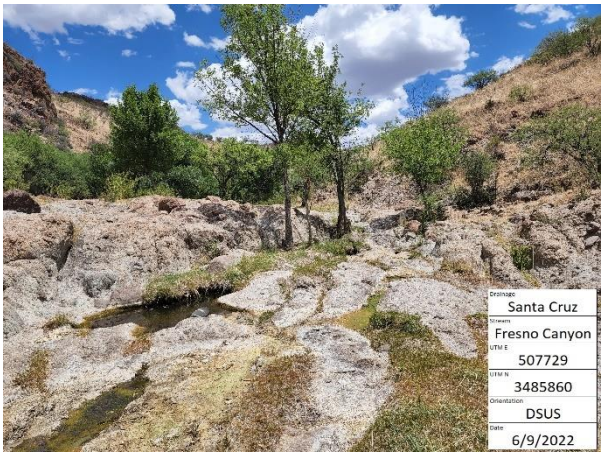

Figure 73. Downstream to upstream view of fixed station FC02 at Fresno Canyon, Arizona.

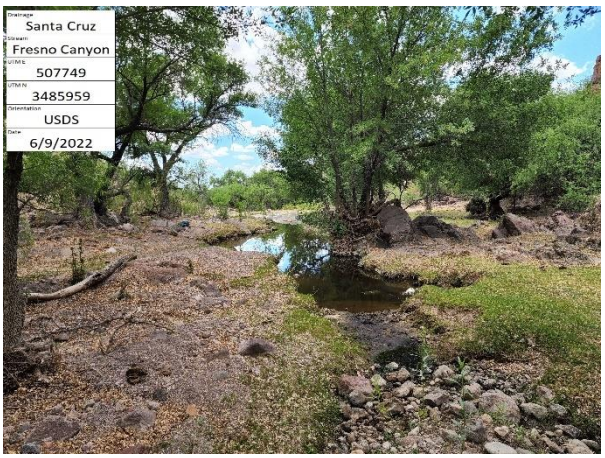

Figure 75. Upstream to downstream view of fixed station FC02 at Fresno Canyon, Arizona.

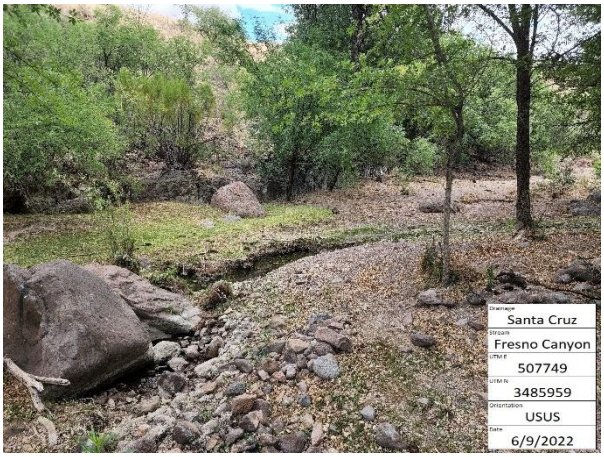

Figure 76. Upstream to upstream view of fixed station FC02 at Fresno Canyon, Arizona.

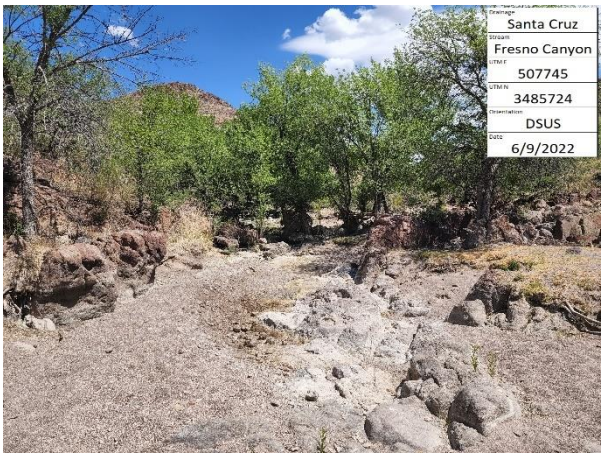

Figure 77. Downstream to upstream view of fixed station FC03 at Fresno Canyon, Arizona.

Figure 78. Downstream to downstream view of fixed station FC03 at Fresno Canyon, Arizona.

Figure 79. Upstream to downstream view of fixed station FC03 at Fresno Canyon, Arizona.

Figure 80. Upstream to upstream view of fixed station FC03 at Fresno Canyon, Arizona.

Sheehy Spring June 21 & 22, 2022

Station		Lower Boundary	Upper Boundary
SS01 (Fixed)	12R NAD83	540080E, 3470466N	540162E, 3470477N
SS02 (Fixed)		539987E, 3470418N	540070E, 3470459N

Sheehy Spring (Santa Cruz County, AZ) is a tributary to Santa Cruz River in San Rafael Valley near Lochiel, AZ. This site is on private land and permission to access the spring must be acquired from San Rafael Cattle Company. Gila Chub is the focal species at Sheehy Spring. A natural population of Gila Chub was first discovered at this site in 1939. Gila Topminnow also existed at this site, however the population declined and eventually disappeared after introduction of Western Mosquitofish in 1988 (Weedman et al. 1996). Sheehy Spring is surveyed annually for GRBMP. The 2021 monitoring event captured totals of 43 Gila Chub and one Western Mosquitofish (Shollenberger et al. 2022).

M&A and retired FWS personnel completed sampling of Sheehy Spring on June 21-22, 2022. Sampling was completed by mini-hoop nets and dip net sweeps. Available habitat was mostly limited to one large pool in a 200-m perennial section surrounding the spring. The area surrounding Sheehy Spring is impacted by grazing cattle, however dense woody vegetation protects the pool from direct impacts.

Two, 100-m fixed stations were sampled at Sheehy Spring (Figure 83). These stations were immediately adjacent to each other and encompassed the majority of surface water present. Ten mini-hoop nets were set throughout a 45-m long series of connected pools located in the lower station, SS02. Algal mats, which covered much of the open water, were cleared from the surface before setting mini-hoop nets. Nets were set overnight for approximately 16 hours. Remaining surface water was limited to marshland and shallow, muddy puddles. Gila Chub (n=55; 64.36%), Sonora Mud Turtle (n=16; 19.28%), and American Bullfrog (n=13; 15.66%) were captured from the downstream station. The second station began immediately upstream of the large pool. Mesohabitat throughout this station was limited to shallow puddles and marshy areas aside from a small, 0.65-m deep pool that was overgrown with aquatic vegetation. A single mini-hoop net was set in this pool and no fish were captured. Ten dip net sweeps were conducted throughout the rest of the station and resulted in capture of one Western Mosquitofish. Catch and effort totals for SS02 and SS01 are summarized in Tables 13-14.

Surface water was higher this year compared to 2021, however Gila Chub habitat is still limited to the large pool within the lower station. This population remains small, but stable. Mean CPUE remained low for Gila Chub but has been increasing with each monitoring event (Figure 81). Water temperature, DO, pH, and conductivity were averaged across sites SS01 and SS02 were recorded at 20.0 °C, 6.2 mg/L, 7.89, and 405 µS, respectively. A length-frequency histogram for all Gila Chub captured in 2021 and 2022 at Sheehy Spring is included below (Figure 81). Photographs of upper and lower extents of each fixed station are provided below (Figures 84-91).

Table 13. Summary of catch at two stations at Sheehy Spring, Arizona, by mini-hoop net, surveyed on June 21 & 22, 2022. Total effort was 191.72 hours.

Station	Statistic	GIIN (51-100)	GIIN (>100)	KISO	RACA	Total
SS01* (17.45 hrs)	Count	0	0	0	0	0
	% total catch	0.00%	0.00%	0.00%	0.00%	0.00%
	CPUE (ind/net hr)	0.00	0.00	0.00	0.00	0.00
SS02* (174.27 hrs)	Count	18	36	16	13	84
	% total catch	21.69%	43.37%	19.28%	15.66%	100%
	CPUE (ind/net hr)	0.11	0.21	0.09	0.07	0.48

*Denotes fixed station

Table 14. Summary of catch at fixed station SS01 at Sheehy Spring, Arizona, by dip net, surveyed on June 22, 2022. Total effort was 10, 1-m sweeps.

Station	Statistic	GAAF	Total
SS01* (3.53 m²)	Count	1	1
	% total catch	100%	100%
	CPUE (ind/net hr)	0.28	0.28

*Denotes fixed station

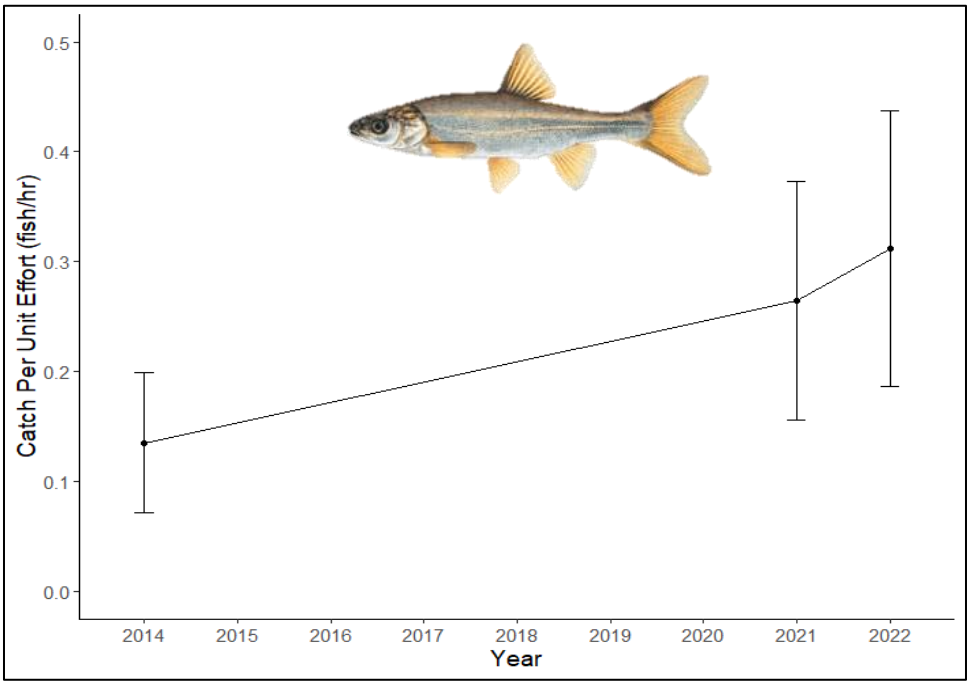

Figure 81. Mean CPUE for Gila Chub captured at Sheehy Spring, Arizona, since 2014 under GRBMP

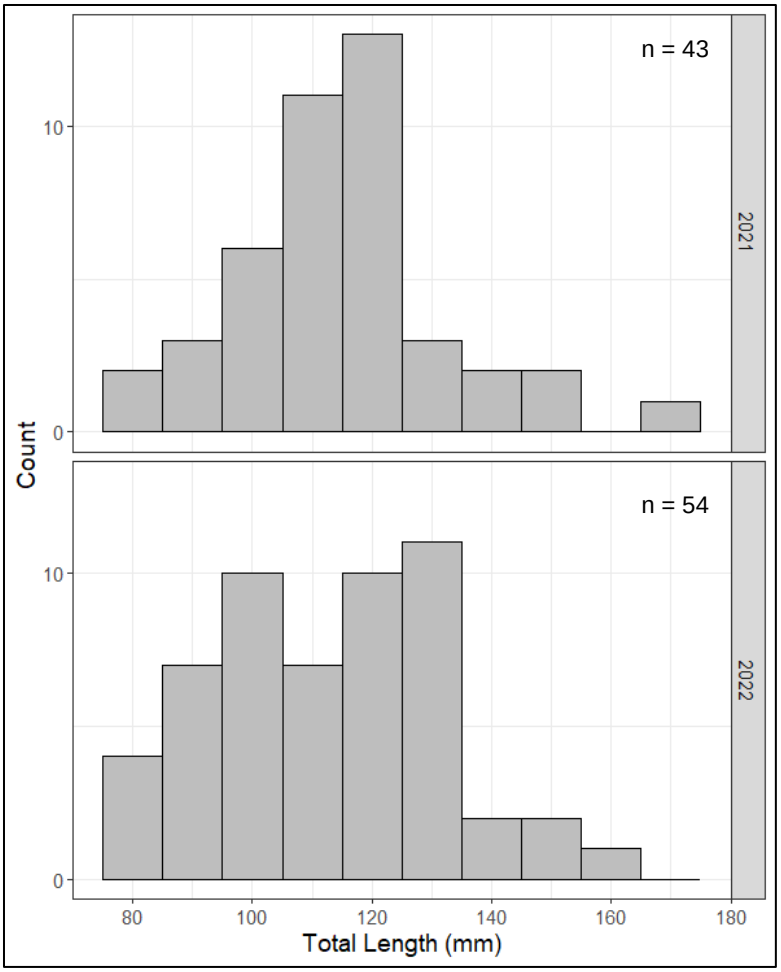

Figure 82. Length-frequency distribution for Gila Chub captured at Sheehy Spring, Arizona, in 2021 (top) and 2022 (bottom).

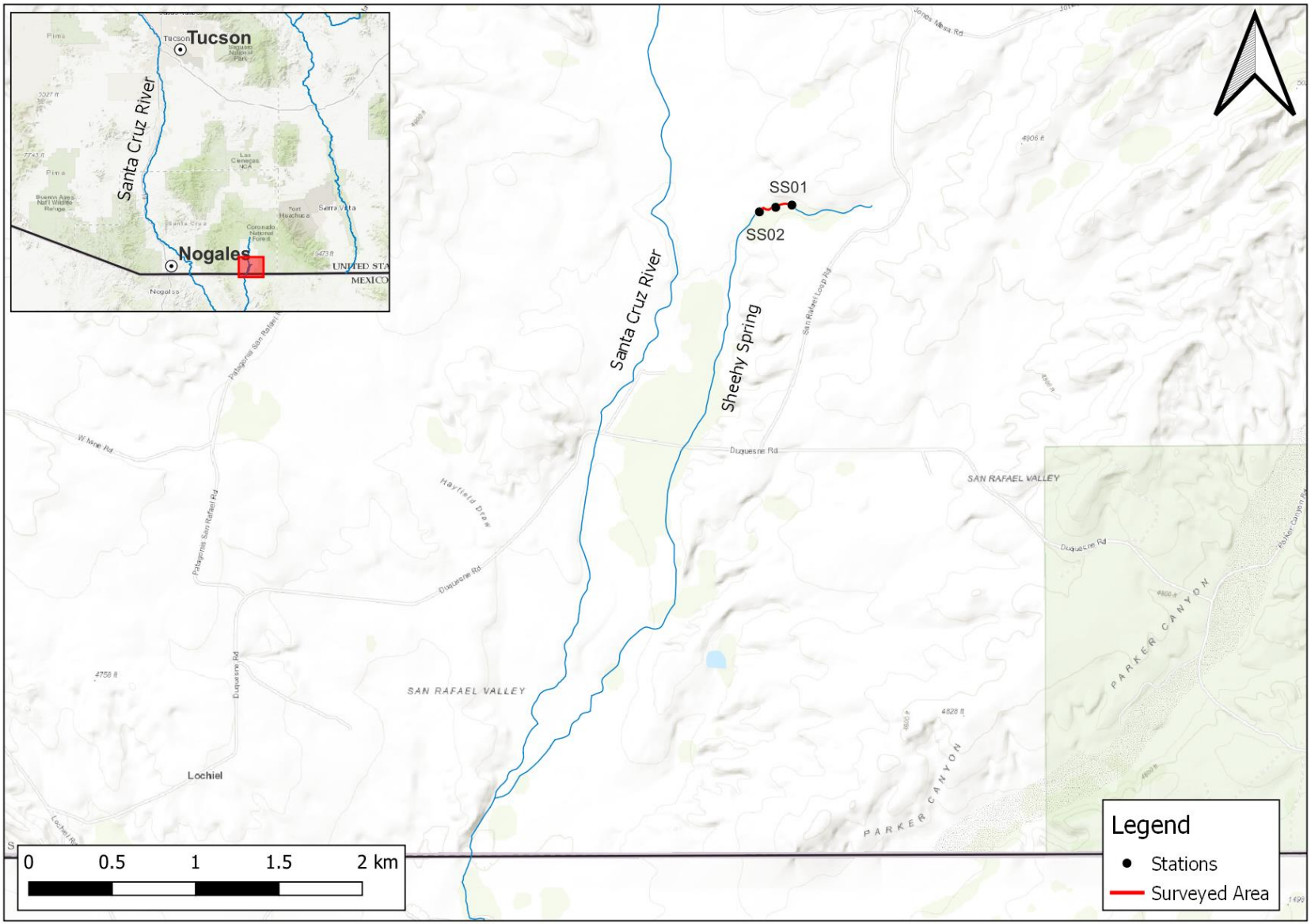

Figure 83. Location of sampling stations at Sheehy Spring, Arizona, surveyed on June 21 & 22, 2022.

Figure 84. Upstream to upstream view of fixed station SS02 at Sheehy Spring, Arizona.

Figure 85. Upstream to downstream view of fixed station SS02 at Sheehy Spring, Arizona.

Figure 86. Downstream to downstream view of fixed station SS02 at Sheehy Spring, Arizona.

Figure 87. Downstream to upstream view of fixed station SS02 at Sheehy Spring, Arizona.

Figure 88. Upstream to upstream view of fixed station SS01 at Sheehy Spring, Arizona.

Figure 89. Upstream to downstream view of fixed station SS01 at Sheehy Spring, Arizona.

Figure 90. downstream to downstream view of fixed station SS01 at Sheehy Spring, Arizona.

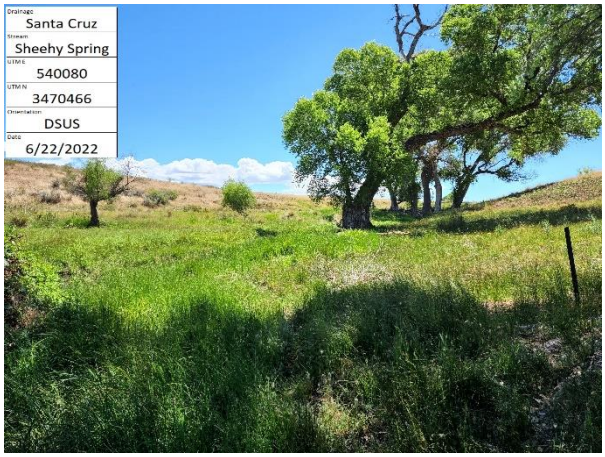

Figure 91. Downstream to upstream view of fixed station SS01 at Sheehy Spring, Arizona.

Parker Canyon June 22 & 23, 2022

Station		Lower Boundary	Upper Boundary
PC02	12R NAD83	551469E, 3476955N	551501E, 3477000N
PC06 (Fixed)		551415E, 3476581N	551415E, 3476666N
PC13		550996E, 3476596N	551041E, 3476660N
PC15		550886E, 3476439N	550947E, 3476515N
PC34		549743E, 3475575N	549832E, 3475647N
PC37		549602E, 3475398N	549635E, 3475481N
PC39		549491E, 3475236N	549553E, 3475310N
PC43		549261E, 3474993N	549274E, 3475095N
PC45		549434E, 3474895N	549375E, 3474977N
PC46		549469E, 3474803N	549433E, 3474900N

Parker Canyon (Santa Cruz County, AZ) begins from Parker Canyon Lake and flows south eventually meeting Santa Cruz River in Mexico about 2.8 km south of the international border (Figure 92). Gila Topminnow were first discovered in Parker Canyon in 2015 in a perennial reach 9 km downstream of Parker Canyon Lake. At the time, non-native fishes including Green Sunfish, Bluegill, and Western Mosquitofish were also present. Gila Topminnow were confirmed to be present by AZGFD in 2018 (K. Mosher, Reclamation, pers. comm). Parker Canyon was last surveyed under this monitoring program in 2020 and resulted in capture of 383 Western Mosquitofish and 21 Longfin Dace (Shollenberger et al. 2021).

M&A personnel completed sampling at Parker Canyon on June 22-23, 2022. Ten (1 fixed, 9 random), 100-m stations were surveyed. Gila Topminnow were not detected. Monitoring efforts this year focused on the perennial stretch beginning immediately below Parker Canyon Lake to Neighbor Spring. Totals of 250 Western Mosquitofish, 1 Longfin Dace, 7 Largemouth Bass, and 26 Green Sunfish were captured across all 10 stations and gear types (Tables 17-19).

The fixed station was located 600-m downstream from Parker Canyon Dam. The majority of this station consisted of a single 66-m long by 25-m wide pond, surrounded by swamp like mesohabitat. Ten minnow traps were set around the edges of the pond. Western Mosquitofish (n=43; 97.73%) and Green Sunfish (n=1; 2.27%) were captured via minnow traps. Dip net sweeps in the shallow swamp mesohabitat captured an additional 15 Western Mosquitofish.

Sampling throughout the randomly selected stations was completed with a combination of seine hauls and dip net sweeps. Depending on available habitat, up to 10 unique efforts were completed within each random station, with the exception of PC43 which was entirely dry. Longfin Dace (n=1; 0.44%), Western Mosquitofish (n=192; 85.33%), Green Sunfish (n=25; 11.11%), and Largemouth Bass (n=7; 3.11%) were captured across the nine random stations. Northern Crayfish were observed but not captured.

We also conducted opportunistic sampling just upstream of the FR194 road crossing where Gila Topminnow were first discovered in 2015 (12R 545276E, 3471018N). Three small, disconnected pools were sampled with dip net sweeps and only Longfin Dace and Western Mosquitofish were encountered.

It is unlikely that Gila Topminnow still remain in Parker Canyon. In April 2022, a captive population of Gila Topminnow collected from Parker Canyon was moved from Arizona State University to the Aquatic Research and Conservation Center by AZGFD personnel where it is currently maintained. A sample from the captive stock clustered genetically with a sample from the Santa Cruz River-Nogales population of Gila topminnow (Mussman et al. 2020), suggesting an unauthorized and undocumented transfer of fish.

Water temperature, DO, pH, and conductivity were recorded at 23.1°C, 9.7 mg/L, 7.89, and 360µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 93-96).

Table 15. Summary of catch at nine stations at Parker Canyon, Arizona, by seine. Total effort was 29, 1-m seine hauls.

Station	Statistic	GAAF	LECY	MISA	Total
PC02 (3.66 m^2)	Count	0	0	0	0
	% total catch	0.00%	0.00%	0.00%	0.00%
	CPUE (ind/m^2)	0.00	0.00	0.00	0.00
PC13 (10.97 m^2)	Count	0	3	2	5
	% total catch	0.00%	60.00%	40.00%	100%
	CPUE (ind/m^2)	0.00	0.27	0.18	0.46
PC15 (18.29 m^2)	Count	0	12	3	15
	% total catch	0.00%	80.00%	20.00%	100%
	CPUE (ind/m^2)	0.00	0.66	0.16	0.82
PC34 (25.60 m^2)	Count	38	0	0	38
	% total catch	100%	0.00%	0.00%	100%
	CPUE (ind/m^2)	1.48	0.00	0.00	1.48
PC37 (14.63 m^2)	Count	0	6	0	6
	% total catch	0.00%	100%	0.00%	100%
	CPUE (ind/m^2)	0.00	0.41	0.00	0.41
PC39 (25.60 m^2)	Count	67	1	2	70
	% total catch	95.71%	1.43%	2.86%	100%
	CPUE (ind/m^2)	2.62	0.04	0.08	2.73
PC45 (7.32 m^2)	Count	15	2	0	17
	% total catch	0.00%	0.00%	0.00%	0.00%
	CPUE (ind/m^2)	2.05	0.27	0.00	2.32
Total	Count	120	24	7	151
	% total catch	79.47%	15.89%	4.64%	100%
	CPUE (ind/m^2)	1.13	0.23	0.07	1.42

*Denotes fixed station

Table 16. Summary of catch at all stations at Parker Canyon, Arizona, by dip net. Total effort was 42, 1-m dip net sweeps.

Station	Statistic	AGCH	GAAF	LECY	MISA	Total
PC02 (2.83 m^2)	Count	0	0	0	0	0
	% total catch	0.00%	0.00%	0.00%	0.00%	0.00%
	CPUE (ind/m^2)	0.00	0.00	0.00	0.00	0.00
PC06* (1.06 m^2)	Count	0	15	0	0	15
	% total catch	0.00%	100%	0.00%	0.00%	100%
	CPUE (ind/m^2)	0.00	14.14	0.00	0.00	14.14
PC13 (2.47 m^2)	Count	0	3	0	0	3
	% total catch	0.00%	100%	0.00%	0.00%	100%
	CPUE (ind/m^2)	0.00	1.21	0.00	0.00	1.21
PC15 (1.77 m^2)	Count	0	2	1	0	3
	% total catch	0.00%	66.67%	33.33%	0.00%	100%
	CPUE (ind/m^2)	0.00	1.13	0.57	0.00	1.70
PC34 (1.06 m^2)	Count	1	18	0	0	19
	% total catch	5.26%	94.74%	0.00%	0.00%	100%
	CPUE (ind/m^2)	0.94	16.97	0.00	0.00	17.91
PC37 (2.12 m^2)	Count	0	23	0	0	23
	% total catch	0.00%	100%	0.00%	0.00%	100%
	CPUE (ind/m^2)	0.00	10.84	0.00	0.00	10.84
PC39 (1.06 m^2)	Count	0	20	0	0	20
	% total catch	0.00%	100%	0.00%	0.00%	100%
	CPUE (ind/m^2)	0.00	18.86	0.00	0.00	18.86
PC45 (1.77 m^2)	Count	0	6	0	0	6
	% total catch	0.00%	100%	0.00%	0.00%	100%
	CPUE (ind/m^2)	0.00	3.39	0.00	0.00	3.39
PC46 (0.71 m^2)	Count	0	0	0	0	0
	% total catch	0.00%	0.00%	0.00%	0.00%	0.00%
	CPUE (ind/m^2)	0.00	0.00	0.00	0.00	0.00
Total	Count	1	87	1	0	89
	% total catch	1.12%	97.75%	1.12%	0.00%	100%
	CPUE (ind/m^2)	0.07	5.86	0.07	0.00	5.99

*Denotes fixed station

Table 17. Summary of catch at fixed station PC06 at Parker Canyon, Arizona, by minnow trap. Total effort was 23.15 hours.

Station	Statistic	GAAF	LECY	Total
PC06* (23.15 hrs)	Count	43	1	44
	% total catch	97.73%	2.27%	100%
	CPUE (ind/net hr)	1.86	0.04	1.90

*Denotes fixed station

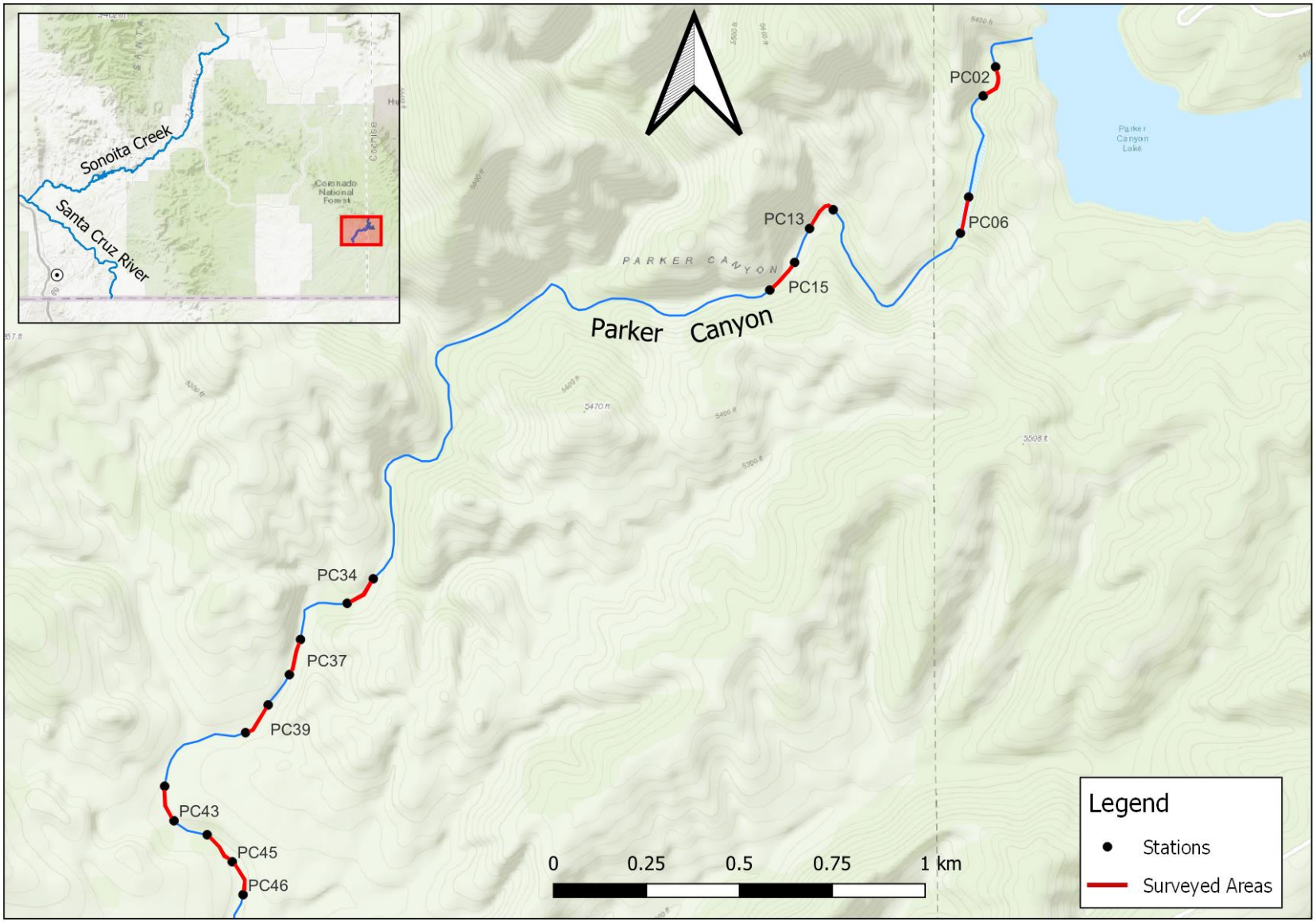

Figure 92. Location of sampling stations at Parker Canyon, Arizona, surveyed on June 22 & 23, 2022.

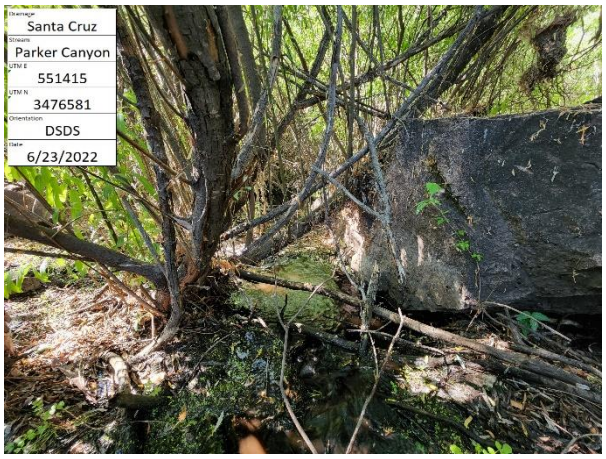

Figure 93. Downstream to downstream view of fixed station PC06 at Parker Canyon, Arizona.

Figure 94. Downstream to upstream view of fixed station PC06 at Parker Canyon, Arizona.

Figure 95. Upstream to downstream view of fixed station PC06 at Parker Canyon, Arizona.

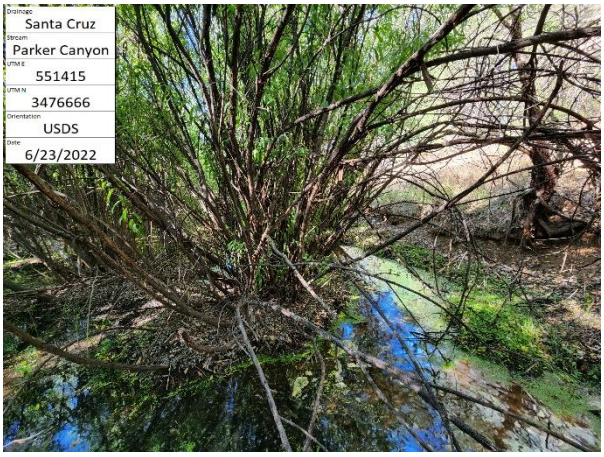

Figure 96. Upstream to upstream view of fixed station C06 at Parker Canyon, Arizona.

Cienega Creek September 16, 2022

Station		Lower Boundary	Upper Boundary
CC01	12S NAD83	535779E, 3541957N	535858E, 3541996N
CC03 (Fixed)		535757E, 3541931N	535693E, 3541874N
CC09		535017E, 3541993N	535114E, 3541958N

Cienega Creek (Pima County, AZ) is located on Pima County's Cienega Creek Natural Preserve near Vail, AZ. It is a tributary to Pantano Wash in Santa Cruz sub-basin. Gila Topminnow is the focal species for this site. Cienega Creek is monitored annually under this monitoring program. During the 2021 survey, 26 Gila Topminnow were captured (Shollenberger et al. 2022).

M&A and Pima County personnel completed monitoring of Cienega Creek on September 16, 2022. One fixed and two random stations were surveyed in the vicinity of the "Horseshoe Bend/Head Cut" section of the creek (Figure 97). This reach of Cienega Creek was accessed via gravel roads off East Marsh Station Road. A total of 10 seine hauls were conducted throughout each random station and minnow traps were used throughout the fixed station. The two large pools that typically are present at this location were almost entirely filled with sediment and overall little pool mesohabitat was present anywhere within the entire 1-km monitoring reach. Across all stations, six Gila Topminnow and 653 Longfin Dace were captured.

Mesohabitat in fixed station CC03 changed significantly compared to 2021 and preferred habitat for Gila Topminnow was limited. Ten minnow traps were set for approximately 2 hours. All traps were set near the surface with an air pocket. Only Longfin Dace (n=513; 100%) were captured via traps at this station. Several Gila Topminnow were observed in the shallow margins near the beginning of the station. A single opportunistic dip net sweep captured four Gila Topminnow within the fixed station.

The first random station, CC01, was located 200-m upstream from the fixed station. Few fish were observed throughout this station and only Longfin Dace (n=8; 100%) were captured via seine hauls. The second random station, CC09, was 600-m downstream from the fixed station. Longfin Dace (n=133; 98.52%) and Gila Topminnow (n=2; 1.48%) were captured via seine hauls. Mesohabitat throughout this station was entirely shallow run. Three Lowland Leopard Frogs and one Red-spotted Toad *Anaxyrus punctatus* were found dead in the creek. Lowland Leopard Frog specimens collected by Pima County personnel tested positive for both *Batrachochytrium dendrobatidis* and ranavirus (A. Owens, AZGFD, pers. comm.).

Catch and effort totals for all stations are summarized in tables 15 & 16. CPUE trends are difficult to assess for Cienega Creek as the majority of topminnow captured in 2021 and 2022 were from opportunistic efforts using a variety of gear types. Stream discharge was measured near the middle of CC03 and calculated to be 0.02 m^3/s (0.66 cfs). Water temperature, DO, pH, and conductivity at the fixed station were recorded at 22.0 °C, 6.5 mg/L, 7.46, and 1,797 µS, respectively. Photographs of upper and lower extents of the fixed station are provided below (Figures 98-101).

Table 18. Summary of catch at two stations at Cienega Creek, Arizona, by seine. Total effort was 20, 1-m seine hauls.

Station	Statistic	AGCH (< 40)	AGCH (>= 40)	POOC (>= 20)	Total
CC01 (11.0 m^2)	Count	4	4	0	8
	% total catch	50.00%	50.00%	0.00%	100%
	CPUE (ind/m^2)	0.11	0.11	0.00	0.22
CC09 (29.3 m^2)	Count	24	109	2	135
	% total catch	17.78%	80.74%	1.48%	100%
	CPUE (ind/m^2)	0.66	2.98	0.05	3.69
Total	Count	28	113	2	143
	% total catch	19.58%	79.02%	1.40%	100%
	CPUE (ind/m^2)	0.38	1.54	0.03	1.95

Table 19. Summary of catch at fixed station CC03 at Cienega Creek, Arizona, by minnow trap. Total effort was 24.50 net hours.

Station	Statistic	AGCH (< 40)	AGCH (>= 40)	Total
CC03* (24.50 hrs)	Count	152	360	512
	% total catch	29.69%	70.31%	100%
	CPUE (ind/net hr)	6.20	14.69	20.90

*Denotes fixed station

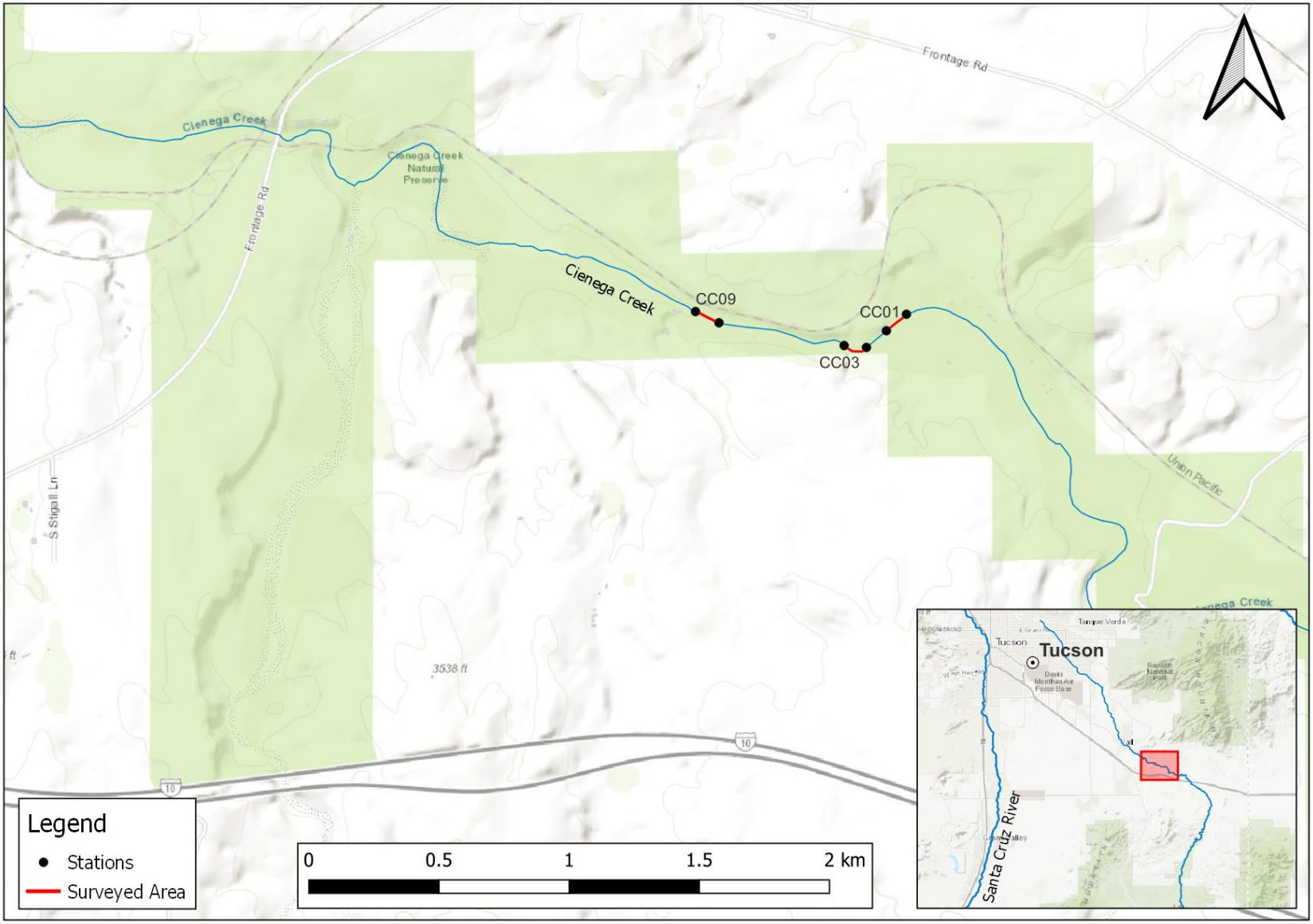

Figure 97. Location of sampling stations at Cienega Creek, Arizona, surveyed on September 16, 2022.

Figure 98. Downstream to downstream view of fixed station CC03 at Cienega Creek, Arizona.

Figure 99. Downstream to upstream view of fixed station CC03 at Cienega Creek, Arizona.

Figure 100. Upstream to downstream view of fixed station CC03 at Cienega Creek, Arizona.

Figure 101. Upstream to upstream view of fixed station CC03 at Cienega Creek, Arizona.

Upper Gila River Basin

San Francisco River (NM) September 26-28, 2022

Reach	Station		Lower Boundary	Upper Boundary
1	SFNM06	12S NAD83	706909E, 3739962N	706725E, 3740060N
1	SFNM10		707096E, 3739441N	706918E, 3739573N
2	SFNM17		704576E, 3723578N	704650E, 3723782N
2	SFNM21		704564E, 3722876N	704657E, 3723061N
3	SFNM25 (Fixed)		697548E, 3679717N	697491E, 3679885N
3	SFNM29		697234E, 3679180N	697165E, 3679429N
3	SFNM32		696932E, 3678709N	697073E, 3678855N
3	SFNM37		696455E, 3678056N	696358E, 3678240N

San Francisco River is a major tributary to Gila River and originates in White Mountains of Arizona. It flows east into New Mexico and then turns south, eventually returning west into AZ near Pleasanton, NM. It joins Gila River near Clifton, AZ. Three separate reaches of San Francisco River were surveyed in New Mexico (Figure 103). The focal species are Loach Minnow and Spikedace at this site. The upper most reach is located north of Reserve, NM near Hog Canyon. The middle reach is located just south of Reserve, NM and the lower reach is in the vicinity of Big Dry Creek from Sipes Canyon to Frisco Hot Springs. The lower reach was monitored for GRBMP in 2020 and detected seven Spikedace and five Loach Minnow (Shollenberger et al. 2021).

M&A personnel completed sampling of San Francisco River on September 26-29, 2022. All stations were 200-meters in length and surveyed using backpack electrofishing and seine where possible. Across all stations 17 Loach Minnow, 354 Longfin Dace, 130 Speckled Dace, 78 Desert Sucker, 48 Sonora Sucker, 14 Fathead Minnow, 7 Flathead Catfish, 3 Red Shiner, 2 Common Carp, 1 Western Mosquitofish, 1 Channel Catfish, and 1 Rainbow Trout were captured.

Two randomly selected stations (SFNM06 & SFNM10) were surveyed in the upper reach. Both stations were accessed via FR 41. Loach Minnow were detected at both stations. Species captured included Loach Minnow (n=17; 3.31%), Longfin Dace (n=254; 49.51%), Speckled Dace (n=123; 23.98%), Desert Sucker (n=69; 13.45%), Sonora Sucker (n=44; 8.58%), Fathead Minnow (n=5; 0.97%), and Rainbow Trout (n=1; 0.19%). Spikedace were not detected.

The middle reach was accessed via a US Forest Service (USFS) administrative road off Reserve-Beaverhead Road. Two random stations (SFNM17 & SFNM21) were surveyed. Mesohabitat throughout this reach consisted of uniform sandy bottom runs with little pool or riffle habitat within the selected stations. Fishes captured were Longfin Dace (n=99; 77.95%), Desert Sucker (n=8; 6.30%), Speckled Dace (n=7; 5.51%), Sonora Sucker (n=4; 3.15%), and Fathead Minnow (n=9; 7.09%). Loach Minnow and Spikedace were not detected.

The lower reach typically is accessed via Soldier Hill Road; however this road was not accessible due to significant flowing water in both Little Dry and Big Dry creeks. An alternative access point was located upstream near Sundial Springs Campground. One fixed (SFNM25) and three random stations (SFNM29, SFNM32, & SFNM37) were completed. Electrofishing was ineffective throughout the lower reach due to

high flow and turbid conditions. Species captured were Longfin Dace (n=1; 6.25%), Desert Sucker (n=1; 6.25%), Flathead Catfish (n=7; 43.75%), Red Shiner (n=3; 18.75%), Common Carp (n=2; 12.50%), Channel Catfish (n=1; 6.25%), and Western Mosquitofish (n=1; 6.25%). Loach Minnow and Spikedace were not detected. Catch and effort totals for all stations are summarized by reach in table 20.

Several suckers caught within the upper reach expressed coloration of Desert Sucker and a slightly fleshy upper lip coinciding with Sonora Sucker and were considered potential hybrids at the time of sampling because these two species are found to hybridized in nature (R.W. Clarkson and Minckley 1988). Recent surveys (K. Mosher, Reclamation, pers. comm) found an abundance of Rio Grande Sucker approximately 3 miles upstream. It thus is possible the individuals we encountered were Rio Grande Sucker and were misidentified. Future surveys at this location should collect fin clips from potential Rio Grande Sucker or hybrids for genetic analysis. The Rainbow Trout captured in reach one was 78mm total length. Larval and juvenile ("fry" and "fingerling") Rainbow Trout have been stocked into Luna Lake by AZGFD from 2011-2021 and have been reported to move downstream during lake spillover events (FWS 2020). It is thought trout are unlikely to persist downstream of the Town of Luna due to high summer water temperatures (FWS 2021).

Stream discharge was measured at the upstream extent of SFNM25 was calculated to be 1.06 m^3/s (37.43 cfs). Water temperature, DO, pH, and conductivity were recorded at 24.1 °C, 7.4 mg/L, 7.97, and 480 µS, respectively. A length-frequency histogram of Loach Minnow caught in San Francisco River (reach 1) is provided in figure 102. Photographs of the lower extent of SFNM25 are provided below (Figures 104-105). Upper extent photos were lost due to file corruption.

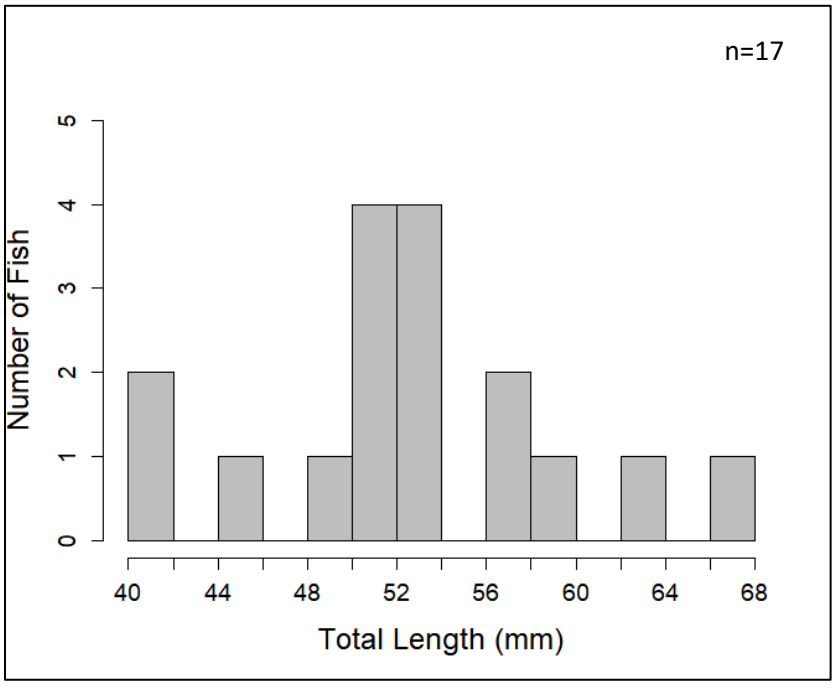

Figure 102. Length-frequency of Loach Minnow captured in San Francisco River, New Mexico, surveyed on September 26-28, 2022.

Table 20. Summary of catch across all stations at San Francisco River, New Mexico, by BPEF, surveyed on September 26-28, 2022. Total effort was 6,025 seconds.

Reach	Stations	Statistic	AGCH	CAIN	CYCA	CYLU	GAAF	ICPU	ONMY	PACL	PIPR	PYOL	TICO	RHOS	Totals
1 (2,714 sec)	SFNM06 SFNM10	Count	254	44	0	0	0	0	1	69	5	0	17	123	513
		% total catch	49.51%	8.58%	0.00%	0.00%	0.00%	0.00%	0.19%	13.45%	0.97%	0.00%	3.31%	23.98%	100%
		CPUE (ind/hr)	336.92	58.36	0.00	0.00	0.00	0.00	1.33	91.53	6.63	0.00	22.55	163.15	680.47
2 (1,153 sec)	SFNM17 SFNM21	Count	99	4	0	0	0	0	0	8	9	0	0	7	127
		% total catch	77.95%	3.15%	0.00%	0.00%	0.00%	0.00%	0.00%	6.30%	7.09%	0.00%	0.00%	5.51%	100%
		CPUE (ind/hr)	309.11	12.49	0.00	0.00	0.00	0.00	0.00	24.98	28.10	0.00	0.00	21.86	396.53
3 (2,158 sec)	SFNM25* SFNM29 SFNM32 SFNM37	Count	1	0	2	3	1	1	0	1	0	7	0	0	16
		% total catch	6.25%	0.00%	12.50%	18.75%	6.25%	6.25%	0.00%	6.25%	0.00%	43.75%	0.00%	0.00%	100%
		CPUE (ind/hr)	1.67	0.00	3.34	5.00	1.67	1.67	0.00	1.67	0.00	11.68	0.00	0.00	26.69
Total		Count	354	48	2	3	1	1	1	78	14	7	17	130	656
		% total catch	53.96%	7.32%	0.30%	0.46%	0.15%	0.15%	0.15%	11.89%	2.13%	1.07%	2.59%	19.82%	100%
		CPUE (ind/hr)	211.52	28.68	1.20	1.79	0.60	0.60	0.60	46.61	8.37	4.18	10.16	77.68	391.97

*Denotes fixed station

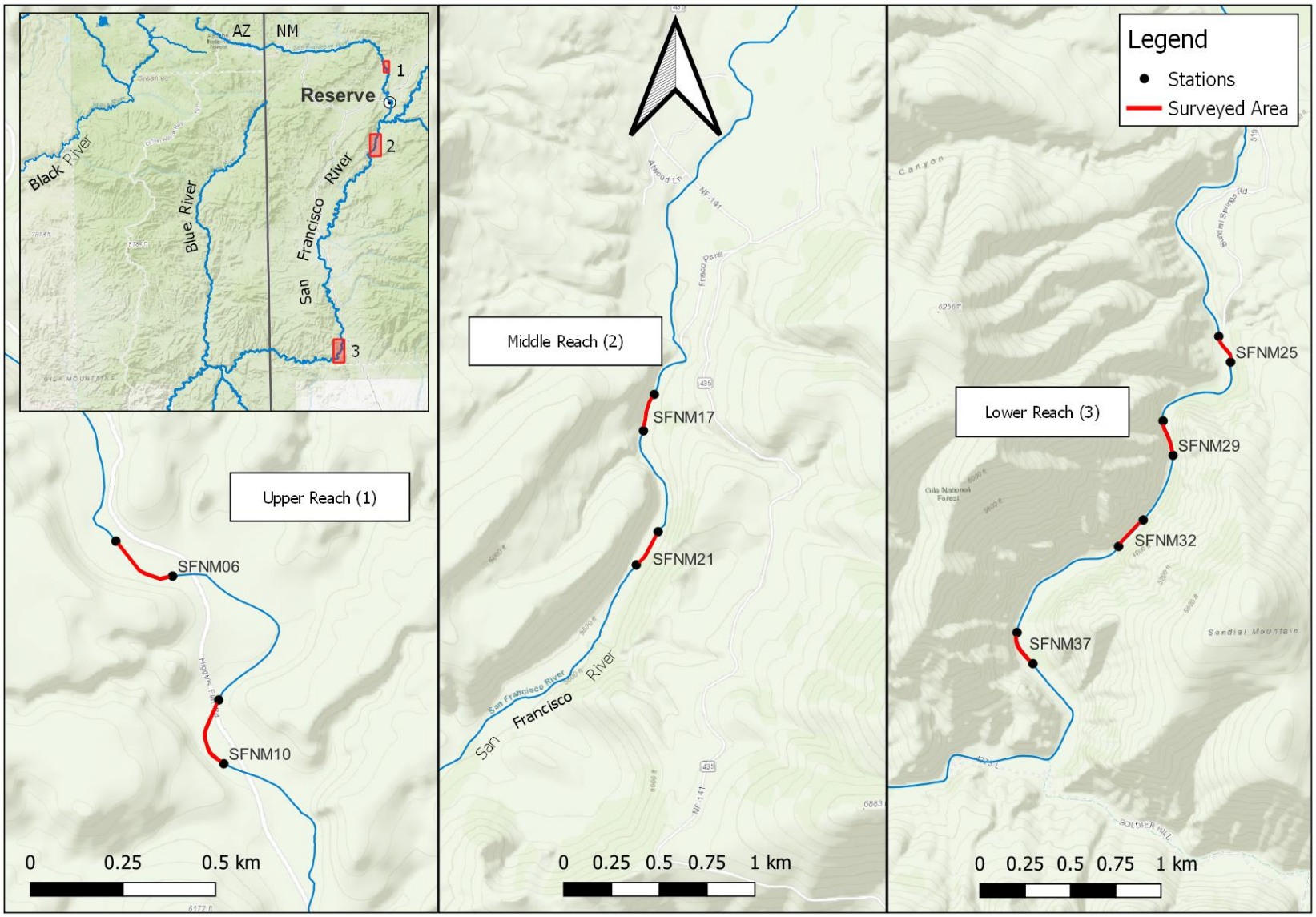

Figure 103. Location of sampling stations at San Francisco River, New Mexico, surveyed on September 26-28, 2022.

Figure 104. Downstream to downstream view of fixed station SFNM25 at San Francisco River, New Mexico.

Figure 105. Downstream to upstream view of fixed station SFNM25 at San Francisco River, New Mexico.

Tularosa River September 26 & 27, 2022

Station		Lower Boundary	Upper Boundary
TR02	12S NAD83	715523E, 3739940N	715415E, 3740103N
TR10		707466E, 3728552N	707649E, 3728446N

Tularosa River (Catron County, NM) is located on Gila National Forest near Reserve, NM. It is a tributary to San Francisco River in Upper Gila sub-basin. Loach Minnow is the focal species at this site. Tularosa River has not been previously surveyed for GRBMP. NMDGF conducts annual monitoring at Tularosa River and last detected Loach Minnow in 2020 (Johnson et al. 2022)

M&A personnel completed monitoring of Tularosa River on September 26 & 27, 2022. Two randomly selected stations were surveyed, the upper reach was accessed near Cruzville, NM via Green Gate and Hells Hole Road. The lower reach was accessed via Negrito Creek Road below the confluence of Tularosa River and Negrito Creek (Figure 106). Tularosa River does not have an assigned fixed station as NMDGF conducts annual sampling at a fixed location. Both random stations were 200-meters in length and surveyed using backpack electrofishing and seine where possible. Across all stations, 173 Longfin Dace, 43 Speckled Dace, 10 Desert Sucker, 8 Sonora Sucker, 8 Western Mosquitofish, 7 Fathead Minnow, 6 Green Sunfish, and 5 Brook Stickleback were captured. No Loach Minnow were detected in this year's survey of Tularosa River.

The first random station, TR02, was located 19 km upstream from the Negrito-Tularosa confluence, and 23 km upstream from where Tularosa runs into the San Francisco River. Longfin Dace (n=157; 83.07%), Speckled Dace (n=6; 3.17%), Western Mosquitofish (n=8; 4.23%), Fathead Minnow (n=7; 3.70%), Green Sunfish (n=6; 3.17%), and Brook Stickleback (n=5; 2.65%) were captured.

The second random station, TR10, was located 1,400-m downstream from the confluence of Negrito Creek and Tularosa River. A combination of BPEF and seine haul efforts were made at the lower site. In the combined effort, Speckled Dace (n=37; 52.11%), Longfin Dace (n=16; 22.54%), Desert Sucker (n=10; 14.08%), and Sonora Sucker (n=8; 11.27%) were captured. Mesohabitat throughout both stations were shallow riffle and run. Catch and effort totals for both stations are summarized in Table 21.

Brook Stickleback (Figure 107) have been previously detected in Tularosa River at NMDGF fixed monitoring location, most recently in 2013 (Johnson et al. 2022). The only other previous detection in Gila River basin is Whitewater Creek, a stream approximately 67 km downstream of Tularosa River (Shollenberger et al. 2020). It is possible that the Brook Stickleback range is expanding in San Francisco watershed. Examples of mesohabitat at both stations are below (Figures 108 & 109)

Table 21. Summary of catch at Tularosa River, New Mexico, by BPEF, surveyed on September 26 & 27, 2022. Total effort was 1,395 seconds.

Stations	Statistic	AGCH	CAIN	CUIN	GAAF	LECY	PACL	PIPR	RHOS	Total
TR02 (610 sec)	Count	157	0	5	8	6	0	7	6	189
	% total catch	83.07%	0.00%	2.65%	4.23%	3.17%	0.00%	3.70%	3.17%	100%
	CPUE (ind/hr)	926.56	0.00	29.51	47.21	35.41	0.00	41.31	35.41	1115.41
TR10 (785 sec)	Count	16	8	0	0	0	10	0	37	71
	% total catch	22.54%	11.27%	0.00%	0.00%	0.00%	14.08%	0.00%	52.11%	100%
	CPUE (ind/hr)	73.38	36.69	0.00	0.00	0.00	45.86	0.00	169.68	325.61
Total	Count	173	8	5	8	6	10	7	43	260
	% total catch	66.54%	3.08%	1.92%	3.08%	2.31%	3.85%	2.69%	16.54%	100%
	CPUE (ind/hr)	446.45	20.65	12.90	20.65	15.48	25.81	18.06	110.97	670.97

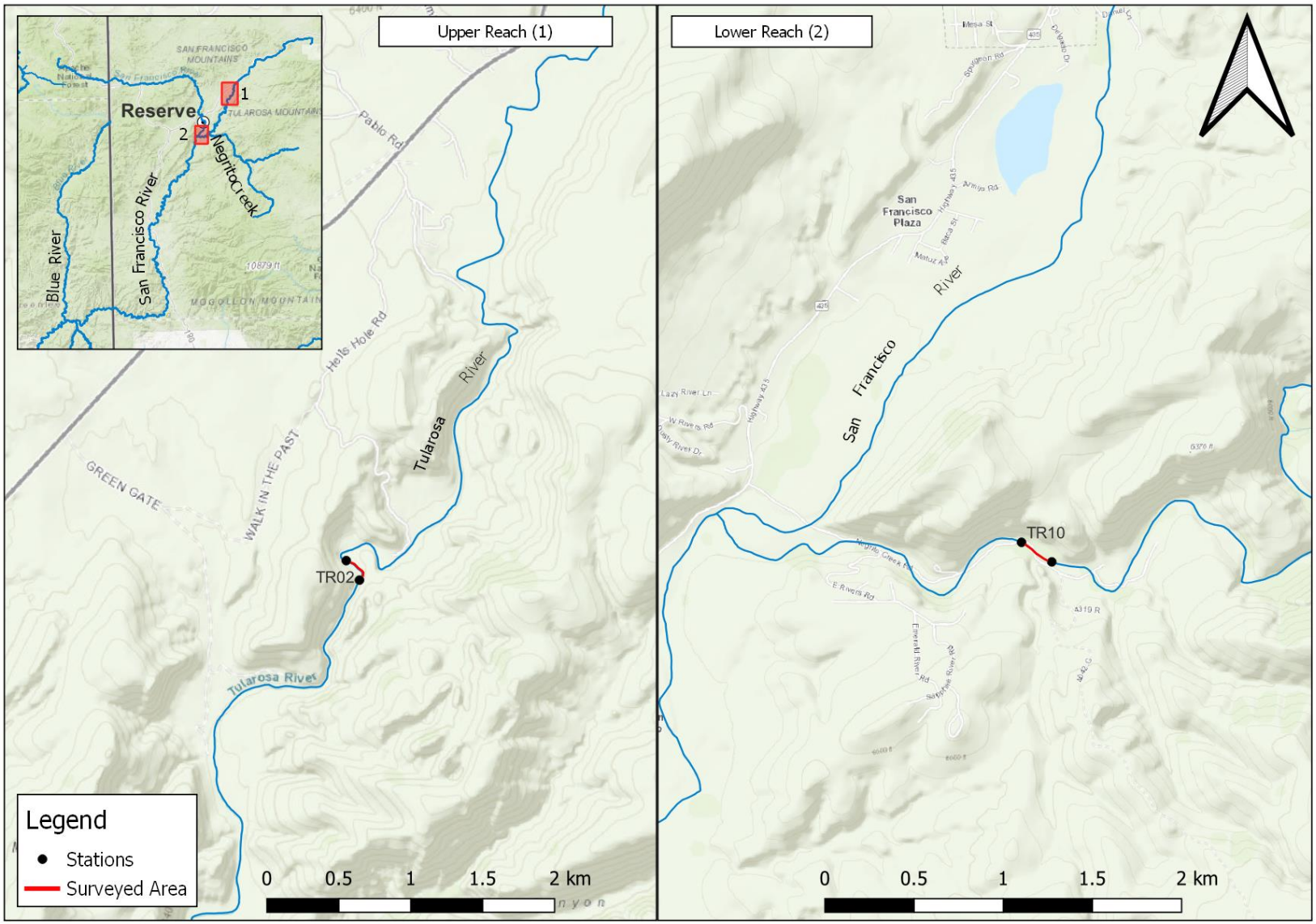

Figure 106. Location of sampling stations at Tularosa River, New Mexico, surveyed on September 26 & 27, 2022.

Figure 107. Brook Stickleback captured at station TR02 at Tularosa River, New Mexico.

Figure 108. Example of habitat at station TR02 at Tularosa River, New Mexico.

Figure 109. Example of habitat at station TR10 at Tularosa River, New Mexico.

Negrito Creek September 27, 2022

Station		Lower Boundary	Upper Boundary
NC06	12S NAD83	711097E, 3728390N	711274E, 3728481N
NC11		710348E, 3728721N	710520E, 3728775N
NC12 (Fixed)		710237E, 3728592N	710340E, 3728729N

Negrito Creek (Catron County, NM) is tributary to San Francisco River located south of Tularosa Creek. Negrito Creek flows into Tularosa Creek 2 miles west of its confluence with San Francisco River. The focal species at Negrito Creek is Loach Minnow. Negrito Creek has not been previously surveyed under this monitoring program. Opportunistic surveys were conducted in Negrito Creek by NMDGF, FWS, and USFS in 2020 and 2021. One Loach Minnow was captured in 2020, but they were not detected in 2021. Other species observed include Desert Sucker, Sonora Sucker, Speckled Dace, and Longfin Dace (Johnson et al. 2022).

M&A personnel completed monitoring of Negrito Creek on September 27, 2022. Three stations (NC06, NC11, NC12) were surveyed by BPEF and seine where possible. The monitoring reach was accessed via FR 4042G and then by hiking down an unnamed drainage to the creek (Figure 110). Totals of 92 Speckled Dace, 46 Longfin Dace, 29 Desert Sucker, and 23 Sonora Sucker were captured across all stations. Loach Minnow were not detected.

Station NC12 was established as a fixed station. Specifically, the BPEF survey at station NC12 resulted in capture of Speckled Dace (n=20; 38.46%), Longfin Dace (n=11; 21.15%), Desert Sucker (n=19; 36.54%), and Sonora Sucker (n=2; 3.85%). The random stations were located further upstream from the fixed station. Efforts across both of the random stations resulted in capture of Speckled Dace (n=72; 52.17%), Longfin Dace (n=35; 25.36%), Sonora Sucker (n=21; 15.22%), and Desert Sucker (n=10; 7.25%). Catch and effort totals for three stations in Negrito Creek are summarized in Table 22.

Run, riffle, and pool mesohabitats were equally represented in all three stations. Stream discharge was measured at the upstream boundary of station NC12 and calculated to be 0.57 m^3/s (20.02 cfs). Water temperature, DO, pH, and conductivity measured at the station were 15.9 °C, 10.6 mg/L, 8.08, and 180µS, respectively. Photographs of the lower extent of the fixed station are provided below (Figures 111-114).

Table 22. Summary of catch at all stations at Negrito Creek, New Mexico, by BPEF, surveyed on September 27, 2022. Total effort was 2,724 seconds.

Stations	Statistic	AGCH	PACL	CAIN	RHOS	Totals
NC06 (785 sec)	Count	3	5	9	35	52
	% total catch	5.77%	9.62%	17.31%	67.31%	100%
	CPUE (ind/hr)	13.76	22.93	41.27	160.51	238.47
NC11 (965 sec)	Count	32	5	12	37	86
	% total catch	37.21%	5.81%	13.95%	43.02%	100%
	CPUE (ind/hr)	119.38	18.65	44.77	138.03	320.83
NC12* (974 sec)	Count	11	19	2	20	52
	% total catch	21.15%	36.54%	3.85%	38.46%	100%
	CPUE (ind/hr)	40.66	70.23	7.39	73.92	192.20
Total	Count	46	29	23	92	190
	% total catch	24.21%	15.26%	12.11%	48.42%	100%
	CPUE (ind/hr)	60.79	38.33	30.40	121.59	251.10

*Denotes fixed station

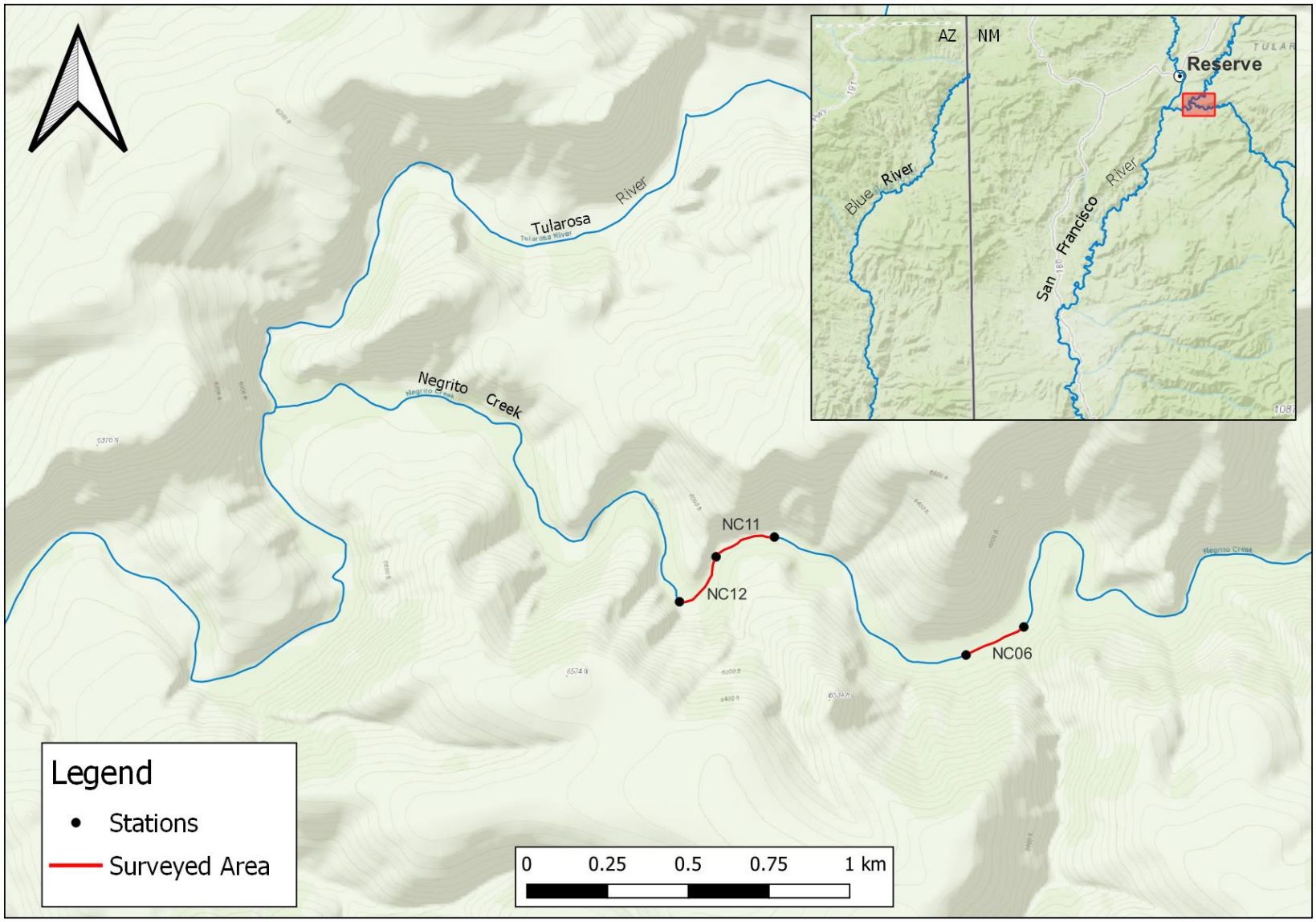

Figure 110. Location of sampling stations at Negrito Creek, New Mexico, surveyed September 27, 2022.

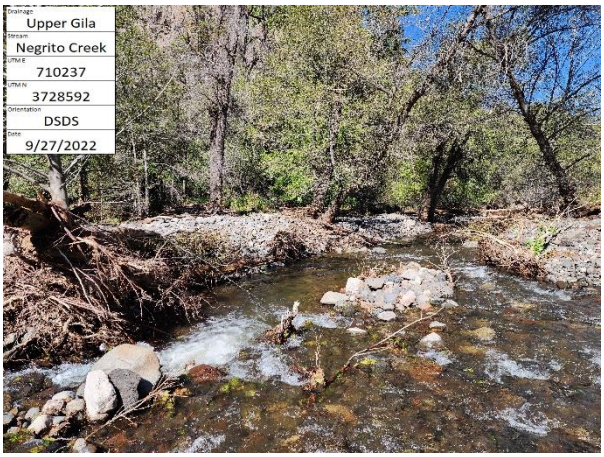

Figure 111. Downstream to downstream view of fixed station NC12 at Negrito Creek, New Mexico.

Figure 112. Downstream to upstream view of fixed station NC12 at Negrito Creek, New Mexico.

Figure 113. Upstream to downstream view of fixed station NC12 at Negrito Creek, New Mexico.

Figure 114. Upstream to upstream view of fixed station NC12 at Negrito Creek, New Mexico.

Lower Blue River October 4-6, 2022

Reach	Station		Lower Boundary	Upper Boundary
1	BL15 (Fixed)	12S NAD83	668134E, 3678444N	668164E, 3678277N
1	BL19		668500E, 3678279N	668572E, 3678456N
1	BL23		668227E, 3678876N	668206E, 3679104N
2	BL27		668510E, 3679449N	668639E, 3679587N
2	BL32		668646E, 3680244N	668556E, 3680418N
3	BL46		667778E, 3682098N	667916E, 3682238N
3	BL47		667916E, 3682238N	668030E, 3682392N
4	BL59		667830E, 3684175N	667937E, 3684335N
4	BL61		667982E, 3684538N	668001E, 3684691N
4	BL64 (Fixed)		667965E, 3685064N	668101E, 3685220N
5	BL68		668327E, 3685744N	668189E, 3685872N
5	BL71		668267E, 3686217N	668476E, 3686242N
6	BL76		668384E, 3686602N	668384E, 3686814N
6	BL88		668618E, 3688182N	668509E, 3688342N
6	BL90 (Fixed)		668614E, 3688487N	668628E, 3688702N

Blue River (Greenlee County, AZ) is a major tributary to San Francisco River and is located in Apache-Sitgreaves National Forest. Following the 2011 Wallow Fire, Spikedace, Loach Minnow, and Roundtail Chub were stocked into lower Blue River and were considered established as self-sustaining populations (Robinson et al. 2017). A fish barrier located 0.8 km upstream from San Francisco River confluence was constructed in 2012 to prevent movement of non-native fishes upstream. Non-natives including Channel Catfish, Red Shiner, Green Sunfish, and Fathead Minnow have not been detected above the barrier since 2013, 2015, 2016, and 2017 respectively (Hickerson et al. 2021). Lower Blue River monitoring efforts have been conducted annually since 2012. Spikedace and Loach Minnow are the focal species for this survey. The survey of lower Blue River conducted in 2021 did not yield Spikedace or Loach minnow (Shollenberger et al. 2022).

M&A and Reclamation personnel completed monitoring of lower Blue River on October 4-6, 2022. Sampling was completed by backpack electrofishing. The monitoring reach for this program is located from the barrier to Fritz Ranch (Figure 116). Stations BL88 and BL90 were accessed from XXX Ranch Road and remaining stations were accessed by hiking from Juan Miller Road crossing.

Fifteen, 200-m stations (12 random, 3 fixed) were surveyed by BPEF in reaches one through six (Barrier to Fritz Ranch). Totals of 207 Longfin Dace, 218 Desert Sucker, 38 Sonora Sucker, 24 Speckled Dace, and 4 Spikedace were captured across all stations. Combined catch and effort totals by reach are summarized in Table 23. Loach Minnow were not detected for the second year in a row.

Overall catch was higher this year compared to just 33 fishes captured in 2021, however it appears that Loach Minnow, Roundtail Chub, and Spikedace did not rebound as well as other native species. All Spikedace captured were adult (>40mm) and most likely originated from the augmentation stocking by AZGFD in March 2022. Two chub were captured during the 2021 monitoring, so it is possible that they are still present in this reach in low numbers.

Flow and visibility were highly variable this year. Conditions were slightly turbid on October 4, but significantly improved by October 5. However, runoff from an overnight storm led to higher flows and turbid water again on October 6. The changing conditions did not appear to influence electrofishing effectiveness as catch per unit effort was consistent across stations. Effects from post-fire floods in 2021 still were present including high embeddedness and fine sediment being the dominant substrate type in pools and runs.

CPUE trends for each focal species across a 10-year period are included in Figure 115. Data from 2012-2019 were collected by AZGFD and provided by Reclamation. Average stream discharge across the three fixed stations was calculated to be 0.67 m^3/s (23 cfs). Average water temperature, DO, pH, and conductivity across the three fixed stations were 18.9 °C, 8.2 mg/L, 8.38, and 628 µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 117-126).

Table 23. Summary of catch by BPEF for the 15 stations sampled on the lower Blue River, Arizona, on October 4-6, 2022. Total effort was 14,003 seconds.

Reach	Stations	Statistic	AGCH	CAIN	MEFU	PACL	RHOS	Totals
1 (3,110 sec)	BL15* BL19 BL23	Count	4	3	0	32	0	39
		% total catch	10.26%	7.69%	0.00%	82.05%	0.00%	100%
		CPUE (ind/hr)	4.63	3.47	0.00	37.04	0.00	45.14
2 (2,380 sec)	BL27 BL32	Count	2	0	1	26	0	29
		% total catch	6.90%	0.00%	3.45%	89.66%	0.00%	100%
		CPUE (ind/hr)	3.03	0.00	1.51	39.33	0.00	43.87
3 (1,561 sec)	BL46 BL47	Count	20	1	0	38	2	61
		% total catch	32.79%	1.64%	0.00%	62.30%	3.28%	100%
		CPUE (ind/hr)	46.12	2.31	0.00	87.64	4.61	140.68
4 (1,206 sec)	BL59 BL61	Count	14	18	0	24	1	57
		% total catch	24.56%	31.58%	0.00%	42.11%	1.75%	100%
		CPUE (ind/hr)	41.79	53.73	0.00	71.64	2.99	170.15
5 (2,947 sec)	BL64* BL68 BL71	Count	66	9	3	31	3	112
		% total catch	58.93%	8.04%	2.68%	27.68%	2.68%	100%
		CPUE (ind/hr)	80.62	10.99	3.66	37.87	3.66	136.82
6 (2,799 sec)	BL76 BL88 BL90*	Count	101	7	0	67	18	193
		% total catch	52.33%	3.63%	0.00%	34.72%	9.33%	100%
		CPUE (ind/hr)	129.90	9.00	0.00	86.17	23.15	248.23
Total		Count	207	38	4	218	24	491
		% total catch	42.16%	7.74%	0.81%	44.40%	4.89%	100%
		CPUE (ind/hr)	53.22	9.77	1.03	56.05	6.17	126.23

*Denotes fixed station

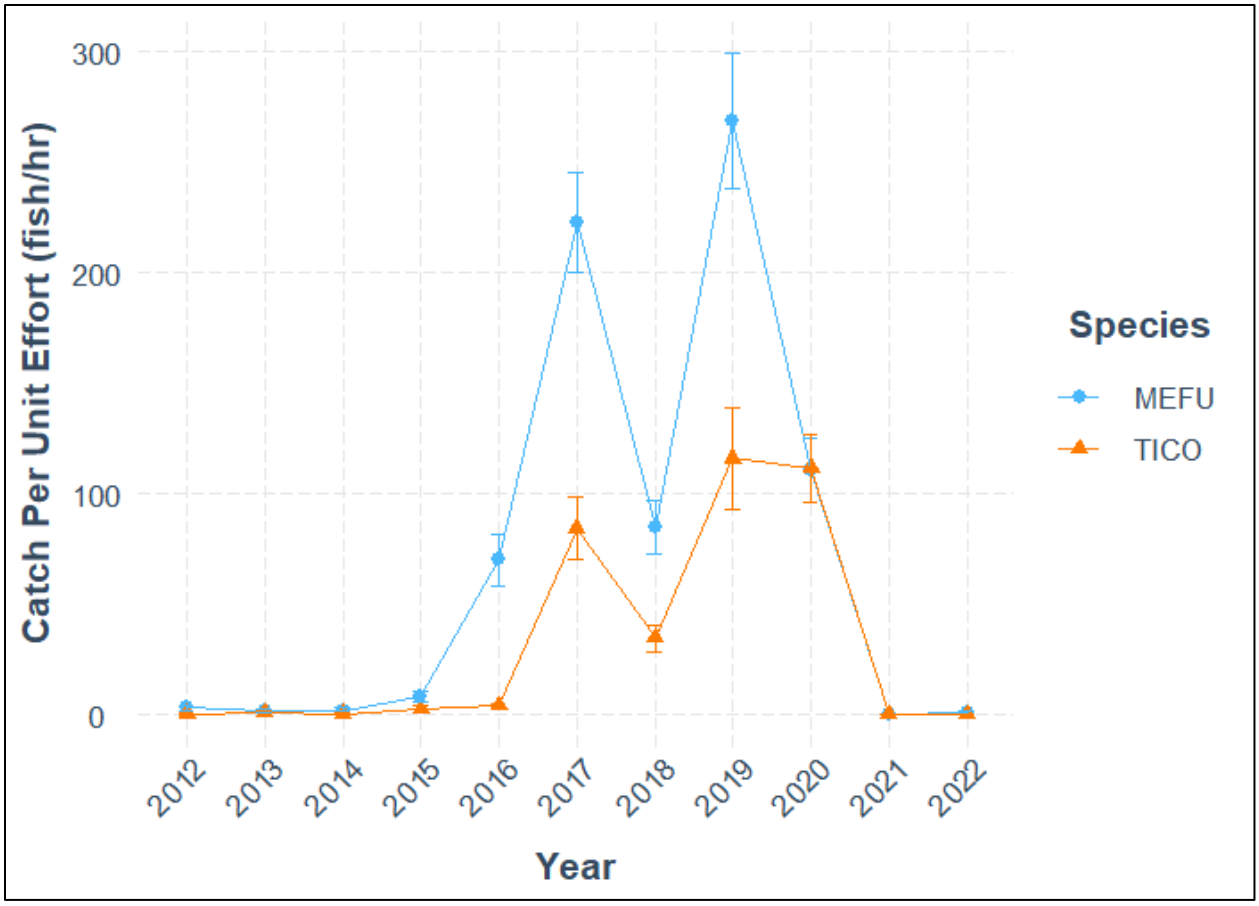

Figure 115. Mean CPUE for all focal species from annual monitoring since 2012 at lower Blue River.

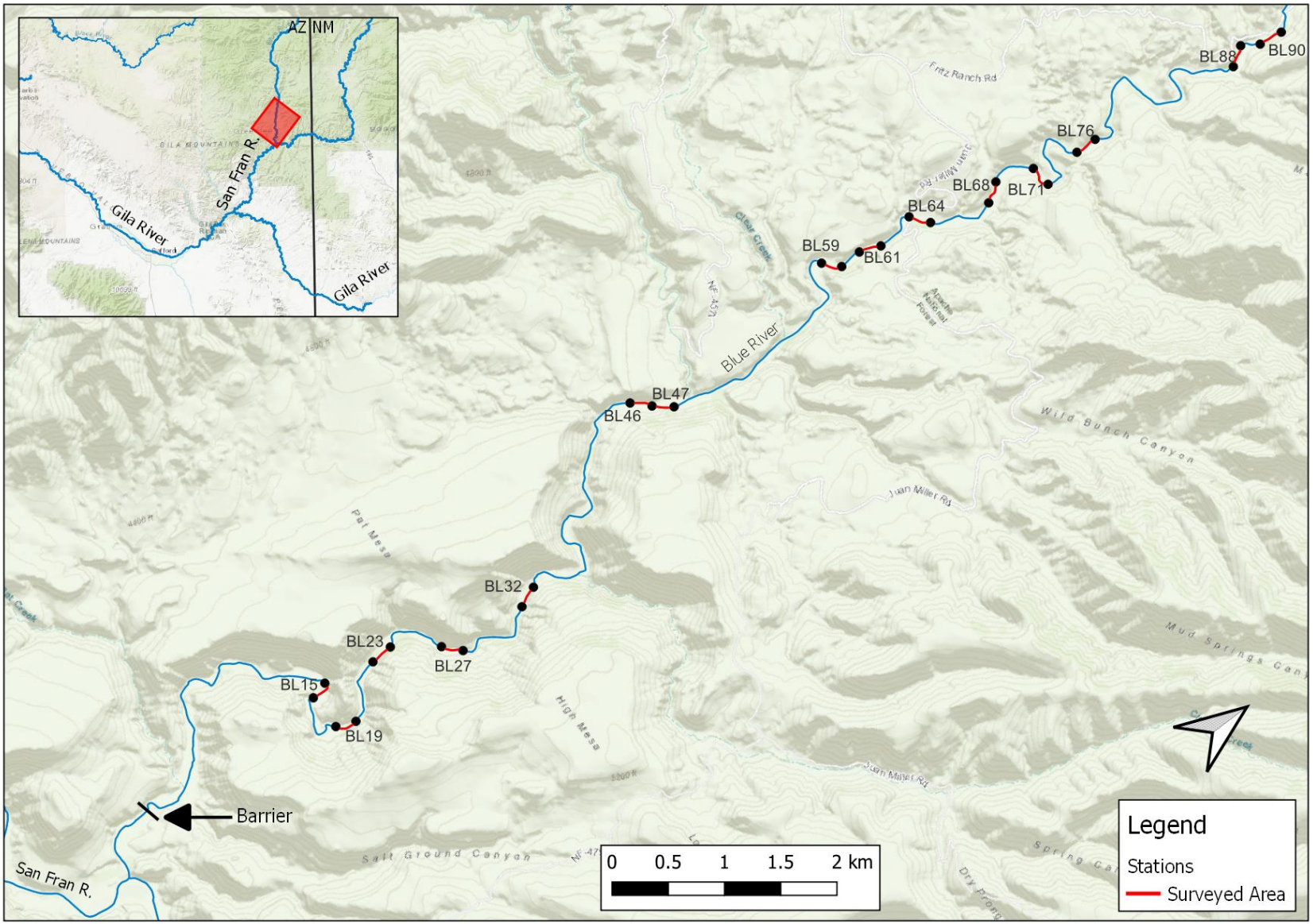

Figure 116. Location of sampling stations at lower Blue River, Arizona, surveyed on October 4-6, 2022.

Figure 117. Downstream to downstream view of fixed station BL15 at lower Blue River, Arizona.

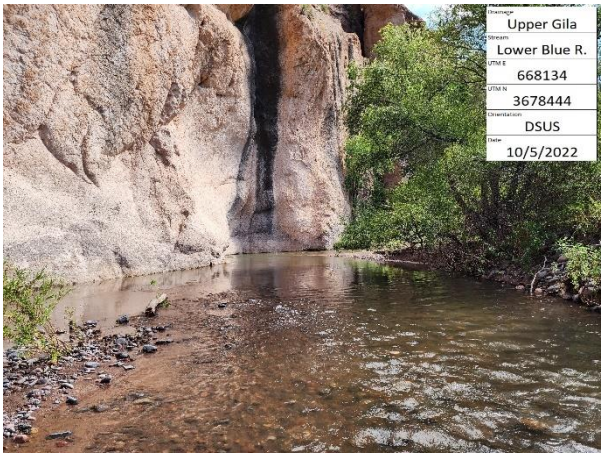

Figure 118. Downstream to upstream view of fixed station BL15 at lower Blue River, Arizona.

Figure 119. Upstream to downstream view of fixed station BL15 at lower Blue River, Arizona.

Figure 120. Upstream to upstream view of fixed station BL15 at lower Blue River, Arizona.

Figure 121. Downstream to downstream view of fixed station BL64 at lower Blue River, Arizona.

Figure 122. Downstream to upstream view of fixed station BL64 at lower Blue River, Arizona.

Figure 123. Downstream to downstream view of fixed station BL90 at lower Blue Rive, Arizona r.

Figure 124. Downstream to upstream view of fixed station BL90 at lower Blue River, Arizona.

Figure 125. Upstream to downstream view of fixed station BL90 at lower Blue River, Arizona.

Figure 126. Upstream to upstream view of fixed station BL90 at lower Blue River, Arizona.

Verde River Basin

Lime Creek July 20, 2022

Station		Lower Boundary	Upper Boundary
LC01 (Fixed)	12S NAD83	427235E, 3763335N	427189E, 3763423N
LC16		427911E, 3762097N	427848E, 3762205N
LC29		428846E, 3761636N	428808E, 3761719N

Lime Creek (Maricopa County, AZ) is located in Verde River drainage and flows into Horseshoe Reservoir. The majority of Lime Creek is ephemeral, but a short perennial stretch exists beginning at Lime Cabin Spring. Gila Topminnow is the focal species at Lime Creek. Monkey Spring lineage Gila Topminnow were stocked into Lime Creek in 1982. This population established and persisted until impacts from the 2004 Humboldt Fire and 2005 Cave Creek Complex Fire led to local extirpation of topminnow from Lime Creek. Sharp Spring lineage Gila Topminnow then were stocked into Lime Creek in 2011 to reestablish a population at this site (AZGFD 2018). A fish barrier was constructed in lower Lime Creek in 2010 to prevent invasion of non-native fishes from Horseshoe Reservoir. Lime Creek has not been previously surveyed for GRBMP.

M&A personnel completed the sampling of Lime Creek on July 20, 2022. Three (1 fixed, 2 random), 100-m stations were examined. The monitoring reach (fish barrier to stove pipe) was accessed from downstream via FR 1530 off Horseshoe Dam Road (Figure 127).

Almost the entirety of the 3.2-km monitoring reach was dry aside from a 13-m long and 3-m wide shallow pool located at the stove pipe within the fixed station (Figure 130). Sampling was conducted with minnow traps at fixed station LC01. Five traps were set within the lone pool for 2 hours. Gila Topminnow (n=131; 19.37%) and Longfin Dace (n=545; 80.62%) were captured. Lowland Leopard Frogs were also observed. Catch and effort totals for fixed station LC01 are summarized in Table 24. Both randomly selected (LC16 & LC29) stations were 100% dry and sampling could not be conducted.

Stream discharge measurements were not taken as there was no flowing water. Water quality parameters were not recorded. Photographs of upper and lower extents of the fixed station are provided below (Figures 128-131).

Table 24. Summary of catch at fixed station LC01 at Lime Creek, Arizona, by minnow trap, surveyed on July 20, 2022. Total effort was 10.35 hours.

Station	Statistic	POOC (<20)	POOC (>=20)	AGCH (<40)	AGCH (>=40)	Total
LC01* (10.35 hrs)	Count	17	114	146	399	676
	% total catch	2.51%	16.86%	21.60%	59.02%	100%
	CPUE (ind/net hr)	1.64	11.01	14.11	38.55	65.31

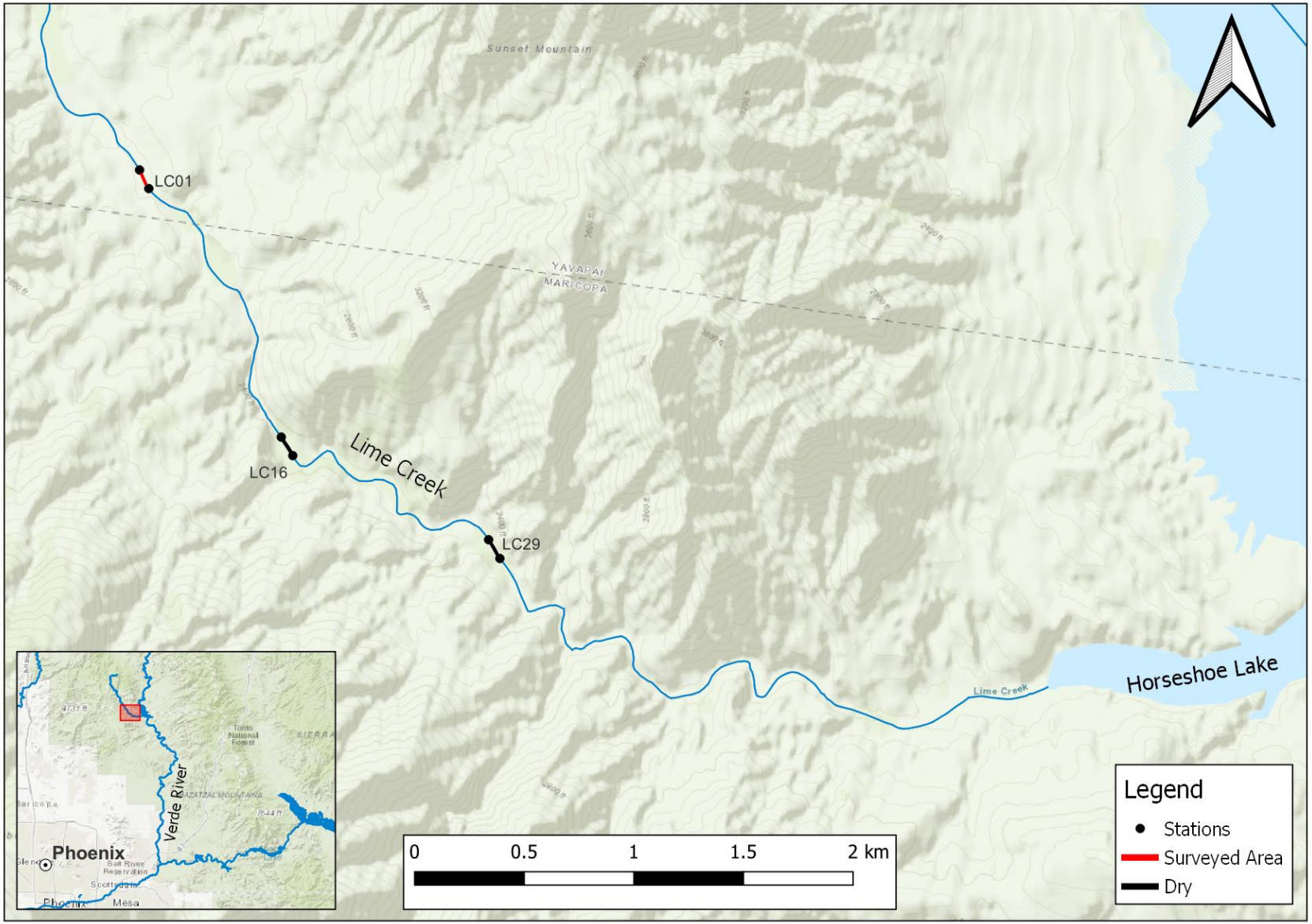

Figure 127. Location of sampling stations at Lime Creek, Arizona, surveyed on July 20, 2022.

Figure 128. Downstream to downstream view of fixed station LC01 at Lime Creek, Arizona.

Figure 129. Downstream to upstream view of fixed station LC01 at Lime Creek, Arizona.

Figure 130. Upstream to upstream view of fixed station LC01 at Lime Creek, Arizona.

Figure 131. Upstream to downstream view of fixed station LC01 at Lime Creek, Arizona.

Figure 132. Photo of the only surface water present within fixed station LC01, Arizona.

Spring Creek August 31 – September 1, 2022

Station		Lower Boundary	Upper Boundary
SP01 (Fixed)	12S NAD83	416122E, 3847251N	416170E, 3847353N
SP10		416351E, 3845806N	416283E, 3845881N
SP14		416628E, 3845824N	416541E, 3845908N

Spring Creek (Yavapai County, AZ) is located in Verde River drainage and is tributary to Oak Creek near Cornville, AZ (Figure 133). Gila Topminnow, Gila Chub, and Spikedace are the focal species at Spring Creek. For 2022, only Gila Topminnow were targeted as AZGFD is currently conducting post-stocking monitoring for Spikedace via BPEF. A fish barrier was constructed in 2015 to prevent the invasion of non-native fishes including Green Sunfish from Oak Creek. Gila Topminnow (Lower Santa Cruz - Peck Canyon lineage) were stocked into Spring Creek in 2015 and 2016 and a small population appeared to establish in the pool above the fish barrier (Robinson et al. 2017). Spring Creek was last monitored for this program in 2014, specifically targeting Gila Chub.

M&A personnel completed sampling of Spring Creek on August 31 & September 1, 2022. Three, 100-m (2 fixed, 1 random) stations were surveyed. Gila Topminnow were not detected at any of the three stations. Totals of 487 Gila Chub, 122 Longfin Dace, 94 Speckled Dace, 2 Spikedace, and 62 Northern Crayfish were captured across all stations.

The upper fixed station (SP01) was located at Willow Point road crossing. Mesohabitat at this station consisted primarily of shallow riffles and runs. Ten minnow traps were set for approximately 2 hours. Species captured include Longfin Dace (n=121; 47.83%), Speckled Dace (n=66; 26.09), Gila Chub (n=63; 24.90%), Spikedace (n=2; 0.79%), and Northern Crayfish (n=1; 0.40%).

The lower fixed station (SP14) was located at the fish barrier. A visual assessment of this station prior to setting traps did not identify any Gila Topminnow. Ten minnow traps were set for approximately 3.5 hours at this station with efforts primarily focused around the barrier pool. Species captured included Gila Chub (n=305; 89.44%), Speckled Dace (n=13; 3.81%), and Northern Crayfish (n=23; 6.74%).

The randomly selected station (SP10) was located 400-m upstream from the barrier. Ten minnow traps were set for approximately 2.5 hours and resulted in capture of Gila Chub (n=108; 68.95%), Speckled Dace (n=5; 3.07%), Longfin Dace (n=1; 0.61%), and Northern Crayfish (n=23; 23.31%). Catch and effort totals for three stations in Spring Creek are summarized in Table 25.

Active monsoon seasons in both 2021 and 2022 may have impacted Gila Topminnow at this site, especially if the population was restricted to a single pool immediately above the fish barrier. Post-stocking monitoring for Spikedace in 2021 noted declines across all fish species in Spring Creek after monsoon flooding (Hickerson et al. 2022). There was evidence of a recent large flood event and visibility was poor due to slightly turbid conditions. Although not a focal species for 2022, Gila Chub appeared to have excellent recruitment in recent years with nearly 500 individuals ≤100mm captured. The low number of adult Gila Chub captured was due to gear bias, as minnow trap openings restrict most large-bodied fish.

Stream discharge measured at both fixed stations was averaged to be 0.09 m^3/s (3.14 cfs). Average water temperature, DO, pH, and conductivity across both stations were recorded at 23.4 °C, 7.2 mg/L, 8.15, and

606 µS, respectively. Photographs of upper and lower extents of the fixed station are provided below (Figures 134-141).

Table 25. Summary of catch at three stations within Spring Creek, Arizona, by minnow trap, surveyed on August 31 - September 1, 2022. Total effort was 83.46 hours.

Station	Statistic	GIIN (<= 50)	GIIN (50 - 100)	GIIN (>100)	RHOS	AGCH	MEFU	ORVI	Total
SP01* (21.12 hrs)	Count	34	25	4	66	121	2	1	253
	% total catch	13.44%	9.88%	1.58%	26.09%	47.83%	0.79%	0.40%	100%
	CPUE (ind/net hr)	1.61	1.18	0.19	3.13	5.73	0.09	0.05	11.98
SP10 (27.41 hrs)	Count	63	55	1	5	1	0	38	163
	% total catch	38.65%	33.74%	0.61%	3.07%	0.61%	0.00%	23.31%	100%
	CPUE (ind/net hr)	2.30	2.01	0.04	0.18	0.04	0.00	1.39	5.95
SP14* (34.93 hrs)	Count	118	187	0	13	0	0	23	341
	% total catch	34.60%	54.84%	0.00%	3.81%	0.00%	0.00%	6.74%	100%
	CPUE (ind/net hr)	3.38	5.35	0.00	0.37	0.00	0.00	0.66	9.76
Total	Count	215	267	5	84	122	2	62	695
	% total catch	30.94%	38.42%	0.72%	12.09%	17.55%	0.29%	8.92%	100%
	CPUE (ind/net hr)	2.58	3.20	0.06	1.01	1.46	0.02	0.74	8.33

*Denotes fixed station

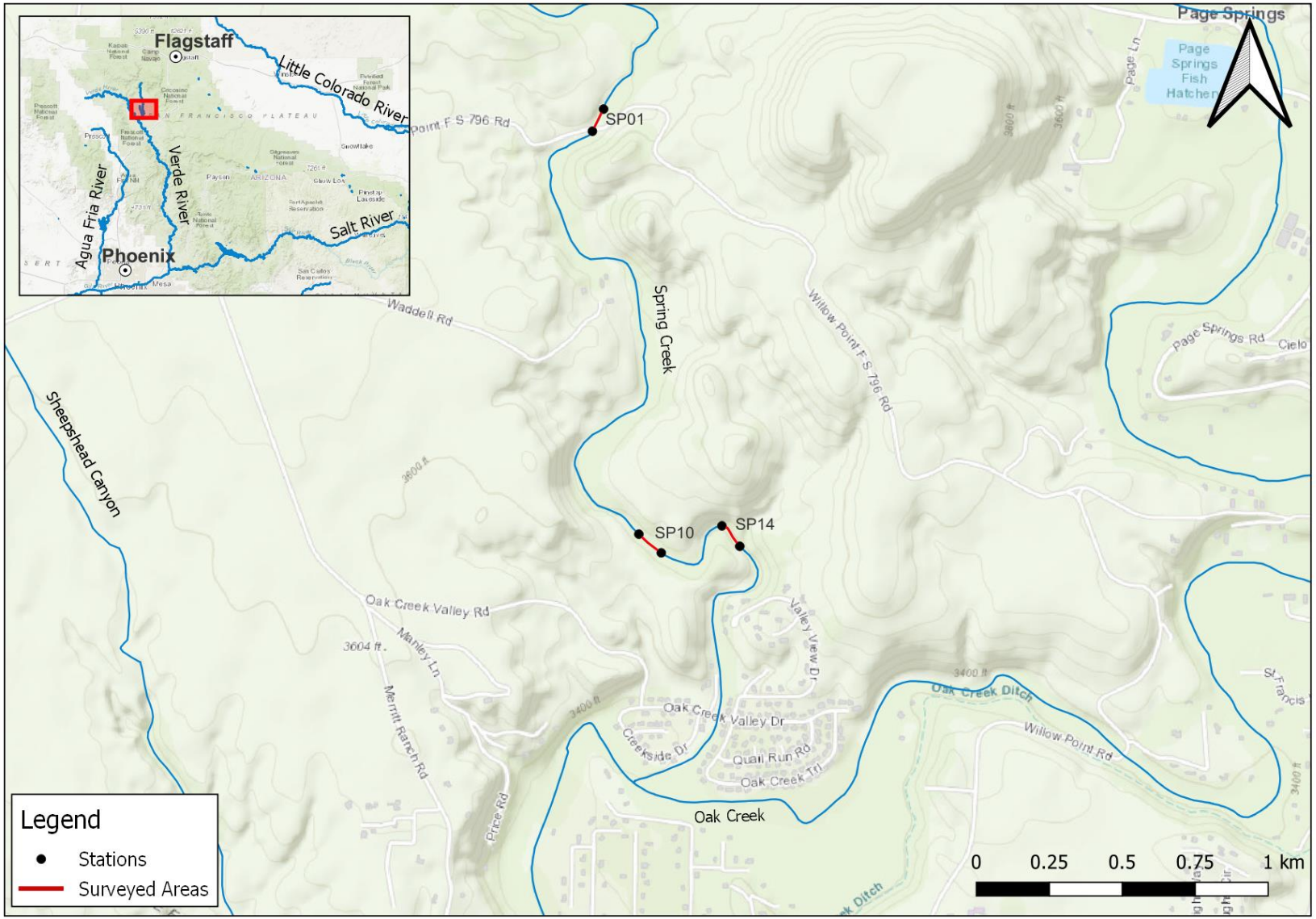

Figure 133. Location of sampling stations at Spring Creek, Arizona, surveyed on August 31 – September 1, 2022.

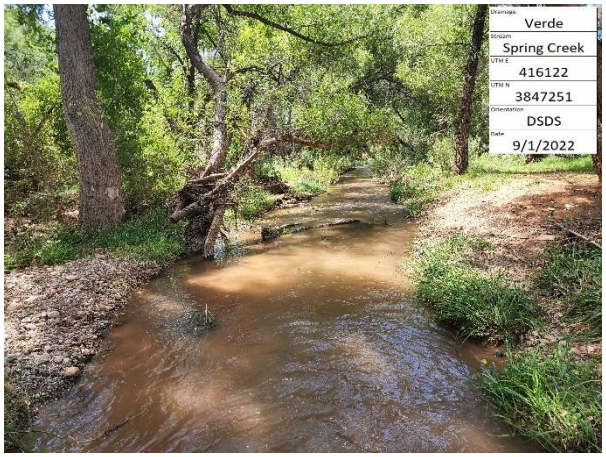

Figure 134. Downstream to downstream view of fixed station SP01 at Spring Creek, Arizona.

Figure 135. Downstream to upstream view of fixed station SP01 at Spring Creek, Arizona.

Figure 136. Upstream to downstream view of fixed station SP01 at Spring Creek, Arizona.

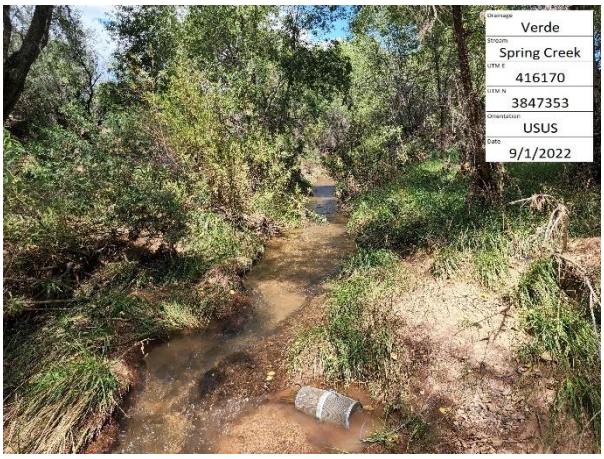

Figure 137. Upstream to upstream view of fixed station SP01 at Spring Creek, Arizona.

Figure 138. Downstream to downstream view of fixed station SP14 at Spring Creek, Arizona.

Figure 139. Downstream to upstream view of fixed station SP14 at Spring Creek, Arizona.

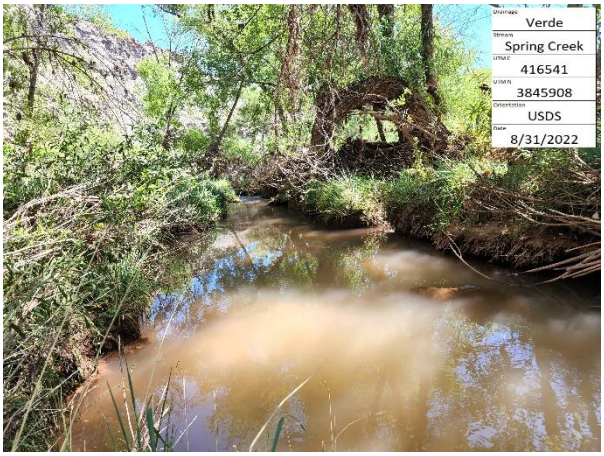

Figure 140. Upstream to downstream view of fixed station SP14 at Spring Creek, Arizona.

Figure 141. Upstream to upstream view of fixed station SP14 at Spring Creek, Arizona.

Sheepshead Canyon September 1, 2022

Station		Lower Boundary	Upper Boundary
SH01 (Fixed)	12S NAD83	414615E, 3845237N	414601E, 3845320N
SH06 (Fixed)		414834E, 3844812N	414774E, 3844901N

Sheepshead Canyon (Yavapai County, AZ) is tributary to Oak Creek near Cornville, AZ. A 600-m reach consisting of wetland and perennial pools is present approximately 1.5 km upstream from the confluence with Oak Creek (Figure 142). Gila Topminnow is the focal species at this site. Sheepshead Canyon was stocked with Gila Topminnow (Lower Santa Cruz- Peck Canyon lineage) in 2014 through 2016 Robinson et al. 2017). Sheepshead Canyon has not been previously surveyed for this monitoring program.

M&A personnel completed the sampling of Sheepshead Canyon on September 1, 2022. Two, 100-m fixed stations were surveyed via minnow traps. The monitoring reach was accessed via an unnamed dirt road off Oak Creek Valley Road. A total of 359 Gila Topminnow was detected at both stations. No other species were captured.

The upper station (SH01) is located below a dry waterfall. An 18-m x 20-m pool was present at the base of the waterfall, followed downstream by 80-m of shallow run mesohabitat. Ten minnow traps were set in this station primarily around the large pool, in which hundreds of Gila Topminnow were observed. Traps were set for approximately 3 hours and captured Gila Topminnow (n=176; 100%). Two Sonora Mud Turtles were observed.

The lower fixed station (SH06) is located 500-m downstream from SH01 and begins at a diversion dam. The only available mesohabitat at this station was two pools immediately above and below the diversion. Ten traps were set throughout these pools for 2 hours and captured Gila Topminnow (n=214; 100%). Catch and effort totals for both stations in Sheepshead Canyon are summarized in Table 26.

Sampleable habitat in-between these two fixed stations was limited and it is not advisable to travel in the canyon between the upper and lower stations due to dense vegetation and flood debris. Average water temperature, DO, pH, and conductivity across both stations were recorded at 23.7 °C, 6.5 mg/L, 7.62, and 736 µS, respectively. Photographs of upper and lower extents of the fixed station are provided below (Figures 143-150).

Table 26. Summary of catch at two stations within Sheepshead Canyon, Arizona, by minnow trap, surveyed on September 1, 2022. Total effort was 50.57 hours.

Stations	Statistic	POOC (< 20)	POOC (>= 20)	Totals
SH01* (30.65 hrs)	Count	97	79	176
	% total catch	55.11%	44.89%	100%
	CPUE (ind/net hr)	3.16	2.58	5.74
SH06* (19.92 hrs)	Count	48	135	183
	% total catch	26.23%	73.77%	100%
	CPUE (ind/net hr)	2.41	6.78	9.19
Total	Count	145	214	359
	% total catch	40.39%	59.61%	100%
	CPUE (ind/net hr)	2.87	4.23	7.10

*Denotes fixed station

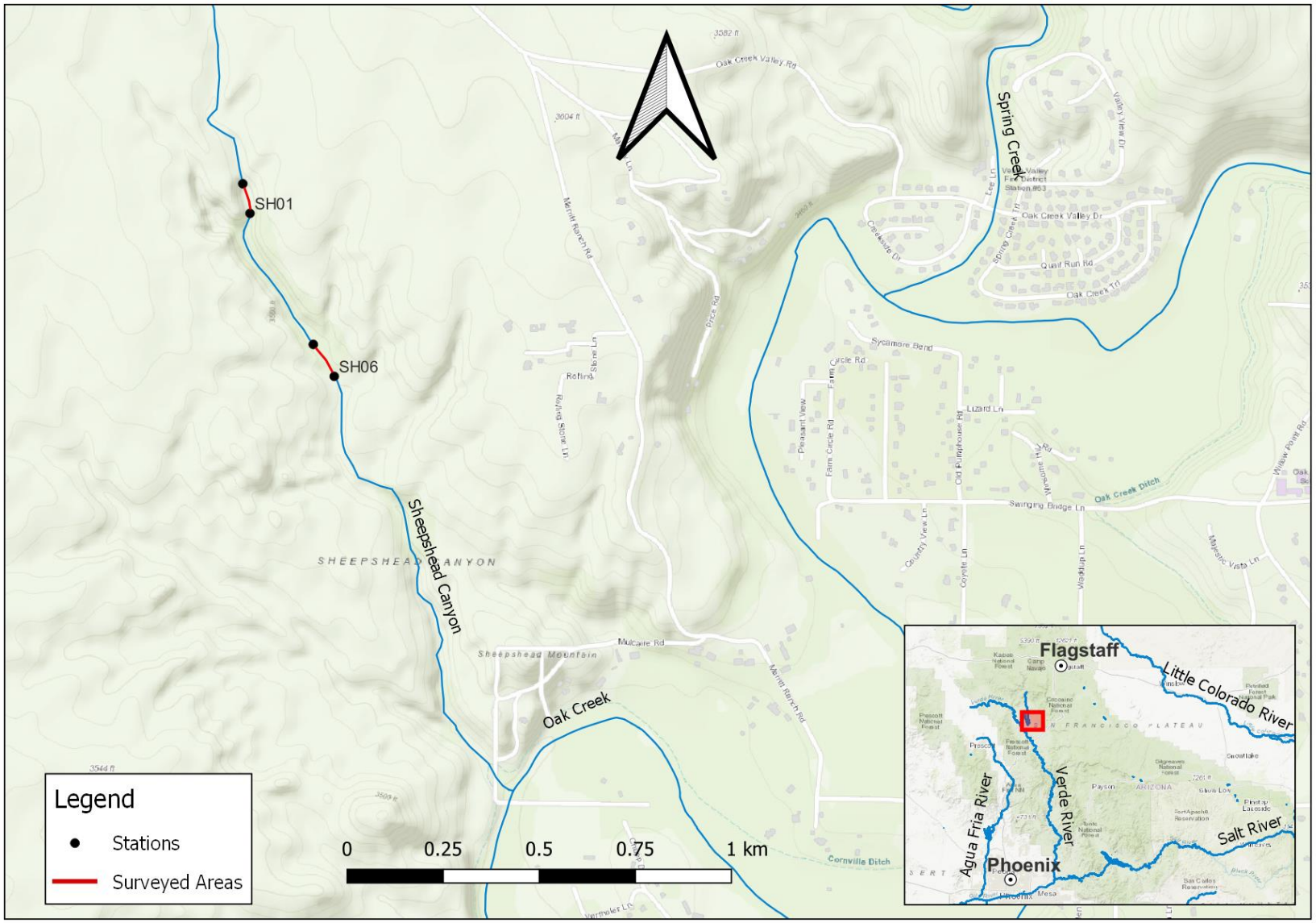

Figure 142. Location of sampling stations at Sheepshead Canyon, Arizona, surveyed on September 1, 2022.

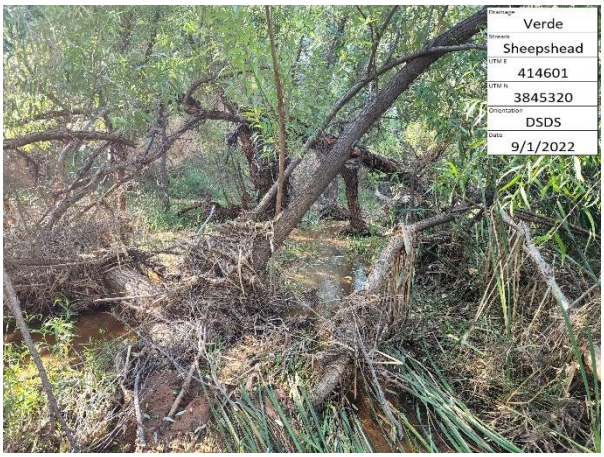

Figure 143. Downstream to downstream view of fixed station SH01 at Sheepshead Canyon, Arizona.

Figure 144. Downstream to upstream view of fixed station SH01 at Sheepshead Canyon, Arizona.

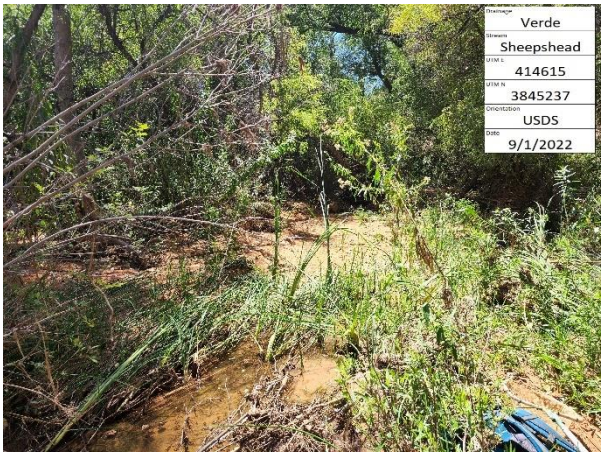

Figure 145. Upstream to downstream view of fixed station SH01 at Sheepshead Canyon, Arizona.

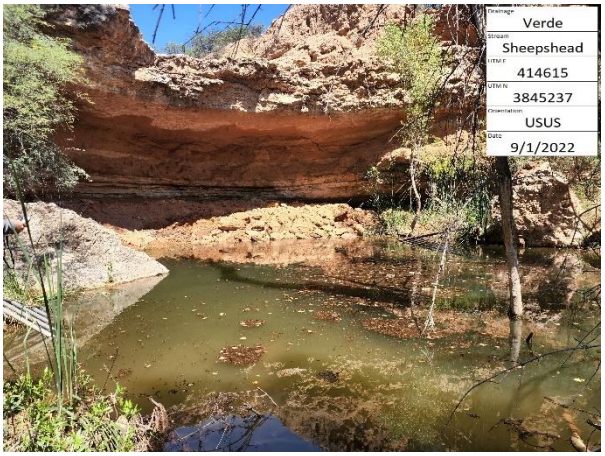

Figure 146. Upstream to upstream view of fixed station SH01 at Sheepshead Canyon, Arizona.

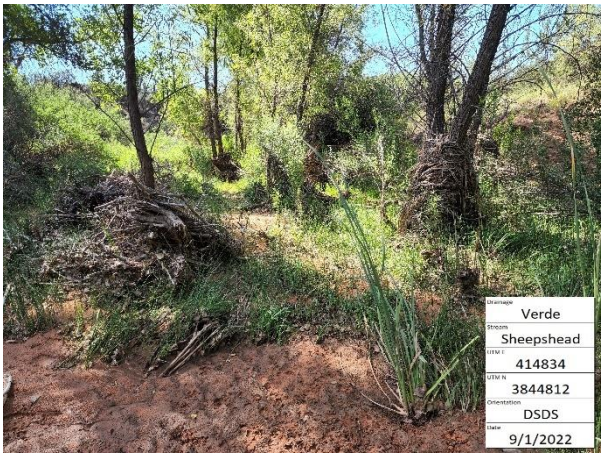

Figure 147. Downstream to downstream view of fixed station SH06 at Sheepshead Canyon, Arizona.

Figure 148. Downstream to upstream view of fixed station SH06 at Sheepshead Canyon, Arizona.

Figure 149. Upstream to downstream view of fixed station SH06 at Sheepshead Canyon, Arizona.

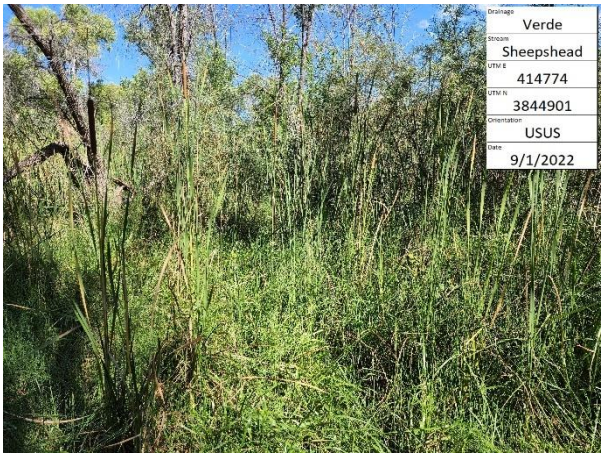

Figure 150. Upstream to upstream view of fixed station SH06 at Sheepshead Canyon, Arizona.

Acknowledgements

The following individuals are acknowledged for their assistance in varying capacities: Joshua Heishman, Alex Marini, Garrett Percy, Taylor Saucier, and Ben Wiley (M&A); Kent Mosher (Reclamation); Ron Day, Joe Koch, Marty Lawrence, Peter Leiterman, and Jessie Pearl (TNC); Ian Murray, Mead Mier, Amanda Webb, and Sami Hammer (Pima County); Amanda Gehrt, Jerry Monzingo, Dustin Myers, and Zac Ribbing (USFS); Nate Berg, Brian Hickerson, Chrissy Kondrat-Smith, Jim Ruff, John Windes (AZGFD); Colt Alford, Dawn Collins, and Athena Sparks (Arizona State Parks); and Doug Duncan (FWS Retired). Collections were authorized under permits issued by FWS and the states of Arizona and New Mexico. Care and use of fish in this study was approved by the Institutional Animal Care and Use Committee, protocol numbers 18-1640R and 21-1827R. Cover photo of upper Tularosa River, Catron Co., New Mexico, by Kurt Shollenberger.

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