

# Gila River Basin Native Fish Monitoring

## 2023 Annual Report



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Submitted to

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In behalf of Reclamation Contract No. 140R3022F0030

April 2024

## Table of Contents

Table of Contents.....	1
<b>Methods.....</b>	<b>10</b>
<b>Results.....</b>	<b>12</b>
Trip Summaries.....	16
Agua Fria Basin .....	16
Sycamore Creek .....	16
Little Sycamore Creek .....	21
Salt River Basin .....	26
Charlebois Spring .....	26
La Barge Creek .....	29
Hidden Water Spring .....	34
Tortilla Creek & Mesquite Creek .....	39
San Pedro River Basin .....	43
Hot Springs Canyon .....	43
Headquarters Spring .....	51
Wildcat Canyon .....	54
Santa Cruz River Basin.....	57
Coal Mine Canyon .....	57
Fresno Canyon .....	62
Cottonwood Spring .....	67
Monkey Spring .....	71
Sheehy Spring .....	75
Cienega Creek .....	80
Upper Gila River Basin.....	83
KP Creek .....	83
Grant Creek .....	87
Campbell Blue Creek .....	91
Dry Blue Creek .....	95
Burro Cienega .....	98
Lower Blue River .....	101
Verde River Basin.....	108
Fossil Creek .....	108

Walker Canyon	.....	114
Spring Creek	.....	118
Acknowledgements.....		123
Literature Cited .....		124

## List of Tables

Table 1. List of species encountered during surveys throughout the Gila River Basin in 2023. ....	11
Table 2. Catch summary of focal species per habitat type and size class for native fishes in Gila River basin streams, Arizona and New Mexico. Numbers bolded and italicized indicate max values for each size class. .....	13
Table 3. Summary of fish species captured by stream, Gila River basin, Arizona, 2023. Focal species for each stream are highlighted in yellow. Streams listed in alphabetic order; species codes are in Table 1. Fossil Creek numbers were based on visual observations and thus not included in overall catch data.....	15
Table 4. Summary of catch at two fixed stations at Sycamore Creek, Yavapai Co, Arizona, by BPEF. Total effort was 640 seconds. ....	17
Table 5. Summary of catch at three fixed stations at Little Sycamore Creek, Arizona, by backpack electrofishing. Total effort was 459 seconds. ....	22
Table 6. Summary of catch at two fixed stations at Charlebois Spring, Arizona, by minnow trap. Total effort was 45.5 hours.....	26
Table 7. Summary of catch at three fixed stations at La Barge Creek, Arizona, by minnow trap. Total effort was 84.9 hours.....	30
Table 8. Summary of opportunistic dip net sweeps in habitat unsuitable for traps in La Barge Creek, AZ. Total Gila Topminnow caught was 39.....	30
Table 9. Catch summary table of fish captured at Hidden Water Spring, Arizona, by minnow trap. Total effort was 69.0 trap hours. ....	35
Table 10. Summary of catch by minnow trap at five stations at Upper and Lower Tortilla Creek, Arizona, surveyed on May 9 & 10, 2023. Total effort was 115.54 hours. ....	40
Table 11. Summary of catch by minnow trap in one station at Mesquite Creek, Arizona, surveyed on May 9, 2023. Total effort was 16.6 hours.....	40
Table 12. Summary of catch by BPEF for nine stations sampled at Hot Springs Canyon, Arizona, on September 12-14, 2023. Total effort was 11,198 seconds. ....	44
Table 13. Summary of catch by minnow trap at Headquarters Spring, Arizona, surveyed September 11, 2023. Total effort was 92.5 trap hours. ....	52
Table 14. Summary of catch by minnow trap at Wildcat Canyon, Arizona, Surveyed September 13, 2023. Total effort was 64.2 trap hours.....	54
Table 15. Summary of catch by minnow trap for two stations sampled at Coal Mine Canyon, Arizona, April 3, 2023. Total effort was 41.6 hours.....	58
Table 16. Summary of catch by dip net sweeps at Coal Mine Canyon, Arizona, April 3, 2023. Total effort was eight dip net sweeps or 2.82 m <sup>2</sup> . ....	58
Table 17. Summary of catch by minnow trap at Fresno Canyon, Arizona, surveyed April 4, 2023. ....	63

Table 18. Summary of catch by dip net sweeps at Cottonwood Spring, Arizona, surveyed April 5, 2023.	
Total effort was 25 dip net sweeps or 8.84m <sup>2</sup> .....	67
Table 19. Summary of catch by seine at Monkey Spring, Arizona, surveyed April 5, 2023. Total effort was 10 seine hauls or 36.58 m <sup>2</sup> .....	71
Table 20. Summary of catch by mini hoop net at Sheehy Springs, Arizona, surveyed April 16-17, 2023.	
.....	76
Table 21. Summary of catch by dip net sweep at Sheehy Springs, Arizona surveyed April 16, 2023.....	76
Table 22. Summary of catch by minnow trap at Cienega Creek, Arizona, surveyed September 7, 2023.	
Total effort was 29.33 trap hours.....	81
Table 23. Summary of catch by seine haul at Cienega Creek, Arizona, surveyed September 7, 2023.	
Total effort was 73.2 m <sup>2</sup> , or 20 seine hauls.....	81
Table 24. Summary of catch by BPEF at KP Creek, Arizona, surveyed June 7, 2023. Total effort was 2,602 seconds.....	84
Table 25. Summary of catch by BPEF at Grant Creek, Arizona, surveyed on June 8, 2023. Total effort was 4,286 seconds.....	88
Table 26. Summary of catch by BPEF at Campbell Blue Creek, Arizona, surveyed June 27-28, 2023.	
Total effort was 5,325 seconds.....	92
Table 27. Summary of Catch by BPEF at Dry Blue Creek, Arizona, surveyed June 28, 2023. Total effort was 1,857 seconds.....	96
Table 28. Catch summary table of fish captured at Lower Blue River, Arizona, by backpack electrofishing, surveyed on October 16-18, 2023. Total effort was 22,781 seconds.....	103
Table 29. Summary of fish observed by visual snorkel survey at Fossil Creek, Arizona, surveyed May 23-25, 2023. Total effort was 649 minutes.....	110
Table 30. Summary of catch of fish captured via backpack electrofishing at Walker Canyon, Arizona, surveyed August 7, 2023. Total effort was 3,623 seconds.....	115
Table 31. Summary of catch via minnow trap at Spring Creek, Arizona, surveyed October 10, 2023.	
Total effort was 135.5 trap hours.....	119

## List of Figures

Figure 1. Major drainages of the Gila River basin, Arizona and New Mexico, where stream surveys were conducted in 2023.....	10
Figure 2. Total distance of mesohabitat encountered during surveys since monitoring protocol was altered in 2021.....	14
Figure 3. Location of fixed sampling stations at Sycamore Creek, Arizona, surveyed on August 8, 2023.	
.....	18
Figure 4. Upstream to downstream view of SYC05-F, Sycamore Creek.	19
Figure 5. Downstream to upstream view of SYC05-F, Sycamore Creek.	19
Figure 6. Downstream to downstream view of SYC05-F, Sycamore Creek.	19
Figure 7. Upstream to upstream view of SYC05-F, Sycamore Creek.	19
Figure 8. Downstream to downstream view of SYC11-F, Sycamore Creek.	20
Figure 9. Downstream to upstream view of SYC11-F, Sycamore Creek.	20
Figure 10. Upstream to downstream view of SYC11-F, Sycamore Creek.	20
Figure 11. Upstream to upstream view of SYC11-F, Sycamore Creek.	20

Figure 12. Location of fixed sampling stations at Little Sycamore Creek, Arizona, surveyed on August 8th, 2023. ....	23
Figure 13. Downstream to Upstream view of LSC01-F, Upstream to upstream view of LSC02-F, Little Sycamore Creek. ....	24
Figure 14. Upstream to upstream view of LSC01-F, Little Sycamore Creek, Arizona. ....	24
Figure 15. Upstream to downstream view of LSC01-F, Little Sycamore Creek, Arizona. ....	24
Figure 16. Downstream to downstream view of LSC01-F, Upstream to downstream view of LSC02-F, Little Sycamore Creek, Arizona. ....	24
Figure 17. Downstream to downstream view of LSC02-F, upstream to downstream view of LSC03-F, Little Sycamore Creek, Arizona. ....	25
Figure 18. Downstream to upstream view of LSC02-F, upstream to upstream view of LSC03-F, Little Sycamore Creek, Arizona. ....	25
Figure 19. Downstream to downstream view of LSC03-F, Little Sycamore Creek, Arizona. ....	25
Figure 20. Downstream to upstream view of Little Sycamore Creek, Arizona. ....	25
Figure 21. Location of fixed sampling stations at Charlebois Spring, Arizona, surveyed on April 18, 2023 .....	27
Figure 22. Upstream to upstream view of CHB02-F, downstream to upstream view of CHB01-F, Charlebois Spring, Arizona. ....	28
Figure 23. Upstream to downstream view of CHB02-F, downstream to downstream view of CHB01-F, Charlebois Spring, Arizona. ....	28
Figure 24. Upstream to upstream view of CHB01-F, Charlebois Spring, Arizona. ....	28
Figure 25. Upstream to downstream view of CHB01-F, Charlebois Spring, Arizona. ....	28
Figure 26. Downstream to downstream view of CHB02-F, Charlebois Spring, Arizona. ....	28
Figure 27. Downstream to upstream view of CHB02-F, Charlebois Spring, Arizona. ....	28
Figure 28. Location of fixed sampling stations at La Barge Creek, Arizona, surveyed on April 19, 2023. ....	31
Figure 29. Upstream to upstream view of LBC01-F, La Barge Creek, Arizona. ....	32
Figure 30. Upstream to downstream view of LBC01-F, La Barge Creek, Arizona. ....	32
Figure 31. Downstream to upstream view of LBC01-F, upstream to upstream view of LBC02-F, La Barge Creek, Arizona. ....	32
Figure 32. Downstream to downstream view of LBC01-F, upstream to downstream view of LBC02-F, La Barge Creek, Arizona. ....	32
Figure 33. Downstream to downstream view of LBC02-F, upstream to downstream view of LBC03-F, La Barge Creek, Arizona. ....	32
Figure 34. Downstream to upstream view of LBC02-F, upstream to upstream view of LBC03-F, La Barge Creek, Arizona. ....	32
Figure 35. Downstream to upstream view of LBC03-F, La Barge Creek, Arizona. ....	33
Figure 36. Downstream to downstream view of LBC03-F, La Barge Creek, Arizona. ....	33
Figure 37. Location of fixed sampling stations at Hidden Water Spring, Arizona, surveyed on May 3, 2023. ....	36
Figure 38. Upstream to upstream view of HWS01-F, Hidden Water Spring, Arizona. ....	37
Figure 39. Upstream to downstream view of HWS01-F, Hidden Water Spring, Arizona. ....	37
Figure 40. Downstream to downstream view of HWS02-F, Upstream to downstream view of HWS03-F, Hidden Water Spring, Arizona. ....	37

Figure 41. Downstream to upstream view of LBC02-F, upstream to upstream view of HWS03-F, Hidden Water Spring, Arizona. ....	37
Figure 42. Downstream to downstream view of HWS01-F, upstream to downstream view HWS02-F, Hidden Water Spring, Arizona.....	37
Figure 43. Upstream to upstream view of HWS02-F, downstream to upstream view of HWS01-F, Hidden Water Spring, Arizona. ....	37
Figure 44. Downstream to downstream view of HWS03-F, Hidden Water Spring, Arizona.....	38
Figure 45. Downstream to upstream view of HWS03-F, Arizona.....	38
Figure 46. Location of sampling stations in Tortilla Creek, Arizona, surveyed on May 9 & 10, 2023.....	41
Figure 47. Location of sampling locations in Mesquite Creek, Arizona, surveyed May 9, 2023.....	42
Figure 48. Location of stations sampled at Hot Springs Canyon, Arizona, surveyed September 12-14, 2023. ....	45
Figure 49. Mean CPUE of focal species from annual monitoring since 2012 at Hot Springs Canyon. ....	46
Figure 50. Length-frequency histogram of Loach Minnow captured at Hot Springs Canyon since 2019. Total number of Loach Minnow captured by year, descending in the graph was 50, 30, 17, 21, and 25, respectively. ....	47
Figure 51. Length-frequency histogram of Gila Chub captured at Hot Springs Canyon under GRBNFMP since 2021. Total numbers of Gila Chub caught in 2021, 2022, and 2023 were 160, 86, and 150, respectively. ....	48
Figure 52. Upstream to downstream view of HSC06-F, Hot Springs Canyon, Arizona. ....	49
Figure 53. Upstream to upstream view of HSC06-F, Hot Springs Canyon, Arizona. ....	49
Figure 54. Upstream to upstream view of HSC23-F, Hot Springs Canyon, Arizona. ....	49
Figure 55. Upstream to downstream view of HSC23-F, Hot Springs Canyon, Arizona. ....	49
Figure 56. Downstream to upstream view of HSC32-F, Hot Springs Canyon, Arizona. ....	50
Figure 57. Downstream to downstream view of HSC32-F, Hot Springs Canyon, Arizona. ....	50
Figure 58. Upstream to upstream view of HSC32-F, Hot Springs Canyon, Arizona. ....	50
Figure 59. Upstream to downstream view of HSC32-F, Hot Springs Canyon, Arizona. ....	50
Figure 60. Location of surveyed stations at Headquarters Spring, Cochise Co, Arizona. Surveyed September 12, 2023. ....	53
Figure 61. Location of sampled stations at Wildcat Canyon, Arizona, surveyed September 13, 2023....	55
Figure 62. Upstream to upstream view of WCC04-F, Wildcat Canyon, Arizona. ....	56
Figure 63. Upstream to downstream view of WCC04-F, Wildcat Canyon, Arizona. ....	56
Figure 64. Location of sampled stations at Coal Mine Canyon, Arizona, surveyed April 3, 2023. ....	59
Figure 65. Mean CPUE of Gila Topminnow captured at Coal Mine Canyon under GRBNFMP since 2019. ....	60
Figure 66. Upstream to upstream view of CMC01-F, Coal Mine Canyon, Arizona. ....	60
Figure 67. Upstream to downstream view of CMC01-F, Coal Mine Canyon, Arizona. ....	60
Figure 68. Downstream to upstream view of CMC01-F, Coal Mine Canyon, Arizona. ....	61
Figure 69. Downstream to downstream view of CMC01-F, Coal Mine Canyon, Arizona. ....	61
Figure 70. Upstream to upstream view of CMC02-F, Coal Mine Canyon, Arizona. ....	61
Figure 71. Upstream to downstream view of CMC02-F, Coal Mine Canyon, Arizona. ....	61
Figure 72. Downstream to downstream view of CMC02-F, Coal Mine Canyon, Arizona. ....	61
Figure 73. Downstream to upstream view of CMC02-F, Coal Mine Canyon, Arizona. ....	61
Figure 74. Location of sampled stations at Fresno Canyon, Arizona, surveyed April 4, 2023. ....	64

Figure 75. Mean CPUE of Gila Topminnow caught at Fresno Canyon since 2012. ....	65
Figure 76. Upstream to downstream view of FRC01-F, Fresno Canyon, Arizona. ....	65
Figure 77. Upstream to upstream view of FRC01-F, Fresno Canyon, Arizona. ....	65
Figure 78. Downstream to upstream view of FRC01-F, upstream to upstream view of FRC02-F, Fresno Canyon, Arizona. ....	66
Figure 79. Downstream to downstream view of FRC01-F, upstream to downstream view of FRC02-F, Fresno Canyon, Arizona. ....	66
Figure 80. Downstream to downstream view of FRC02-F, upstream to downstream view of FRC03-F, Fresno Canyon, Arizona. ....	66
Figure 81. Downstream to upstream view of FRC02-F, upstream to upstream view of FRC03-F, Fresno Canyon, Arizona. ....	66
Figure 82. Downstream to upstream view of FRC03-F, Fresno Canyon, Arizona. ....	66
Figure 83. Location of sampled stations at Cottonwood Spring, Arizona, surveyed April 5, 2023. ....	68
Figure 84. Mean CPUE of Gila Topminnow caught at Cottonwood Spring since 2014. ....	69
Figure 85. Upstream to upstream view of CWS01-F, Cottonwood Spring, Arizona. ....	69
Figure 86. Upstream to downstream view of CWS01-F, Cottonwood Spring, Arizona. ....	69
Figure 87. Downstream to downstream view of CWS01-F, Cottonwood Spring, Arizona. ....	70
Figure 88. Downstream to upstream view of CWS01-F, Cottonwood Spring, Arizona. ....	70
Figure 89. Location of sampled station at Monkey Spring, Arizona, surveyed April 5, 2023. ....	72
Figure 90. Mean CPUE of Gila Topminnow caught at Monkey Spring, Arizona since 2019. ....	73
Figure 91. Upstream to upstream view of MKS01-F, Monkey Spring, Arizona. ....	73
Figure 92. Downstream to upstream view of MKS01-F, Monkey Spring, Arizona. ....	73
Figure 93. Downstream to downstream view of MKS01-F, Monkey Spring, Arizona. ....	74
Figure 94. Upstream to downstream view of MKS01-F, Monkey Spring, Arizona. ....	74
Figure 95. Location of sampled stations at Sheehy Springs, Arizona, surveyed April 16-17, 2023. ....	77
Figure 96. Mean CPUE of Gila Chub captured at Sheehy Springs, Arizona, since 2014. ....	78
Figure 97. Length-frequency histogram of Gila Chub captured under GRBNFMP 2021-2023, Sheehy Springs, Arizona. ....	79
Figure 98. Location of sampled stations at Cienega Creek, Arizona, surveyed September 7, 2023. ....	82
Figure 99. Location of sampled stations at KP Creek, Arizona, surveyed June 7, 2023. ....	85
Figure 100. Downstream to upstream view of KPC25-F, KP Creek, Arizona. ....	86
Figure 101. Upstream to downstream view of KPC25-F, KP Creek, Arizona. ....	86
Figure 102. Upstream to upstream view of KPC25-F, KP Creek, Arizona. ....	86
Figure 103. Downstream to downstream view of KPC25-F, KP Creek, Arizona. ....	86
Figure 104. Length-frequency histogram of Apache Trout captured at Grant Creek, Arizona, surveyed June 8, 2023. ....	88
Figure 105. Location of sampled stations at Grant Creek, Arizona, surveyed June 8, 2023. ....	89
Figure 106. Upstream to upstream view of GRC61-F, Grant Creek, Arizona. ....	90
Figure 107. Upstream to downstream view of GRC61-F, Grant Creek, Arizona. ....	90
Figure 108. Downstream to upstream view of GRC61-F, Grant Creek, Arizona. ....	90
Figure 109. Downstream to downstream view of GRC61-F, Grant Creek, Arizona. ....	90
Figure 110. Location of sampled stations at Campbell Blue Creek, Arizona, surveyed June 27-28, 2023. ....	93
Figure 111. Downstream to downstream view of CBC51-F, Campbell Blue Creek, Arizona. ....	94

Figure 112. Downstream to upstream view of CBC51-F, Campbell Blue Creek, Arizona.....	94
Figure 113. Location of sampled stations at Dry Blue Creek, Arizona, surveyed June 28, 2023.....	97
Figure 114. Location of pond habitats surveyed at Burro Cienega, New Mexico, surveyed July 11, 2023.....	99
Figure 115. Downstream to upstream view of BCN01-F, Burro Cienega, New Mexico.....	100
Figure 116. Upstream to downstream view of BCN03-F, Burro Cienega, New Mexico.....	100
Figure 117. Location of sampling stations at Lower Blue River, Arizona, surveyed on October 16-18, 2023.....	104
Figure 118. Mean CPUE for all focal species from annual monitoring since 2012 at Lower Blue River.....	105
Figure 119. Length-frequency histogram of Spikedace captured at Lower Blue River since 2019. No Spikedace were captured in 2021.....	105
Figure 120. Upstream to downstream view of LBL15-F, Blue River, Arizona.....	106
Figure 121. Upstream to upstream view of LBL15-F, Blue River, Arizona.....	106
Figure 122. Downstream to upstream view of LBL64-F, Blue River, Arizona.....	106
Figure 123. Downstream to downstream view of LBL64-F, Blue River, Arizona.....	106
Figure 124. Downstream to downstream view of LBL15-F, Blue River, Arizona.....	106
Figure 125. Downstream to upstream view of LBL15-F, Blue River, Arizona.....	106
Figure 126. Upstream to downstream view of LBL90-F, Blue River, Arizona.....	107
Figure 127. Downstream to upstream view of LBL90-F, Blue River, Arizona.....	107
Figure 128. Downstream to downstream view of LBL90-F, Blue River, Arizona.....	107
Figure 129. Upstream to upstream view of LBL90-F, Blue River, Arizona.....	107
Figure 130. Location of sampled stations at Fossil Creek, Arizona, surveyed May 23-25, 2023.....	111
Figure 131. Upstream to downstream view of FSC017-F, Fossil Creek, Arizona.....	112
Figure 132. Upstream to upstream view of FSC017-F, Fossil Creek, Arizona.....	112
Figure 133. Downstream to downstream view of FSC17-F, Fossil Creek, Arizona.....	112
Figure 134. Downstream to upstream view of FSC017-F, Fossil Creek, Arizona.....	112
Figure 135. Upstream to upstream view of FSC125-F, Fossil Creek, Arizona.....	112
Figure 136. Upstream to downstream view of FSC125-F, Fossil Creek, Arizona.....	112
Figure 137. Downstream to downstream view of FSC125-F, Fossil Creek, Arizona.....	113
Figure 138. Downstream to upstream view of FSC125-F, Fossil Creek, Arizona.....	113
Figure 139. Length-frequency histogram of Gila Chub (n=83) captured at Walker Canyon, Arizona, surveyed August 7, 2023.....	115
Figure 140. Location of stations sampled at Walker Canyon, Arizona, surveyed August 7, 2023.....	116
Figure 141. Upstream to downstream view of WLC14-F, Walker Canyon, Arizona.....	117
Figure 142. Upstream to upstream view of WLC14-F, Walker Canyon, Arizona.....	117
Figure 143. Downstream to downstream view of WLC14-F, Walker Canyon, Arizona.....	117
Figure 144. Downstream to upstream view of WLC14-F, Walker Canyon, Arizona.....	117
Figure 145. Location of stations sampled at Spring Creek, Arizona, surveyed October 10, 2023.....	120
Figure 146. Upstream to upstream view of SPC01-F, Spring Creek, Arizona.....	121
Figure 147. Upstream to downstream view of SPC01-F, Spring Creek, Arizona.....	121
Figure 148. Downstream to downstream view of SPC01-F, Spring Creek, Arizona.....	121
Figure 149. Downstream to upstream view of SPC01-F, Spring Creek, Arizona.....	121
Figure 150. Downstream to upstream view of SPC01-F, Spring Creek, Arizona.....	121

Figure 151. Downstream to downstream view of SPC01-F, Spring Creek, Arizona. ....	121
Figure 152. Downstream to upstream view of SPC14-F, Spring Creek, Arizona. ....	122
Figure 153. Downstream to downstream view of SPC14-F, Spring Creek, Arizona. ....	122
Figure 154. Upstream to upstream view of SPC14-F, Spring Creek, Arizona. ....	122
Figure 155. Upstream to downstream view of SPC14-F, Spring Creek, Arizona. ....	122

## 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 federally-listed and candidate fishes.

The primary objective of the current monitoring program is to identify 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. The program goal is to 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 assist with meeting this goal.

This report summarizes monitoring activities conducted by Marsh & Associates, LLC (M&A) during calendar year 2023 for the Gila River Basin Native Fish Monitoring Project (GRBNFMP). 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 (i.e., 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*.

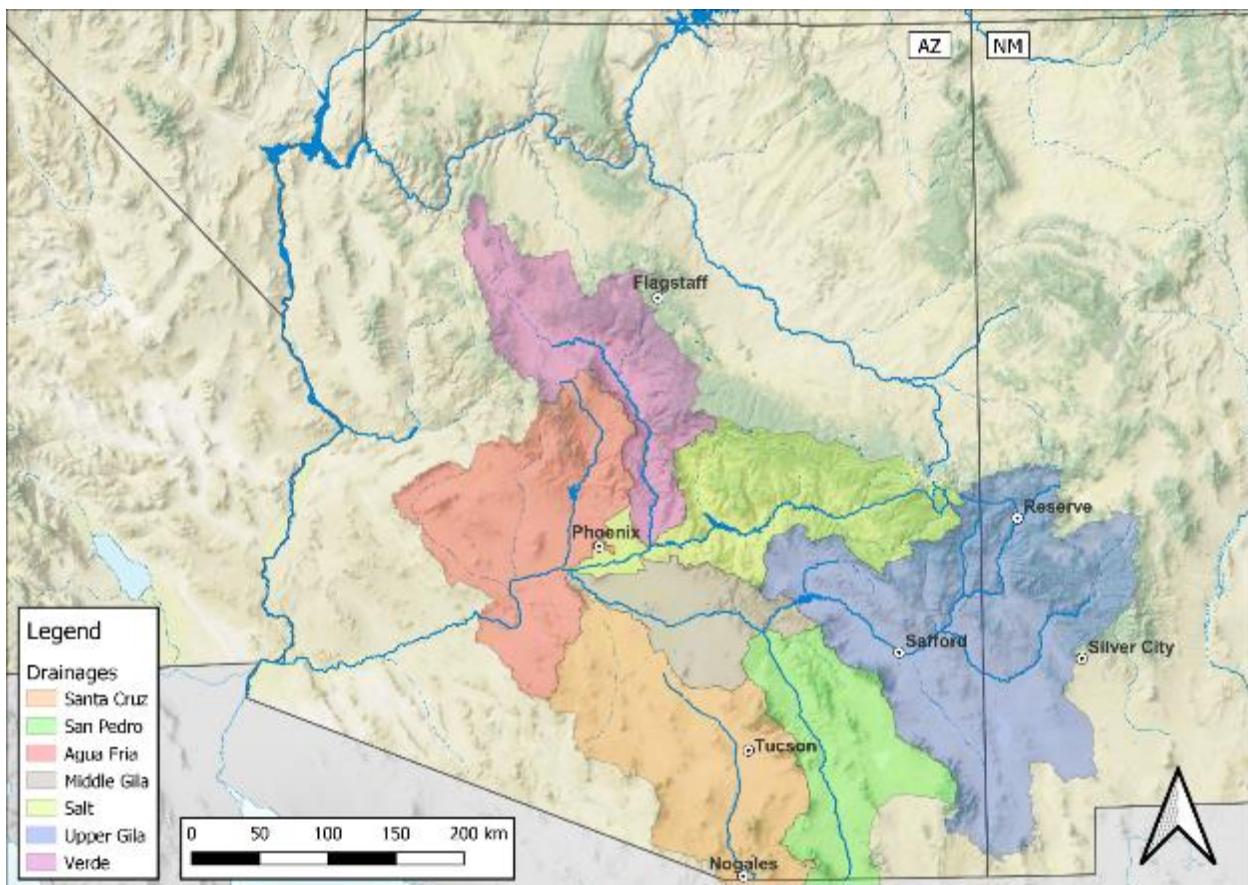


Figure 1. Major drainages of the Gila River basin, Arizona and New Mexico, where stream surveys were conducted in 2023.

## Methods

A generalized sampling design and methodology, including site-specific monitoring protocols, was implemented in 2021 following Mosher et al. (2020). Any deviations from Mosher et al. (2020) are reported in the trip summaries section below. Uniform application of 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).

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, segment 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 event.

Survey stations were subdivided into mesohabitat types (Riffle, Run, Pool) and efforts were recorded individually for each type. For example, at the end of each habitat 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 Gila Chub, Spikedace, Loach Minnow, 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 and >20 mm TL for Gila Topminnow and Western Mosquitofish *Gambusia affinis*, ≤40 and >40 mm TL for small-bodied fishes (e.g., Speckled Dace *Rhinichthys osculus* and Longfin Dace *Agosia chrysogaster*, and ≤50, 51-100 and >100 mm TL 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 at fixed stations was estimated from velocity and depth measurements 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 2023.

Common name	Code	Scientific Name
Apache Trout	ONAP	<i>Oncorhynchus apache</i>
Brown Trout	SATR	<i>Salmo trutta</i>
Desert Sucker	PACL	<i>Pantosteus clarkii</i>
Gila Chub	GIIN	<i>Gila intermedia</i>
Gila Topminnow	POOC	<i>Poeciliopsis occidentalis</i>
Loach Minnow	TICO	<i>Tiaroga cobitis</i>
Longfin Dace	AGCH	<i>Agosia chrysogaster</i>
Rainbow Trout	ONMY	<i>Oncorhynchus mykiss</i>
Roundtail Chub	GIRO	<i>Gila robusta</i>
Sonora Sucker	CAIN	<i>Catostomus insignis</i>
Speckled Dace	RHOS	<i>Rhinichthys osculus</i>
Spikedace	MEFU	<i>Meda fulgida</i>
Western Mosquitofish	GAAF	<i>Gambusia affinis</i>
American Bullfrog	RACA	<i>Rana catesbeiana</i>

Canyon Treefrog	HYAR	<i>Hyla arenicolor</i>
Lowland Leopard Frog	RAYA	<i>Rana yavapaiensis</i>
Tiger Salamander	AMTI	<i>Ambystoma tigrinum</i>
Northern Crayfish	FAVI	<i>Faxonius virilis</i>
Sonora Mud Turtle	KISO	<i>Kinosternon sonoriense</i>
Black-necked Gartersnake	THCY	<i>Thamnophis cyrtopsis</i>
Gophersnake	PICA	<i>Pituophis catenifer</i>
Narrow-headed Gartersnake	THRU	<i>Thamnophis rufipunctatus</i>
Western Terrestrial Gartersnake	THEL	<i>Thamnophis elegans</i>
Western Diamondback Rattlesnake	CRAT	<i>Crotalus atrox</i>
Western Patch-Nosed Snake	SAHE	<i>Salvadora hexalepis</i>

### Data summary and analyses

Fish capture data were summarized and compiled in tabular form, separately for each stream, that provide numerical, catch-per-unit effort (CPUE), and relative abundance for each species and each age (size) class. Length-frequency histograms are included where data are available to evaluate size-structure and reproduction. Also, a narrative text summarizes 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 are described, and additional recommendations are offered that might contribute to program improvement. Station maps were constructed in QGIS (QGIS Development Team 2023).

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. GRBNFMP surveys completed before 2021 utilized a different sampling protocol, therefore meaningful CPUE comparisons were not possible in some instances. TL typically was not 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 110 sampling stations were completed across 25 streams. Gila Chub were detected at 16 of 20 stations (5 of 5 streams) where they were a focal species, Spikedace were detected at 11 of 41 stations (2 of 3 streams), Loach Minnow were detected at 9 of 45 stations (2 of 6 streams), Gila Topminnow were detected at 20 of 47 stations (12 of 15 streams) where they were a focal species.

Across all streams, a total of 17,445 individuals across 13 fish species (10 native and 3 non-native) was captured (Table 3). No new taxa were detected for the Gila River basin. However, a notable discovery in 2023 was the capture of 90 Apache Trout in Grant Creek. Native taxa accounted for 98.13% of total catch. BPEF was the primary sampling gear and was used at 54 sampling stations. BPEF was effective at capturing both large and small-bodied fishes and accounted for 59.96% (n=10,460) of total catch. Total

effort for BPEF in 2023 was 50,718 seconds. However, BPEF was not effective in stream reaches with deep pools or high turbidity. Minnow traps were employed at 31 stations to target Gila Topminnow and young-of-year (YOY) Gila Chub in pools. Minnow traps accounted for 35.16% (n=6,133) of total catch. Seining was employed at three stations in deeper pools and flowing habitat with smooth substrate and accounted for 2.78% (n=485) of total catch. Other gears were used less frequently, such as dip-net sweeps that targeted Gila Topminnow in shallow, vegetated stream margins at eight stations and accounted for 1.73% (n=302) 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 0.37% (n=65) of total catch. Visual surveys were conducted at 16 stations in Fossil Creek. A total of 3,700 fish that were observed in this survey were not included in overall catch data. Large hoop nets were not used in 2023.

Focal species were captured across all mesohabitat classifications. Catch was broken down by size class and highlighted where species were predominately caught at differing size classes. Gila Chub under 100 mm inhabited runs, while adults were mostly captured in pools. Spikedace and Loach Minnow unsurprisingly were caught mostly in riffles. Gila Topminnow were largely caught in pool habitats, likely because most of the sites that have Gila Topminnow as the focal species are spring pools. Mesohabitat encountered in 2023 differed from years prior. The most common habitat surveyed in 2023 was riffle, comprising 5,185 m of 12,353 total sampled habitat (Figure 2). Whereas in 2022 and 2021 the most common habitat sampled was run totaling 5,513 m and 5,490 m, respectively. This could suggest alterations in habitat across surveyed sites. On the other hand, these observations could be dependent on the year, as most sites sampled are on three or five-year rotations. Continued monitoring of total sampled mesohabitat could indicate changes in available habitat for focal species across years where site sampling is similar and could explain differing catch totals for target species.

Table 2. Catch summary of focal species per habitat type and size class for native fishes in Gila River basin streams, Arizona and New Mexico. Numbers bolded and italicized indicate max values for each size class.

Mesohabitat Size Class (mm)	GIIN			MEFU		POOC		TICO		Catch
	<=50	51-100	>100	<40	>=40	<20	>=20	<40	>=40	
Cascade	0	1	3	0	0	0	0	0	0	4
Pool	39	73	<b>222</b>	3	22	<b>244</b>	<b>2360</b>	0	5	2,970
Riffle	15	28	15	<b>33</b>	<b>101</b>	62	985	<b>1</b>	<b>51</b>	1,292
Run	<b>171</b>	<b>99</b>	29	1	34	118	383	0	0	836

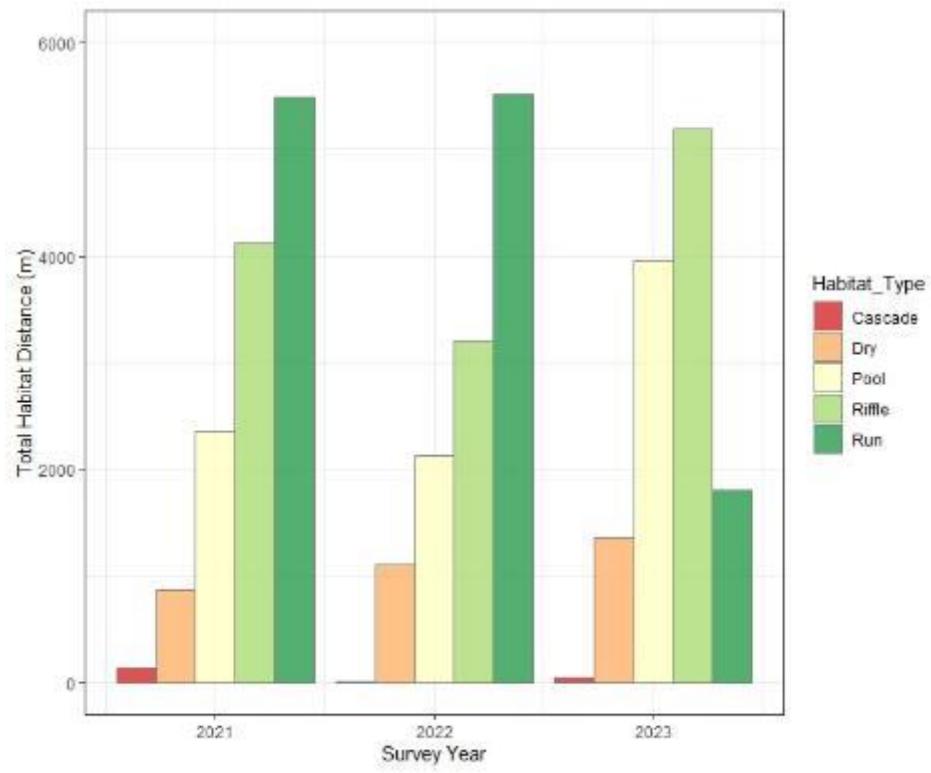


Figure 2. Total distance of mesohabitat encountered during surveys since monitoring protocol was altered in 2021.

Table 3. Summary of fish species captured by stream, Gila River basin, Arizona, 2023. Focal species for each stream are highlighted in yellow. Streams listed in alphabetic order; species codes are in Table 1. Fossil Creek numbers were based on visual observations and thus not included in overall catch data.

Stream	AGCH	CAIN	GAAF	GIIN	GIRO	MEFU	ONAP	ONMY	PACL	POOC	RHOS	SATR	TICO	Catch
Burro Cienega	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Campbell Blue Creek	187	10	-	-	-	-	-	-	181	-	926	13	32	1,349
Charlebois Spring	-	-	-	-	-	-	-	-	-	24	-	-	-	24
Cienega Creek	1,173	-	-	-	-	-	-	-	-	-	-	-	-	1,173
Coal Mine Canyon	1	-	-	-	-	-	-	-	-	231	-	-	-	232
Cottonwood Spring	-	-	-	-	-	-	-	-	-	173	-	-	-	173
Dry Blue Creek	23	-	-	-	-	-	-	-	-	-	419	8	-	450
Fossil Creek*	82	100	-	-	2,835	6	-	-	329	-	345	-	-	3,700
Fresno Canyon	374	-	-	-	-	-	-	-	-	1,016	-	-	-	1,390
Grant Creek	3	1	-	-	-	-	90	-	31	-	175	3	-	303
Headquarters Spring	-	-	-	-	-	-	-	-	-	1,945	-	-	-	1,945
Hidden Water Spring	81	-	-	-	-	-	-	-	-	-	-	-	-	81
Hot Springs Canyon	1,254	11	-	150	-	188	-	-	81	-	912	-	25	2,433
KP Creek	3	8	-	-	-	-	-	-	92	-	193	13	-	309
La Barge Creek	-	-	-	-	-	-	-	-	-	42	-	-	-	42
Little Sycamore Creek	8	-	-	12	-	-	-	-	-	-	-	-	-	20
Lower Blue River	1,128	763	-	-	471	188	-	-	1729	-	1068	-	-	5,347
Lower Tortilla Creek	-	-	-	-	-	-	-	-	-	7	-	-	-	7
Mesquite Creek	-	-	-	-	-	-	-	-	-	35	-	-	-	35
Monkey Spring	-	-	-	-	-	-	-	-	-	103	-	-	-	103
Sheehy Spring	-	-	16	61	-	-	-	-	-	-	-	-	-	77
Spring Creek	505	-	-	325	-	-	-	-	1	166	293	-	-	1,292
Sycamore Creek	-	2	-	68	-	-	-	2	-	-	-	-	-	72
Upper Tortilla Creek	-	-	-	-	-	-	-	-	-	17	-	-	-	17
Walker Canyon	-	-	-	83	-	-	-	-	13	-	80	-	-	176
Wildcat Canyon	-	-	-	-	-	-	-	-	-	393	-	-	-	393
<b>Total</b>	<b>4,740</b>	<b>795</b>	<b>16</b>	<b>699</b>	<b>471</b>	<b>188</b>	<b>90</b>	<b>2</b>	<b>2,128</b>	<b>4,152</b>	<b>4,066</b>	<b>37</b>	<b>57</b>	<b>17,445</b>

## Trip Summaries

### Agua Fria Basin

#### Sycamore Creek

Station		Lower Boundary	Upper Boundary
SYC02	12S NAD83	420113E, 3798228N	420196E, 3798284N
SYC05-F		419891E, 3798038N	419975E, 3798087N
SYC11-F		416150E, 3798804N	417093E, 3797699N

Sycamore Creek (Yavapai Co., AZ) originates at Pine Springs in Black Hills and runs ~32 km southwest to its confluence with Agua Fria River. Streamflow is primarily intermittent with deep perennial pools that persist during dry periods. The focal species in Sycamore Creek is Gila Chub and according to Weedman et al. (1996) the earliest recorded collection from Sycamore Creek was in 1930. Based on previous surveys, Gila Chub persist at the site (Timmons and Upton 2015; Timmons and Paulus 2016), but populations are isolated and never locally abundant. The last survey conducted at this site in 2018 caught 12 Gila Chub and two Rainbow Trout *Oncorhynchus mykiss* (Burghad et al. 2019).

M&A surveyed Sycamore Creek August 8, 2023. Sycamore Creek was accessed via Forest Road (FR) 68. Three, 100-m stations (2 fixed, 1 random) were surveyed (Figure 3). Totals of 68 Gila Chub, two Sonora Sucker, and two Rainbow Trout were captured across all three stations (Table 4). This site was last surveyed in 2018 and resulted in capture of 32 Gila Chub.

The fixed station in the area known as Middle Box (SYC11-F) was dry for 47 m before reaching a plunge pool just below the falls. No fish were caught above the falls, but there was water covered with filamentous algae. The fixed station located at Double T Falls (SYC05-F) consisted of plunge pools and dry streambed composed of cobble and boulder substrate. Most fish captured at this station were in a shallow shaded pool below a dry cliff. The most upstream sampled station (SYC02) was dry. Other wildlife observed was a Western Diamondback Rattlesnake *Crotolus atrox* at station SYC02.

Water temperature, DO (dissolved oxygen), pH, and conductivity at this site averaged 23.1°C, 9.4 mg/L, 8.37, and 798.8 µS, respectively. Photographs of upstream and downstream extents of fixed stations are provided below (Figures 4-11).

Despite presence of non-native fish at this site, Gila Chub continue to persist. Gila Chub catch is similar to what has been captured in previous surveys. This population is at risk of drought conditions, especially in the lowest station SYC11-F. The diminished pool below the falls is the only place where fish were found.

Table 4. Summary of catch at two fixed stations at Sycamore Creek, Yavapai Co, Arizona, by BPEF. Total effort was 640 seconds.

<b>Stations</b>	<b>Statistic</b>	<b>GIIN &lt;=50</b>	<b>GIIN 51-100</b>	<b>GIIN &gt;100</b>	<b>ONMY</b>	<b>CAIN</b>	<b>Totals</b>
SYC05-F (417 sec)	Count	6	10	26	2	0	44
	% total catch	13.64%	22.73%	59.09%	4.55%	0.00%	100.00%
	CPUE (ind/hr)	51.80	86.33	224.46	17.27	0.00	379.86
SYC11-F (223 sec)	Count	0	3	23	0	2	28
	% total catch	0.00%	10.71%	82.14%	0.00%	7.14%	100.00%
	CPUE (ind/hr)	0.00	48.43	371.30	0.00	32.29	452.02
Total	Count	6	13	49	2	2	72
	% total catch	8.33%	18.06%	68.06%	2.78%	2.78%	100.00%
	CPUE (ind/hr)	33.75	73.13	275.63	11.25	11.25	405.00

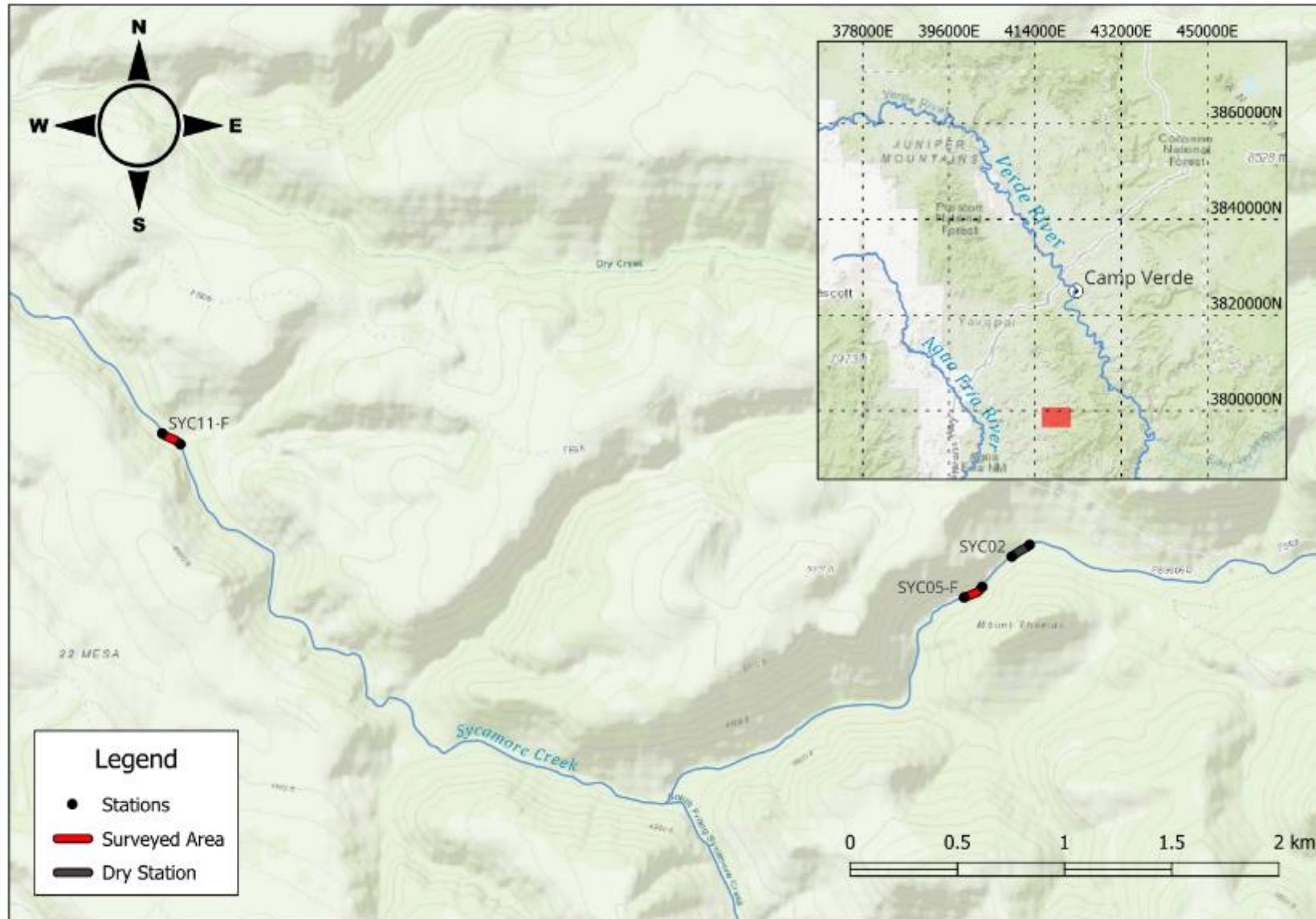


Figure 3. Location of fixed sampling stations at Sycamore Creek, Arizona, surveyed on August 8, 2023.

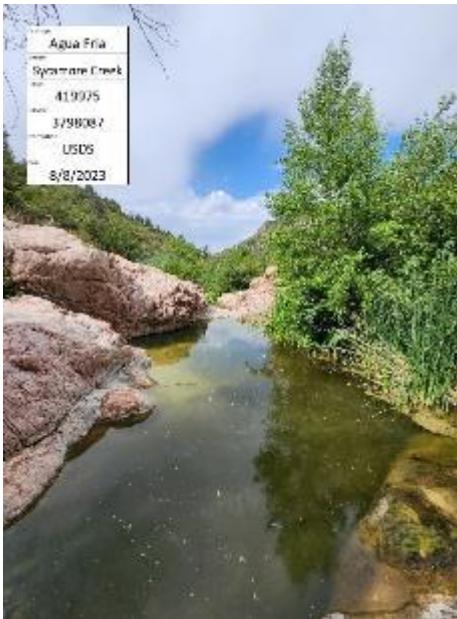


Figure 4. Upstream to downstream view of SYC05-F, Sycamore Creek.

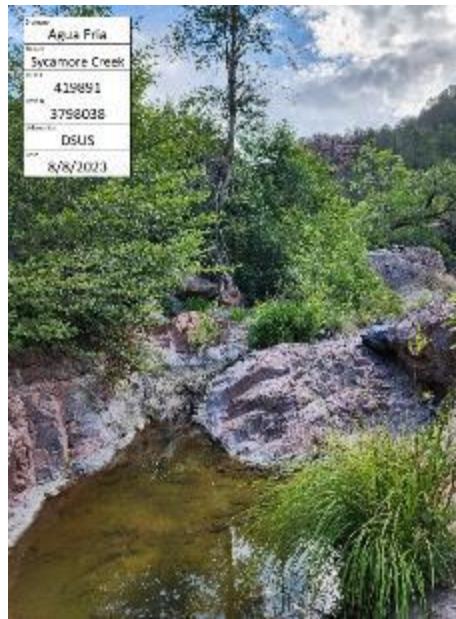


Figure 5. Downstream to upstream view of SYC05-F, Sycamore Creek.

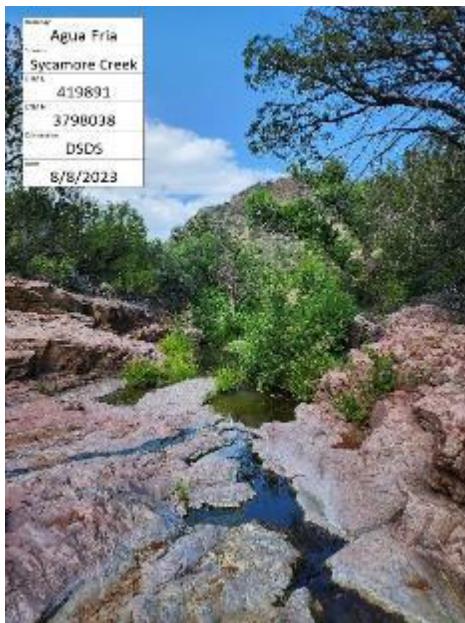


Figure 6. Downstream to downstream view of SYC05-F, Sycamore Creek.

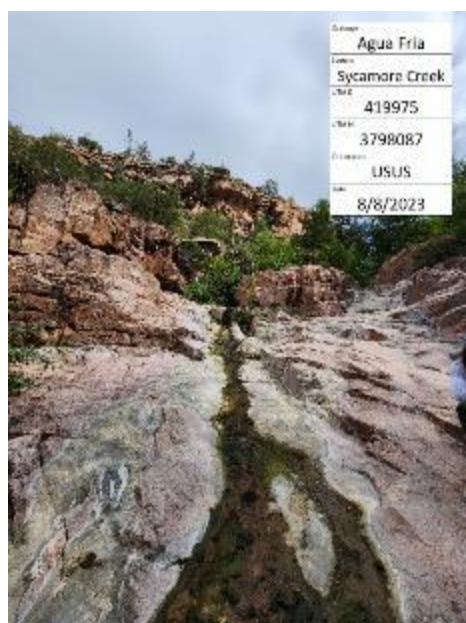


Figure 7. Upstream to upstream view of SYC05-F, Sycamore Creek.

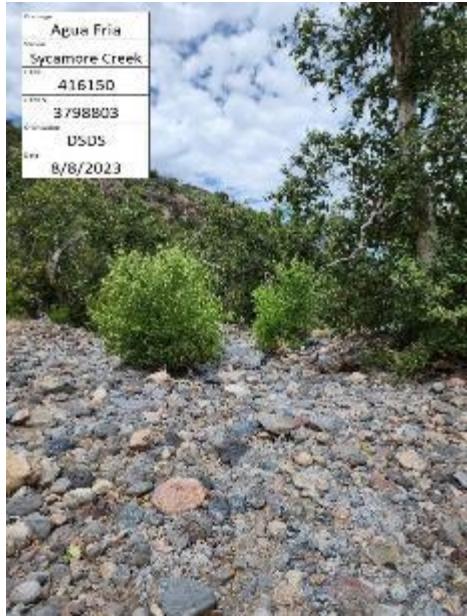


Figure 8. Downstream to downstream view of SYC11-F, Sycamore Creek.

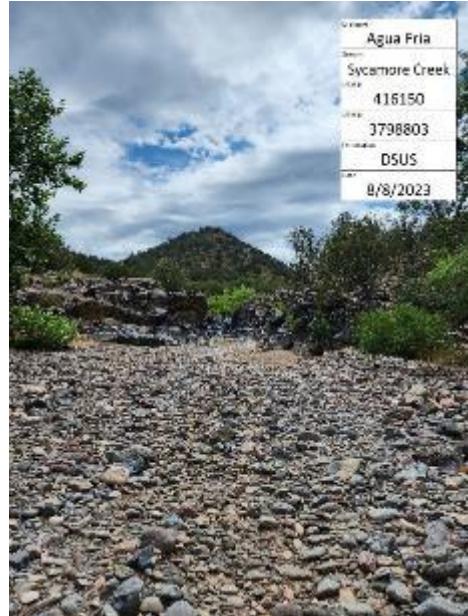


Figure 9. Downstream to upstream view of SYC11-F, Sycamore Creek.

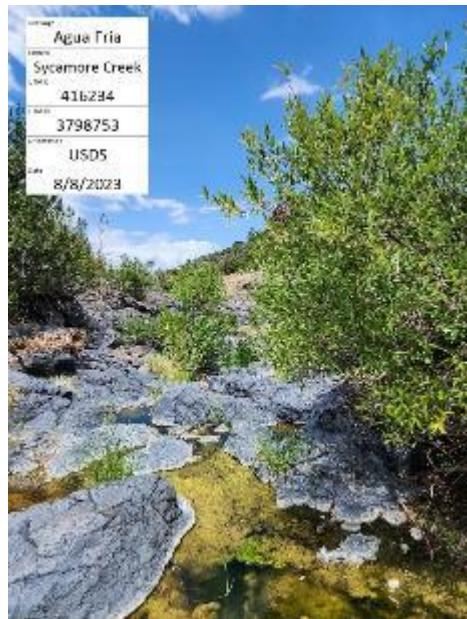


Figure 10. Upstream to downstream view of SYC11-F, Sycamore Creek.

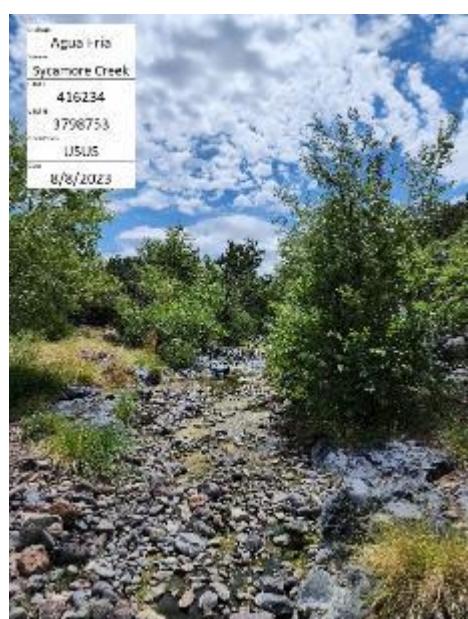


Figure 11. Upstream to upstream view of SYC11-F, Sycamore Creek.

## Little Sycamore Creek

Station		Lower Boundary	Upper Boundary
LSC01-F	12S NAD83	413871E, 3802794N	413971E, 3702817N
LSC02-F		413808E, 3802749N	413873E, 3802793N
LSC03-F		413702E, 3802697N	413809E, 3802750N

Little Sycamore Creek (Yavapai Co., AZ) flows west to its confluence with Sycamore Creek, a tributary to Agua Fria River (Figure 12). It consists of a series of isolated pools with dense filamentous algae that go dry over the summer. Despite prescribed fire within the watershed, multi-year drought, and high sediment loads (Timmons and Upton 2015), Gila Chub continues to persist. The last survey was conducted in 2018 and resulted in the capture of 21 Gila Chub (Shollenberger et al 2019).

Little Sycamore Creek was surveyed on August 8, 2023. Three, fixed 100-m stations were surveyed. This site was accessed via FR 68 and Horner Mountain Road. Vehicles were parked near the creek on private property; access was granted by the landowners. Total electrofishing effort was 459 seconds, which resulted in capture of 12 Gila Chub and eight Longfin Dace *Agosia chrysogaster* (Table 5).

The most northwest fixed station LSC01-F was mostly dry, therefore, effort recorded was only 15 seconds with no catch. At the second site LSC02-F, 10 Gila Chub, of all size classes were captured but no Longfin Dace. However, at the most downstream station LSC03-F, two Gila Chub less than 50 mm and eight Longfin Dace were captured and recorded.

Previous surveys conducted in 2012 and 2015 performed by AZGFD (Timmons and Upton 2015; Timmons and Paulus 2016) found higher abundance of Gila Chub and no detections of Longfin Dace. Future monitoring of Little Sycamore Creek will be required to determine persistence and abundance patterns of Longfin Dace.

Water temperature, dissolved oxygen (DO), pH, and conductivity at this site averaged 22.6°C, 7.4 mg/L, 7.68, and 622.3 µS, respectively. Photographs of upstream and downstream extents of stations are provided below (Figures 13-20).

Table 5. Summary of catch at three fixed stations at Little Sycamore Creek, Arizona, by backpack electrofishing. Total effort was 459 seconds.

<b>Stations</b>	<b>Statistic</b>	<b>GIIN &lt;=50</b>	<b>GIIN 51-100</b>	<b>GIIN &gt;100</b>	<b>AGCH</b>	<b>Totals</b>
LSC01-F (15 sec)	Count	0	0	0	0	0
	% total catch	0.00%	0.00%	0.00%	0.00%	0.00%
	CPUE (ind/hr)	0.00	0.00	0.00	0.00	0.00
LSC02-F (188 sec)	Count	3	2	5	0	10
	% total catch	30.00%	20.00%	50.00%	0.00%	100.00%
	CPUE (ind/hr)	57.45	38.30	95.74	0.00	191.49
LSC03-F (256 sec)	Count	2	0	0	8	10
	% total catch	20.00%	0.00%	0.00%	80.00%	100.00%
	CPUE (ind/hr)	28.13	0.00	0.00	112.50	140.63
Total	Count	5	2	5	8	20
	% total catch	25.00%	10.00%	25.00%	40.00%	100.00%
	CPUE (ind/hr)	39.22	15.69	39.22	62.75	156.86

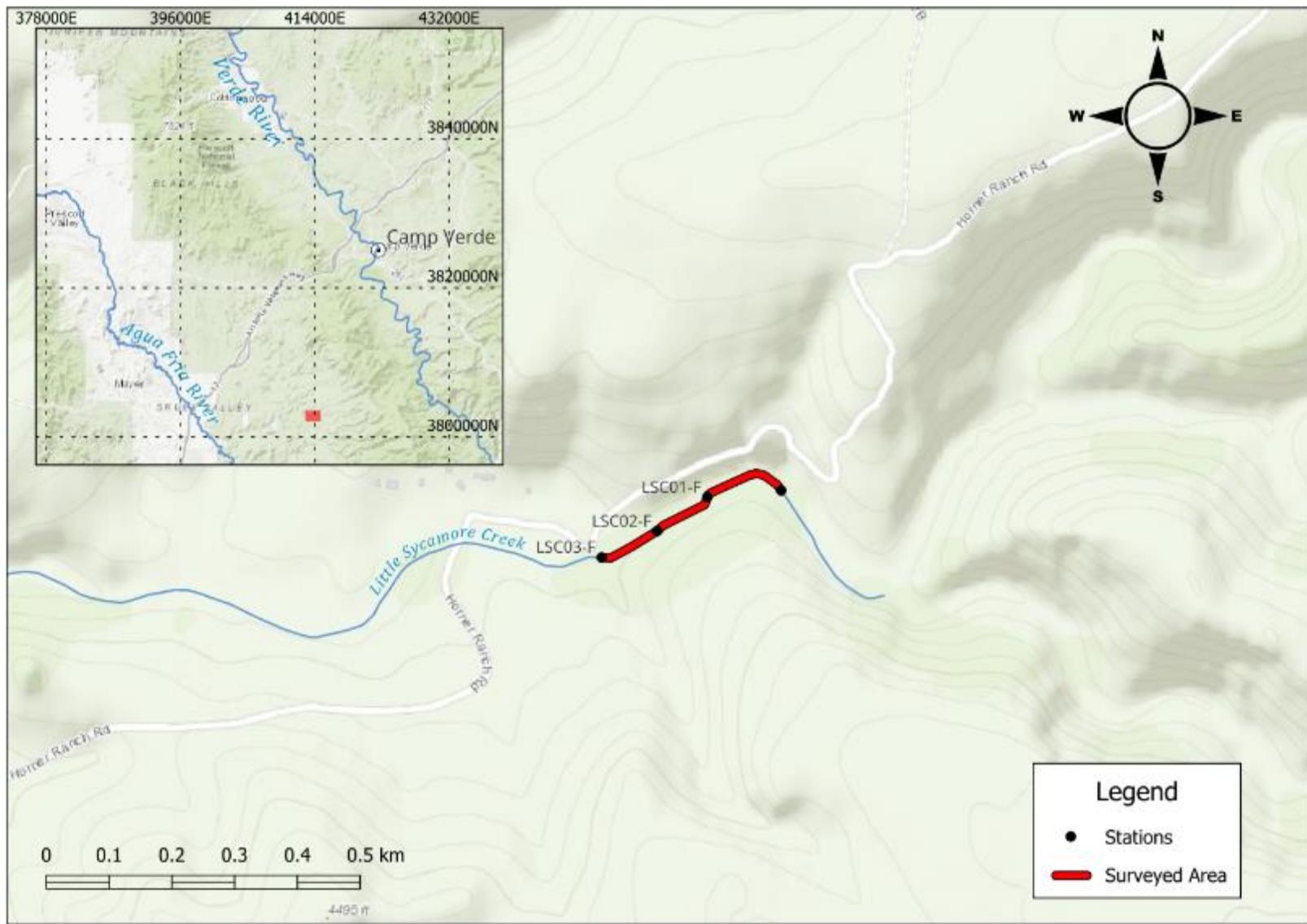


Figure 12. Location of fixed sampling stations at Little Sycamore Creek, Arizona, surveyed on August 8th, 2023.

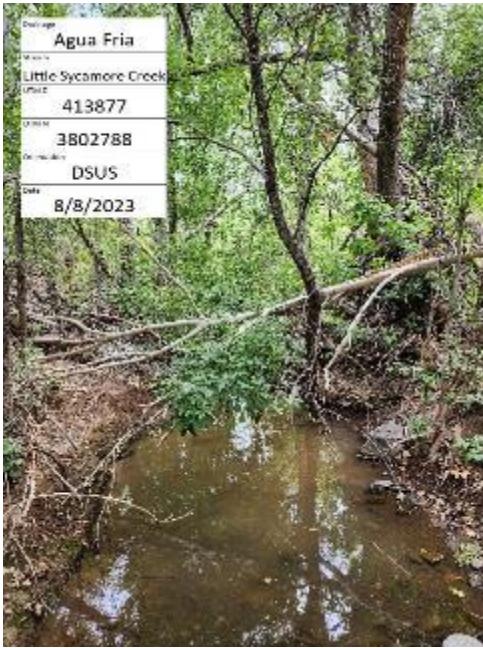


Figure 13. Downstream to Upstream view of LSC01-F, Upstream to upstream view of LSC02-F, Little Sycamore Creek.

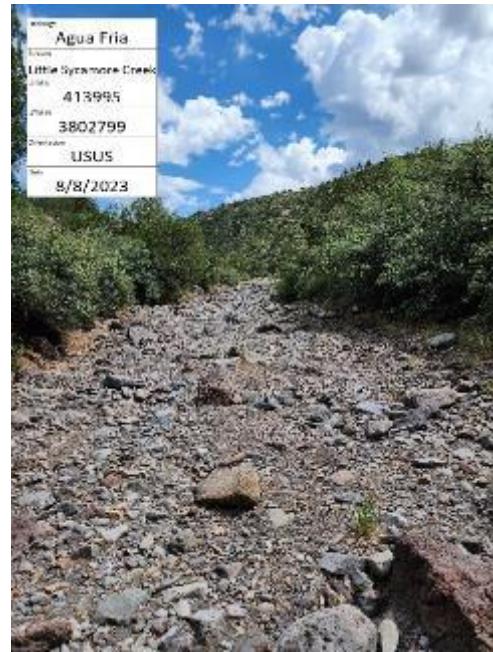


Figure 14. Upstream to upstream view of LSC01-F, Little Sycamore Creek, Arizona.



Figure 15. Upstream to downstream view of LSC01-F, Little Sycamore Creek, Arizona.

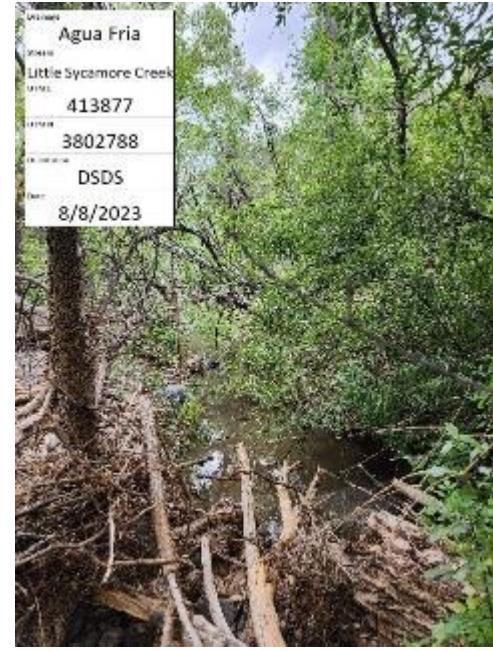


Figure 16. Downstream to downstream view of LSC01-F, Upstream to downstream view of LSC02-F, Little Sycamore Creek, Arizona.

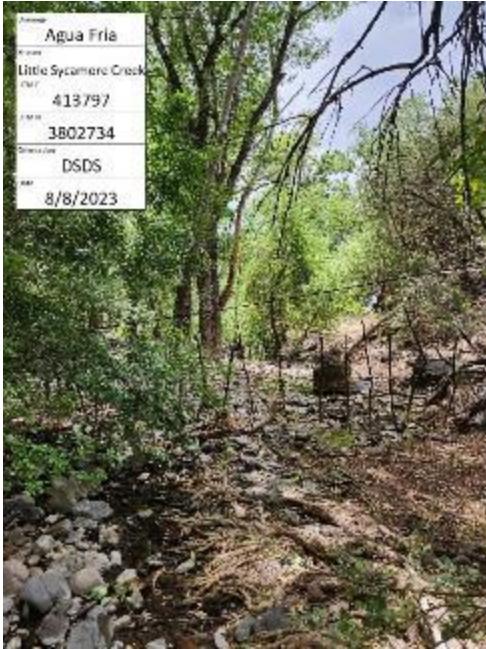


Figure 17. Downstream to downstream view of LSC02-F, upstream to downstream view of LSC03-F, Little Sycamore Creek, Arizona.

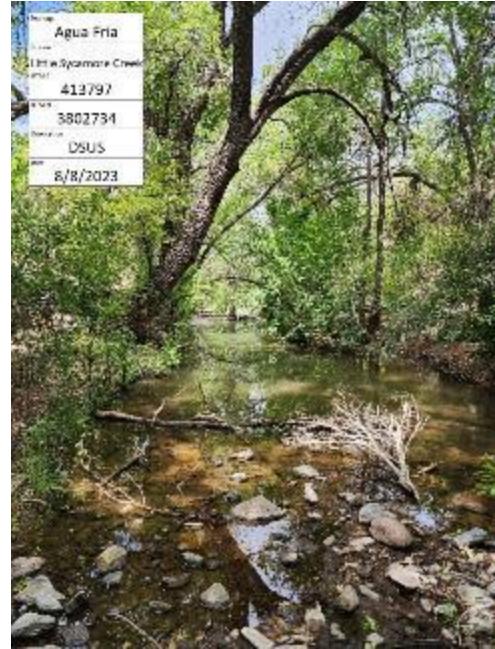


Figure 18. Downstream to upstream view of LSC02-F, upstream to upstream view of LSC03-F, Little Sycamore Creek, Arizona.

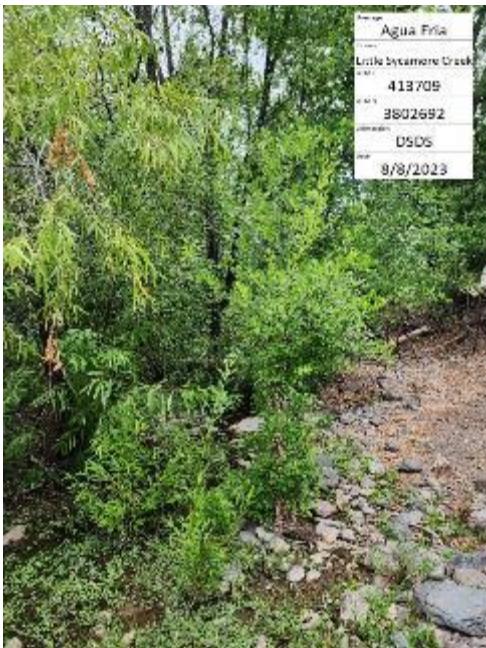


Figure 19. Downstream to downstream view of LSC03-F, Little Sycamore Creek, Arizona.



Figure 20. Downstream to upstream view of Little Sycamore Creek, Arizona.

## Salt River Basin

### Charlebois Spring

April 18, 2023

Station	Lower Boundary	Upper Boundary
CHB01-F	12S NAD83	468080E, 3702273N
CHB02-F		467984E, 3702203N

Charlebois Spring (Pinal Co., AZ) is located in Tonto National Forest (NF) in the Superstition Mountains near Apache Junction, AZ. The spring runs south-west and is tributary to La Barge Creek in the Salt River basin (Figure 21). Gila Topminnow is the focal species at this site. Gila Topminnow were established by a stocking in Charlebois Spring in 1983, however heavy monsoon rains may have flushed the population down to La barge Creek (Jones et al. 2016). The spring was restocked with Gila Topminnow in 2017. This is the first survey conducted at Charlebois Spring under the GRBNFMP.

M&A personnel completed monitoring of Charlebois Spring on April 18, 2023. Two stations each were surveyed with 10 minnow traps baited with dry dog food and dip net sweeps where traps were ineffective. The monitoring reach was accessed via hiking from First Water Trailhead, Dutchman's Trail 104, and bull Pass trail 129 (Figure 21). Totals of 24 Gila Topminnow and 64 Lowland Leopard Frogs *Rana yavapaiensis* were captured across both stations (Table 6).

Twenty-four Gila Topminnow were captured from the station starting at the springhead (CHB01-F). Gila Topminnow were common in the sampled pools at this station (50-100 observed). Traps were not successful in capturing fish that occupied deeper sections of the pool where most of the effort occurred. Three Sonora Mud Turtles *Kinosternon sonoriensis* and an abundance of Lowland Leopard Frogs at different life cycle stages were observed. The downstream station CHB02-F did not yield Gila Topminnow in the traps that were set but the species was observed in low densities (15-30 observed) and its presence was confirmed by one dip net sweep in a pool that encompassed most of the available habitat.

The sampled habitats were separated mostly by dry stretches and small pockets of water that appeared to be fishless. Average water temperature, DO, pH, and conductivity across the two fixed stations was 18.7 °C, 7.7 mg/L, 7.3, and 233.1 µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 22-27).

Table 6. Summary of catch at two fixed stations at Charlebois Spring, Arizona, by minnow trap. Total effort was 45.5 hours.

Station	Statistic	POOC (<20)	POOC ( $\geq 20$ )	RAYA	Total
CHB01-F (22.5 hrs)	Count	0	24	21	45
	% total catch	0.00%	53.33%	46.67%	100.00%
	CPUE (ind/net hr)	0.00	1.07	0.93	2.00
CHB02-F (23.0 hrs)	Count	0	0	43	43
	% total catch	0.00%	0.00%	100.00%	100.00%
	CPUE (ind/net hr)	0.00	0.00	1.87	1.87
Total	Count	0	24	64	88
	% total catch	0.00%	27.27%	72.73%	100.00%
	CPUE (ind/net hr)	0.00	0.53	1.41	1.93

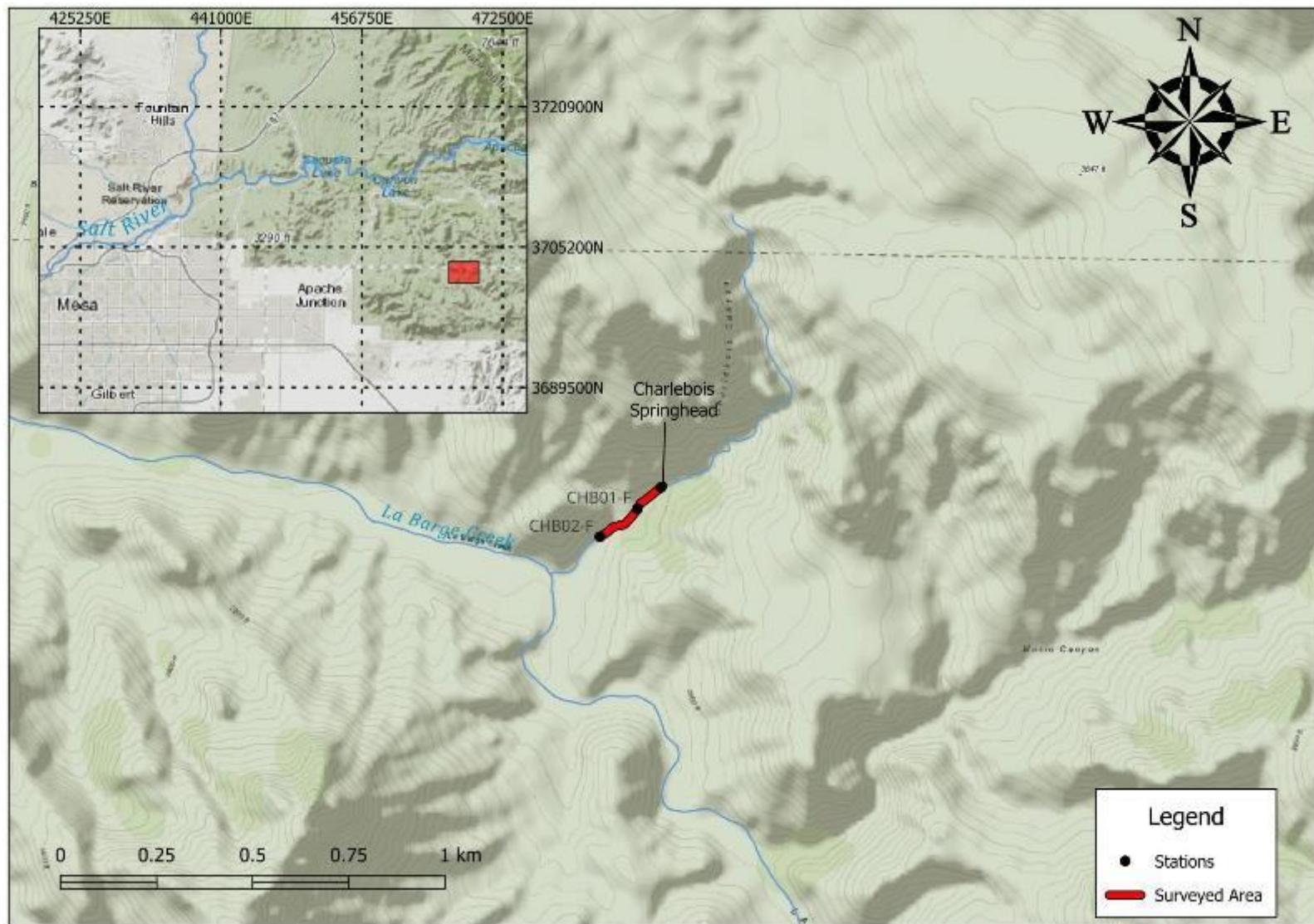


Figure 21. Location of fixed sampling stations at Charlebois Spring, Arizona, surveyed on April 18, 2023



Figure 22. Upstream to upstream view of CHB02-F, downstream to upstream view of CHB01-F, Charlebois Spring, Arizona.



Figure 23. Upstream to downstream view of CHB02-F, downstream to downstream view of CHB01-F, Charlebois Spring, Arizona.

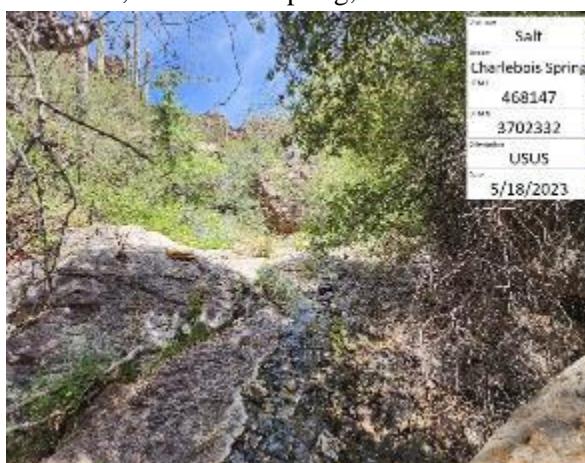


Figure 24. Upstream to upstream view of CHB01-F, Charlebois Spring, Arizona.

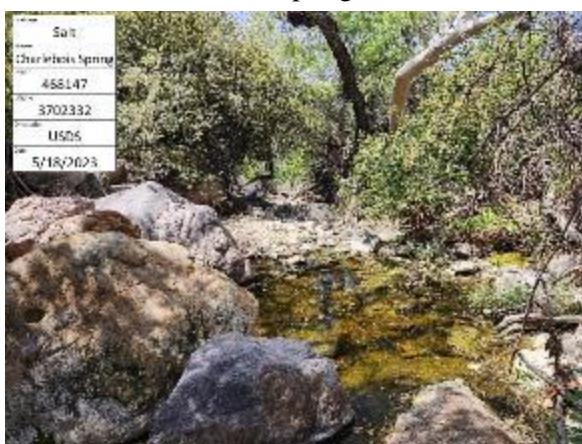


Figure 25. Upstream to downstream view of CHB01-F, Charlebois Spring, Arizona.

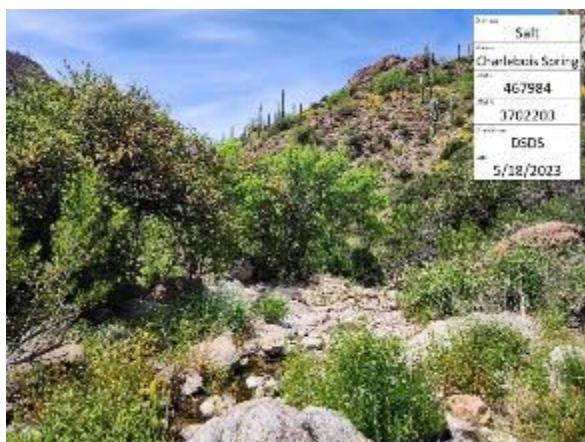


Figure 26. Downstream to downstream view of CHB02-F, Charlebois Spring, Arizona.

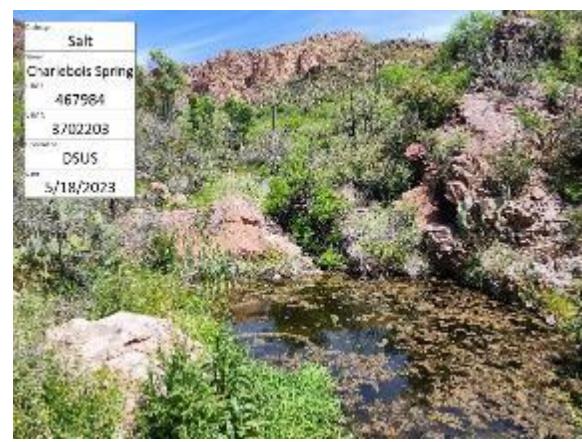


Figure 27. Downstream to upstream view of CHB02-F, Charlebois Spring, Arizona.

## La Barge Creek

Station		Lower Boundary	Upper Boundary
LBC01-F	12S NAD83	463713E, 3705999N	463683E, 3705940N
LBC02-F		463680E, 3706071N	463713E, 3705999N
LBC03-F		463588E, 3706043N	463680E, 3706071N

La Barge Creek (Maricopa Co., AZ) is fed from a spring in the Superstition Mountains and is tributary to Canyon Lake (Figure 28). Most of La Barge Creek is intermittent, but a perennial section of stream consisting of three to four large pools is located near Battleship Mountain in a slick rock canyon known as “The Box.” Gila Topminnow first were confirmed in La Barge Creek in 2015 by AZGFD, but unidentified fish were reported in the drainage as early as 2001. These fish likely originated upstream from Charlebois Spring, where Gila Topminnow were stocked in 1983 (Jones et al. 2016). In 2017, the GRBNFMP established a 100-m station in “The Box” where 364 Gila Topminnow were captured, the same station yielded 2,240 Gila Topminnow in a 2020 survey completed under the GRBNFMP (Shollenberger et al. 2021).

La Barge Creek survey was completed by M&A personnel on April 19, 2023. La Barge Creek was sampled in “The Box” and was accessed via hiking on Dutchman’s Trail 104 and Calvary Trail 239 from Marsh Valley (Figure 28). Three stations adjacent to each other were surveyed beginning at UTM 12S 463587/3706042. Minnow traps and opportunistic dip net sweeps were used to capture Gila Topminnow.

The highest concentration of Gila Topminnow was observed in the main pool of the middle station (LBC02-F) although relatively low numbers were captured in minnow traps (Table 7). Fish at this station were concentrated near algal mats in groups of 5 – 10 individuals. Water levels were higher compared to the 2020 GRBNFMP survey across all stations. Many Lowland Leopard Frogs were observed along the edges of pools near vegetation. Ten minnow traps were set within each station for a total of 84.9 trap hours, resulting in capture of three Gila Topminnow, two adult Lowland Leopard Frogs, and 25 Lowland Leopard Frog tadpoles (Table 7). Opportunistic dip net sweeps were conducted in habitat unsuitable for traps where topminnow were observed. Seven dip net sweeps resulted in capture of 39 Gila Topminnow (Table 8). Gila Topminnow were not detected at the upper-most station (LCB01).

Average water temperature, DO, pH, and conductivity across three stations was 16.4°C, 8.1 mg/L, 8.5, and 196 µS, respectively. Photographs of upper and lower extents are provided below (Figures 29-36).

Capture of Gila Topminnow at La Barge Creek has significantly decreased since the site was last surveyed in 2020. Due to high canyon walls and slick rock occupying the streambed, this population is at risk from monsoonal flooding. However, Gila Topminnow have been caught for three surveys in a row, which may indicate risk of being flushed downstream from monsoon events is not high.

Table 7. Summary of catch at three fixed stations at La Barge Creek, Arizona, by minnow trap. Total effort was 84.9 hours.

<b>Station</b>	<b>Statistic</b>	<b>POOC (&lt;20)</b>	<b>POOC (&gt;=20)</b>	<b>RAYA</b>	<b>Total</b>
LBC01-F (23.3 hrs)	Count	0	0	0	0
	% total catch	0.00%	0.00%	0.00%	100.00%
	CPUE (ind/net hr)	0.00	0.00	0.00	0.00
LBC02-F (38.4 hrs)	Count	0	3	0	3
	% total catch	0.00%	100.00%	0.00%	100.00%
	CPUE (ind/net hr)	0.00	0.08	0.00	0.08
LBC03-F (23.3 hrs)	Count	0	0	27	27
	% total catch	0.00%	0.00%	100.00%	100.00%
	CPUE (ind/net hr)	0.00	0.00	1.16	1.16
<b>Total</b>	Count	0	0	27	30
	% total catch	0.00%	0.00%	90.00%	100.00%
	CPUE (ind/net hr)	0.00	0.00	0.32	0.35

Table 8. Summary of opportunistic dip net sweeps in habitat unsuitable for traps in La Barge Creek, AZ. Total Gila Topminnow caught was 39.

<b>Station</b>	<b>Statistic</b>	<b>POOC (&lt;20)</b>	<b>POOC (&gt;=20)</b>	<b>Total</b>
LBC02-F (2.12 m <sup>2</sup> )	Count	1	26	27
	% total catch	3.70%	96.30%	100.00%
	CPUE (ind/m <sup>2</sup> )	0.47	12.26	12.73
LBC03-F (0.35 m <sup>2</sup> )	Count	0	12	12
	% total catch	0.00%	100.00%	100.00%
	CPUE (ind/m <sup>2</sup> )	0.00	33.94	33.94
<b>Total</b>	Count	1	38	39
	% total catch	2.56%	97.44%	100.00%
	CPUE (ind/m <sup>2</sup> )	0.40	15.35	15.76



Figure 28. Location of fixed sampling stations at La Barge Creek, Arizona, surveyed on April 19, 2023.

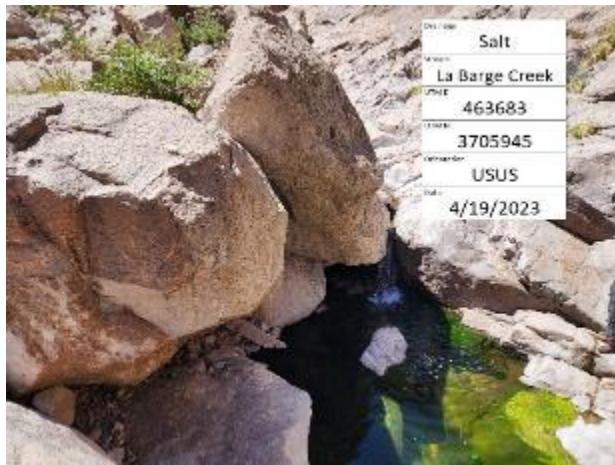


Figure 29. Upstream to upstream view of LBC01-F, La Barge Creek, Arizona.



Figure 30. Upstream to downstream view of LBC01-F, La Barge Creek, Arizona.

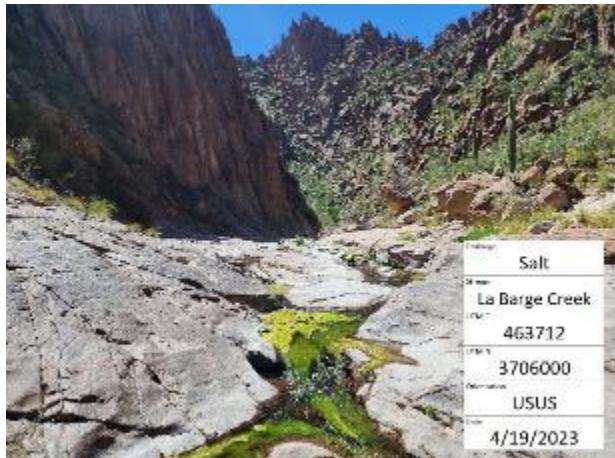


Figure 31. Downstream to upstream view of LBC01-F, upstream to upstream view of LBC02-F, La Barge Creek, Arizona.



Figure 32. Downstream to downstream view of LBC01-F, upstream to downstream view of LBC02-F, La Barge Creek, Arizona.



Figure 33. Downstream to downstream view of LBC02-F, upstream to downstream view of LBC03-F, La Barge Creek, Arizona.

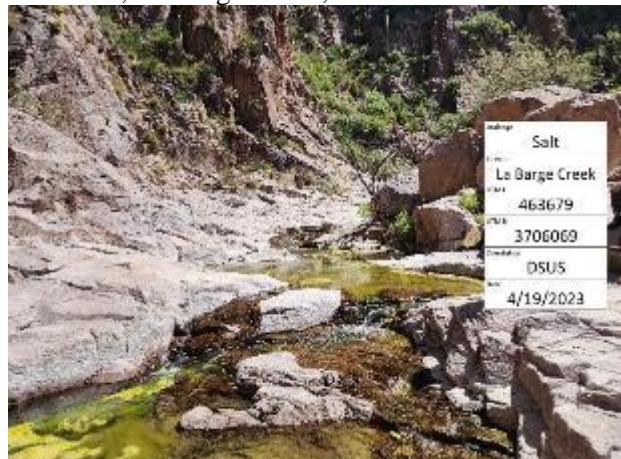


Figure 34. Downstream to upstream view of LBC02-F, upstream to upstream view of LBC03-F, La Barge Creek, Arizona.



Figure 35. Downstream to upstream view of LBC03-F, La Barge Creek, Arizona



Figure 36. Downstream to downstream view of LBC03-F, La Barge Creek, Arizona.

## **Hidden Water Spring**

<b>Station</b>		<b>Lower Boundary</b>	<b>Upper Boundary</b>
HWS01-F	12S NAD83	459294E, 3717221N	459384E, 3717225N
HWS02-F		459251E, 3717125N	459294E, 3717221N
HWS03-F		459219E, 3717039N	459251E, 3717125N

Hidden Water Spring (Maricopa Co., AZ) is located in Cane Spring Canyon 0.5 km upstream of Cottonwood Creek. The spring currently flows for about 350-m and is comprised predominantly of small, connected pools. Gila Topminnow was stocked in this site in 1976 and 1981. This population persisted until 2010 when it disappeared for an unknown reason(s). Efforts to re-establish Gila Topminnow took place in 2016 by AZGFD.

Hidden Water Spring sampling was completed by M&A personnel on May 3, 2023. Three, 100-m stations were surveyed. The site was accessed via hiking from NF-401. All three stations were immediately adjacent to each other beginning at UTM 12S 459236/3717033 (Figure 37). Gila Topminnow were not observed during this survey.

Longfin Dace were detected, but only downstream of a small waterfall (two meters in height) at the downstream station (HWS03). Longfin Dace also were observed in an isolated pool approximately 90-m downstream from the monitoring site. Surface water was present throughout the majority of the monitoring reach; however, the remainder of the canyon was dry outside of the aforementioned isolated pool. Numerous YOY (10 – 15 mm) Longfin Dace were present near algal mats in pools and were confirmed by dip net sweeps. Lowland Leopard Frogs were seen across all stations and at different life cycle stages. Ten minnow traps were set within each station for a total of 69.0 trap hours, which resulted in capture of 81 Longfin Dace and 149 Lowland Leopard Frogs at several life cycle stages. A summary table of catch for all stations is provided below (Table 9).

Most of the available habitat in stations HWS01 and HWS02 was overgrown by cattails *Typha* and other vegetation and no fish were observed. Average water temperature, DO, pH, and conductivity across three fixed stations was 22.1 °C, 5.7 mg/L, 7.82, and 453 µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 38-45).

This is the second instance where Gila Topminnow were stocked at Hidden Water Spring and were extirpated by unknown circumstances. Longfin Dace appear to be doing well below the small waterfall in the most downstream station where many YOY fish were observed. Restocking is not recommended until the mechanism limiting Gila Topminnow persistence is understood.

Table 9. Catch summary table of fish captured at Hidden Water Spring, Arizona, by minnow trap. Total effort was 69.0 trap hours.

<b>Station</b>	<b>Statistic</b>	<b>AGCH (&lt;40)</b>	<b>AGCH (&gt;=40)</b>	<b>RAYA</b>	<b>Total</b>
HWS01-F (24.6 hrs)	Count	0	0	106	106
	% total catch	0.00%	0.00%	100.00%	100.00%
	CPUE (ind/net hr)	0.00	0.00	4.31	4.31
HWS02-F (23.7 hrs)	Count	0	0	35	35
	% total catch	0.00%	0.00%	100.00%	100.00%
	CPUE (ind/net hr)	0.00	0.00	1.48	1.48
HWS03-F (20.7 hrs)	Count	0	81	10	91
	% total catch	0.00%	89.01%	10.99%	100.00%
	CPUE (ind/net hr)	0.00	3.91	0.48	4.40
<b>Total</b>	Count	0	81	151	232
	% total catch	0.00%	34.91%	65.09%	100.00%
	CPUE (ind/net hr)	0.00	1.17	2.19	3.36



Figure 37. Location of fixed sampling stations at Hidden Water Spring, Arizona, surveyed on May 3, 2023.



Figure 38. Upstream to upstream view of HWS01-F, Hidden Water Spring, Arizona.



Figure 39. Upstream to downstream view of HWS01-F, Hidden Water Spring, Arizona.



Figure 40. Downstream to downstream view of HWS02-F, Upstream to downstream view of HWS03-F, Hidden Water Spring, Arizona.



Figure 41. Downstream to upstream view of LBC02-F, upstream to upstream view of HWS03-F, Hidden Water Spring, Arizona.



Figure 42. Downstream to downstream view of HWS01-F, upstream to downstream view HWS02-F, Hidden Water Spring, Arizona.

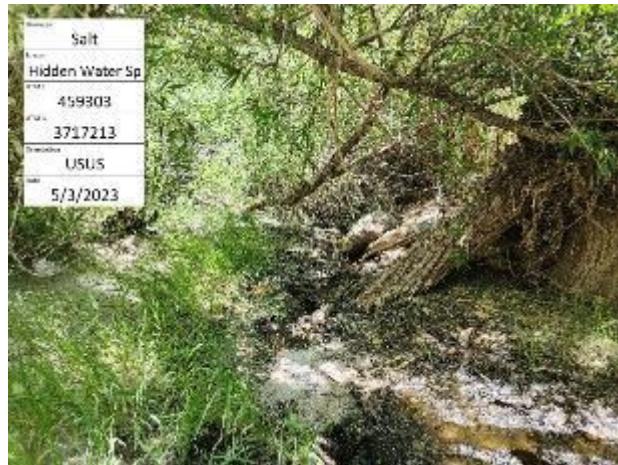


Figure 43. Upstream to upstream view of HWS02-F, downstream to upstream view of HWS01-F, Hidden Water Spring, Arizona.



Figure 44. Downstream to downstream view of HWS03-F, Hidden Water Spring, Arizona.

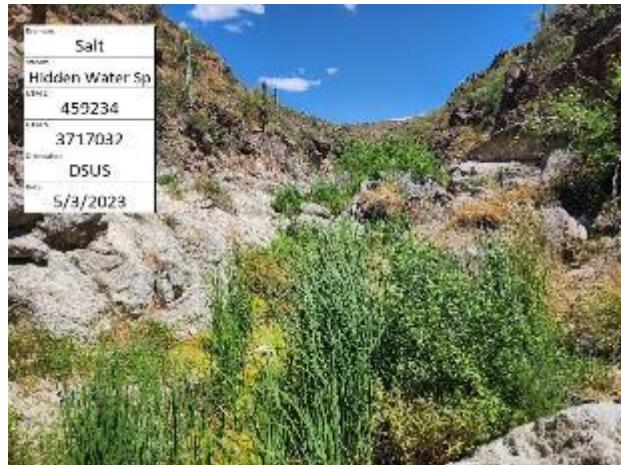


Figure 45. Downstream to upstream view of HWS03-F, Hidden Water Spring, Arizona.

## Tortilla Creek & Mesquite Creek

Station		Lower Boundary	Upper Boundary
LTC08	12S NAD83	464517E, 3709839N	464604E, 3709790N
LTC13-F		463952E, 3709830N	464044E, 3709785N
UTC01-F		467249E, 3708611N	467365E, 3708587N
UTC02-F		467159E, 3708652N	467249E, 3708611N
UTC03-F		467061E, 3708672N	467159E, 3708652N
MSQ01-F		464517E, 3709839N	464604E, 3709790N

Tortilla Creek (Maricopa Co., AZ) is located within Tonto NF in the Salt River drainage and flows into Canyon Lake. Gila Topminnow were first detected in 2005 and are the focal species for this site. The population in Lower Tortilla Creek originated sometime after the establishment of Gila Topminnow in Unnamed Drainage #68b as fish likely dispersed downstream during periods of connected flows (Gray 2018). Non-native fishes, such as Green Sunfish *Lepomis cyanellus* and Fathead Minnow *Pimephales promelas*, also have been found in this reach. The last survey conducted at Tortilla Creek was 2020 when personnel captured 1,782 Gila Topminnow (Shollenberger et al. 2021).

M&A personnel surveyed Lower Tortilla Creek May 9, 2023. The fixed site (LTC13-F) was located 100-m upstream of the AZ-88 road crossing starting above a semi-natural waterfall and one random 100-m station (LTC08) was surveyed 300-m above the Mesquite Creek confluence (Figure 46). Both stations largely consisted of pools connected by shallow, slow-moving riffles. Minnow traps were not successful at capturing Gila Topminnow at either station, but one dip net sweep confirmed the presence of YOY Gila Topminnow at LTC08. Lowland Leopard Frog tadpoles were observed in high densities across both stations. Ten minnow traps were set within each station for 46.2 trap hours, which resulted in capture of 16 Lowland Leopard Frog tadpoles. No other fish species were detected.

Mesquite Creek monitoring was completed on May 9, 2023. One fixed, 100-m station was surveyed 250 m upstream of the Tortilla Creek confluence (Figure 47). The site consisted of scattered deep pools separated by dry streambed. At the time of the sampling, this station had the most visually abundant population of Gila Topminnow across all sites, although, the species was detected in only one pool at the most upstream section of the station. Eight minnow traps were set for 16.7 trap hours and resulted in capture of 35 Gila Topminnow and 25 Lowland Leopard Frog tadpoles. Gila Topminnow were not detected at this location during the previous GRBNFMP survey in 2020. It is likely that the Gila Topminnow captured this year came from Unnamed Drainage #68B, which was recently restocked with Gila Topminnow in April 2022 by AZGFD.

Monitoring of Upper Tortilla Creek was completed on May 10, 2023. Three fixed, 100-m stations were surveyed. The site was accessed via hiking from Highway 88 and is located 4.5 km upstream from the Mesquite Creek confluence. Stations were immediately adjacent to each other beginning at UTM 12S 467061/3708672. Gila Topminnow were only captured in the middle station (UTC02-F) at this site and were observed in low densities (5-10 individuals). Gila Topminnow were not observed or captured in the most upstream station (UTC01-F). A single Gila Topminnow was visually detected at the upper extent of the most downstream station (UTC03-F). Lowland Leopard Frog tadpoles were captured across all three

stations. Ten minnow traps were set within each station for a total of 69.4 trap hours, which resulted in capture of 17 Gila Topminnow and 16 Lowland Leopard Frogs. A catch summary table for both reaches is provided below in Table 10.

Average water temperature, DO, pH, and conductivity was 19.9 °C, 6.0 mg/L, 7.73, and 172.4 µS. Photographs of upper and lower extents were not taken at this site.

Table 10. Summary of catch by minnow trap at five stations at Upper and Lower Tortilla Creek, Arizona, surveyed on May 9 & 10, 2023. Total effort was 115.54 hours.

<b>Stations</b>	<b>Statistic</b>	<b>POOC (&lt;20)</b>	<b>POOC (&gt;=20)</b>	<b>RAYA</b>	<b>Totals</b>
UTC01-F (26.2 hrs)	Count	0	0	7	7
	% total catch	0.00%	0.00%	100.00%	100.00%
	CPUE (ind/net hr)	0.00	0.00	0.27	0.27
UTC02-F (22.9 hrs)	Count	0	17	6	23
	% total catch	0.00%	73.91%	26.09%	100.00%
	CPUE (ind/net hr)	0.00	0.74	0.26	1.00
UTC03-F (20.3 hrs)	Count	0	0	3	3
	% total catch	0.00%	0.00%	100.00%	100.00%
	CPUE (ind/net hr)	0.00	0.00	0.15	0.15
*LTC08 (20.8 hrs)	Count	0	0	15	15
	% total catch	0.00%	0.00%	100.00%	100.00%
	CPUE (ind/net hr)	0.00	0.00	0.72	0.72
LTC13-F (25.4 hrs)	Count	0	0	1	1
	% total catch	0.00%	0.00%	100.00%	100.00%
	CPUE (ind/net hr)	0.00	0.00	0.04	0.04
<b>Total</b>	Count	0	17	32	49
	% total catch	0.00%	34.69%	65.31%	100.00%
	CPUE (ind/net hr)	0.00	0.15	0.28	0.42

\*one dip net sweep producing seven <20 POOC

Table 11. Summary of catch by minnow trap in one station at Mesquite Creek, Arizona, surveyed on May 9, 2023. Total effort was 16.6 hours.

<b>Station</b>	<b>Statistic</b>	<b>POOC (&lt;20)</b>	<b>POOC (&gt;=20)</b>	<b>RAYA</b>	<b>Total</b>
MSQ01-F (16.6 hrs)	Count	2	33	25	60
	% total catch	3.33%	55.00%	41.67%	100.00%
	CPUE (ind/net hr)	0.12	1.98	1.50	3.60

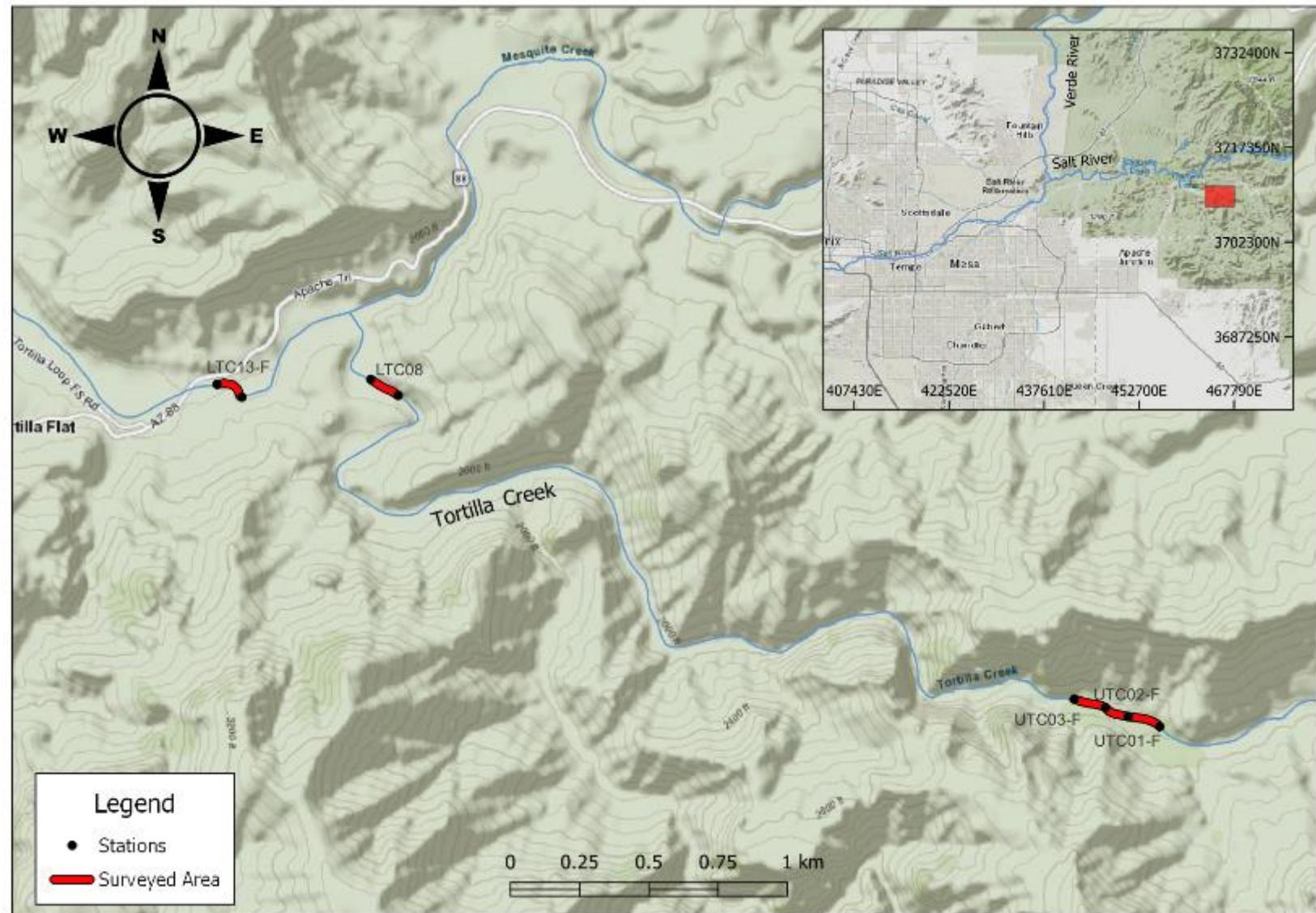


Figure 46. Location of sampling stations in Tortilla Creek, Arizona, surveyed on May 9 & 10, 2023

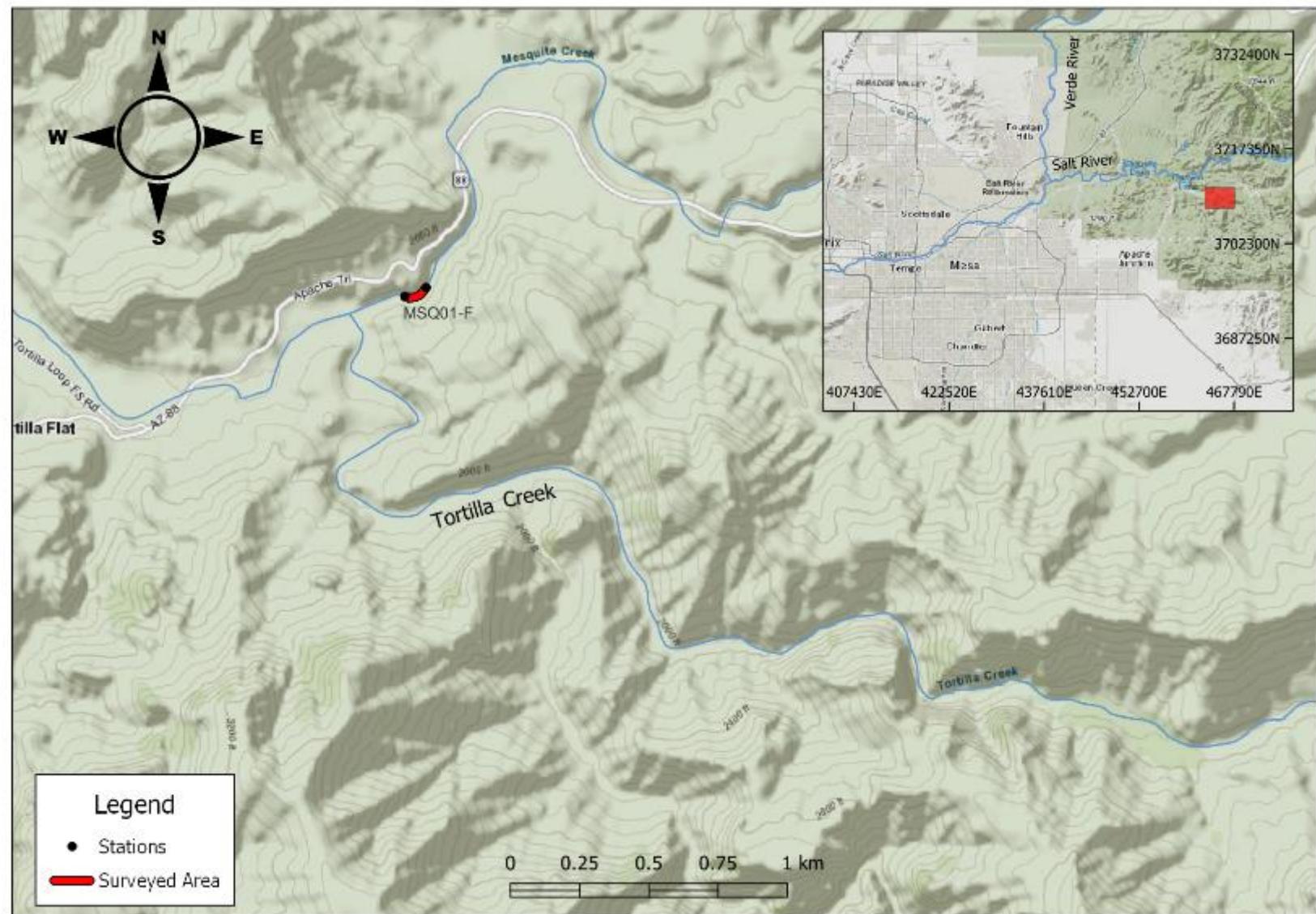


Figure 47. Location of sampling locations in Mesquite Creek, Arizona, surveyed May 9, 2023.

## San Pedro River Basin

### Hot Springs Canyon

Station		Lower Boundary	Upper Boundary
HSC02	12S NAD83	569604E, 3579847N	569700E, 3579823N
HSC05		569425E, 3579930N	569501E, 3579985N
HSC06-F		569369E, 3579961N	567614E, 3606979N
HSC13		568852E, 3579964N	568899E, 3579894N
HSC17		568524E, 3580012N	568593E, 3579962N
HSC23-F		568062E, 3580023N	568120E, 3580076N
HSC27		567953E, 3580000N	567973E, 3579912N
HSC29		567885E, 3580130N	567948E, 3580070N
HSC32-F		567659E, 3580035N	567733E, 3580052N

Hot Springs Canyon (Cochise Co., AZ) originates from western slopes of Winchester Mountains and is 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). Gila Chub, Loach Minnow, and Spikedace are the focal species for Hot Springs Canyon with monitoring efforts conducted annually since 2011. In 2022 86 Gila Chub, 21 Loach Minnow, and 0 Spikedace were captured (Shollenberger et al. 2023).

M&A personnel completed monitoring of Hot Springs Canyon September 12-14, 2023. Sampling was completed by BPEF. Nine, 100-m stations were sampled throughout reaches 1-3 in Hot Springs Canyon (Figure 48). One fixed and two randomly selected stations were sampled in each reach. Stations were accessed by hiking downstream from Muleshoe Ranch Headquarters.

Totals of 25 Loach Minnow, 150 Gila Chub, 1,254 Longfin Dace, 912 Speckled Dace, 81 Desert Sucker, and 11 Sonora Sucker were captured across all nine stations. Catch and effort totals are summarized by reach below (Table 12). No non-native species were captured or observed. Overall catch significantly increased to 2,433 total fish captured from 535 total fish captured in 2022. Loach Minnow were detected at four 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 fourth consecutive year and were last detected during autumn monitoring in 2019 when two individuals were captured (Hickerson et al. 2020). Loach Minnow catch has not changed significantly despite overall catch for the survey being significantly higher this year. Length-frequency histograms for all Gila Chub and Loach Minnow captured at Hot Springs Canyon between 2020 and 2023 are included below (Figures

49-51). CPUE trends for each focal species across a 10-year period are included in Figure 51. Data from 2012-2019 were collected by AZGFD and provided by Reclamation.

Average stream discharge across three fixed stations was calculated to be 0.01 m<sup>3</sup>/s (3.88 cfs). Average water temperature, DO, pH, and conductivity across three fixed stations was 25.5 °C, 8.23 mg/L, 8.11, and 597 µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 52-59).

Loach Minnow catch has declined since its peak at 50 individuals captured in 2019, however, there has been no significant difference between catch from year to year. Loach Minnow CPUE in 2023, 9.18 Fish/Hour (Hr), decreased from last year's CPUE of 15.99 Fish/Hr. Gila Chub CPUE varies from year to year seemingly dependent on habitat availability. Sampling efforts have been unsuccessful at capturing Spikedace, despite relatively recent stocking events.

Table 12. Summary of catch by BPEF for nine stations sampled at Hot Springs Canyon, Arizona, on September 12-14, 2023. Total effort was 11,198 seconds.

<b>Reach</b>	<b>Stations</b>	<b>Statistic</b>	<b>AGCH</b>	<b>CAIN</b>	<b>GIIN</b>	<b>PACL</b>	<b>TICO</b>	<b>RHOS</b>	<b>Totals</b>
1 (3,244 sec)	HSC02	Count	945	3	88	43	1	486	1,566
	HSC05	% total catch	60.34%	0.19%	5.62%	2.75%	0.06%	31.03%	100.00%
	HSC06-F	CPUE (ind/hr)	1048.71	3.33	97.66	47.72	1.11	539.33	1737.85
2 (3,879 sec)	HSC13	Count	181	8	56	37	24	342	648
	HSC17	% total catch	27.93%	1.23%	8.64%	5.71%	3.70%	52.78%	100.00%
	HSC23-F	CPUE (ind/hr)	167.98	7.42	51.97	34.34	22.27	317.40	601.39
3 (4,075 sec)	HSC27	Count	128	0	6	1	0	84	219
	HSC29	% total catch	58.45%	0.00%	2.74%	0.46%	0.00%	38.36%	100.00%
	HSC32-F	CPUE (ind/hr)	113.08	0.00	5.30	0.88	0.00	74.21	193.47
<b>Total</b>		Count	1,254	11	150	81	25	912	2,433
		% total catch	51.54%	0.45%	6.17%	3.33%	1.03%	37.48%	100.00%
		CPUE (ind/hr)	403.14	3.54	48.22	26.04	8.04	293.20	782.18

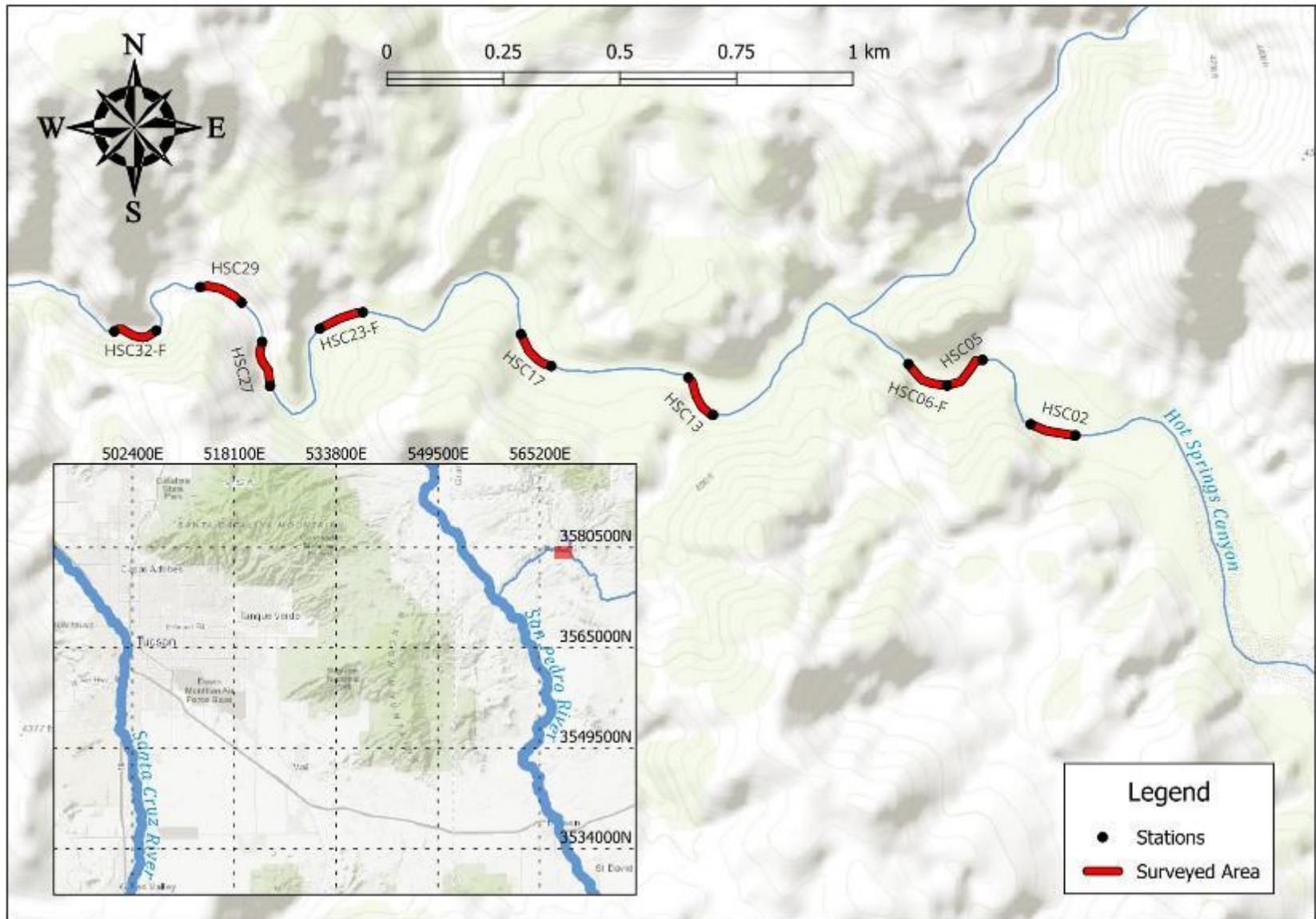


Figure 48. Location of stations sampled at Hot Springs Canyon, Arizona, surveyed September 12-14, 2023.

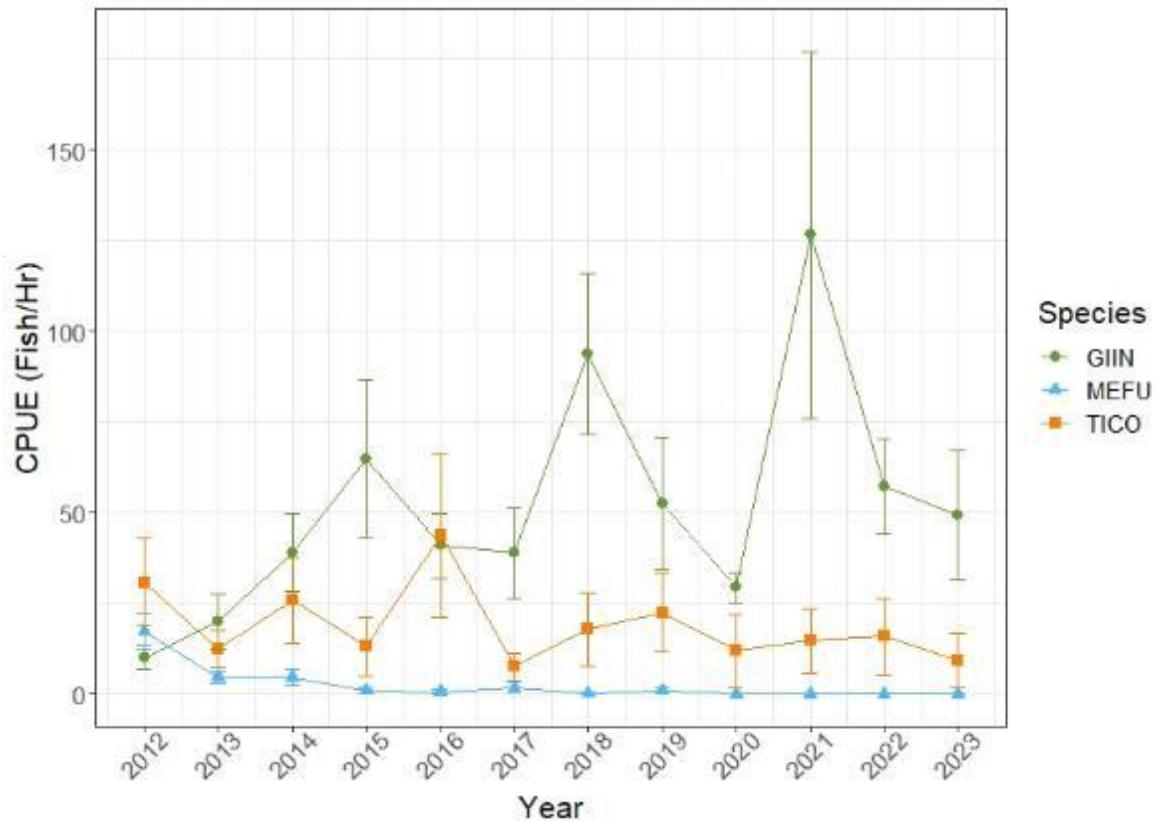


Figure 49. Mean CPUE of focal species from annual monitoring since 2012 at Hot Springs Canyon.

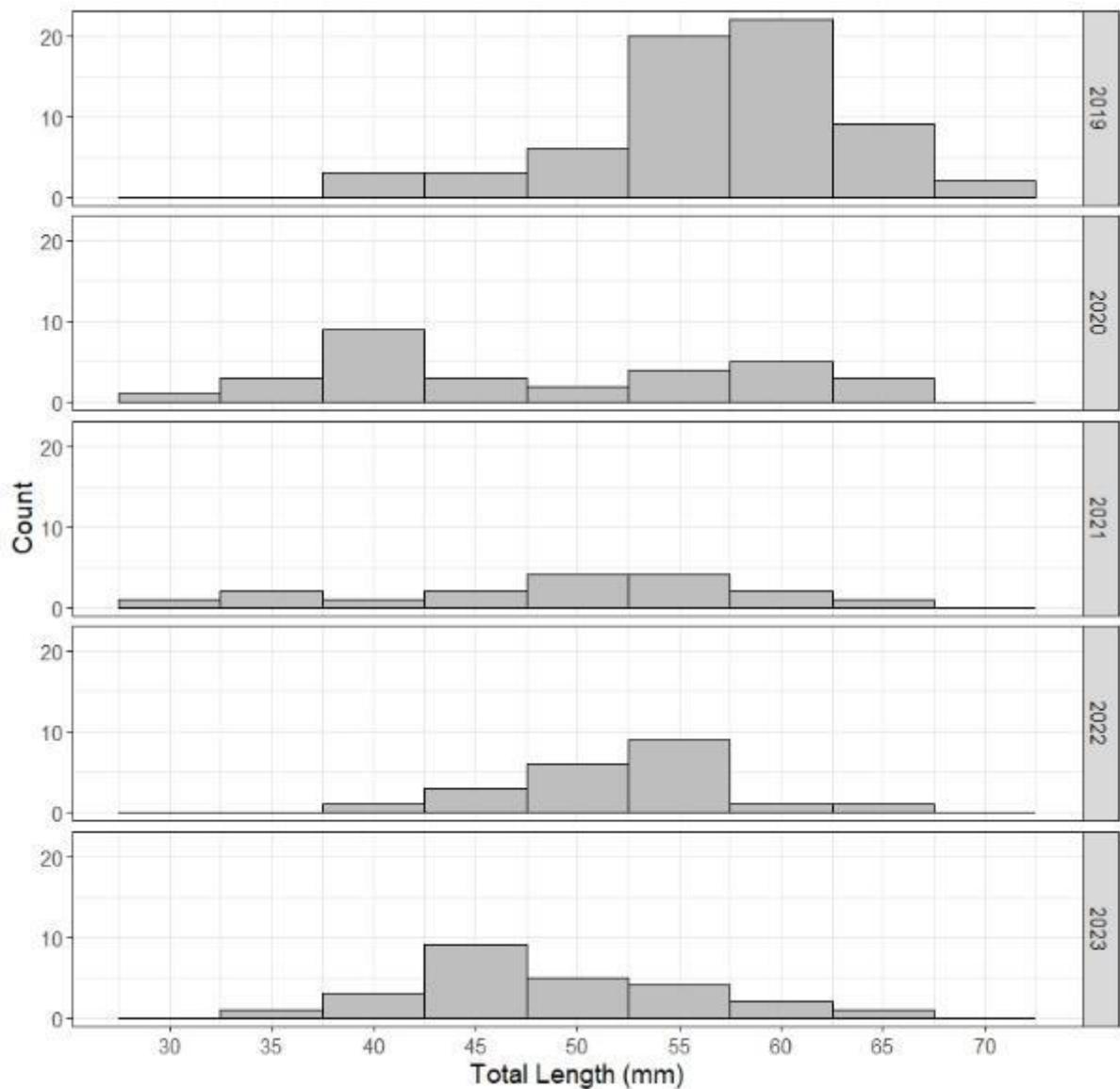


Figure 50. Length-frequency histogram of Loach Minnow captured at Hot Springs Canyon since 2019. Total number of Loach Minnow captured by year, descending in the graph was 50, 30, 17, 21, and 25, respectively.

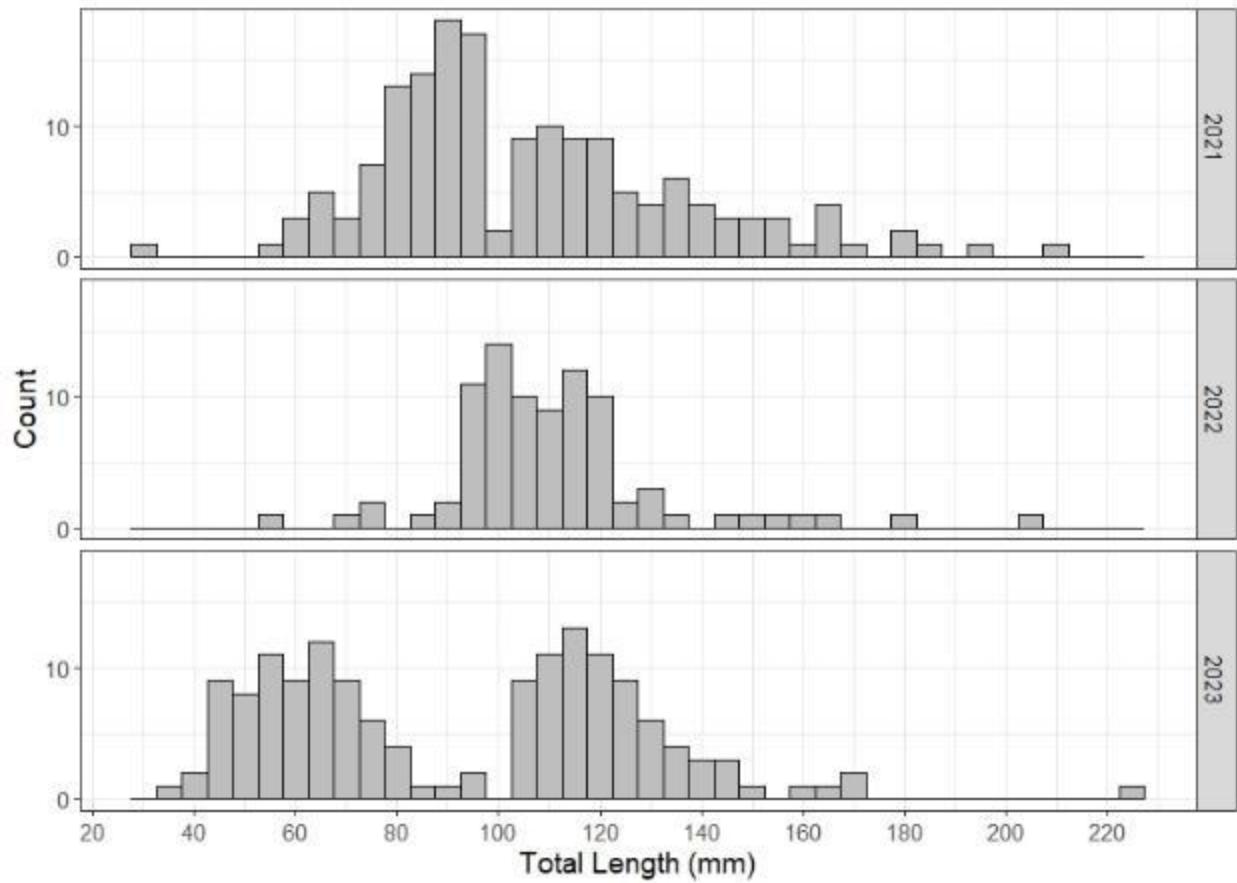


Figure 51. Length-frequency histogram of Gila Chub captured at Hot Springs Canyon under GRBNFMP since 2021. Total numbers of Gila Chub caught in 2021, 2022, and 2023 were 160, 86, and 150, respectively.

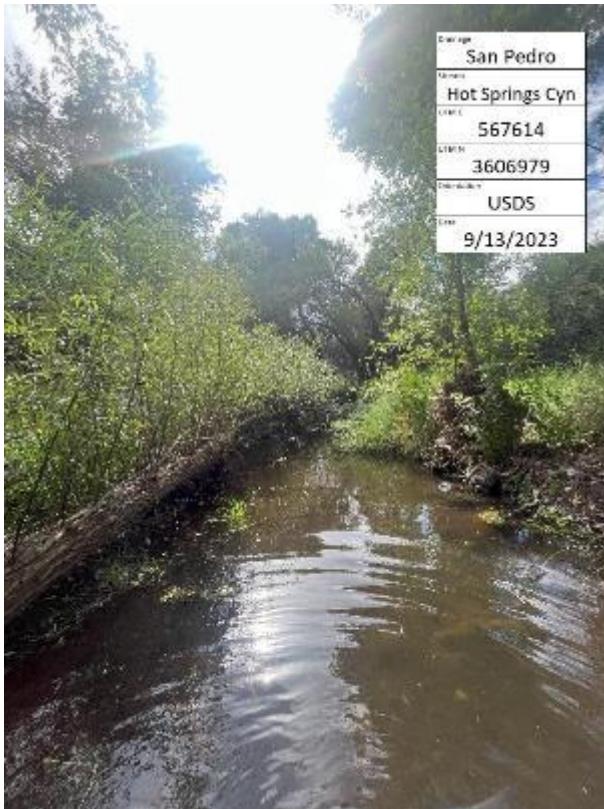


Figure 52. Upstream to downstream view of HSC06-F, Hot Springs Canyon, Arizona.

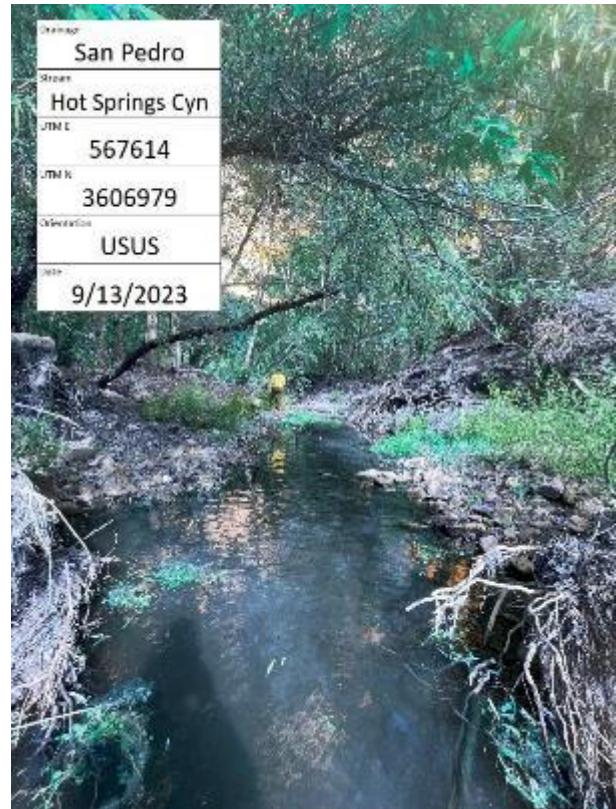


Figure 53. Upstream to upstream view of HSC06-F, Hot Springs Canyon, Arizona.

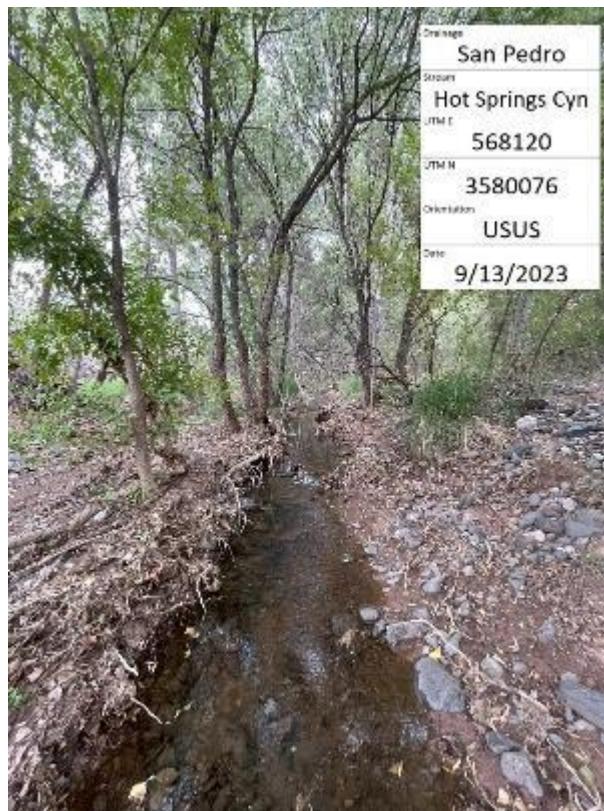


Figure 54. Upstream to upstream view of HSC23-F, Hot Springs Canyon, Arizona.

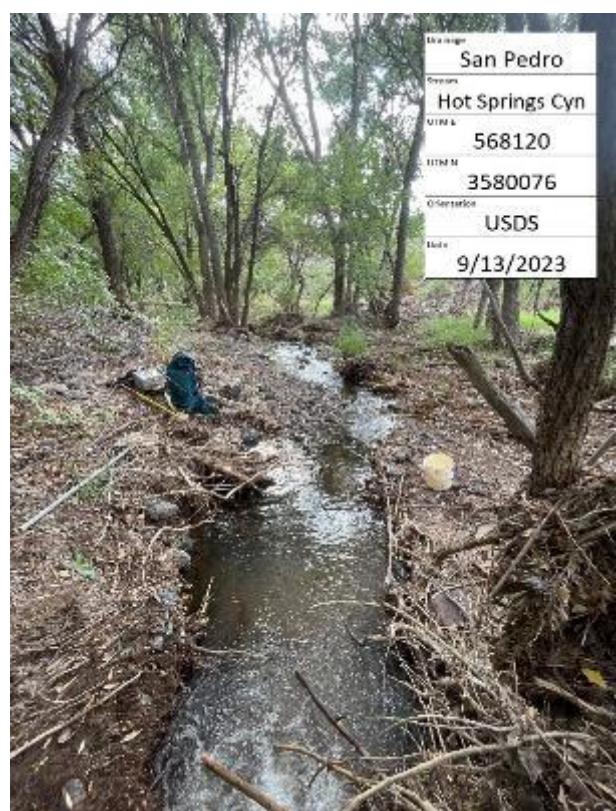


Figure 55. Upstream to downstream view of HSC23-F, Hot Springs Canyon, Arizona.

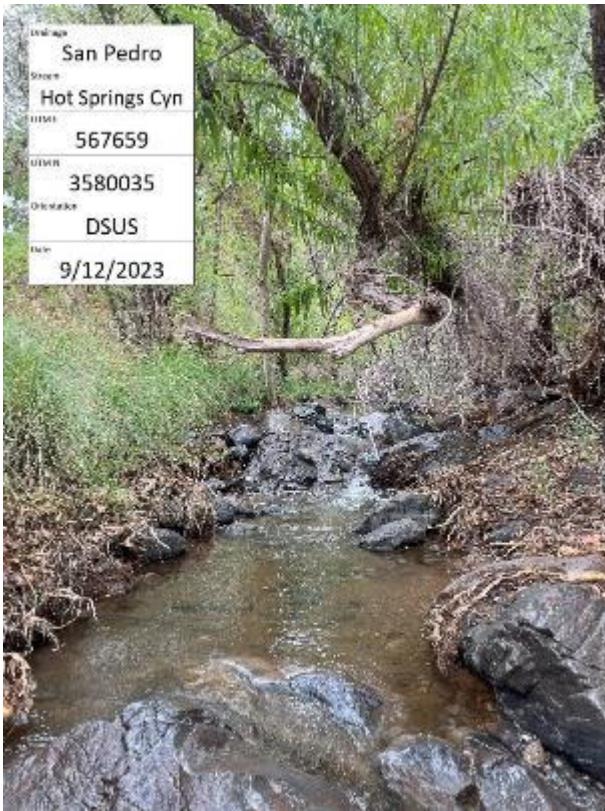


Figure 56. Downstream to upstream view of HSC32-F, Hot Springs Canyon, Arizona.

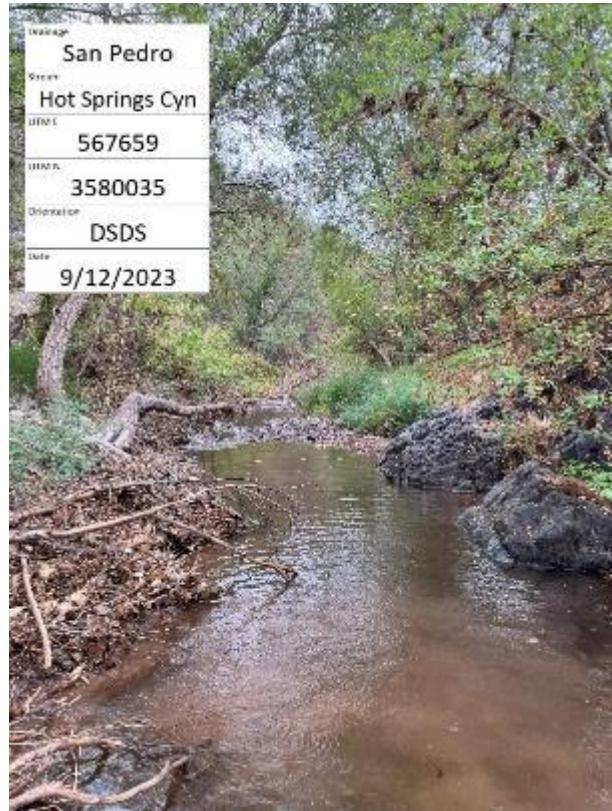


Figure 57. Downstream to downstream view of HSC32-F, Hot Springs Canyon, Arizona.

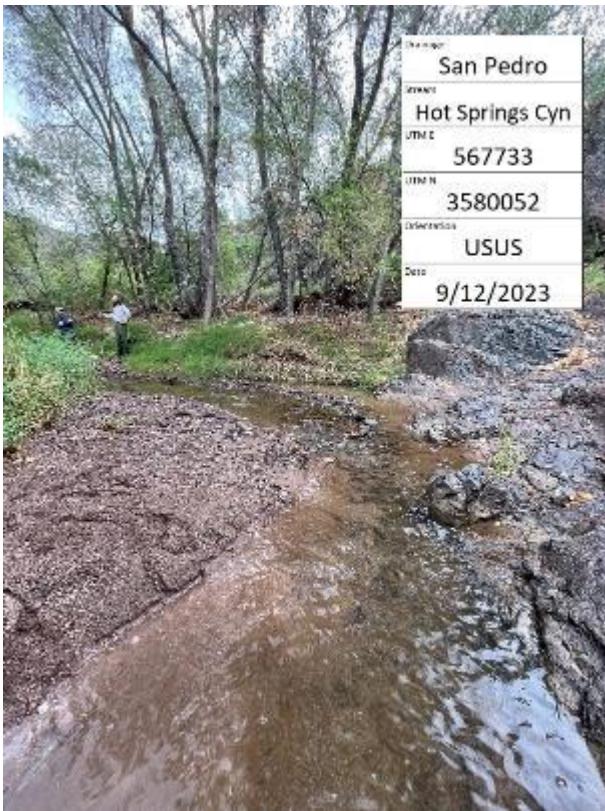


Figure 58. Upstream to upstream view of HSC32-F, Hot Springs Canyon, Arizona.

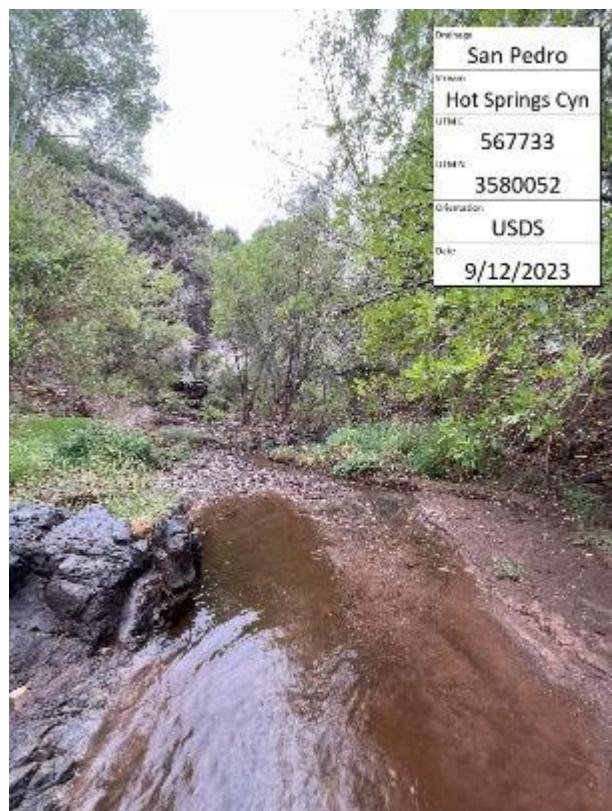


Figure 59. Upstream to downstream view of HSC32-F, Hot Springs Canyon, Arizona.

### **Headquarters Spring**

<b>Station</b>		<b>Lower Boundary</b>	<b>Upper Boundary</b>
HQS01-F	12S NAD83	571687E, 3578008N	571644E, 3578087N
HQS02-F		571649E, 3578094N	571603E, 3578163N
HQS03-F		571599E, 3578173N	571644E, 3578238N

Headquarters Spring (Cochise Co., AZ; alternatively known as Hookers Hot Springs) is located within the Muleshoe Ranch Cooperative Management Area and begins south of The Nature Conservancy (TNC) Headquarters building. Headquarters Springs fills several large pools and two metal hot tubs which overflow into a narrow stream that runs for about 300 m until it merges with Hot Springs Canyon. Gila Topminnow were initially stocked in Headquarters Spring in 2008. No other fish species are present in Headquarters Spring; however, Loach Minnow, Spikedace, Gila Chub, Speckled Dace, and Longfin Dace are present downstream in Hot Springs Canyon. A constructed fish barrier is present in Hot Springs Canyon about 9 km upstream of its confluence with the San Pedro River to prevent the upstream movement of non-native fish. This is the first survey conducted at this site for the GRBNFMP.

M&A personnel surveyed Headquarters Spring September 11, 2023. Three fixed, 100-m stations were surveyed (Figure 60). Ten minnow traps were deployed within each station and set for a minimum of 2 hours. Sampled stations were accessed by foot from Muleshoe Ranch Headquarters.

A total of 1,945 Gila Topminnow was captured across three fixed stations, however, only one fish was caught in the most upstream station (HQS01-F). Several Lowland Leopard Frogs of different life cycle stages (n=14) and one Black-Necked Garter Snake *Thamnophis cyrtopsis* were captured in minnow traps. A summary of catch for all stations is provided below in table 12.

Mesohabitat consisted mainly of a continuous, slow-moving run immediately downstream of the springhead. Average water temperature, DO, pH, and conductivity was 28.2 °C, 9.23 mg/L, 8.55, and 327.3 µS, respectively. Photographs of upper and lower extents were not taken at this site.

Table 13. Summary of catch by minnow trap at Headquarters Spring, Arizona, surveyed September 11, 2023. Total effort was 92.5 trap hours.

<b>Station</b>	<b>Statistic</b>	<b>POOC (&lt;20)</b>	<b>POOC (&gt;=20)</b>	<b>Total</b>
HQS01-F (24.5 hrs)	Count	0	1	1
	% total catch	0.00%	100.00%	100.00%
	CPUE (ind/net hr)	0.00	0.04	0.04
HQS02-F (22.4 hrs)	Count	85	1122	1,207
	% total catch	7.04%	92.96%	100.00%
	CPUE (ind/net hr)	3.80	50.13	53.93
HQS03-F (25.6 hrs)	Count	58	679	737
	% total catch	7.87%	92.13%	100.00%
	CPUE (ind/net hr)	2.26	26.47	28.73
<b>Total</b>	Count	143	1,802	1,945
	% total catch	7.35%	92.65%	100.00%
	CPUE (ind/net hr)	1.97	24.84	26.81



Figure 60. Location of surveyed stations at Headquarters Spring, Cochise Co, Arizona. Surveyed September 12, 2023.

## Wildcat Canyon

<b>Station</b>		<b>Lower Boundary</b>	<b>Upper Boundary</b>
WCC02	12S NAD83	569861E, 3580757N	569904E, 3580838N
WCC03		569806E, 3580679N	569911E, 3580796N
WCC04-F		569724E, 3580695N	569806E, 3580684N

Wildcat Canyon (Cochise Co., AZ) is located within the Muleshoe Ranch Cooperative Management Area and is tributary to Hot Springs Canyon in the San Pedro drainage (Figure 61). There is about 1.4 km of perennial habitat present in Wildcat Canyon. Gila Topminnow were stocked in 2014 (Bylas Spring lineage) into Wildcat Canyon above a large waterfall approximately 900 m upstream of its confluence with Hot Springs Canyon and have persisted there ever since (Gray 2018). Wildcat Canyon was last surveyed under the GRBNFMP in 2020 (Shollenberger et al. 2021).

M&A personnel surveyed Wildcat Canyon September 14, 2023. Three 100-m stations (one fixed, two random) were surveyed with 10 minnow traps set for a minimum of 2 hours. The site was accessed from a small 4x4 trail via a Honda side-by-side provided by Muleshoe Ranch personnel.

A total of 393 Gila Topminnow were captured across all surveyed stations (Table 14). This total is approximately 50% of overall catch from the last survey conducted at this site in 2020 (n=735). One metamorph Lowland Leopard Frog was also captured.

This population is protected from upstream movement of non-native fishes by natural waterfalls in the drainage as well as a constructed fish barrier located in lower Hot Springs Canyon. Severe flooding would be the biggest threat to the persistence of Gila Topminnow in Wildcat Canyon due to the narrow nature of this canyon.

Water temperature, DO, pH, and conductivity was 20.3 °C, 9.6 mg/L, 8.70, and 800 µS, respectively. Photographs of upper and lower extents are provided below (Figures 62-63).

Table 14. Summary of catch by minnow trap at Wildcat Canyon, Arizona, Surveyed September 13, 2023. Total effort was 64.2 trap hours.

<b>Station</b>	<b>Statistic</b>	<b>POOC (&lt;20)</b>	<b>POOC (&gt;=20)</b>	<b>Total</b>
WCC02 (20.2 hrs)	Count	13	240	253
	% total catch	5.14%	94.86%	100.00%
	CPUE (ind/hr)	0.64	11.87	12.51
WCC03 (20.7 hrs)	Count	4	24	28
	% total catch	14.29%	85.71%	100.00%
	CPUE (ind/hr)	0.19	1.16	1.35
WCC04-F (23.3 hrs)	Count	7	105	112
	% total catch	6.25%	93.75%	100.00%
	CPUE (ind/hr)	0.30	4.51	4.81
<b>Total</b>	Count	24	369	393
	% total catch	6.11%	93.89%	100.00%
	CPUE (ind/m <sup>2</sup> )	0.37	5.75	6.12

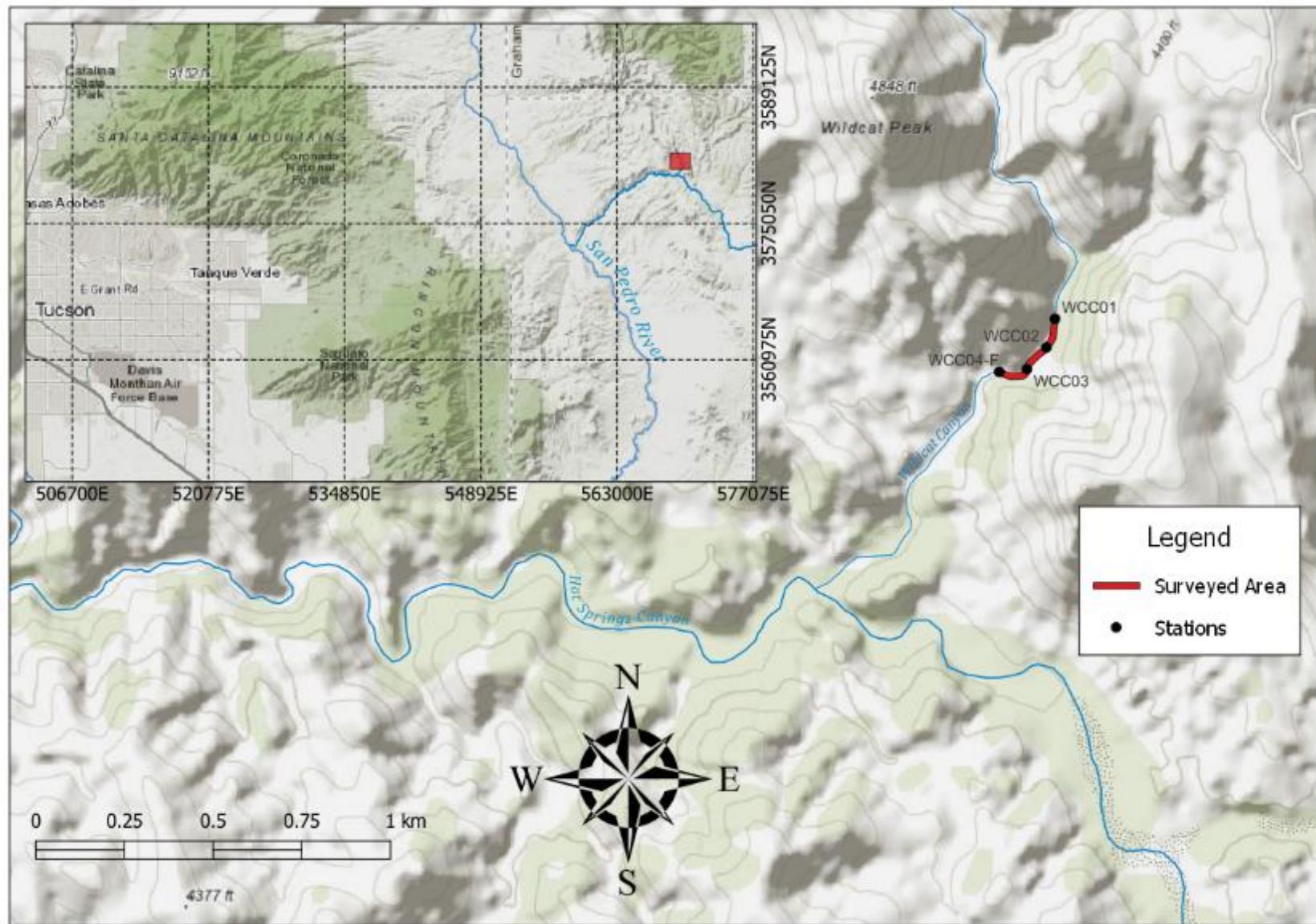


Figure 61. Location of sampled stations at Wildcat Canyon, Arizona, surveyed September 13, 2023.

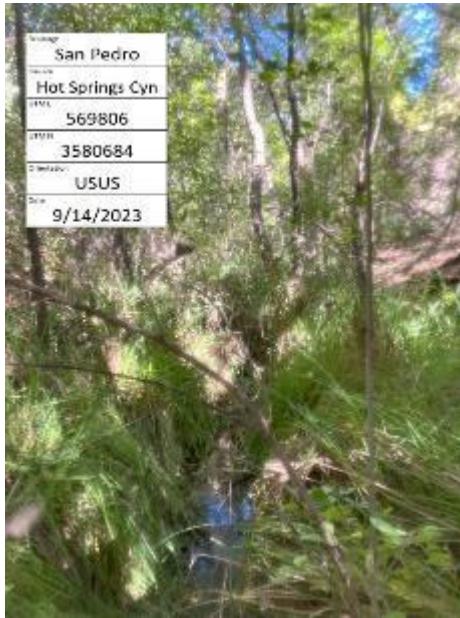


Figure 62. Upstream to upstream view of WCC04-F, Wildcat Canyon, Arizona.

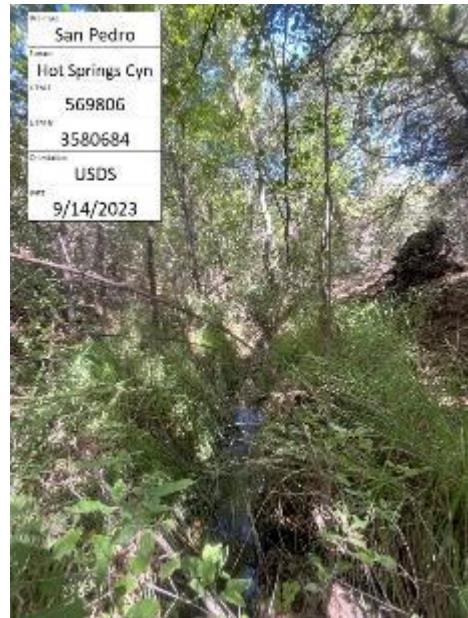


Figure 63. Upstream to downstream view of WCC04-F, Wildcat Canyon, Arizona.

## Santa Cruz River Basin

### Coal Mine Canyon

Station		Lower Boundary	Upper Boundary
CMC01-F	12R NAD83	510442E, 3487943N	510512E, 3488016N
CMC02-F		510053E, 3487035N	510035E, 3487135N

Coal Mine Canyon (Cochise Co., AZ) is 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). This site is surveyed annually for GRBNFMP, and 1,033 Gila Topminnow were captured in 2022 (Shollenberger et al. 2023).

M&A personnel surveyed Coal Mine Canyon on April 3, 2023. 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. Maintenance on Montezuma Well Road made the drive much more manageable in a 4x4 truck. Two, 100-m fixed stations were surveyed, with each station encompassing one of the perennial pools (Figure 64). Totals of 880 Gila Topminnow and 13 Longfin Dace were captured across both stations.

The upstream station, CMC01-F, was located at a large, fenced spring pool. This spring pool was approximately 16-m long and 18-m wide with higher water levels observed then in 2022 when this pool was 11-m long and 12-m wide. In addition, the rest of the station was wetted whereas in past surveys it was dry. Ten minnow traps were set within this station, which resulted in capture of six Gila Topminnow. Opportunistic dip net sweeps were conducted in the spring pool and in a disconnected shallow pool within the enclosure fence. Four dip net sweeps resulted in capture of 30 Gila Topminnow (Table 16).

The second station, CMC02, was located approximately 1 km downstream from CMC01-F. This station consisted of a single pool about 22-m in length, 8-m wide, and 2-m deep, similar to conditions encountered in the last survey. This year, however, the entirety of the station was wetted. Ten minnow traps were set, which resulted in the capture of 159 Gila Topminnow. In addition, one Longfin Dace was visually observed and confirmed through four dip net sweeps that resulted in capture of 36 Gila Topminnow, one Longfin Dace, and two American Bullfrogs *Rana catesbeiana*. Catch and effort totals for both stations are summarized in tables 15 and 16.

Improved conditions in Coal Mine Canyon led to approximately half the mean CPUE for Gila Topminnow at this site compared to last year (Figure 65). Minnow traps were only able to sample the very edges of the large spring pool. It is suspected that Gila Topminnow reside in the deeper portions of the pool that were unable to be sampled with the gear used. Surface water was nearly continuous between both spring stations. Longfin Dace were detected here for the second time since 2012, indicating the species has persisted in Coal Mine Canyon since its introduction by AZGFD in 2007.

Average water temperature, DO, pH, and conductivity across the two fixed stations was 17.0 °C, 14.0 mg/L, 8.43, and 245.2 µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 66-73).

Table 15. Summary of catch by minnow trap for two stations sampled at Coal Mine Canyon, Arizona, April 3, 2023. Total effort was 41.6 hours.

Station	Statistic	POOC (<20)	POOC ( $\geq 20$ )	Total
CMC01-F (20.9 hrs)	Count	0	6	6
	% total catch	0.00%	100.00%	100.00%
	CPUE (ind/net hr)	0.00	6.00	6.00
CMC02-F (20.7 hrs)	Count	19	140	159
	% total catch	11.95%	88.05%	100.00%
	CPUE (ind/net hr)	0.92	6.76	7.68
<b>Total</b>	Count	19	146	165
	% total catch	11.52%	88.48%	100.00%
	CPUE (ind/net hr)	0.46	3.51	3.96

Table 16. Summary of catch by dip net sweeps at Coal Mine Canyon, Arizona, April 3, 2023. Total effort was eight dip net sweeps or 2.82 m<sup>2</sup>.

Station	Statistic	POOC (<20)	POOC ( $\geq 20$ )	AGCH	RACA	Total
CMC01-F (1.41 m <sup>2</sup> )	Count	6	24	0	0	30
	% total catch	20.00%	80.00%	0.00%	0.00%	100.00%
	CPUE (ind/m <sup>2</sup> )	4.24	16.97	0.00	0.00	21.21
CMC02-F (1.41 m <sup>2</sup> )	Count	4	32	1	2	39
	% total catch	10.26%	82.05%	2.56%	5.13%	100.00%
	CPUE (ind/m <sup>2</sup> )	2.83	22.63	0.71	1.41	27.58
<b>Total</b>	Count	10	56	1	2	69
	% total catch	14.49%	81.16%	1.45%	2.90%	100.00%
	CPUE (ind/m <sup>2</sup> )	3.54	19.80	0.35	0.71	24.39

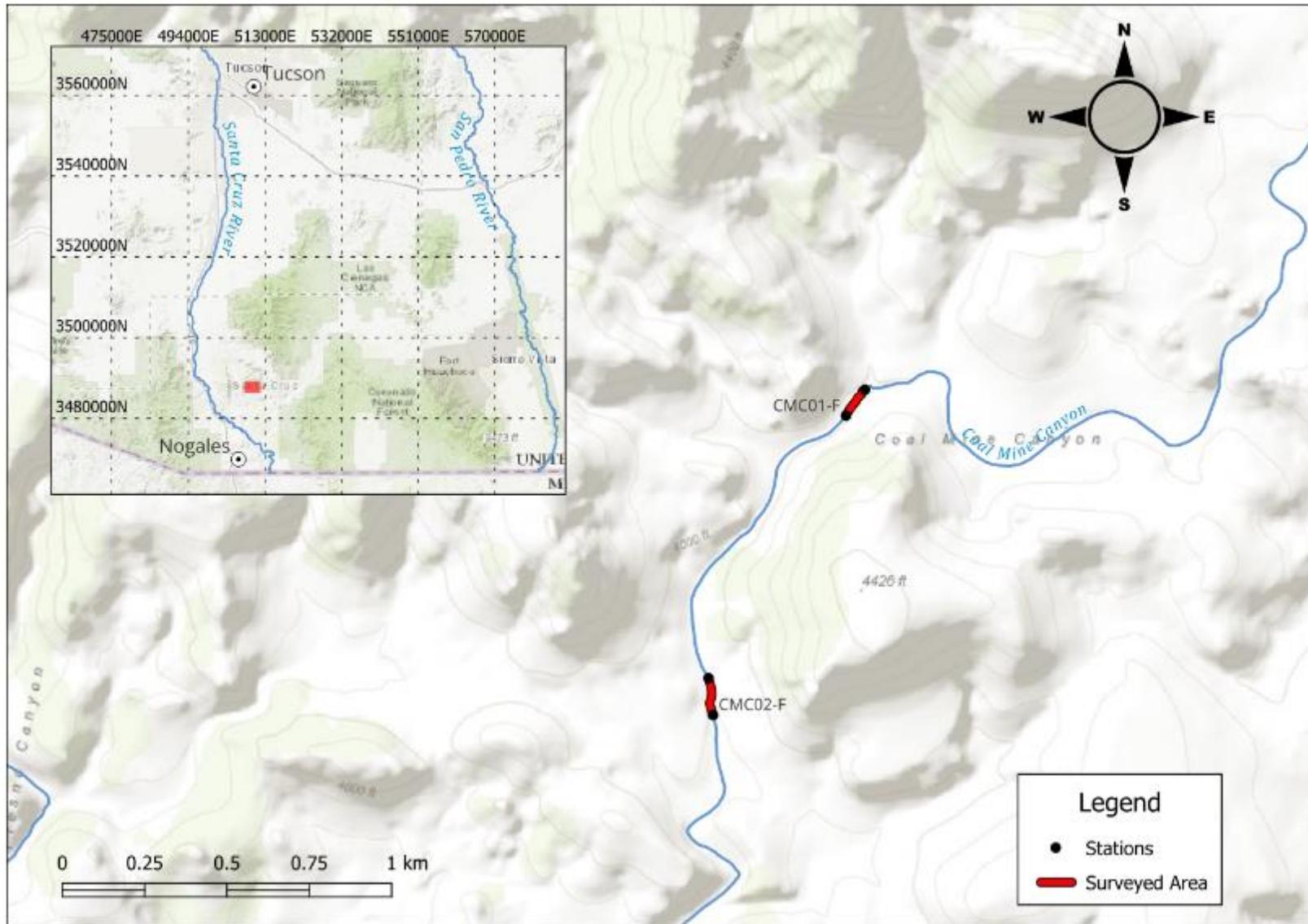


Figure 64. Location of sampled stations at Coal Mine Canyon, Arizona, surveyed April 3, 2023.

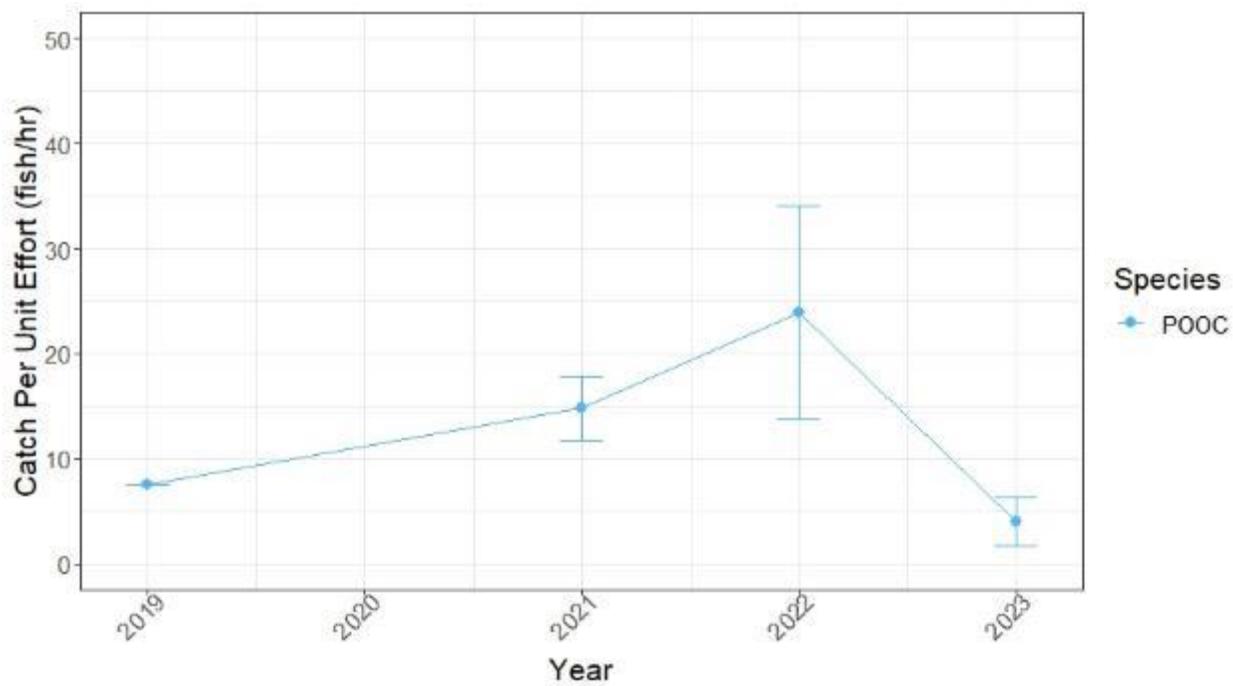


Figure 65. Mean CPUE of Gila Topminnow captured at Coal Mine Canyon under GRBNFMP since 2019.

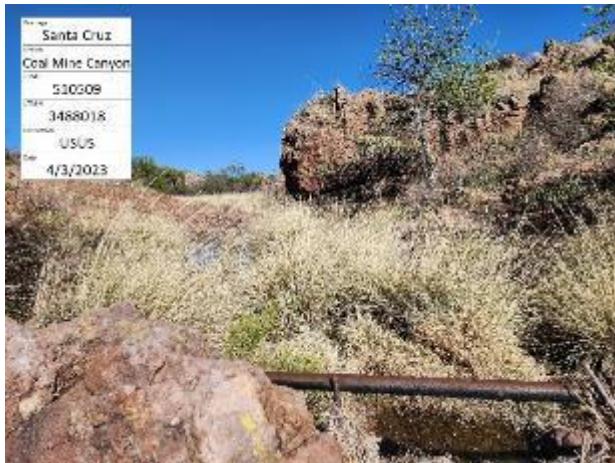


Figure 66. Upstream to upstream view of CMC01-F, Coal Mine Canyon, Arizona.



Figure 67. Upstream to downstream view of CMC01-F, Coal Mine Canyon, Arizona.



Figure 68. Downstream to upstream view of CMC01-F, Coal Mine Canyon, Arizona.



Figure 69. Downstream to downstream view of CMC01-F, Coal Mine Canyon, Arizona.



Figure 70. Upstream to upstream view of CMC02-F, Coal Mine Canyon, Arizona.

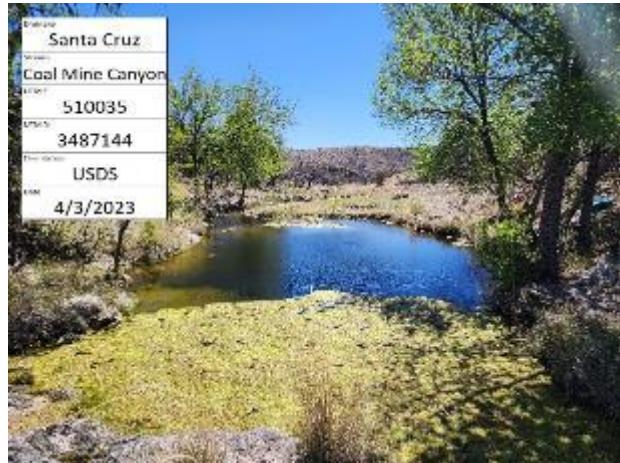


Figure 71. Upstream to downstream view of CMC02-F, Coal Mine Canyon, Arizona.



Figure 72. Downstream to downstream view of CMC02-F, Coal Mine Canyon, Arizona.

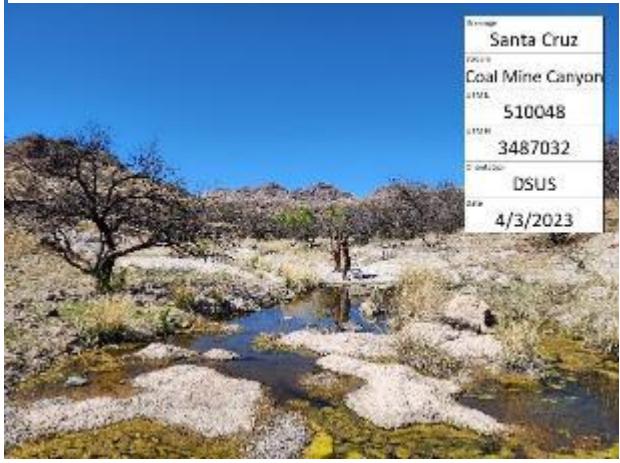


Figure 73. Downstream to upstream view of CMC02-F, Coal Mine Canyon, Arizona.

## Fresno Canyon

Station		Lower Boundary	Upper Boundary
FRC01-F	12R NAD83	507749E, 3485964N	507848E, 3485986N
FRC02-F		507729E, 3485860N	507749E, 3485959N
FRC03-F		507745E, 3485724N	507727E, 3485857N

Fresno Canyon (Santa Cruz Co., AZ) is 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 GRBNFMP; 24 and 1,242 Gila Topminnow were captured in 2021 and 2022 respectively (Shollenberger et al. 2023).

M&A personnel surveyed Fresno Canyon on April 4, 2023. 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 74). Ten minnow traps were set within each station for approximately 2 hours. Surface water was higher and lesser duckweed *Lemna minor* was far less prevalent throughout the monitoring reach compared to 2021. Still, there was little flowing water and mesohabitat consisted of mostly disconnected pools. Totals of 1,016 Gila Topminnow and 374 Longfin Dace were captured across all stations (Table 17).

Efforts in the upper station captured 323 Gila Topminnow and 139 Longfin Dace. The fence near the upper portion of this perennial stretch is still damaged and cattle impacts were readily apparent, and several cows were observed on the hike to the monitoring reach. Efforts in the middle station captured 130 Gila Topminnow and 139 Longfin Dace. Efforts within the downstream station captured 563 Gila Topminnow, 96 Longfin Dace, and one Northern Crayfish *Faxonius virilis*.

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 (14.47 (Fish/Hr); Figure 75). A Green Sunfish (75 mm TL) was captured at this site in 2022. No Green Sunfish were captured or observed in this survey. There was a significant decrease in Northern Crayfish captured compared to recent surveys (n=194, 2022). Many dead Northern Crayfish were observed in wet and dry portions of the canyon. A Sonora Mud Turtle was observed in station FRC03-F.

Stream discharge measurements were not taken as there was no flowing water. Average water temperature, DO, pH, and conductivity across the three fixed stations was 14.6 °C, 21.1 mg/L, 8.02, and 443 µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 76-82).

Table 17. Summary of catch by minnow trap at Fresno Canyon, Arizona, surveyed April 4, 2023.

<b>Station</b>	<b>Statistic</b>	<b>POOC (&lt;20)</b>	<b>POOC (&gt;=20)</b>	<b>AGCH (&lt;40)</b>	<b>AGCH (&gt;=40)</b>	<b>FAVI</b>	<b>Total</b>
FRC01-F (30.6 hrs)	Count	37	286	53	86	0	462
	% total catch	8.01%	61.90%	11.47%	18.61%	0.00%	100.00%
	CPUE (ind/net hr)	1.21	9.35	1.73	2.81	0.00	15.10
FRC02-F (23.9 hrs)	Count	10	120	48	91	0	269
	% total catch	3.72%	44.61%	17.84%	33.83%	0.00%	100.00%
	CPUE (ind/net hr)	0.42	5.02	2.01	3.81	0.00	11.26
FRC03-F (28.7 hrs)	Count	45	518	23	73	1	660
	% total catch	6.82%	78.48%	3.48%	11.06%	0.15%	100.00%
	CPUE (ind/net hr)	1.57	18.05	0.80	2.54	0.03	23.00
<b>Total</b>	Count	92	924	124	250	1	1,391
	% total catch	6.61%	66.43%	8.91%	17.97%	0.07%	100.00%
	CPUE (ind/net hr)	1.11	11.11	1.49	3.00	0.01	16.72

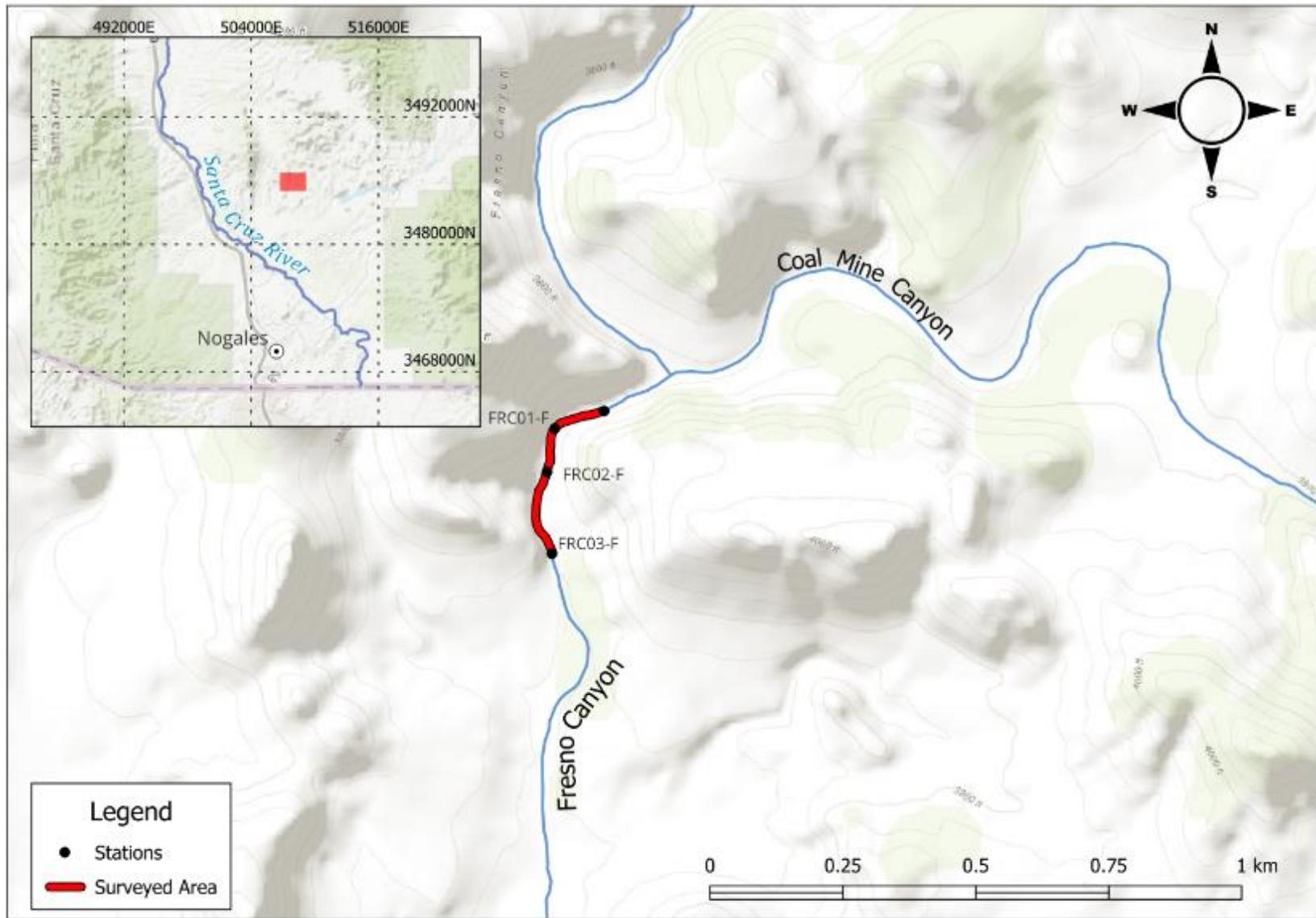


Figure 74. Location of sampled stations at Fresno Canyon, Arizona, surveyed April 4, 2023.

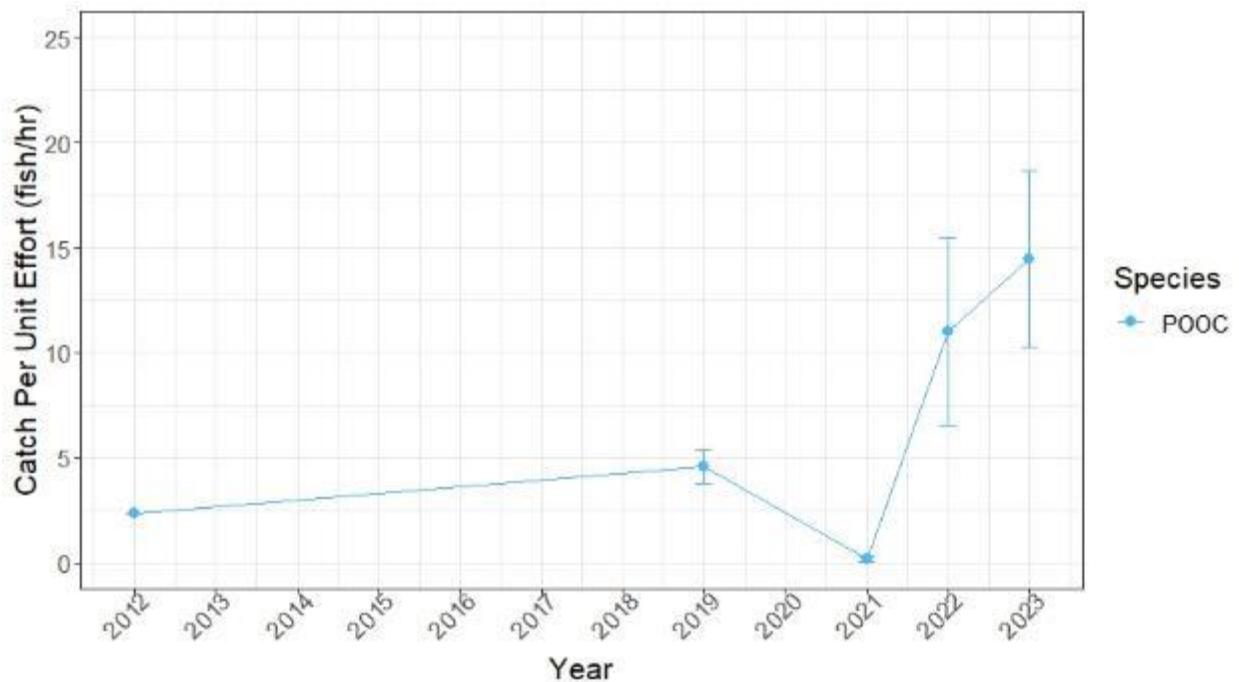


Figure 75. Mean CPUE of Gila Topminnow caught at Fresno Canyon since 2012.



Figure 76. Upstream to downstream view of FRC01-F, Fresno Canyon, Arizona.



Figure 77. Upstream to upstream view of FRC01-F, Fresno Canyon, Arizona.



Figure 78. Downstream to upstream view of FRC01-F, upstream to upstream view of FRC02-F, Fresno Canyon, Arizona.



Figure 79. Downstream to downstream view of FRC01-F, upstream to downstream view of FRC02-F, Fresno Canyon, Arizona.



Figure 80. Downstream to downstream view of FRC02-F, upstream to downstream view of FRC03-F, Fresno Canyon, Arizona.



Figure 81. Downstream to upstream view of FRC02-F, upstream to upstream view of FRC03-F, Fresno Canyon, Arizona.



Figure 82. Downstream to upstream view of FRC03-F, Fresno Canyon, Arizona.

## Cottonwood Spring

<b>Station</b>	<b>Lower Boundary</b>	<b>Upper Boundary</b>
CWS01-F	12R NAD83	527493E, 3502122N
		527554E, 3502055N

Cottonwood Spring (Santa Cruz Co., AZ) is 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 2022, resulting in capture of 292 Gila Topminnow (Shollenberger et al. 2023).

M&A personnel completed sampling of Cottonwood Spring on April 5, 2023. 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 83).

A total of 173 Gila Topminnow 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. Overall CPUE decreased this year by 13.35 individuals per m<sup>2</sup> compared to the 2022 survey (Figure 84). Catch and effort totals for CWS01-F are summarized in Table 10.

The vegetation noted in 2022 was dredged out near the diversion dam by the landowner two weeks prior to sampling efforts. Two pools located in Sonoita Creek just below the diversion dam were assessed visually and no fishes were observed. Despite lower catch than 2022, many YOY Gila Topminnow were encountered suggesting natural recruitment is occurring at this site. In addition, sampling was limited at the diversion dam due to algal growth along the bottom of the diversion pipe.

Water temperature, DO, pH, and conductivity at the springhead was 26.9 °C, 8.6 mg/L, 7.23, and 1,630 µS, respectively. Photographs of upper and lower extents of the fixed station are provided below (Figures 85-88).

Table 18. Summary of catch by dip net sweeps at Cottonwood Spring, Arizona, surveyed April 5, 2023. Total effort was 25 dip net sweeps or 8.84m<sup>2</sup>.

<b>Station</b>	<b>Statistic</b>	<b>POOC (&lt;20)</b>	<b>POOC (&gt;=20)</b>	<b>Total</b>
CWS01-F (8.84 m <sup>2</sup> )	Count	98	75	173
	% total catch	56.65%	43.35%	100.00%
	CPUE (ind/m <sup>2</sup> )	11.09	8.48	19.57

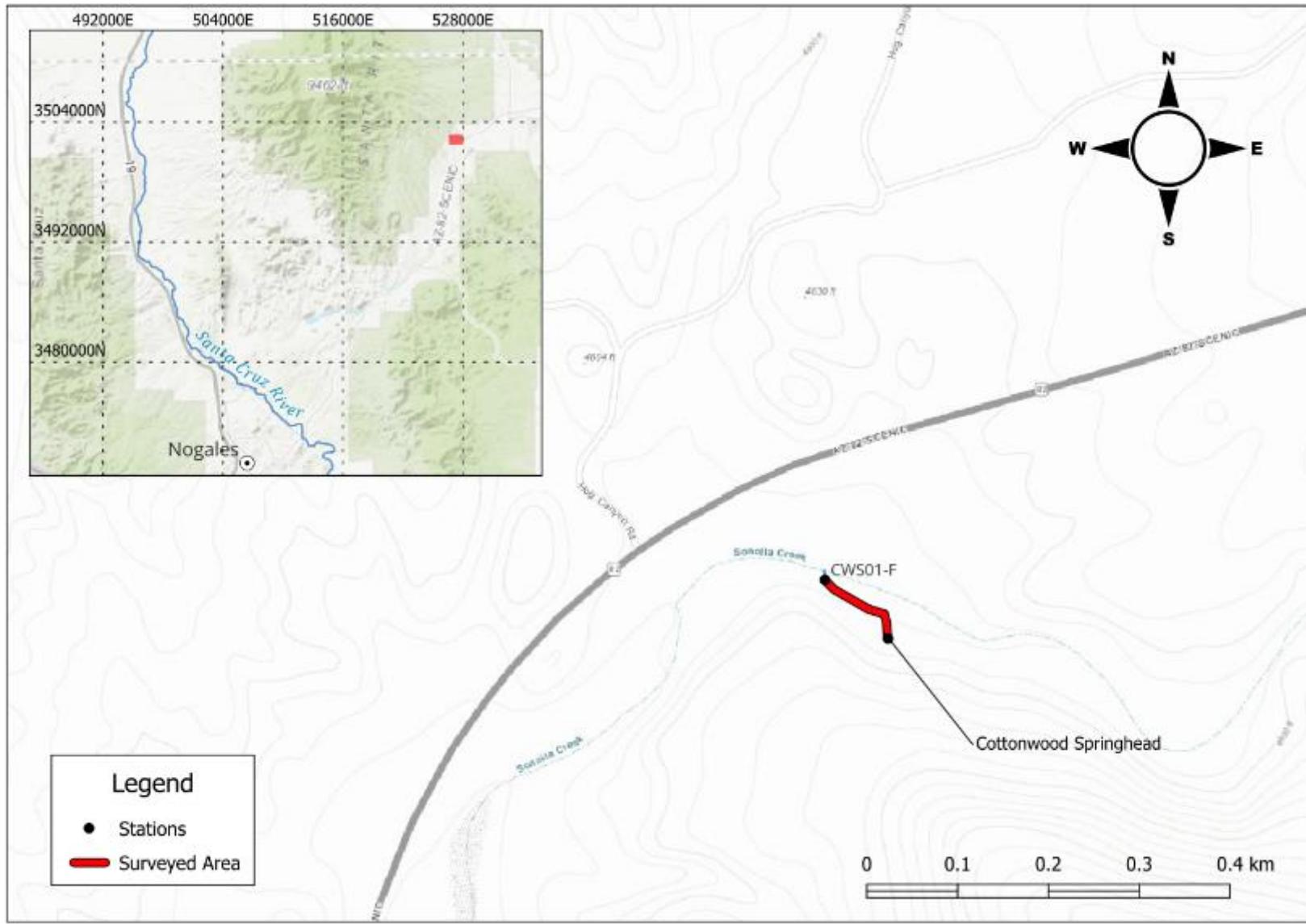


Figure 83. Location of sampled stations at Cottonwood Spring, Arizona, surveyed April 5, 2023.

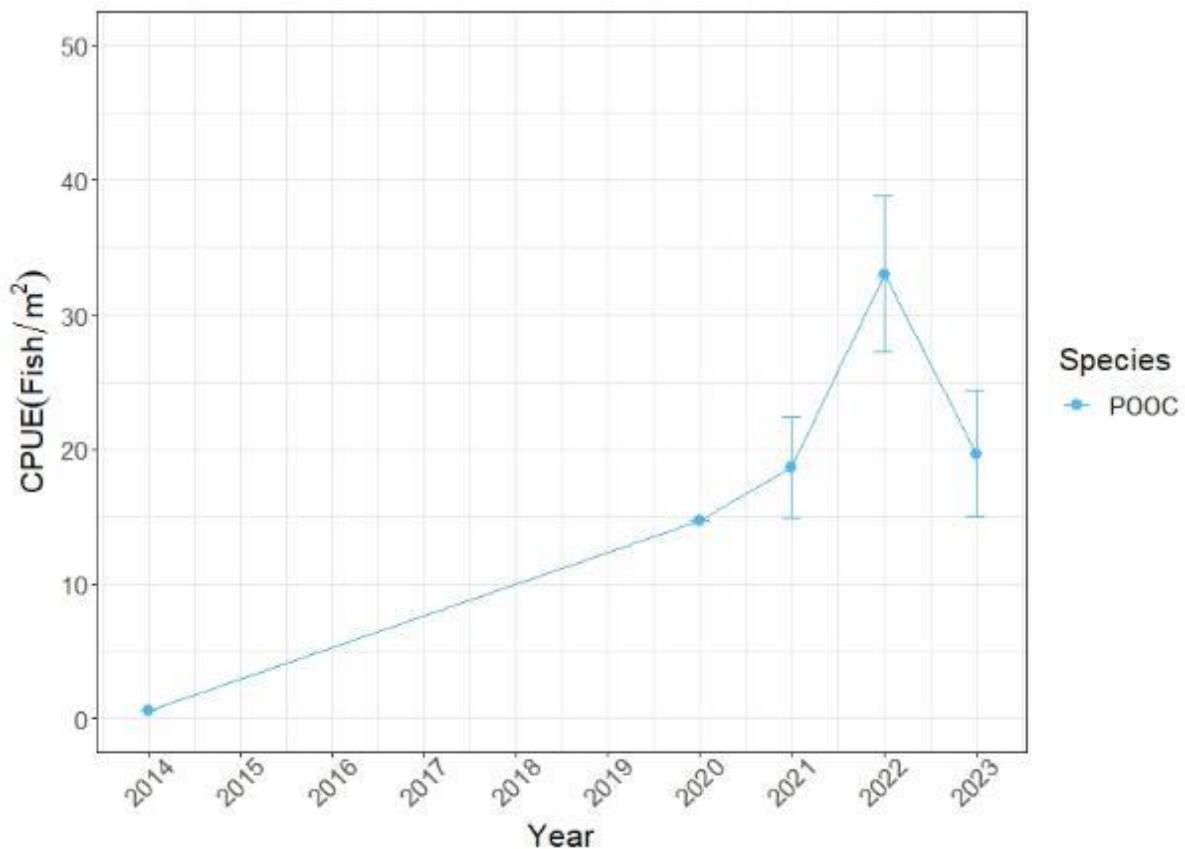


Figure 84. Mean CPUE of Gila Topminnow caught at Cottonwood Spring since 2014.

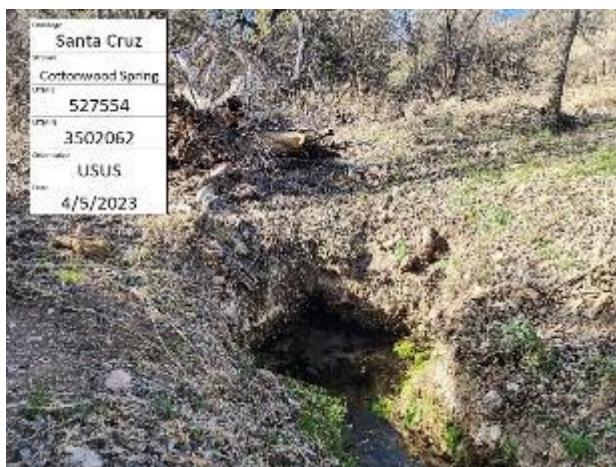


Figure 85. Upstream to upstream view of CWS01-F, Cottonwood Spring, Arizona.



Figure 86. Upstream to downstream view of CWS01-F, Cottonwood Spring, Arizona.

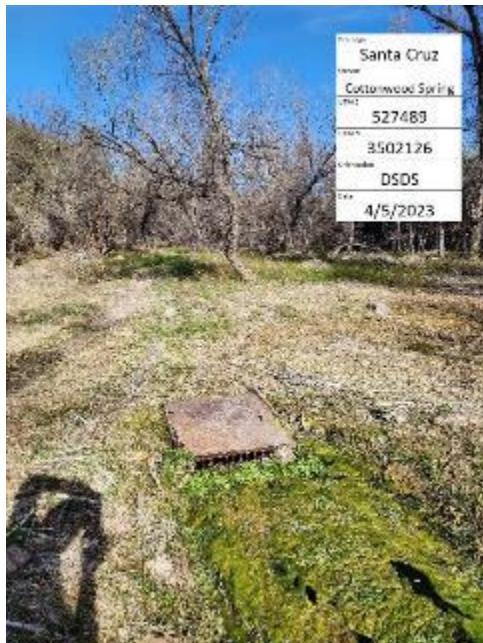


Figure 87. Downstream to downstream view of CWS01-F, Cottonwood Spring, Arizona.



Figure 88. Downstream to upstream view of CWS01-F, Cottonwood Spring, Arizona.

## Monkey Spring

<b>Station</b>	<b>Lower Boundary</b>	<b>Upper Boundary</b>
MKS01-F	12R NAD83	528085E, 3499695N
		528070E, 3499792N

Monkey Spring (Santa Cruz Co., AZ) is tributary to Sonoita Creek near Patagonia, AZ (Figure 89). 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 GRBNFMP, and 284 Gila Topminnow were captured in 2021 and 225 in 2022 (Shollenberger et al. 2023).

M&A personnel completed sampling of Monkey Spring on April 5, 2023. 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, MKS01-F, was surveyed (Figure 89). 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 103 Gila Topminnow was captured. No other fish species were detected. A Sonora Mud Turtle was captured within the enclosed spring. Catch and effort totals for MKS01-F are summarized in Table 19.

The majority (74.7%) 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. This is the third consecutive year of diminishing CPUE at Monkey Spring (Figure 90). Numerous YOY Gila Topminnow were observed that were small enough to fit through the 1/8-inch mesh of the seine. Another decrease in catch in next year's survey will be cause for concern for this population. However, the effectiveness of seining within the springhead is reduced by vegetation and narrow water flow. Dip netting may be more effective near the springhead in future sampling efforts.

Water temperature, DO, pH, and conductivity at the fixed station were 27.1 °C, 5.2 mg/L, 7.37, and 1,360 µS, respectively. Photographs of upper and lower extents of the fixed station are provided below (Figures 91-94).

Table 19. Summary of catch by seine at Monkey Spring, Arizona, surveyed April 5, 2023. Total effort was 10 seine hauls or 36.58 m<sup>2</sup>.

<b>Station</b>	<b>Statistic</b>	<b>POOC (&lt;20)</b>	<b>POOC (&gt;=20)</b>	<b>Total</b>
MKS01-F (36.58 m <sup>2</sup> )	Count	13	90	103
	% total catch	12.62%	87.38%	100.00%
	CPUE (ind/m <sup>2</sup> )	0.36	2.46	2.82

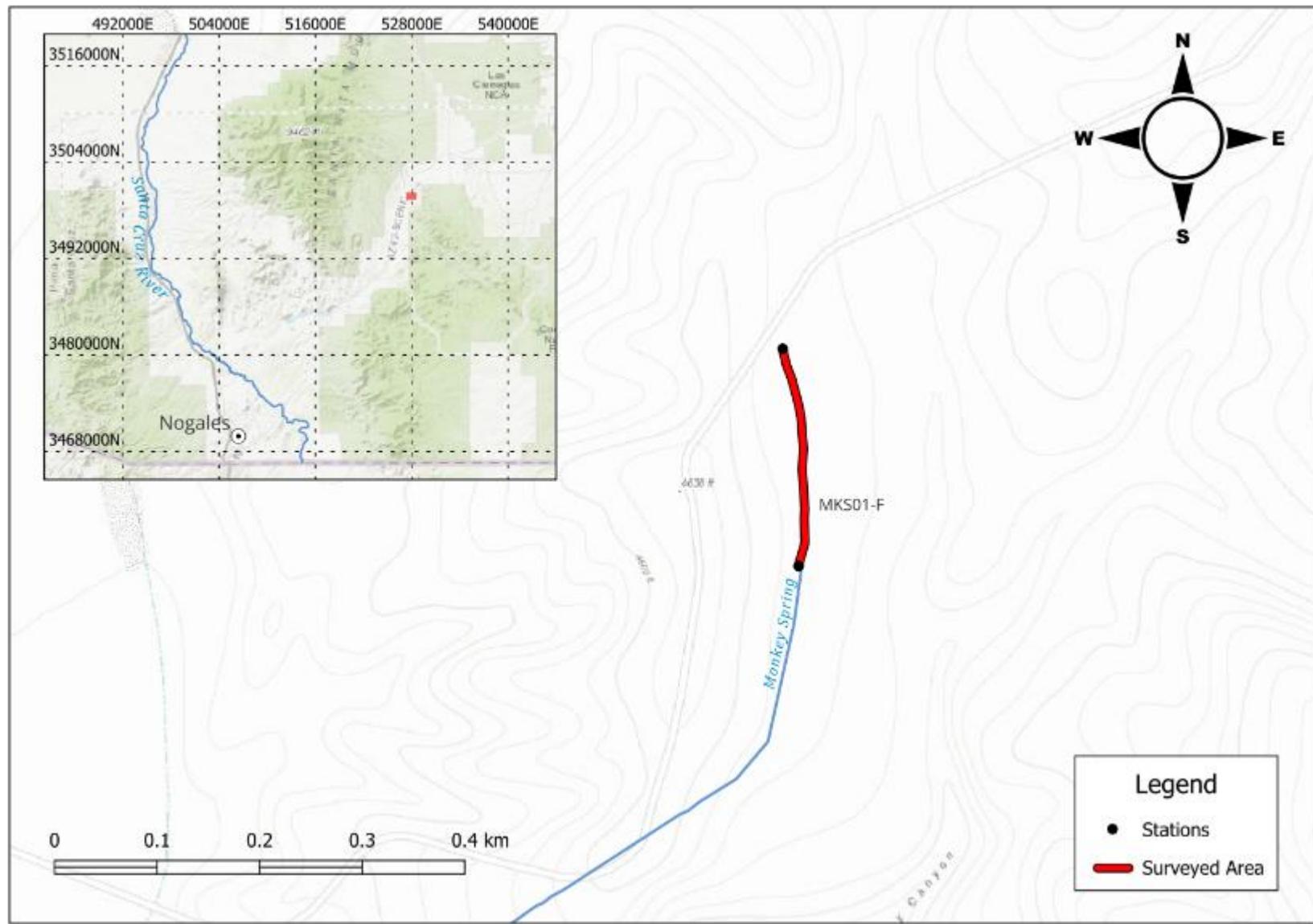


Figure 89. Location of sampled station at Monkey Spring, Arizona, surveyed April 5, 2023.

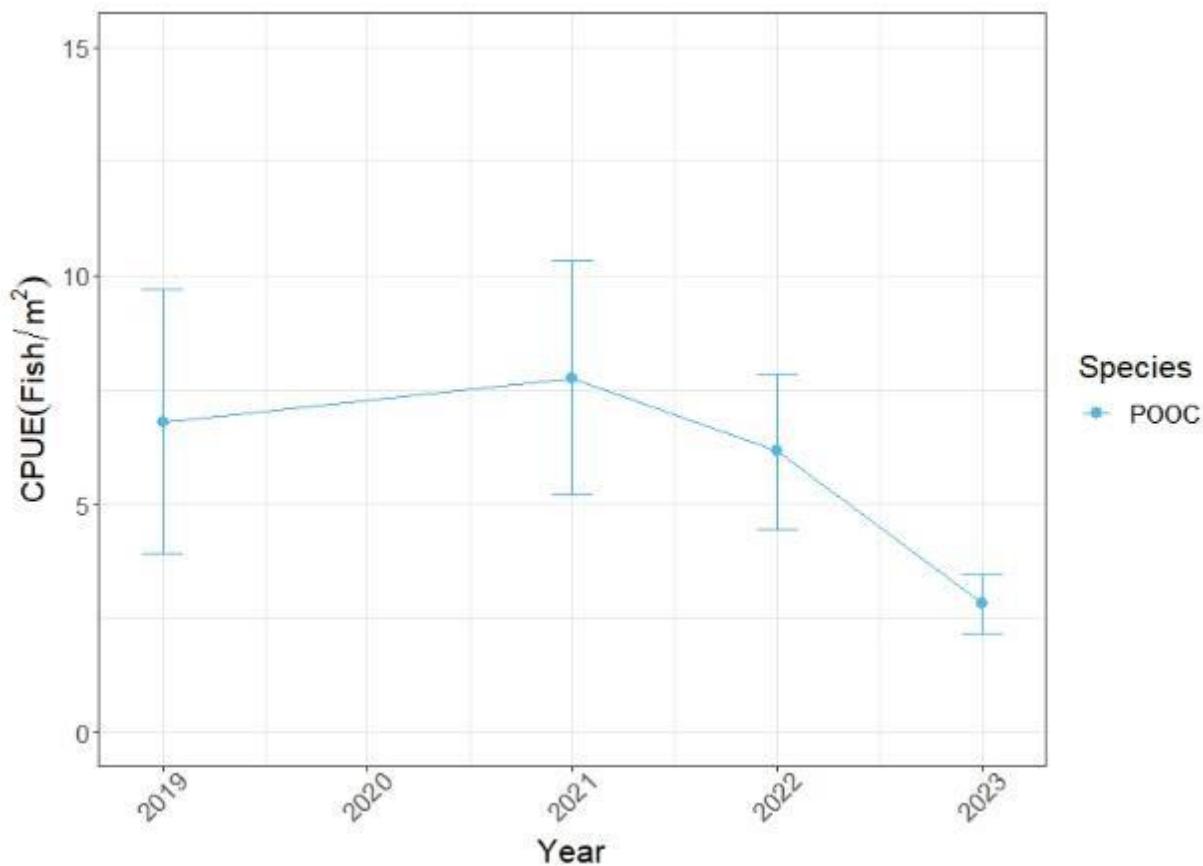


Figure 90. Mean CPUE of Gila Topminnow caught at Monkey Spring, Arizona since 2019.



Figure 91. Upstream to upstream view of MKS01-F, Monkey Spring, Arizona.



Figure 92. Downstream to upstream view of MKS01-F, Monkey Spring, Arizona.



Figure 93. Downstream to downstream view of MKS01-F, Monkey Spring, Arizona.



Figure 94. Upstream to downstream view of MKS01-F, Monkey Spring, Arizona.

## **Sheehy Spring**

<b>Station</b>		<b>Lower Boundary</b>	<b>Upper Boundary</b>
SHS01-F	12R NAD83	540094E, 3470462N	540179E, 3470483N
SHS02-F		540004E, 3470442N	540094E, 3470462N

Sheehy Spring (Santa Cruz Co., AZ) is 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 the introduction of Western Mosquitofish in 1988 (Weedman et al. 1996). Sheehy Spring is surveyed annually for GRBNFMP. The 2022 monitoring event captured totals of 54 Gila Chub and one Western Mosquitofish (Shollenberger et al. 2023).

M&A personnel completed sampling of Sheehy Spring on April 16-17, 2023. 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 95). 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, SHS02-F. 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 pools. In the downstream station 61 Gila Chub, seven Sonora Mud Turtles, and 21 American Bullfrogs were captured.

The most upstream station (SHS01-F) began immediately upstream of a large pool. Mesohabitat throughout this station was limited to shallow puddles and marshy areas with some trickling water through grassland. A single dip net sweep in an open pool above dense vegetation confirmed the presence of Western Mosquitofish (n=16). Catch totals for all fish captured are summarized in tables 20 and 21 provided below.

Surface water was higher this year compared to 2022, however Gila Chub habitat still is 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 96). A length-frequency histogram for all Gila Chub captured in 2021, 2022, and 2023 at Sheehy Spring is included below (Figure 97). Water temperature, DO, pH, and conductivity taken at SHS02-F were 23.3 °C, 10.4 mg/L, 7.67, and 464 µS, respectively. Photographs of upper and lower extents were not taken at this site.

Table 20. Summary of catch by mini hoop net at Sheehy Springs, Arizona, surveyed April 16-17, 2023.

<b>Station</b>	<b>Statistic</b>	<b>GIIN (51-100)</b>	<b>GIIN (&gt;100)</b>	<b>KISO</b>	<b>RACA</b>	<b>Total</b>
SHS02-F (198.46 hrs)	Count	11	50	7	21	89
	% total catch	12.36%	56.18%	7.87%	23.60%	100.00%
	CPUE (ind/net hr)	0.06	0.25	0.04	0.11	0.45

Table 21. Summary of catch by dip net sweep at Sheehy Springs, Arizona surveyed April 16, 2023.

<b>Station</b>	<b>Statistic</b>	<b>GAAF (&lt;20)</b>	<b>GAAF (&gt;=20)</b>	<b>Total</b>
SHS02-F (0.71 m <sup>2</sup> )	Count	0	16	16
	% total catch	100.00%	100.00%	100.00%
	CPUE (ind/m <sup>2</sup> )	0.00	22.63	22.63

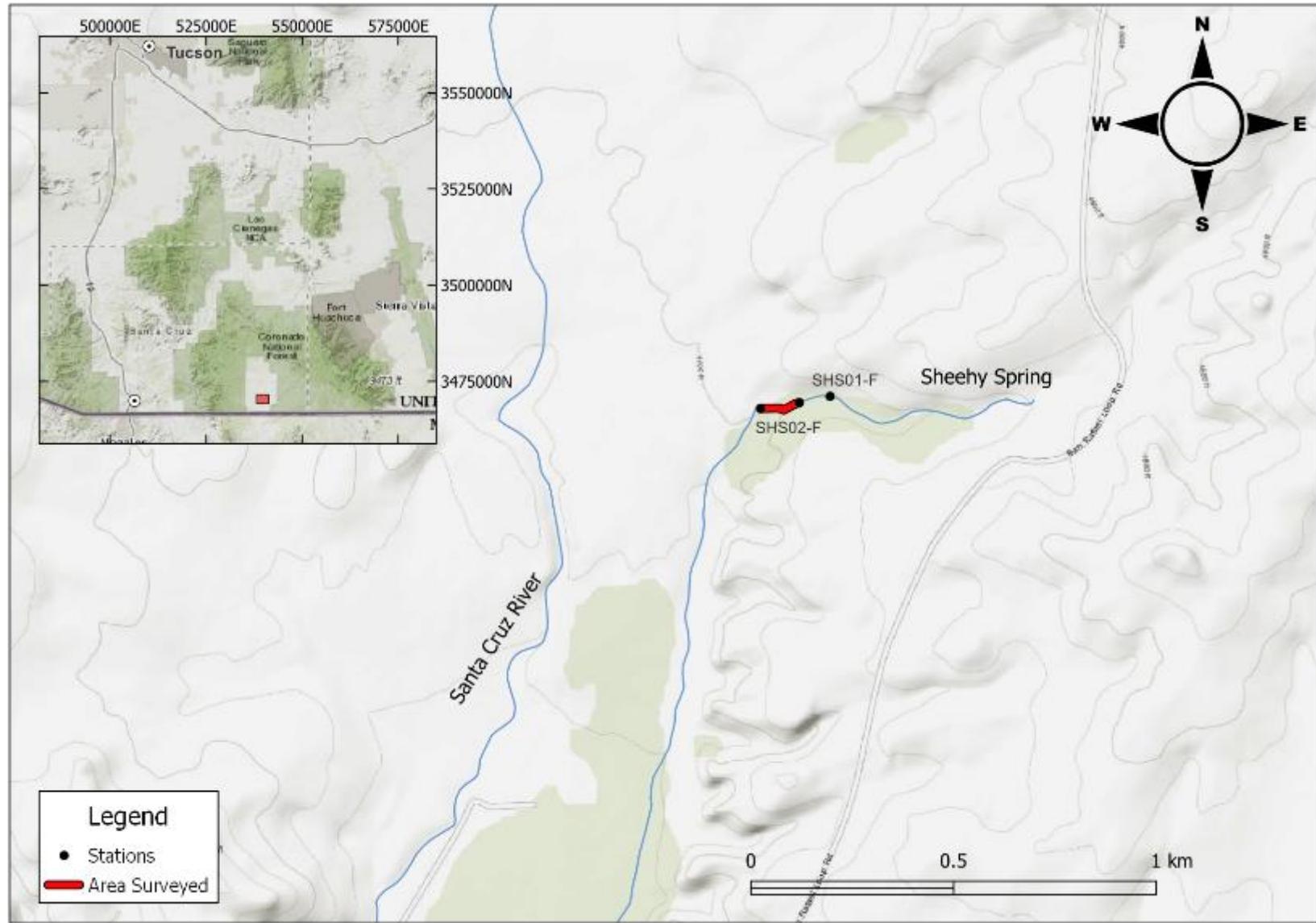


Figure 95. Location of sampled stations at Sheehy Springs, Arizona, surveyed April 16-17, 2023.

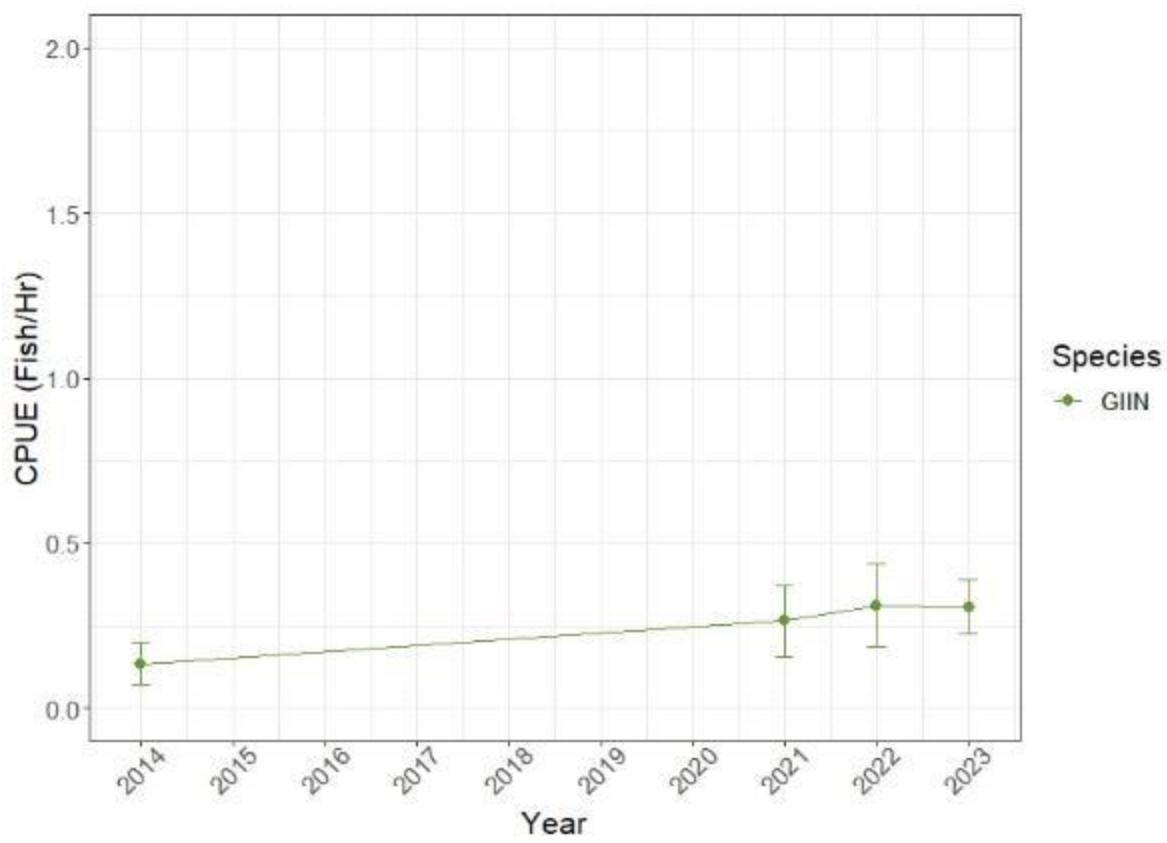


Figure 96. Mean CPUE of Gila Chub captured at Sheehy Springs, Arizona, since 2014.

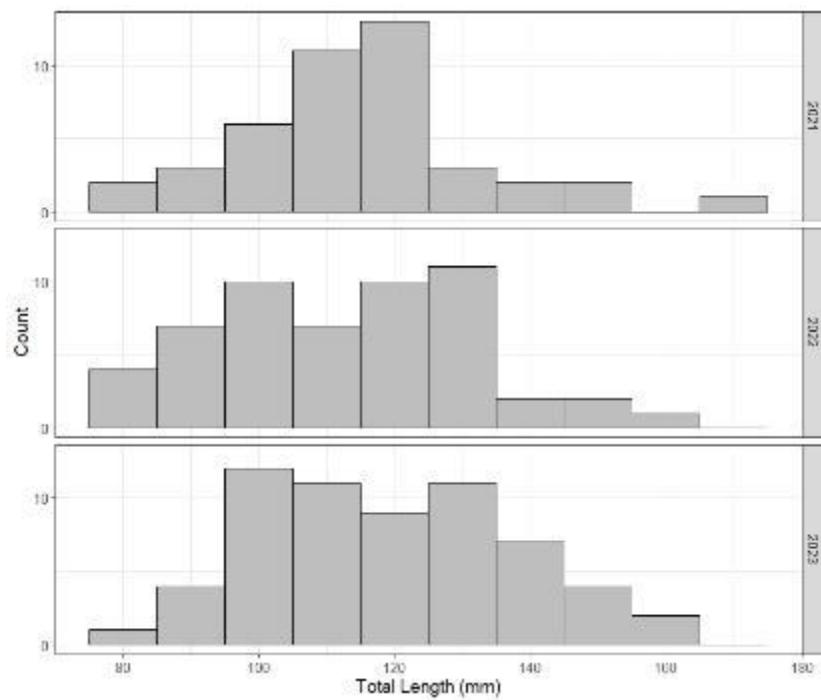


Figure 97. Length-frequency histogram of Gila Chub captured under GRBNFMP 2021-2023, Sheehy Springs, Arizona.

## Cienega Creek

<b>Station</b>		<b>Lower Boundary</b>	<b>Upper Boundary</b>
CNC03-F	12S NAD83	507749E, 3485964N	507848E, 3485986N
CNC05		507729E, 3485860N	507749E, 3485959N
CNC10		507745E, 3485724N	507727E, 3485857N

Cienega Creek (Pima Co., AZ) is located on Pima County Cienega Creek Natural Preserve near Vail, AZ. It is 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 and 2022 surveys, 26 and six Gila Topminnow were captured, respectively (Shollenberger et al. 2023).

M&A and Pima County personnel completed monitoring of Cienega Creek on September 7, 2023. One fixed and two random stations were surveyed in the vicinity of the “Horseshoe Bend/Head Cut” section of the creek (Figure 98). This reach of Cienega Creek was accessed via gravel roads off East Marsh Station Road. A total of 10 seine hauls was 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, 1,173 Longfin Dace were captured.

At the time of monitoring mesohabitat in fixed station CNC03-F was similar to habitat encountered in 2022 and preferred habitat for Gila Topminnow was limited. Historically, the fixed station had a single deep pool along a rocky cliff that had been filled in with sediment prior to survey efforts in 2022. Ten minnow traps were set for approximately 2 hours. All traps were set near the surface with an air pocket. In total, 791 Longfin Dace were captured via traps at this station. No Gila Topminnow were observed in the survey extent. A single opportunistic dip net sweep captured five Gila Topminnow in the three bridges area downstream of the survey site.

The first random station, CNC05, was located 200-m downstream from the fixed station. Few fish were observed throughout this station and only 182 Longfin Dace were captured via seine hauls. The second random station, CNC10, was 700-m downstream from the fixed station. In total, 200 Longfin Dace were captured via seine hauls. Mesohabitat throughout this station was entirely shallow run. Lowland Leopard Frog specimens collected by Pima County personnel tested positive for both *Batrachochytrium dendrobatidis* and ranavirus (A. Owens, AZGFD, pers. comm.) at this site in 2022. No Lowland Leopard Frogs were observed during this survey.

Catch and effort totals for all stations are summarized in tables 22 & 23. CPUE trends were difficult to assess for Cienega Creek as the majority of Gila Topminnow captured in 2021 and 2022 were from opportunistic efforts using a variety of gear types. Stream discharge was not measured. Water temperature, DO, pH, and conductivity at the fixed station were 18.8 °C, 5.3 mg/L, 7.91, and 1,672 µS, respectively. Photographs of upper and lower extents of the fixed station were not taken at this survey.

Table 22. Summary of catch by minnow trap at Cienega Creek, Arizona, surveyed September 7, 2023. Total effort was 29.33 trap hours.

<b>Station</b>	<b>Statistic</b>	<b>AGCH (&lt;40)</b>	<b>AGCH (&gt;=40)</b>	<b>Total</b>
CNC03-F (29.33 hrs)	Count	293	498	791
	% total catch	37.04%	62.96%	100.00%
	CPUE (ind/net hr)	9.99	16.98	26.97

Table 23. Summary of catch by seine haul at Cienega Creek, Arizona, surveyed September 7, 2023. Total effort was 73.2 m<sup>2</sup>, or 20 seine hauls.

<b>Station</b>	<b>Statistic</b>	<b>AGCH (&lt;40)</b>	<b>AGCH (&gt;=40)</b>	<b>Total</b>
CNC05 (36.58 m <sup>2</sup> )	Count	138	44	182
	% total catch	75.82%	24.18%	100.00%
	CPUE (ind/m <sup>2</sup> )	3.77	1.20	4.98
CNC10 (36.58 m <sup>2</sup> )	Count	187	13	200
	% total catch	93.50%	6.50%	100.00%
	CPUE (ind/m <sup>2</sup> )	5.11	0.36	5.47

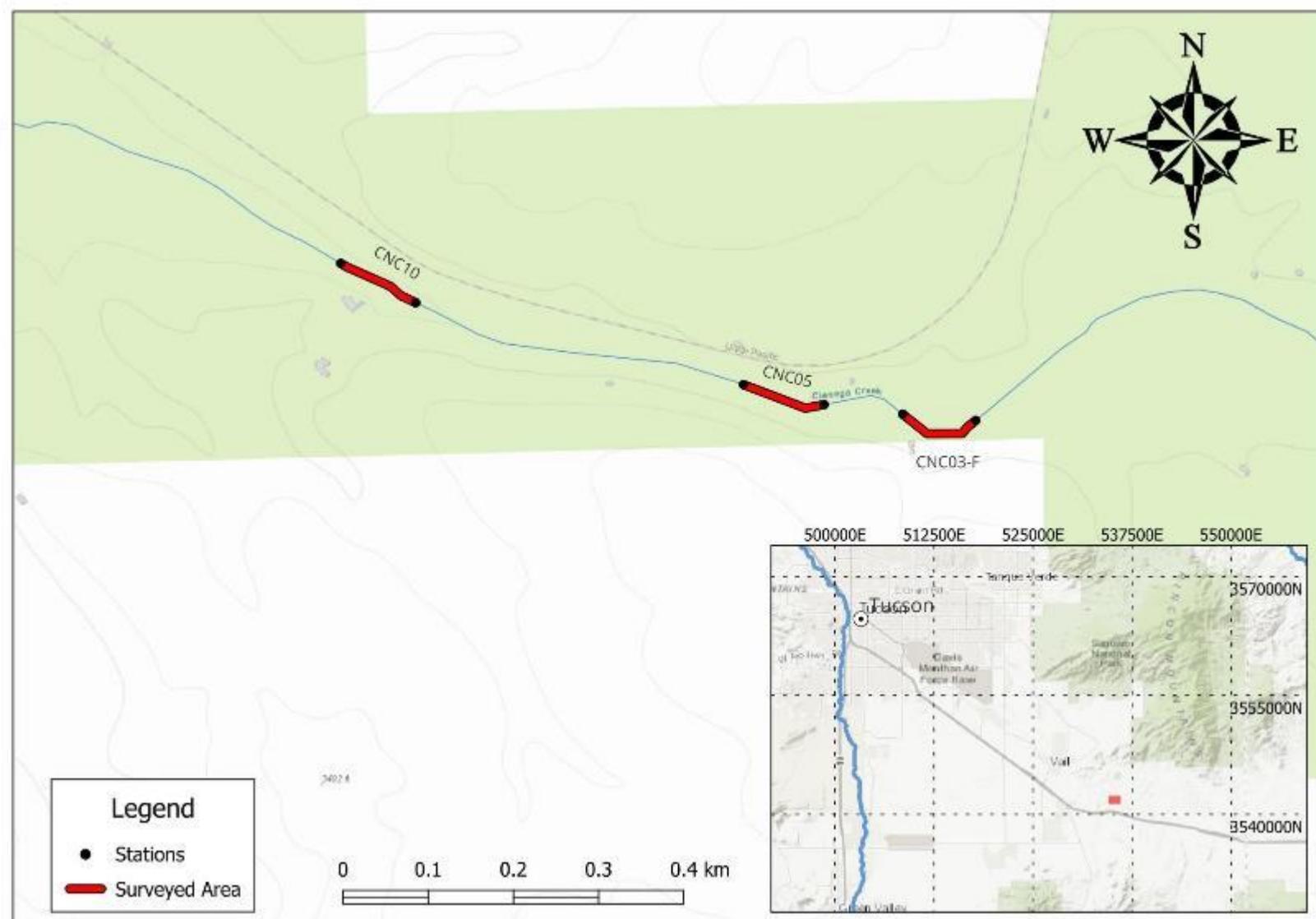


Figure 98. Location of sampled stations at Cienega Creek, Arizona, surveyed September 7, 2023.

## Upper Gila River Basin

### KP Creek

Station		Lower Boundary	Upper Boundary
KPC18	12S NAD83	665320E, 3713367N	665278E, 3713442N
KPC25-F		665726E, 3712915N	665692E, 3712984N
KPC29		666021E, 3712699N	665972E, 3712760N
KPC35		666782E, 3711627N	666710E, 3711681N

KP Creek (Greenlee Co) is tributary to Blue River and is located in Apache-Sitgreaves NF. In 2017 and 2019, eDNA samples were collected in lower KP Creek as part of a Loach Minnow and Spikedace rangewide eDNA study. Loach Minnow eDNA was detected at 100-m and 2,000-m above KP's confluence with the Blue River (Mosher et al. 2020). This is the first survey conducted under the GRBNFMP and the focal species was Loach Minnow. The next survey at this site will take place in 2024.

KP Creek was surveyed on June 7, 2023. Four 100-m stations (1 fixed, 3 random) were surveyed by backpack electrofishing. The upper stations of the creek were accessed via Blue River Road until private property boundaries were met. Personnel then hiked upstream through private property, with permission, to stations KPC18, KPC25-F, and KPC29. The most downstream station, KPC35, was accessed from Blue River Road just beyond the creek crossing (Figure 99).

Totals of 193 Speckled Dace, 92 Desert Sucker, 13 Brown Trout *Salmo trutta*, eight Sonora Sucker, and three Longfin Dace were captured (Table 24). Loach Minnow were not captured or observed at KP Creek. Brown Trout were encountered at all but the furthest downstream station. Most of the Brown Trout sampled were 150 mm or longer (one individual 53 mm), the largest measuring 235 mm.

Sediment in the streambed appeared to be mostly highly embedded cobble and large gravel, not conducive to Loach Minnow habitat. Mesohabitat consisted of long, shallow riffles separated by short 1-m deep pools. Stream discharge at KPC25-F and was calculated at 0.045 m<sup>3</sup> (1.6 cfs). Water temperature, DO, pH, and conductivity were 17.2 °C, 8.8 mg/L, 8.32, and 213 µS, respectively. Photographs of upper and lower extents of the fixed station are provided below (Figures 100-103).

Table 24. Summary of catch by BPEF at KP Creek, Arizona, surveyed June 7, 2023. Total effort was 2,602 seconds.

<b>Stations</b>	<b>Statistic</b>	<b>RHOS</b>	<b>ONAP</b>	<b>PACL</b>	<b>AGCH</b>	<b>SATR</b>	<b>CAIN</b>	<b>Totals</b>
KPC18 (609 sec)	Count	79	0	14	0	6	1	100
	% total catch	79.00%	0.00%	14.00%	0.00%	6.00%	1.00%	100.00%
	CPUE (ind/hr)	467.00	0.00	82.76	0.00	35.47	5.91	591.13
KPC25-F (643 sec)	Count	45	1	11	0	1	2	60
	% total catch	75.00%	1.67%	18.33%	0.00%	1.67%	3.33%	100.00%
	CPUE (ind/hr)	251.94	5.60	61.59	0.00	5.60	11.20	335.93
KPC29 (501 sec)	Count	22	0	10	1	5	1	39
	% total catch	56.41%	0.00%	25.64%	2.56%	12.82%	2.56%	100.00%
	CPUE (ind/hr)	158.08	0.00	71.86	7.19	35.93	7.19	280.24
KPC35 (849 sec)	Count	47	0	57	2	0	4	110
	% total catch	42.73%	0.00%	51.82%	1.82%	0.00%	3.64%	100.00%
	CPUE (ind/hr)	199.29	0.00	241.70	8.48	0.00	16.96	466.43
Total	Count	193	1	92	3	12	8	309
	% total catch	62.46%	0.32%	29.77%	0.97%	3.88%	2.59%	100.00%
	CPUE (ind/hr)	267.03	1.38	127.29	4.15	16.60	11.07	427.52

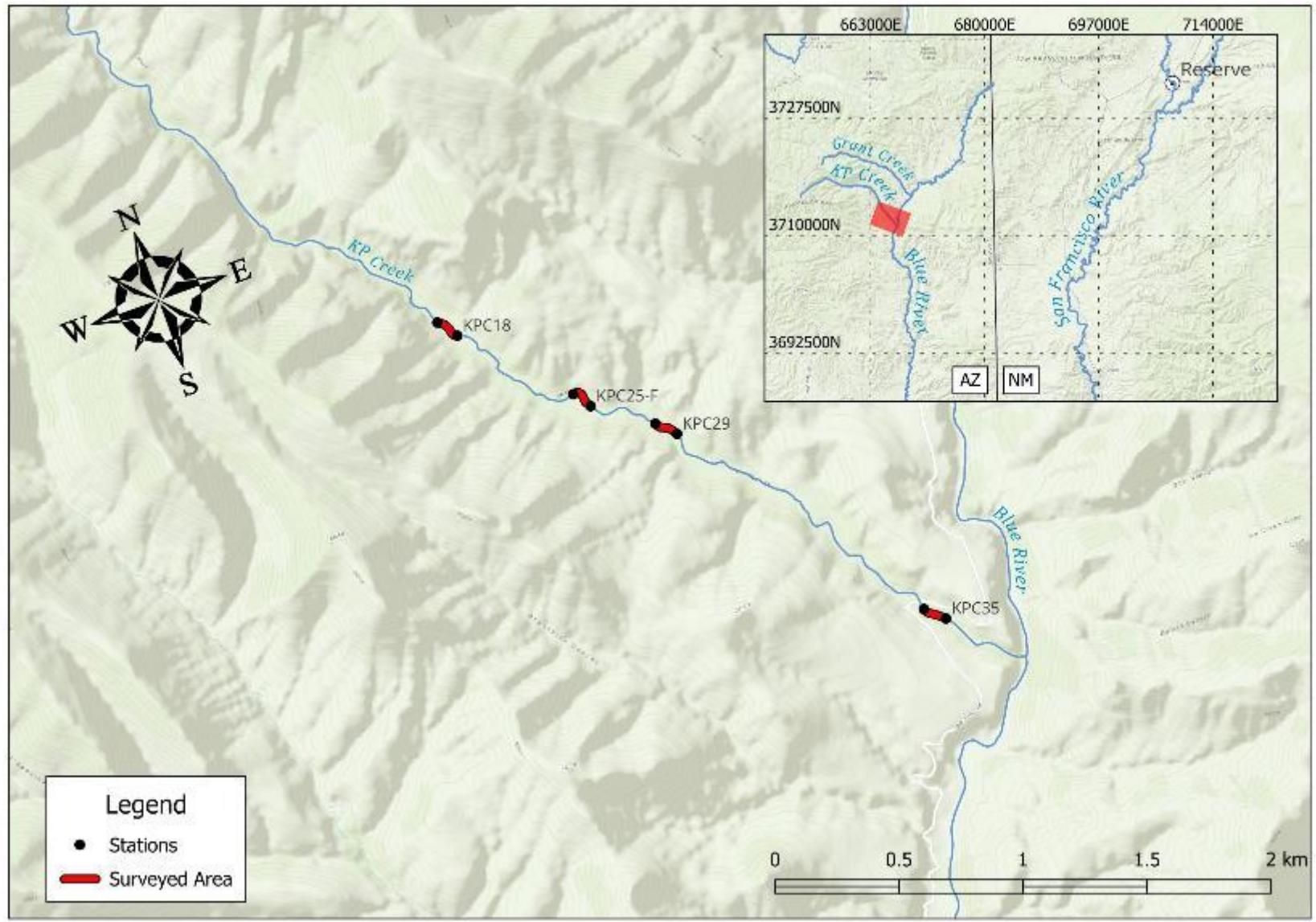


Figure 99. Location of sampled stations at KP Creek, Arizona, surveyed June 7, 2023.



Figure 100. Downstream to upstream view of KPC25-F, KP Creek, Arizona.



Figure 101. Upstream to downstream view of KPC25-F, KP Creek, Arizona.



Figure 102. Upstream to upstream view of KPC25-F, KP Creek, Arizona.

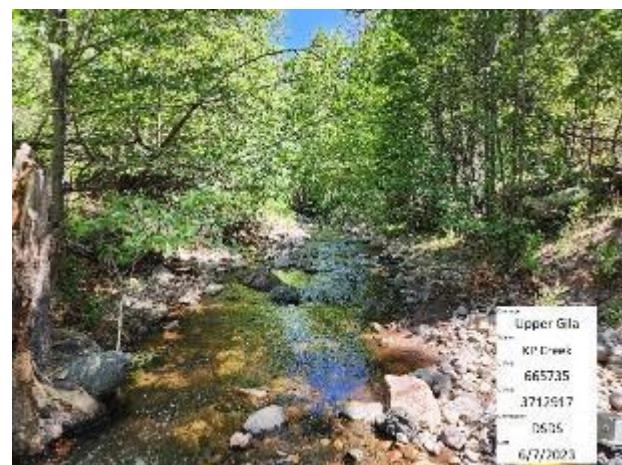


Figure 103. Downstream to downstream view of KPC25-F, KP Creek, Arizona.

## Grant Creek

Station		Lower Boundary	Upper Boundary
GRC10	12S NAD83	665368E, 3720242N	665263E, 3720253N
GRC20		665995E, 3719694N	665922E, 3719751N
GRC47		667535E, 3717851N	667527E, 3717946N
GRC59		668055E, 3716884N	668024E, 3716974N
GRC61-F		668186E, 3716762N	668122E, 3716838N
GRC70		668745E, 3716214N	668654E, 3716266N
GRC72		668922E, 3716171N	668829E, 3716186N

Grant Creek (Greenlee Co) is tributary to Blue River and flows for 16 km from its origin near Hannagan Meadow. In 2017, eDNA sampling detected Loach Minnow in Grant Creek at 100, 600, 1,000, and 2,000 m upstream of its confluence with the Blue River. Loach Minnow presence was confirmed later that year during backpack electrofishing surveys. Since few fish surveys have occurred in Grant Creek, limited information is available on the fish community for this site. This is the first survey conducted in Grant Creek under the GRBNFMP and Loach Minnow is the focal species for this site. The next survey at Grant Creek will be conducted in 2024.

Grant Creek was surveyed June 8, 2023. Seven (1 fixed, 6 random), 100-m stations were surveyed with backpack electrofishing (Figure 105). Stations were accessed via hiking Grant Creek Trail #75 from Blue River Road near the confluence with Blue River. The trail veers north toward White Oak Spring, off course with the creek, 5 km upstream of where the trail begins. The hiking off trail is consists of bushwacking in a narrow canyon to a natural barrier another 2 km upstream.

Totals of 175 Speckled Dace, 90 hybrid Apache × Rainbow Trout, 31 Desert Sucker, 3 Longfin Dace, 3 Brown Trout, and 1 Sonora Sucker (Table 25) were captured. Loach Minnow were not captured or observed at Grant Creek. From the confluence of Blue River, the stream mainly consisted of shallow slow-moving riffles for approximately 5 km, before turning into a canyon with 6-m high walls, thick overhanging vegetation, and shallow riffles separated by 1.5-m step pools. The catch of the two stations (GRC10, GRC20) following this change in habitat was comprised of 85 Apache × Rainbow Trout and 28 Speckled Dace, whereas before this change catch comprised of 147 Speckled Dace, 31 Desert Sucker, five Apache Trout, three Brown Trout, three Longfin Dace, and one Sonora Sucker.

A length-frequency histogram of the Apache Trout sample suggests that there is both a strong presence of sexually mature fish and abundant recruitment (Figure 104). Upon further investigation, water temperature at Grant Creek is 7 degrees cooler than its neighboring stream KP Creek. This may contribute to the success of the Apache Trout population encountered during this survey.

Stream discharge measured at the fixed station (GRC61-F) was 0.036 m<sup>3</sup> (1.28 cfs). Water temperature, DO, pH, and conductivity were 10.8 °C, 12.1 mg/L, 8.60, and 227 µS, respectively. Photographs of upper and lower extents at one fixed station are provided below (Figures 106-109).

Table 25. Summary of catch by BPEF at Grant Creek, Arizona, surveyed on June 8, 2023. Total effort was 4,286 seconds.

<b>Stations</b>	<b>Statistic</b>	<b>RHOS</b>	<b>ONAP</b>	<b>PACL</b>	<b>AGCH</b>	<b>SATR</b>	<b>CAIN</b>	<b>Totals</b>
GRC10 (756 sec)	Count	0	51	0	0	0	0	51
	% total catch	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	100.00%
	CPUE (ind/hr)	0.00	242.86	0.00	0.00	0.00	0.00	242.86
GRC20 (572 sec)	Count	28	34	0	0	0	0	62
	% total catch	45.16%	54.84%	0.00%	0.00%	0.00%	0.00%	100.00%
	CPUE (ind/hr)	176.22	213.99	0.00	0.00	0.00	0.00	390.21
GRC47 (558 sec)	Count	46	4	8	1	0	0	59
	% total catch	77.97%	6.78%	13.56%	1.69%	0.00%	0.00%	100.00%
	CPUE (ind/hr)	296.77	25.81	51.61	6.45	0.00	0.00	380.65
GRC59 (480 sec)	Count	30	0	9	0	1	0	40
	% total catch	75.00%	0.00%	22.50%	0.00%	2.50%	0.00%	100.00%
	CPUE (ind/hr)	225.00	0.00	67.50	0.00	7.50	0.00	300.00
GRC61-F (608 sec)	Count	26	1	10	0	2	1	40
	% total catch	65.00%	2.50%	25.00%	0.00%	5.00%	2.50%	100.00%
	CPUE (ind/hr)	153.95	5.92	59.21	0.00	11.84	5.92	236.84
GRC70 (589 sec)	Count	18	0	1	1	0	0	20
	% total catch	90.00%	0.00%	5.00%	5.00%	0.00%	0.00%	100.00%
	CPUE (ind/hr)	110.02	0.00	6.11	6.11	0.00	0.00	122.24
GRC72 (723 sec)	Count	27	0	3	1	0	0	31
	% total catch	87.10%	0.00%	9.68%	3.23%	0.00%	0.00%	100.00%
	CPUE (ind/hr)	134.44	0.00	14.94	4.98	0.00	0.00	154.36
Total	Count	175	90	31	3	3	1	303
	% total catch	57.76%	29.70%	10.23%	0.99%	0.99%	0.33%	100.00%
	CPUE (ind/hr)	146.99	75.59	26.04	2.52	2.52	0.84	254.50

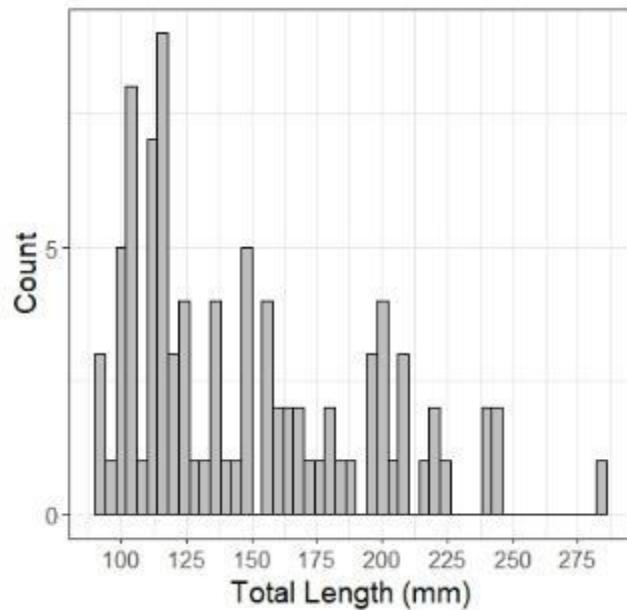


Figure 104. Length-frequency histogram of Apache Trout captured at Grant Creek, Arizona, surveyed June 8, 2023.

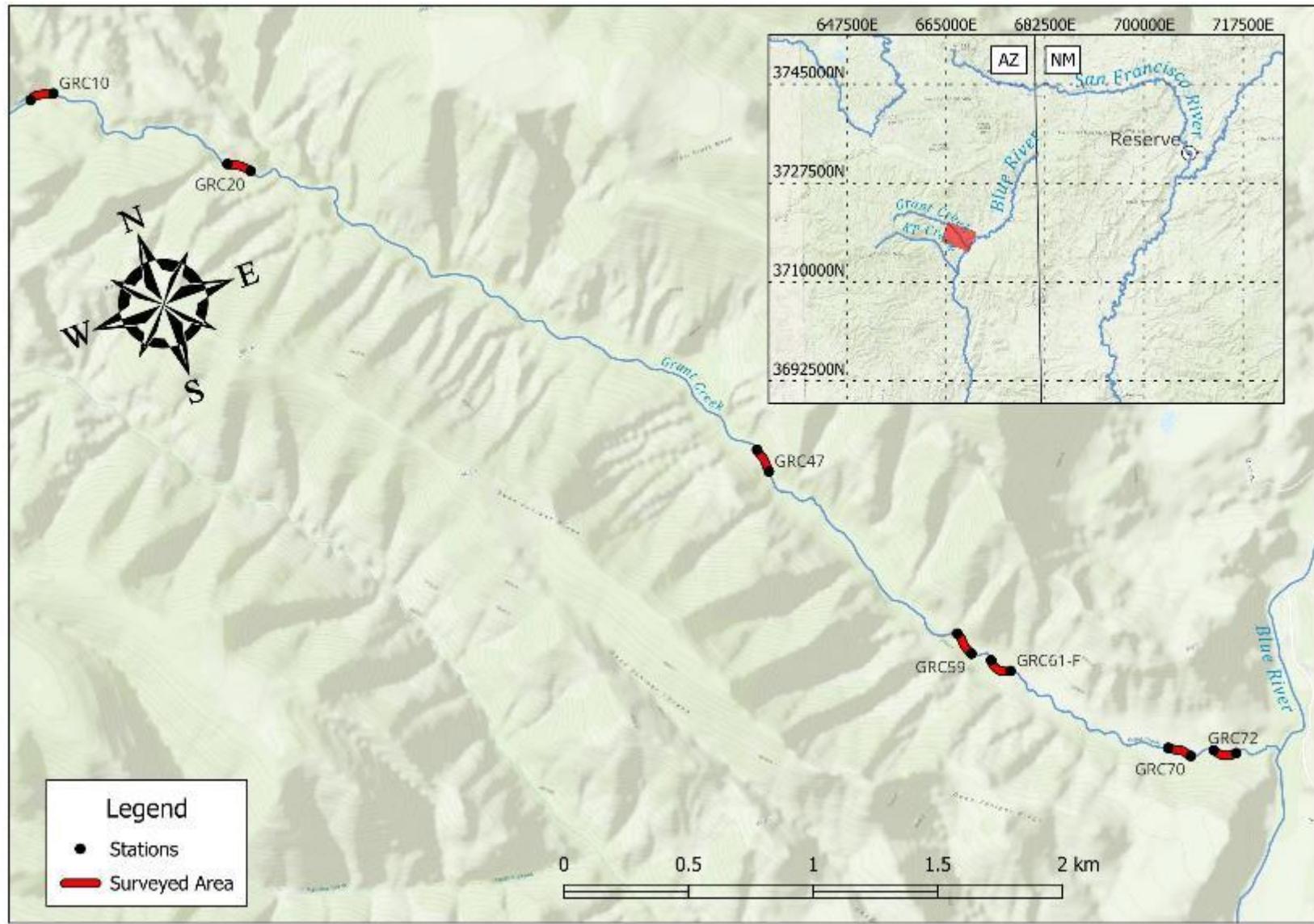


Figure 105. Location of sampled stations at Grant Creek, Arizona, surveyed June 8, 2023.

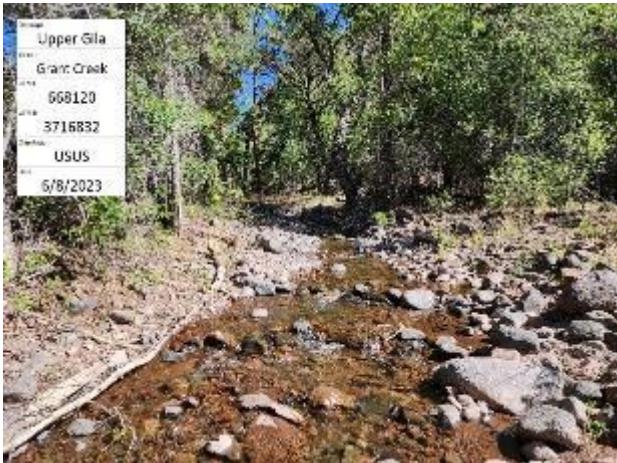


Figure 106. Upstream to upstream view of GRC61-F, Grant Creek, Arizona.

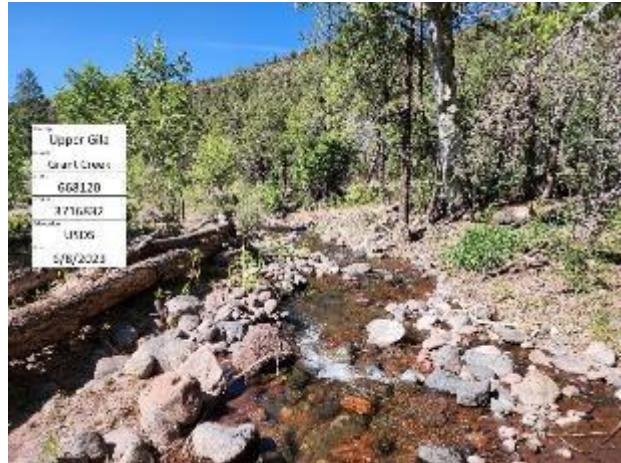


Figure 107. Upstream to downstream view of GRC61-F, Grant Creek, Arizona.



Figure 108. Downstream to upstream view of GRC61-F, Grant Creek, Arizona.

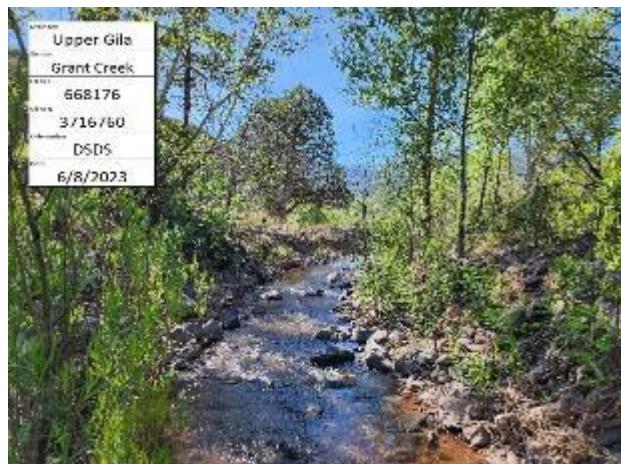


Figure 109. Downstream to downstream view of GRC61-F, Grant Creek, Arizona.

## Campbell Blue Creek

Station		Lower Boundary	Upper Boundary
CBC12	12S NAD83	675953E, 3734809N	675831E, 3734845N
CBC21		676660E, 3734923N	676556E, 3734952N
CBC36		677953E, 3734751N	677853E, 3734725N
CBC51-F		678952E, 3734584N	678898E, 3734589N
CBC56		679128E, 3734366N	679065E, 3734272N
CBC63		679744E, 3734324N	679664E, 3734394N
CBC64		679874E, 3734348N	679655E, 3734362N

Campbell Blue Creek (Greenlee Co., AZ) is located within Apache-Sitgreaves NF near Alpine, AZ. It flows southeast and merges with Dry Blue Creek to form Blue River (Figure 108). The focal species at Campbell Blue Creek is Loach Minnow. Loach Minnow were widely distributed throughout Campbell Blue Creek until 2011 when the Wallow Fire burned 2,115 km<sup>2</sup> (522,642 acres) of forest in AZ and fish kills were observed in upper Gila River basin. Immediate post-fire surveys (2011- 2012) found Loach Minnow were absent from Campbell Blue Creek (Kesner et al. 2011; Patterson et al. 2012). However, Loach Minnow populations naturally recovered in Campbell Blue Creek three years post-fire and continue to persist (Humphrey et al. 2015; Timmons et al. 2017; Burgad et al. 2019). Campbell Blue Creek was last surveyed for the GRBNFMP in 2020 when personnel captured 41 Loach Minnow (Shollenberger et al. 2021).

M&A personnel surveyed Campbell Blue Creek June 27 and 28, 2023. Seven, 100-m stations (1 fixed, 6 random) were surveyed via backpack electrofishing (Figure 110). All stations surveyed were accessed via Blue River Road and Luce Ranch Road.

Totals of 32 Loach Minnow, 926 Speckled Dace, 187 Longfin Dace, 181 Desert Sucker, 13 Brown Trout, and 10 Sonora Sucker were captured across all seven stations (Table 26). Loach Minnow were captured at five of seven stations sampled in Campbell Blue Creek. The two most upstream stations (CBC12 & CBC21) failed to capture Loach Minnow. Loach Minnow have not been detected above 12S 677116E/ 3734850N in previous surveys under the GRBNFMP. Individuals caught ranged in TL from 45 – 59 mm. The last survey conducted at this site in 2020 resulted in capture of 41 Loach Minnow following a stocking of 172 individuals near Turkey Creek – Campbell Blue Creek confluence two weeks prior to sampling. Brown Trout were encountered at all but the furthest upstream station. Most Brown Trout sampled were 100 mm or longer, the largest and smallest measuring 252 mm and 119 mm, respectively. In addition, six Western Terrestrial Garter Snakes *Thamnophis elegans*, two Narrow-headed Garter Snakes *T. rufipunctatus*, and one Canyon Treefrog *Hyla arenicolor* were captured.

Mesohabitat consisted of shallow, slow-moving riffles separated by ~1-m deep pools formed behind debris piles. Several isolated pools created by debris pile ups were observed within the riparian corridor but were not connected to the main channel. There also was evidence of the channel moving within the flood plain, as was observed at the fixed station where a dry streambed was seen trailing off from where the stream now flows.

Stream discharge at one fixed station (CBC51-F) was  $0.017 \text{ m}^3$  (0.6 cfs). Water temperature, DO, pH, and conductivity were  $26.1^\circ\text{C}$ , 6.3 mg/L, 8.83, and 278  $\mu\text{S}$ , respectively. Photographs of the downstream extent of one fixed station are provided below (Figures 111-112).

Table 26. Summary of catch by BPEF at Campbell Blue Creek, Arizona, surveyed June 27-28, 2023. Total effort was 5,325 seconds.

<b>Stations</b>	<b>Statistic</b>	<b>AGCH</b>	<b>CAIN</b>	<b>PACL</b>	<b>RHOS</b>	<b>SATR</b>	<b>TICO</b>	<b>Totals</b>
CBC12 (451 sec)	Count	0	0	1	57	0	0	58
	% total catch	0.00%	0.00%	1.72%	98.28%	0.00%	0.00%	100.00%
	CPUE (ind/hr)	0.00	0.00	7.98	454.99	0.00	0.00	462.97
CBC21 (933 sec)	Count	12	6	13	138	1	0	170
	% total catch	7.06%	3.53%	7.65%	81.18%	0.59%	0.00%	100.00%
	CPUE (ind/hr)	46.30	23.15	50.16	532.48	3.86	0.00	655.95
CBC36 (938 sec)	Count	14	3	80	131	7	1	236
	% total catch	5.93%	1.27%	33.90%	55.51%	2.97%	0.42%	100.00%
	CPUE (ind/hr)	53.73	11.51	307.04	502.77	26.87	3.84	905.76
CBC51-F (826 sec)	Count	14	0	46	172	1	2	235
	% total catch	5.96%	0.00%	19.57%	73.19%	0.43%	0.85%	100.00%
	CPUE (ind/hr)	61.02	0.00	200.48	749.64	4.36	8.72	1024.21
CBC56 (685 sec)	Count	19	0	24	133	1	15	192
	% total catch	9.90%	0.00%	12.50%	69.27%	0.52%	7.81%	100.00%
	CPUE (ind/hr)	99.85	0.00	126.13	698.98	5.26	78.83	1009.05
CBC63 (771 sec)	Count	67	1	8	142	3	6	227
	% total catch	29.52%	0.44%	3.52%	62.56%	1.32%	2.64%	100.00%
	CPUE (ind/hr)	312.84	4.67	37.35	663.04	14.01	28.02	1059.92
CBC64 (721 sec)	Count	61	0	9	153	0	8	231
	% total catch	26.41%	0.00%	3.90%	66.23%	0.00%	3.46%	100.00%
	CPUE (ind/hr)	304.58	0.00	44.94	763.94	0.00	39.94	1153.40
Total	Count	187	10	181	926	13	32	1,349
	% total catch	13.86%	0.74%	13.42%	68.64%	0.96%	2.37%	100.00%
	CPUE (ind/hr)	126.42	6.76	122.37	626.03	8.79	21.63	912.00

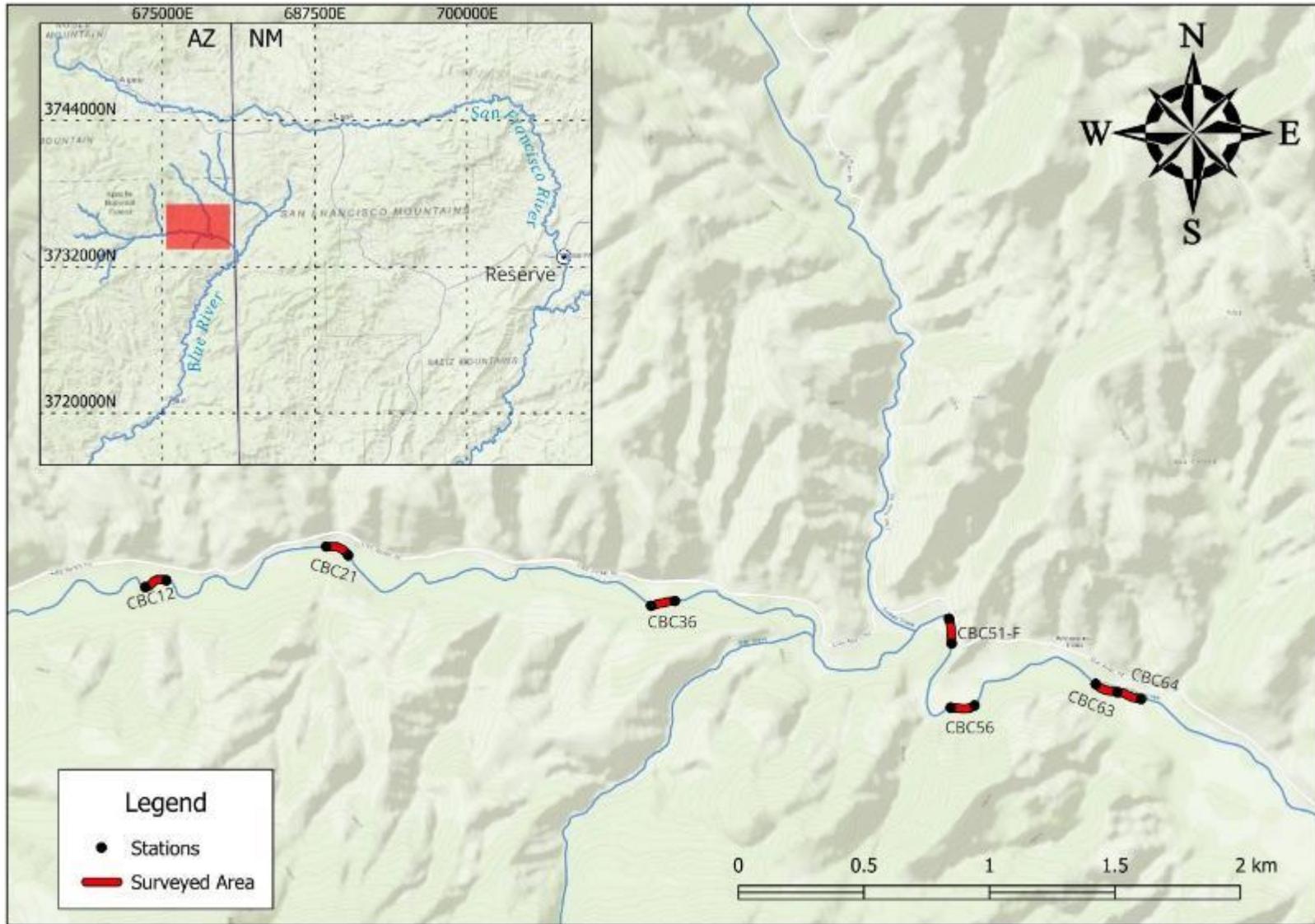


Figure 110. Location of sampled stations at Campbell Blue Creek, Arizona, surveyed June 27-28, 2023.



Figure 111. Downstream to downstream view of CBC51-F, Campbell Blue Creek, Arizona.

Figure 112. Downstream to upstream view of CBC51-F, Campbell Blue Creek, Arizona.

## Dry Blue Creek

Station		Lower Boundary	Upper Boundary
DBC12	12S NAD83	682285E, 3734564N	682329E, 3734635N
DBC18		682081E, 3734135N	682026E, 3734228N
DBC22-F		681871E, 3733836N	681896E, 3733939N

Dry Blue Creek (Catron Co., NM) is located in Apache-Sitgreaves NF. Dry Blue Creek merges with Campbell Blue Creek to form Blue River. The focal species at this site is Loach Minnow. Loach Minnow were reported before the 2011 Wallow Fire (Bagley et al. 1998, Karam and Kesner 2007) but have not been detected from Dry Blue Creek post-fire (Massure et al. 2013; Humphrey et al. 2015; Timmons et al. 2017; Burgad et al. 2019). The last survey conducted at Dry Blue Creek was in 2020 and did not detect Loach Minnow.

M&A personnel surveyed Dry Blue Creek June 28, 2023. Three 100-m stations (1 fixed, 2 random) were surveyed via backpack electrofishing. Dry Blue Creek was accessed by hiking FR 4039 N approximately two miles to reach the site.

Across all stations, 419 Speckled Dace, 23 Longfin Dace, and eight Brown Trout were captured. Loach Minnow were not captured or detected during this survey. Loach Minnow have not recovered from fires experienced in the area despite the population rebounding in Campbell Blue Creek and the apparent availability of suitable habitat for Loach Minnow in the reach. Brown Trout could be a prohibiting factor, but they continue to be encountered in low numbers. A summary table of fish caught at Dry Blue Creek is provided below in table 27.

Mesohabitat consisted of shallow riffles throughout the entirety of the stations sampled. The first 1 km of stream upstream of the private property boundary (12S 681885E/3733728N) was channelized and crowded with vegetation on both banks (Figure 113). The stations that preceded upstream were shallow with slower moving riffles and open grassland.

Stream discharge at one fixed station (DBC22-F) was  $0.032 \text{ m}^3$  (1.13 cfs). Water temperature, DO, pH, and conductivity were  $12.5^\circ\text{C}$ , 8.1 mg/L, 8.47, and 404  $\mu\text{S}$ , respectively. Photographs of upper and lower extents were not taken at this site.

Table 27. Summary of Catch by BPEF at Dry Blue Creek, Arizona, surveyed June 28, 2023. Total effort was 1,857 seconds.

<b>Stations</b>	<b>Statistic</b>	<b>AGCH &lt;40</b>	<b>AGCH ≥40</b>	<b>RHOS &lt;40</b>	<b>RHOS ≥40</b>	<b>SATR ≤50</b>	<b>SATR 51- 100</b>	<b>SATR &gt;100</b>	<b>Totals</b>
DBC12 (771 sec)	Count	0	1	3	102	0	0	1	107
	% total catch	0.00%	0.93%	2.80%	95.33%	0.00%	0.00%	0.93%	100.00%
	CPUE (ind/hr)	0.00	4.67	14.01	476.26	0.00	0.00	4.67	499.61
DBC18 (506 sec)	Count	7	12	53	107	1	6	0	186
	% total catch	3.76%	6.45%	28.49%	57.53%	0.54%	3.23%	0.00%	100.00%
	CPUE (ind/hr)	49.80	85.38	377.08	761.26	7.11	42.69	0.00	1323.32
DBC22-F (580 sec)	Count	2	1	68	86	0	0	0	157
	% total catch	1.27%	0.64%	43.31%	54.78%	0.00%	0.00%	0.00%	100.00%
	CPUE (ind/hr)	12.41	6.21	422.07	533.79	0.00	0.00	0.00	974.48
Total	Count	9	14	124	295	1	6	1	450
	% total catch	2.00%	3.11%	27.56%	65.56%	0.22%	1.33%	0.22%	100.00%
	CPUE (ind/hr)	17.45	27.14	240.39	571.89	1.94	11.63	1.94	872.37

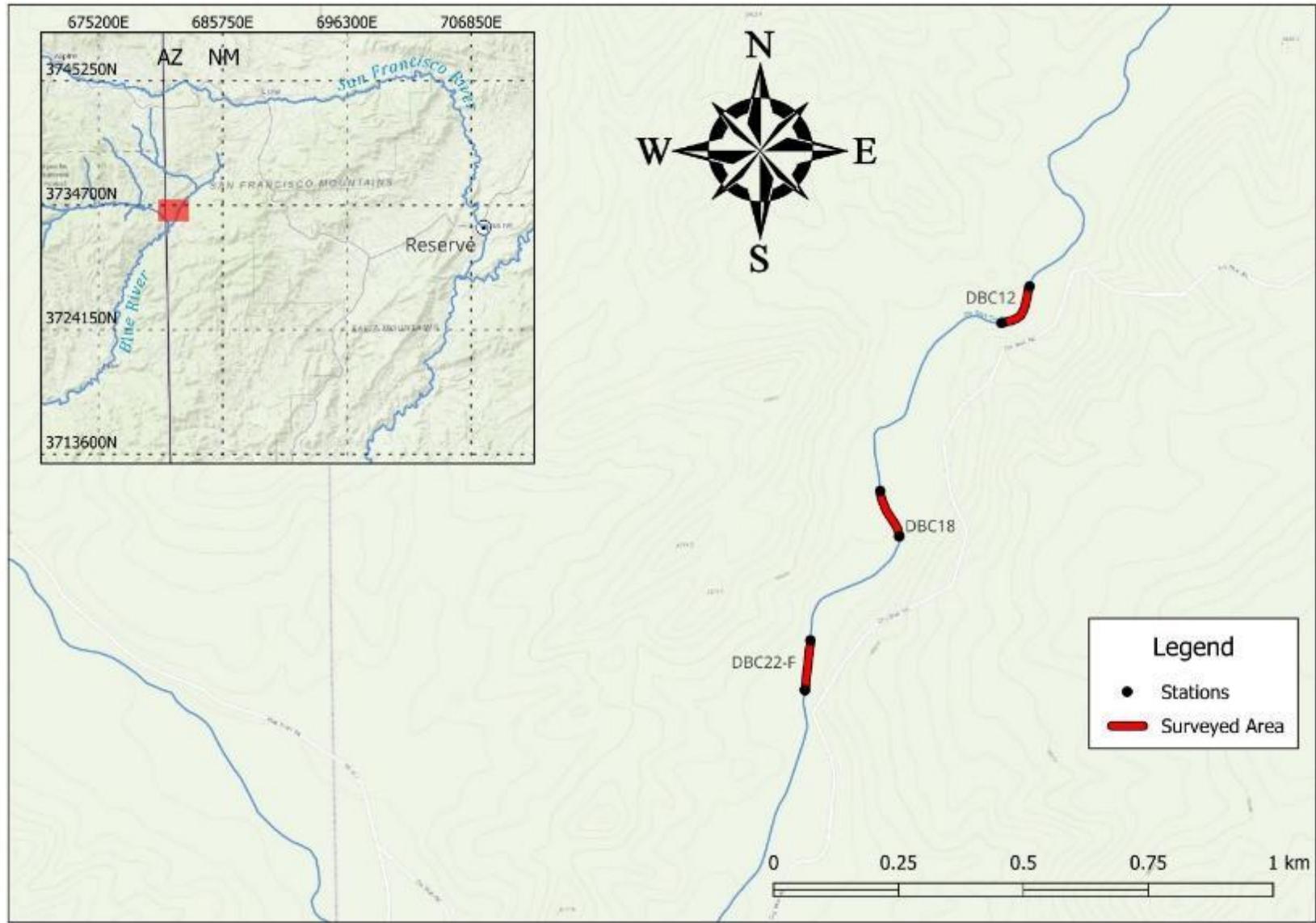


Figure 113. Location of sampled stations at Dry Blue Creek, Arizona, surveyed June 28, 2023.

## Burro Cienega

Station		Upper Boundary
BCN01-F	12S NAD83	747813E, 3591493N
BCN02-F		747883E, 3591297N
BCN03-F		747931E, 3591112N
BCN04-F		748000E, 3590866N
BCN05-F		748377E, 3590739N

Burro Cienega (Grant Co., NM) is located within the Pitchfork Ranch property located an hour south of Silver City in southwestern New Mexico. Burro Cienega is 12.2 km in length and was prehistorically connected to the Gila River; however, perennial water is restricted to about a 3.2 km section located on private land. Gila Topminnow were initially stocked into Burro Cienega in 2007 and 2008. Following floods in 2009, Gila Topminnow became distributed throughout the perennial reach. Five isolated pools are located within Burro Cienega and Gila Topminnow typically occupy these locations. Gila Topminnow are the focal species at this site.

M&A personnel surveyed Burro Cienega July 11, 2023. Five, 100-m stations were surveyed. The site was accessed via 4x4 vehicle from Pitchfork Ranch. All stations were encompassed in a 3.2 km stretch of perennial flow beginning at UTM 12S 748377/3590739 (Figure 114).

Two of the five stations (BCN01-F and BCN03-F) comprised of habitat suitable for trapping, however, stations BCN05-F and BCN02-F were dry. BCN04-F consisted of overgrown cattails and grass making trapping ineffective. Ten minnow traps were set within two stations for a total of 42.3 trap hours resulting in no catch. Gila Topminnow were not observed during this survey.

The last survey conducted in 2018 resulted in capture of four Gila Topminnow, it was noted by NMDFG that determining abundance was difficult due to poor sampling conditions. Two larval stage Tiger Salamanders *Ambystoma tigrinum* were observed and one Black-necked Garter Snake was captured.

Suitable habitat and water availability is minimal at this site. Three of the five pool-like habitats were dry and did not detect any activity. Dissolved oxygen taken at the two ponds measured at 4.0 mg/L. Water quality measurements were taken approximately at noon during time of sampling. This measurement is low given the time when sampling took place. DO is likely lower at night and may be approaching the lower threshold of DO for Gila Topminnow.

Average water temperature, DO, pH, and conductivity at two ponds was 23.6 °C, 4.0 mg/L, 7.73, and 891 µS, respectively. Photographs of habitat at BCN01-F and BCN03-F are provided below (Figures 115-116).

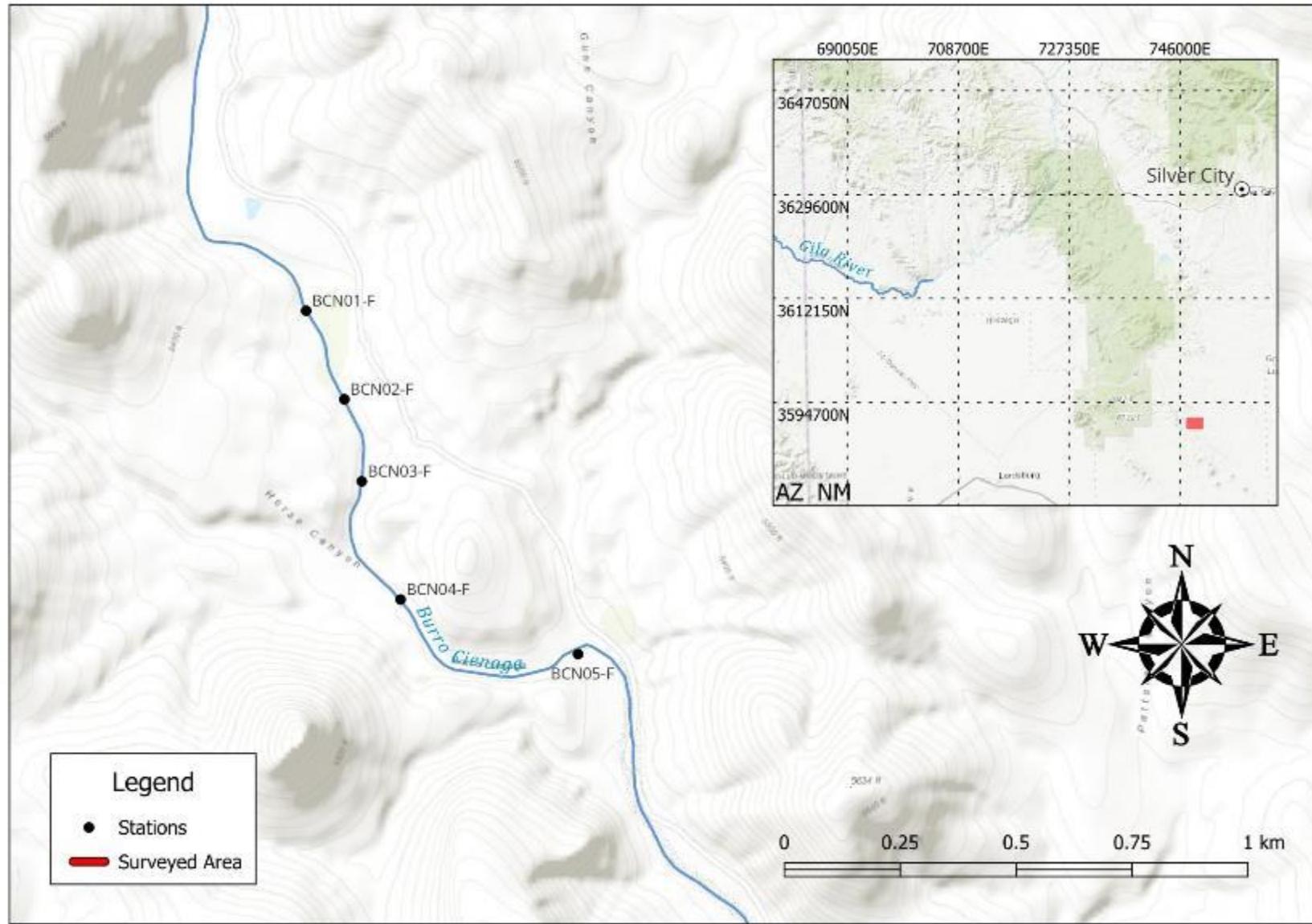


Figure 114. Location of pond habitats surveyed at Burro Cienega, New Mexico, surveyed July 11, 2023.

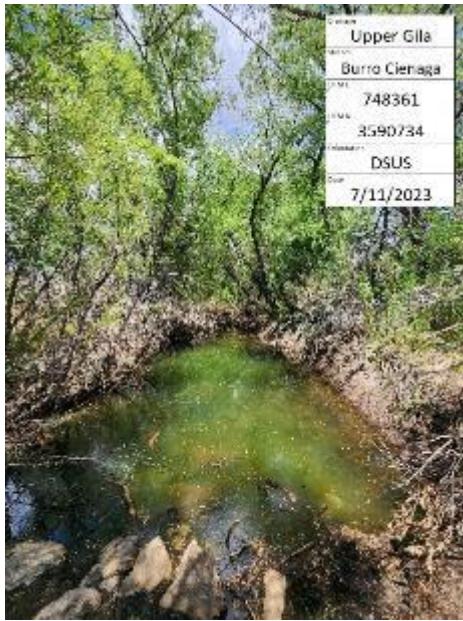


Figure 115. Downstream to upstream view of BCN01-F, Burro Cienaga, New Mexico.

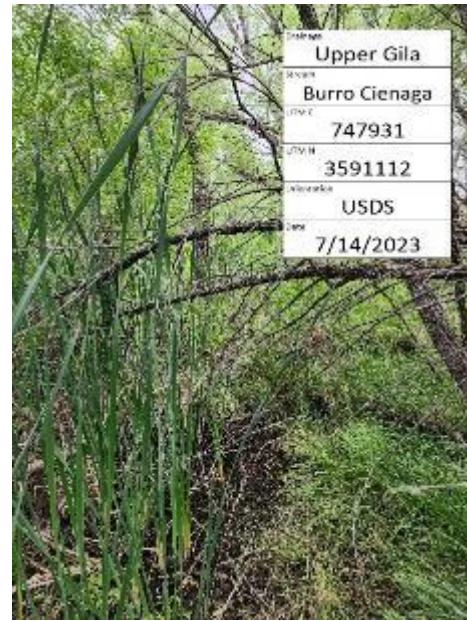


Figure 116. Upstream to downstream view of BCN03-F, Burro Cienaga, New Mexico.

## Lower Blue River

<b>Station</b>		<b>Lower Boundary</b>	<b>Upper Boundary</b>
LBL08	12S NAD83	667477E, 3677466N	667490E, 3677667N
LBL15-F		668151E, 3678440N	668165E, 3678272N
LBL20		668575E, 3678470N	668441E, 3678595N
LBL27		668525E, 3679464N	668655E, 3679592N
LBL38		668341E, 3680918N	668263E, 3681085N
LBL44		667741E, 3681735N	667708E, 3681939N
LBL49		668107E, 3682574N	668150E, 3682784N
LBL56		668111E, 3683943N	668037E, 3684068N
LBL58		667835E, 3684054N	667831E, 3684181N
LBL64-F		667956E, 3685036N	668089E, 3685219N
LBL69		668172E, 3685881N	668188E, 3686049N
LBL73		668404E, 3686367N	668181E, 3686395N
LBL77		668388E, 3686822N	668413E, 3686954N
LBL85		668390E, 3687673N	668391E, 3687848N
LBL90-F		668621E, 3688486N	668644E, 3688593N

Blue River (Greenlee Co., AZ) is a major tributary to San Francisco River and is located in Apache Sitgreaves NF. Following the 2011 Wallow Fire, Spikedace, Loach Minnow, and Roundtail Chub *Gila robusta* were stocked into lower Blue River and were considered established as a self-sustaining population (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 *Ictalurus punctatus*, Red Shiner *Cyprinella lutrensis*, 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 site. The survey of lower Blue River conducted in 2022 yielded four Spikedace and no Loach Minnow (Shollenberger et al. 2023).

M&A 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 upstream to Fritz Ranch (Figure 117). Stations LBL85 and LBL90-F 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 1,729 Desert Sucker, 1,128 Longfin Dace, 1,068 Speckled Dace, 763 Sonora Sucker, 471 Roundtail Chub, and 188 Spikedace were captured across all stations. Combined catch and effort totals by reach are summarized in Table 28. Loach Minnow were not detected for the third year in a row. Other wildlife observed included a Western Patch-Nosed Snake *Salvadora hexalepis* was encountered on a trail in between sampled stations.

Overall catch was higher this year compared to just 491 fishes captured in 2022. Spikedace captured were adult and YOY most likely originating from augmentation stockings by AZGFD in March 2022 and 2023. A length-frequency histogram of the sampled population indicates a successful spawn for Spikedace in this site occurred following stocking events this year. Many adult Roundtail Chub (>100 mm) were captured in this survey and appear to have re-established after disturbance events transpired in 2020 and 2021.

Flow and visibility were much more conducive to shocking efforts than were encountered last year. The impacts of post-fire floods in 2021 still were present including high embeddedness and fine sediment being the dominant substrate type in pools and runs. At the time of sampling in 2023 the stations below LBL18 to the fish barrier were dry.

CPUE trends for focal species at Lower Blue River across a 10-year period are included below (Figure 118) as well as length-frequency histograms of Spikedace captured from the last five surveys (Figure 119). Subsequent monitoring efforts will be able to extrapolate how successful the most recent stockings were and how the two cohorts respond to being stocked into the lower Blue River. Data from 2012- 2019 were collected by AZGFD and provided by Reclamation.

Average stream discharge across the three fixed stations was calculated to be 0.05 m<sup>3</sup> / s (2.1 cfs). Average water temperature, DO, pH, and conductivity across the three fixed stations was 16.2 °C, 7.2 mg/L, 8.54, and 708 µS, respectively. Photographs of upper and lower extents of each fixed station are provided below (Figures 120 – 129).

Table 28. Catch summary table of fish captured at Lower Blue River, Arizona, by backpack electrofishing, surveyed on October 16-18, 2023. Total effort was 22,781 seconds.

<b>Reach</b>	<b>Stations</b>	<b>Statistic</b>	<b>AGCH</b>	<b>CAIN</b>	<b>GIIN</b>	<b>MEFU</b>	<b>PACL</b>	<b>RHOS</b>	<b>Totals</b>
1 (1,009 sec)	LBL08 LBL15-F LBL20	Count	5	0	0	0	1	0	6
		% total catch	83.33%	0.00%	0.00%	0.00%	16.67%	0.00%	100.00%
		CPUE (ind/hr)	17.84	0.00	0.00	0.00	3.57	0.00	21.41
2 (3,385 sec)	LBL27 LBL38	Count	358	100	51	6	382	16	913
		% total catch	39.21%	10.95%	5.59%	0.66%	41.84%	1.75%	100.00%
		CPUE (ind/hr)	380.74	106.35	54.24	6.38	406.26	17.02	970.99
3 (3,168 sec)	LBL44 LBL49	Count	190	118	70	29	185	60	652
		% total catch	29.14%	18.10%	10.74%	4.45%	28.37%	9.20%	100.00%
		CPUE (ind/hr)	215.91	134.09	79.55	32.95	210.23	68.18	740.91
4 (2,635 sec)	LBL56 LBL58	Count	107	177	97	36	189	90	696
		% total catch	15.37%	25.43%	13.94%	5.17%	27.16%	12.93%	100.00%
		CPUE (ind/hr)	146.19	241.82	132.52	49.18	258.22	122.96	950.89
5 (7,457 sec)	LBL64-F BL69 BL73	Count	174	246	122	91	237	237	1,107
		% total catch	15.72%	22.22%	11.02%	8.22%	21.41%	21.41%	100.00%
		CPUE (ind/hr)	84.00	118.76	58.90	43.93	114.42	114.42	534.42
6 (5,127 sec)	LBL77 LBL85 LBL90-F	Count	294	122	131	26	735	665	1,973
		% total catch	14.90%	6.18%	6.64%	1.32%	37.25%	33.71%	100.00%
		CPUE (ind/hr)	206.44	85.66	91.98	18.26	516.09	466.94	1385.37
<b>Total</b>		Count	1,128	763	471	188	1,729	1,068	5,347
		% total catch	21.10%	14.27%	8.81%	3.52%	32.34%	19.97%	100.00%
		CPUE (ind/hr)	178.25	120.57	74.43	29.71	273.23	168.77	844.97

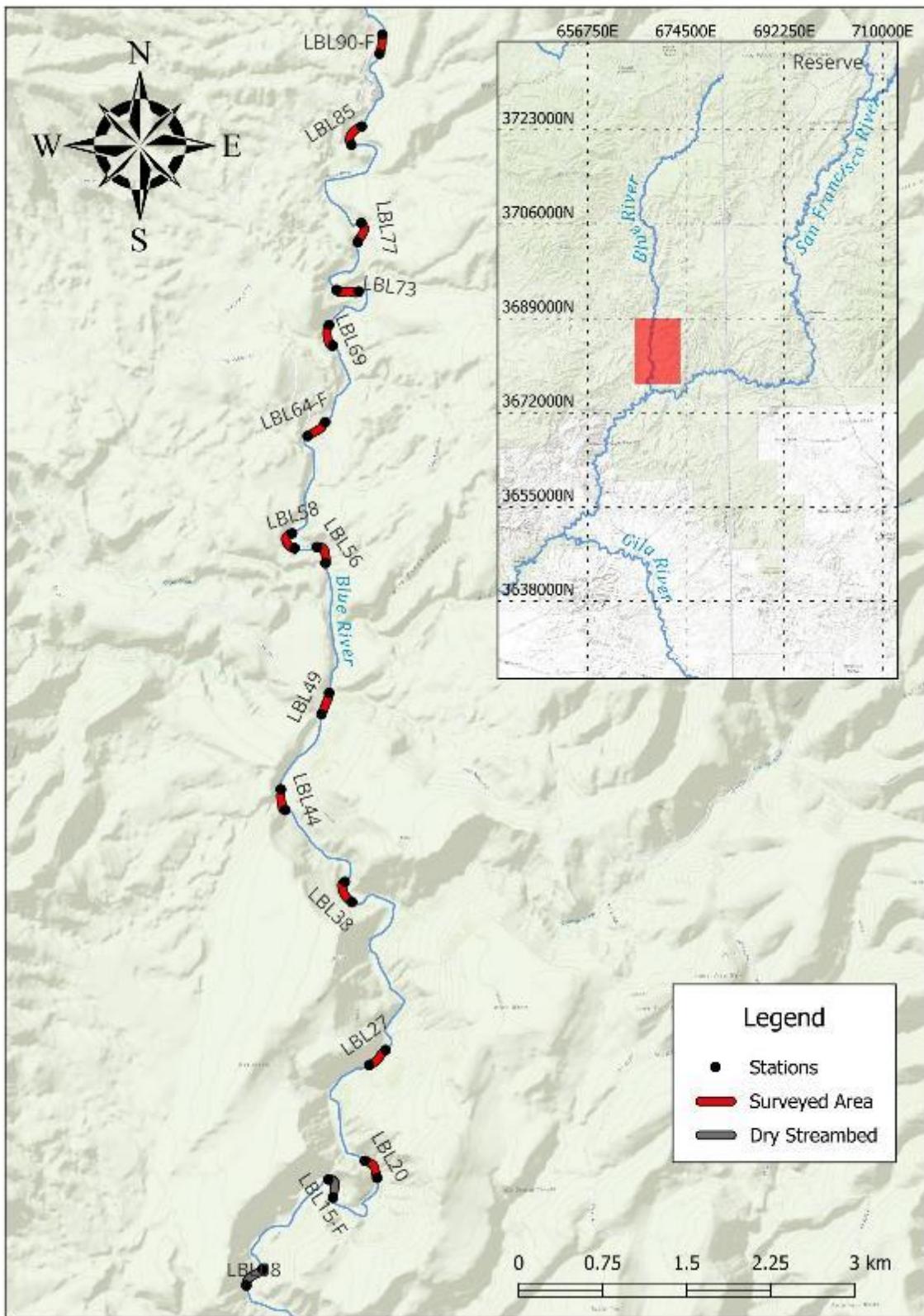


Figure 117. Location of sampling stations at Lower Blue River, Arizona, surveyed on October 16-18, 2023.

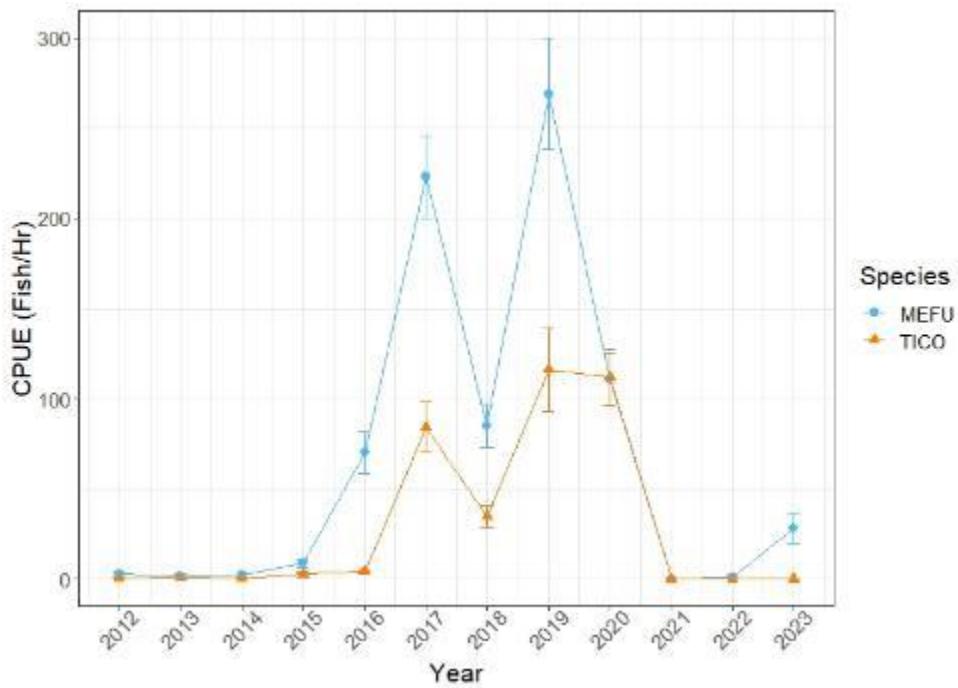


Figure 118. Mean CPUE for all focal species from annual monitoring since 2012 at Lower Blue River.

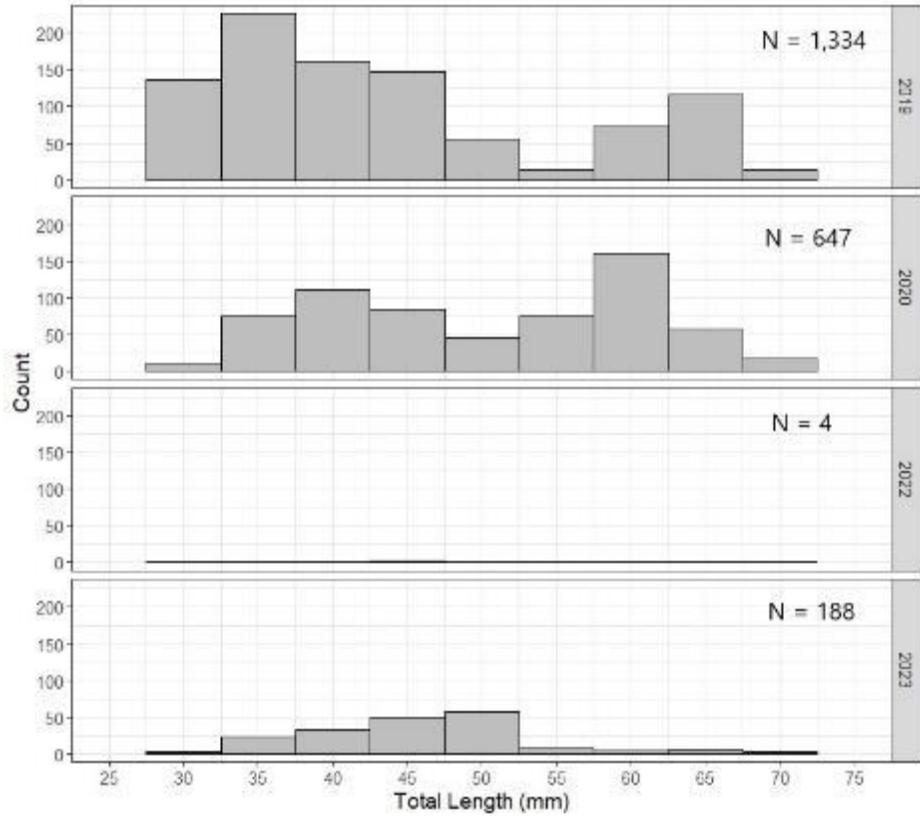


Figure 119. Length-frequency histogram of Spikedace captured at Lower Blue River since 2019. No Spikedace were captured in 2021.



Figure 120. Upstream to downstream view of LBL15-F, Blue River, Arizona.

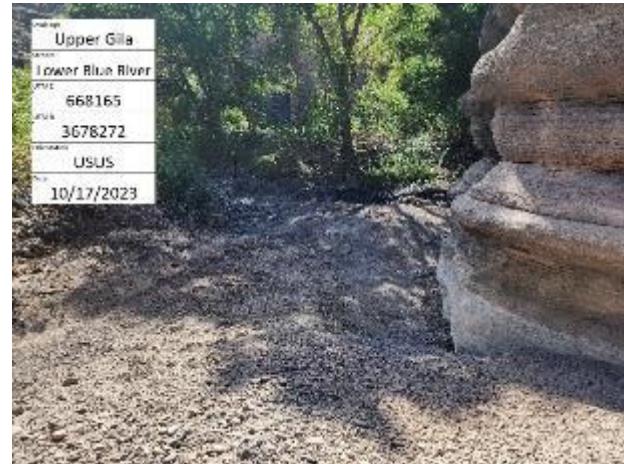


Figure 121. Upstream to upstream view of LBL15-F, Blue River, Arizona.

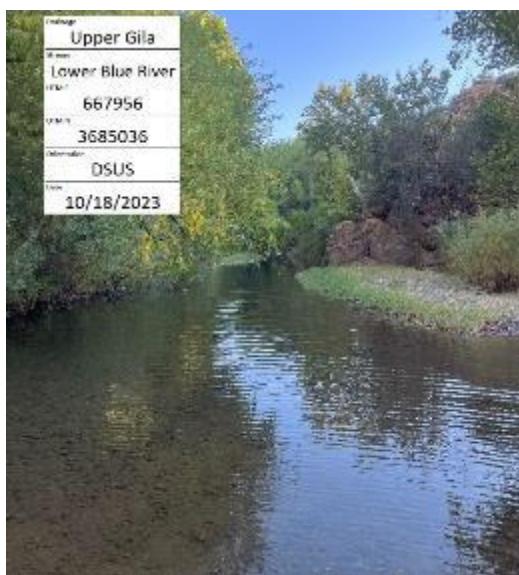


Figure 122. Downstream to upstream view of LBL64-F, Blue River, Arizona.

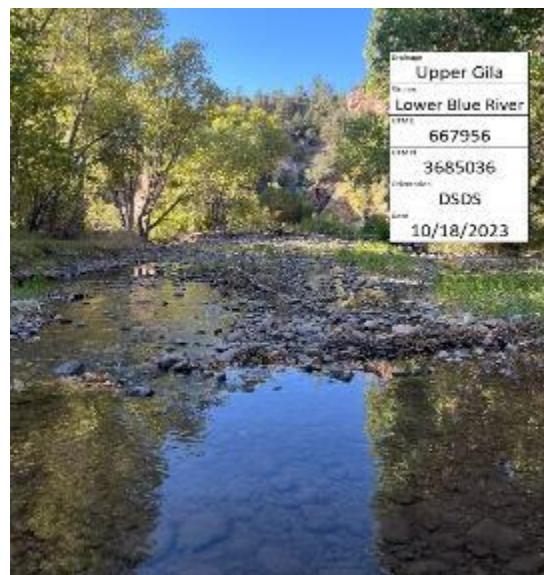


Figure 123. Downstream to downstream view of LBL64-F, Blue River, Arizona.



Figure 124. Downstream to downstream view of LBL15-F, Blue River, Arizona.

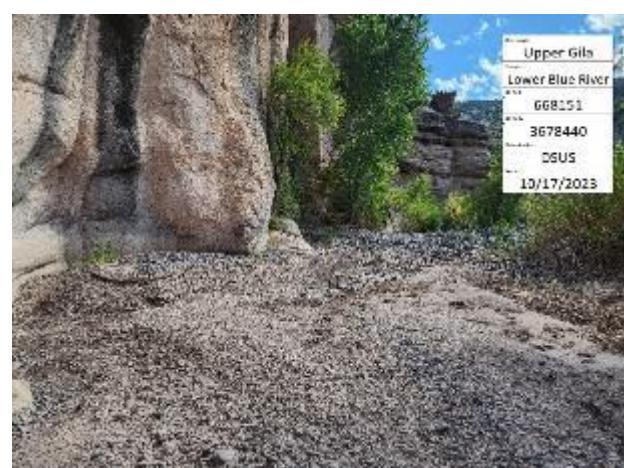


Figure 125. Downstream to upstream view of LBL15-F, Blue River, Arizona.

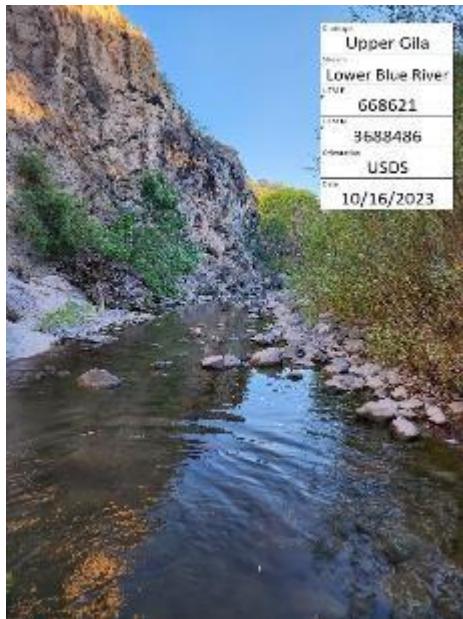


Figure 126. Upstream to downstream view of LBL90-F, Blue River, Arizona.

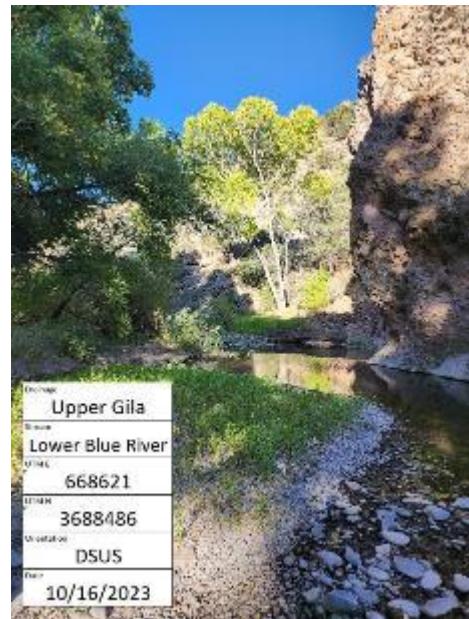


Figure 127. Downstream to upstream view of LBL90-F, Blue River, Arizona.

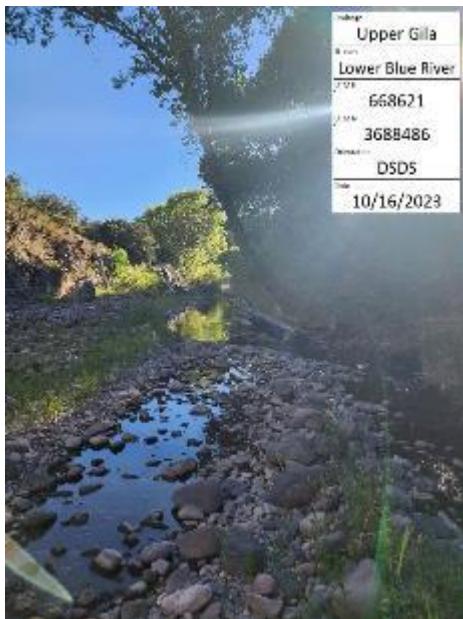


Figure 128. Downstream to downstream view of LBL90-F, Blue River, Arizona.

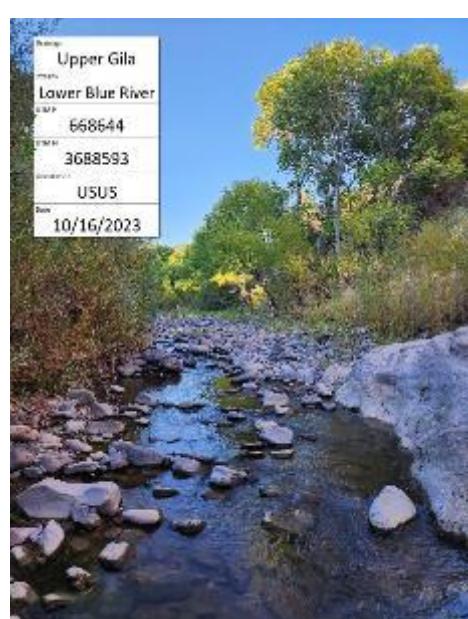


Figure 129. Upstream to upstream view of LBL90-F, Blue River, Arizona.

## Verde River Basin

### Fossil Creek

Station		Lower Boundary	Upper Boundary
FSC015	12S NAD83	446247E, 3808966N	446249E, 3808978N
FSC017-F		446058E, 3808900N	446159E, 3808927N
FSC037		444662E, 3808663N	444712E, 3808750N
FSC043		444403E, 3808196N	444379E, 3808292N
FSC051		443987E, 3807661N	444017E, 3807752N
FSC056		443737E, 3807243N	443822E, 3807305N
FSC065-F		443093E, 3806788N	443198E, 3806839N
FSC071		442553E, 3806667N	442639E, 3806723N
FSC083-F		442012E, 3805970N	442084E, 3806015N
FSC091		441300E, 3805997N	441395E, 3805978N
FSC095		440932E, 3805979N	441005E, 3806062N
FSC100		440593E, 3805896N	440684E, 3805856N
FSC120		439461E, 3804840N	439501E, 3804919N
FSC122		439425E, 3804634N	439448E, 3804718N
FSC125-F		439459E, 3804347N	439444E, 3804435N
FSC135		439486E, 3803401N	439446E, 3803473N

Fossil Creek (Yavapai & Gila cos., AZ) is located within Tonto NF and is tributary to Verde River (Figure 130). Gila Topminnow (Sharp Spring lineage) were stocked into Fossil Creek multiple times between 2007 and 2011 (Gray 2018). Visual counts from snorkel surveys have fluctuated over the years, but Gila Topminnow were considered established in Fossil Creek (Robinson et al. 2017). Gila Topminnow are thought to be distributed from the constructed fish barrier to Fossil Springs, with them being observed most consistently Mazatzal Recreation Area. Fossil Creek was last surveyed for GRBNFMP in 2020. Gila Topminnow and Spikedace are the focal species for this site.

M&A personnel completed sampling of Fossil Creek from May 23-25, 2023. Sixteen (4 fixed, 12 random), 100-m stations were surveyed targeting Gila Topminnow and Spikedace. All stations were surveyed via double pass snorkeling with four observers and time in minutes was recorded for each pass. Snorkeling efforts for Gila Topminnow were focused in slackwater pools, backwaters, and vegetated margins. Gila Topminnow were not observed, so no traps were set. Environmental DNA samples were collected at the start of each station prior to snorkeling.

On May 23, four stations (FSC120, FSC122, FSC125-F, FSC135) were accessed downstream from the Mazatzal parking area. Visibility at these four stations was relatively poor presumably from impacts of the 2021 Backbone Fire. These stations were located downstream of Boulder Canyon, which had severe sediment runoff. Substrate in the creek was primarily fine sediment that further impaired visibility once disturbed. Remaining stations were upstream from Boulder Canyon and visibility was excellent. Two

additional stations (FSC051, FSC056) were surveyed upstream from the Waterfall Trail parking lot. Spikedace were not observed during these snorkel efforts.

On May 24, four stations (FSC15, FSC17-F, FSC037, FSC043) were sampled beginning 100-m below the large waterfall located at 12S 444362/3808304 and ending ~1 km downstream from Fossil Creek Dam. Fixed site FSC017-F encompassed the location where Gila Topminnow were observed during the GRBNFMP survey in 2020, when approximately 40 individuals were observed along a 10-m long shelf under algal mats. This year, the shelf was above the water line due to changes in the travertine dams (Figure 130; shelf on lower left of photo) and no longer provided suitable cover. Spikedace were not observed during these snorkel efforts.

On May 25, three stations (FSC100, FSC095, FSC091) were accessed from the Homestead parking lot. Six Spikedace were observed at station FSC100 in a single pool in turbulent water below a cascade. These were the only Spikedace observed throughout all surveyed stations. Station FSC083-F was accessed from the Fossil Creek Bridge parking area. The final two stations (FSC071, FSC065-F) were located near the Irving Day Use Area.

Roundtail Chub were the most abundant species observed, followed by Speckled Dace, Desert Sucker, Sonora Sucker, Longfin Dace, then Spikedace. Northern Crayfish, Sonora Mud Turtles, and a Gophersnake *Pituophis catenifer* also were observed. A summary table of fish observed for all stations is provided below (Table 29).

Environmental DNA results concluded Spikedace were detected in 6 samples (FSC095, FSC100, FSC120, FSC122, FSC125, and FSC135) and Gila Topminnow DNA detected in 3 samples (FSC037, FSC083-F, and FSC100).

Average stream discharge was 3.43 m<sup>3</sup> (121.13 cfs). Average water temperature, DO, pH, and conductivity was 21.0 °C, 8.25 mg/L, 8.68, and 636 µS. Photographs of upper and lower extents of fixed stations are provided below (Figures 131-138).

Table 29. Summary of fish observed by visual snorkel survey at Fossil Creek, Arizona, surveyed May 23-25, 2023. Total effort was 649 minutes.

<b>Stations</b>	<b>Statistic</b>	<b>AGCH</b>	<b>CAIN</b>	<b>GIRO</b>	<b>MEFU</b>	<b>PACL</b>	<b>RHOS</b>	<b>Totals</b>
FSC015	Count	0	0	461	0	30	50	541
FSC017-F	Count	0	0	590	0	5	87	682
FSC037	Count	9	0	249	0	1	34	293
FSC043	Count	15	25	150	0	75	60	325
FSC051	Count	5	15	90	0	35	14	159
FSC056	Count	50	13	218	0	33	15	329
FSC065-F	Count	0	15	165	0	33	16	229
FSC071	Count	0	9	220	0	22	34	285
FSC083-F	Count	0	3	121	0	5	5	134
FSC091	Count	0	8	175	0	20	5	208
FSC095	Count	0	2	180	0	7	7	196
FSC100	Count	0	4	158	6	22	17	207
FSC120	Count	3	2	25	0	24	0	54
FSC122	Count	0	1	8	0	4	0	13
FSC125-F	Count	0	0	22	0	4	1	27
FSC135	Count	0	3	3	0	9	0	15
	Total	82	100	2,835	6	329	345	3,697

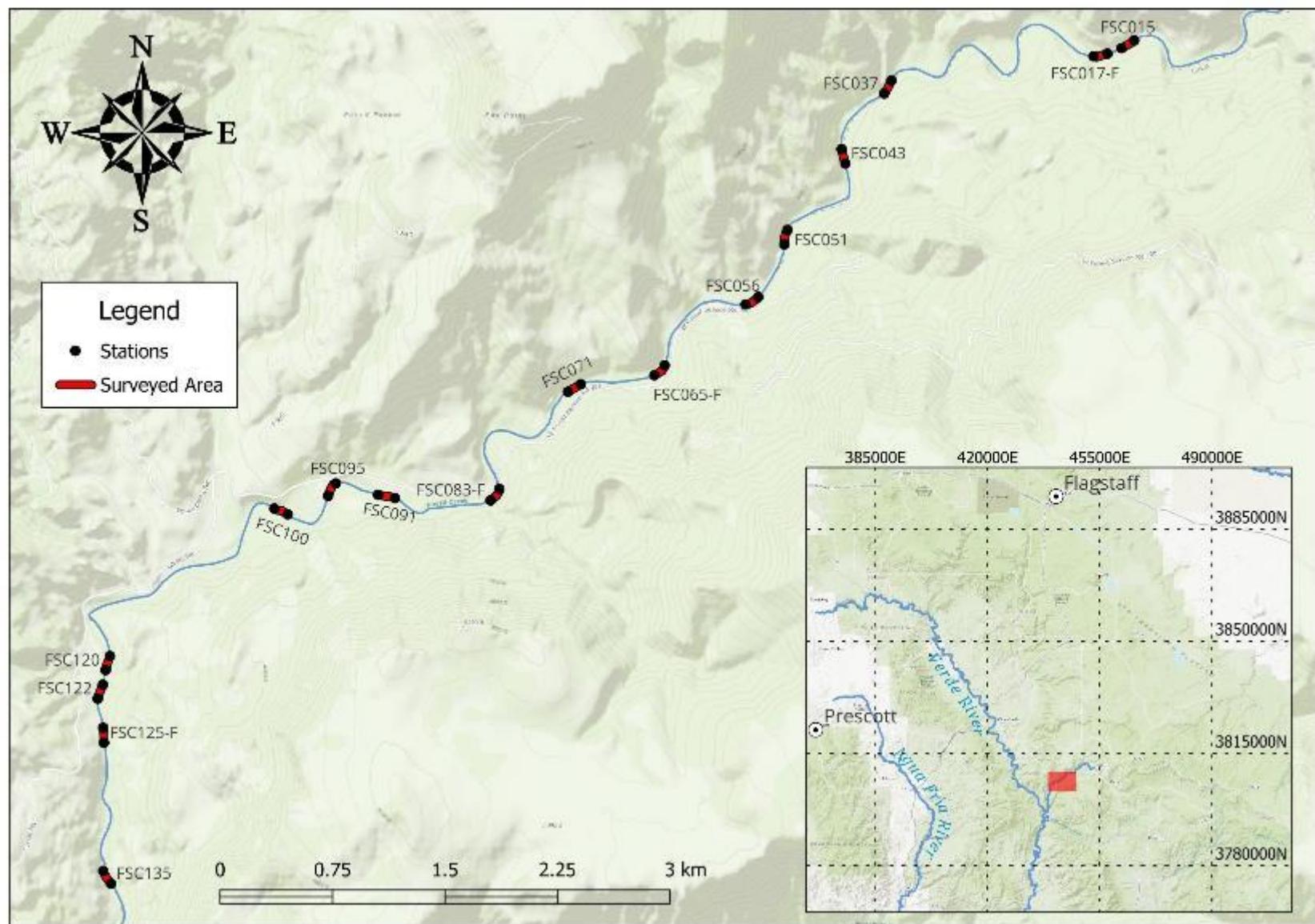


Figure 130. Location of sampled stations at Fossil Creek, Arizona, surveyed May 23-25, 2023.

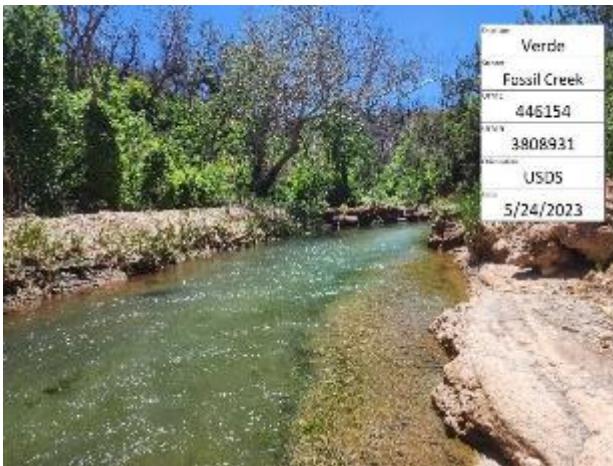


Figure 131. Upstream to downstream view of FSC017-F, Fossil Creek, Arizona.



Figure 132. Upstream to upstream view of FSC017-F, Fossil Creek, Arizona.



Figure 133. Downstream to downstream view of FSC17-F, Fossil Creek, Arizona.



Figure 134. Downstream to upstream view of FSC17-F, Fossil Creek, Arizona.

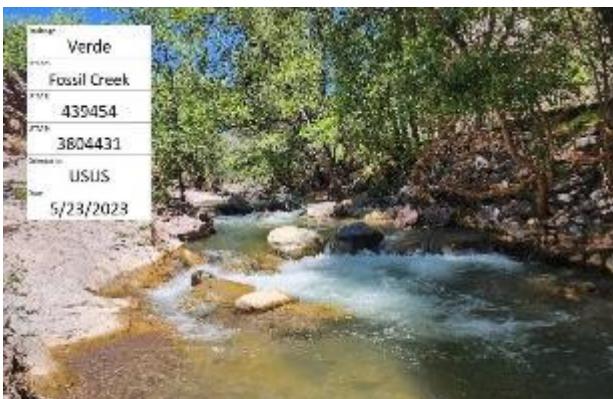


Figure 135. Upstream to upstream view of FSC125-F, Fossil Creek, Arizona.

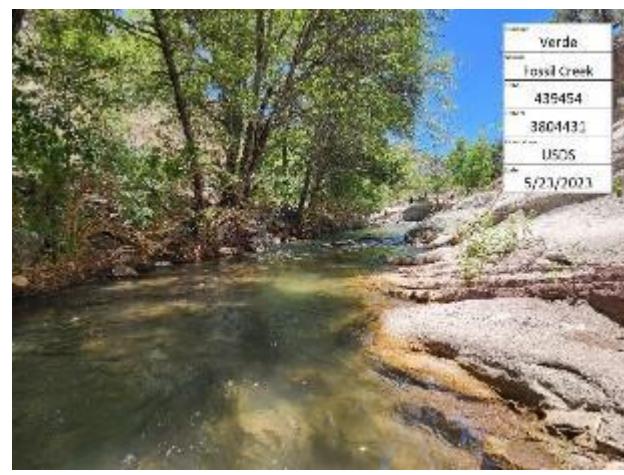


Figure 136. Upstream to downstream view of FSC125-F, Fossil Creek, Arizona.

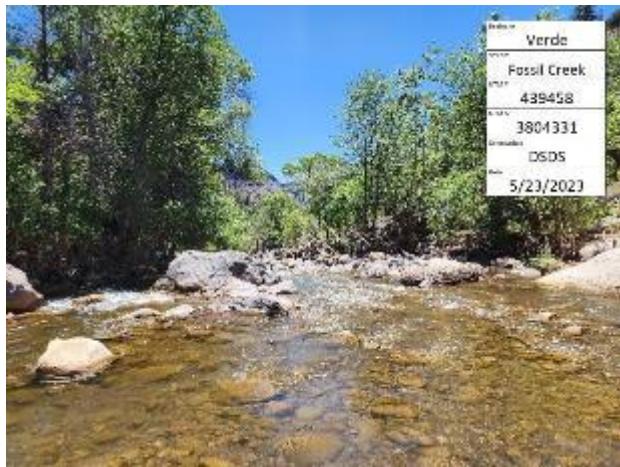


Figure 137. Downstream to downstream view of FSC125-F, Fossil Creek, Arizona.

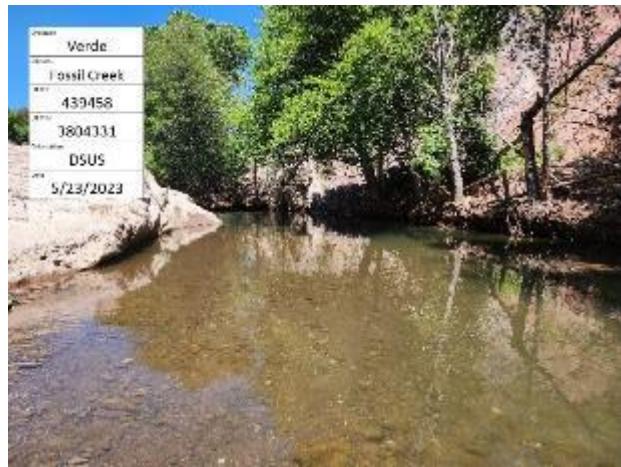


Figure 138. Downstream to upstream view of FSC125-F, Fossil Creek, Arizona.

## **Walker Canyon**

<b>Station</b>		<b>Lower Boundary</b>	<b>Upper Boundary</b>
WLC09	12S NAD83	436416E, 3833816N	436461E, 3833897N
WLC13		436085E, 3833699N	436193E, 3833694N
WLC14-F		435973E, 3833693N	436088E, 3833696N

Walker Creek (Yavapai Co., AZ) is tributary to Wet Beaver Creek and is located in Coconino NF in the Verde River basin (Figure 140). A small diversion dam is present near the private property boundary that may act as barrier to non-native fish during low flows. The focal species for Walker Creek is Gila Chub. Previous GRBNFMP surveys established a 100-m station upstream of Rancho Roco Roja. Recent surveys in 2018 and 2020 captured totals of 38 and 26 Gila Chub, respectively.

M&A personnel surveyed Walker Creek August 7, 2023. Three, 100-m stations (1 fixed, 2 random) were surveyed via backpack electrofishing. The sampled stations were accessed via FR 618 to FR 9201C and a 1.4 km hike along Walker Basin Trail. A 4x4 vehicle is recommended for the drive leading to the trailhead.

Across all stations, species captured were comprised of 83 Gila Chub, 80 Speckled Dace, and 13 Desert Sucker. Gila Chub were captured at every sampled station. Individuals ranged from 69 to 204 mm (Figure 139). This survey produced the greatest number of Gila Chub caught since monitoring began for GRBNFMP. Non-native fish were not detected during this year's sampling efforts. Northern Crayfish were observed across all sampling stations. A summary table of catch for all sampling stations is provided below (Table 30).

Mesohabitat consisted of shallow, slow-moving runs separated by short multi-step falls. There was a 2-m deep pool below a small diversion dam at the start of the fixed station and was the only significantly deep pool observed at this site. Stream discharge at (WLC14-F) was 0.031 m<sup>3</sup> (1.08 cfs). Water temperature, DO, pH, and conductivity were 22.0 °C, 7.6 mg/L, 8.40, and 391 µS, respectively. Photographs of upper and lower extents at one fixed station are provided below (Figures 141-144).

Table 30. Summary of catch of fish captured via backpack electrofishing at Walker Canyon, Arizona, surveyed August 7, 2023. Total effort was 3,623 seconds.

Stations	Statistic	GIIN 51-100	GIIN >100	RHOS <40	RHOS >=40	PACL <=50	PACL >100	Totals
WLC09 (1,005 sec)	Count	1	26	12	16	1	3	59
	% total catch	1.69%	44.07%	20.34%	27.12%	1.69%	5.08%	100.00%
	CPUE (ind/hr)	3.58	93.13	42.99	57.31	3.58	10.75	211.34
WLC13 (1,358 sec)	Count	2	38	2	22	0	7	71
	% total catch	2.82%	53.52%	2.82%	30.99%	0.00%	9.86%	100.00%
	CPUE (ind/hr)	5.30	100.74	5.30	58.32	0.00	18.56	188.22
WLC14-F (1,260 sec)	Count	1	15	6	22	1	1	46
	% total catch	2.17%	32.61%	13.04%	47.83%	2.17%	2.17%	100.00%
	CPUE (ind/hr)	2.86	42.86	17.14	62.86	2.86	2.86	131.43
Total	Count	4	79	20	60	2	11	176
	% total catch	2.27%	44.89%	11.36%	34.09%	1.14%	6.25%	100.00%
	CPUE (ind/hr)	3.97	78.50	19.87	59.62	1.99	10.93	174.88

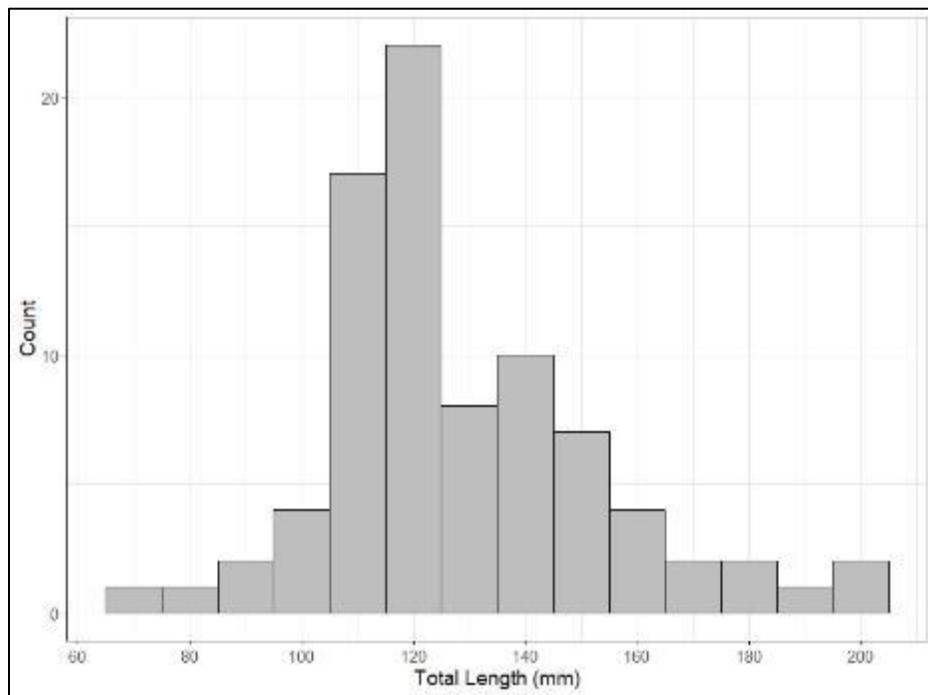


Figure 139. Length-frequency histogram of Gila Chub (n=83) captured at Walker Canyon, Arizona, surveyed August 7, 2023.

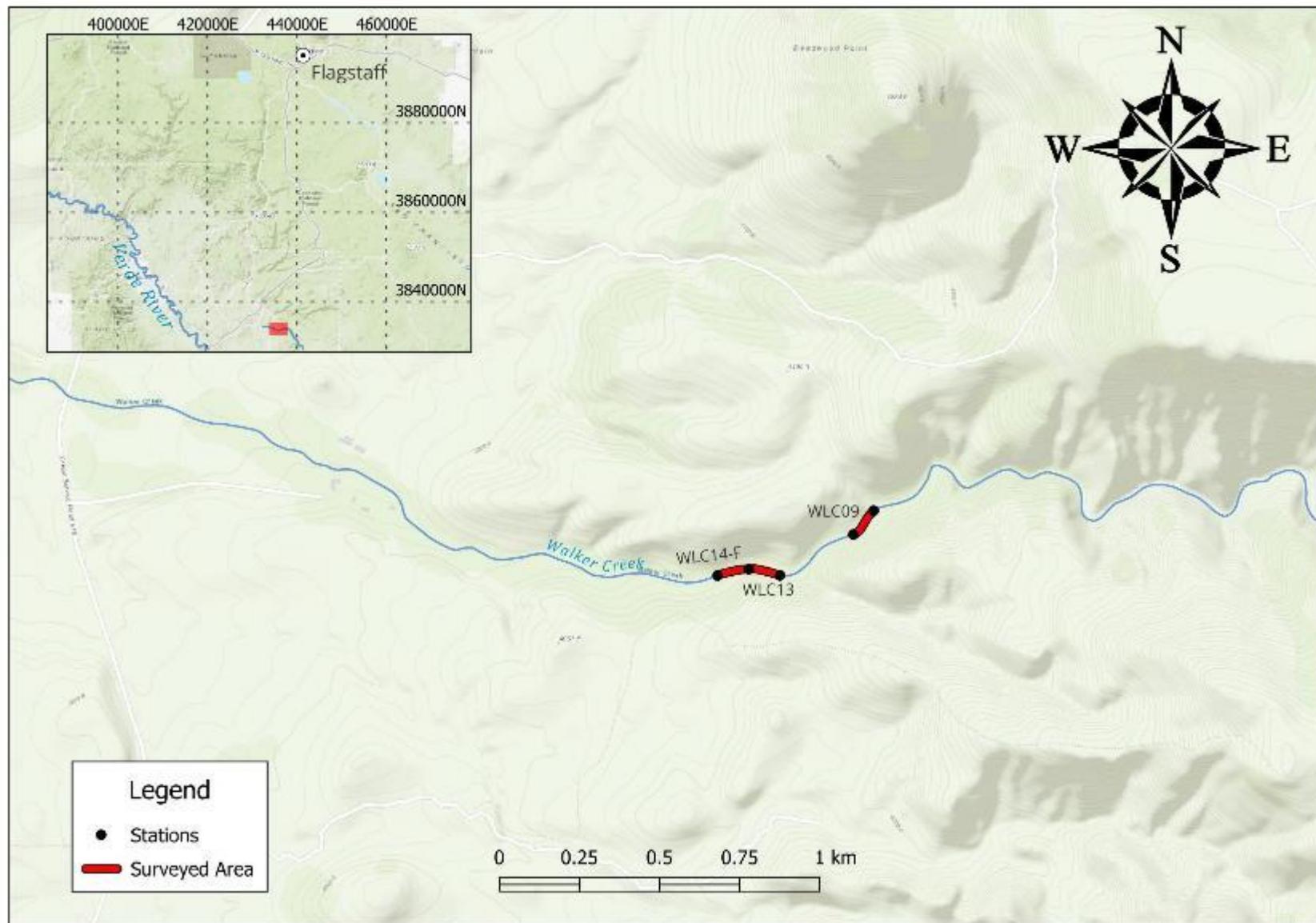


Figure 140. Location of stations sampled at Walker Canyon, Arizona, surveyed August 7, 2023.

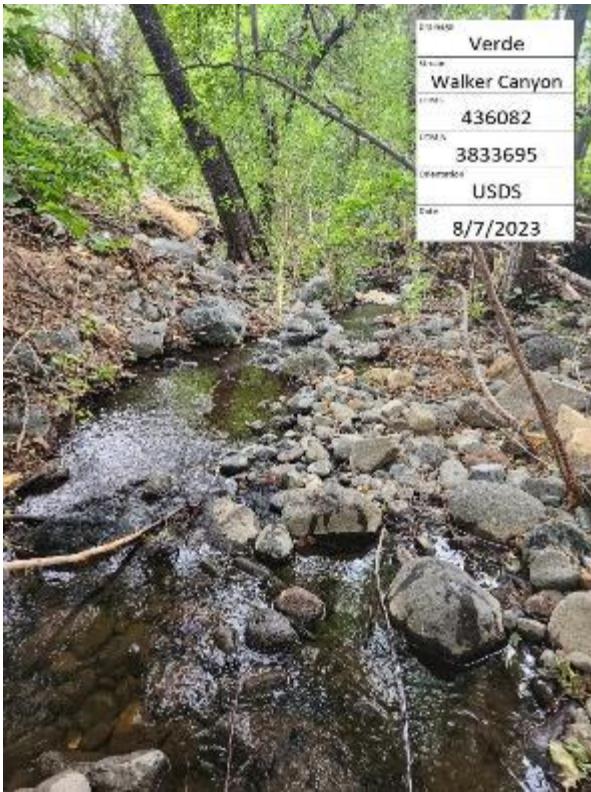


Figure 141. Upstream to downstream view of WLC14-F, Walker Canyon, Arizona.

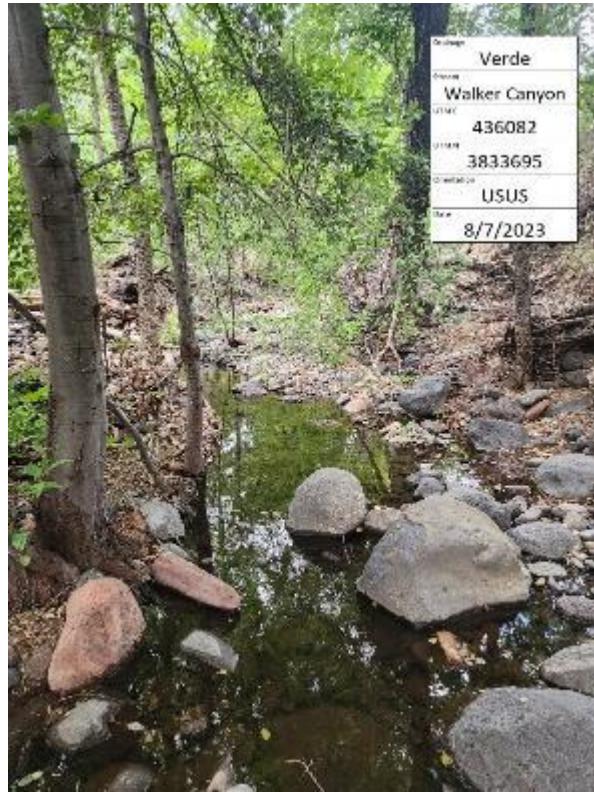


Figure 142. Upstream to upstream view of WLC14-F, Walker Canyon, Arizona.

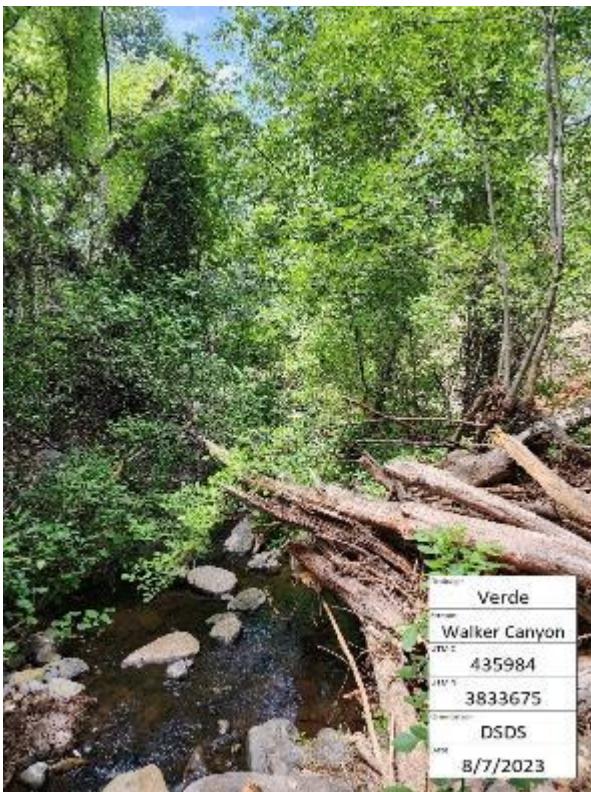


Figure 143. Downstream to downstream view of WLC14-F, Walker Canyon, Arizona.

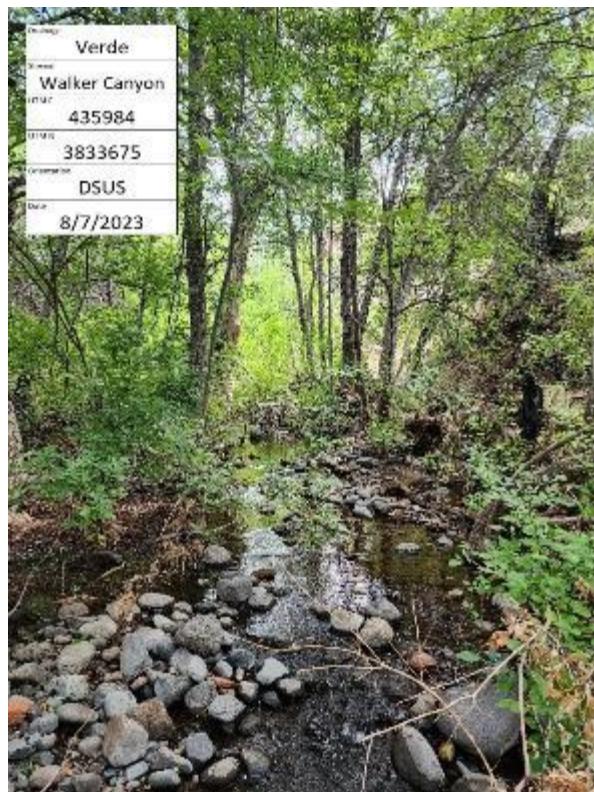


Figure 144. Downstream to upstream view of WLC14-F, Walker Canyon, Arizona.

## **Spring Creek**

<b>Station</b>		<b>Lower Boundary</b>	<b>Upper Boundary</b>
SPC01-F	12S NAD83	436416E, 3833816N	436461E, 3833897N
SPC03		436085E, 3833699N	436193E, 3833694N
SPC14-F		435973E, 3833693N	436088E, 3833696N

Spring Creek (Yavapai Co., AZ) is located in Verde River drainage and is tributary to Oak Creek near Cornville, AZ (Figure 143). Gila Topminnow, Gila Chub, and Spikedace are the focal species at Spring Creek. For 2023, only Gila Topminnow was targeted because AZGFD currently is 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 2022, specifically targeting Gila Topminnow and in 2014, specifically targeting Gila Chub.

M&A personnel completed sampling of Spring Creek on October 10, 2023. Three (2 fixed, 1 random), 100-m stations were surveyed (Figure 145). Ten minnow traps were set in each station resulting in a total of 135.47 trap hours. The upper reach of Spring Creek containing stations SPC01-F and SPC03 was accessed via East Willow Pt Road. The downstream stations were accessed by North Oak Creek Valley Road to a trail just north of a gated community.

Totals of 166 Gila Topminnow, 325 Gila Chub, 505 Longfin Dace, 295 Speckled Dace, and one Desert Sucker were captured. Gila Topminnow were only detected in slow-moving water immediately upstream (~ 20 m) of the fish barrier within the lowest fixed station (SPC14-F). Gila Topminnow were not detected at this site when surveyed in 2022. Gila Chub catch totals were lower than in 2022, when 476 individuals were captured with less sampling effort (83.46 hr).

Mesohabitat upstream of the fish barrier was a slow-moving shallow run dominated by clay/silt substrate. Once mesohabitat transitioned to step-runs, cobble and gravel were the dominant substrates. Average water temperature, DO, pH, and conductivity was 18.5 °C, 8.2 mg/L, 8.47, and 605 µS, respectively. Photographs of upper and lower extents of fixed stations are provided below (Figures 146-155).

Table 31. Summary of catch via minnow trap at Spring Creek, Arizona, surveyed October 10, 2023.  
 Total effort was 135.5 trap hours.

<b>Station</b>	<b>Statistic</b>	<b>POOC (&lt;20)</b>	<b>POOC (&gt;=20)</b>	<b>GIIN</b>	<b>AGCH</b>	<b>RHOS</b>	<b>PACL</b>	<b>Total</b>
SPC01-F (59.43 hrs)	Count	0	0	142	472	224	1	839
	% total catch	0.00%	0.00%	16.92%	56.26%	26.70%	0.12%	100.00%
	CPUE (ind/net hr)	0.00	0.00	2.39	7.94	3.77	0.02	14.12
SPC03 (53.83 hrs)	Count	0	0	63	33	53	0	149
	% total catch	0.00%	0.00%	42.28%	22.15%	35.57%	0.00%	100.00%
	CPUE (ind/net hr)	0.00	0.00	1.17	0.61	0.98	0.00	2.77
SPC14-F (22.2 hrs)	Count	15	151	120	0	16	0	302
	% total catch	4.97%	50.00%	39.74%	0.00%	5.30%	0.00%	100.00%
	CPUE (ind/net hr)	0.68	6.80	5.41	0.00	0.72	0.00	13.60
<b>Total</b>	Count	15	151	325	505	293	1	1,290
	% total catch	1.16%	11.71%	25.19%	39.15%	22.71%	0.08%	100.00%
	CPUE (ind/net hr)	0.11	1.11	2.40	3.73	2.16	0.01	9.52

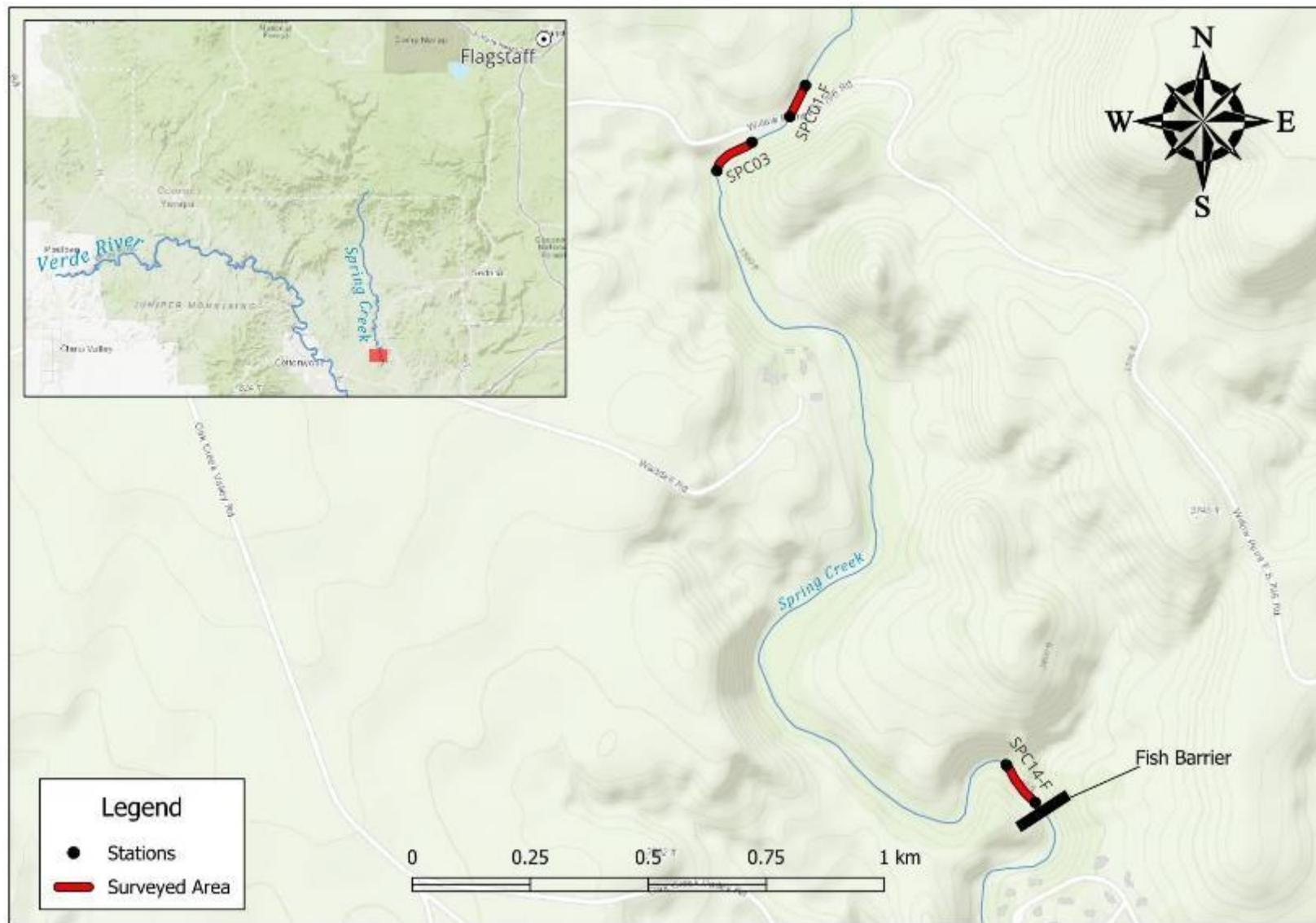


Figure 145. Location of stations sampled at Spring Creek, Arizona, surveyed October 10, 2023.

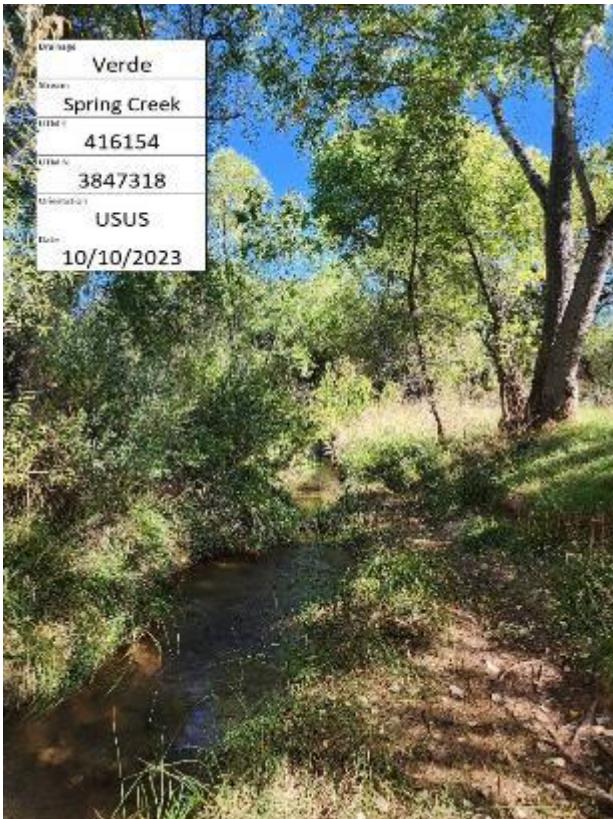


Figure 146. Upstream to upstream view of SPC01-F, Spring Creek, Arizona.

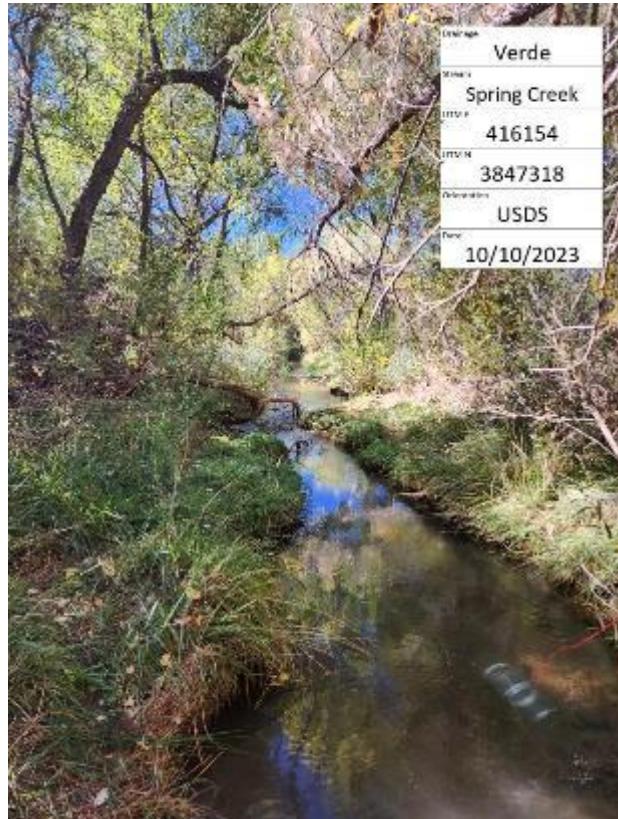


Figure 147. Upstream to downstream view of SPC01-F, Spring Creek, Arizona.

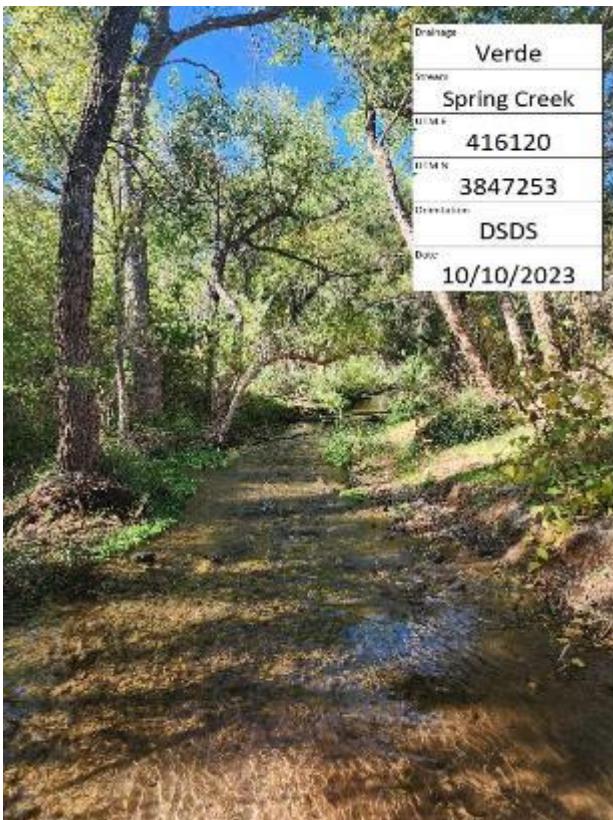


Figure 148. Downstream to downstream view of SPC01-F, Spring Creek, Arizona.

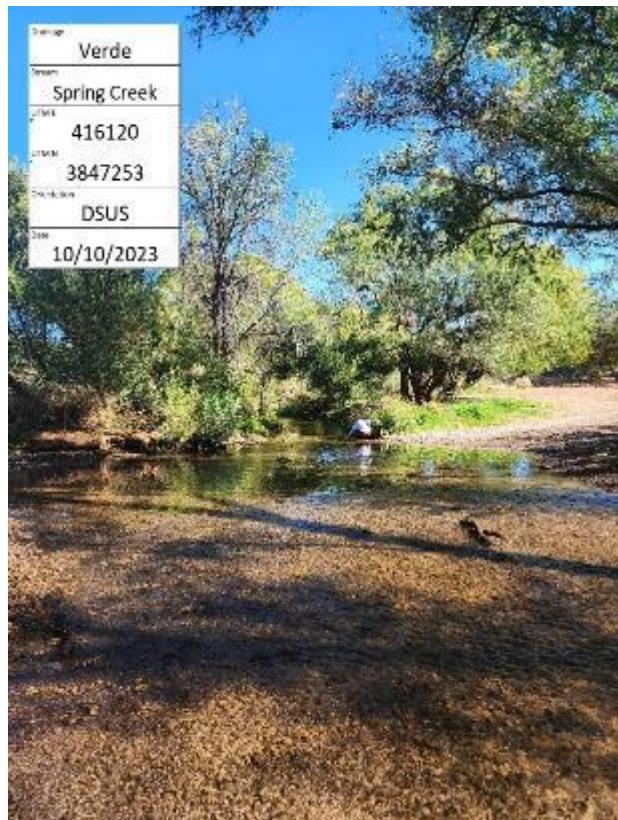


Figure 149. Downstream to upstream view of SPC01-F, Spring Creek, Arizona.



Figure 152. Downstream to upstream view of SPC14-F, Spring Creek, Arizona.



Figure 153. Downstream to downstream view of SPC14-F, Spring Creek, Arizona.

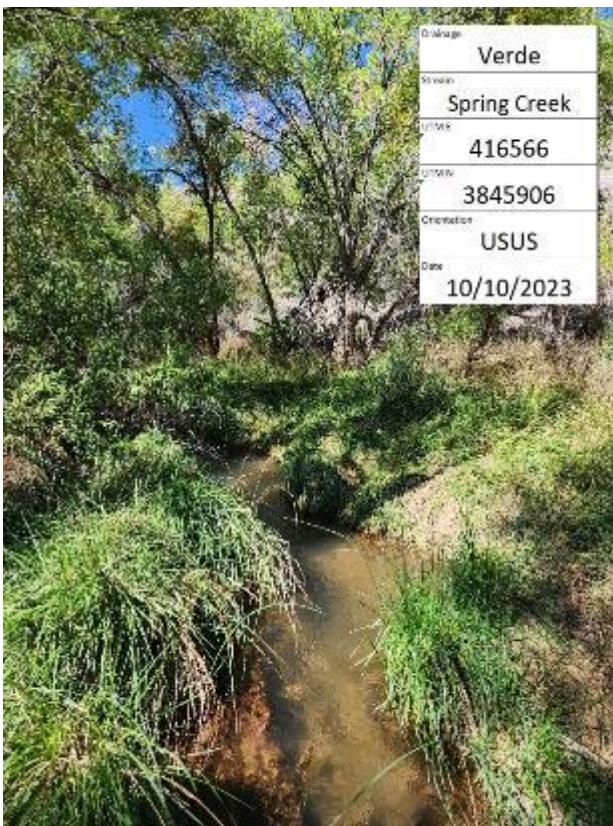


Figure 154. Upstream to upstream view of SPC14-F, Spring Creek, Arizona.

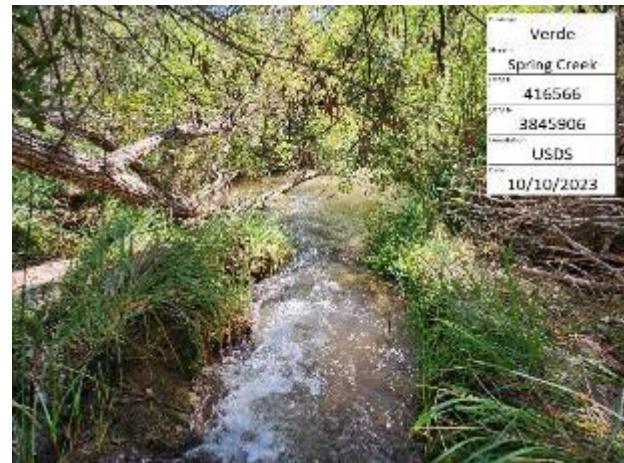


Figure 155. Upstream to downstream view of SPC14-F, Spring Creek, Arizona.

## Acknowledgements

The following individuals are acknowledged for their assistance in varying capacities: Kurt Shollenberger, Wes Franklin, Alex Marini, Garrett Percy, Cora McClelland, and Allison Downey (M&A); Kent Mosher (Reclamation); Ron Day, Joe Koch, Marty Lawrence, Peter Leiterman, and Jessie Pearl (TNC); Ian Murray, Mead Mier, Amanda Webb, John Walker, and Sami Hammer (Pima County); Stephanie Coleman, Kelly Kessler, Mathew Lane, Yvette Paroz (Forest Service); Nate Berg, Brian Hickerson, Chrissy Kondrat-Smith, Jim Ruff, John Windes (AZGFD); Jasmine Johnson (NMDGF); 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 Fossil Creek, Yavapai Co., Arizona, by Kurt Shollenberger.

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