FISH MONITORING OF SELECTED STREAMS WITHIN THE GILA RIVER BASIN, 2012

Annual Report

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INTRODUCTION

This report summarizes monitoring activities conducted during 2012 for Contract No. 12PC32007, Monitoring of Gila River Basin Waters. Monitoring activities were conducted on a subset of streams identified in the "Scope of Work - Monitoring of Gila River Basin Waters to Assist with Conservation of Federally-listed Warm Water Fishes (Native Fish Monitoring)".

While the scope of work indicates roughly one quarter of the sites (15-16) should be monitored each year, due to the late availability of funds only 11 streams were sampled during 2012. Streams from five different sub-basins were sampled: the Agua Fria River sub-basin (Indian, Little Sycamore, Sycamore and Tule creeks); the Verde River sub-basin (Red Tank Draw); the Salt River sub-basin (Cherry Creek); and the Santa Cruz River sub-basin (lower Cienega Creek, upper Cienega Creek, Coalmine, Fresno, Romero and Sabino canyons, and the Santa Cruz River). While Upper Cienega Creek (on BLM administered lands) and the Santa Cruz River were also sampled, no Contract funds were expended for the effort as other monitoring efforts were already underway.

Various problems were encountered during monitoring activities, but appear minor and will be easily remedied in future efforts. For example, in some instances data sheets were incomplete (e.g. missing co-ordinate data for individual habitats and date/time entries) or reflect an inconsistency in adjacent habitat boundaries. Discussions with those responsible for completion of the sheets suggest this is mainly attributable to one of the following: the repetitive nature of some of the qualitative information for each sampling effort; perceived time limitations (e.g. a sense of running out of daylight before the effort is complete); or perceived inaccuracy of GPS readings between adjacent habitats that share boundaries. Future efforts will be spread-out over a greater portion of the year, allowing sufficient time for proper time management during monitoring efforts. Discrepancies between photo boundary coordinates, map coordinates and data sheet coordinates on data sheets do not reflect actual changes in localities for each, but are due largely to changing reception quality of satellite signals in many of the canyon-bound environments that the work was conducted in.

All Tables and Figures referred to in text are located in Appendix I; upper and lower boundary photographs for the locations sampled are located in Appendix II and are available on disk. A summary of habitats sampled at each survey site as well as the presence/absence of target species within habitats is provided in Figure 1. Table 1 summarizes species occurrence (native and nonnative) across all sites sampled for the project during 2012.

We suggest changing datasheet design to capture relevant qualitative data only once, and eliminate redundant or uninformative fields. In future efforts, greater attention to detail by field personnel should result in more informative maps as well as complete sets of boundary photos for each site.

METHODS

Initial monitoring on each stream was directed to points of access with historical occurrence of the target species, with subsequent efforts concentrating on preferred habitats of the target species. Monitoring sites focused on readily accessible points of access on the streams, with streams less than five miles in length having one monitoring site, between five and ten miles in length having two monitoring sites, and streams over ten miles in length having three monitoring sites. The initial detection search from the point of access was conducted over a survey reach of 500-m (0.5 km), concentrating on habitats preferred by the species. Once the target species was encountered within the 500-m reach, a 100-m quantitative monitoring reach was established, and sampled according to procedures in Clarkson et al. (2011). If the target species was not encountered in the 500-m reach, another 500-m search was initiated at another accessible site on the stream. Within the 100-m quantitative monitoring reach, each species encountered and the number of individuals per species encountered within each of the major mesohabitat types (pool, run, riffle) was recorded to determine assemblage structure. If the focus species was rare (<25) within the 100-m quantitative reach, sampling continued into adjacent stream segments with suitable habitats; if suitable habitats were not available adjacent to the monitoring reach, the effort was repeated at other access sites on the stream (if available) that contained habitat deemed suitable for the target species.

For the majority of surveys, electrofishing using either the Smith-Root Model-12R or the Model LR24 Backpack Electroshocker (BPES) was the primary method of sampling. Generally, in areas where stream morphology, water depth, or substrate instability made sampling with the BPES unsafe or impossible, other sampling techniques were employed, including minnow traps (Promar 8” x8” x 24” – 1/8” and 3/16” mesh), hoop nets (3’ x 5’ x ¼”; Promar 12” x 36” x ¾” mesh), dip-nets (1236 in^2, 1/8” mesh), seines (4’ x 10’ x 1/8”; 4’ x 15’ x 1/8”) and trammel nets (6’ x 50’ x 1”). Water quality measurements at most sites were taken using EXTECH Instruments ExStik II EC500 pH/Conductivity/TDS/Temperature Meter, and the EXTECH Instruments ExStik II DO600 dissolved oxygen meter. Minnow and hoop traps were baited with dry dog food unless otherwise stated. All coordinates reported reference the Universal Transverse Mercator (UTM) geographic coordinate system, North American Datum 1983 (NAD83). Coordinates were determined using either a Garmin GPS 60 or Garmin GPS Map 78s GPS unit.

RESULTS

Cherry Creek #39

Tributary to the Salt River, Cherry Creek drains the eastern slopes of the Sierra Ancha Mountains in Gila County, Arizona. To the north and northwest, the drainage abuts the Naegelin Rim. Major tributaries to Cherry Creek include Crouch, Walnut and PB creeks. Cherry Creek was the initial sampling trip of the project, and in a number of instances, portions of the sampling routine were not completed, such as photo-documentation of the up- and downstream boundaries, or quality control measures for datasheet completion.

Monitoring activities for the drainage were conducted between 18 and 21 September, 2012. Three sampling reaches within Cherry Creek were specified in the scope of work; sampling reaches were numbered from upstream (Reach 1) to downstream. Initial access to the stream was at the downstream end, so the lowermost of the three sites (Reach 3) was sampled first, with the remaining two reaches (Reach 2 and Reach 1) sampled on subsequent days. Roads to and between sites were rough, and travel speeds between sites were low. For future efforts, the upper reach of Cherry Creek Road between reaches 1 and 2 should be avoided because of poor road condition. Reach 1 should be accessed from the north via Hwy 288 and FSR54 (Cherry Creek Rd.), and reaches 2 and 3 should be accessed from the north via Highway 288 and Board Tree Saddle, or alternatively from the south on Cherry Creek Road. In all cases and at each of the sites, a 500-m detection reach was sampled, but a complete set of boundary photographs were not taken, because of oversight on the part of the personnel involved.

The target species for Cherry Creek was roundtail chub (*Gila robusta*; GIRO) which was not collected at any of the three localities during the surveys. Several other native species were encountered, including desert sucker (*Pantosteus clarki*; PACL), Sonora sucker (*Catostomus insignis*; CAIN), longfin dace (*Agosia chrysogaster*; AGCH), and speckled dace (*Rhynichthys osculus*; RHOS).

Currently, the primary threat to native fishes in Cherry Creek is posed by nonnative fishes found in the stream during the surveys. Nonnatives captured in Cherry Creek during the monitoring efforts included yellow bullhead (*Ameiurus natalis*; AMNA), green sunfish (*Lepomis cyanellus*; LECY), fathead minnow (*Pimephales promelas*; PIPR), red shiner (*Cyprinella lutrensis*; CYLU) and flathead catfish (*Pylodictus olivaris*; PYOL). Of the nonnative fishes, flathead catfish pose a particular threat to the continued existence of native fishes in the drainage; additional sampling to determine their distribution within the stream should be conducted and practicable options for the removal of nonnatives from the lower stream should be considered. Sonora sucker should be translocated from below the natural barrier (located between reaches 1 and 2) into suitable habitats above the barrier. Secondary threats to the drainage may include increased future surface water withdrawals upstream, and increased groundwater pumping within the drainage.

Cherry Creek #39 - Reach 1 09/21/2012

UTM 12S In: 0510836E, 3763041N Out: 0510775E, 3763502N

Reach 1 was the third and last section of three sites sampled on Cherry Creek (Figure 2). On the morning of September 21, 2012, a 500-m detection reach of stream was sampled using a Smith-Root Model 12 R BPES. Weather was sunny and warm with light clouds. Water temperature at the end of sampling (0955 hours) was 17.5°C, with dissolved O_2 (dO_2) of 7.0 mg/L; pH and conductivity were not recorded for this site because equipment malfunctioned. Predominant trees encountered along the riparian zone included oak (*Quercus* sp.), alder (*Alnus oblongifolia*), and willow (*Salix* sp.).

Four species (three native and one nonnative) were sampled in Cherry Creek within Reach 1. Roundtail chub was the target species for this stream but was not captured; therefore no fixed station was established. Native species captured included desert sucker, longfin dace and speckled dace; the only nonnative species sampled within this stream section was green sunfish. Results of the effort are summarized in Table 2. Desert suckers (n=139) were common throughout the 500-m reach, while longfin dace (n=25) and speckled dace (n=19) were found locally within the reach; green sunfish (n=3) were relatively uncommon throughout the 500-m sampled in Reach 1.

Heavy suspended sediments encountered on previous days at downstream reaches were greatly reduced at this location, allowing visibility of approximately 10-12 inches depth. Crayfish (*Orconectes virilis*) were abundant in this reach, however very few of the fishes sampled showed any sign of fin damage.

A complete set of photographs was not taken for this reach of stream; photos were taken only from the upper boundary facing downstream and the lower boundary facing upstream. These can be found in Appendix II (photos 1 and 2).

Cherry Creek #39 - Reach 2 09/19-20/2012

UTM 12S In: 0508767E, 3753351N Out: 0508705E, 3753805N

Cherry Creek Reach 2 is located roughly 5.8 miles SSW of Reach 1, but the road distance between the two sites is over twice that distance (Figure 3). Reach 2 is located 6.6 miles NNW of Reach 3, with roughly 11.5 road miles between the two sites. Road condition of Cherry Creek Road between reaches 1 and 2 is exceptionally poor, requiring very low travel speeds. In the interest of saving time during future monitoring efforts, it is strongly recommended that travel between Reach 1 and Reach 2 be conducted via Highway 288, and ingress or egress of Cherry Cr. (road) and the remaining two sites be via the road leaving Hwy 288 at Board Tree Saddle (12S 504426E 3758669N).

On September 19, 2012, a 500-m reach of stream was sampled between 1224 and 1424 hours using a Smith-Root BPES. Weather at Reach 2 was hot and clear; at 1424 hours the water

temperature at 5 cm depth was 23°C, conductivity was 540 µS/cm, and dissolved O_2 was 6.76 mg/L; water pH was not collected because the meter malfunctioned. Similar to conditions the previous day at Reach 3, the water was still turbid with suspended sediment and ash, resulting in visibility between 4 -10 inches in pooled areas. Predominant trees along the riparian zone included cottonwood (*Populus fremontii*), willows, alder, western sycamore (*Platanus occidentalis*), Arizona ash (*Fraxinus velutina*), and oak.

Results of the effort at Reach 2 are provided in Tables 3 and 4. Only one of the nonnatives found at Reach 3 on the previous day was found to be present. In considering the variety of species captured in Reach 2, of particular interest was the relative scarcity of the nonnative compared to native species, perhaps reflecting the effect of recent ash-flow events. One of the native species seen downstream at Reach 3, the Sonora sucker, was not detected in Reach 2. Speckled dace, another native species that was not detected in Reach 3 was relatively common in Reach 2.

Habitat within Reach 2 was predominantly elongated pools with small to large in-stream boulders, and relatively short reaches of riffle and run. Most pools were sufficiently shallow to be effectively sampled with the BPES. One particular pool within the reach was too deep for effective sampling with the BPES, so accessible portions of the pool margins were electrofished, and later that afternoon, two hoop nets were deployed to fish the pool overnight. The nets were allowed to fish for over 16 hours and the resulting catch was surprisingly small, resulting in two desert sucker, two green sunfish, and multiple crayfish (Table 3). Only one photo was taken at each of the lower and upper boundaries (photos 3 and 4).

Cherry Creek #39 - Reach 3 09/18/2012

UTM 12S In: 0513293E, 3743130N Out: 0513053E, 3743543N

Due to accessibility, the lowermost of the three sampling reaches on Cherry Creek (Figure 4) was sampled first, followed on successive days by reaches 2 and 1. On September 18, 2012, a 500-m reach of stream was sampled between 1311 and 1643 hours, using a Smith-Root Model 12R BPES. Weather at Reach 3 was hot and clear, with a recorded water temperature at 1318 hours of 25°C, and 7.6 mg/L dissolved O_2; water pH and conductivity were not recorded because of a meter malfunction. Flows were declining at the time of sampling, with fine ash and coarse, charred woody debris clearly apparent and deposited on the stream banks. Stream waters were turbid, carrying a good deal of suspended sediments and ash; visibility in pooled habitats was very poor, between 1 - 2 inches depth.

Habitats in Reach 3 consisted primarily of large pools and secondarily of runs, with riffle being the least frequent. Submerged boulders were present in all of the habitats sampled, and due to poor visibility slowed work considerably. Only one photograph was taken at Reach 3, from the lower boundary facing upstream. Trees within the riparian corridor were primarily western sycamore, cottonwood, Arizona ash, willow spp., seep willow (*Baccharis glutinosa*) alder, and mesquite (*Prosopis velutina*).

Of the three 500m reaches sampled on Cherry Creek, Reach 3 proved to have the greatest diversity and number of nonnative species in the stream (Table 5). Four of the five nonnatives present in Reach 3 (yellow bullhead, red shiner, fathead minnow and flathead catfish) were not found in either of the other two upstream quantitative reaches. Speckled dace, one of the native species relatively common at both upstream reaches was not found here, while the desert sucker, another native that was the most common species encountered in both upstream reaches, was relatively rare at this site. Sonora sucker was relatively common here, yet was not found in either of the upstream reaches. Due to oversight, only one photo was taken at this site (photo 5).

Indian Creek #14 - Reach 1 10/10/2012

UTM 12S In: 0413337E, 3798875N Out: 0413442E, 3798879N

The upper portion of the Indian Creek drainage runs north and west from the southwest side of 22 Mesa in the Agua Fria sub-basin, gradually turning in a southwesterly direction to its confluence with the Agua Fria River. The target species for Indian Creek was Gila chub. A 100m reach was established in the upper portion of the drainage (Figure 5). Water temperature at mid-day was 20^{o}C, pH 8.41, conductivity 524 µS/cm, salinity 260ppm, and total dissolved solids 366mg/L. Heavy grazing was evident throughout much of the lower portion of the reach. The greatest perceived threats to the site at this time are dewatering due to extended drought or climate change, and continued habitat degradation by excessive cattle use. Three photos were taken of this site (photos 6-8).

Several hundred meters of dry channel separated the upper 100-m sample reach of stream from surface waters downstream, where suitable habitat had been sampled in previous years. At the downstream location, surface waters were limited to less than a few tens of meters, with fish (n~6) observed only in a small pool at the spring source and no others seen in the few pools below. The majority of habitat sampled in the 100-m quantitative reach was riffle (Figure 1). There was heavy impact to stream banks and channel by cattle use.

Only native fishes (longfin dace and Gila chub) were found within the 500-m sampled in upper Indian Creek (Table 6). Once chub had been found in the stream, the boundaries for the 100-m quantitative reach were set and the sampling conducted. For unknown reasons, the upper boundary was actually established at 108m rather than the specified 100-m, and sampling through the 108-m reach yielded only 10 chub. Further exploration of the stream found a sizeable pool with good depth 30m upstream of the upper boundary, with numerous fish occupying the pool. It was decided to continue sampling qualitatively up and into the large pool, the results producing an additional 143 Gila chub and 11 longfin dace. If during future sampling the stream morphology remains the same, it is recommended that the upper limit of the Reach be reestablished to capture the upper pool within the sample reach. Other native fauna observed in the habitat included black-necked gartersnake (*Thamnophis cyrtopsis*, THCY) and lowland leopardfrog (*Lithobates yavapaiensis*, RAYA).

Little Sycamore Creek #16 – Reach 1 10/10/2012

UTM 12S In: 0413788E, 3802736N Out: 0413860E, 3802791N

Little Sycamore Creek flows into Sycamore Creek, which is tributary to the Agua Fria River. Tributaries to Little Sycamore include Willow Spring Gulch, Rock Spring Draw, Chalk Tank Canyon and Reno Canyon. From its upper end, the drainage flows in a westerly direction to its confluence with Sycamore Creek, approximately 3 miles. Prescribed fire was applied to the watershed in 2001, followed by a few years of drought. A large storm event in 2005 resulted in high sediment/bedload in the drainage, partially filling habitats within the drainage with fine sediments. Additional storms and associated runoff in 2006 and 2007 further filled in habitats (Albert Sillas, USFS, pers. comm.). Surveys in 2008 found only four chub at this location as the result of 568 seconds of shocking effort. Vegetation in the area of the reach sampled was largely mixed juniper grasslands and chaparral, with riparian species including sycamore, Arizona ash, alder, oak and cottonwood.

On October 10, 2012, a 100-m reach (Reach 1) was established and sampled on Little Sycamore Creek (Figure 6), immediately to the east of a private in-holding (Horner Mountain Ranch). Access to the site requires coordination with the ranchers as the road to the monitoring reach crosses private land and is gated. Vehicles were parked on USFS lands beyond the private property. Weather at Little Sycamore Creek was warm with clear skies. At the time of sampling (1500 h), water temperature was 20.5^{o}C, pH was 7.54 and conductivity 551µS/cm. Three photos were taken for this site (photos 9-11).

Connected pools were the primary habitat present (Figure 1), with various substrates including bedrock, cobble and silt present throughout the reach. Sampling was conducted using a BPES, with Gila chub and longfin dace being the only fish sampled. Gila chub were common in the sample reach, but only one longfin dace was captured (Table 7). Adult and juvenile crayfish were also found in the sample reach.

Surface flow extended beyond the boundary fence onto private land below the lower end of Reach 1, but no attempt was made to access or sample the stream there. Owners of Horner Mountain Ranch were present and expressed interest in the effort and accompanied the sampling crew, observing and offering information on the drainage above the sampling reach. Both they and Albert Sillas (USFS, pers. comm.) reported that little or no aquatic habitats other than occasional small, ephemeral, isolated rock pools existed upstream from the location sampled. (Albert Sillas, pers. comm.). The only threats currently perceived for this population is potential future loss of aquatic habitats within the drainage due to extended drought conditions or to additional sediment flows. The drainage below should be surveyed to identify additional suitable habitat for native fishes.

Sycamore Creek #19

Located in Yavapai County, Sycamore Creek is a tributary of the Agua Fria River, draining west from the Black Hills and Pine Mountain on the western slope of the Verde Rim. Flow is intermittent throughout much of Sycamore Creek with fishes in the system persisting through dryer times in perennial surface waters of canyon-bound reaches. The target species of the monitoring effort in Sycamore Creek was Gila chub. Two teams sampled the stream at two locations in the drainage on October 11, 2012, one sampling the upper location (identified as Reach 1 in Figure 7; Table 8), the other team sampling the lower site (Reach 2, Figure 7; Table 9). Although chub were found at both locations, their numbers were low, their distribution very local, and they should not be considered common at either locale.

Apparent threats to Gila chub in this system were two-fold; competition with nonnatives in the upper drainage (Reach 1), and loss of habitat due to drought throughout the system. Where suitable water conditions in the upper drainage allow persistence of rainbow trout, competition almost certainly occurs between chub and trout due to limited habitat availability. A more thorough survey of the entire drainage should be conducted to identify additional suitable habitat for chub, and their presence or absence in these habitats. Gila chub should be introduced into any suitable habitats found above Double-T Falls. Consideration should also be given to the reestablishment of chub into remaining suitable wild sites within the basin, in addition to the establishment of captive refuge populations.

Sycamore Creek #19 - Reach 1 (Double-T Falls) 10/11/2012

UTM 12S In: 0419858E, 3798098N Out: 0419949E, 3798069N

On October 11, 2012 a group comprised of AGFD and USFS personnel accessed upper Sycamore Creek on USFS land to sample Reach 1 (the uppermost reach), a reach known to hold water perennially and was known to have been previously occupied by Gila chub. Weather while travelling to the sample site was cool and windy with heavy clouds and moderate rain. Rainfall stopped and weather generally improved after arriving at Reach 1. Hiking to the location took roughly 30 minutes, dropping several hundred feet in elevation during the hike.

The upper boundary of Reach 1 is roughly 30 – 40-m below a large waterfall which forms an effective barrier to any fish passage further upstream. The 100-m reach was established downstream of the falls and the two large, deep pools immediately below and adjacent to the falls. A full set of photographs was taken for this site at the upper and lower boundaries (photos 12-15).

To set up the 500-m detection reach, the two larger pools adjacent to the falls (Double-T Falls) were bypassed; pool depth and wall steepness precluded conducting effective sampling of these pools using the BPES. The third pool downstream of the waterfall was the first that could be effectively sampled using the BPES, so was chosen as the upstream boundary of the 500-m reach. Gila chub were observed in this pool, and a brief effort with the BPES verified their

presence, so the pool was selected to be the upper boundary of the permanent 100-m quantitative reach. The 100-m boundaries were established and the reach sampled; only two species were captured, the native Gila chub and the nonnative rainbow trout (*Oncorhyncus mykiss;* ONMY; Table 8). The primary habitat sampled was connected pools interspersed with relatively short reaches of riffle. Forest Service personnel informed us that approximately the lower 40-m of habitat sampled in the 100-m quantitative reach is often (perhaps normally) dry during summer months. Gila chub proved to be the most abundant species in the sample reach, but with only 15 individuals captured, cannot be considered abundant.

A particularly large pool that appeared suitable for Gila chub was observed immediately below the 100-m reach and after completion of quantitative sampling was qualitatively sampled. Using the BPES, an additional four Gila chub were collected, bringing the total sampled to 19 (because it was a qualitative sample, these additional four fish are not reflected in Table 8). Catch numbers and effort are summarized in Table 8. Pictures of one specimen of Gila chub are included in Appendix II (photos 16-18).

Sycamore Creek #19 - Reach 2 (aka Middle Box) 10/11/2012

UTM 12S In: 0416151E, 3798796N Out: 0416227E, 3798737N

On October 11, 2012, a 100-m monitoring site was established at Reach 2 on Sycamore Creek. Monitoring was conducted by a crew consisting of three AGFD personnel, who arrived at the stream during mid-morning. Weather while hiking into the sampling site was cool and windy with heavy clouds and moderate rain; soon after arrival at the stream, rainfall decreased and skies largely cleared, with temperatures warming and becoming intermittently cloudy throughout the remainder of the day.

Sampling within Reach 2 was conducted using a BPES and trammel net. Additional qualitative samples were conducted upstream of Reach 2 with hoop nets at 12S 0416645N 3798027E, and at 12S 0416839N 3797818E. Sampling was focused on the area referred to as "Middle Box", a large pool lined by basalt walls, of which a significant portion is too deep to sample effectively with the BPES. The lower boundary of Reach 2 is the lower boundary of the same pool. The primary habitat sampled in this reach was connected pools (Figure 1). Gila chub was the only species detected and captured, and was found only in the first and largest pool sampled. Due to the inaccessibility of part of the pool, a trammel net was set in the deeper portion and allowed to fish for slightly more than 2 h. The two hoop nets set for qualitative samples roughly 1 km upstream of Reach 2 produced no fish. Tables 9 and 10 provide summaries of the effort and results for Reach 2. Photographs for the upper and lower boundaries of this sample site are provided in Appendix II (photos 19-22).

Red Tank Draw #26 - Reach 1 10/17/2012

UTM 12S In: 0435027E, 3840265N Out: 0435030E, 3840281N

Located on the Coconino National Forest in Yavapai County, Red Tank Draw is tributary to Wet Beaver Creek in the Verde River drainage (Figure 8). Streamflow in Red Tank Draw is intermittent throughout much of the year. Riparian vegetation commonly occurring in the drainage includes cattail (*Typha dominguensis,* TYDO*),* cottonwood, sycamore (*Plantanus wrightii*), Arizona ash, alder and willow. Photographs of the upper and lower boundaries for this sampling site are provided in Appendix II (photos 23-26).

On October 17, 2012, a 100-m monitoring site was established on Red Tank Draw (roughly 200m upstream of the FR645a crossing). Habitat within the 100m reach consisted primarily of pools with one large pool comprising the majority of the reach (Figure 1). Both the BPES and hoop nets were used to sample the reach, neither of which proved particularly effective in capturing chub. Some of the riffle habitats within Reach 1 were too shallow to shock with the BPES, and none of them produced fish. Species collected within the reach included Gila chub, fathead minnow and green sunfish. A summary of the sampling results are provided in Tables 11 and 12. An additional pool roughly 230m upstream of Reach 1 was qualitatively sampled (only one set of coordinates was recorded for this pool: 12S 435235E 3840500N), producing many more chub than were caught in Reach 1. This pool was shallower, and thus more effectively sampled with the BPES. Due to the superior habitat and much greater abundance of chub in this pool, consideration should be given to making it the permanent quantitative sampling site in future efforts, rather than the one used initially in this effort.

Threats to Gila chub within the drainage include the presence of nonnative species and loss of habitat due to drought. Extensive habitats capable of supporting a large chub population are present downstream in Wet Beaver Creek, but are dominated by nonnative species. (e.g. smallmouth bass; *Micropterus dolomieui*; MIDO). Along with remaining aquatic habitat within Red Tank Draw, the nonnatives should be removed from Wet Beaver Creek and chub be allowed to re-occupy suitable habitats within the drainage. Additionally, as a precaution against future drought, serious consideration should be given to the establishment of captive refuge populations within the general area of the drainage. Other than the establishment of managed refuge populations, there may be little that can be done against threats associated with long-term drought.

Tule Creek #20 - Reach 1 10/17/2012

UTM 12S In: 382329E, 3763997N Out: 382307E, 3763892N

Tule Creek is a tributary to the Agua Fria River, originating from a spring at the edge of the Bradshaw Mountains. Formerly draining into the Agua Fria River, the lower end of the drainage now connects to Lake Pleasant. Under management of the Bureau of Land Management (BLM), the upper drainage containing perennial springs and spring pools has been enclosed by barbed-

wire fence to exclude burros and cattle. The target species at this site was Gila topminnow (*Poeciliopsis o.occidentalis;* POOC), and was the only species detected. Although the amount of available aquatic habitat is seriously declining at Tule Creek, Gila topminnow are still abundant in remaining available habitat. Only one permanent survey site was established (Figure 9). The majority of the wetted portion of the drainage is currently dominated by cattail; other plants found in the drainage include seep willow, arrow weed (*Pluchea sericea)*, willow, cottonwood, mesquite, saguaro (*Carnegiea gigantea*), salt cedar (*Tamarix sp.*), bulrush (*Scirpus sp.*) and yerba mansa (*Anemopsis californica*).

A 100-m reach of stream, Reach 1, was established ~300-m below the upper boundary fence of the exclosure. The entire upper reach of the stream was nearly overgrown with cattails; at some places the cattails and arrow weed were so thick as to make passage very difficult. The uppermost pool with suitable habitat was designated as the upper boundary of the 100-m quantitative sampling reach, with the lower boundary established 100-m downstream; three additional pools were present in the 100-m reach. Water temperature at the lowermost pool in Reach 1 at ~1500 h was 20^{o}C, pH was 7.7, and dO_2 was 1.76mg/L. Minnow traps were the primary means of sampling at Tule Creek, with 1-m long dip-net sweeps carried out in smaller pools encountered. Photographs for Tule Creek can be found in Appendix II (photos 27 -30).

Minnow traps were set in three of four pools within Reach 1 and left to fish for ~2 hours each. Large numbers of Gila topminnow were caught and in order to increase the rate of processing the traps and reducing stress on captured fish, a subsample (n~400) of the 1220 POOC captured were scrutinized to confirm they were not mosquitofish (*Gambusia affinis;* GAAF). Beyond this subsample, each individual fish was briefly assessed before being returned to the water. No nonnative fishes were captured or observed at Tule Creek. One small slot-pool with little open water was surveyed by dip-netting, resulting in only a few adult topminnow (n=9) captured; numerous young-of-year topminnow less than 5 mm TL were observed in the slot pool, however. Results of effort and catch rates are summarized in Tables 13 and 14.

Qualitative sampling upstream of Reach 1 found several surface pools of varying size, all of which were very shallow and several of which were stagnant. A number of these pools showed signs of disturbance, likely due to rooting by javelina (*Pecari tajacu*; PETA). Dip net sweeps through these found no fish, however it appeared most were occupied by lowland leopard frogs and a variety of aquatic invertebrates. One Sonora mud turtle (*Kinosternon sonoriensis;* KISO) was captured and released, and numerous lowland leopard frogs were seen throughout the upper wetted portions of the exclosure. Pools in the lower portion of the drainage appeared heavily degraded by cattle use, and water quality was likely too poor to support fish.

The primary threat to the population in Tule Creek is the loss of aquatic habitats due to natural, but extensive encroachment of emergent aquatic vegetation into open-water habitats within the drainage. Vegetation such as cattail have established in extensive stands through much of the formerly available aquatic habitat. The cattail die and lie down into open water, forming coarse organic mats that increase the entrapment and deposition of airborne dust and dirt, subsequently forming soils within the channel, with a simultaneous decrease of surface water quality and quantity, and eventual loss of aquatic habitat available for native fishes. Efforts should be expended to remove up to 90% of aquatic sedges and cattails currently choking the main stream

channel at Tule Creek, which would open up additional aquatic habitat for Gila topminnow. There is a continuing trend of intentional exclusion-fence damage that has allowed repeated encroachment by cattle and burros into the exclosure. The fences should be repaired and increased monitoring by law-enforcement personnel should be considered to serve as a deterrent against future damage.

Coal Mine Canyon #51 – Reach 1 10/23/2012

UTM 12R In: 510483E, 3488020N Out: 510430E, 3487943N

Located in Santa Cruz County, Coal Mine Canyon is tributary to Fresno Canyon in the Sonoita Creek drainage of the Santa Cruz River sub-basin. The target species for Coal Mine Canyon was Gila topminnow. Surface flow within Coal Mine is absent throughout much of the year, however bedrock pools or sand-lined pools overlying bedrock provide most of the permanent aquatic habitat throughout the year. Riparian vegetation typical of Reach 1 includes sedges (*Schoenoplectus pungens)*, Arizona ash, oak, net-leaf hackberry (*Celtis reticulata*), seep willow, desert broom (*B. saranthoides*), and deer grass (*Muhlenbergia rigens*).

On the way into Coal Mine, a large pool was encountered on State lands within 50-m of where Montezuma Well Road crosses Ash Canyon (it was initially believed the drainage was part of upper Coal Mine Canyon, but data mapping indicates the site was in the adjacent drainage, Ash Canyon). The pool was not remembered from previous trips into Coal Mine Canyon, so the decision was made to sample it. One hoop net and six minnow traps were set and fished for over 4 h, but no fish were seen or caught. A black-necked gartersnake was caught there later in the day when traps were pulled.

ATV's were required to access Coal Mine in a timely fashion. The gate entering the State land exclosure was open, and fencing a short distance up the drainage from the road was knocked down. Because of the small amount of perennial aquatic habitat in Coal Mine Canyon, Reach 1 was established at the location in the canyon that has historically maintained surface water and a large population of Gila topminnow and longfin dace during previous years (Figure 10). Minnow traps and hoop nets were fished for up to 3 h at both Reach 1 and at two additional qualitative sites, one "upstream" pool (actually in Ash Canyon), and two pools adjacent to one another roughly 630 m downstream. A full set of photographs was taken at Reach 1 at both the upper and lower boundaries (photos 29-32). Cattle sign was abundant and widespread in the sampling area, and a large number of cattle were present throughout much of the area below the large perennial pool at Coal Mine.

Due to time limitations, the large number of fish to be processed and concerns regarding minimizing stress to the fish, a sub-sample of ~400 fish were scrutinized to detect the presence of mosquitofish; none were found. The remaining fish were processed with all individuals being briefly assessed before being returned to the pool. Both topminnow and longfin dace persist at Coal Mine Canyon, and no nonnative fish species were captured or observed during the sampling. Species catch and effort are summarized in Table 15. Two other small pools roughly

630 m downstream from Reach 1 were qualitatively sampled with minnow traps. Both the pool in the quantitative reach and one of the downstream pools that was sampled qualitatively were found to contain Gila topminnow and longfin dace; the other downstream qualitative pool appeared to contain only Gila topminnow. Also present in both Reach 1 and the qualitative pools below were bullfrogs (*Rana catesbiana;* RACA*),* canyon tree frog (*Hyla arenicolor;* HYAR*),* and crayfish (*sp*. unknown).

The major threats to the Coal Mine Canyon population of topminnow appear to be loss of aquatic habitat due to extended drought, or degradation of aquatic habitats due to leaving cattle on the stream for too long a period. During periods of high temperatures and hot weather, cattle often linger at water sources, regularly entering them and fouling the water, which can prove fatal to a variety of aquatic species. During dry conditions or periods of drought, cattle should be removed at the first sign of excessive impact to vegetation, to stream bank stability, or to water quality. George Wise Spring, a site east of the sampling location in Coal Mine Canyon, should be renovated to remove nonnative fishes and stocked with topminnow from the Coal Mine/Fresno populations, or other suitable populations within the Sonoita Creek drainage. Depending on the amount and quality of the habitat present at George Wise Spring and after establishment of Gila topminnow, consideration should also be given to stocking other appropriate species of native fishes.

Post/Freeman Canyon #63 – Reach 1 10/23/2012

UTM 12R In: 545025E, 3493946N Out: 545000E, 3493888N

Located in Santa Cruz County, Post and Freeman canyons are tributary to O'Donnell Creek, which is tributary to the Babocomari River in the San Pedro River drainage. The monitoring site for Post/Freeman was located in Freeman Canyon, approximately 90 m upstream of its confluence with Post Canyon. The 100-m survey site was established with the lowermost dam serving as the upper boundary of the reach (Figure 11). The target species for Post/Freeman Canyon was Gila chub; efforts within the drainage found no chub, instead finding only nonnative green sunfish and mosquitofish. Habitat within the quantitative 100-m sampling reach was exclusively isolated rock pools (Figure 1). Plant species within the drainage include oaks, cottonwood and willow.

Sampling gear used in Reach 1 included minnow traps, hoop nets and dip nets. The only fishes sampled in the reach were two nonnative species, green sunfish and mosquitofish; Tables 16-18 provide a summary of the data for Post/Freeman Reach 1. Bait for the minnow traps and hoop nets was forgotten for this particular site, so sardines and Vienna sausages were used to bait the traps. Sonora mud turtles were also captured in the pools sampled. A full set of photographs from both upper and lower boundaries was taken for this site (photos 33-36).

It was reported to one of the monitoring participants by personnel at the Audubon Society Appelton-Whittell Research Ranch that Post Canyon had flooded twice during summer monsoons, with floodwaters in the canyon reaching bank-to-bank (R. Cogan pers. comm. to T.

Robinson). Since during high flows there is connection with O'Donnell Creek, reclamation of these waters for native fishes would likely be useless unless O'Donnell Creek was also renovated. Participants sampled qualitatively further upstream to Welch Spring, but visual observation and dip-netting found no other fishes during these efforts.

Habitat boundary coordinates for each of the habitats sampled were not recorded. Rather than recording habitat boundary coordinates, coordinates for each trap set (a set-location) within a habitat were recorded. Future efforts utilizing traps will record habitat boundaries, the type and number of traps set within each habitat, and total effort for each trap.

Major threats to any remaining native fishes in Post/Freeman must include nonnative fishes and loss of habitat. Additional surveys of the drainage should be conducted to identify other locations of nonnatives (upstream as well as downstream) and additional suitable habitats for native species. All practicable effort should be considered to remove nonnatives from remaining suitable surface waters in the drainage, and replacing them with appropriate native fishes.

Sabino Canyon # 56 - Reach 1 10/24/2012

UTM 12S In: 520165E, 3578069N Out: 520205E, 3578148N

Located in the outskirts of Tucson in Pima County, Sabino Canyon drains in a south-westerly direction from the Santa Catalina Mountains into Tanque Verde Wash, which is tributary to the Rillito River of the Santa Cruz River sub-basin. The target species in Sabino Canyon was Gila chub. A sample reach identified as Sabino Canyon Reach 1 was established in the stream "below train stop 8" (Figure 12). Access was easily obtained along the pedestrian trail from the main park gate. Due to its accessibility, this location experiences a high level of pedestrian traffic. Substrate and banks of the sample reach consisted of bedrock and sand, with the predominant vegetation being willows, cottonwood, sycamore and ash. Water temperature at ~1400h was 23.5^{o} C, with a pH of 7.81 and conductivity of 121.8µS/cm. Weather conditions were clear, warm and dry. A full set of photographs was taken for this site at both upper and lower boundaries (photos 37-40).

Sampling within the reach was conducted using baited minnow traps, hoop nets and visual observation. Gila chub were successfully captured during the effort, but found only in pooled habitats, which comprised the majority of the reach. Traps were baited and set in five different pools within the reach and allowed to fish for approximately 2 h; results of the effort are provided in Tables 19-20. Gila chub were common in the sample reach, and were also observed in several pools below the reach. No nonnative fishes were observed or captured during this effort. Predominant vegetation in the canyon included willows, cottonwoods, sycamore and ash. Substrate and banks were comprised largely of bedrock, boulder and sand. Other species observed were black-necked garternakes, canyon tree frogs and Sonoran mud turtles.

Ash runoff from the Aspen Fire on Mt. Lemmon in 2003 threatened the population, but fish were salvaged from the stream prior to flows, and hundreds returned to the stream in 2005. The habitat

in Sabino Canyon currently appears stable, and the population of Gila chub appears relatively robust and secure. The only current threats perceived for this population would be possible loss of habitat due to prolonged drought conditions, for which no preventative measures are available, and illegal stocking or release of nonnative species. Given the tenuous state of other native fishes within the Santa Cruz River basin however, serious consideration should be given to stocking other species of desert fishes, particularly speckled dace (*Rhinichthys osculus;* RHOS) and desert sucker (*Pantosteus clarki;* PACL).

Fresno Canyon #53 – Reach 1 10/24/2012

UTM 12R In: 507763E, 3485966N Out: 507854E, 3485991N

Located in Santa Cruz County, Fresno Canyon drains south from the Grosvenor Hills to its confluence with Sonoita Creek of the Santa Cruz River sub-basin; Coal Mine Canyon is a tributary of Fresno Canyon (Figure 13). The target species for Fresno Canyon was Gila topminnow. Surface waters are scarce within Fresno Canyon throughout much of the year, however surface flow is maintained in the vicinity of the confluence of Fresno and Coal Mine canyons, providing permanent habitat for native fishes through the drier months. Riparian vegetation typical to Fresno Canyon includes mesquite, Arizona ash, net-leaf hackberry, seep willow, and deer grass. Photographs from the upper and lower boundaries are provided in Appendix II (photos 41-44).

Access to Fresno Canyon is limited, and should be coordinated through State Parks. Personnel accessed the sampling site in Fresno Canyon by riding ATVs to within 800m of the confluence of Fresno Canyon and Sonoita Creek and hiking up the Fresno Canyon drainage. The upper boundary of the 100-m quantitative sampling reach (Reach 1) was established roughly 140 m below the confluence of Coalmine Canyon with Fresno Canyon (Figure 13). Habitat within Reach 1 was dominated by pools, with small stretches of run and riffle (Figure 1). Water quality was not recorded for the Fresno Canyon site.

Straight-seine and minnow traps were the sampling methods employed, resulting in 4,169 topminnow and 68 longfin dace captured (Tables 21-22). Datasheets indicate seining was conducted from top of the reach to the bottom. Boundary coordinates for each of the habitats sampled were not recorded. Rather than recording habitat boundary coordinates, one set of coordinates was recorded for each trap set (a set-location) or seine-haul within a habitat. Start and stop times for sampling efforts, orientation towards north on the map, and habitats identified and measured on the map but not referenced on the data sheet or in field notes were also not recorded; these oversights will be corrected in future efforts.

Fresno Canyon and Coal Mine Canyon drainages experience periodic connectivity and presumably the populations maintain sufficient gene flow between them to be considered the same stock. Invasion by nonnative fishes from Sonoita Creek during periods of connected flow appears unlikely due to a natural barrier downstream of the upper drainage where permanent habitat is found, however green sunfish have found their way into the drainage on previous

occasions. Current threats include potential loss of habitat due to drought or long-term climate change, continued or increased predation by bullfrogs, and continued predation and habitat degradation by crayfish. Establishment of a duplicate wild population at George Wise Spring should be considered, as well as the establishment of several captive populations. Plans for the establishment of Gila chub (Sheehy Spring lineage) into Fresno Canyon waters should be carried through at the earliest opportunity, and waters at George Wise Spring should be assessed to determine if they provide sufficient habitat of quality and quantity to support additional native species to Gila topminnow.

Romero Canyon #77 - Reach 1 10/25/2012

UTM 12S In: 511540E, 3586855N Out: 511585E, 3586782N

Located in Pima County, Romero Canyon drains northwest from the Santa Catalina Mountains in the Santa Cruz River sub-basin to its confluence with Sutherland Wash. Access to this site involved hiking from the Romero canyon trailhead ~1.5 hours to the first stream crossing. The day was clear and warm after cool overnight temperatures. A 100-m quantitative survey reach (Figure 14) was established between approximately 50 and 150 m downstream of the first stream crossing on the main canyon trail. The target species in Romero Canyon was Gila chub. Habitat sampled consisted of a series of slick-rock plunge pools separated by heavily vegetated riffles (Figure1). Riparian vegetation in the drainage includes willow, oak, seep willow and deer grass. Water quality parameters at ~1130h were as follows: temperature 19.1^{o}C; pH 7.8; conductivity 91.6 µS; salinity 46.2 ppm. Photographs for both the upper and lower boundaries are provided in Appendix II (photos 45-48).

Sampling techniques used at Romero Canyon included seining, dip-netting and visual observation. Six of the pools were surveyed using a seine, and one small pool was surveyed using 1-m sweeps of a dip net; catch and effort are summarized in Tables 23-24. The stream was bordered by slick bedrock with plunge pools up to 6ft deep. The riffles encountered during the effort were visually surveyed because dense vegetation prevented other methods from being used effectively. Gila chub was the only species sampled or observed at this site, with no evidence of nonnative species, and appeared locally common.

The population of Gila chub at Romero Canyon was stocked (n=120) in 2005 with fish from the 2003 Aspen Fire salvage at Sabino Creek. The population established in Romero currently appears secure, however consideration should be given to expanding their distribution into upstream perennial habitats that remain unoccupied.

Given its isolated location and the persistence of habitat through drought conditions of the past decade, threats to this population of Gila chub appear largely limited to potential loss of habitat due to long-term climate change, which cannot be quantified or accurately predicted at this time. Monitoring of the population should occur regularly to promptly identify any threat that develops. Romero Canyon should also be evaluated for the introduction of additional native species; however, due to the limited habitat, it is unlikely it can support more than one additional

species. Also, taking into consideration the current status of Gila chub and apparent stability of this population, adding any other species to the site should be undertaken with caution after careful consideration of both the costs and benefits associated with such an action.

Cienega Creek #78 – Reach 1 (3-Bridges) 11/07/2012

UTM 12S In: 533455E, 3542662N Out: 533550E, 3542704N

On November 7, 2012 a group comprised of AGFD, USFWS and Pima County personnel accessed lower Cienega Creek at 3-Bridges on Cienega Creek Natural Preserve to monitor native fishes, targeting Gila chub and Gila topminnow. Weather conditions at the site were sunny, warm and dry.

The initial intent for sampling was to use coordinates from previous monitoring efforts, however these plans were changed due to lack of surface water and the presence of local law enforcement personnel practicing their mountain rescue skills off of the highway bridge into the stream bottom. The lower boundary of the previously determined 100-m quantitative monitoring reach was moved approximately 50 m upstream (to the east), and a 100 m reach of stream was measured upstream from this location (Figure 15). The BPES was the only fish sampling gear used at this locality. Primary riparian vegetation at this location included cottonwood, willow, seep willow and deer grass. Both upper and lower boundaries were moved from previous efforts at Reach 1, and a full set of photographs were taken at the newly located upper and lower boundaries (photos 49-52).

The entire reach was comprised largely of riffle habitat (Figure 1), with two connected pools and one isolated pool adjacent to the main flow of the stream. Much of the stream was too shallow to provide good habitat for any of the target species. Although low in numbers, two species of native fishes were captured: longfin dace and Gila topminnow. The majority of longfin dace were found in a connected pool formed between and under a fissured bedrock wall within 5m of the lower boundary. Although much of the riffle habitat in this reach was too shallow to sample effectively with the BPES, Gila topminnow were collected exclusively in riffle habitat; most of these were juveniles. Table 25 provides a summary of catch numbers and effort. Lowland leopard frogs were also captured at this location.

Although only one sample site was required for lower Cienega Creek, few Gila topminnow and no Gila chub were captured, so it was decided to access and sample a site further upstream with the intent of finding better flows and greater numbers of fish (see Cienega Creek #78 – Reach 2). Habitat lengths were not recorded for this (Reach 1) locality.

The only relatively current threat perceived to the lower Cienega Creek populations appears to be habitat loss due to drought, climate change or dewatering of the channel due to upstream water uses.

Cienega Creek #78 – Reach 2 (Quarry) 11/07/2012

UTM 12S In: 53544841E, 3541890N Out: 535586E, 3541869N

On November 7, 2012 a group comprised of AGFD, USFWS and Pima County personnel accessed lower Cienega Creek at Cienega Creek Natural Preserve to monitor native fishes, targeting Gila chub and Gila topminnow. Sampling on Cienega Creek downstream earlier in the day had produced only very few Gila topminnow and longfin dace, so the decision was made to sample another reach further upstream with the intent of finding greater surface flows and larger numbers of fish. The stream was accessed roughly 2.7 stream-km upstream and a monitoring reach established (Figure 15). Common riparian vegetation encountered at this location included cottonwood, willow, mesquite and cattail; photographs were taken at this site for both upper and lower boundaries (photos 53-56).

Major habitats sampled in Reach 2 were riffle and shallow pool, and were sampled using BPES. Gila topminnow were most common in riffle habitats, while longfin dace were common in both riffle and pool habitats. According to conversations with USFWS personnel, Gila chub had been captured at this location during previous years (D. Duncan, pers. comm.). The upper end of the reach incorporated shallower portions (< 1 m depth) of a large pool that appeared to be excellent chub habitat, but none were caught. Qualitative sampling of additional portions of the pool that could be effectively sampled with the BPES also produced longfin dace and Gila topminnow, but no Gila chub; the BPES was the only sampling method employed at this sampling reach. Catch numbers and effort for Reach 2 are summarized in Table 26.

Due to superior habitat quality and quantity, it is recommended that in future efforts, this reach be designated as the primary monitoring reach for lower Cienega Creek, with the 3-Bridges site serving as a qualitative sampling location. Should stream morphology remain similar to that found during this effort, future efforts should also employ hoop nets to sample deeper portions of the pool at the upstream boundary of the reach. Consideration should also be given to moving the reach boundaries upstream roughly 20 m to capture the entire pool and riffles below, increasing the likelihood of sampling both Gila chub and Gila topminnow at this location.

Threats perceived to the lower Cienega Creek populations appears primarily to be potential dewatering of the channel due to drought, climate change, groundwater pumping or diversion of upstream surface waters. Although no Gila chub were captured in either location on Cienega Creek (Reach 1 or 2), this may be more likely due to a failure to sample in suitable habitats for the species. Larger and deeper portions of a pool found above the upper boundary of Reach 2 were more likely to have held chub than the majority of the waters sampled.

Appendix I.

Figures and Tables

Table of figures and tables

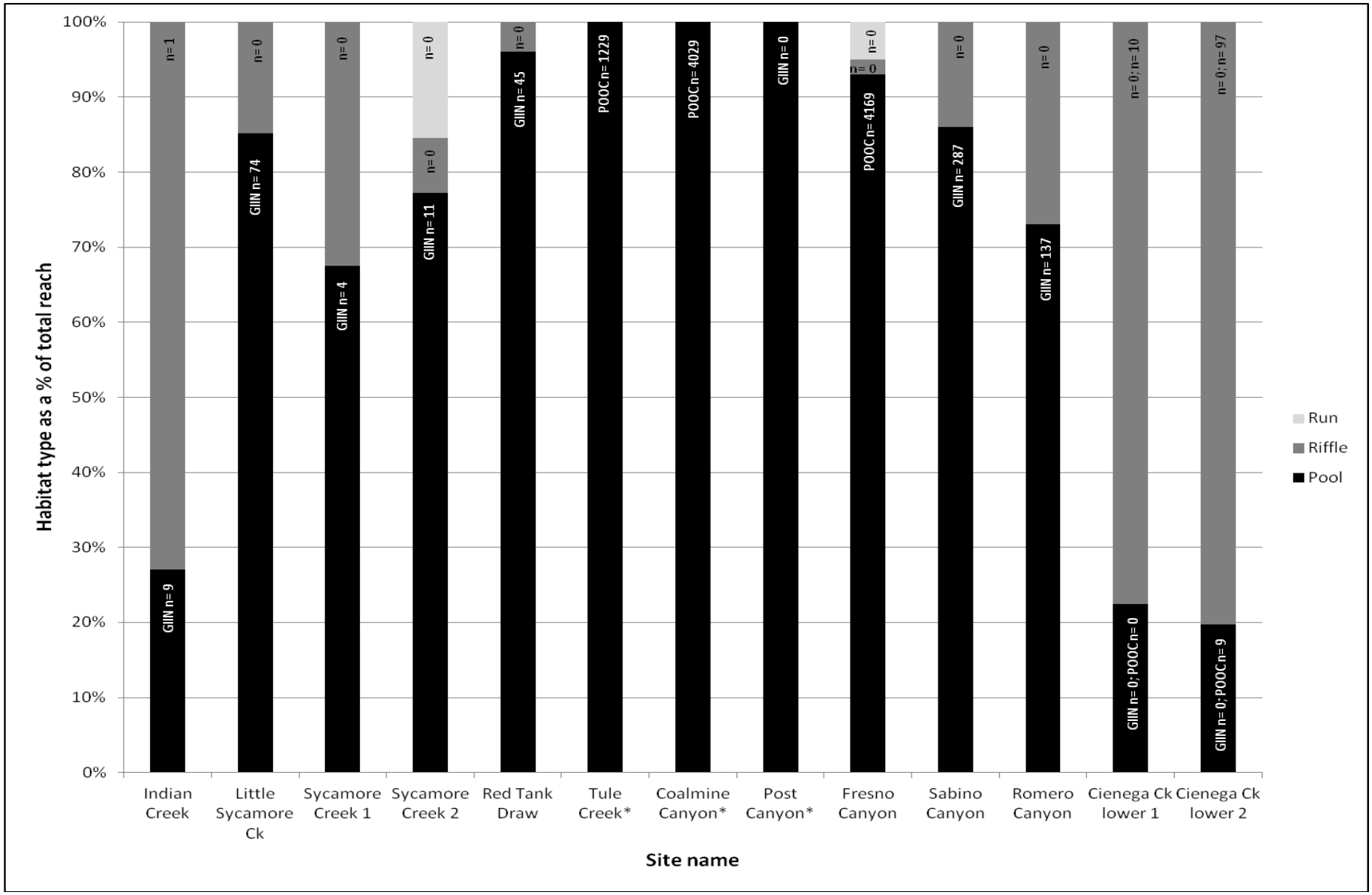

Figure 1: Habitat type as a percent of the total habitat sampled at each site surveyed. The target species at each site is listed inside the column, along with the total number recorded within each habitat type (GIIN = Gila chub; POOC = Gila topminnow). *These sites were composed of intermittent or single pools with no connecting habitat; therefore the total habitat sampled was 100% 'pool'. Cherry Creek sites are not included on this table as the target species was not found and therefore a 100 m quantitative survey was not completed.

Site/Species	AGCH	AMNA	CAIN	CYLU	GAAF	GIIN	LECY	ONMY	PACL	PIPR	POOC	PYOL	RHOS
Cherry Creek reach 1	+	-	-	-	-	-	+	-	+	-	-	-	+
Cherry Creek reach 2	+	-	-	-	-	-	+	-	+	-	-	-	+
Cherry Creek reach 3	-	+	+	+	-	-	+	-	+	+	-	+	-
Indian Creek	+	-	-	-	-	+	-	-	-	-	-	-	-
Little Sycamore Creek	+	-	-	-	-	+	-	-	-	-	-	-	-
Sycamore Creek reach 1	-	-	-	-	-	+	-	+	-	-	-	-	-
Sycamore Creek reach 2	-	-	-	-	-	+	-	-	-	-	-	-	-
Red Tank Draw	-	-	-	-	-	+	+	-	-	+	-	-	-
Tule Creek	-	-	-	-	-	-	-	-	-	-	+	-	-
Coalmine Canyon	+	-	-	-	-	-	-	-	-	-	+	-	-
Post Canyon	-	-	-	-	+	-	+	-	-	-	-	-	-
Fresno Canyon	+	-	-	-	-	-	-	-	-	-	+	-	-
Sabino Canyon	-	-	-	-	-	+	-	-	-	-	-	-	-
Romero Canyon	-	-	-	-	-	+	-	-	-	-	-	-	-
Cienega Creek lower reach 1	+	-	-	-	-	-	-	-	-	-	+	-	-
Cienega Creek lower reach 2	+	-	-	-	-	-	-	-	-	-	+	-	-

Table 1: Native and nonnative species occurrence across all sites sampled in 2012. Blue text indicates native species; red text indicates nonnative species.

Cherry Creek #39 - Reach 1 09/21/2012

NAD 83 UTM 12S In: 0510836E 3763041N Out: 0510775E 3763502N

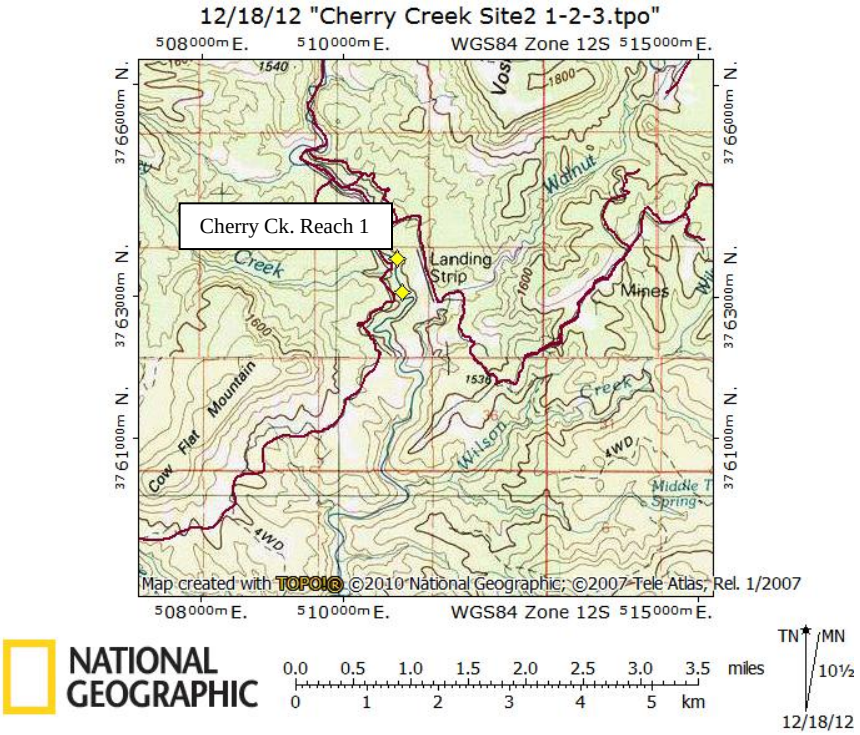

Figure 2: Survey site on Cherry Creek Reach 1 in the upper portion of Cherry Creek, Salt River sub-basin, Gila County; site is adjacent to private property, but the entire sample reach and access are on USFS.

Species	Age class	Number	CPUE (fish/sec)	% of total
PACL	1	101	97.9	54
PACL	0	38	36.8	20
AGCH	N/A	25	24.2	13
RHOS	N/A	19	18.4	10
LECY	0	3	2.9	2
TOTAL		186	180.2	100

Table 2: Summary of fishes sampled by backpack electro-shocker (BPES) at Cherry Creek Reach 1 (total effort was 1032 seconds shocked). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Cherry Creek #39 - Reach 2 09/19-20/2012

NAD 83 UTM 12S In: 0508767E 3753351N Out: 0508705E 3753805N

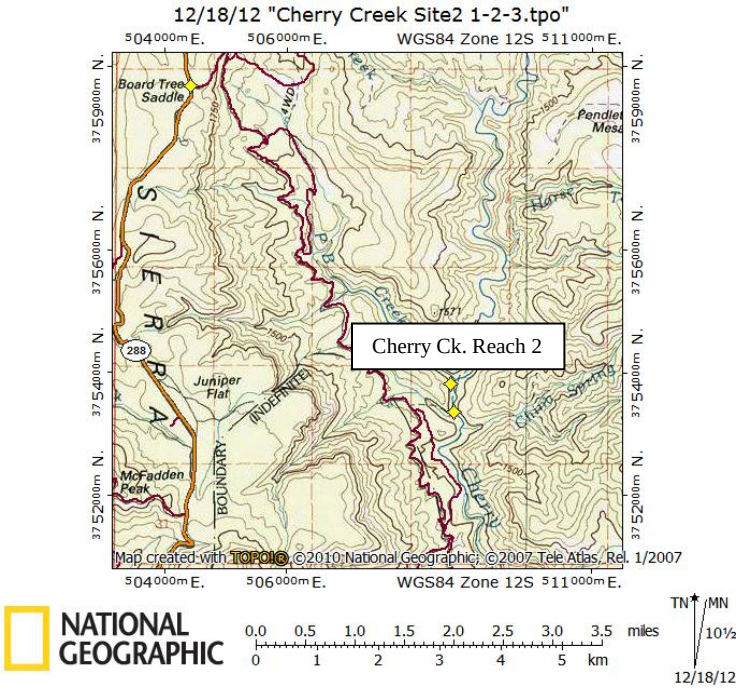

Figure 3: Survey site at Cherry Creek Reach 2, Salt River sub-basin, Gila County; portions in the lowermost reach of 4WD access road to the creek had been washed out by recent heavy runoff.

Species	Age class	Number	CPUE (fish/sec)	% of total
AGCH	N/A	13	19.9	19
RHOS	N/A	8	12.2	11
PACL	1	40	61.2	57
PACL	0	8	12.2	11
LECY	0	1	1.5	1
TOTAL		70	107.0	100

Table 3: Summary of fishes sampled by BPES at Cherry Creek Reach 2 (total effort was 654 seconds shocked). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Species	Age class	Number	CPUE (fish/hr)	% of total
PACL	1	2	0.1	50
LECY	1	2	0.1	50
TOTAL		4	0.2	100

Table 4: Summary of fishes sampled by hoop nets at Cherry Creek Reach 2 (total effort was 992 minutes). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Cherry Creek #39 - Reach 3 09/18/2012

NAD 83 UTM 12S In: 0513293E 3743130N Out: 0513053E 3743543N

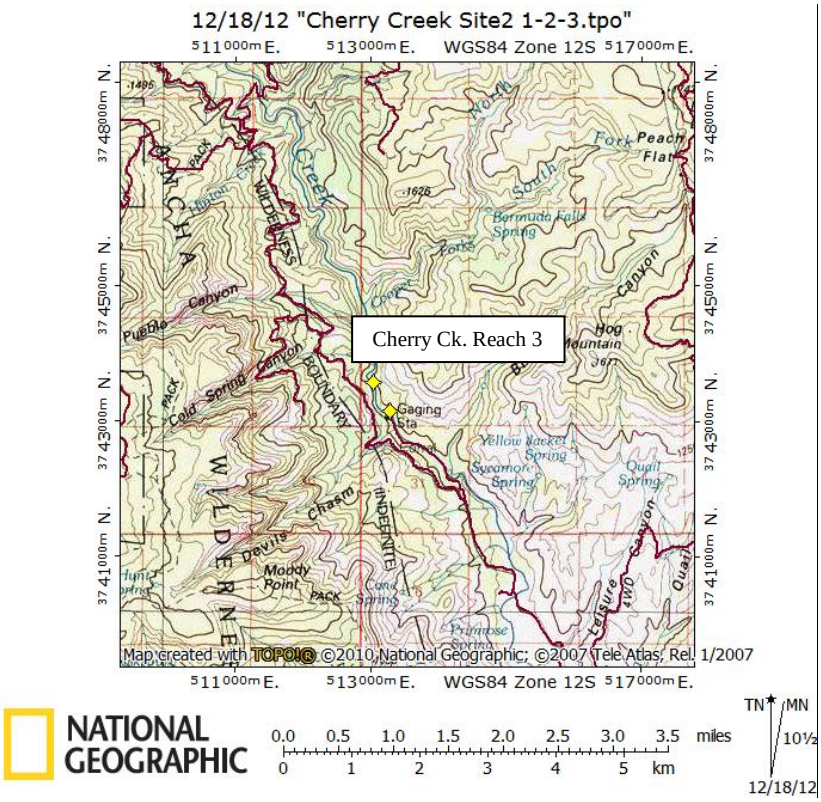

Figure 4: Survey site at Cherry Creek Reach 3, Salt River sub-basin, Gila County; the lowermost access point for establishing a monitoring station on Cherry Cr., this 500m survey reach was started downstream of the USGS Gaging Station.

Species	Age class	Number	CPUE (fish/sec)	% of total
AMNA	0	3	0.002	2
AMNA	1	10	0.008	7
LECY	1	5	0.004	3
LECY	0	9	0.007	6
CYLU	N/A	88	0.073	60
PIPR	N/A	5	0.004	3
PACL	1	3	0.002	2
PACL	0	2	0.002	1
CAIN	1	9	0.007	6
CAIN	0	11	0.009	7
PYOL	1	2	0.002	1
TOTAL		147	0.122	100

Table 5: Summary of fishes sampled by BPES at Cherry Creek Reach 3 (total effort was 1205 seconds shocked). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Indian Creek #14 - Reach 1 10/10/2012

NAD83 UTM 12S In: 0413337E 3798875N Out: 0413442E 3798879N

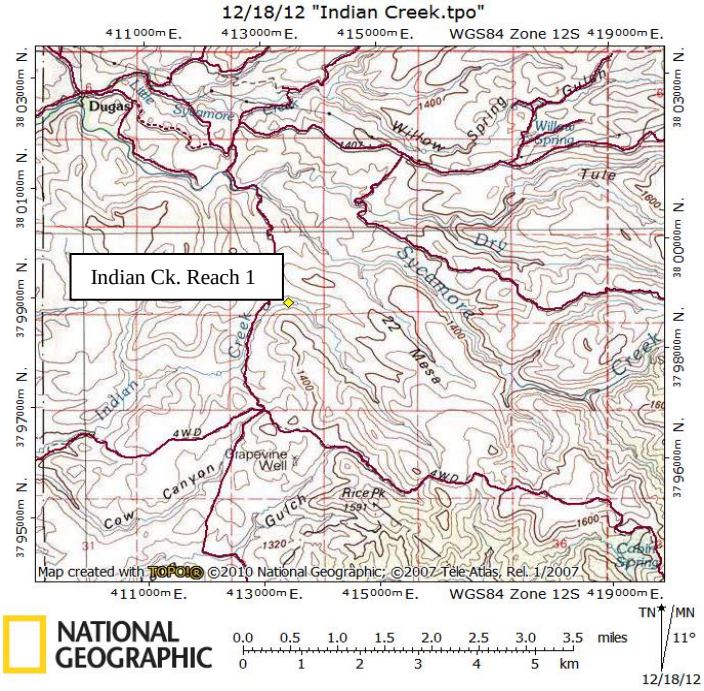

Figure 5: Survey site location on Indian Creek, Agua Fria sub-basin, Yavapai County.

Species	Age class	Number	CPUE (fish/sec)	% of total
GIIN	1	45	0.032	35
GIIN	0	17	0.012	13
AGCH	N/A	65	0.047	51
TOTAL		127	0.091	100

Table 6: Summary of fishes sampled by BPES at Indian Creek (total effort was 1388 seconds shocked). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Little Sycamore Creek #16 – Reach 1 10/10/2012

NAD83 UTM 12S In: 0413788E 3802736N Out: 0413860E 3802791N

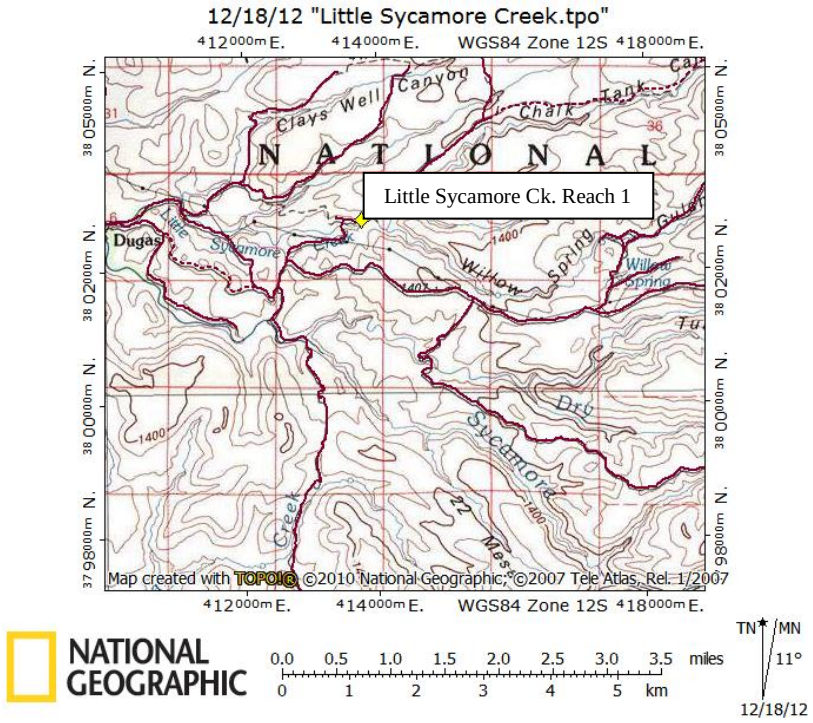

Figure 6: Site location of Little Sycamore Creek, Agua Fria sub-basin, Yavapai County.

Species	Age class	Number	CPUE (fish/sec)	% of total
GIIN	1	33	0.043	44
GIIN	0	41	0.053	55
AGCH	N/A	1	0.001	1
TOTAL		75	0.097	100

Table 7: Summary of fishes sampled by BPES at Little Sycamore Creek (total effort was 774 seconds shocked). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Sycamore Creek #19 - Reach 1 (Double-T Falls) 10/11/2012

NAD83 UTM 12S In: 0419858E 3798098N Out: 0419949E 3798069N

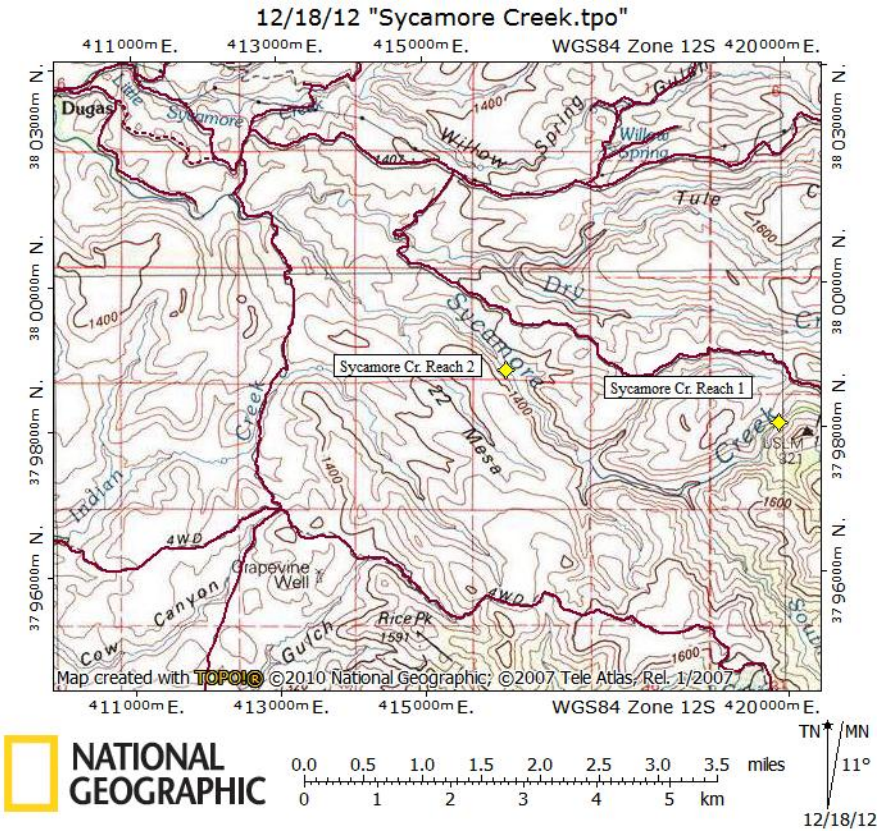

Figure 7: Location of two sampling sites on Sycamore Creek, Agua Fria sub-basin, Yavapai County.

Species	Age class	Number	CPUE (fish/sec)	% of total
GIIN	0	3	0.003	13
GIIN	1	12	0.011	50
ONMY	1	9	0.008	38
TOTAL		24	0.022	100

Table 8: Summary of fishes sampled by BPES at Sycamore Creek, Reach 1 (total effort was 1083 seconds shocked). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Sycamore Creek #19 - Reach 2 (Middle Box) 10/11/2012

NAD83 UTM 12S In: 0416151E 3798796N Out: 0416227E 3798737N

(See Fig. 7 for map)

Species	Age class	Number	CPUE (fish/sec)	% of total
GIIN	1	6	0.011	100

Table 9: Summary of fishes sampled by BPES at Sycamore Creek Reach 2 (total effort was 563 seconds shocked). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Species	Age class	Number	CPUE (fish/hr)	% of total
GIIN	1	5	2.3	100

Table 10: Summary of fishes sampled by trammel net at Sycamore Creek Reach 2 (total effort was 132 minutes).

Red Tank Draw #26 - Reach 1 10/17/2012

NAD83 UTM 12S In: 435027E 3840265N Out: 435030E 3840281N

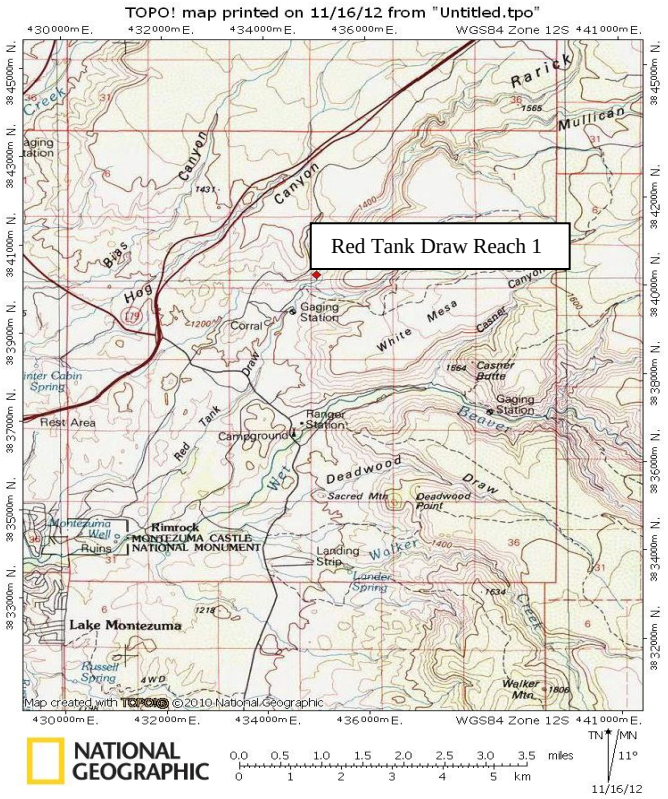

Figure 8: Survey site location at Red Tank Draw, Verde River sub-basin, Yavapai County.

Species	Age class	Number	CPUE (fish/sec)	% of total
PIPR	N/A	80	0.045	45
LECY	1	38	0.021	21
LECY	0	15	0.008	8
GIIN	0	11	0.006	6
GIIN	1	34	0.019	19
TOTAL		178	0.100	100

Table 11: Summary of fishes sampled by BPES at Red Tank Draw (total effort was 1774 seconds shocked). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Species	Age class	Number	CPUE (fish/hr)	% of total
PIPR	N/A	10	1.0	30
LECY	N/A	2	0.2	6
LECY	1	20	2.0	61
LECY	0	1	0.1	3
TOTAL		33	3.3	100

Table 12: Summary of fishes sampled by hoop net at Red Tank Draw (total effort was 593 minutes). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Tule Creek #20 - Reach 1 10/17/2012

NAD83 UTM 12S In: 382329E 376399N Out: 382307E 3763892N

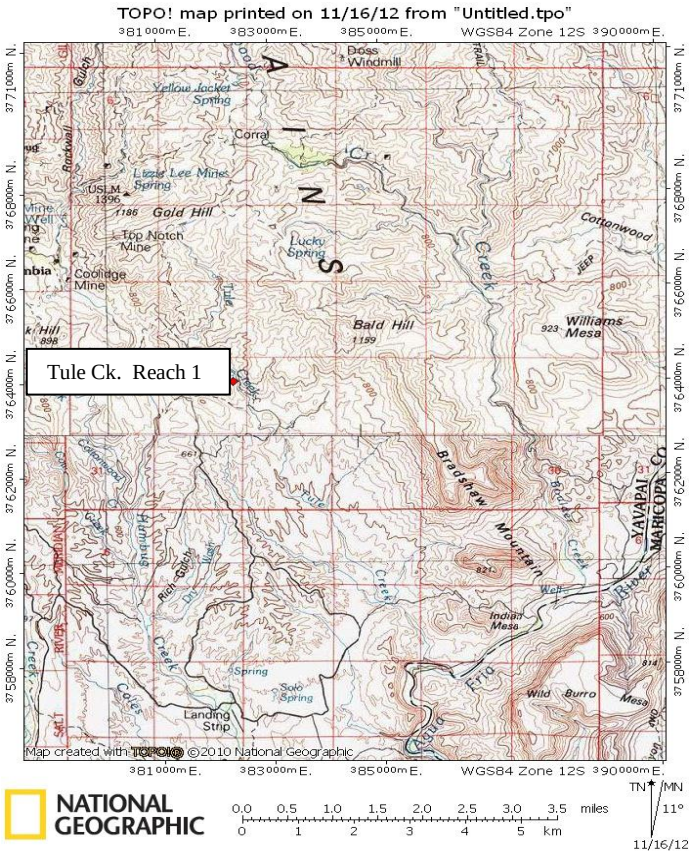

Figure 9: Survey site location on Tule Creek, Agua Fria sub-basin, Yavapai County.

Species	Age class	Number	CPUE (fish/hr)	% of total
POOC	N/A	1220	67.7	100

Table 13: Summary of fishes sampled by minnow trap at Tule Creek (total effort was 1082 minutes).

Species	Age class	Number	CPUE (fish/m2)	% of total
POOC	N/A	9	1.5	100

Table 14: Summary of fishes sampled by dip-net at Tule Creek (total effort was 6m^2 seined).

Coal Mine Canyon #51 - Reach 1 10/23/2012

NAD83 UTM 12S In: 510485E 3488011N Out: 510430E 3487943N

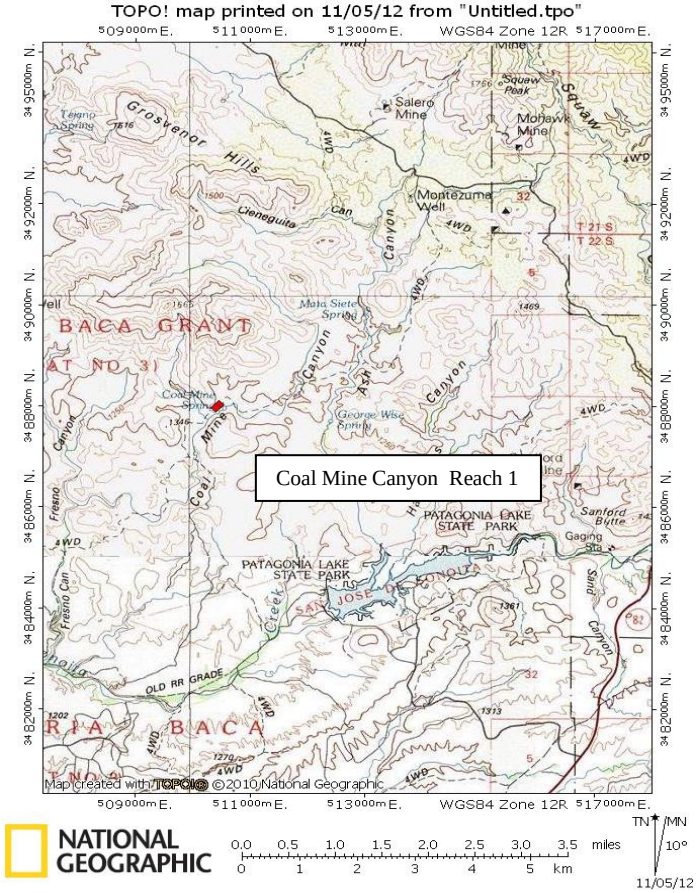

Figure 10: Location of the survey site on Coal Mine Canyon, Santa Cruz sub-basin, Santa Cruz County.

Species	Age class	Number	CPUE (fish/hr)	% of total
POOC	N/A	4029	357.1	95
AGCH	N/A	218	19.3	5
TOTAL		4247	376.4	100

Table 15: Summary of fishes sampled by minnow trap at Coal Mine Canyon Reach 1 (total effort was 677 minutes).

Post/Freeman Canyon #63 – Reach 1 10/23/2012

NAD83 UTM 12R In: 545025E 3493946N Out: 545000E 3493888N

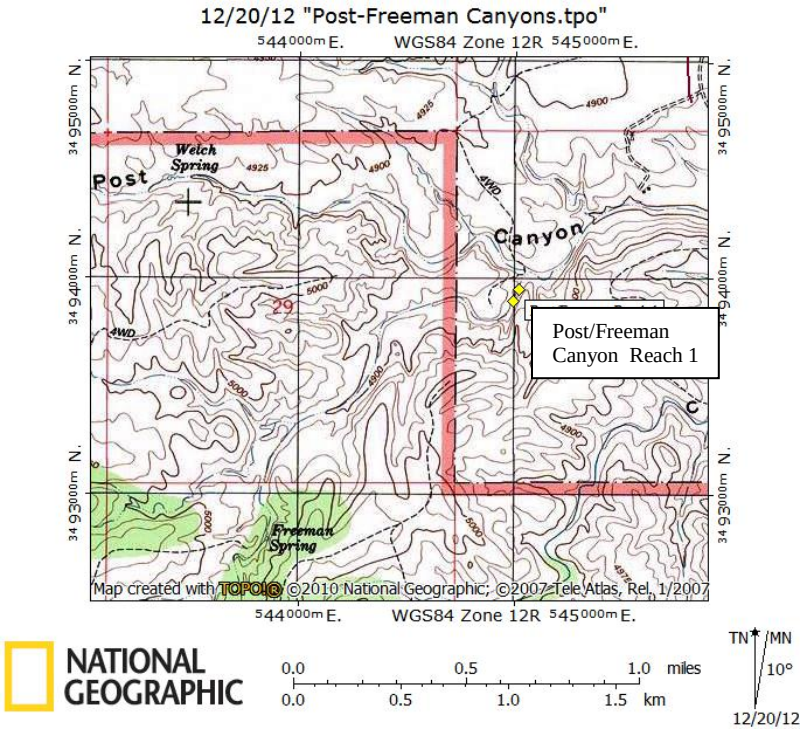

Figure 11: Location of the survey site at Post/Freeman Canyon, San Pedro sub-basin, Santa Cruz County.

Species	Age class	Number	CPUE (fish/hr)	% of total
LECY	0	5	0.3	50
LECY	1	5	0.3	50
TOTAL		10	0.6	100

Table 16: Summary of fishes sampled by minnow trap at Post/Freeman Canyon Reach 1 (total effort was 1008 minutes). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Species	Age class	Number	CPUE (fish/hr)	% of total
LECY	0	10	0.5	37
LECY	1	17	0.9	63
TOTAL		27	1.4	100

Table 17: Summary of fishes sampled by hoop trap at Post/Freeman Canyon Reach 1 (total effort was 1161 minutes). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Species	Age class	Number	CPUE (fish/m2)	% of total
GAAF	N/A	50	50	100

Table 18: Summary of fishes sampled by dip net at Post/Freeman Canyon Reach 1 (total effort was $1m^2$).

Sabino Canyon #56 - Reach 1 10/24/2012

NAD83 UTM 12S In: 520165E 3578069N Out: 520205E 3578748N

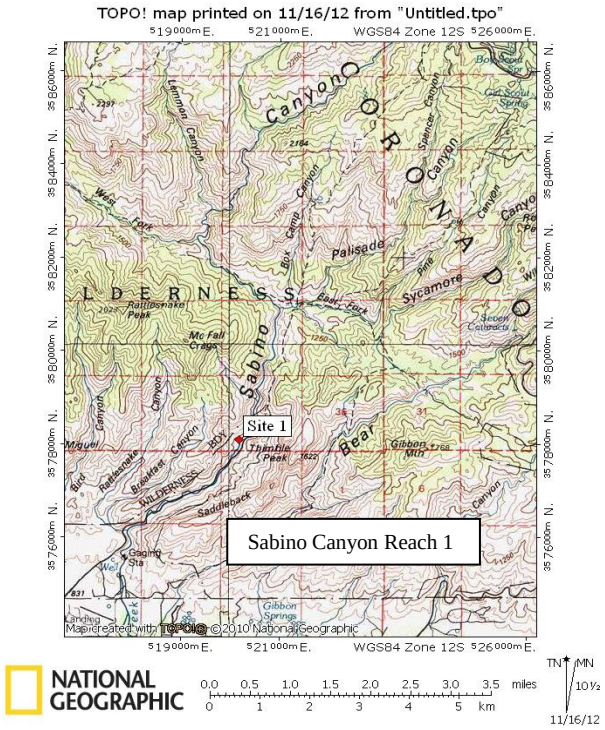

Figure 12: Survey site at Sabino Canyon Reach 1, Santa Cruz sub-basin, Pima County.

Species	Age class	Number	CPUE (fish/hr)	% of total
GIIN	0	91	5.2	57
GIIN	1	68	3.9	43
TOTAL	--	159	9.1	100

Table 19: Summary of fishes sampled by minnow trap in Sabino Canyon (total effort was 1053 minutes). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Species	Age class	Number	CPUE (fish/hr)	% of total
GIIN	1	128	9.6	100

Table 20: Summary of fishes sampled by hoop net in Sabino Canyon (total effort was 796 minutes). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Fresno Canyon #53 - Reach 1 10/24/2012

NAD83 UTM 12R In: 507763E 3485966N Out: 507854E 3485991N

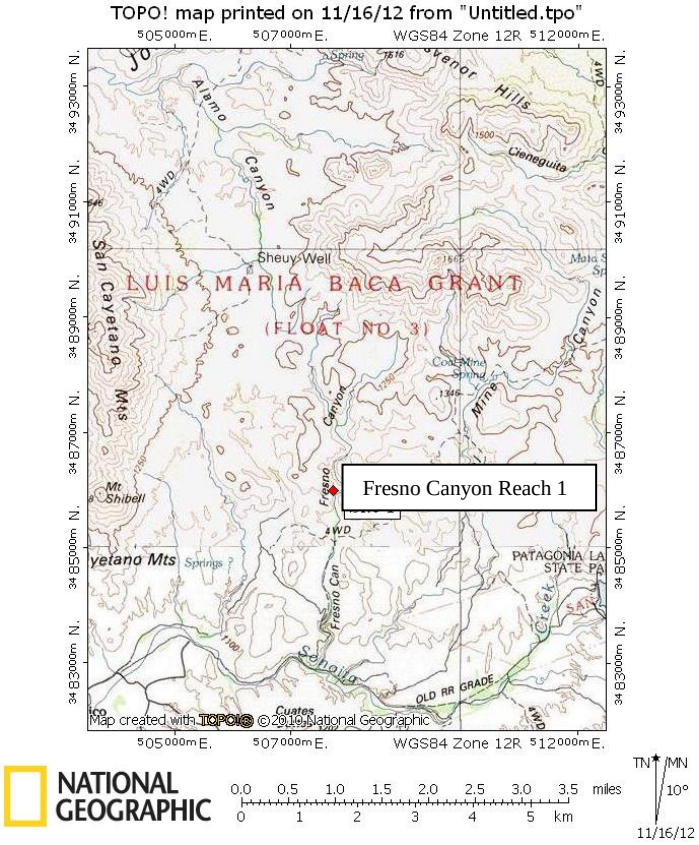

Figure 13: Survey site at Fresno Canyon, Reach 1, Santa-Cruz sub-basin, Santa Cruz County.

Species	Age class	Number	CPUE (fish/m2)	% of total
POOC	N/A	4164	68.8	98
AGCH	N/A	68	1.1	2
TOTAL		4232	70.0	100

Table 21: Summary of fishes sampled by straight seine in Fresno Canyon (total effort was 60.5m^2).

Species	Age class	Number	CPUE (fish/hr)	% of total
POOC	N/A	5	2.3	100

Table 22: Summary of fishes sampled by minnow trap in Fresno Canyon (total effort was 128 minutes).

Romero Canyon #77 - Reach 1 10/25/2012

NAD83 UTM 12S In: 511540E 3586855N Out: 511585E 3586782N

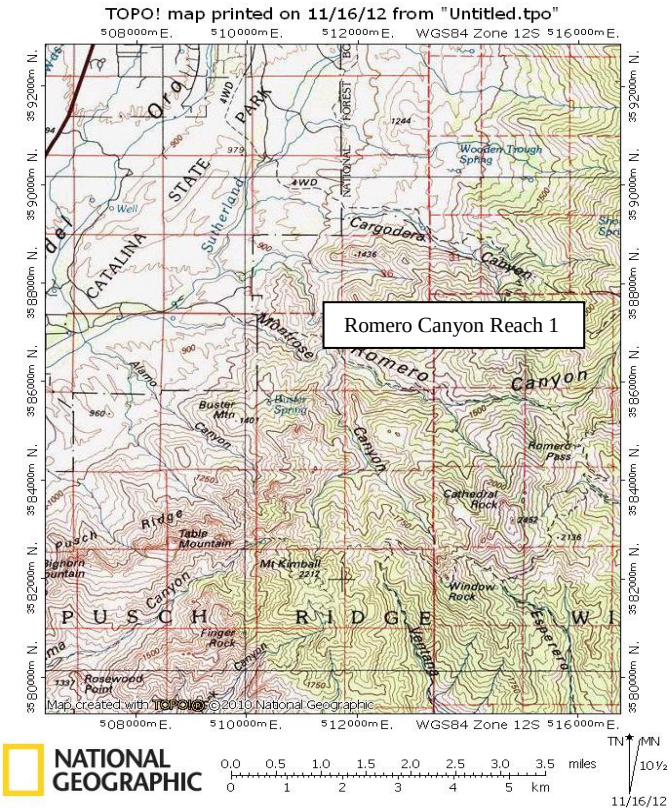

Figure 14: Survey site Romero Canyon Reach 1, Santa Cruz River sub-basin, Pima County.

Species	Age class	Number	CPUE (fish/m2)	% of total
GIIN	0	64	0.58	47
GIIN	1	71	0.65	53
TOTAL		135	1.23	100

Table 23: Summary of fishes sampled by seine net in Romero Canyon (total effort was 110m^2). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Species	Age class	Number	Effort (m2)	CPUE (fish/m2)	% of total
GIIN	0	2	6	0.333	100

Table 24: Summary of fishes sampled by dip-net in Romero Canyon (total effort was 6m^2). Effort for adult and Y-O-Y remain separate for large-bodied fishes.

Cienega Creek lower #78 - Reach 1 11/07/2012

NAD83 UTM 12S In: 533455E 3542662N Out: 533550E 3542704N

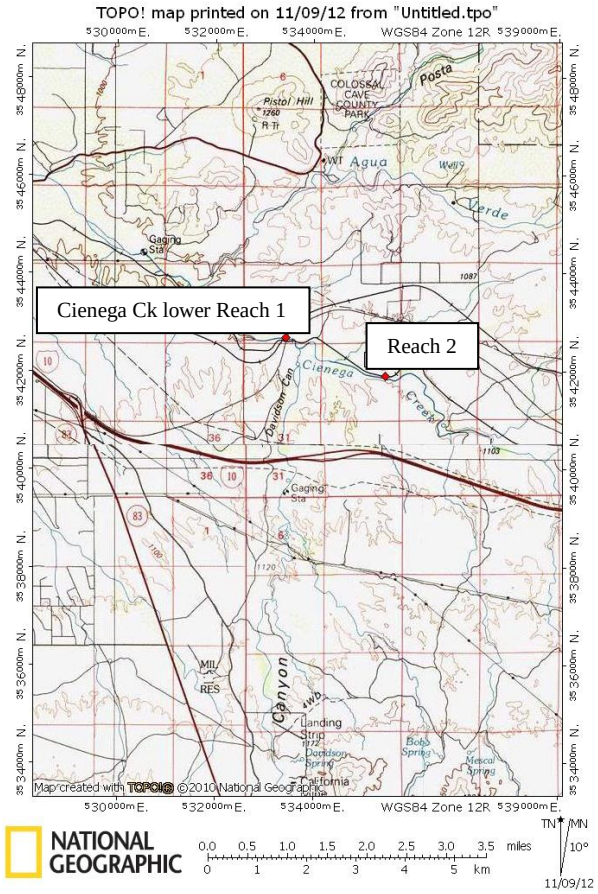

Figure 15: Survey sites on Cienega Creek lower, Santa Cruz sub-basin, Pima County.

Species	Age class	Number	CPUE (fish/sec)	% of total
AGCH	N/A	11	0.020	52
POOC	N/A	10	0.018	48
TOTAL		21	0.039	100

Table 25: Summary of fishes sampled by BPES in Cienega Creek lower Reach 1 (total effort was 541 seconds).

Cienega Creek lower #78 - Reach 2

NAD 83 UTM 12S In: 535481E 3541890N Out: 535586E 3541869N

(see Fig. 15 for map).

Species	Age class	Number	CPUE (fish/sec)	% of total
AGCH	N/A	100	0.105	49
POOC	N/A	106	0.111	51
TOTAL		206	0.216	100

Table 26: Summary of fishes sampled by BPES in Cienega Creek lower Reach 2 (total effort was 953 seconds).

Appendix II

Site Photographs

Table of photographs

Photo 1: Cherry Creek Reach 1 - Upper boundary of the 500m reach facing downstream.

Photo 2: Cherry Creek Reach 1 – Lower boundary facing downstream.

Photo 3: Cherry Creek Reach 2 - Lower boundary looking upstream.

Photo 4: Cherry Creek Reach 2 - Upper boundary looking downstream.

Photo 5: Cherry Creek Reach 3- Lower boundary looking upstream (USGS gauge above placard is roughly 20 meters upstream of lower boundary).

Photo 6: Indian Creek Reach 1 - Upper boundary facing downstream.

Photo 7: Indian Creek Reach 1 - Upper boundary facing upstream.

Photo 8: Indian Creek Reach 1 - Lower boundary facing upstream (placard incorrect).

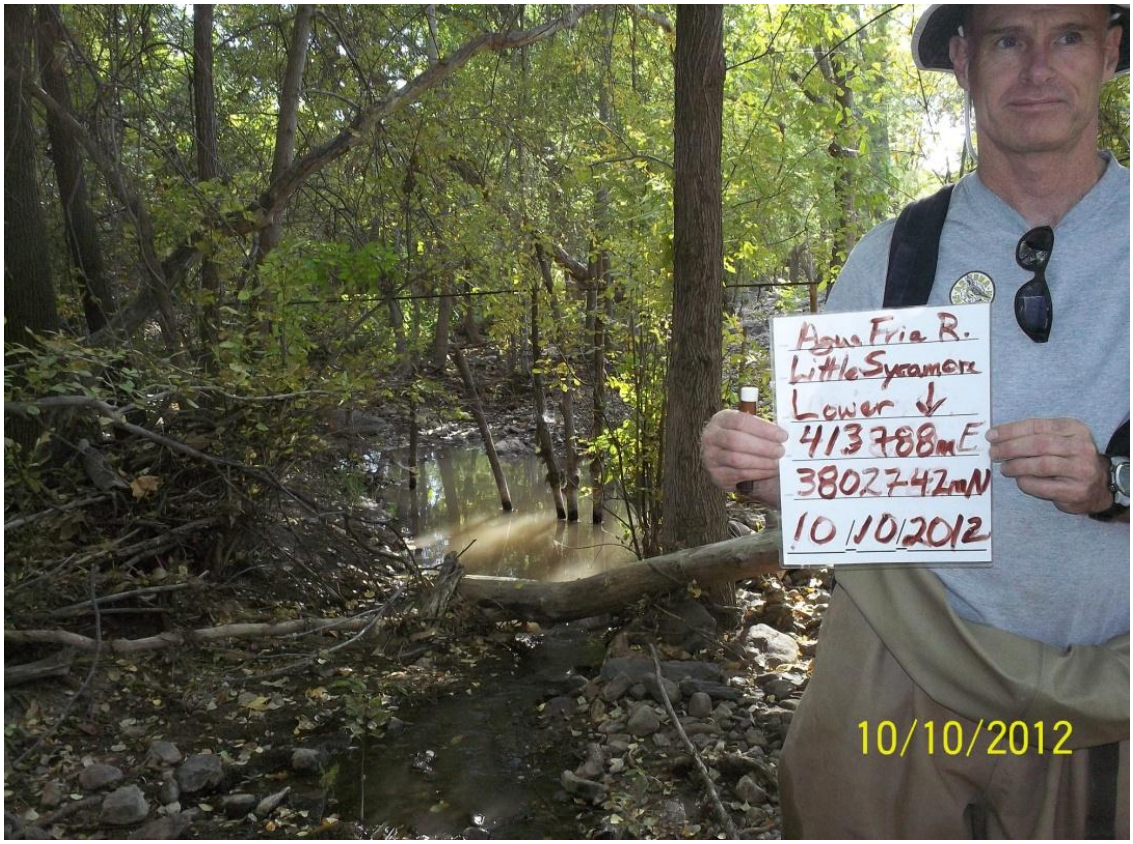

Photo 9: Little Sycamore Creek - Lower boundary facing downstream.

Photo 10: Little Sycamore Creek - Lower boundary facing upstream.

Photo 11: Little Sycamore Creek - Upper boundary facing downstream.

Photo 12: Sycamore Creek Reach 1 - Lower boundary facing downstream.

Photo 13: Sycamore Creek Reach 1 - Lower boundary facing upstream.

Photo 14: Sycamore Creek Reach 1 - Upper boundary facing downstream.

Photo 15: Sycamore Creek Reach 1 - Upper boundary facing upstream.

Photo 16: Gila chub (GIIN) at Sycamore Creek Reach 1.

Photo 17: Gila chub (GIIN) at Sycamore Creek Reach 1.

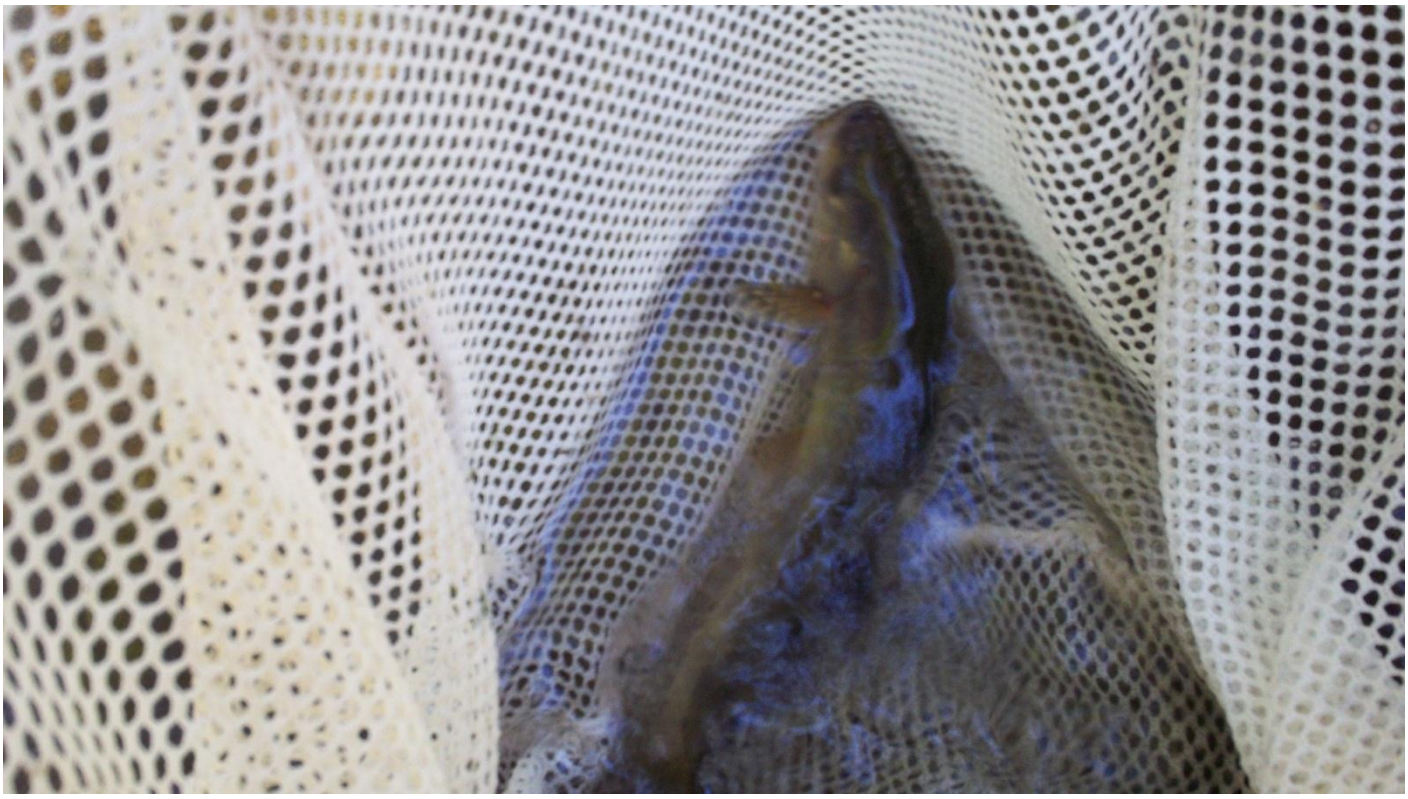

Photo 18: Gila chub (GIIN) at Sycamore Creek Reach 1.

Photo 19: Sycamore Creek Reach 2 - Lower boundary facing downstream.

Photo 20: Sycamore Creek Reach 2 - Lower boundary facing upstream.

Photo 21: Sycamore Creek Reach 2 - Upper boundary facing downstream.

Photo 22: Sycamore Creek Reach 2 - Upper boundary facing upstream.

Photo 23: Red Tank Draw – Lower boundary facing downstream.

Photo 24: Red Tank Draw – Lower boundary facing upstream.

Photo 25: Red Tank Draw – Upper boundary facing downstream.

Photo 26: Red Tank Draw –Upper boundary facing upstream.

Photo 27: Tule Creek – Upper boundary facing upstream.

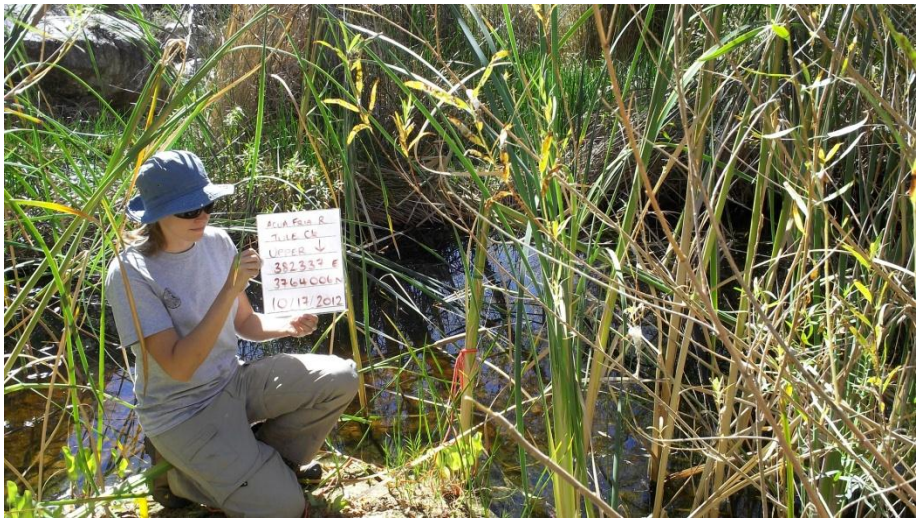

Photo28: Tule Creek – Upper boundary facing downstream.

Photo 29: Tule Creek – Lower boundary facing upstream.

Photo 30: Tule Creek – Lower boundary facing downstream.

Photo 31: Coal Mine Canyon – Upper boundary facing upstream.

Photo 32: Coal Mine Canyon – Upper boundary facing downstream.

Photo 33: Coal Mine Canyon – Lower boundary facing upstream.

Photo 34: Coal Mine Canyon – Lower boundary facing downstream.

Photo 35: Post Canyon – Upper boundary facing upstream.

Photo 36: Post Canyon – Upper boundary facing downstream.

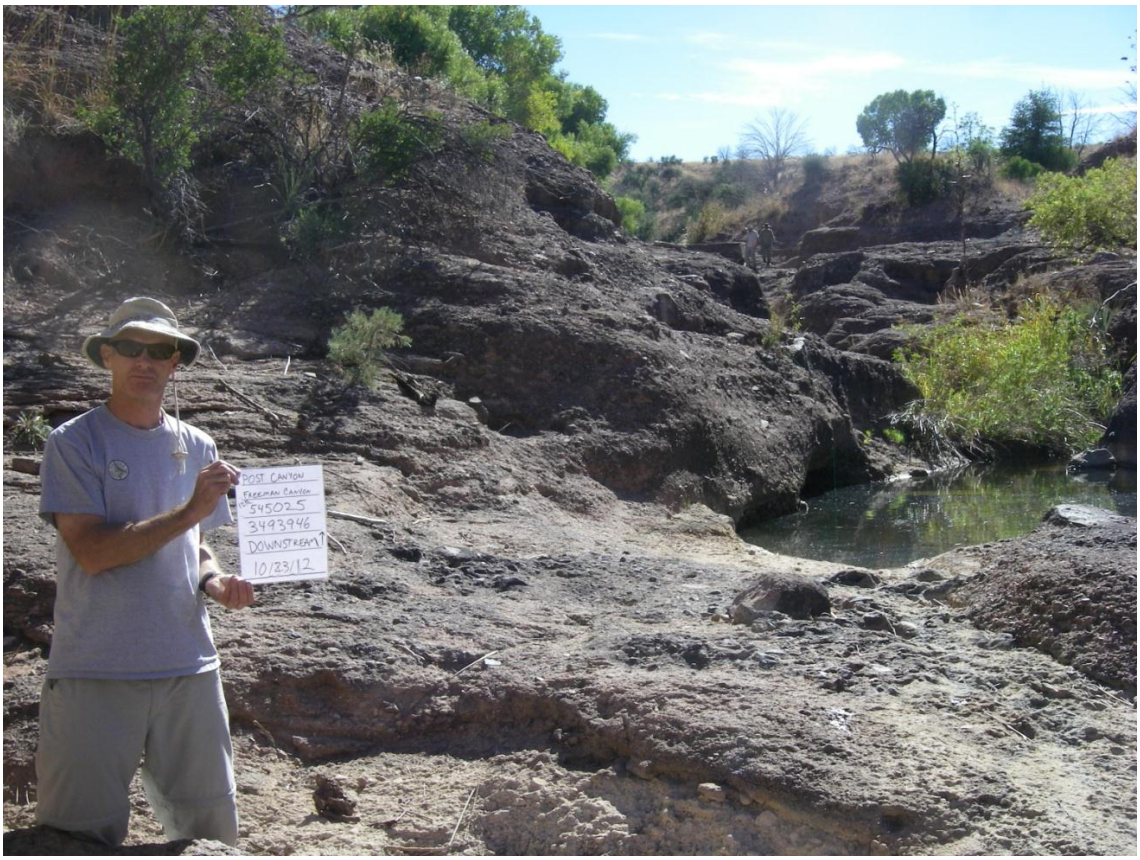

Photo 37: Post Canyon – Lower boundary facing upstream.

Photo 38: Post Canyon – Lower boundary facing downstream.

Photo 39: Sabino Canyon – Upper boundary facing upstream.

Photo 40: Sabino Canyon – Upper boundary facing downstream.

Photo 41: Sabino Canyon – Lower boundary facing upstream.

Photo 42: Sabino Canyon – Lower boundary facing downstream.

Photo 43: Fresno Canyon – Upper boundary facing upstream.

Photo 44: Fresno Canyon – Upper boundary facing downstream.

Photo 45: Fresno Canyon – Lower boundary facing upstream.

Photo 46: Fresno Canyon – lower boundary facing downstream.

Photo 47: Romero Canyon – Upper boundary facing upstream.

Photo 48: Romero Canyon – Upper boundary facing downstream.

Photo 49: Romero Canyon – Lower boundary facing upstream.

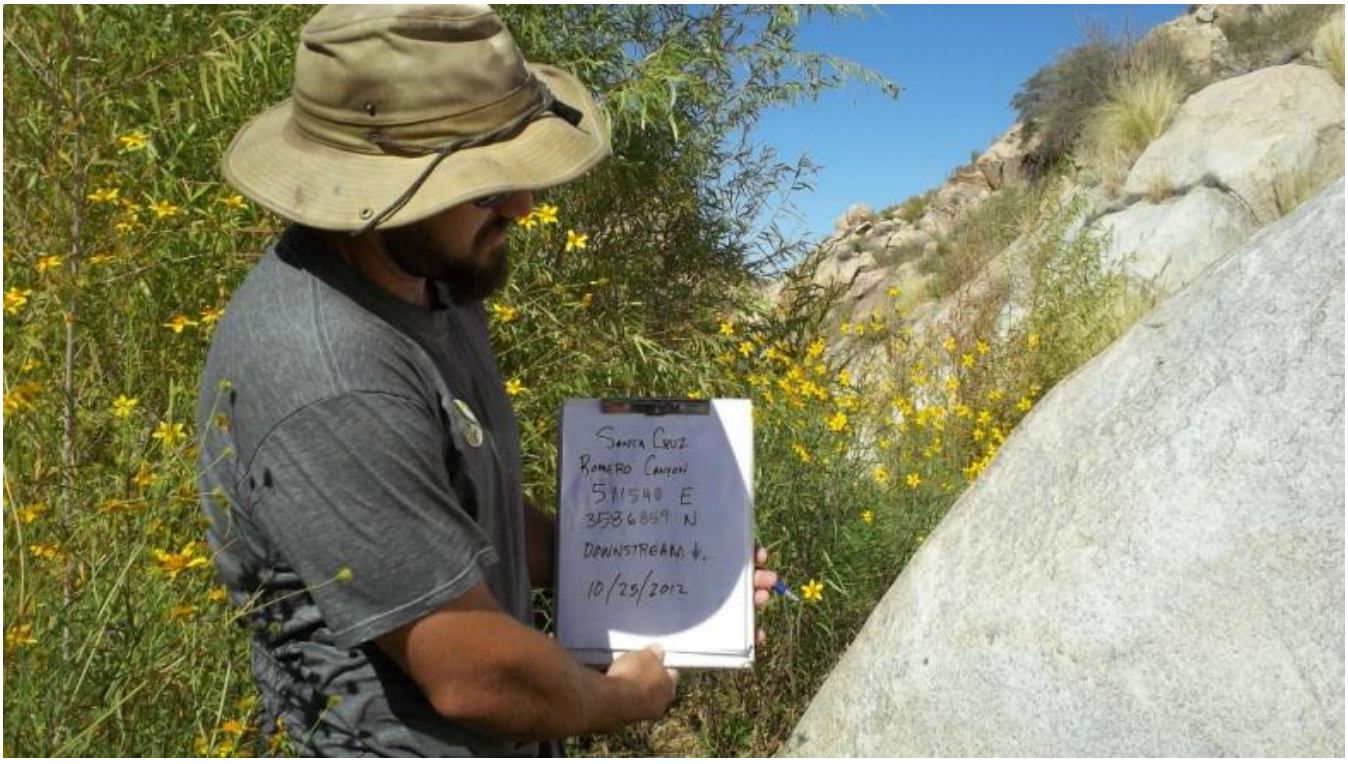

Photo 50: Romero Canyon – Lower boundary facing downstream.

Photo 51: Cienega Creek lower Reach Site 1 - Lower boundary facing downstream.

Photo 52: Cienega Creek lower Reach Site 1 - Lower boundary facing upstream.

Photo 53: Cienega Creek lower Reach Site 1 - Upper boundary facing downstream.

Photo 54: Cienega Creek lower Reach Site 1 - Upper boundary facing upstream.

Photo 55: Cienega Creek lower Reach Site 2 - Lower boundary facing downstream.

Photo 56: Cienega Creek lower Reach Site 2 - Lower boundary facing downstream.

Photo 57: Cienega Creek lower Reach Site 2 – Upper boundary facing downstream.

Photo 58: Cienega Creek lower Reach Site 2 – Upper boundary facing upstream.