FISH MONITORING OF SELECTED STREAMS WITHIN THE GILA RIVER BASIN, 2013

Annual Report

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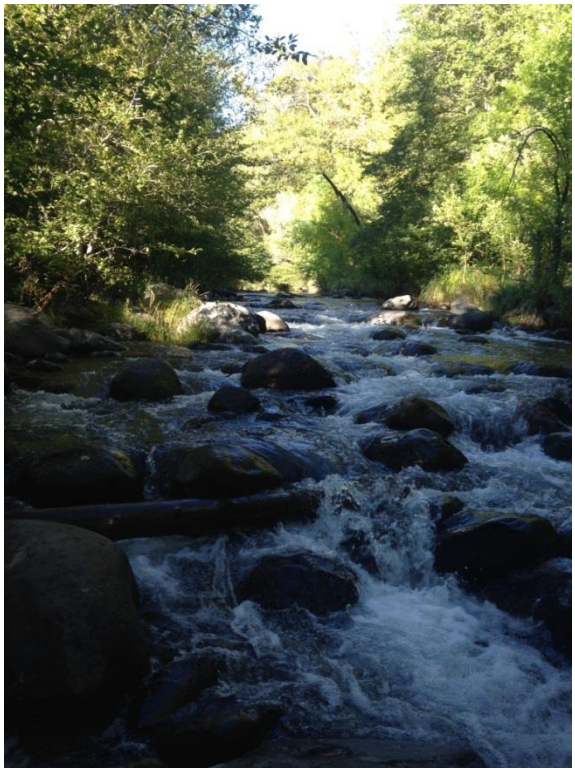

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INTRODUCTION

This report summarizes monitoring of various native fish populations by Arizona Game and Fish Department (Department) during 2013 for Bureau of Reclamation Contract No. 12PC32007, Monitoring of Gila River Basin Waters (MGRBW). Monitoring activities were conducted on a subset of streams identified in the "Scope of Work - Monitoring of Gila River Basin Waters (SOW) to Assist with Conservation of Federally-listed Warm Water Fishes (Native Fish Monitoring)".

Between the 2012 and 2013 season, the original contract was extended for an additional year of monitoring, and modified to increase the number of streams/sites monitored per year. The original goal was to sample approximately one-quarter of the sites per year (roughly 17 streams/26 sites/year). Because the original contract was not awarded until June 2012, a full field season of work could not be completed that year. However, based on results of the work completed in 2012 and following discussions with the Contracting Officer Representative, it was estimated that one-third of the streams and sites could easily be completed during a full field season, so the SOW was modified to monitor each stream/stream site at least once every three years, i.e., about 22 streams and 35 sites are to be monitored each year.

Focal species identified to monitor for this project include the Gila topminnow (*Poeciliopsis occidentalis*), Gila chub (*Gila intermedia*), headwater chub (*G. nigra*), roundtail chub (*G. robusta*), loach minnow (*Tiaroga cobitis*), and spikedace (*Meda fulgida*).

METHODS

According to protocol (Clarkson et al. 2011), initial monitoring on each stream was directed primarily to points of historical occurrence of the target species that had vehicular access. If such access sites were not readily available, initial monitoring was directed to points of vehicular access that could be approached within several miles and safely hiked into; in some cases, sampling occurred at locations that were not closely accessible by vehicle. According to the protocol, streams less than five miles in length required one monitoring site, streams between five and ten miles in length required two monitoring sites, and streams over ten miles in length required three monitoring sites. Any deviations to the sampling protocol at a site are outlined in the Results section.

At each site, a 0.5 km reach of stream was initially surveyed and numbers of each species recorded. If the target species was not detected within the initial search, another 0.5 km portion of the stream was surveyed at another access site within its known or suspected former range, unless the stream was too short or habitat too limited to allow an expanded search. Once the target species was detected, a measured 100-m long reach was quantitatively sampled according to procedures in Clarkson et al. (2011) to record number of individuals and species encountered within major mesohabitat types (riffle, run, pool). If the focus species was rare within the 100-m reach, sampling continued upstream for another 0.5 km, again targeting preferred habitats of the focus species. If less than 25 individuals of the target species were captured, an attempt was made to repeat the entire process at another access point not immediately adjacent to the prior

sample but geographically representative of the expected or former known distribution; a maximum of three sites were to be sampled in this manner.

Species- and habitat-appropriate gear was selected to survey each reach. For the majority of surveys, electrofishing using the Smith-Root Model-12R Backpack Electrofisher (BPES) was the primary method of sampling. In areas where stream morphology, water depth, or substrate instability made sampling with the backpack electrofisher unsafe or impractical, other sampling techniques were employed, including baited minnow traps (Promar 18" x 10" – 1/8" mesh) and hoop nets (Promar 12" x 24" - 1/2" mesh), dip-nets (1,236 in^2, 1/8" mesh), trammel nets (6' x 50' x 1"), canoe electrofishing (Smith-Root GPP 5.0), seines (6' x 10' x ¼") and angling. Opportunistic angling, using species appropriate bait (meal worms and grasshoppers), was employed where access restricted the use of nets, or for qualitative sampling beyond the established 100-m quantitative reach. 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 62s.

Large-bodied fishes captured during the efforts were identified to species, classified as age 0 (<10-cm) or age 1+ (>10-cm), enumerated and released. Small-bodied fishes were identified, enumerated and released. In some drainages, tissue samples (fin clips) of headwater chub were collected for ongoing genetic studies.

RESULTS

During the 2013 monitoring season, a total of 28 sites within 20 streams were monitored from June-December, 2013. Streams within five different sub-basins were sampled: the Verde River sub-basin (Oak, Webber and West Clear creeks); the Salt River sub-basin (Buzzard Roost, Gordon, Gun, Marsh, Rock and Tonto creeks and lower Salt River.); the Santa Cruz River sub-basin (Sharp Spring, Santa Cruz River, Redrock and O'Donnell canyons and Sonoita Creek); the San Pedro River sub-basin (Babocomari River, T4 Spring, and Swamp Springs and Cherry Spring canyons); and the Upper Gila River sub-basin (Dix Creek). With the twelve streams monitored in 2012, a total of 32 streams and 43 sites have been monitored to date for this project.

Deviations from the protocol consisted primarily of not surveying a second or third 0.5 km reach if none or less than 25 individuals of the target species were captured during the initial survey. There were multiple reasons for this type of deviation: 1) lack of additional habitat, 2) lack of access to suitable habitat, and 3) concerns for trespass onto private property. On a number of occasions, emphasis and efforts were mistakenly focused on adherence to a preset schedule and sampling the next site or stream scheduled rather than surveying a second or third 0.5 km reach. The planned schedule for 2013 was based on an estimated one day to complete sampling at each site, and on the premise that the target species would be found at a given site. With hindsight, planning on the premise that the target species would be absent from a given site, and planning on needing one to three days sampling for each site would have been a better strategy.
A second deviation from protocol at some sites was that data sheets were not filled out in their entirety while in the field, but the remaining fields were filled out in the office. As an example, redundant fields (e.g., stream name, reach name, and date) might have been filled out on the top of the data sheet for the first habitat unit, but not in the middle of the sheet for the second habitat

unit; these fields were filled in later at the office. In other instances, all fields were not filled in because the site was a 0.5 km qualitative survey, and so the fields were not applicable to the effort. Another deviation, was that in some cases UTMs for the upper (the "out" coordinates) and lower (the "in" coordinates) boundaries were reversed, (e.g. the coordinates for the downstream boundary of a 100-m reach recorded as the "out" coordinates), which was usually not detected until the sites were mapped. Also, inadvertently, a map was not drawn for one of the sampled 100-m reaches, even though the habitats were measured.

A list of the species encountered in the surveys, their scientific names and four-lettered codes are provided in Table 1 and the relative abundance of native to nonnative species at each of the survey sites is graphed in Figure 1. A summary of species detected at each survey site is provided in Table 2.

Sharp Spring 06/04/2013

UTM 12R Lower: 0540103E, 3468711N Upper: 0540529E, 3468788N

Located in the San Rafael Valley roughly 1.4 miles north of the international border, Sharp Spring is an intermittent tributary to the upper Santa Cruz River (Fig. 2). It is composed of a series of disconnected pools of various size and depth, with the surface waters of most of the system connecting only during periods of high runoff. Willow (*Salix* sp.) and cottonwood (*Populus fremonti*) are prevalent along the perennial reach, with deergrass (*Muhlenbergia rigens*) covering most of the dry portions of the channel bottom. The focal species for this location was Gila topminnow. Sharp Spring has been sampled annually over the past 7 years, finding only mosquitofish during that period of time. This project affords a platform to continue the sampling on a formal basis, directing attention towards the importance of Sharp Spring in topminnow management and recovery efforts, and providing a formal protocol for sampling the system. Suitable habitat for the survey was available at specific points throughout the established 0.5-km reach. Minnow traps and a dip net were used to sample the pools with sufficient water; results of the efforts are provided in Tables 3-4, respectively. Suitable habitat for additional sampling was not present in the Sharp Spring drainage, so no other 0.5-km search reaches were established.

The only fish species collected at this site was the non-native mosquitofish (*Gambusia affinis*), totaling 152 individuals (Table 3); visual observation indicated the species was present in pools of the middle reach, but more common in the lowermost 3-4 pools of the system; they appeared absent or rare in the uppermost 2—3 pools in the system. Bullfrogs were also common through much of the reach sampled.

Gila topminnow does not persist at this site. The presence of mosquitofish in the Sharp Spring system precludes the reintroduction of topminnow until the exotics are removed.

To eradicate mosquitofish, Arizona Game and Fish Department (Department) attempted to pump the pools in Sharp Spring dry during the summer of 2013. Because of the complexity of the habitat and unexpected spring inflow, the effort was not successful. The Department is currently considering alternative methods for the removal of mosquitofish from the system in preparation for the reestablishment of Gila topminnow (and perhaps Gila chub). Eradication methods should be evaluated and appropriate actions implemented to remove the undesirable species. Prior to

future actions, vegetation within the drainage should be thinned and the excess removed to facilitate activities at the site. Monitoring of Sharp Spring should be continued under this project until after mosquitofish have been removed and topminnow have been stocked back into the system, at which time monitoring responsibilities should be transferred to the appropriate program in the Department. Monitoring under this project should be resumed five years after the last stocking of topminnow or chub into the system.

Santa Cruz River 06/05/2013

UTM 12R Lower: 0538271E, 3466579N Upper: 0538418E, 3466956N

Bounded by the Patagonia Mountains to the west and northwest, the Canelo Hills to the north and the Huachuca Mountains to the east, the upper river of the Santa Cruz River begins roughly 20 miles northeast of Nogales in the San Rafael Valley of southern Arizona, and flows south into Sonora, Mexico. Surface waters of the upper Santa Cruz are intermittent, with flows from seasonal precipitation periodically connecting isolated pools and reaches in the drainage. Vegetation along the Santa Cruz River corridor in the San Rafael Valley consists primarily of Willow and Cottonwood, with deergrass along the drier portions of the river bottom and margins.

Santa Cruz River has been sampled annually over the past seven years, finding primarily nonnatives during that time. This project affords a platform to continue the sampling on a formal basis, directing attention towards the importance of Sharp Spring in topminnow management and recovery efforts, and providing a formal protocol for future sampling efforts of the system. The site was established at the international border with Mexico, extending upstream for 500 m (Fig. 3). The focal species was Gila topminnow. A 10-ft. straight seine was used to survey this reach of stream. The entire 0.5-km survey reach had surface water, much of which consisted of vegetation-choked pools, with current often indiscernible through the reach. The majority of the stream was shallow with extensive submergent vegetation and moderate amounts of submerged woody debris. Stream banks along the reach were moderately to heavily vegetated. Flow at the upper end of the 500-m reach was more apparent and was confined to a much narrower channel than further downstream. Open water suitable for sampling was scarce at the upper extent of the reach.

Only nonnative species were captured at this site, with mosquitofish being the most abundant, comprising 86.5% of the total catch (Table 5). Green sunfish (*Lepomis cyanellus*) and largemouth bass (*Micropterus salmoides*) were also collected, comprising 8.3% and 5.2% of the total catch respectively. No native fishes were collected or observed.

Because the target species were not captured in the 0.5-km reach, the protocol called for sampling one to two additional 0.5-km reaches Two other sites along the drainage were qualitatively sampled, but not in accordance to protocol and were not considered part of this effort. One of the two sites was private property and as such was not considered for the project, and the other had little open and accessible water suitable for sampling. Green sunfish, mosquitofish, and black bullhead (*Ameiurus melas*) were collected during these efforts. High undocumented immigrant traffic along the river creates safety concerns and limits sampling to sites with close vehicular access and high visibility. Future sampling of less accessible portions of the stream will likely require the presence of law enforcement officers for the effort.

Gila topminnow does not persist in the Santa Cruz River in Arizona. Nonnative fishes are found throughout the drainage and pose an obstacle to any successful reintroduction of native fishes in the upper Santa Cruz River. Nonnative fishes should be removed from waters (including stock tanks) of the valley. After removal of nonnatives fishes, Gila topminnow and other appropriate native fishes should be reestablished in the drainage. Although topminnow have not been sampled in the upper Santa Cruz over the past seven years, consideration should be given to completing at least one more complete cycle of monitoring the River under this program. There may also be some unexplored opportunities for recovery actions within the uppermost reaches of the drainage, although perhaps initially only in a piecemeal fashion.

Gordon Creek

With most of its upper drainage flowing from the southern face of the Mogollon Rim, Gordon Creek is a small stream in northeastern Gila County tributary to Haigler Creek. Located on private property within the Tonto National Forest, the monitoring site was approximately 14 miles northwest of Young, AZ. Dry throughout much of its length, the upper reaches of Gordon Creek are formed by a number of smaller drainages flowing in a generally southwesterly direction off of the Mogollon Rim. Gordon Creek flows into Haigler Creek from the northeast, roughly five miles upstream of its confluence with Tonto Creek in the Hellsgate Wilderness (Fig. 4). Common plant species within the riparian zone of Gordon Creek include Arizona alder (*Alnus oblongifolia*), juniper (*Juniperus* sp.), Velvet ash (*Fraxinus velutina*), and Arizona Sycamore (*Platanus wrightii*). The focal species at Gordon Creek was headwater chub. The BPES was used to survey the stream and no chub were found. Longfin dace was the only species sampled in Gordon Creek. Two sites were sampled on Gordon Creek, one above the canyon bound reach below Ellinwood Ranch Road, and the other above Ellinwood Ranch Road.

Gordon Creek - Reach 1 lower 08/13/2013

UTM 12S Lower: 0495854E, 3785122N Upper: 0496190E, 3785032N

The lower boundary for the 0.5 km survey reach was established roughly 1 km below the Ellinwood Ranch Road crossing (Fig. 4) just above where the canyon narrows and its walls abruptly steepen to the vertical forming long, deep pools. Much of the water in the survey reach was shallow (<0.5 m), with primarily silt-covered bedrock and cobble substrates; submergent vegetation and algae were absent from the entire reach. What could be seen of downstream habitat was canyon-bound with narrow, deep pools and deemed inaccessible for additional sampling.

Longfin dace was the only species captured in Gordon Creek, with a total of 188 individuals captured (Table 6). However crayfish were abundant throughout the reach. A second 0.5-km survey reach starting roughly 500 m upstream of the lower found no fish at all, however, crayfish remained abundant throughout.

A nearly total lack of in-stream vegetation and heavy silt cover over substrates was presumably

due to the high density of crayfish, and the lack of suitable habitat in this section of stream may limit chub distribution. With the exception of crayfish, no nonnative aquatic species appear established in this reach.

A second 0.5 km reach upstream of the initial survey reach was also sampled (see below) but the reach contained little habitat suitable for chub. The development of a suitable method for removing crayfish from aquatic habitats should continue and once identified, be applied to this system. Although stream substrates were similar to that seen in other small desert streams with high densities of crayfish, heavy silt substrates suggest an examination of the drainage above the survey reach to identify a possible source of excess sediment input into the system.

Gordon Creek - Reach 1 upper 08/13/2013

UTM 12S Lower: 0496684E, 3785315N Upper: 0496759E, 3785459N

As Gila chub were not found in the initial 0.5 km reach, a second 0.5 km reach was surveyed above the Ellinwood Ranch road crossing. Stream channel within this reach was primarily broad and shallow (the majority of this section of stream was < 0.25 m), with predominant substrates silt-covered cobbles. Suitable habitat for chub was limited to four separate pools in the reach, with most of the habitat consisting of broad, shallow flows. No fish were captured or seen within this reach, however crayfish remained abundant throughout. Suitable waters for sampling were found only within the first 170 m of the survey reach and surface water disappeared above this point. Due to lack of adequate surface water, no additional sampling occurred beyond the last pool deemed suitable for chub (at the170 m point). Coordinates of the upper end (0496759E, 3785459N) are of the location of the uppermost pool at 170 m, not the upper end of the 0.5 km. There was no other suitable habitat within the reach.

A third 0.5-km qualitative site was not established because site suitable habitat was not present above this reach and there was no access to habitat below the initial 0.5 km site. Coordinates for the upstream boundary of this 0.5 km site were inadvertently not recorded.

Headwater chub were not found in this 0.5 km reach of stream. Assessment of threats and management recommendations are the same as those of the "Reach 1 lower" section for Gordon Creek (previous section).

Marsh Creek 08/14/2013

UTM 12S Lower: 0497155E, 3780773N Upper: 0497253E, 3780739N

Draining in a westerly direction into the Hellsgate Wilderness, Marsh Creek has its upper tributaries originating along the base of the Naegelin Rim in Tonto National Forest and eventually converges with Haigler Creek. Common plant species within the riparian zone of the creek include Arizona alder, Arizona black walnut (*Juglans major*), Arizona ash and willow, with oak (*Quercus* sp.), pinyon pine (*Pinus edulis*) and juniper (*Juniperus* sp.) on adjacent

slopes. The focal species for Marsh Creek surveys was the headwater chub. The survey site for Marsh Creek is located in the Hellsgate Wilderness, approximately 5.6 miles northwest of Young, AZ (Fig. 5).

Roughly 90 m upstream from the lower boundary of the 500m survey reach chub were encountered and a 100-m sample reach was established. Habitats within the 100-m reach consisted of a series of pools, separated by short reaches of run and riffle, which were sampled using the BPES. Two pools that formed what was considered the best chub habitat in the immediate sample vicinity were over 100 m apart. Habitat suitable for chub between the two pools was poor or lacking. Because the 100m sample reach did not produce a sufficient number of chub, the sample reach was expanded upstream by an additional 30m to incorporate the second pool. A total of 16 headwater chub were collected from pool habitat within the 130m reach; Table 7 provides a summary of effort and species collected. After sampling was complete on the 130m reach, other chub (n=21) were observed in a 45m long pool upstream of the original reach (coordinates of pool were 497351E 3780535N), but the pool could not be effectively sampled with the BPES (the pool was observed for about 10 minutes). Above the 45m pool an additional 130m of stream was surveyed (469 seconds of effort), but surface water was limited to a series of shallow pools (< 12' deep). No additional sampling was conducted from the end of the second 130m up to the private property boundary upstream, because of the lack of suitable habitat.

Headwater chub (16 individuals or 43% of catch) and green sunfish (20 individuals or 57% of catch) were the only species captured in Marsh Creek, totaling 36 individuals. An equal number of Age-0 and Age-1+ chub were captured (Table 7); additional chub were observed but not captured. Potential threats to this population of chub include nonnative green sunfish and limited habitat.

Deviations from the sampling protocol include not completing an additional 500m survey reach in Marsh Creek. Sampling of Marsh Creek will be completed during the 2014 season.

Rock Creek 08/15/2013

UTM 12S Lower: 0493118E, 3766136N Upper: 0493142E, 3766028N

Rock Creek is located on Tonto National Forest, approximately 7 miles southwest of Young, AZ (Fig.6). It is tributary to Haigler Creek, flowing in a northerly direction to its confluence with Haigler. Predominant riparian vegetation along this reach of Rock Creek is Arizona alder. Water volume and clarity during sampling were good, with substrates in the sample reach consisting primarily of large cobble and small boulders. The target species for Rock Creek was headwater chub. Habitat in the sample reach averaged ~2 m wide and up to ~1 m deep. Boulders, undercut banks and downed branches provided cover and suitable habitat for chub. A 100m fixed quantitative reach was established below the mine road crossing and sampled using the BPES. The pool immediately above the road (and above the 100-m reach) was sampled opportunistically by angling.

Using the BPES, headwater chub, desert sucker (*Pantosteus clarki*), speckled dace (*Rhinicthys*

osculus), and green sunfish were captured at this site, totaling 334 individuals; native species comprised 90% of the total catch. Adult and juvenile chub comprised 66% of the total catch, with 33% of chub classified as Age-0 (Table 8). A total of 35 green sunfish were captured. Angling in the pool above and adjacent to the road crossing, resulted in the capture of an additional 20 chub and 3 green sunfish (Table 9).

Remarkably, headwater chub appear to maintain a healthy population despite the presence of green sunfish. Green sunfish and parasites both pose potential threats to the population. *Lernaea cyprinacea* was present on individual suckers and chub, but were low in number. Light to heavy black grub (*Neascus* spp.) infection was noted on chub, suckers and speckled dace.

West Clear Creek

With its headwaters formed by the confluence of Willow Valley and Clover Creek, West Clear Creek flows from the Mogollon Rim to its confluence with the Verde River approximately 25 miles to the west. Located on the Coconino National Forest in Coconino and Yavapai counties, it flows through the West Clear Creek Wilderness Area to the Verde River. Common vegetation along the riparian area was primarily Arizona alder and willow. The focal species for surveys on West Clear Creek was roundtail chub. Having over 10 miles of stream, West Clear Creek requires 3 distinct sampling reaches, an upper, middle, and lower reach.

Deviation from the sampling protocol included not completing a third 0.5 km qualitative survey in the lower reach. After completing the second 0.5 km survey, there was not enough time left in the day to sample a third, and the crew travelled from Bullpen to a camping area in preparation for surveying the following day. Due to rain, sampling the following day and the rest of the week was cancelled. Further coordination with the Regional Fisheries Program to complete the sampling identified a conflict in sampling efforts. The Regional Fisheries Program planned to do a canyon hike-through the following year (2014) and sample the entire stream. It was also pointed out that during the time of year we planned to reenter and sample West Clear Creek (November or December), chub activity would be very low and the validity of results would be questionable. Plans are currently underway to accompany Regional staff during their efforts and complete sampling according to protocol, or to make point access into the canyon at upper, middle and lower locations and complete sampling for the project during the 2014 season.

West Clear Creek - Reach 3 upper 08/20/2013

UTM 12S Lower: 0435771E, 3822166N Upper: 0436192E, 3822259N

This site (commonly known as Bull Pen; Fig. 7) is a heavily used recreation area. The stream is wide and up to 1m deep in most places with a slick, cobble streambed. Overhanging trees create a dense canopy through much of the reach and downed limbs create complex snag habitats. Additionally, the steep canyon wall on the south side provides reaches of deep bedrock pool and occasional under-cut bank habitat. A qualitative 0.5 km site was surveyed using a BPES beginning at the recreation area parking lot. The focal species was not detected, so a second reach was established, detailed in "West Clear Creek Reach 3 lower".

A total of 65 fish were captured in the first 0.5 km site. Desert sucker was the only native species captured, and comprised 29% of the total catch (Table 10). Four nonnative species were also collected including green sunfish, smallmouth bass (*Micropterus dolomieu*), yellow bullhead (*Ameiurus natalis*), and rainbow trout (*Oncorynchus mykiss*). Smallmouth bass was the most abundant species, with 39 captured comprising 60% of the total catch. Nonnative species comprised 71% of species assemblage.

Roundtail chub were not found at this site, for unknown reasons. There are however an abundance of nonnative, piscivorous species, that may preclude roundtail chub. The pressure of recreational use probably makes the removal of nonnative species an unlikely management option at this location, however the possibility should be explored.

West Clear Creek - Reach 3 lower 08/20/2013

UTM 12S Lower: 0435375E, 3822171N Upper: 0435771E, 3822166N

A second 0.5 km qualitative survey site was established, beginning over 500 m below the initial site and ending slightly downstream from the start of the initial site (Fig. 7). A BPES was used to sample this second site. Habitat in the lower survey reach was different to the initial reach, with deeper edges, more complex bank-habitat composed of downed or submerged branches and root masses, with a stream bed composed primarily of silt and silt covered cobbles.

No native species were captured in this lower reach. Green sunfish, yellow bullhead and smallmouth bass were the only species captured (Table 11), totaling 64 individuals. Of the total number of fish sampled, 76% were smallmouth bass.

Roundtail chub were not found in this second 0.5-km survey reach of stream. Assessment of threats and management recommendations are the same as those for the "Reach 3 upper" section of West Clear Creek (previous section).

Webber Creek 8/21/2013

UTM 12S Lower: 0469159E, 3797746N Upper: 0469122E, 3798113N

Webber Creek is located on the Tonto National Forest, and flows intermittently to its confluence with the East Verde River approximately 9 miles south of its headwaters (Fig. 8). The focal species at this site was headwater chub which was not detected. The stream was accessed via a dry tributary off of FR 1171. Surface water was present and flowing where the dry tributary joined Webber, but a very short distance above the tributary water was only in disjunct shallow surface pools and further upstream was dry streambed. The stream was shallow (typically up to 0.5m deep), with varying width throughout the 500m survey site. Primary substrate in the reach was cobble, secondary was bedrock followed by sand and gravel; all substrates were covered in

silt. Under-cut bank and root-mass habitat was available throughout the stream. Two deep slot pools were found below the start of the reach (below the downstream boundary), but no fish were observed in either pool.

Webber Creek was sampled using the BPES. A total of 423 individuals were captured, 79% of which were speckled dace and 21% desert sucker (Table 12). Crayfish were abundant throughout the reach.

The stream reach was too short to establish a second or third 0.5-km qualitative site. Private property was downstream and believed to be in close proximity to the lower boundary of the initial 0.5-km site surveyed, so a second 0.5 km survey was not conducted downstream of the first. There was no surface water upstream of the surveyed 0.5 km site, so a second site could not be established upstream.

Headwater chub were not captured or observed at this site. Available habitat throughout much of the survey reach that was sampled may be too shallow. The two large pools at the downstream end of the reach may provide suitable habitat for the re-introduction of headwater chub. If future surveys fail to detect chub in Webber Creek, it should be evaluated for future reintroduction of headwater chub.

Tonto Creek

Tributary to the Salt River, Tonto Creek is located on the Tonto National Forest, beginning at the base of the Mogollon Rim, and when flowing throughout its entire length, flows south for approximately 50 miles to Roosevelt Lake. Surface flow of Tonto Creek is seasonally intermittent below Gun Creek, where it enters a broad alluvial basin. The focal species for Tonto Creek was headwater chub.

Tonto Creek - Reach 1 (Hellsgate) 9/17-18/2013

UTM 12S Lower: 0491125E, 3786051N Upper: 0491184E, 3786191N

This site is located in the Hellsgate Wilderness Area, approximately 16 miles east of Payson, AZ. Packhorses were used to pack equipment into the site. Access was by Hellsgate Trail from the western side of the drainage, with sampling beginning above the trail crossing to ~170m downstream (Fig. 9). High flows, high turbidity and steep canyon walls prevented access up- and downstream of this reach during the sampling period and as a result, the reach sampled was only approximately 160m long. The uppermost pool in the survey reach was large and deep, but quickly became narrow and canyon bound immediately above the upper boundary of the survey reach. The remainder of the reach downstream consisted primarily of boulder-strewn run and riffle habitat flowing into another long pool with heavily vegetated boulder-strewn banks and steep canyon walls. Flows appeared higher than normal and water throughout the reach was extremely turbid, eliminating any opportunity for visual identification of fish and making wading particularly hazardous. The lowermost habitat sampled was a large pool, only accessible at the

upstream end. Appropriate habitat for chub was most abundant in the upper and lower pools, but under the conditions at the time, the majority of the habitat could not be sampled. Fifteen collapsible hoop nets were used to sample the entire reach and were fished overnight.

Four different species were captured within this 0.5 km site (Table 13), two native (headwater chub and desert sucker) and two nonnative (yellow bullhead and green sunfish). All 14 chub captured were Age-1+ and comprised over 16% of the total catch. Nonnative species comprised 82% of total catch, with green sunfish being particularly abundant. All chub were captured in the upper- and lowermost pools of the reach. Although only 14 chub were captured at this site, an additional 0.5 km qualitative reach was not established because the stream immediately upstream and downstream was largely inaccessible, one of the crew members was injured, one of the horses fell and nearly drowned in a pool, and there was then insufficient time left in the day to establish another site. The sampled site was treated as a 100m sample site, but unfortunately the next morning when work was being completed, habitats were inadvertently not mapped. Time scheduled to be spent angling the day prior was lost because of problems with the pack horses and injury to one of the sampling crew.

Headwater chub persist at this 0.5 km site, however their population may be limited by the abundance of nonnative species. Tonto Creek should be evaluated for the installation of a barrier, the removal of nonnative fishes and the reestablishment of headwater chub, as well as other suitable species of native fishes. Additional sampling in the upper drainage should be conducted to determine the upper and lower extent of the distribution of chub in Tonto Creek. Removal of nonnative species would reduce competition and predation.

Tonto Creek - Reach 2 (Gisela) 9/19/2013

UTM 12S Lower: 0473672E, 3771405N Upper: 0473749E, 3771868N

This site is located south of Gisela, AZ, at the first road crossing (Fig. 10). The focal species for this site was the headwater chub. The 0.5 km qualitative survey reach was established below the road crossing on the north side of a large pool where the main channel entered the pool. The reach extended upstream over the road crossing though a narrowed, heavily vegetated run, before opening up to another large pool, which was dammed at the lower end by beavers. Water was turbid throughout the survey reach creating poor visibility, and in the reach between the two large pools, water flowed through multiple channels. Cobbles and silt comprised the majority of substrates in the flowing portion of the stream. Sampling was carried out primarily with the BPES, however hoop nets were also deployed in the lowermost large pool and in a section of stream immediately above it.

Only one native species, the Sonora sucker (*Catostomus insignis*) was captured in this sample reach comprising 4.6% of the total catch (Table 14). Nonnative species captured at this site include yellow bullhead, green sunfish, Western mosquitofish, smallmouth bass, largemouth bass and fathead minnow (*Pimephales promelas*). Nonnative species comprised 9% of the total BPES catch. Fathead minnow was the most abundant nonnative, and comprised 53% of total catch (Table 14).

Deviations from the sampling protocol include not completing a second or third 0.5 km

qualitative survey. The stream above the sample site flowed against the west bank and based on maps, appeared to flow through private property. Downstream of the initial 0.5 km site, the stream entered a heavily overgrown, relatively narrow channel with high volume and velocity, and with poor visibility due to high turbidity. The area downstream of the 0.5 km site was therefore deemed unsuitable for sampling with the BPES or other methods at that time. Plans were to revisit the downstream area later in the field season, but the site was not revisited because other scheduled sampling took priority.

It is unclear if headwater chub persist in this reach of Tonto Creek. Additional sampling in the reach should be conducted when flows are lower and water visibility greater. Tonto Creek should be evaluated for the installation of a barrier, the removal of nonnative fishes and the reestablishment of headwater chub, as well as other suitable native fishes. Several canyon bound reaches occur downstream of this site that may prove suitable for the installation of a barrier.

Tonto Creek - Reach 3 (Gauging Station) 9/20/2013

UTM 12S Lower: 0471806E, 3759896N Upper: 0472108E, 3760221N

This site is located at the USGS Gaging Station (09499000) above the confluence with Gun Creek, approximately 2.5 miles southeast of Jakes Corner, AZ (Fig. 11). A 0.5-km qualitative reach covered shallow riffle, deep (up to 1.5m) backwater pools with boulders, and a long pool, ~2m deep, edged with cattail (*Typha* sp.). Throughout the reach, the BPES was the primary means of sampling, with hoop nets set in deep pools against steep bedrock walls, which were otherwise not accessible. Water levels appeared high but receding and turbidity was high throughout the survey reach, limiting visibility in all but the shallowest of riffles.

A total of 11 species of fishes were captured from this reach on Tonto Creek (tables 15-16). In hoop nets, only yellow bullhead and green sunfish were captured, each comprising 50% of the total catch (Table 15). With the BPES, two native species were captured, the longfin dace and Sonora sucker, which comprised just over 6% of the total catch (Table 16). All of the nonnative species captured at the other two 0.5 km-reaches, were also captured at this third 0.5-km site. In addition, four nonnatives, the common carp (*Cyprinus carpio*), red shiner (*Cyprinella lutrensis*), channel catfish (*Ictalurus punctatus*) and bluegill (*Lepomis macrochirus*) were also captured. The most abundant nonnative species captured was fathead minnow, comprising 45% of the total catch, followed by red shiner at 29%. Headwater chub were not found at this 0.5-km site.

The stream above and below the surveyed 0.5-km reach was assessed for the establishment of a second or third 0.5-km qualitative reach. Throughout the upper extent of the 500m survey reach, the channel became increasingly canyon bound with a concomitant increase in underwater boulders and sudden channel drop-offs. These factors in combination with high turbidity resulted in increasingly treacherous conditions, so an additional upstream reach was not sampled. Downstream of the 0.5-km surveyed site, flow was ephemeral, but due to recent runoff, the channel was broad and shallow with sand and silt, large cobble and small boulders. The downstream habitat did not appear suitable for chub. Therefore an additional 0.5 km site was not established downstream. Plans were to revisit the site later in the field season, when conditions might be more optimal for sampling. However, other scheduled sampling was a higher priority so this reach of Tonto Creek was not revisited.

Headwater chub do not appear to persist at this site. The site is dominated by nonnative species and has minimal suitable habitat for headwater chub. Upstream portions of Tonto Creek should be evaluated for the installation of a barrier, the removal of nonnative fishes and the reestablishment of headwater chub, as well as other suitable native fishes.

Sonoita Creek 10/01/2013

UTM 12R Lower: 0521053E, 3487838N Upper: 0521423E, 3487967N

Sonoita Creek is an intermittent tributary stream of the Santa Cruz River, draining in a generally southwesterly direction from west of Sonoita, AZ to its confluence with the Santa Cruz River just south of Rio Rico. Upper reaches of the stream have intermittent surface flows and during periods of high runoff, flow into Patagonia Lake southwest of the town of Patagonia.

The focal species for the survey on Sonoita Creek was Gila topminnow. The survey was conducted on the TNC Patagonia Sonoita Creek Preserve in Patagonia, AZ (Fig. 12). A 0.5-km qualitative reach was established, beginning at the lower boundary of the TNC property and continuing upstream. The primary method of sampling was the BPES, however minnow traps were set in one small pool at the uppermost end of the 500 m survey reach. The last 60 m of reach was too shallow to effectively sample with the BPES, so sampling was completed with 19 dip net sweeps of 1m each (Table 17). Gila topminnow was not detected within the 0.5-km qualitative reach. Sampling effort was extended ~20m above the upper boundary of the 500m reach in habitat that looked suitable for topminnow, but none were captured. Dip net sweeps outside of the 500 m reach were not enumerated. The stream was narrow and shallow and the margins heavily vegetated. Substrate consisted primarily of sand with organic debris.
Sampling using the BPES resulted in the capture of longfin dace (60.6%), speckled dace (26.7%) and desert sucker (12.6%;Table 18). The only nonnative detected was a single fathead minnow captured in a minnow trap set in a small pool at the upper end of the 0.5-km sample reach (Table 19). Although 99.8% of the fishes captured were native species, no Gila topminnow were detected.

Deviations from the sampling protocol include not completing a second or third 0.5-km qualitative survey. The stream flows through private property upstream of the sampled 0.5-km site, and coordination attempts with the landowner were not successful. Coordination with landowners downstream of Patagonia Lake was not initiated, so a 0.5 km sites was not established there. Coordination with landowners downstream of Patagonia Lake should be done next field season.

Although documented in the past, Gila topminnow were not captured in the sampled 0.5-km reach of Sonoita Creek. Habitat throughout this section of stream appears suitable for topminnow, and threats from nonnative species appear minimal, so the reason for their absence is unclear. Additional surveys should be completed in the upper and lower drainage.

Gun Creek

Gun Creek is an intermittent stream tributary to Tonto Creek on the Tonto National Forest, that drains in a northerly then southwesterly direction off of the western slopes of the Sierra Ancha Mountains. The focal species for the sampling of Gun Creek was the headwater chub. The SOW called for three sites to be sampled along Gun Creek, but based on appearances and photographic evidence, it appears a majority of the drainage is dry. After accessing the upper drainage and finding no suitable habitat, it was decided to move on to other potential sites lower in the drainage. Subsequent examination of satellite photographs indicated most of the upper drainage had little or no permanent surface flow within a number of miles of the access point. For this reason elimination of the sample site in the upper part of the drainage is recommended.

Deviation from the monitoring protocol included not completing another survey site in the mid-drainage. A second potential monitoring point appears to exist in the middle portion of the stream, between the upper and lower sites (at 12S 478503E 3767739N). Forest Service maps show access to a 4-wheel drive road crossing Tonto Creek through private property being the direct point of access. An attempt was made to take this route to middle Gun Creek, but it was found that a gate on the road was locked (believed to be the boundary of private property), preventing access. After searching for an alternative route to cross Tonto Cr. and access the road on Forest Service lands, none was found and the search was ended due to the late hour. An additional attempt should be made to access this site during 2014, perhaps from the eastern side.

Gun Creek - Reach 1 (Upper reach) 10/02/2013

UTM 12S Upper: 0484230E, 3759769N Lower: 0484046E, 3759514N

Gun Creek Reach 1 is in the headwaters of Gun Creek in the Sierra Ancha Mountains (Fig. 13). This site was identified as the only accessible site in the upper drainage; it was accessed via FR 416B. A visual survey of ~400m of stream bed was conducted to determine the presence of permanent surface water and suitable chub habitat within this reach. Twelve small surface pools were present at the upper site, adjacent to and downstream of a small spring seep. All were less than 0.3m deep and appeared ephemeral; they were devoid of any vegetation, had minimal algal growth, very few aquatic insects and no fish. Visual examination of the streambed downstream found no additional surface water. Examination of satellite photographs indicate that the streambed is dry for miles below the 400 m surveyed. No further sampling was attempted in the upper reach. Due to lack of suitable habitat, it is suggested this site be removed as a permanent monitoring site, and the number of permanent monitoring sites on Gun Creek be reduced to two.

Gun Creek - Reach 2 (Lower reach) 10/03/2013

UTM 12S Lower: 0472868E, 3759666N Upper: 0473193E, 3759890N

This site is slightly over 1 mile upstream from the confluence of Gun Creek and Tonto Creek (Fig. 14). About the first 3/4 mile of streambed upstream of the confluence was dry. The reach of stream surveyed was canyon bound and the walls steep throughout, with small to large pools

separated by short reaches of dry streambed. Access was gained by hiking the stream margin and climbing along the canyon walls when the stream bottom was too choked with vegetation to allow passage.

Bedrock pool comprised the majority of habitat within the 500m qualitative survey reach, which was bounded at the upstream end by a large house-sized boulder, effectively creating an upstream barrier and likely preventing any upstream passage of fishes. This barrier also prevented any further up-canyon access. Minnow traps and hoop nets were used to sample the lower 400m and collapsible hoop nets and angling used to sample the upper 100m of the 0.5 km qualitative survey reach.

Chub were first captured in the upper 100m, so a 100m quantitative site was started there. Habitat data was collected and a map drawn, however only six chub were captured, so the site was not considered as a completed 100m quantitative site. Data sheets were transcribed at the office into the 0.5-km format to make the data more interpretable, supplemented by field notes of the downstream sets, effort and resulting catch. There was insufficient perennial water downstream of the 0.5 km sampled site, and no access to the stream above the 0.5 km sampled site, so no additional qualitative sites could be established.

Headwater chub and green sunfish were the only species captured in the 0.5-km qualitative reach. Hoop nets set in the uppermost pool of the upper 100m caught 18 green sunfish (Table 20), while angling resulted in the capture of five Age-1+ chub (Table 21). Minnow traps set in the lower 400m yielded an additional 30 green sunfish (Table 22), while hoop nets produced an additional 56 green sunfish and one headwater chub (Table 23).

Headwater chub persist in the lower reach of Gun Creek, however numbers are low and no juvenile recruitment was indicated by sampling or observation. Predation and competition with nonnative species may be limiting the population below the waterfall. Additional sampling should be conducted upstream of the waterfall if access can be found.

Dix Creek

Dix Creek is a small, north-flowing tributary stream of the San Francisco River (Fig. 15) approximately 50 miles northeast of Safford, AZ. The stream is formed by the Right Prong Dix Creek and the Left Prong Dix Creek, both located on the Apache Sitgreaves National Forest. The focal species in Dix Creek was Gila chub. An initial effort in August had to be cancelled due to heavy rains in the area and the associated danger of flash floods resulting from the narrow topography of the canyon. Dix Creek was revisited in October and the sampling completed.

Dix Creek - Reach 1 (Left Prong) 10/08/2013

UTM 12S Lower: 0672508E, 3672755N Upper: 0672559E, 3672726N

Left Prong Dix Creek is the eastern-most drainage of Dix Creek. The 0.5-km site was accessed by hiking upstream from the FR 215 road crossing. Chub were observed during the hike, so a

100m quantitative survey reach was established, incorporating a 5m waterfall. Available habitat consisted of a large pool beneath the waterfall, a series of smaller pools and runs immediately above the falls, and a bedrock pool at the top of the 100m reach. The most suitable habitat for Gila chub was found in the two larger pools. Collapsible minnow and hoop traps were used to sample this reach. Access to the upper portion of the sampling site in the Left Prong is attained by scaling and climbing along the northern canyon wall.

Two native species (Gila chub and speckled dace) were captured in the Left Prong Dix Creek, totaling 34 individuals. Of the fish captured, 33 were chub and one was a speckled dace. Sampling with collapsible hoop nets produced a total of 28 chub (Table 24) of which 29% were Age-0 and 71% were Age-1+. Minnow traps caught an additional five Age-1+ chub (Table 25) and one speckled dace. Between the two methods, chub comprised 97% of the total fish sampled. No nonnative species were captured in this reach.

The Gila chub population in the Left Prong Dix Creek appears to be doing well at this time. Densities appeared lower than expected based on the amount of suitable habitat found throughout the reach; however some pools are moderately or very shallow and may be ephemeral. Although canyon-bound, stream margins and in-channel structure likely provide refuge during high flow events, with several of the largest pools undoubtedly providing suitable habitat to sustain individuals during dry periods. This population should continue to be regularly monitored.

Dix Creek - Reach 2 (Right Prong) 10/09/2013

UTM 12S Lower: 0671528E, 3673234N Upper: 0671537E, 3673164N

Right Prong Dix Creek is the western-most drainage of Dix Creek. The site was accessed by hiking downstream from the FR 215 crossing to the confluence with Left Prong Dix Creek and then hiking up the Right Prong Dix until chub and suitable habitat were observed. A 100m quantitative survey reach was established at the upper end of the drainage below the spring. Habitat throughout the 100m reach consisted of mostly large pools with cover in the form of bedrock, boulders, under-cut banks and roots. Collapsible hoop traps were used to survey the 100m reach.

Gila chub, Sonora sucker and desert sucker were captured in the 100m reach, totaling 41 individuals (Table 26). Gila chub comprised 93% of total catch, with 87% of the total chub caught classified as Age-1+. No nonnative fish species were detected.

Gila chub are present and appear to be doing well in Right Prong Dix Creek. Suitable habitat is distributed throughout the reach and several large pools likely provide suitable habitat during the driest periods of the year. Nonnative species do not currently pose a threat in this reach. This population should be regularly monitored.

Oak Creek

Oak Creek is one of several larger Verde River tributaries, flowing for over 50 stream miles from its headwaters at Sterling Springs to its confluence with the Verde River, roughly 20 miles to the southwest. Located in Coconino and Yavapai counties, Oak Creek flows in a southerly direction to the vicinity of Sedona, from where it flows in a generally southwestern direction. The focal species in Oak Creek is roundtail chub. The SOW specified three sample sites be established in Oak Creek. Unknown to us until the day we began sampling, 1398 chub had been stocked in the upper reach of Oak Creek, and 169 stocked in the middle reach during December of 2012. With dispersal and a lack of instream barriers to movement, the chub sampled during our efforts at Oak Creek could be survivors of these stockings, confounding the results and intent of this project. It is recommended that Oak Creek be removed from the current list of streams to be monitored by this project until at least 5 years after the last stocking of chub into the system takes place.

Oak Creek - Reach 1 (Grasshopper Point) 10/16/2013

UTM 12S Lower: 0433190E, 3860694N Upper: 0433223E, 3860769N

The upper sampling reach of Oak Creek is located at the Grasshopper Picnic Area, north of Sedona, AZ (Fig. 16). A 0.5-km qualitative survey reach was established from just above the large pool at the trail access point downstream (to 12S 432808E 3860585N). Most sampling was conducted through fast flowing run and riffle, around complex habitats of boulders and bedrock, as well as overhanging vegetation. Flow at the time of the survey was ~32 cfs and footing was precarious throughout the sample reach. The BPES was used to sample, but capture efficiency was likely low in some habitats, particularly the deeper, more turbulent portions of the stream. Chub were not detected until near the very end of the 500m qualitative survey, in riffle habitat 61m from the top of the reach. A 100m quantitative sample reach was established, and the BPES was used as the primary means of sampling. The seconds shocked in the lower 440m of stream sampled was not recorded because the BPES time counter was inadvertently zeroed before the data could be recorded. Therefore, catch-per-unit-effort could not be calculated for the first 440m of stream sampled, however the relative abundance of the fish captured is provided in Table 29.

Roundtail chub, Sonora sucker and speckled dace were the only native species collected within the 100m sample reach, along with two nonnative species, the rainbow trout and brown trout (*Salmo trutta*). A total of 44 fish were caught in the 100m sample reach 89% of which were native species. Three Age-1+ roundtail chub comprised 7% of the total catch (Table 27). Speckled dace was the most abundant species captured in the sample reach, comprising 73% of the catch, whereas , rainbow trout was the most abundant nonnative species captured, accounting for 7% of the total catch. The effort used to calculate the CPUE in Table 27 is described as approximately 724 seconds because the seconds of effort were inadvertently not recorded for the first habitat sampled before the counter was zeroed; effort for the first habitat sampled was estimated at approximately 200 seconds. Four hoop nets set overnight in a large pool at the upper extent of the 100m quantitative sample reach resulted in the capture of one rainbow trout (Table 28), and two additional hoop nets set above the end of the 100m reach in what appeared to be suitable pool habitat for chub caught nothing in overnight sets. Although roundtail chub were found, very few individuals were captured, despite suitable habitat and a stocking of chub near this location in December of 2012. On the morning of sampling, it was found out that the Department had previously stocked 1,398 2-6 inch roundtail from their Bubbling Ponds Hatchery

into Oak Creek near the upper boundary of the 0.5 km qualitative survey reach (Frank Agyagos, AGFD, pers. comm.). There appeared to be no shortage of suitable habitat within the 0.5 km site, but few chub were detected. Besides the likely impacts of nonnative fish on the native species, Bubbling Ponds Fish Hatchery personnel suggest that predation by river otters are likely playing a significant role in suppressing fish numbers in the stream.

Stocking of the target species prior to sampling had occurred at least in the upper and middle reaches of the stream, confounding the results of our sampling efforts. Whether the chub we had captured were stocked fish, or individuals from a remnant population could not be determined. Deviation from sampling protocol included sampling a stream in which the target species had been stocked within the previous 5 years, as well as not completing an additional second or third 0.5-km qualitative survey in the upper drainage. During the sampling effort, focus and a sense of priority were mistakenly directed to moving on to the next of the three portions of the stream (upper, middle and lower) and adhering to the predetermined schedule rather than adhering to the sampling protocol and conducting triplicate samples.

Oak Creek - Reach 2 (Crescent Moon Ranch) 10/17/2013

UTM 12S Lower: 426006E, 3853965N Upper: 426244E, 3854009N

The middle sampling reach on Oak Creek is located at Crescent Moon Ranch, south of Sedona, AZ (Fig. 17). A 100m quantitative sampling reach was established at the lower trail crossing, where roundtail chub was first captured, and extended upstream though a short riffle and a large pool (~70m long). Suitable habitat was marginal for chub, consisting primarily of slightly under-cut banks and overhanging and submerged vegetation along the stream margin. Throughout the 100m survey reach only 1 chub was captured. Therefore, it was decided to extend the qualitative effort through an extended reach (~108m) of boulder-strewn stream above the 100m sample reach. Suitable habitat within the extended area consisted of a few scattered, moderately-sized boulders, and only one additional chub was caught.

A total of 30 fish were captured in the100m sample reach (Table 30), including four native species (roundtail chub, Sonora sucker, desert sucker and speckled dace) and three nonnative species [(yellow bullhead, green sunfish and rock bass (*Ambloplites rupestris*)]. Nonnatives comprised 57% of the catch, with Rock bass accounting for 33% of the catch. Only a single Age-1+ roundtail was captured within the sample reach, however an additional Age-0 chub was collected within the 180m that was sampled upstream of the 100m quantitative reach.

Roundtail chub appear to persist in very low numbers at this site. In December 2012, 169 6-12 inch chub were stocked at this site. A second stocking occurred after the survey, in November 2013, when 6,114 2-4 inch individuals were released. Chub captured here during our efforts could very well be from stocking that occurred the previous winter. As stated in the previous section, besides the likely impacts of nonnative fish on the native fishes, predation by river otters likely plays a role in suppressing fish numbers. Deviations from the sampling protocol are the same as those of Reach 1.

Oak Creek - Reach 3 (Bubbling Ponds Fish Hatchery) 10/18/2013

UTM 12S Lower: 0418389E, 3846822N Upper: 0418473E, 3847373N

The lower sampling reach on Oak Creek is located adjacent to Bubbling Ponds Native Fish Conservation Facility, in Cottonwood AZ (Fig. 18). A 0.5 km qualitative survey reach was delineated on the west bank of the stream below the Page Springs Road bridge and downstream, following the western bank of the stream. The majority of the eastern bank was too deep to sample effectively with the BPES, however hoop nets were set and fished overnight in appropriate habitats. Portions of the east bank had under-cut banks and root masses, which looked like good habitat for roundtail, however none were captured or seen. Approximately 200m from the downstream boundary of the 500m survey reach was a fast-flowing, shallow riffle habitat (up to 0.5m deep) in which most of the fish were captured. Hoop nets and minnow traps were set along the margin of the deeper, pooled portions of the stream and the BPES was employed to sample the shallower habitats. In the future, the pooled upper 300m of the reach would be more effectively sampled using an electroshocking canoe or boat.

Seven species of fishes were captured within this survey reach, including two native species and five nonnatives; roundtail chub were not detected. Native fishes captured included desert and Sonora suckers, whereas nonnative fishes included yellow bullhead, rock bass, green sunfish, smallmouth bass, and rainbow trout. Five overnight hoop net sets caught two nonnative species for a total of 11 fishes, 91% of which were rock bass and 9% yellow bullhead (Table 31). For BPES (Table 32), nonnative smallmouth bass was the most abundant species, comprising 35% of the total sampled, followed closely by the native desert sucker which accounted for 33%.

No roundtail chub were detected at this site, and no stocking activities have occurred here in recent times. Habitat available throughout much of the 500m qualitative reach consisted of deeper water with undefined bottom features, and undercut banks and root masses along the eastern bank of the stream. Similar to the other two sampled sections of Oak Creek, nonnative piscivorous fishes and river otter likely play a role in limiting native fish numbers. Deviations from the sampling protocol are the same as those for Reach 1.

Redrock Canyon (Cott Tank Drainage) 10/29/2013

UTM 12R Lower: 0536198E, 3486705N Upper: 0536279E, 3486244N

Redrock Canyon is located in the Patagonia Mountains northwest of the San Rafael Valley. The survey site was chosen at Cott Tank drainage (a tributary of Redrock Canyon) due to ease of access, permanence of habitat, and continuity with previous sampling (Fig. 19). Vegetation along the drainage consists primarily of Oak trees (*Quercus* sp.) and deer grass. A 500m qualitative reach was established beginning at the first permanent water accessed from the trail and continued downstream. Although it was beyond the established 500m reach, a downstream pool, which appeared to be the last of the wetted section, was included in the survey. The entire reach consisted of a series of 7-8 disconnected pools of varying dimensions, most of which were largely unshaded and full of algae. Pools most suitable for topminnow may be those in the middle and upper section of the reach, however, since no fish were detected in them, they may not be permanent.

Hoop nets, minnow traps and dip net sweeps were employed to sample available habitats in the 500m qualitative reach. The only fish species captured were mosquitofish, with a total of 197 individuals collected from three separate pools in the lower portion of the reach. Most mosquitofish were captured using dip nets (119 – 1m sweeps; Table 33), with roughly 1/3 as many caught in 24 minnow trap sets (Table 34).

There was no observable surface water between 100-200m downstream of the 0.5 km surveyed reach, so no additional 0.5-km qualitative survey sites could be established in the immediate vicinity. There may have been other potential sites further down in the drainage, but they were not visited in the next few days because attention and effort were mistakenly focused on adhering to a previously established sampling schedule of other sites that were already coordinated for.

Gila topminnow were not present in the Cott Tank drainage. Mosquitofish appear to be restricted to the lowermost three pools in the survey reach. A minor increase in flows in the streambed could allow mosquitofish to move into the unoccupied upstream pools. Management recommendations for the site include removal of all mosquitofish by whatever means available and acceptable, and reintroduction of Gila topminnow (Redrock lineage) into the available habitat.

O'Donnell Canyon 10/30-31/2013

UTM 12R Lower: 544947E, 3492362N Upper: 0544792E, 3492136N

O'Donnell Canyon is located on The Nature Conservancy's Canelo Hills Cienega Reserve, southeast of Sonoita, AZ (Fig. 20). Tributary to the Babocomari River, it drains northern portions of the Canelo Hills, draining in a northeasterly direction to its confluence with the Babocomari River. Its perennial waters are limited to the middle reaches of the drainage, largely to the TNC property. Tributary drainages of O'Donnell Canyon include Post Canyon and Turkey Creek. The target species for O'Donnell Creek was Gila chub.

Sampling was initiated downstream at the TNC property boundary using the BPES. The effort was unsuccessful because the dense vegetation precluded the ability to move along the stream channel, so this method was abandoned as ineffective. Chub were observed upstream in a pool immediately below the erosion control dam, so a 100m sample reach was established from the lower end of the pool upstream, encompassing a series of runs and riffles and another large pool. Much of the stream habitat was 0.5-1m deep. Except for the lower- and uppermost pools, vegetation was dense throughout the reach, forming a thick canopy of interwoven branches that shaded the stream and deposited a complete cover of leaves over most of the water surface. Minnow traps and hoop nets, which were set overnight, were used to survey the 100m reach. An attempt was made to electrofish other portions upsteam of the 100m quantitative reach, however again, the vegetation was too dense to effectively sample using the BPES. Much of the habitat within the 100m quantitative reach appeared marginal for chub. Therefore minnow traps and hoop nets were also set in one pool upstream and one pool downstream of the 100m reach that appeared to have more suitable chub habitat.

Three species were captured in the sampled reach (Tables 35-36), including Gila chub, Sonora

sucker, and the nonnative mosquitofish, for a total of 34 fish caught. Nineteen Gila chub were captured in the sample reach, comprising 56% of the catch. An additional 18 chub were caught in up- and downstream opportunistic sets in pool habitats (Tables 37-38) outside of the 100m sample reach. Overall, native species made up 79% of the total catch, with Gila chub comprising 56% and mosquitofish 21% of the total catch.

Gila chub are still present in O'Donnell Creek and the population appears to be doing well, even in the presence of mosquitofish. Efforts to remove mosquitofish and replace them with Gila topminnow should be evaluated and implemented if deemed achievable. Invasion by nonnative species has been limited and suitable habitat for topminnow appears to exist throughout the reach. Due to extremely high density of streamside vegetation, consideration should be given to removing some of it to decrease cover and increase sun exposure; this might increase productivity in the stream and perhaps result in an overall increase in chub population.

T4 Spring 10/30-31/2013

UTM 12R Lower: 0549732E, 3500045N Upper: 0549756E, 3500146N

Tributary to the Babocomari River, T4 Spring is located north of the river channel on the Babocomari Ranch, north of Canelo Hills (Fig. 21). It consists primarily of a large modified pool/cattle tank (10x10 m) with a series of several small, unconnected pools upstream. Where surface flows were present in the past, during the survey there was only dry channel and disconnected small pools. The sampling crew hiked 400m up the channel from the cattle tank and found three or four small pools, short extents of wet, exposed mud, and dry stream channel. Downstream of the cattle tank, surface water was present across the road, and a short distance below it. There was not sufficient habitat to complete an entire 0.5-km qualitative survey. However, the available habitat was sampled. An approximately 120m reach was established that included the cattle tank and the several small pools upstream. The cattle tank was ~50% covered with cattail growth and most of the bank and shallow margin showed signs of heavy cattle use. The focal species at this location was Gila chub. Minnow traps and hoop nets were used to sample the reach.

Mosquitofish were the only species of fish detected at this location, with a total of 295 fish caught in a roughly 23 ½ hour minnow trap set (Table 39). Bullfrogs (juvenile and adult) and Sonoran mud turtle (*Kinosternon sonoriense*; n=7) were also captured. Crayfish were abundant with over 276 caught in hoop and minnow trap sets. The focal species was not captured, however, all of the available habitat within the drainage was surveyed. Therefore, an additional 0.5-km qualitative site could not be established.

Gila chub are no longer present at this site. Serious effort should be expended to explore the possibility of obtaining a conservation easement from the landowners to allow proper management of this site for native aquatic species. Habitat should be temporarily modified to concentrate aquatic species, the native turtles should be salvaged and the nonnative aquatic species eradicated. Following their successful removal, the pool should be deepened, the channel up to the springhead reformed and ½ of pond and the entire spring channel fenced to control cattle access, or a drinker to serve the cattle should be built away from the channel. Gila chub, Gila topminnow and longfin dace should be reintroduced.

Babocomari River 10/31 – 11/01/2013

UTM 12R Lower: 0554029E, 3500251N Upper: 0553652E, 3500373N

Tributary to the San Pedro River, the upper drainage of the Babocomari River drains portions of the Mustang Mountains and Canelo Hills watersheds. The river channel passes southeast through Elgin and the Babocomari Ranch headquarters, and eventually joins the San Pedro River roughly 18 miles downstream. Important tributaries to the Babocomari River include O'Donnell Creek and Lyle Canyon. The river comes to the surface roughly 1.4 miles east of the Ranch headquarters where the channel crosses the elevated bedrock sills of the adjacent hills, and forms a slow moving stream with a variety of habitats from very short, shallow, sandy riffles, to long, shallow runs, as well as long pools in excess of 2m depth. Except for the presence of piscivorous nonnative fishes, the river appears to haves excellent habitat for Gila chub, longfin dace, Gila topminnow and Sonora sucker. Gila chub was the target species for the Babocomari River monitoring effort. The SOW specified two 0.5 km sites to be sampled in the Babocomari River.

Roughly 1.4 miles east of the Ranch headquarters, a 0.5-km qualitative reach was established and minnow traps and hoop nets were used to sample throughout (Fig. 22). Three nonnative fish species were captured, but no native species were captured or observed. Collapsible hoop nets were set throughout the reach, and the results are presented in Table 40. Largemouth bass (most of them 1 pound or larger) comprised 82% of the fish captured by hoop net, with bluegill being the only other identifiable species captured. Minnow trap sets throughout the reach caught only mosquitofish (Table 41). Sonoran mud turtles were also common throughout the reach.

After sampling the first 0.5-km qualitative site and not catching the focal species, the survey team travelled down the railroad bed road looking for access to suitable habitat at a downstream site on the Babocomari Ranch. The entire length of the road was fenced, but access was found at a location where additional surface water occurred. However, the area was posted, citing no admittance due to ongoing studies. Therefore the area was not entered to conduct an additional 0.5-km qualitative survey.

Despite what appears to be an abundance of suitable habitat, Gila chub were not captured at the one site sampled, most likely due to the prevalence of largemouth bass in the system. Conversations with the landowners and other local interested parties should be undertaken to explore the possibility for the removal of nonnative species from the system, and the reestablishment of Gila chub and other native fishes. An effort should be undertaken to explore the potential for obtaining a conservation easement from the landowners to allow for the management of native aquatic species, or the development of an HCP for the ranch.

Buzzard Roost Creek 11/07/2013

UTM 12S Lower: 0492809E, 3763861N Upper: 0492825E, 3763800N

Buzzard Roost Creek is a major tributary to Rock Creek, located in the Tonto National Forest Pleasant Valley Ranger District. It is a deep and often narrow canyon with many large pools

throughout. The deepest pool sampled was ~3 m deep. The focal species for this stream was headwater chub. Chub were visually observed in a large, canyon-bound pool and a 100 m survey reach was established upstream to incorporate a series of runs, riffles and smaller pools (Fig. 23). Minnow traps, hoop nets and angling were used to survey this site.

Headwater chub was the only species detected at this site, with a total of 189 individuals caught. Minnow traps resulted in the capture of 54 chub (Table 42), while collapsible hoop nets captured 135 chub (Table 43). Seventy-four percent of the chub caught here were Age-1+. No nonnative species were captured or observed in the system. While hiking up the stream channel, one dead desert sucker was seen lying on submerged aquatic vegetation in roughly 0.5 m of water, with only minor signs of decomposition. While no suckers were captured or observed anywhere else in this stream, the species very likely inhabits the stream at least periodically.

Headwater chub appear to be doing well at this location. Suitable habitat is available for a short distance above the sample site and presumably below, and the population appears free from any immediate threat from nonnative species (including crayfish) at this time.

Cherry Spring Canyon 11/12/2013

UTM 12S Lower: 0565426E, 3586939N Upper: 0566003E, 3587091N

Cherry Spring Canyon is located on the western slopes of the Galiuro Mountains, in the Muleshoe Ranch Cooperative Management Area, approximately 30 miles north of Benson, AZ (Fig. 24). Typical vegetation in the drainage includes Arizona black walnut, Arizona ash and sycamore. The focal species for this site was Gila topminnow. A 0.5-km reach was established containing all of the perennial water, but about 60% of the reach was dry. The uppermost 40m of the 0.5-km qualitative survey reach contained two large and one small pool, all heavily shaded and covered with leaves. The only other surface water was a 20m long tinaja at the lower end of the 0.5-km survey reach.

Minnow traps were used to sample the three pools at the upper end of the reach. Only one fish, a juvenile Gila topminnow (<10mm), was captured in the minnow traps (Table 44). No other fish were observed, potentially because there was a dense cover of floating leaves on the first three pools. The lower tinaja was clear and unshaded and was visually observed for 15-20 minutes, but no fish were detected. There was no other perennial water in the system, so additional 0.5-km qualitative reaches were not established.

Despite stockings that took place in 2007 and 2008, it appears that Gila topminnow at Cherry Spring may not persist into the near future. The pools that topminnow were stocked in is heavily shaded throughout much of the year, with low productivity and high input of coarse organic debris. Selective removal of vegetation to allow the pools direct exposure to sunlight during summer and winter may help improve conditions for Gila topminnow.

Swamp Springs Canyon 11/12/2013

UTM 12S Lower: 0566506E, 3589044N Upper: 0566587E, 3589081N

Swamp Springs Canyon is located on the western slopes of the Galiuro Mountains in the Muleshoe Ranch Cooperative Management Area, roughly 30 miles north of Benson, AZ (Fig. 25). The focal species for Swamp Spring Canyon is Gila topminnow. The sampling crew hiked from the crossing of the Pride Ranch Road down the dry streambed to the section with perennial water. Topminnow were found near the upper end of the perennial water. The majority of available habitat consisted of long pool habitats separated by small riffles or debris piles. Leaf litter covered ~40% of water surface area throughout the reach. A 100m quantitative survey reach was established beginning at the first large pool, where the species was previously stocked in 2007 and 2008, and extending downstream. Minnow traps were used to sample the 100m site.

Two native species were captured, totaling 1,749 individuals, with Gila topminnow comprising 79% of the catch, and longfin dace comprising 21% (Table 45). No nonnative fish species were detected.

Gila topminnow continue to do well in Swamp Spring Canyon after being stocked in 2007 and 2008. While high-flow events are evident in the canyon, there appears to be suitably complex habitat and cover to prevent total displacement of topminnow from the system during such events. If the stream is kept free of nonnative predators and competitors, Gila topminnow should continue to do well.

Lower Salt River

Salt River extends from the confluence of the White and Black rivers in east-central Arizona to its confluence with the Gila River at the northern end of the Sierra Estrella Mountains. The lower Salt River is delineated for the purposes of this report as the reach of river from Stewart Mountain Dam at its upper end to Granite Reef Dam at its lower. The length of the river between the two dams is roughly 13 miles. Skirting the margins of the Goldfield Mountains to the south, the river is bordered to the north by Stewart and Red mountains. Shortly upstream of Granite Reef Dam, the Salt and Verde rivers combine; on reaching the dam, the entire flow is diverted into two main canals, delivering water to downstream consumers in the Phoenix metropolitan area. Typical vegetation along the lower Salt River includes mesquite (*Prosopis velutina*), willow (*Salix* sp.), Fremont cottonwood (*Populus fremontii*), and cattail (*Typha* sp.). The Lower Salt River is located on Tonto National Forest in the Mesa Ranger District, and is a heavily used recreational area. Flow in the lower Salt River during the period of sampling was less than 9 cfs, creating large, isolated pools, separated by extremely shallow riffles. The SOW specified three sampling sites in the lower Salt River, and roundtail chub as the focal species.

Lower Salt River - Reach 1 12/10/2013

UTM 12S Lower: 449650E, 3712857N Upper: 450022E, 3713182N

The upper qualitative survey site on the lower Salt River was located roughly 1.5 km downstream from Stewart Mountain Dam, at Water Users Park (Fig. 26). A 500m reach was established to incorporate a large main channel pool and two small connected backwaters downstream. Trammel nets, large hoop nets and minnow traps were used to survey the reach.

Approximately 200 m of the downstream section of the reach consisted of very shallow riffle.

Efforts at this site produced two native species, the Sonora and desert suckers, and four nonnative species, the green sunfish, bluegill, largemouth bass and rainbow trout, for a total of 21 individuals captured (Tables 46-48). Native species comprised 54% of the total catch, with Sonora sucker being the most common; the most common nonnative species captured was bluegill, which accounted for 29% of the total caught.

Deviation from the project sampling protocol at this and the other Salt River sites consists of not sampling a second or third 0.5-km qualitative site when chub were not found. Focus of the sampling and subsequent efforts were mistakenly directed at moving on to the next scheduled site and adhering to a preset schedule rather than completing a second and third 0.5-km site in each of the reaches.

Although suitable habitat was available for roundtail chub through much of the reach, chub were not captured at this site. Future sampling here should include the use of a canoe electroshocking boat to increase the chance of detecting roundtail chub. Consideration should be given to the salvage of roundtail found in the canal system immediately below Granite Reef Dam during periodic monitoring efforts, and their translocation upstream into the river below Stewart Mountain Dam. Concerns about disease or nuisance species transfer from the canals to the lower Salt River should be evaluated to see if an acceptable prophylactic treatment or quarantine can be developed to prevent the transfer of unwanted organisms.

Lower Salt River - Reach 2 12/11/2013

UTM 12S Lower: 442940E, 3713480N Upper: 443429E, 3713527N

The middle 0.5-km survey site on the lower Salt River was accessed via the Goldfield Recreation Site, north of Bush Highway located near the Blue Point Rangers Station and accessed from North Usery Pass Road (Fig. 26). A 0.5-km reach was established which encompassed varying habitats, including deep pools immediately adjacent to a cliff face, shallow, connected backwater pools, and vegetated shallows, and riffles. As described for Reach 1, and for the same reasons, additional 0.5 km qualitative sites were not surveyed in Reach 2.

The canoe electrofisher (CAES) was used to sample the entire 0.5-km reach. Three native and six nonnative species were captured at this site, totaling 531 individuals. Native species accounted for 78% of the catch, with Sonora sucker and desert sucker each comprising 39% (Table 49). Largemouth bass was the most abundant nonnative and accounted for 16% of the catch (Table 49). Some of the Sonora suckers showed breeding tubercles, and some of the Sonora and desert suckers were infected with yellow grub (*Clinostomum* spp.) and Lernaea.

Suitable habitat for roundtail chub was available in much of the area sampled, but chub were not found in this survey reach. Total numbers of nonnatives occupying suitable habitat was high in much of the survey reach. Recommendations for management actions in this reach of the lower Salt River are the same as for Reach 1.

Lower Salt River - Reach 3 12/12/2013

UTM 12S Lower: 439599E, 3712260N Upper: 440085E, 3712218N

The lower sampling reach of the lower Salt River was located above the confluence with the Verde River (Fig. 26), and was accessed from Coon Bluff Campground. A 0.5-km qualitative sampling reach was established and sampled with the canoe electrofisher, BPES and trammel nets. Habitats sampled included deep pools adjacent to large boulder outcrops, steep cliffs and overhangs, deep connected backwaters and shallow riffles. As described for Reach 1, and for the same reasons, additional 0.5 km qualitative sites were not surveyed in Reach 3.

Three native species and seven nonnative species were captured in the 0.5-km site, totaling 1,497 individuals (Tables 50-52). The electrofishing canoe was used to sample the pools and runs that were considered the best chub habitat in the reach, capturing 530 fish total (Table 50). Only two native species (the Sonora and desert suckers) were collected with CAES, but they appeared to be the most abundant species in the reach. Sonora suckers comprised 54% of the total catch and desert suckers 31%. The most abundant nonnative was the largemouth bass, accounting for 9% of the CAES catch. Sampling of deeper areas with trammel nets proved much less effective (Table 51), resulting in less than 5% as many fish caught as with the CAES. The most effective sampling method in this reach from a perspective of total numbers caught was the BPES (Table 52). Total numbers captured were almost double that produced by the CAES, however the two methods differed greatly in which habitats they were effective in. A total of six species were collected with the BPES, three native (desert and Sonora suckers, and longfin dace), and three nonnative (yellow bullhead, mosquitofish and sailfin molly). Desert sucker comprised 90% of the total catch, Sonora sucker 9%, and longfin dace 0.2%. The most abundant nonnative collected with the BPES was mosquitofish, accounting for 0.3% of the total catch.

Although there appeared to be an abundance of suitable habitat in this survey reach, roundtail chub were not found. Suitable water and cover was available throughout the area sampled, but low flows, the presence of nonnative species and heavy recreational use may be factors in the apparent absence of chub. Predaceous nonnatives were often found in habitat and cover where expectations for the capture of roundtail chub were high. Recommendations for management actions in this reach of the lower Salt River are the same as for the previous two reaches.

Literature Cited

Clarkson, R.W., B.R. Kesner, and P.C. Marsh. 2011. Long-term monitoring plan for fish populations in selected waters of the Gila River Basin, Arizona; Revision No. 3. Bureau of Reclamation, Phoenix Area Office, Phoenix, AZ.

Appendix I

Tables

Common name	Scientific name	Species code
Longfin dace	*Agosia chrysogaster*	AGCH
Rock bass	*Ambloplites rupestris*	AMRU
Yellow bullhead	*Ameiurus natalis*	AMNA
Sonoran sucker	*Catostomus insignis*	CAIN
Red shiner	*Cyprinella lutrensis*	CYLU
Common carp	*Cyprinus carpio*	CYCA
Mosquito fish	*Gambusia affinis*	GAAF
Gila chub	*Gila intermedia*	GIIN
Headwater chub	*Gila nigra*	GINI
Roundtail chub	*Gila robusta*	GIRO
Channel catfish	*Ictalurus punctatus*	ICPU
Sonoran mud turtle	*Kinosternon sonoriense*	KISO
Green sunfish	*Lepomis cyanellus*	LECY
Bluegill	*Lepomis macrochirus*	LEMA
Smallmouth bass	*Micropterus dolmieui*	MIDO
Largemouth bass	*Micropterus salmoides*	MISA
Rainbow trout	*Oncorhynchus mykiss*	ONMY
Desert sucker	*Pantosteus clarki*	PACL
Fathead minnow	*Pimephales promelas*	PIPR
Sailfin molly	*Poecilia latipinna*	POLA
American bullfrog	*Rana catesbeiana*	RACA
Speckled dace	*Rhinicthys osculus*	RHOS
Brown trout	*Salmo trutta*	SATR

Table 1. List of species, their scientific names and 4-letter codes, surveyed in the Gila River Basin streams monitored in 2013.

Site/Species	AGCH	CAIN	GIIN	GINI	GIRO	PACL	POOC	RHOS	AMNA	AMRU	CYCA	CYLU	GAAF	ICPU	LECY	LEMA	MIDO	MISA	ONMY	PIPR	POLA	SATR
Sharp Spring	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Santa Cruz River	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	+	-	-	-	-
Gordon Creek Reach 1 Upper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gordon Creek Reach 1 Lower	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marsh Creek	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Rock Creek	-	-	-	+	-	+	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-
West Clear Creek Reach 3 Upper	-	-	-	-	-	+	-	-	+	-	-	-	-	-	+	-	-	+	+	-	-	-
West Clear Creek Reach 3 Lower	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	+	-	-	-	-	-
Webber Creek	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tonto Creek Reach 1	-	-	-	+	-	+	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-
Tonto Creek Reach 2	-	+	-	-	-	-	-	-	+	-	-	-	+	-	+	-	+	+	-	+	-	-
Tonto Creek Reach 3	+	+	-	-	-	-	-	-	+	-	+	+	-	+	+	+	+	+	-	+	-	-
Sonoita Creek	+	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Gun Creek Reach 1 (Dry)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gun Creek Reach 2	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Dix Creek Left Prong	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dix Creek Right Prong	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oak Creek Reach 1	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	+
Oak Creek Reach 2	-	+	-	-	+	+	-	+	+	+	-	-	-	-	+	-	-	-	-	-	-	-
Oak Creek Reach 3	-	+	-	-	-	+	-	-	+	+	-	-	-	-	+	-	+	-	+	-	-	-
Redrock Canyon		-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
O'Donnell Canyon	-	+	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
T4 Spring	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Babocomari River	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	-	-	-	-
Buzzard Roost Creek	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cherry Spring Canyon	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Swamp Springs Canyon	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salt River Reach 1	-	+	-	-	-	+	-	-	-	-	-	-	-	-	+	+	-	+	+	-	-	-
Salt River Reach 2	+	+	-	-	-	+	-	-	+	-	+	-	+	-	-	+	-	+	-	-	+	-
Salt River Reach 3	+	+	-	-	-	+	-	-	+	-	+	-	+	-	+	+	-	+	-	-	+	-

Table 2. Summary of fish species detected by stream (highlights indicate the target species for a specific stream).

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GAAF	N/A	143	0.994	100

Table 3. Summary of fish captured in eleven minnow traps in a 500m qualitative sample of Sharp Spring.

Species	Age class	Fish captured	CPUE (fish/m^2)	% of total catch
GAAF	N/A	9	4.500	100

Table 4. Summary of fish captured in two dip-net sweeps in a 500m qualitative sample of Sharp Spring.

Species	Age class	Fish captured	CPUE (fish/m^2)	% of total catch
GAAF	N/A	83	16.600	86.46
LECY	1+	8	1.600	8.33
MISA	1+	5	1.000	5.21
TOTAL		**96**	**19.200**	**100**

Table 5. Summary of fish captured in five hauls of a straight seine in a 500m qualitative sample of the Santa Cruz River.

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
AGCH	N/A	188	0.122	100

Table 6. Summary of fish captured in 1,543 seconds of backpack electrofishing in a 500m qualitative sample of Gordon Creek - Reach 1-lower.

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
GINI	0	8	0.008	21.05
GINI	1+	8	0.008	21.05
LECY	0	7	0.007	18.42
LECY	1+	15	0.014	39.47
TOTAL		**38**	**0.036**	**100**

Table 7. Summary of fish captured in 1,063 seconds of backpack electrofishing in a 100m quantitative sample of Marsh Creek.

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
GINI	0	73	0.044	21.86
GINI	1+	146	0.089	43.71
PACL	0	1	0.001	0.30
PACL	1+	67	0.041	20.06
RHOS	N/A	12	0.007	3.59
LECY	0	11	0.007	3.29
LECY	1+	24	0.015	7.19
TOTAL		**334**	**0.204**	**100**

Table 8. Summary of fish captured in 1,641 seconds of backpack electrofishing in a 100m quantitative sample of Rock Creek.

Species	Age class	Fish captured	CPUE (fish/min)	% of total catch
GINI	1+	20	0.444	86.96
LECY	1+	3	0.067	13.04
TOTAL		**23**	**0.511**	**100**

Table 9. Summary of fish captured in 45 minutes of angling in an additional qualitative sample of Rock Creek.

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
PACL	1+	19	0.008	29.23
AMNA	1+	3	0.001	4.62
LECY	1+	2	0.001	3.08
MIDO	0	21	0.009	32.31
MIDO	1+	18	0.008	27.69
ONMY	1+	2	0.001	3.08
TOTAL		**65**	**0.028**	**100**

Table 10. Summary of fish captured in 2,358 seconds of backpack electrofishing in a 500m qualitative sample of West Clear Creek - Reach 3 upper.

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
AMNA	0	1	0.001	1.56
AMNA	1+	11	0.008	17.19
LECY	1+	3	0.002	4.69
MIDO	0	32	0.022	50.00
MIDO	1+	17	0.012	26.56
TOTAL		**64**	**0.045**	**100**

Table 11. Summary of fish captured in 1,434 seconds of backpack electrofishing in a 500m qualitative sample of West Clear Creek - Reach 3 lower.

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
PACL	0	38	0.039	8.98
PACL	1+	49	0.050	11.58
RHOS	N/A	336	0.344	79.43
TOTAL		**423**	**0.433**	**100**

Table 12. Summary of fish captured in 978 seconds of backpack electrofishing in a 500m qualitative sample of Webber Creek.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GINI	1+	14	0.062	16.47
PACL	1+	1	0.004	1.18
AMNA	1+	24	0.107	28.24
LECY	0	12	0.053	14.12
LECY	1+	34	0.151	40.00
TOTAL		**85**	0.378	**100**

Table 13. Summary of fish captured in fifteen hoop nets in a 500m qualitative sample of Tonto Creek - Reach 1 (Hellsgate).

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
CAIN	1+	4	0.002	4.55
AMNA	1+	10	0.006	11.36
GAAF	N/A	1	0.001	1.14
LECY	0	3	0.002	3.41
LECY	1+	9	0.005	10.23
MIDO	0	12	0.007	13.64
MISA	0	1	0.001	1.14
MISA	1+	2	0.001	2.27
PIPR	N/A	46	0.026	52.27
TOTAL		**88**	**0.049**	**100**

Table 14. Summary of fish captured in 1,789 seconds of backpack electrofishing in a 500m qualitative sample of Tonto Creek - Reach 2 (Gisela).

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
AMNA	0	4	0.274	50.00
LECY	0	4	0.274	50.00
TOTAL		**8**	**0.549**	**100**

Table 15. Summary of fish captured in five hoop nets in a 500m qualitative sample of Tonto Creek - Reach 3 (Gauging Station).

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
AGCH	N/A	5	0.004	2.02
CAIN	0	11	0.009	4.44
AMNA	0	6	0.005	2.42
AMNA	1+	2	0.002	0.81
CYCA	0	15	0.013	6.05
CYLU	0	72	0.061	29.03
ICPU	0	4	0.003	1.61
LECY	0	16	0.014	6.45
LECY	1+	1	0.001	0.40
LEMA	0	1	0.001	0.40
MIDO	0	2	0.002	0.81
MISA	0	1	0.001	0.40
MISA	1+	1	0.001	0.40
PIPR	N/A	111	0.094	44.76
TOTAL		**248**	**0.209**	**100**

Table 16. Summary of fish captured in 1,184 seconds of backpack electrofishing in a 500m qualitative sample of Tonto Creek - Reach 3 (Gauging Station).

Species	Age class	Fish captured	CPUE (fish/m^2)	% of total catch
AGCH	N/A	16	0.842	84.21
RHOS	N/A	3	0.158	15.79
TOTAL		**19**	**1.000**	**100**

Table 17. Summary of fish captured in nineteen hauls of a dip-net in a 500m qualitative sample of Sonoita Creek.

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
AGCH	N/A	379	0.295	60.64
PACL	0	29	0.023	4.64
PACL	1+	50	0.039	8.00
RHOS	N/A	167	0.130	26.72
TOTAL		**625**	**0.487**	**100**

Table 18. Summary of fish captured in 1,284 seconds of backpack electrofishing in a 500m qualitative survey reach of Sonoita Creek.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
AGCH	N/A	13	3.25	68.42
RHOS	N/A	5	1.25	26.32
PIPR	N/A	1	0.25	5.26
TOTAL		**19**	**4.75**	**100**

Table 19. Summary of fish captured in one minnow trap set for 4.92 hours in a 500m qualitative sample of Sonoita Creek.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
LECY	0	5	1.132	27.78
LECY	1+	13	2.943	72.22
TOTAL		**18**	**4.075**	**100**

Table 20. Summary of fish captured in 2 hoop nets in a 100m quantitative sample of Gun Creek - Reach 2.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GINI	1+	5	0.048	100
TOTAL		**5**	**0.048**	**100**

Table 21. Summary of results for angling effort (105 minutes) in Gun Creek – Reach 2.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
LECY	0	30	1.88	100
TOTAL		**30**	**1.88**	**100**

Table 22. Summary of results for 2 minnow traps set in the 400m below the 100m sampling reach of Gun Cr. - Reach 2.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
LECY	0	34	1.85	59.65
LECY	1+	22	1.20	38.60
GINI	1+	1	0.05	1.75
TOTAL		**57**	**3.10**	**100**

Table 23. Summary of results for 5 hoop nets set in the 400m below the 100m sampling reach on Gun Cr. – Reach 2.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GIIN	0	8	0.395	28.57
GIIN	1+	20	0.987	71.43
TOTAL		**28**	**1.382**	**100**

Table 24. Summary of fish sampled in 3 hoop nets in Dix Creek -Reach 1 (Left Prong).

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GIIN	1+	5	0.247	83.33
RHOS	N/A	1	0.049	16.67
TOTAL		**6**	**0.296**	**100**

Table 25. Summary of fish caught in 1 minnow trap at Dix Creek - Reach 1 (Left Prong).

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GIIN	0	5	0.408	12.20
GIIN	1+	33	2.694	80.49
CAIN	0	1	0.082	2.44
CAIN	1+	1	0.082	2.44
PACL	1+	1	0.082	2.44
TOTAL		**41**	**3.347**	**100**

Table 26. Summary of fish caught in 3 hoop nets at Dix Creek - Reach 2 (Right Prong).

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
GIRO	1+	3	0.004	6.82
CAIN	0	4	0.006	9.09
ONMY	1+	3	0.004	6.82
RHOS	N/A	32	0.044	72.73
SATR	1+	2	0.003	4.55
TOTAL		**44**	**0.061**	**100**

Table 27. Summary of fish captured by BPES in Oak Creek - Reach 1 (Grasshopper Point) for ~ 720 seconds of effort.

Species	Age class	Fish captured	CPUE (Fish/net hour)	% of total catch
ONMY	1+	1	0.017	100

Table 28. Summary of fish sampled in four hoop nets at Oak Creek - Reach 1 (Grasshopper Point).

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
GIRO	1+	3		2.08
PACL	0	1	-----	0.69
PACL	1+	13	-----	9.03
CAIN	0	13	-----	9.03
CAIN	1+	1	-----	0.69
RHOS	N/A	100	-----	69.44
ONMY	1+	5	-----	3.47
SATR	1+	7	-----	4.86
MIDO	1+	1	------	0.69
TOTAL		**144**	**-----**	

Table 29. Relative abundance of fish captured in a 500m reach of Oak Creek – Reach 1(Grasshopper Point) using the BPES. The total seconds for the entire reach were not recorded, so CPUE could not be calculated.

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
GIRO	1+	1	0.002	3.33
CAIN	1+	4	0.008	13.33
PACL	1+	4	0.008	13.33
RHOS	N/A	4	0.008	13.33
AMNA	0	6	0.012	20.00
AMRU	0	10	0.020	33.33
LECY	0	1	0.002	3.33
TOTAL		**30**	**0.059**	**100**

Table 30. CPUE for 507 seconds of backpack electrofishing in a 100m quantitative sample of Oak Creek – Reach 2 (Crescent Moon Ranch).

Species	Age class	Fish captured	CPUE (Fish/net hour)	% of total catch
AMNA	0	1	0.056	9.09
AMRU	1+	10	0.561	90.91
TOTAL		**11**	**0.617**	**100**

Table 31. CPUE for five hoop nets in a 500m qualitative sample of Oak Creek - Reach 3 (Bubbling Ponds Fish Hatchery).

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
CAIN	1+	1	0.000	1.01
PACL	0	1	0.000	1.01
PACL	1+	32	0.012	32.32
AMRU	1+	2	0.001	2.02
LECY	0	8	0.003	8.08
LECY	1+	13	0.005	13.13
MIDO	0	3	0.001	3.03
MIDO	1+	32	0.012	32.32
ONMY	1+	7	0.003	7.07
TOTAL		**99**	**0.037**	**100**

Table 32. Summary of fish captured in 2,661 seconds of backpack electrofishing in a 500m qualitative sample of Oak Creek - Reach 3 (Bubbling Ponds Fish Hatchery).

Species	Age class	Fish captured	CPUE (fish/m^2)	% of total catch
GAAF	N/A	150	1.261	100

Table 33. Summary of fish captured by dip-net at Redrock Canyon (Cott Tank Drainage).

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GAAF	N/A	47	0.566	100

Table 34. Summary of fish captured in 24 minnow traps in a 500m qualitative sample of Redrock Canyon (Cott Tank Drainage).

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GIIN	0	3	0.041	15.79
GIIN	1+	8	0.111	42.11
CAIN	1+	8	0.111	42.11
TOTAL		**19**	**0.263**	**100**

Table 35. Summary of fish captured in six hoop nets in a 100m quantitative sample of O'Donnell Canyon.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GIIN	0	7	0.068	46.67
GIIN	1+	1	0.010	6.67
GAAF	N/A	7	0.068	46.67
TOTAL		**15**	**0.145**	**100**

Table 36. Summary of fish captured in six minnow traps in a 100m quantitative sample of O'Donnell Canyon.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GIIN	1+	7	0.052	58.33
CAIN	1+	5	0.037	41.67
TOTAL		**12**	**0.089**	**100**

Table 37. Summary of fish captured in six hoop nets during opportunistic sampling outside the 100m quantitative sample of O'Donnell Canyon.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GIIN	0	11	0.122	100

Table 38. Summary of fish captured in four minnow traps during opportunistic sampling outside the 100m quantitative sample of O'Donnell Canyon.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GAAF	N/A	295	0.965	100

Table 39. Summary of fish captured in fourteen minnow traps in a 500m qualitative sample of T4 Spring.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
LEMA	1+	1	0.004	9.09
Lepomis sp.	0	1	0.004	9.09
MISA	1+	9	0.032	81.82
TOTAL		**11**	**0.039**	**100**

Table 40. Summary of fish captured in sixteen hoop nets in a 500m qualitative sample of the Babocomari River.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GAAF	N/A	92	0.582	100

Table 41. Summary of fish captured in nine minnow traps in a 500m qualitative sample of the Babocomari River.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GINI	0	49	6.062	90.74
GINI	1+	5	0.619	9.26
TOTAL		**54**	**6.680**	**100**

Table 42. Summary of fish captured in four minnow traps in a 100m quantitative sample of Buzzard Roost Creek.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
GINI	1+	135	5.287	100

Table 43. Summary of fish captured in eleven hoop nets in a 100m quantitative sample of Buzzard Roost Creek.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
POOC	N/A	1	0.390	100

Table 44. CPUE for minnow trap in 500m survey reach of Cherry Spring Canyon; habitat was limited to two isolated pools.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
POOC	N/A	1384	44.573	79.13
AGCH	N/A	365	11.755	20.87
TOTAL		**1749**	**56.329**	**100**

Table 45. Summary of fish captured in fourteen minnow traps in a 100m quantitative sample of Swamp Springs Canyon.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
MISA	0	1	0.046	100

Table 46. Summary of fish captured in ten minnow traps in a 500m qualitative sample of the Lower Salt River - Reach 1.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
LECY	1+	1	0.054	14.29
LEMA	0	3	0.161	42.86
LEMA	1+	3	0.161	42.86
TOTAL		**7**	**0.376**	**100**

Table 47. Summary of fish captured in five hoop nets in a 500m qualitative sample of the Lower Salt River - Reach 1.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
CAIN	1+	7	0.444	53.85
PACL	1+	5	0.317	38.46
ONMY	1+	1	0.063	7.69
TOTAL		**13**	**0.825**	**100**

Table 48. Summary of fish captured in three trammel nets in a 500m qualitative sample of the Lower Salt River - Reach 1.

Species	Age class	Fish captured	Effort (sec)	CPUE (fish/sec)	% of total catch
AGCH	N/A	3	2251	0.001	0.56
CAIN	0	58	2251	0.026	10.92
CAIN	1+	148	2251	0.066	27.87
PACL	0	111	2251	0.049	20.90
PACL	1+	95	2251	0.042	17.89
AMNA	0	9	2251	0.004	1.69
AMNA	1+	3	2251	0.001	0.56
CYCA	1+	5	2251	0.002	0.94
GAAF	N/A	3	2251	0.001	0.56
LEMA	0	3	2251	0.001	0.56
LEMA	1+	6	2251	0.003	1.13
MISA	0	43	2251	0.019	8.10
MISA	1+	43	2251	0.019	8.10
POLA	N/A	1	2251	0.000	0.19
TOTAL		**531**	**2251**	**0.236**	**100**

Table 49. Summary of fish captured in 2251 seconds of canoe electrofishing in a 500m qualitative sample of the Lower Salt River - Reach 2.

Species	Age class	Fish captured	% of total catch
CAIN	0	52	9.81
CAIN	1+	236	44.53
PACL	0	62	11.70
PACL	1+	100	18.87
AMNA	0	1	0.19
AMNA	1+	20	3.77
CYCA	1+	2	0.38
GAAF	N/A	1	0.19
LECY	1+	1	0.19
LEMA	1+	6	1.13
MISA	0	34	6.42
MISA	1+	15	2.83
TOTAL		**530**	**100**

Table 50. Summary of fish captured by canoe electrofishing in a 500m qualitative sample of the Lower Salt River - Reach 3.

Species	Age class	Fish captured	CPUE (fish/net hour)	% of total catch
CAIN	1+	14	1.660	53.85
PACL	1+	9	1.067	34.62
LEMA	1+	2	0.237	7.69
MISA	1+	1	0.119	3.85
TOTAL		**26**	**3.083**	**100**

Table 51. Summary of fish captured in two trammel nets in a 500m qualitative sample of the Lower Salt River - Reach 3.

Species	Age class	Fish captured	CPUE (fish/sec)	% of total catch
AGCH	N/A	2	0.002	0.21
CAIN	0	68	0.060	7.23
CAIN	1+	15	0.013	1.59
PACL	0	773	0.682	82.15
PACL	1+	76	0.067	8.08
AMNA	0	2	0.002	0.21
GAAF	N/A	3	0.003	0.32
POLA	N/A	2	0.002	0.21
TOTAL		**941**	**0.830**	**100**

Table 52. Summary of fish captured in 1,134 seconds of backpack electrofishing in a 500m qualitative sample of the Lower Salt River - Reach 3.

Appendix II

Figures

Figures.

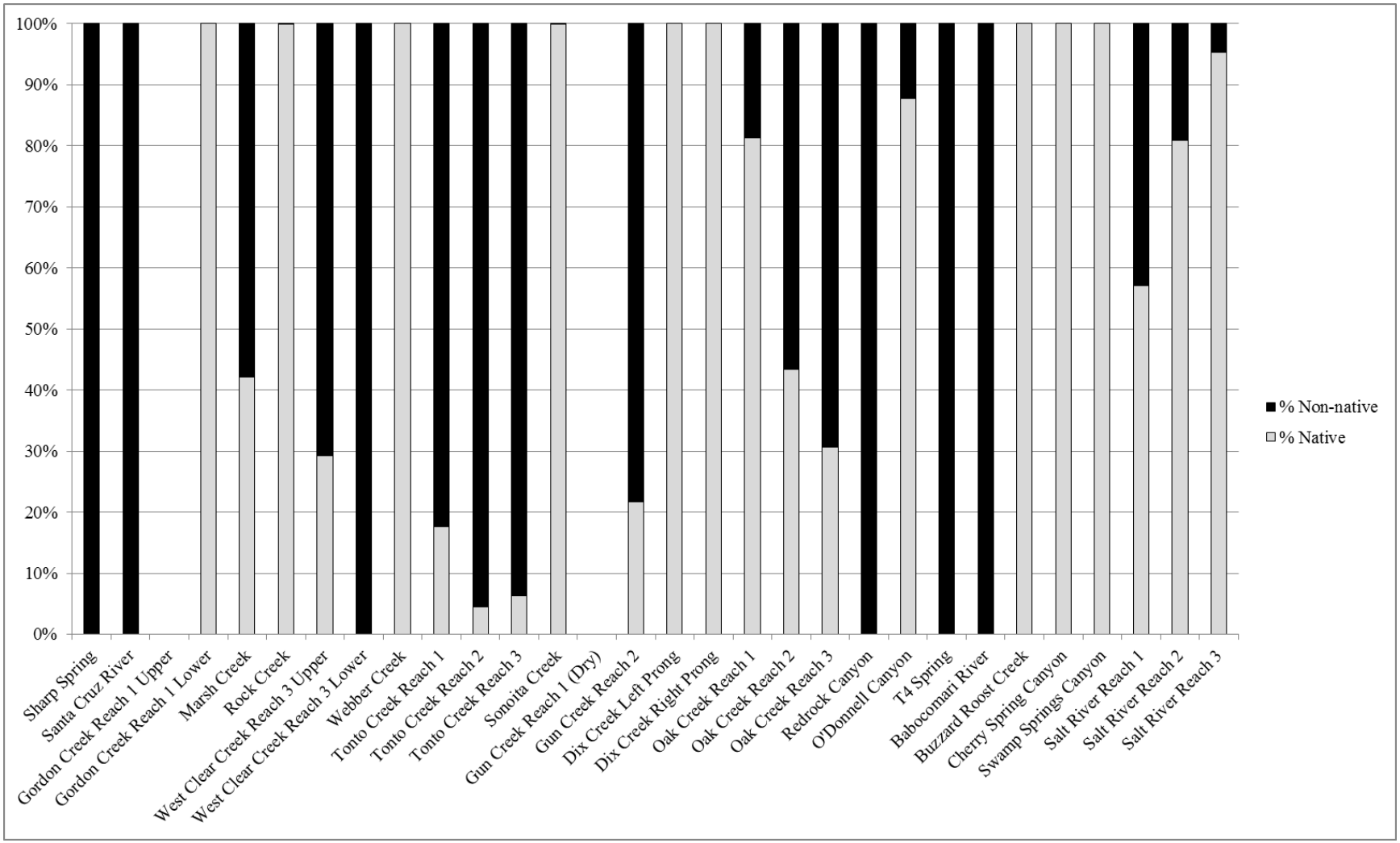


Figure 1. Relative abundance of native to nonnative species by stream reach.

Sharp Spring 06/04/2013

UTM 12R Lower: 0540102E, 3468712N Upper: 0540529E, 3468788N

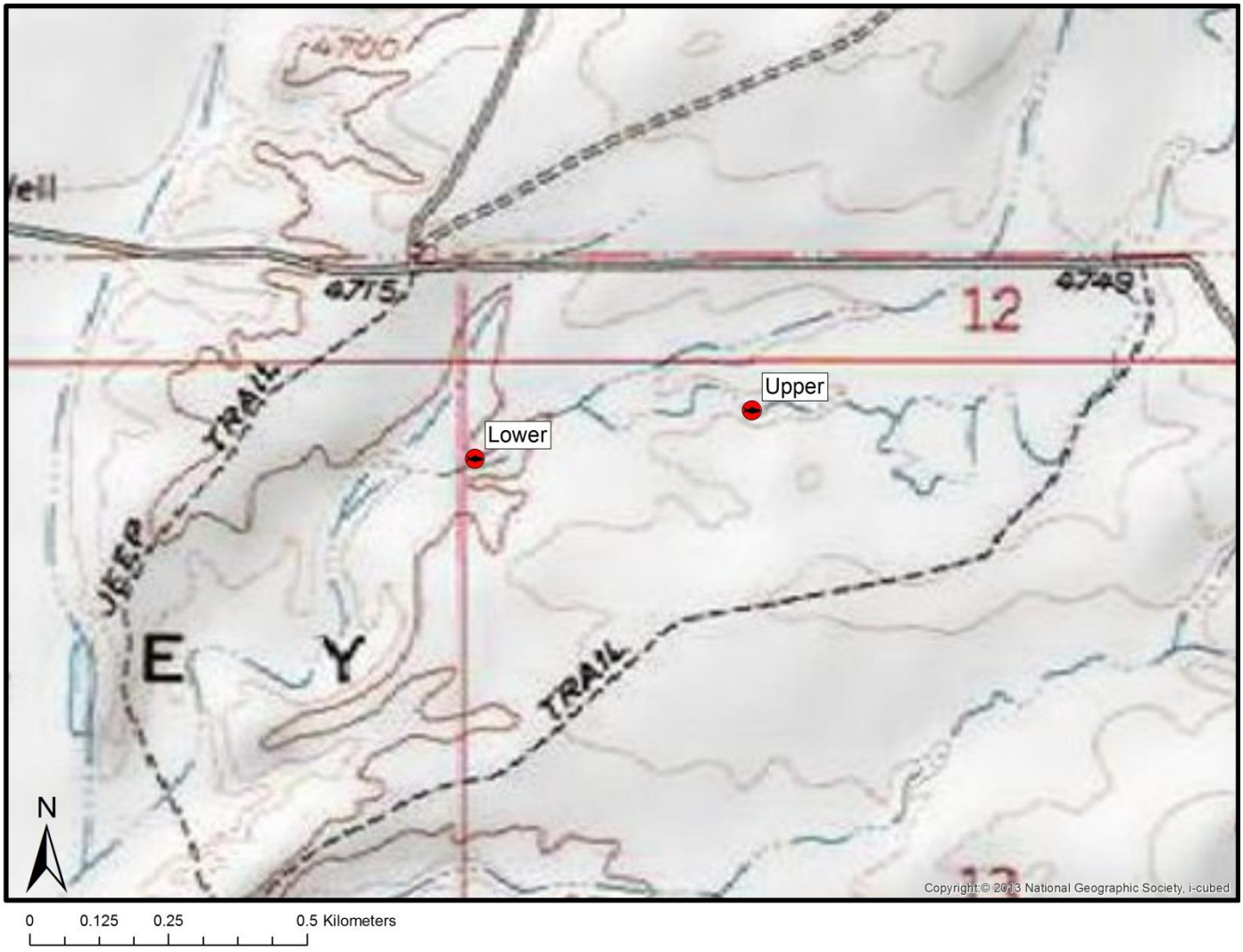


Figure 2. Survey site at Sharp Spring.

Santa Cruz River 06/05/2013

UTM 12R Lower: 0538271E, 3466579N Upper: 0538418E, 3466956N

Figure 3. Survey site on Santa Cruz River.

Gordon Creek - Reach 1 08/14/2013

Upper (above Ellinwood Ranch Rd crossing):
UTM 12S Lower: 0496684E, 3785315N Upper: 0496759E, 3785459N

Lower (below Ellinwood Ranch Rd crossing):
UTM 12S Lower: 0495854E, 3785122N Upper: 0496190E, 3785032N

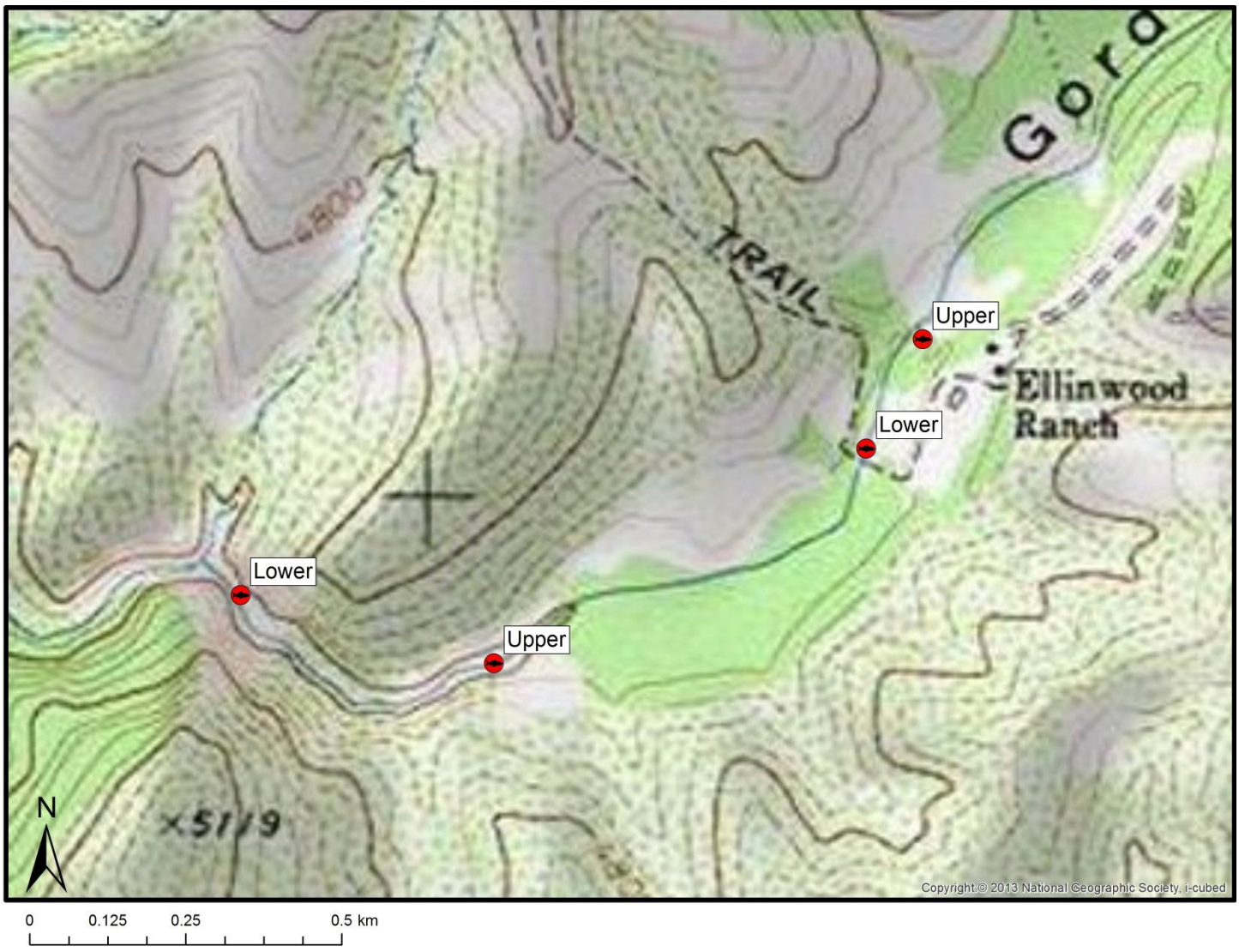


Figure 4. Survey sites on Gordon Creek Reach 1.

Marsh Creek 08/14/2013

UTM 12S Lower: 0497155E, 3780773N Upper: 0497253E, 3780739N

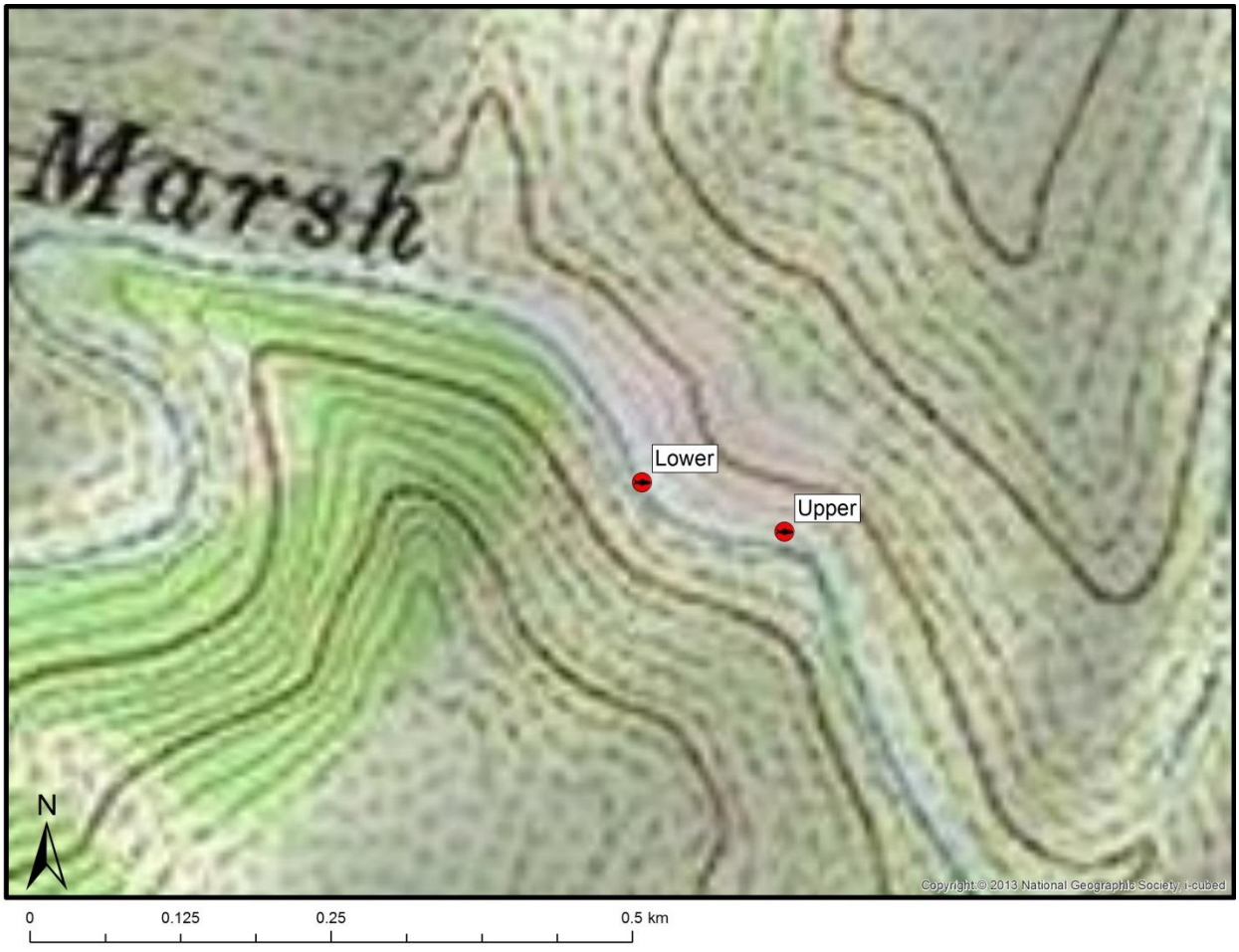


Figure5. Survey site on Marsh Creek.

Rock Creek 08/15/2013

UTM 12S Lower: 0493118E, 3766136N Upper: 0493142E, 3766028N

Figure 6. Survey site on Rock Creek.

West Clear Creek - Reach 3 08/13/2013

Upper: UTM 12S Lower: 0435771E, 3822166N Upper: 0436192E, 3822259N

Lower: UTM 12S Lower: 0435375E, 3822171N Upper: 0435771E, 3822259N

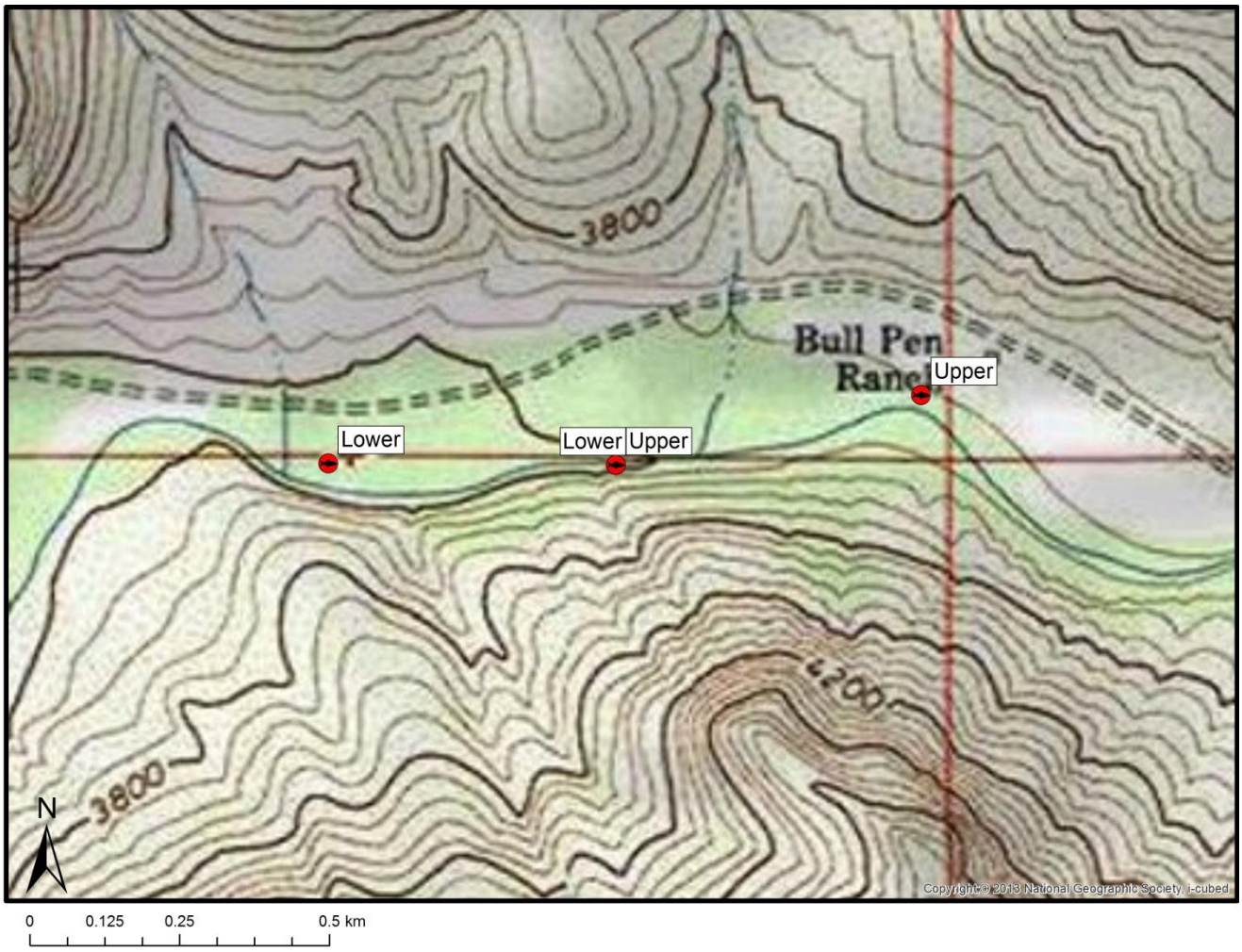


Figure 7. Survey sites on West Clear Creek - Reach 3.

Webber Creek 08/21/2013

UTM 12S Lower: 0469159E, 3797746N Upper: 0469122E, 3798113N

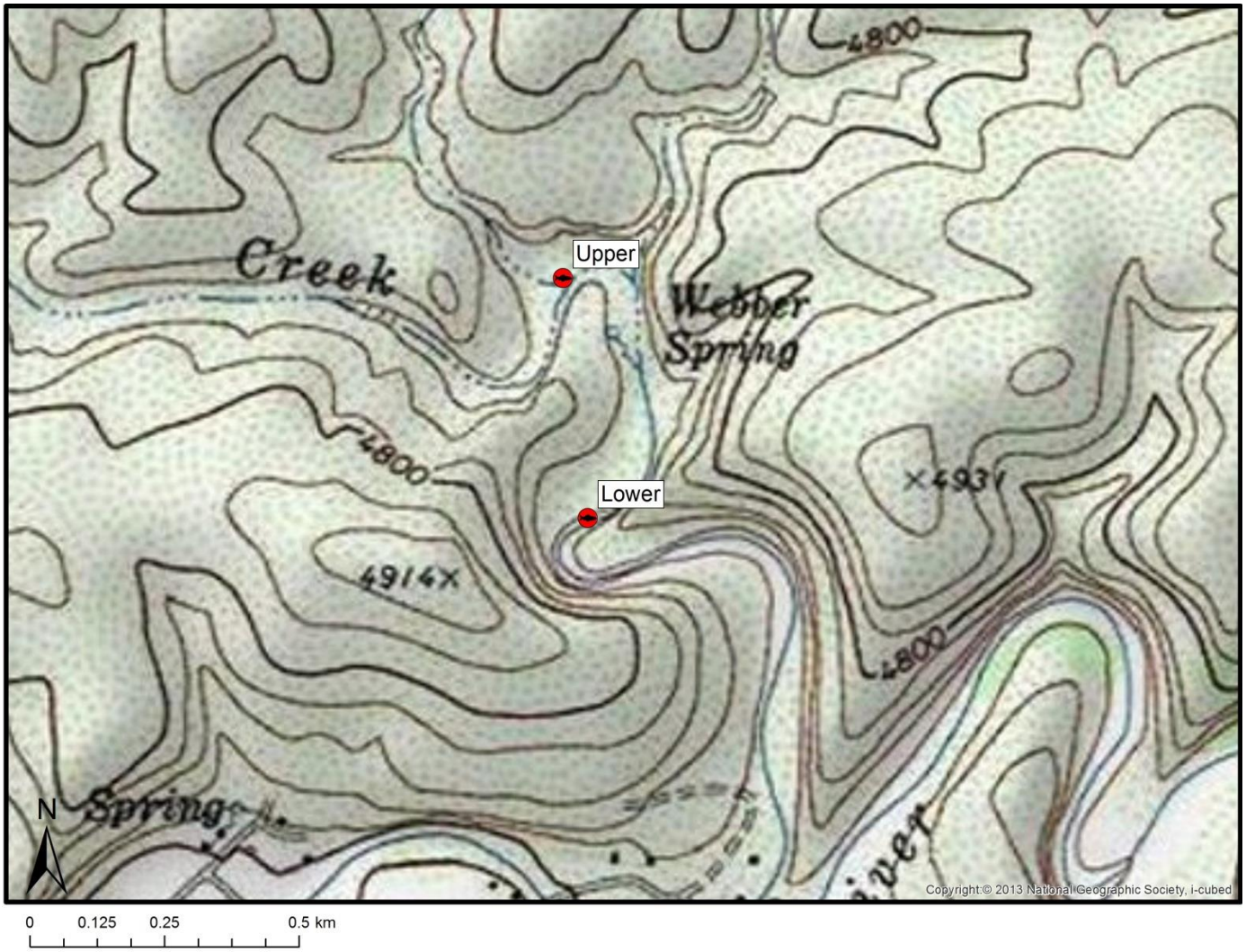


Figure 8. Survey site on Webber Creek.

Tonto Creek - Reach 1 (Hellsgate) 9/17-18/2013

UTM 12S Lower: 0491184E, 3786191N Upper: 0491170E, 3786168N

Figure 9. Survey site on Tonto Creek - Reach 1.

Tonto Creek - Reach 2 (Gisela) 9/19/2013

UTM 12S Lower: 0473672E, 3771405N Upper: 0473608E, 3771501N

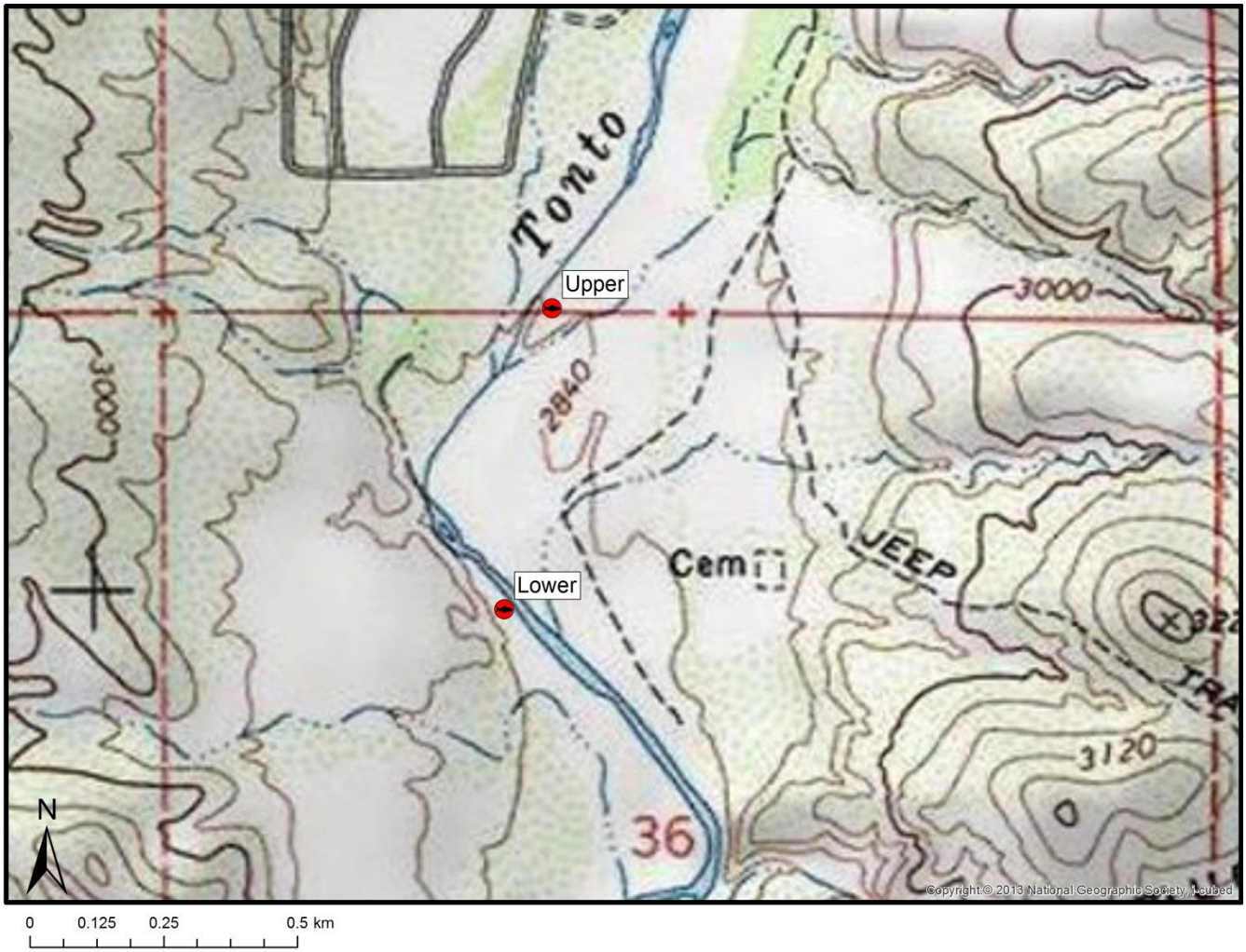


Figure 10. Survey site on Tonto Creek - Reach 2.

Tonto Creek - Reach 3 (Gauging Station) 9/20/2013

UTM 12S Lower: 0471806E, 3759896N Upper: 0472108E, 3760221N

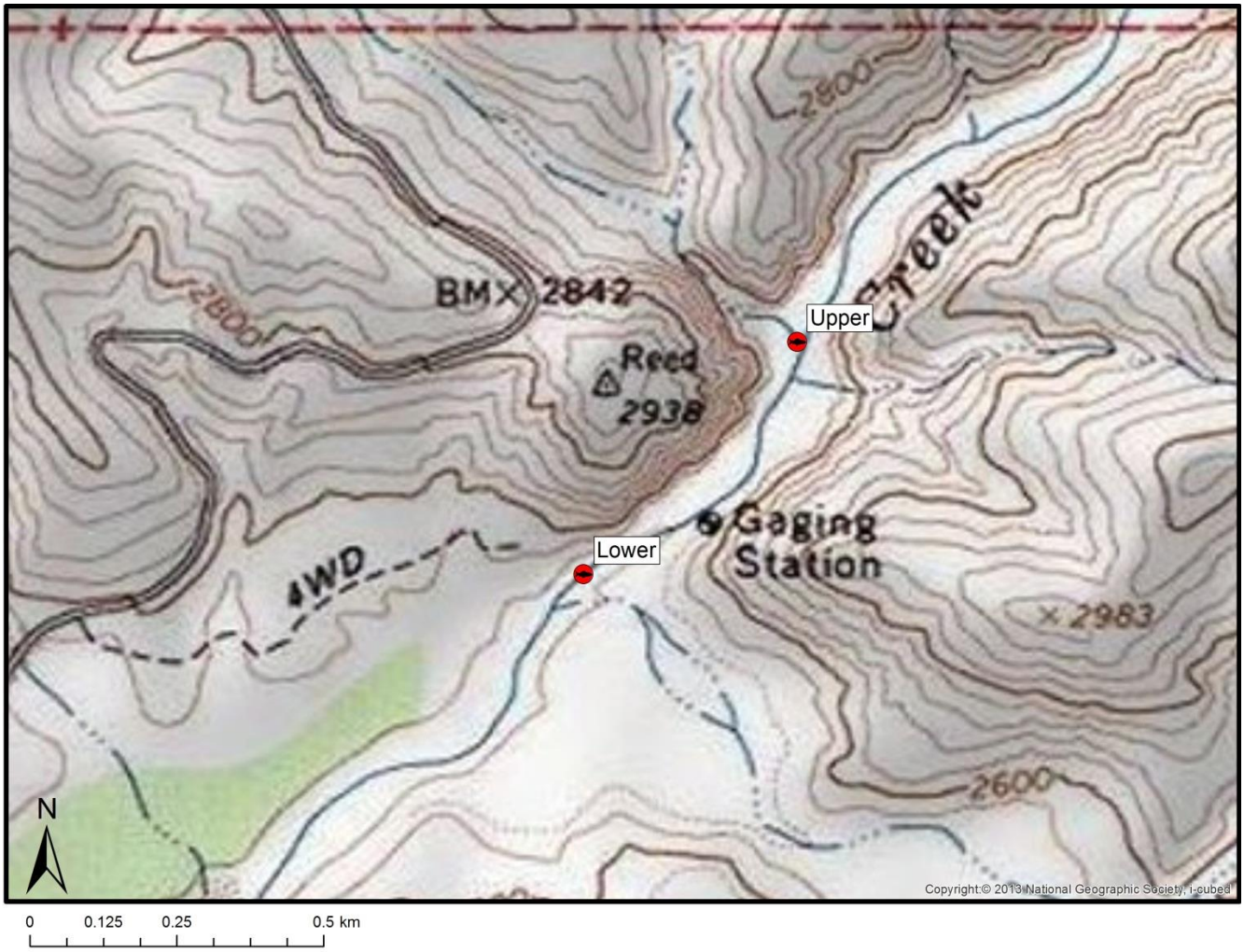


Figure 11. Survey site on Tonto Creek - Reach 3.

Sonoita Creek 10/01/2013

UTM 12R Lower: 0521053E, 3487838N Upper: 0521423E, 3487967N

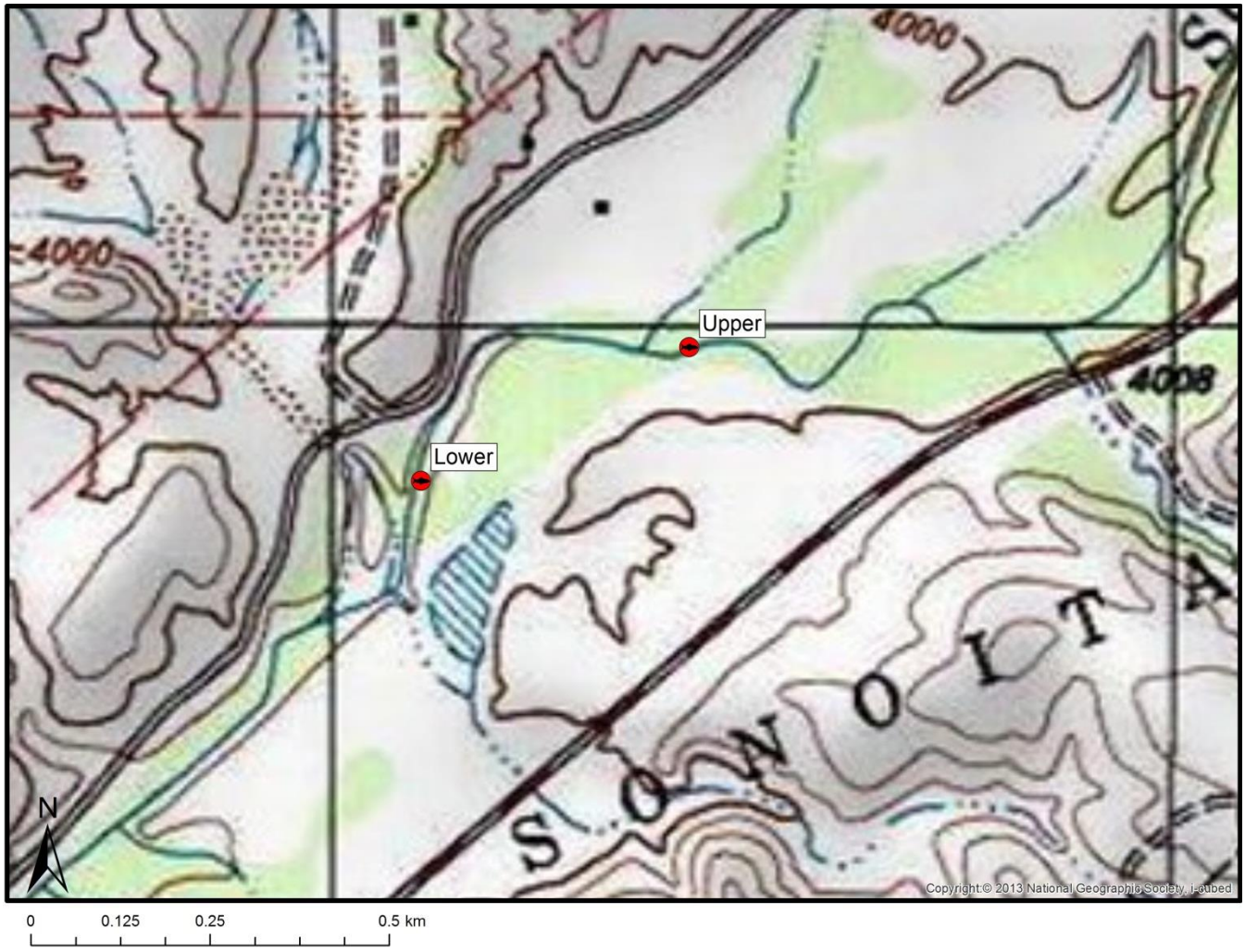


Figure 12. Survey site on Sonoita Creek.

Gun Creek - Reach 1 10/02/2013

UTM 12S Lower: 0484230E, 3759769N Upper: 0484046E, 3759514N

Figure 13. Survey site on Gun Creek - Reach 1.

Gun Creek - Reach 2 10/03/2013

UTM 12S Lower: 0473193E, 3759890N Upper: 0473120E, 3759914N

Figure 14. Survey site on Gun Creek - Reach 2.

Dix Creek - Reach 1(Left Prong) 10/08/2013

UTM 12S Lower: 0672508E, 3672755N Upper: 0672559E, 3672726N

Dix Creek - Reach 2 (Right Prong) 10/09/2013

UTM 12S Lower: 0671528E, 3673234N Upper: 0671537E, 3673164N

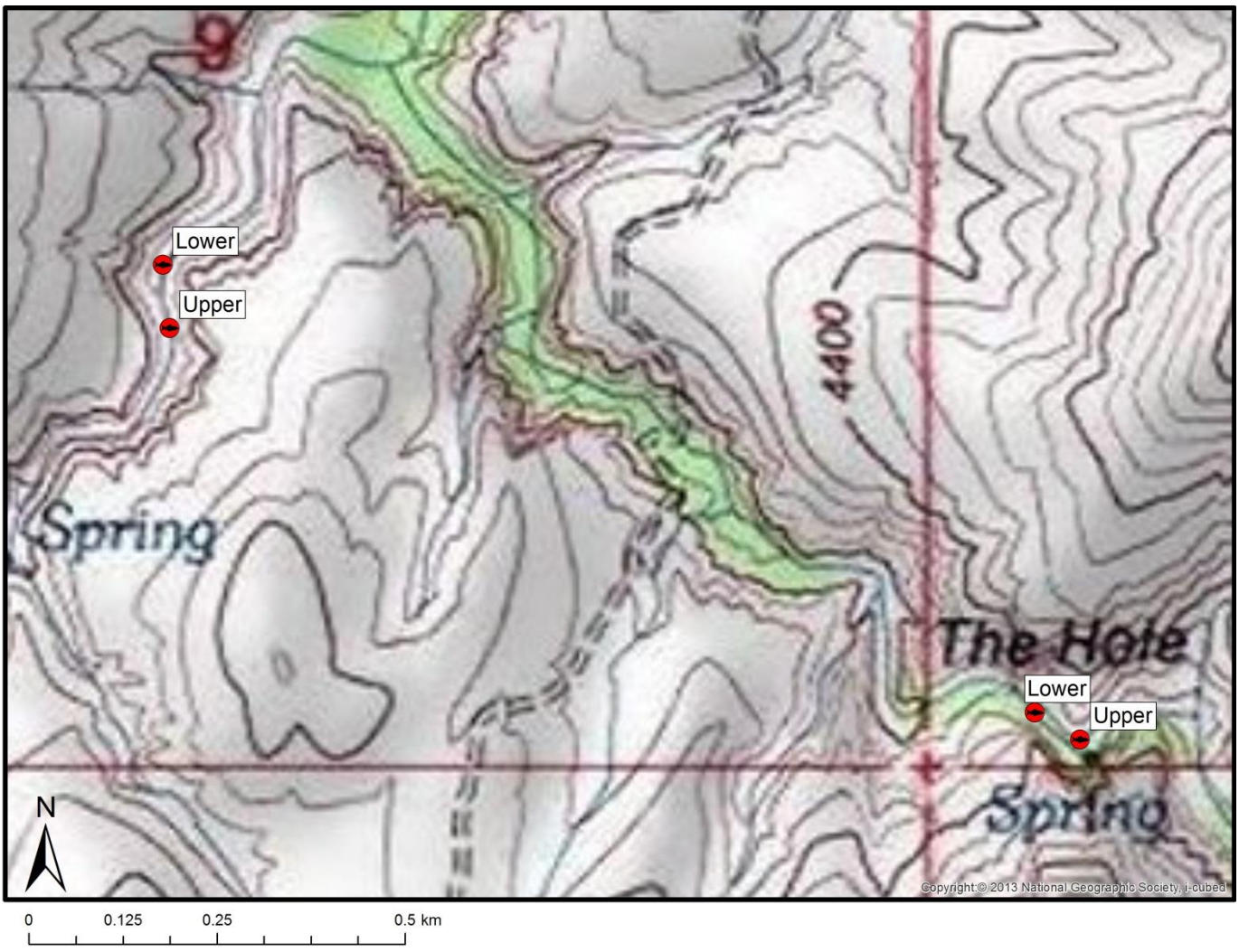


Figure 15. Survey sites on Dix Creek (Right Prong to the West of screen, Left Prong to the East).

Oak Creek – Reach 1 (Grasshopper Point) 10/16/2013

UTM 12S Lower: 0433190E, 3860694N Upper: 0433223E, 3860769N

Figure 16. Survey site on Oak Creek - Reach 1.

Oak Creek - Reach 2 (Crescent Moon Ranch) 10/17/2013

UTM 12S Lower: 0426055E, 3853973N Upper: 0426145E, 3853973N

Figure 17. Survey site on Oak Creek - Reach 2.

Oak Creek - Reach 3 (Bubbling Ponds Fish Hatchery) 10/18/2013

UTM 12S Lower: 0418389E, 3846822N Upper: 0418469E, 3847313N

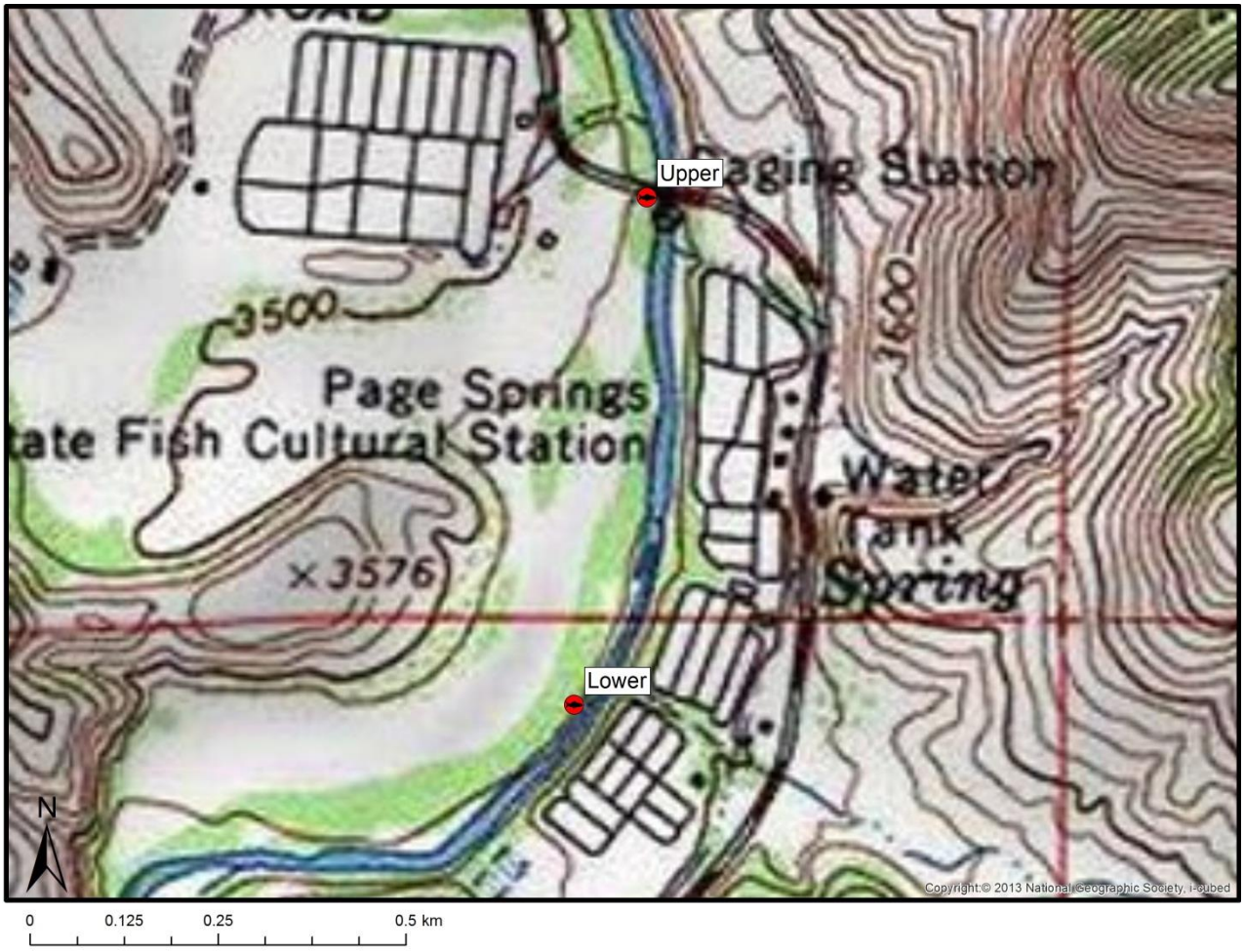


Figure 18. Survey site on Oak Creek - Reach 3.

Redrock Canyon (Cott Tank Drainage) 10/29/2013

UTM 12R Lower: 0536198E, 3486705N Upper: 0536279E, 3486244N

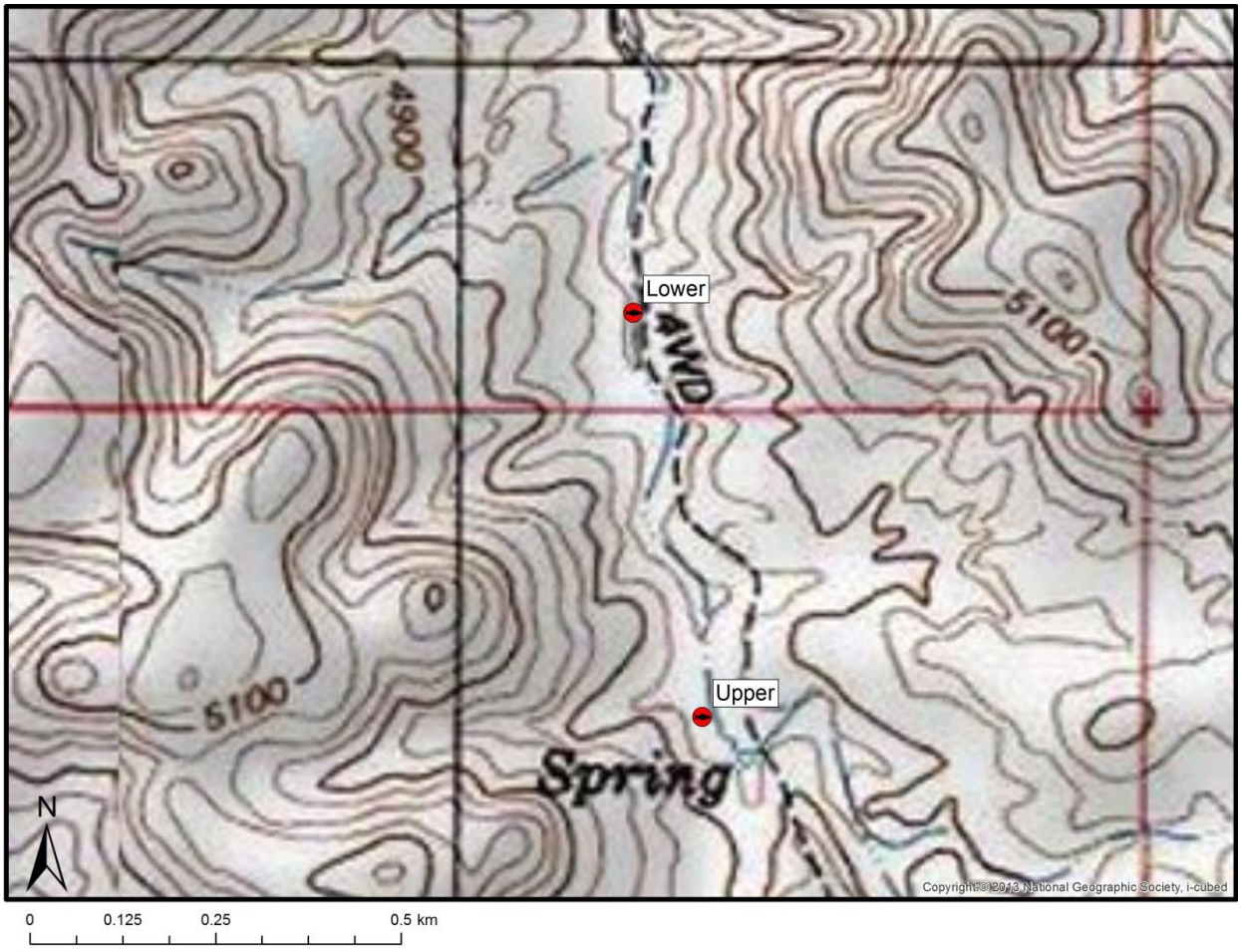


Figure 19. Survey site in Redrock Canyon (Cott Tank Drainage).

O’Donnell Canyon 10/30/2013

UTM 12R Lower: 0544876E, 3492301N Upper: 0544853E, 3492220N

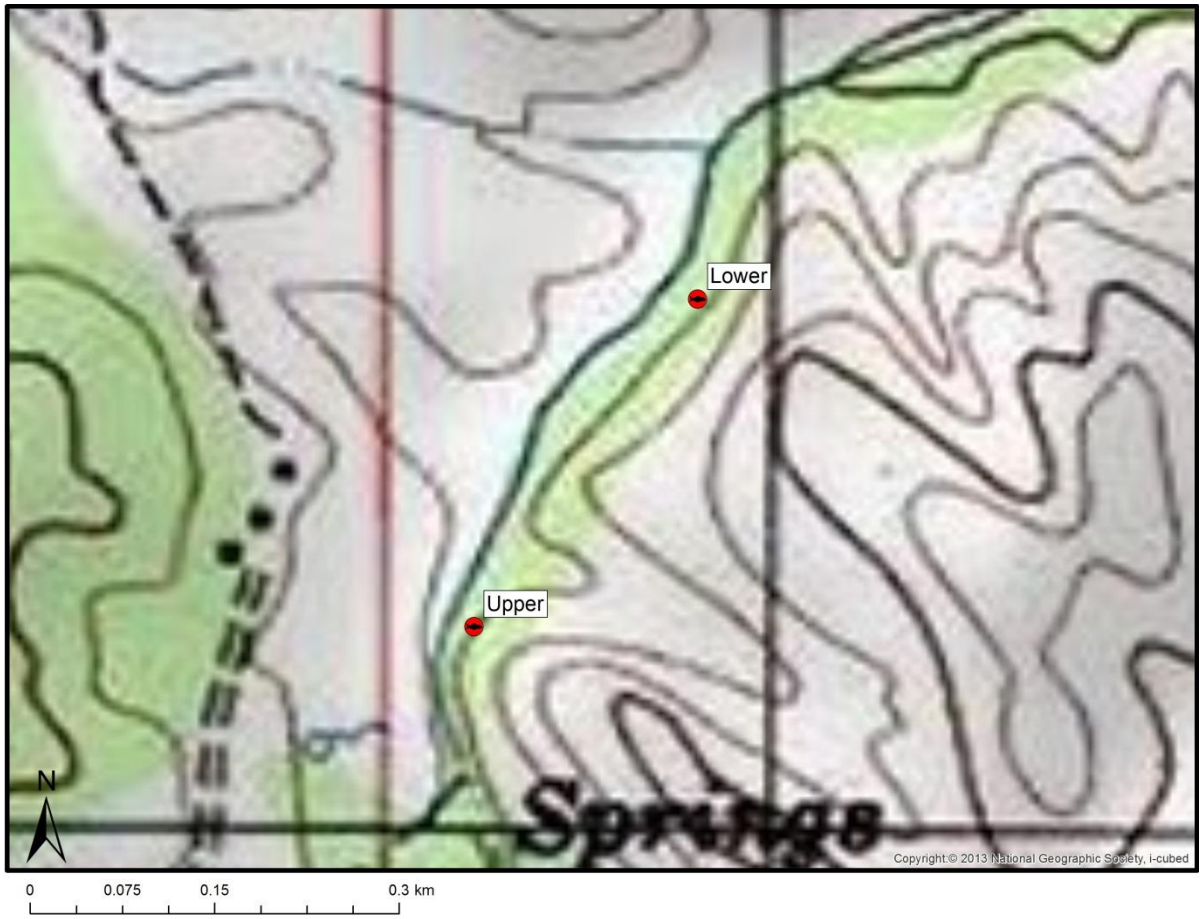


Figure 20. Survey site in O’Donnell Canyon.

T4 Spring 10/31/2013

UTM 12R Lower: 0549772E, 3500045N Upper: 0549756E, 3500146N

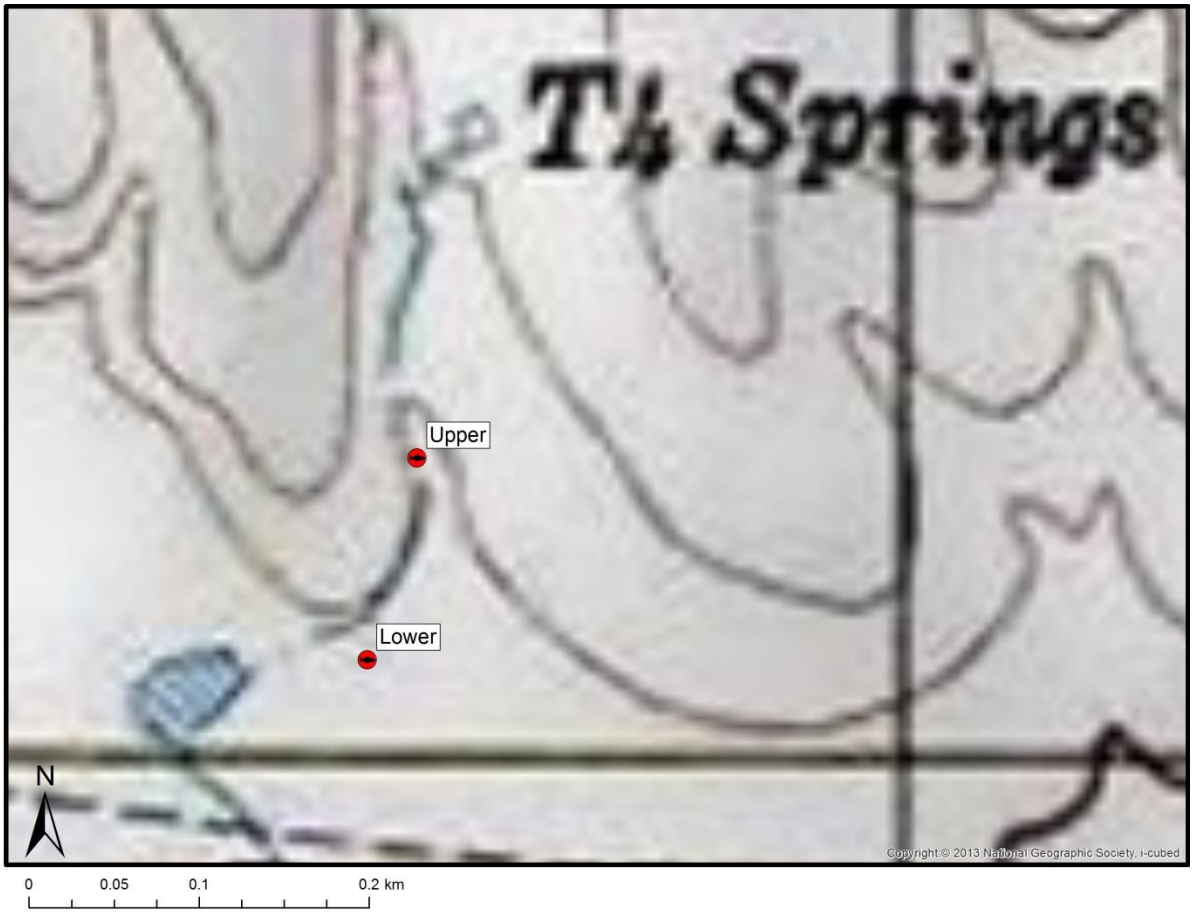


Figure 21. Survey site at T4 Spring.

Babocomari River 10/31/2013

UTM 12R Lower: 0553652E, 3500373N Upper: 0554029E, 3500251N

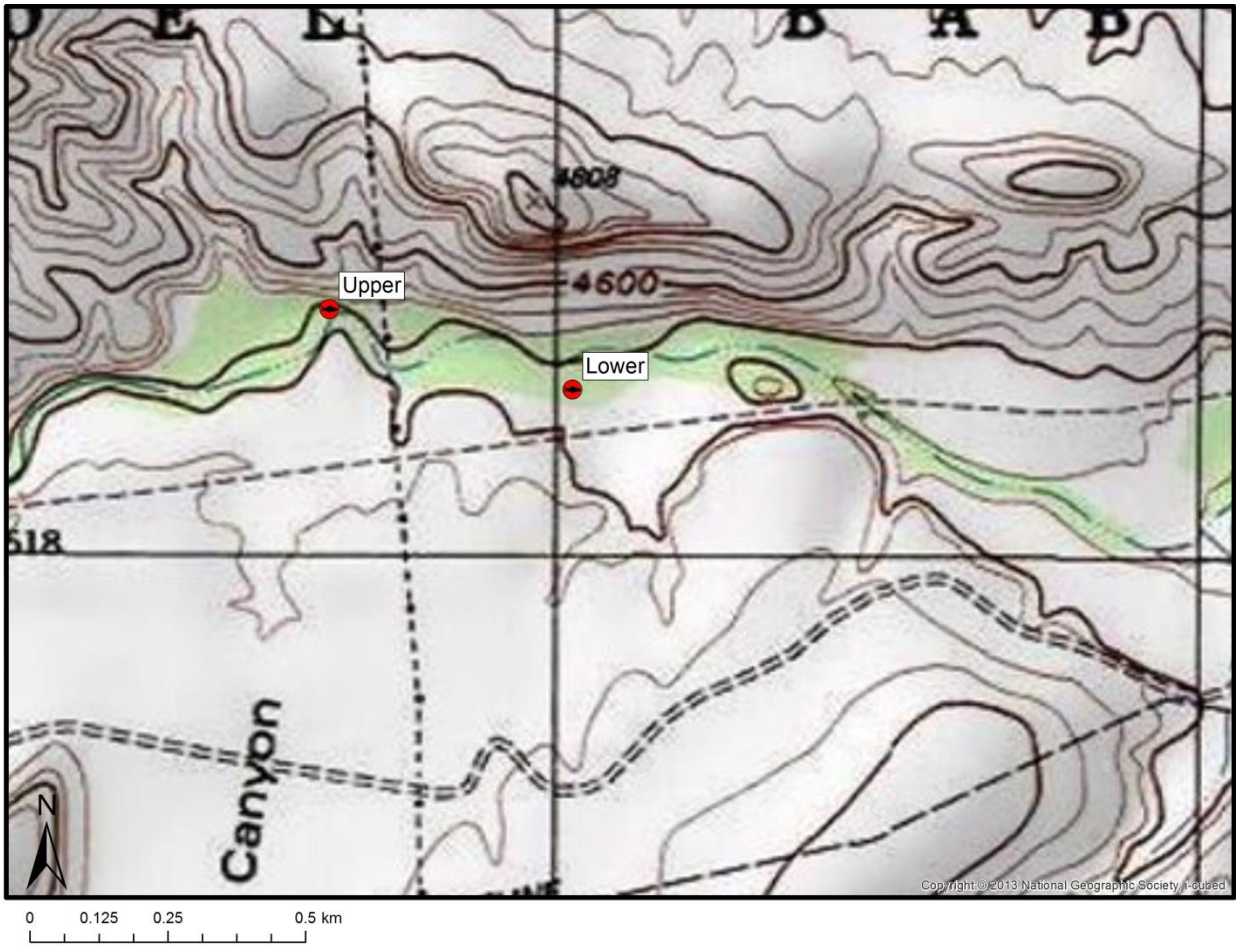


Figure 22. Survey site on Babocomari River.

Buzzard Roost Creek 11/07/2013

UTM 12S Lower: 0492809E, 3763861N Upper: 0492825E, 3763800N

Figure 23. Survey site on Buzzard Roost Creek.

Cherry Spring Canyon 11/12/2013

UTM 12S Lower: 0566003E, 3587091N Upper: 0565880E, 3587062N

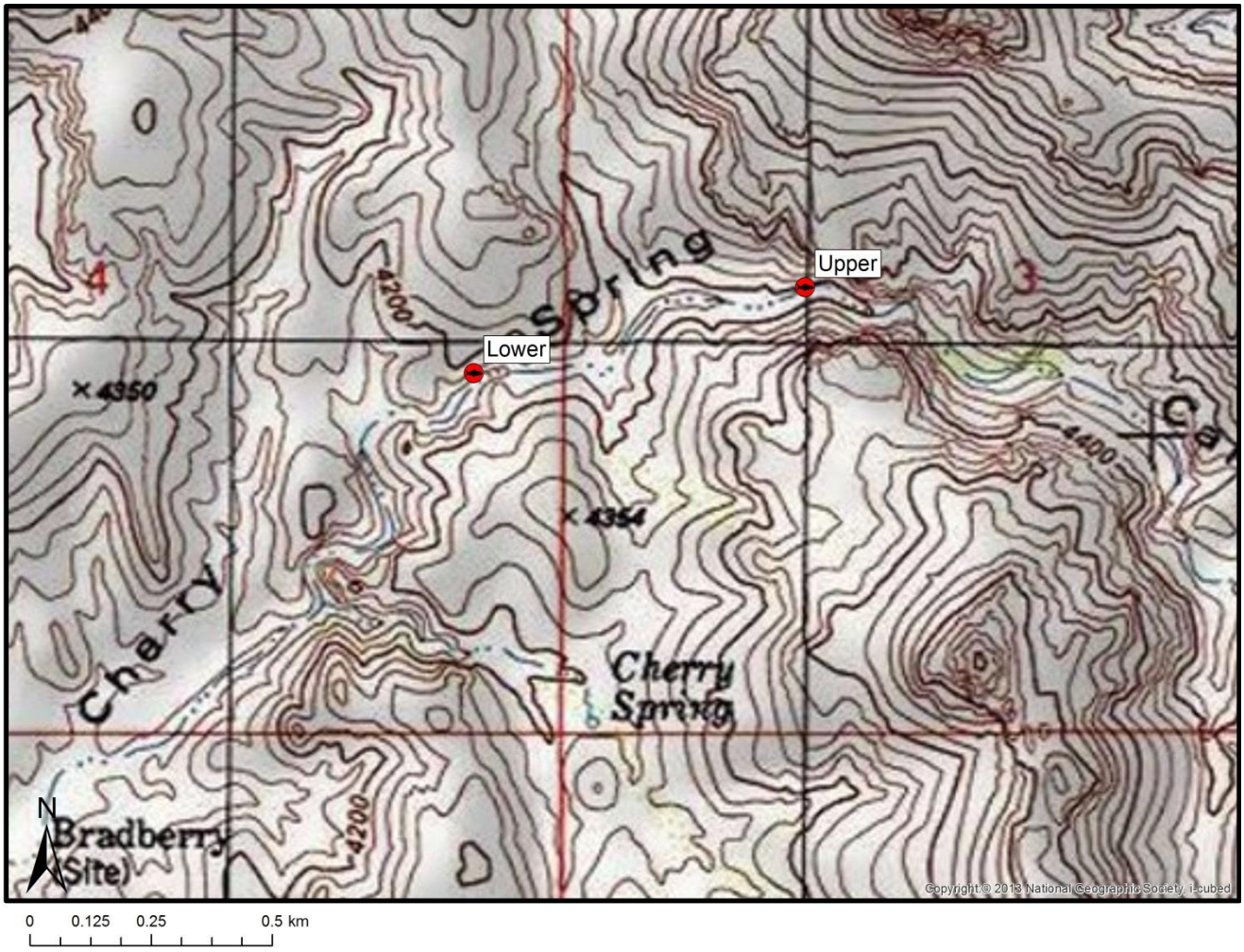


Figure 24. Survey site on Cherry Spring Canyon.

Swamp Springs Canyon 11/12/2013

UTM 12S Lower: 0566506E, 3589044N Upper: 0566587E, 3589081N

Figure 25. Survey site on Swamp Springs Canyon.

Lower Salt River - Reach 1 12/10/13

UTM 12S Lower: 0449650E, 3712857N Upper: 0450022E, 3713182N

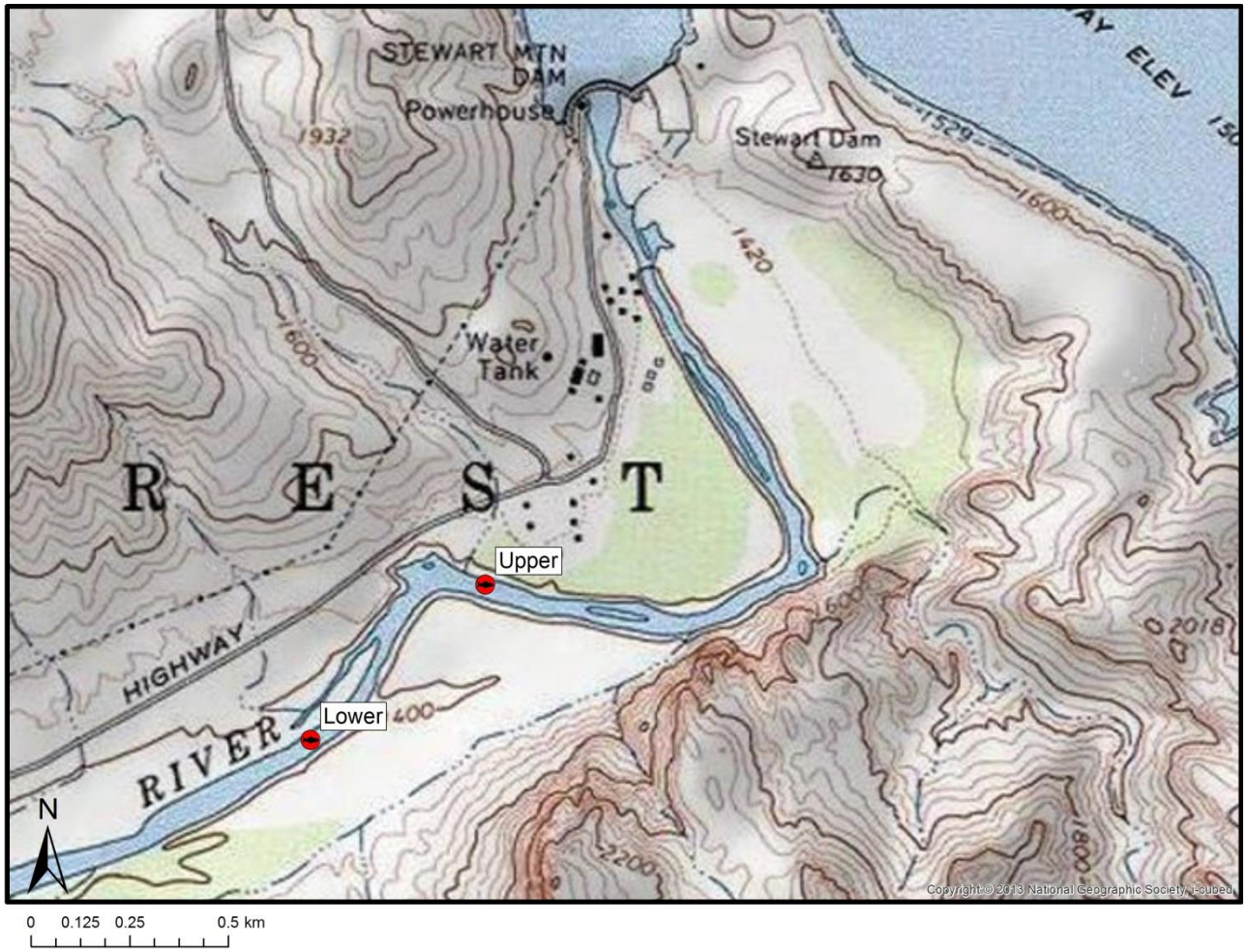


Figure 26. Survey site on Lower Salt River upper reach.

Lower Salt River - Reach 2 12/11/13

UTM 12S Lower: 0443429E, 3713527N Upper: 0442940E, 3713480N

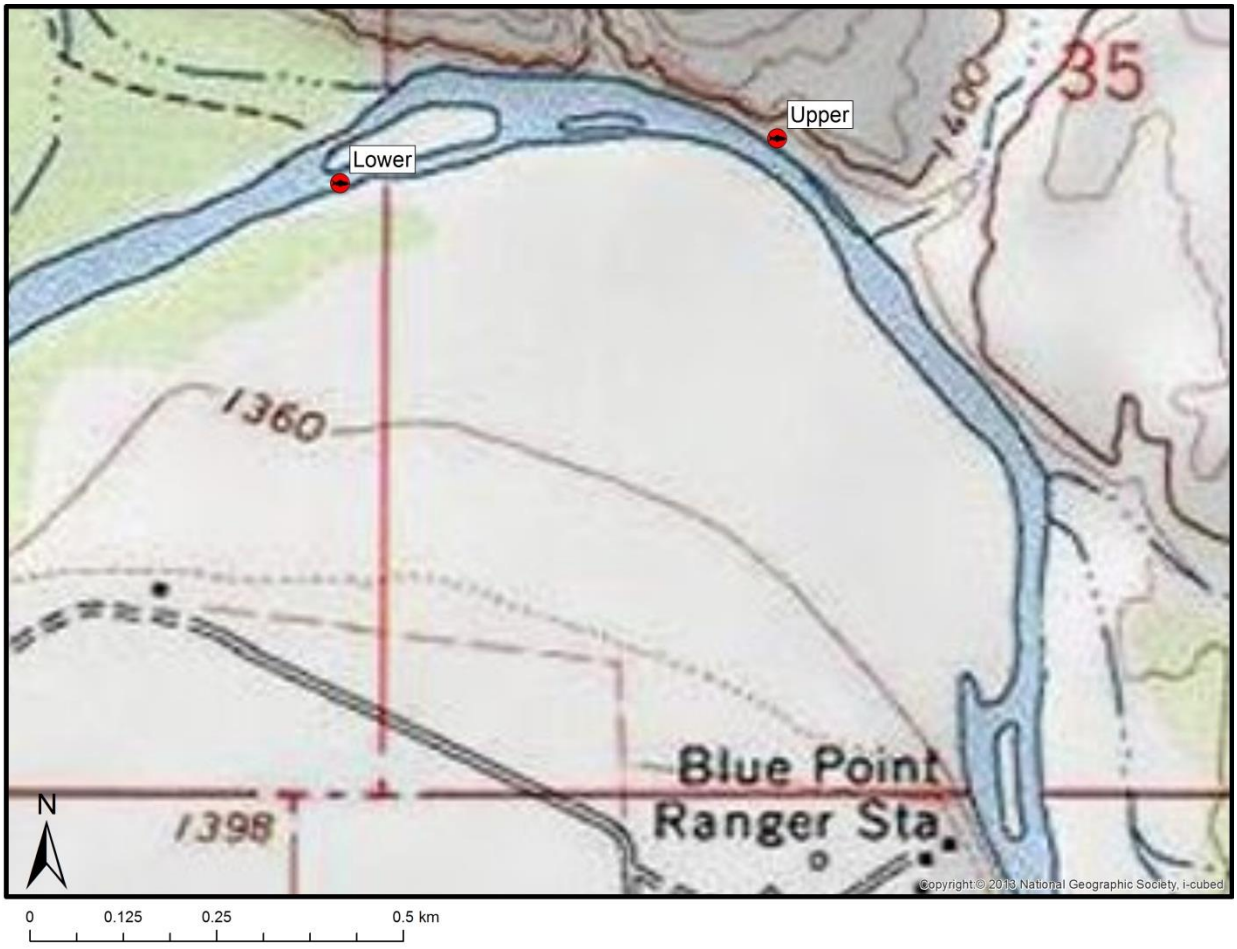
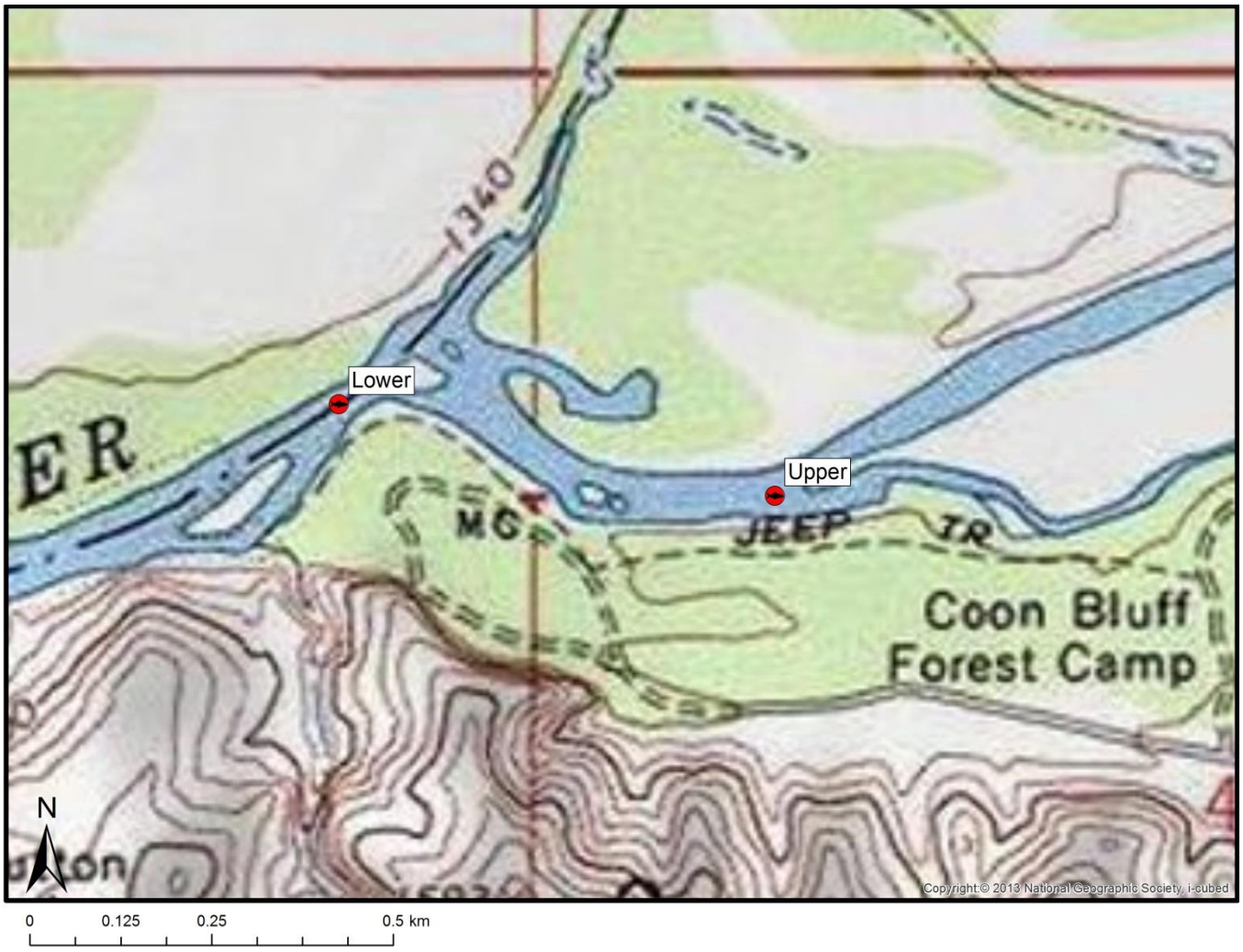


Figure 27. Survey site on Lower Salt River middle reach.

Lower Salt River - Reach 3 12/12/13

UTM 12S Lower: 0439599E, 3712260N Upper: 0440085E, 3712218N



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Appendix III

Photographs

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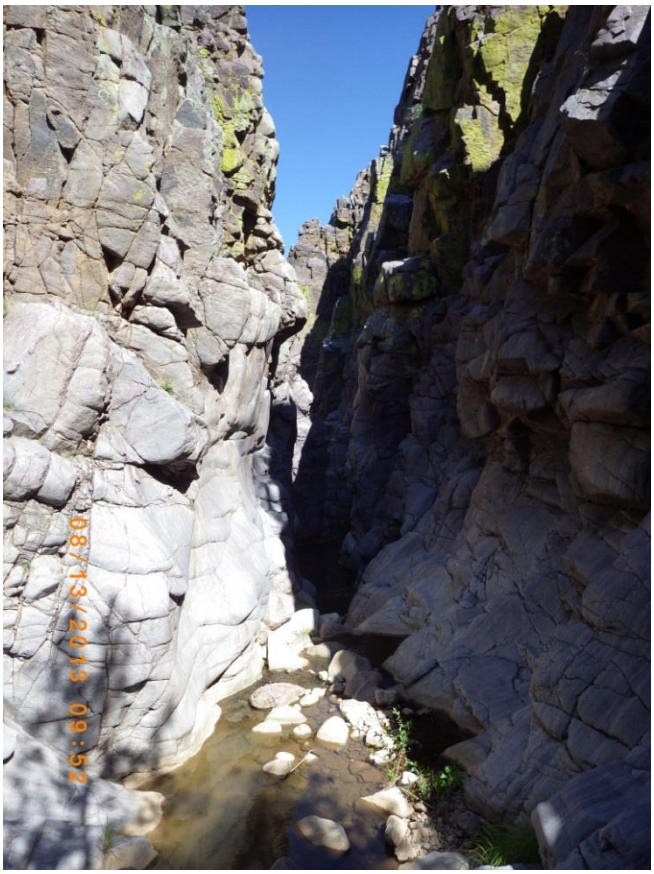
Photo 2. Sharp Spring - Example of habitat within the 500m reach.

Photo 3. Santa Cruz River - Example of habitat within 500m reach.



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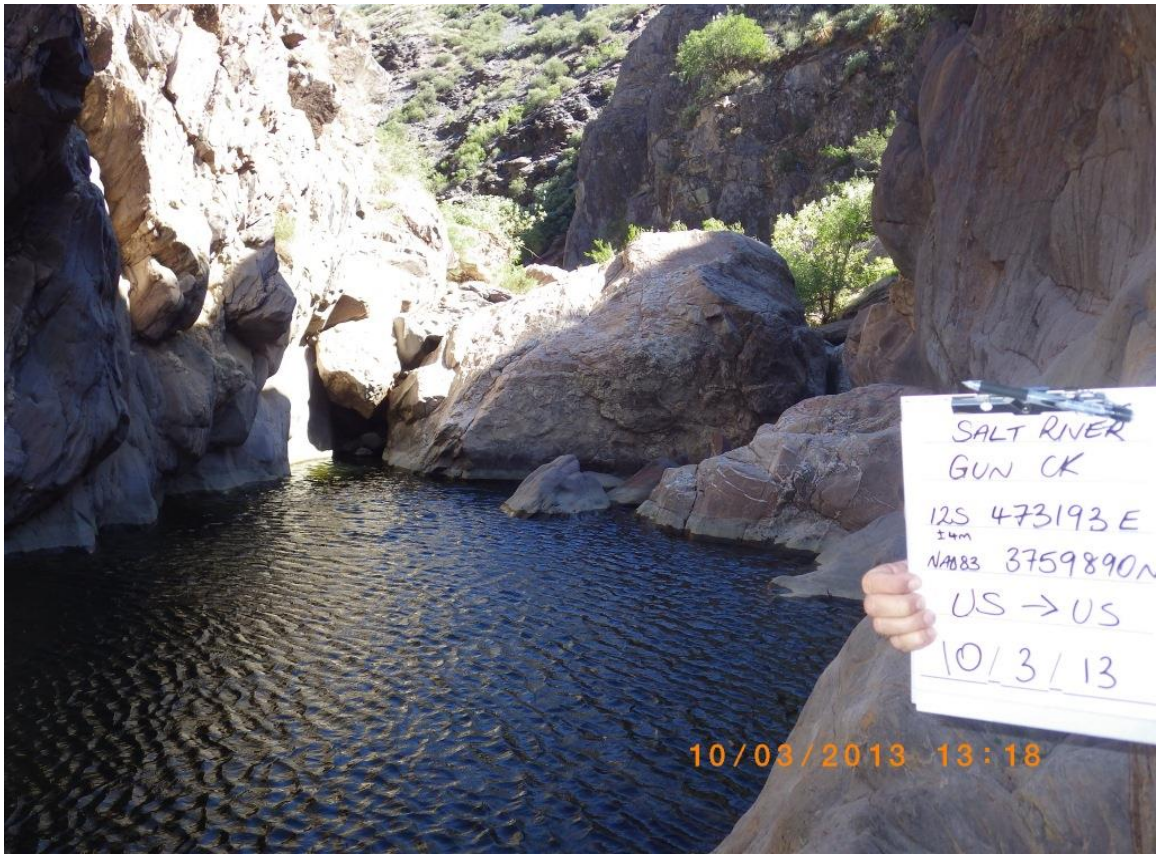


Photo 24. Gun Creek - Reach 2 - Upper boundary of the 100m reach looking upstream.

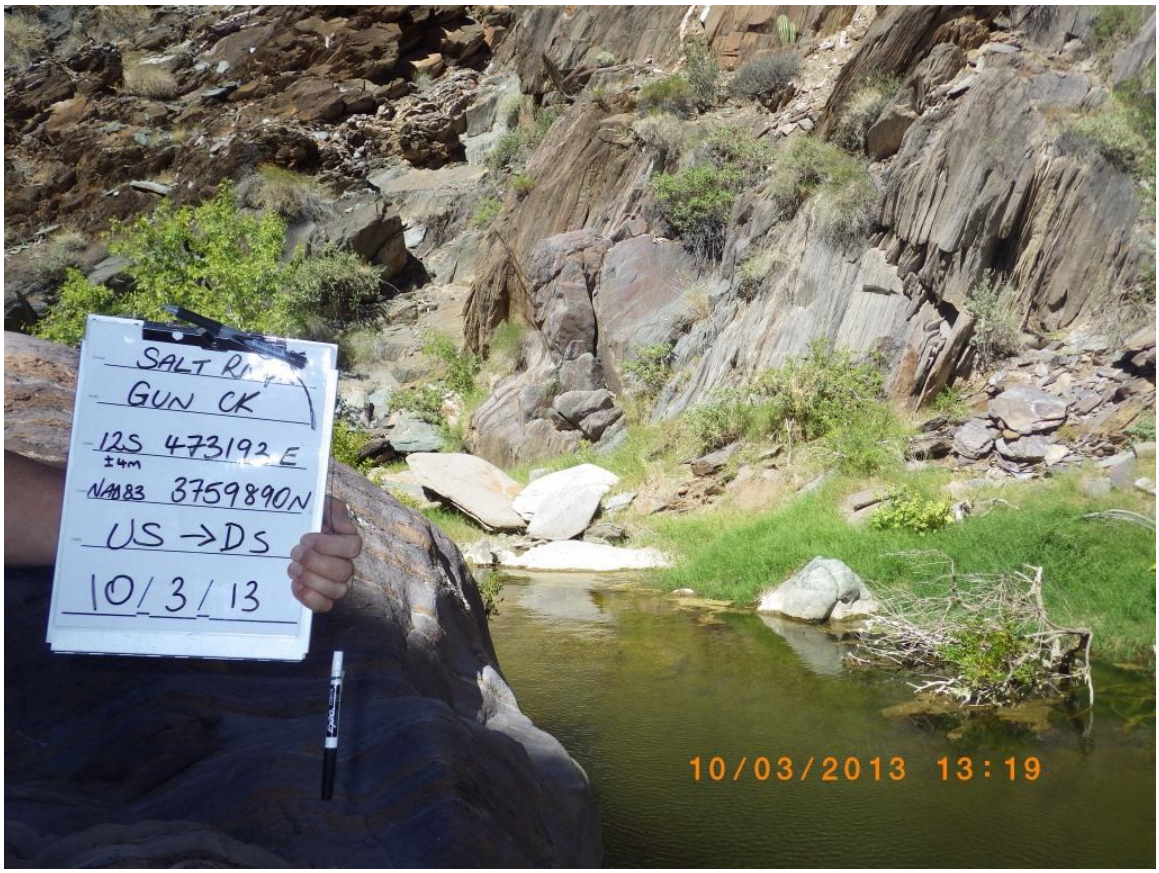


Photo 25. Gun Creek - Reach 2 - Upper boundary of the 100m reach looking downstream.

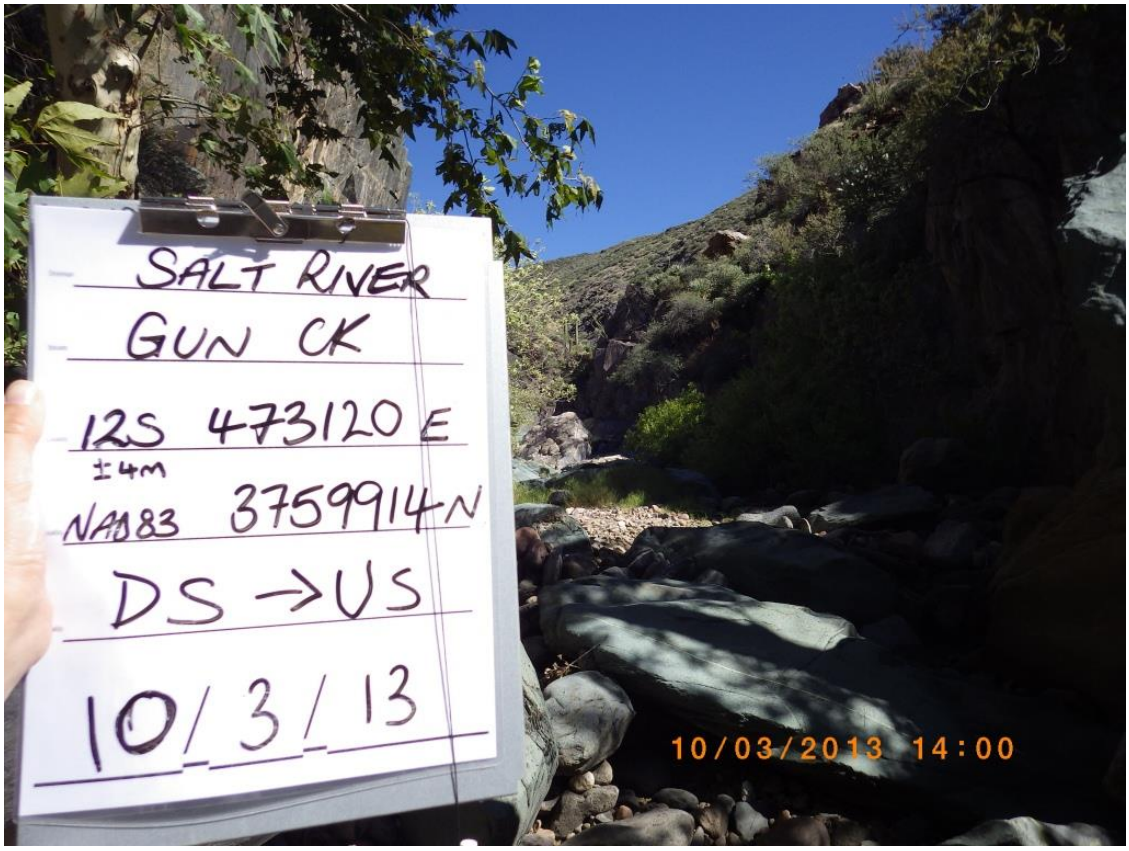
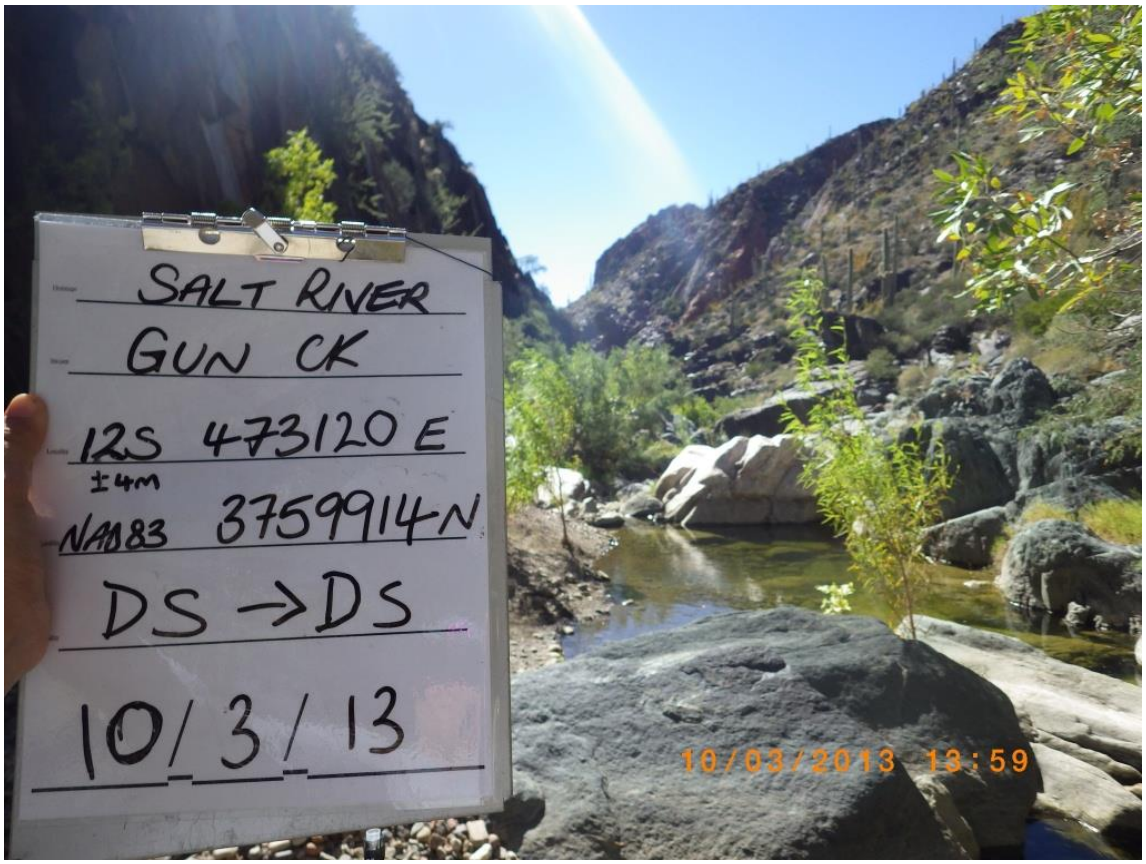


Photo 26. Gun Creek - Reach 2 - Lower boundary of the 100m reach looking upstream.



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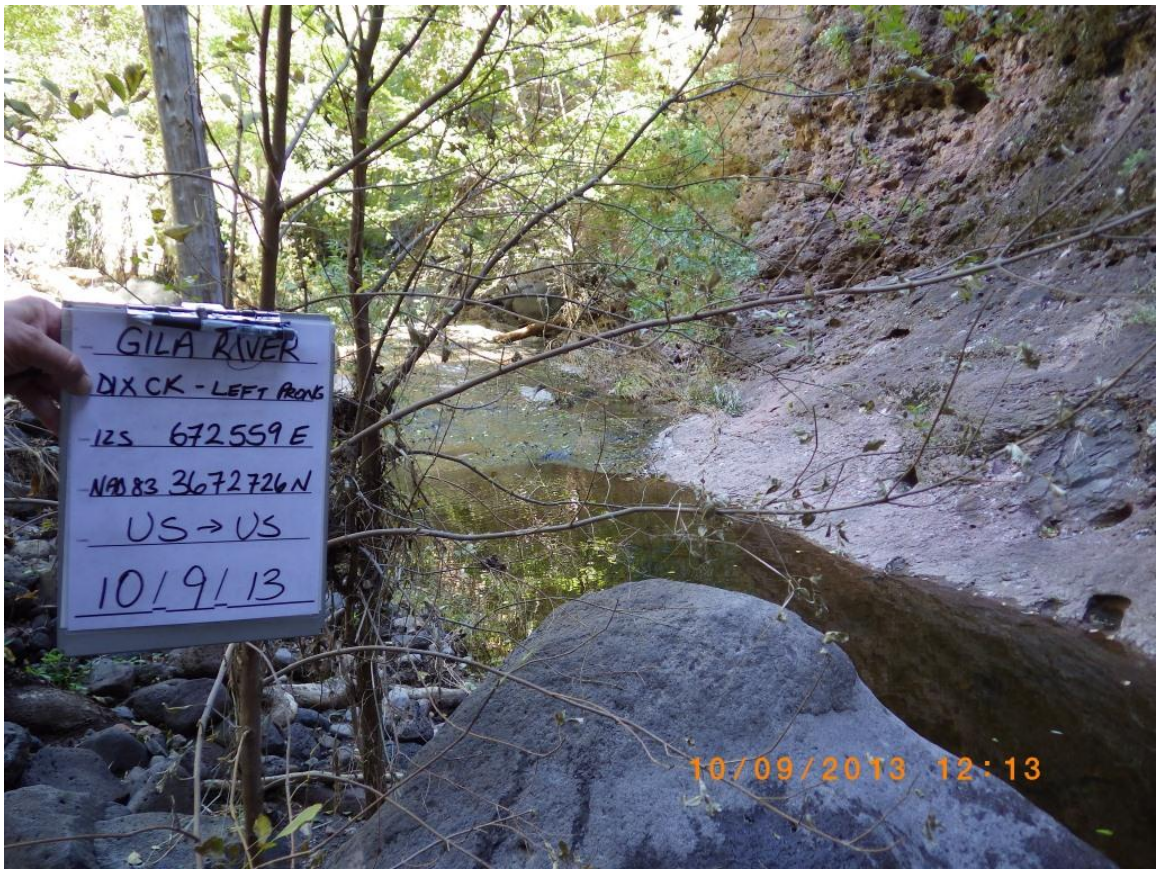

Photo 29. Dix Creek - Reach 1 - Upper boundary of the 100m reach looking upstream.

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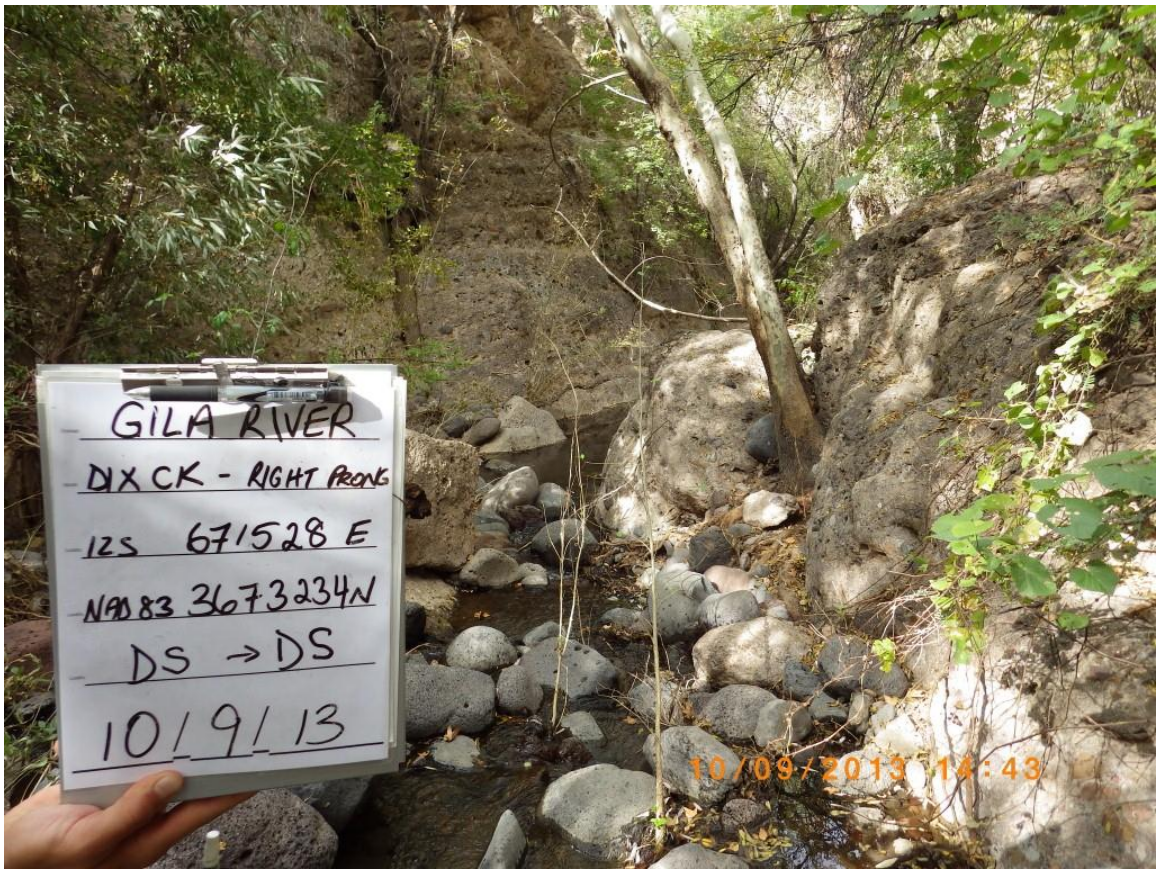

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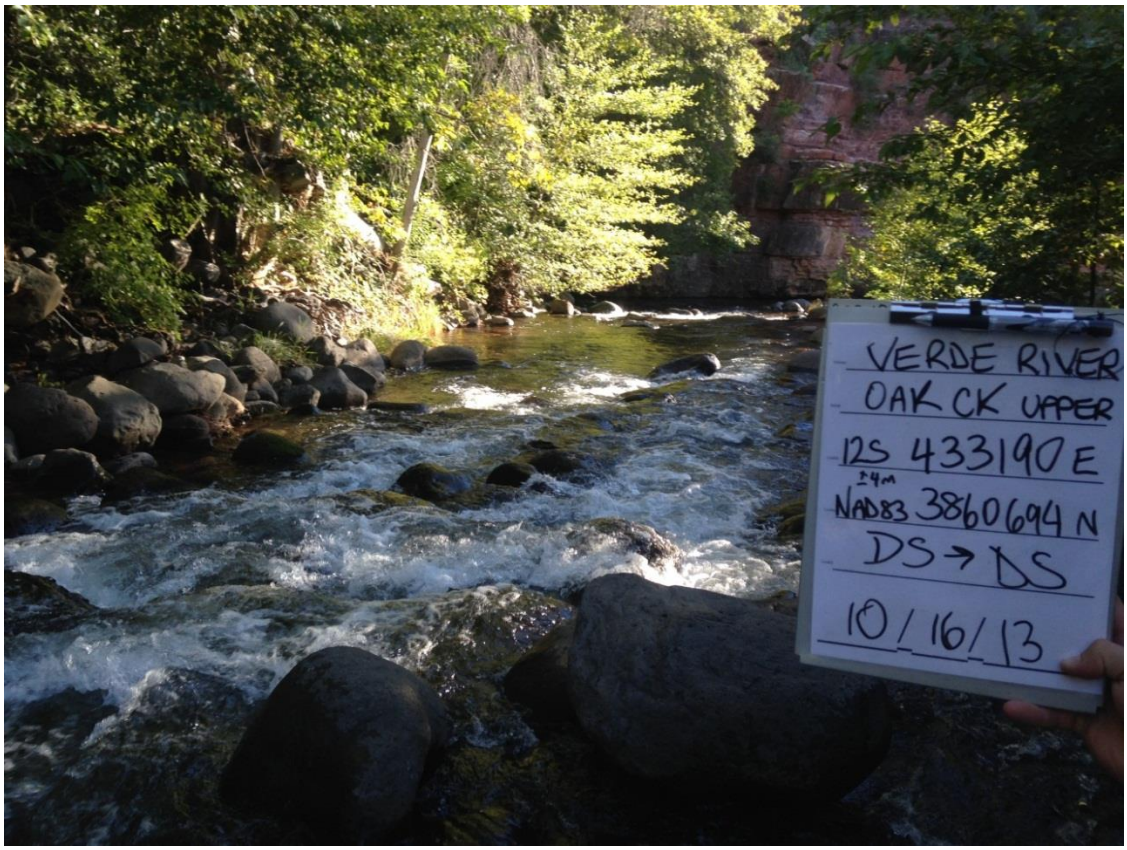

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Photo 46. Oak Creek - Reach 2 - Upper boundary of the 100m reach looking downstream.

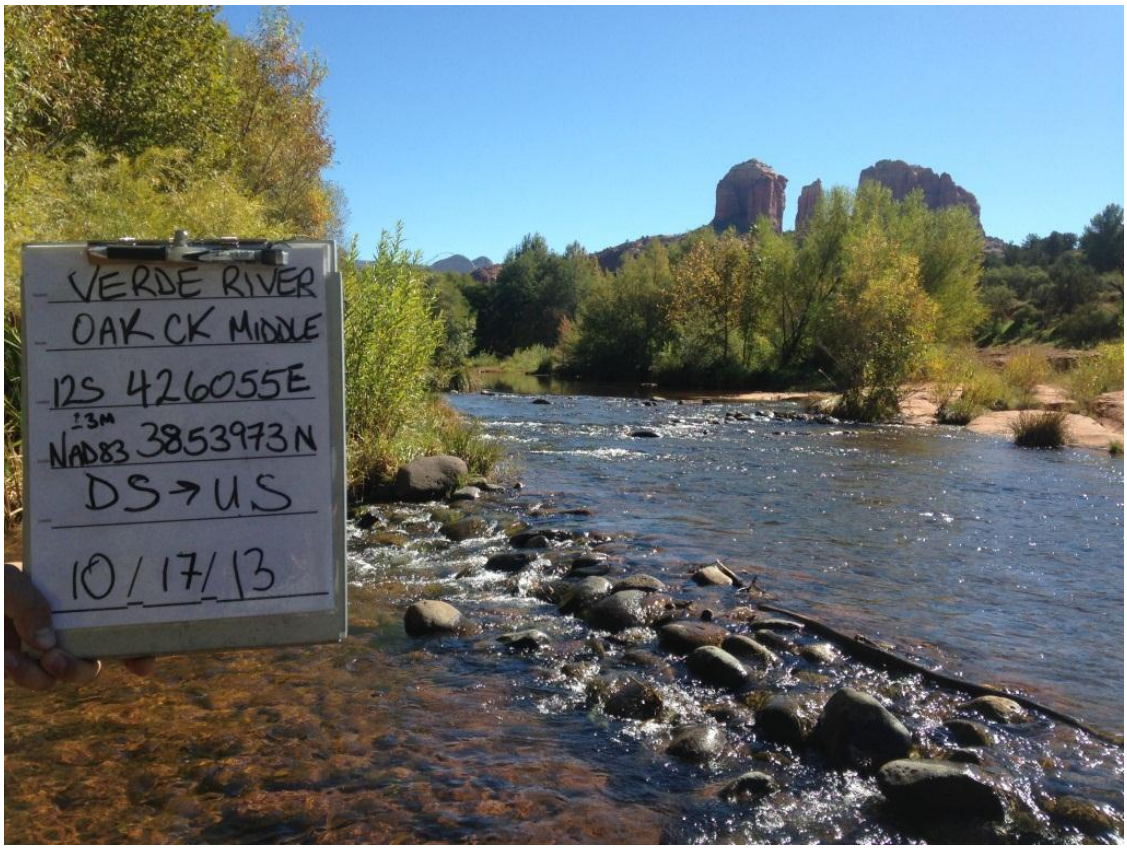

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Photo 62. Buzzard Roost Creek - Upper boundary of the 100m reach looking downstream.

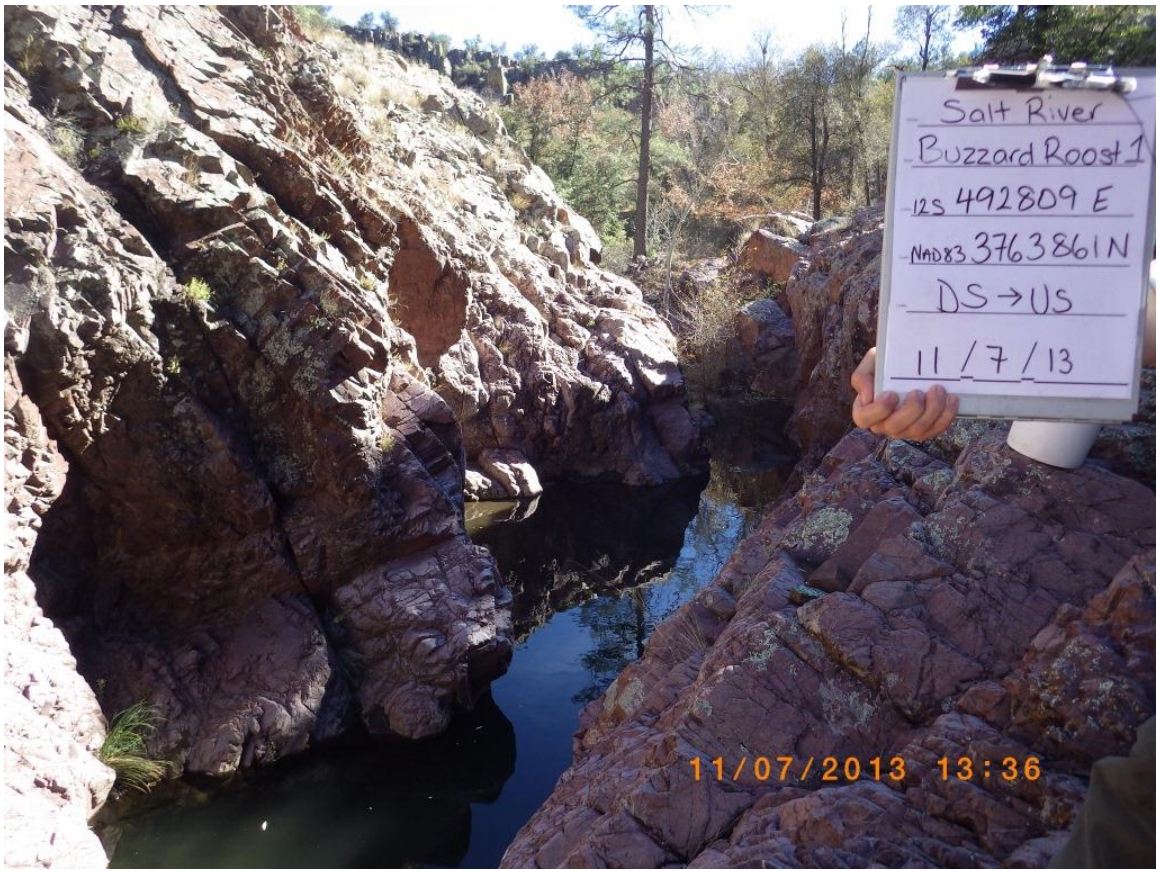
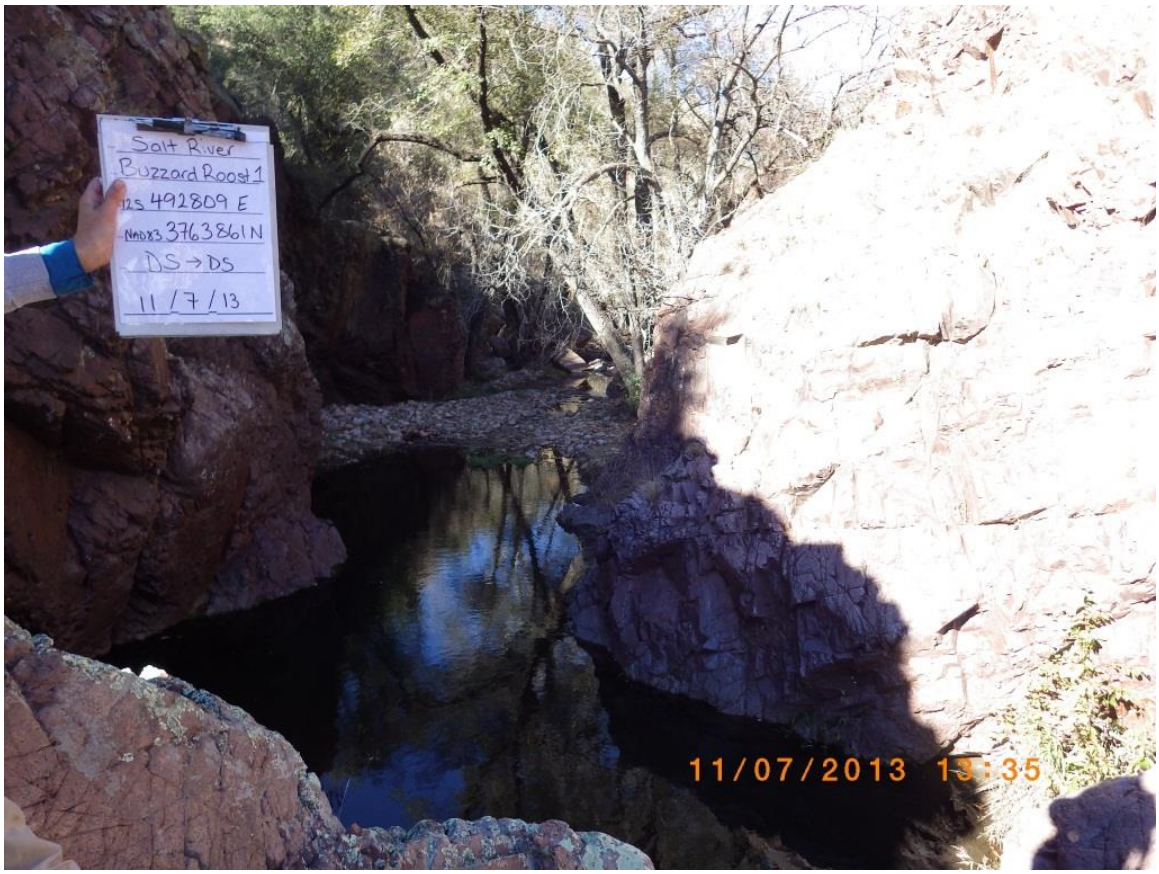


Photo 63. Buzzard Roost Creek - Lower boundary of the 100m reach looking upstream.



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