Gila River Basin Native Fishes Conservation Program:
Arizona Game and Fish Department's Native Fish Conservation Efforts During 2017

Cooperative Agreement R16AC00077
Between Bureau of Reclamation and Arizona Game and Fish Department
Annual Report

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Program Cooperators:

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OVERVIEW

The Gila River Basin Native Fishes Conservation Program (Program; previously known as the Central Arizona Project [CAP] Fund Transfer Program) was developed to partially mitigate impacts of the CAP on threatened and endangered native fishes of the Gila River basin. The U.S. Fish and Wildlife Service (USFWS) concluded in a 1994 biological opinion that the CAP would be a conduit for transfers of nonnative fishes and other aquatic organisms from the lower Colorado River (where the CAP originates) to waters of the Gila River basin. That opinion identified the spread and establishment of nonnative aquatic organisms as a serious long-term threat to the status and recovery of native aquatic species, following a long history of habitat loss and degradation. Impacts of nonnatives include predation, competition, hybridization, and parasite and pathogen transmission.

The 1994 USFWS opinion concluded that operation of the CAP would jeopardize the continued existence of four native threatened or endangered fish species: Gila Topminnow *Poeciliopsis occidentalis*, Spikedace *Meda fulgida*, Loach Minnow *Rhinichthys cobitis*, and Razorback Sucker *Xyrauchen texanus*. The Service also concluded that the CAP would adversely modify designated critical habitat of Spikedace, Loach Minnow, and Razorback Sucker. Five reasonable and prudent alternatives were specified: 1) construction and operation of barriers to prevent the spread of nonnative fishes from the CAP to native fish habitats, 2) monitoring of nonnative fish, 3) transfer of funds to USFWS to recover natives, 4) transfer of funds to USFWS to manage nonnatives and research to support that management, and 5) inform and educate the public about native fishes and the impacts caused by nonnative fishes. The transfer of funds under reasonable and prudent alternatives 3 and 4 became known as the CAP Funds Transfer Program. In a 2001 revision of the 1994 opinion, the reasonable and prudent alternatives became conservation measures, and the Santa Cruz River drainage was added to its geographic scope. In a 2008 revision, the newly-listed endangered Gila Chub[1] *Gila intermedia* and Chiricahua Leopard Frog *Lithobates chiricahuensis* were added to the Program as species affected by operation of the CAP, and the Santa Cruz River drainage was added to its geographic scope.

The Program is funded by the U.S. Bureau of Reclamation (Reclamation), and is directed by the U.S. Fish and Wildlife Service (Service) and Reclamation in cooperation with the New Mexico Department of Game and Fish (NMDGF) and Arizona Game and Fish Department (Department). Reclamation began taking over administration of the funding Program from USFWS in 2015. The Department and Reclamation finalized a one-year agreement (R16AC00077) in August 2016, which was modified and extended to five years in August 2017. The Program mission is to undertake and support conservation actions (recovery and protection) for federal/state-listed or candidate fish species native to the Gila River basin by implementing existing and future recovery plans for those fishes. There are finalized recovery plans for four of the five priority

[1] See paragraph on page 2 describing the taxonomic reclassification of Gila Chub into Roundtail Chub.

species, and a draft recovery plan for the Gila Chub (U.S. Fish and Wildlife Service, 1983, 1990, 1991, 2002, 2015).

However, the taxonomic classification of Gila Chub changed in 2016, so its listing status may change. In September 2016, the American Fisheries Society and the American Society of Ichthyologists and Herpetologists reclassified and merged Roundtail Chub *Gila robusta*, Gila Chub *Gila intermedia,* and Headwater Chub *Gila nigra* into one species, the Roundtail Chub. Arizona Game and Fish Department recognizes these changes, and all populations formerly recognized and referred to as Headwater Chub or Gila Chub (sensu Minckley and DeMarais, 2000) are reported herein as Roundtail Chub, *Gila robusta*. To maintain consistency with previous reports, chub in locations that were formerly considered to contain Gila Chub are indicated with a footnote.

In addition to the fish and frog species specified above, other species mentioned in this report include: Longfin Dace *Agosia chrysogaster*, Speckled Dace *Rhinichthys osculus*, Woundfin *Plagopterus argentissimus,* Desert Pupfish *Cyprinodon macularius,* Desert Sucker *Catostomus clarki*, Sonora Sucker *Catostomus insignis*, Green Sunfish *Lepomis cyanellus*, Channel Catfish *Ictalurus punctatus*, Black Bullhead *Ameiurus melas*, Yellow Bullhead *Ameiurus natalis*, Smallmouth Bass *Micropterus dolomieu*, Fathead Minnow *Pimephales promelas,* Red Shiner *Cyprinella lutrensis*, Western Mosquitofish *Gambusia affinis,* Apache Trout *Oncorhynchus gilae apache*, Gila Trout *Oncorhynchus gilae,* and Brown Trout *Salmo trutta*. Other aquatic species mentioned include Lowland Leopard Frog *Lithobates yavapaiensis,* Chiricahua Leopard Frogs *Lithobates chiricahuensis,* American Bullfrog *Rana catesbeiana,* Canyon Treefrogs *Hyla arenicolor,* Sonora Mud Turtle *Kinosternon sonoriense*, Northern Crayfish *Orconectes virilis,* Red Swamp Crayfish *Procambrus clarkii,* Northern Mexican Gartersnake *Thamnophis eques,* Narrow-headed Gartersnake *Thamnophis rufipunctatus*, and Black-necked Gartersnake *Thamnophis cyrtopsis*.

This report summarizes Program work performed by the Department during 2017. For each priority action, work completed during 2017 is presented, followed by recommendations.

PERFORMANCE MEASURES

Cooperative Agreement R16AC00077 between U.S. Bureau of Reclamation and Arizona Game and Fish Department specified the following annual performance measures.

1. Complete a minimum of three repatriation stockings and one non-indigenous species control action.

   Results: During 2017 Department staff completed repatriation stockings into 11 waters: (Appendix 1). Also during the performance period Department staff completed five non-indigenous species control actions: two nonnative fish removal efforts in Red Tank Draw, one in the Blue River, one in Redfield Canyon, and assisted with one in Spring Creek.

2. Monitor fish to determine if population(s) have established at all locations where repatriations were attempted within the previous 3 to 5 years, or other period as agreed upon by the CAP Technical and Policy committees. The number of years to monitor is based on life-span and age-at-maturity of the species, and is three years for Gila Topminnow and Desert Pupfish, and five years for Spikedace, Loach Minnow, and Roundtail Chub.

   Results: During 2017, Department staff conducted post-stocking monitoring of 41 populations (Appendix 2): 3 Loach Minnow, 3 Spikedace, 11 Desert Pupfish, 21 Gila Topminnow, and 4 Roundtail Chub. Sites where native fish were repatriated and subsequent monitoring information indicated that the species had established populations are reported in Appendix 3.

3. Monitor to determine if non-indigenous fish have been eradicated where non-indigenous control was attempted within the previous year or other period as agreed upon by the Technical and Policy committees.

   Results: During 2017, Department staff monitored four locations where nonnative fish removals have been implemented: Blue River, Redfield Canyon, Spring Creek, and Red Tank Draw.

4. Attempt to spawn all Loach Minnow and Spikedace populations held at the Department's Aquatic Research and Conservation Center (ARCC).

   Results: In 2017, all Loach Minnow and Spikedace populations at ARCC spawned. ARCC produced 1,341 Aravaipa Creek Spikedace, 384 upper Gila River Spikedace, 1,183 Gila River Forks Spikedace, 47 Blue River Loach Minnow, 305 Aravaipa Creek Loach Minnow, 177 San Francisco River Loach Minnow, and 7 Gila River Forks Loach Minnow.

GENERAL ACTIVITIES

Department staff administered and managed Program projects identified in the agreement. Staff entered data into survey and stocking datasets, and checked data for accuracy. Department staff finalized the annual report, drafted an old agreement final report, drafted two progress reports, drafted Environmental Assessment Checklists, and drafted necessary paperwork and budgets to modify the existing agreement. Staff coordinated with intra-agency staff, other agencies, and private landowners to continue work on existing projects and to develop potential new projects.

PRIORITY ACTIONS

General methods

Fish Stockings: The Department coordinates with USFWS about locations to stock and sources and lineages of fish to use. Fish for repatriations were collected, transported, and stocked according to AGFD's fish collection, transport, and stocking protocol (best management practice #4; AGFD 2011), and Hazard Analysis and Critical Control Point (HACCP) practices. Fish were collected from pre-determined waters inhabited by desired lineage. Fish were collected using gear appropriate for the given water; typical gear types were seines, minnow traps, or electrofishing. Fish were placed into aerated 5-gallon buckets from which they were sorted to confirm species and assess condition. Fish were then transferred into a 100-qt transport cooler(s) equipped with aerators and filled with well water that was treated with salt and Amquel®. At the repatriation site, the fish were transferred from the transport cooler back to aerated 5-gallon buckets and carried to the stocking location. Water quality characteristics in the buckets and the stocking location were measured. Conductivity (µS), salinity (mg/L), total dissolved solids (mg/L), pH, and water temperature (°C), were measured using a Hach® Combo meter, and dissolved oxygen (mg/L) using a Hach® dissolved oxygen meter. Fish were acclimated to stocking site conditions by exchanging 25-50% of bucket water with stream water, about every 10 minutes, until bucket temperatures were within one degree of the stream. Fish were sorted a final time to verify species, assess condition, and determine a final count and were then released into the stream.

Data recorded for stocking included: site name, date, time of arrival and stocking, participants, type of transport container, water characteristics in the tanks and site (water temperature, pH, conductivity) counts of individuals stocked, condition of fish, fish behavior after release, and number of mortalities.

Fish Surveys: Backpack electrofishing through 100-m transects (except in the Blue River where transects are 200-m long) was used to survey repatriated populations of Spikedace, Loach Minnow, and Roundtail Chub, and to assess habitats for fish repatriations. The number of transects sampled in a given stream depended on the length of the stream or target reach, with a minimum of three transects for short streams and the number in longer streams summing to at least 12% of the reach length (e.g., there were twelve 200-m transects in the 18 km of the lower Blue River). A Smith Root model 12-B was used to electrofish upstream through each transect in a single pass. Stunned fish were netted with dip nets (tear-drop shaped, 0.43 m x 0.37 m with

2 or 3 mm mesh). At the end of each major mesohabitat type (pool, run, riffle, cascade) within a transect, fish were processed and data were recorded. Captured fish were identified to species and counted. All Spikedace, Loach Minnow, Roundtail Chub were measured (mm total length, TL). Other species were counted within two size classes: ≤40 mm and > 40 mm for Speckled Dace and Longfin Dace, ≤20 and >20 mm for Desert Pupfish and Gila Topminnow, and <50, 50-100, and >100 mm for suckers and any other large-bodied fish. Except for topminnow and pupfish, we categorized fish <20 mm TL as larvae. After processing, fish were released alive just downstream from where they were captured. Data recorded for each sampling effort included: site name, site location (GPS coordinates), length of site, date, time, participants, gear type, gear settings, gear dimensions, seconds shocked, species of fish captured, size class of fish, and counts of individuals within each species-size-class category.

Minnow traps or hoop nets baited with dry Gravy Train® dog food were used to survey for Gila Topminnow, Desert Pupfish, and many chub populations. Promar® collapsible minnow traps (0.46 m long x 0.3 m wide, with 2 mm mesh) were used for Gila Topminnow and Desert Pupfish monitoring, whereas Promar® collapsible mini-hoop nets (0.85 m long x 0.3 m diameter circular hoops, with 9 mm mesh) were used for chub monitoring. Typically 10 traps were set in each stream or pond. Traps were pulled 2-3 h after they were set, fish were processed and were then released alive back to the area from which they were captured. Data recorded for each sampling effort included: site name, site location (GPS coordinates), date, time, participants, gear type, gear dimensions, set and pull times for each trap set, species of fish captured, size class of fish (≤20 mm or >20 mm), and counts of individuals within each species-size-class category.

Evaluation of Species Establishment: The goal of the repatriations is to establish populations of Spikedace, Loach Minnow, Gila Topminnow and Roundtail Chub[1] and to thus contribute to recovery of these species. A species is considered to have established (a successful repatriation) when it is reproducing to the point where it is self-sustaining (Griffith et al. 1989, Bright and Smithson 2001, Armstrong and Seddon 2007), and as per the Spikedace recovery plan (USFWS 1991) with characteristics of abundance, age-class structure, and recruitment in the range of natural variation. To assess the goal, post-stocking monitoring data were collected for each repatriated species to evaluate species presence, an index of abundance, population size structure, and dispersion. Arguably, the two most important of these four measures for determining if a species has established are population size structure and an index of abundance.

The objectives of monitoring are to:

1) determine presence of repatriated fish species and non-native fish species;
2) evaluate trends in relative abundance (estimated as catch-per-unit effort) of the repatriated species, extant native fish species, and non-native piscivores;

[1] Some of the chub repatriations were of species formerly classified as Gila Chub.

3) evaluate size-structure of each population of fish species to detect reproduction and recruitment to the population;
4) determine if repatriated species have dispersed outside of the stocking area.

Presence of individuals during post-stocking monitoring is evidence that the species has persisted, but not in and of itself evidence of population establishment. Presence of juvenile fish is evidence of reproduction, and the proportion of all individuals that are juvenile is evidence of year-class strength. Size structure is used as an indicator of age-structure. Presence of age-0, age-1, and older size classes for several years in a row, and consistently high catch rates for several years in a row is an indication that a population has established. Capture of individuals beyond stocking locations is evidence of dispersal.

After stocking, a site is monitored for several years to determine whether or not the species has established a population. The number of years of monitoring was dependent upon species, and generally exceeded the life span of the species by at least one year. For Gila Topminnow and Desert Pupfish, which typically live only one to two years, two years may be sufficient to detemine if they have established a population. However, if no fish are detected in three consecutive monitoring events, the population may be considered extirpated (Weedman and Young 1995). Therefore, three years of post-stocking monitoring will be used for Gila Topminnow and Desert Pupfish. Spikedace and Loach Minnow can live three to four years, so monitoring for five years post-stocking should be sufficient to determine if the species has established a population, because all fish stocked will have died by that time. Roundtail Chub typically live about seven years. However, a yearly examination of size structure for five years after stocking is probably sufficient to determined if Roundtail Chub are established.

At one year post stocking, any fish captured that is < 40 mm TL would be the result of a fairly recent spawning event, and therefore not a stocked fish. However, even after populations of the repatriated species have been determined to be established, they will continue to be monitored periodically, by one or more of the cooperators, for at least 10 years to determine if they persist and remain viable.

Nonnative Piscivore Removal: Nonnative fishes were typically removed using traps and electrofishing, except in the Blue River, where snorkeling and spearfishing was also used (Robinson et al. 2010). A variety of traps were used, depending on habitat size: hoop nets (0.5 m diameter, 2 m long, and 6 mm mesh) and mini-hoop nets (Promar® TR-502 collapsible traps; cylindrical, 0.85 m long x 0.3 m wide, with 9 mm mesh) baited with dry dog food (Gravy Train®). Traps were dispersed throughout the targeted reach and were primarily set in pools or runs that were more than 1-m deep. Traps were and set during the afternoon and retrieved 2 to 22 h later. For backpack electrofishing, typically the entire targeted reach was shocked, and any nonnative fish captured were removed.

In the Blue River, snorkelers used spear fishing equipment (JBL Enterprises., 1.5 m polespear affixed with a three pronged, barbless, Paralyzer spear tip; or a JBL Enterprises Mini-Carbine spear fishing gun) to remove large-bodied piscivorous nonnative fish. To improve the chances of sighting fish, sampling was restricted to 8:30 am to 4:30 pm when the sun was high in the sky. All pools ≥1m deep in the project reach were surveyed via snorkeling, and each pool was snorkeled through three times. The following data were recorded at each pool: coordinates (UTM, NAD 83 northing and easting), reach number or name, pool number, estimated pool length (m), width (m), and depth (m), date, snorkeling start and end time for each diver, species captured, number of each species, total length (TL, mm) of each individual fish, water clarity (m distance that fish can be accurately identified; estimated with polespear), and snorkeling crew member names.

Evaluation of Nonnative Removal: There are two general goals for nonnative removals: control or eradication. For situations where there aren't any barriers to invasions of nonnative species, the goal is to control the nonnative population until barriers can be installed. However, for locations where there are barriers to invasion of nonnative, the goal of is to eradicate the nonnative populations. Multiple removals are conducted until goals are achieved. The catch of nonnatives across removal events will be examined, and a decrease in abundance of the targeted nonnative species to low levels or to zero will be evidence of control. Absence of nonnatives for five or more consecutive removal events will indicate eradication.

Acquire Spikedace, Loach Minnow and rare populations of other native fish

Recovery Objectives:

- Spikedace recovery objective 8.1. Determine wild stocks suitable for contribution to hatchery stocks.
- Loach Minnow recovery objective 8.1. Determine wild stocks suitable for contribution to hatchery stocks.
- Spikedace recovery objective 8.2. Collect and transfer wild stocks to suitable facility.
- Loach Minnow recovery objective 8.2. Collect and transfer wild stocks to suitable facility.

Background: The purpose of this task is to acquire Spikedace and Loach Minnow from all extant lineages and bring them to the Department's Aquatic Research and Conservation Center (ARCC), or another facility, for propagation and to establish refuge populations. The goal is to have 500 adults on station for each lineage. There are few natural populations left, and they need to be protected. Removing too many fish from a wild population could negatively impact it. The number of fish to remove from a given population is a coordinated decision between USFWS and state wildlife agencies, and is usually based on monitoring information about the estimated number of fish in the stream. If necessary, new individuals are brought into ARCC every year to maintain the population size and genetic similarity with wild stock.

Loach Minnow (Aravaipa Creek lineage) were first brought into the ARCC in August 2002 to develop propagation techniques (Childs 2004). Spikedace and more Loach Minnow from Aravaipa Creek were brought on station in 2007 to establish broodstocks. Since then the number of fish and lineages brought each year has fluctuated from none to several hundred. Spikedace from Aravaipa Creek, Upper Gila River, and Gila River Forks), and Loach Minnow from Aravaipa Creek, Blue River and upper Gila River were brought on station in 2009. Only twice have more than 300 individuals of a given lineage been brought into the facility: 640 upper Gila River Spikedace in 2007, and 434 Gila River Forks Loach Minnow in 2011.

Results: On November 7, 2017, Department staff collected and transported 160 Spikedace and 100 Loach Minnow from Aravaipa Creek to ARCC. All fish were collected via seining downstream of the TNC Guest House site from NAD83 12S 556094 3638097 to 556130 3638256.

On November 30, 2017 ARCC staff acquired 110 Gila Forks lineage Loach Minnow from New Mexico Game and Fish Department and brought them back to ARCC.

No collections of the other lineages were completed because they were not planned for; repatriations using those lineages were not planned for 2018.

Recommendations: Continue to collect Spikedace and Loach Minnow from remnant populations, with goals to minimize impact on remnant population but acquiring the number of fish necessary to maintain a refuge population of at least 500 adults. The Loach Minnow population in the upper Blue River needs to be assessed and more of them brought into ARCC in 2018. ARCC staff should coordinate with NMDGF regarding acquiring more stock of the New Mexico lineages.

Muleshoe ecosystem stream and spring repatriations

Recovery Objectives:

- Spikedace recovery objective 6.3. Reintroduce Spikedace to selected reaches.
- Spikedace recovery objective 6.4. Monitor success/failure of reintroductions.
- Loach Minnow recovery objective 6.3. Reintroduce Loach Minnow to selected reaches.
- Loach Minnow recovery objective 6.4. Monitor success/failure of reintroductions.
- Gila Topminnow 1999 draft revised recovery plan objective 2.2. Reestablish Gila topminnow in suitable habitats following geographic guidelines.
- Gila Topminnow 1999 draft revised recovery plan objective 2.4 Protect habitats of reestablished or potential populations from detrimental nonnative aquatic species.
- Gila Topminnow 1999 draft revised recovery plan objective 3. Monitor natural and reestablished populations and their habitats.

- Desert Pupfish recovery objective 2. Re-establish Desert Pupfish populations.
- Desert Pupfish recovery objective 5. Monitor and maintain natural, re-established, and refugium populations.
- Gila Chub draft recovery plan objective 1.3.1. Eliminate or control problematic nonnative aquatic organisms
- Gila Chub draft recovery plan objective 2. Ensure representation, resiliency, and redundancy by expanding the size and number of populations within Gila chub historical range via replication of remnant populations within each RU.
- Gila Chub draft recovery plan objective 7. Monitor remnant, repatriated, and refuge populations to inform adaptive management strategies.

Background: The purpose of this action was to establish Spikedace, Loach Minnow, Gila Topminnow, and Desert Pupfish into various waters on the Muleshoe Ranch Cooperative Management Area. The Muleshoe CMA is located on the western slopes of the Winchester and Galiuro mountains. The various waters and stream reaches are described in Robinson et al. 2010, and Love-Chezem et al. (2015a). Fish stockings began in 2007, when Spikedace and Loach Minnow were stocked into Hot Springs Canyon and Redfield Canyon; both species were again stocked into Redfield Canyon in 2008 and 2010, and into Hot Springs Canyon each year through 2011. In 2007, Roundtail Chub[1], Sonora Sucker, and Speckled Dace were translocated upstream of a waterfall in Redfield Canyon to expand their range in that system. Gila Topminnow and Desert Pupfish were stocked into Swamp Springs Canyon (2007 and 2008), Cherry Spring Canyon (2007 and 2008), and Secret Spring (2007 and desert pupfish only in 2010). Gila Topminnow and Desert Pupfish were stocked into Headquarters Spring in 2008, and in 2010 more pupfish were added. Gila Topminnow was stocked into Wildcat Canyon in 2014 and into Bass Canyon in 2014 and 2015. Desert Pupfish were stocked into Larry & Charlie Tank in 2009 and into Mint Spring in 2015.

By the end of 2016, Loach Minnow were considered established in Hot Springs Canyon because adults were consistently captured and there was evidence of recruitment every year since they were last stocked in 2011. Spikedace persist in Hot Springs Canyon but it is unclear if they are established because recruitment has not been detected every year and numbers captured have steadily decreased since 2012. Both Spikedace and Loach Minnow failed to establish in Redfield Canyon. Gila Topminnow were established in Swamp Springs Canyon, Headquarters Spring, Secret Spring, and Redfield Canyon and likely failed to establish in Cherry Spring Canyon. Desert Pupfish were established in Larry and Charlie Tank and in Secret Spring, but failed to establish in Swamp Springs Canyon, Cherry Spring Canyon, and Headquarters Spring.

Both Redfield Canyon and Hot Springs Canyon drainages are occupied by other native fishes including: Roundtail Chub[1], Speckled Dace, Longfin Dace, Desert Sucker, and Sonora Sucker.

Results: On January 11, 2017, Department staff met with other members of the Muleshoe Native Fish Team (U. S. Fish and Wildlife Service, U. S. Bureau of Land Management, U. S. Bureau of Reclamation, The Nature Conservancy, Marsh & Associates) to discuss results of native fish past conservation efforts and plan efforts within the Muleshoe Ranch Cooperative Management Area.

Nonnative Control. During May 30 – June 1, 2017, Department and The Nature Conservancy staff performed a Green Sunfish removal in Redfield Canyon. Single-pass backpack electrofishing was conducted from below the Swamp Springs confluence at the downstream end of perennial water (UTM NAD83 12S 562924 3588779) to the Sunfish Barrier (UTM NAD83 12S 563858 3589841) on May 30, 2017. Staff electrofished for 5,434 seconds and captured 1 Green Sunfish (124 mm TL) at UTM NAD83 12S 563464 3589254. Other species captured included 140 Roundtail Chub[1], 76 Sonora Sucker, 1 Gila Topminnow, and 7 Longfin Dace. On May 31, 2017, 20 mini-hoop nets were set in the same reach and left to fish overnight. Traps were checked on the morning of June 1, 2017 (about 22 hour trap set). No Green Sunfish were captured; however, 163 chub and 78 Sonora Sucker were captured. On May 31, 2017, 19 mini-hoop nets were set in the other perennial section near the wilderness boundary. Traps were set between UTM NAD83 12S 559912 3589238 to 559647 3589061. Traps were initially set for 2-3 hours and 145 Green Sunfish (70-206 mm TL), 1 Sonora Sucker, and 1 Sonora Mud Turtle were captured. One staff member also fly fished for 50 minutes and captured 20 Green Sunfish (72 – 156 mm TL). About 300 – 400 Gila Topminnow (adult and YOY) were observed in the main pool. Traps were reset in the same location and left to fish overnight. Traps were checked on the morning of June 1, 2017 (about 18 hour trap set); 55 Green Sunfish (52 – 146mm TL), 7 Sonora Sucker, and 4 Sonora Mud Turtles (3 mortalities) were captured. All Green Sunfish captured were removed. Overall, 221 Green Sunfish were removed from Redfield Canyon. Similar to the last two years, Green Sunfish numbers remain low in the upper perennial section (Reach 1 and the upper end of Reach 2), indicating that control efforts have been successful (Figure 1). Green Sunfish numbers in the lower perennial section (downstream end of Reach 3) remain high, and this location is likely the source of Green Sunfish to the upper reach. The proposed barrier will be upstream of the downstream perennial water, so will secure the upstream native fish populations from further invasions of Green Sunfish. After the barrier is in place, the Green Sunfish population can be eradicated upstream, rather than just controlled.

Monitoring of Repatriated Populations. During September 18-20, 2017, Department, The Nature Conservancy, and Reclamation staff monitored Hot Springs Canyon for Loach Minnow and Spikedace; Redfield Canyon above the large waterfall (UTM NAD83 12S 564212 3590025)

[1] Chub in Hot Springs and Redfield canyons were previously classified as Gila Chub.

for Roundtail Chub[1]; Mint Spring for Desert Pupfish; Upper Bass Canyon, Lower Bass Canyon, and Wildcat Canyon for Gila Topminnow. In Hot Springs Canyon, sampling crews captured 21 Loach Minnow, 4 Spikedace, 1 Gila Topminnow, 85 Roundtail Chub[1], 24 Sonora Sucker, 103 Desert Sucker, 262 Speckled Dace, and 264 Longfin Dace (Table 1). For Loach Minnow, catch rates have fluctuated up and down from one year to the next since 2009 (Figure 2). Years with low catch were previously those when flooding occurred immediately before sampling, but no flooding was reported in late August or early September 2017. Also, about 20% of the Loach Minnow were young-of-year in 2017, so reproduction was evident as in previous years (Figure 3). The 2017 length frequency graph appears to be similar to that of 2011, with predominantly younger adult cohorts. Loach Minnow are considered established in Hot Springs Canyon because their catch rates have been fairly consistent and they have reproduced each year since the final stocking. Four Spikedace were captured in 2017 (Figure 4), which is greater than 2015 or 2016, and one of the fish was obviously a young-of-year (Figure 5), so Spikedace are still reproducing. It seems unlikely that Spikedace are reproducing to the point where they are self-sustaining (i.e., established), and it is unclear if they will continue to persist in Hot Springs Canyon. The one Gila Topminnow captured in Hot Springs Canyon likely dispersed downstream from either Wildcat Canyon or Bass Canyon. If Gila Topminnow continues to disperse out of these streams, the species may become established in Hot Springs Canyon.

In Redfield Canyon, Department staff captured 26 Roundtail Chub[1] and 17 Sonora Sucker in one 100-m transect above the waterfall in 2017 (Table 1). They also sampled beyond the transect to collect fin clips from chub for genetic analysis, and captured and additional 44 Roundtail Chub[1], 11 Sonora Sucker and one Speckled Dace. Two of the chub were <50 mm TL, and another 36 were 51-100 mm TL, indicating the species has reproduced in this reach. This was the first year that the reach above the waterfall was surveyed since fish were translocated there from downstream in 2007. So, Roundtail Chub[1], Sonora Sucker, and Speckled Dace have established populations above the waterfall.

Staff captured 56 Desert Pupfish in Mint Spring (Table 2), which was more than the zero captured in 2016. Mint Spring was seined in 2017 rather than sampled by dip nets as was done in 2016, so seining may be a more effective sampling method here. About 29% (16) of the pupfish were <20 mm TL, so the species reproduced in Mint Spring. Because of the reproduction, the Department decided to not stock Desert Pupfish into Mint Spring in 2017.

At Wildcat Canyon 341 Gila Topminnow were captured (Table 2), which is less than the 448 captured in 2016, and more than the 58 captured in 2015. Young-of-year represented over 15% of the catch in 2017 and the previous two years, indicating reproduction each year. Gila Topminnow is now considered established in Wildcat Canyon. Also on September 28, 2017, 128 Gila Topminnow were translocated about 100 m upstream of the initial upper stocking location

[1] Chub in Redfield Canyon and Hot Springs Canyon were previously classified as Gila Chub.

(Appendix 1). Fish were collected the same day during the monitoring effort in lower Wildcat Canyon. There were four mortalities during collection and transport.

At upper Bass Canyon 25 Gila Topminnow were captured (Table 2) which was less than the 70 captured in 2016. About 48% of the Gila Topminnow captured in 2017 were <20 mm TL and about 77% were <20 mm TL in 2016 indicating that reproduction had occurred in both years. Also captured in upper Bass Canyon were 207 Roundtail Chub[1], 1 Sonora Sucker, and 1 Lowland Leopard Frog. In lower Bass Canyon, only 3 Gila Topminnow were captured in 2017 (Table 2) and all were ≥20 mm TL. The lower portion of this site dried during June 2017, which may have affected number of fish captured. However, also captured in lower Bass Canyon during September 2017 were 141 Roundtail Chub[1], 4 Sonora Sucker, 2 Desert Sucker, and 2 Speckled Dace.

Repatriation Stockings. On June 13, 2017 Program, TNC, BLM, FWS, and Reclamation staff visited Double R Canyon to assess suitability for Gila Topminnow. A lower pool (UTM NAD83 571730 3579864) about 30 m in length, with a variety of shoreline vegetation looked like good habitat for Gila Topminnow. An upper pool (UTM NAD83 571778 3579977) was more isolated by intervening dry sections and was about 10 long by 3 m wide and with a maximum depth of 0.4 m. Program staff recommended that Gila topminnow be stocked into the lower section of Double R Canyon in 2017.

On September 18, 2017, 574 Gila Topminnow were stocked into Double R Canyon (Appendix 1). Fish were collected the same day from Headquarters Spring. There were 131 mortalities during collection and transport; mortalities were likely high due to warm water temperatures and muddy conditions during the fish collection.

Recommendations: As of the end of 2017, the multi-agency Muleshoe Native Fish Conservation Team had completed six years of post-stocking monitoring in Hot Springs Canyon and Redfield Canyon. Loach Minnow are considered established in Hot Springs Canyon, but Spikedace numbers have decreased and may not establish or have established a very small population. The multi-agency team recommended that annual monitoring be continued in Hot Springs Canyon. Neither Spikedace nor Loach Minnow established in Redfield Canyon so continued annual monitoring is not necessary. Instead it is recommended that the fish assemblage in Redfield Canyon be monitored every three years. Gila Topminnow is now considered established in Wildcat Canyon, so that population can now be monitored every three years.

Monitoring of Gila Topminnow in Bass Canyon should continue until 2019 because more were stocked in 2016. Gila Topminnow should be monitored to determine if they establish in lower Double R Canyon until at least 2020, and longer if more are stocked.

Monitoring of Desert Pupfish in Mint Spring should continue until at least 2019. More Desert Pupfish should be stocked into Mint Spring, Larry & Charlie Spring, and Secret Spring as necessary.

Fresno Canyon repatriations

Recovery Objectives:

- Gila Topminnow 1999 draft revised recovery plan objective 2.2. Reestablish Gila topminnow in suitable habitats following geographic guidelines.
- Gila Topminnow 1999 draft revised recovery plan objective 3. Monitor natural and reestablished populations and their habitats.
- Gila Chub draft recovery plan objective 2. Ensure representation, resiliency, and redundancy by expanding the size and number of populations within Gila chub historical range via replication of remnant populations within each RU.
- Gila Chub draft recovery plan objective 7. Monitor remnant, repatriated, and refuge populations to inform adaptive management strategies.

Background: The purpose of this action was to establish viable populations of Gila Topminnow and Roundtail Chub[1] into Fresno Canyon. Fresno Canyon was treated with rotenone in 2007 to remove Green Sunfish. Afterwards, Gila Topminnow naturally colonized from upstream Coal Mine Canyon, but topminnow and Longfin Dace were also stocked in 2008. The plan was to also stock Roundtail Chub[1] (Sheehy Spring lineage), but that was delayed until after a Habitat Conservation Plan could be completed for the private land on which Sheehy Spring is located. The Habitat Conservation Plan was completed in late 2016. Catch rates of chub in Sheehy Spring have been low (less than 90 captured) since 2011 (Figure 6), so this small population is at risk of extirpation from stochastic events. Reproduction was evident in most years (Figure 6), but 2009 had the highest percentage of fish <50 mm TL (54.3%) and the highest total number of fish captured (385). It is unclear why catch rates were so much higher in 2009 than the other years.

Results: The Department's Aquatic Wildlife Branch staff coordinated potential native fish conservation actions with the landowner and FWS staff while they surveyed Sheehy Spring and other sites in the San Rafael Valley during June 2017. Only 13 chub were captured in 2017, which is the fewest number since 2007, but catch rates have been stable, but very low since 2011 (Figure 6). The group considered a direct translocation to Pasture 9 Tank, so that a refuge population could be established there. However, aquatic vegetation in Pasture 9 Tank had grown very dense and only 31 Gila Topminnow were captured, so habitat may not be very suitable for chub.

[1] Chub to be repatriated were previously classified as Gila Chub.

Recommendations: Fewer than 100 chub have been captured in Sheehy Spring every year since 2011, so the population could become extirpated if a stochastic event altered environmental conditions in the spring channel or if habitat quality worsens. Action needs to be taken to secure the population. Some potential actions are: 1) improve habitat at Sheehy Spring; thin out the riparian vegetation to provide more open water; 2) decrease completion and predation by eradicating Western Mosquitofish and relocating Sonora Mud Turtles to the Santa Cruz River; 3) capture a portion of the population and move to one or more refuge sites (pond or facility) for propagation; 4) capture as many chub as possible and move to one or more refuge sites (e.g., Pasture 9 Tank or ARCC) where they might be able to establish a larger population.

If chub are transported to a facility for propagation, or to refuge sites, then progeny from these locations can be used to establish a population at Fresno Canyon. If habitat improvements and competition and predation abatement result in an increased chub population in Sheehy Spring, then progeny from the spring could be used to establish a population at Fresno Canyon.

Bonita Creek renovation and repatriations

Recovery Objectives:

- Spikedace recovery objective 6.2.5 Reclaim as necessary to remove non-native fishes.
- Spikedace recovery objective 6.3. Reintroduce Spikedace to selected reaches.
- Spikedace recovery objective 6.4. Monitor success/failure of reintroductions.
- Loach Minnow recovery objective 6.2.5 Reclaim as necessary to remove non-native fishes.
- Loach Minnow recovery objective 6.3. Reintroduce Loach Minnow to selected reaches.
- Loach Minnow recovery objective 6.4. Monitor success/failure of reintroductions.
- Gila Topminnow 1999 draft revised recovery plan objective 2.2. Reestablish Gila topminnow in suitable habitats following geographic guidelines.
- Gila Topminnow 1999 draft revised recovery plan objective 2.4 Protect habitats of reestablished or potential populations from detrimental nonnative aquatic species.
- Gila Topminnow 1999 draft revised recovery plan objective 3. Monitor natural and reestablished populations and their habitats.
- Desert Pupfish recovery objective 2. Re-establish Desert Pupfish populations.
- Desert Pupfish recovery objective 5. Monitor and maintain natural, re-established, and refugium populations.

Background: The Department, Bureau of Land Management, Reclamation, and USFWS began implementing a native fish restoration project in Bonita Creek near Safford during 2008 with the construction of a fish barrier. The same year, a reach between the City of Safford infiltration gallery dike and the constructed fish barrier was chemically treated with rotenone to eliminate nonnative fishes (Robinson et al., 2009). Following the renovation, salvaged native fishes

Roundtail Chub[1], Longfin Dace, Speckled Dace, Sonora Sucker, and Desert Sucker were returned to the treated reach. In addition, federally-listed Loach Minnow, Spikedace, Desert Pupfish, and Gila Topminnow were translocated to and stocked into the treated reach. Nonnative fish were found in the treated reach in 2009, and Bureau of Land Management began leading efforts to mechanically remove them. Plans to stock more threatened and endangered fish into the treated reach were postponed until the nonnative fishes could be eradicated.

However, as planned, the Department stocked the same threatened and endangered fish into upper Bonita Creek (above the infiltration gallery), which is free of nonnative fishes except Fathead Minnow. Spikedace were stocked near Red Knoll in 2009, and both Spikedace and Loach Minnow were stocked near Red Knoll in 2010 (Figure 7). Desert Pupfish and Gila Topminnow were stocked at Lee Trail in 2010 and at Red Knoll in 2011. Of the species stocked, only Gila Topminnow were captured during annual monitoring by BLM, and appeared to have established at Red Knoll. The agencies discussed additional stockings, and in 2014 Desert Pupfish and Gila Topminnow were stocked near the Reservation Boundary, and Gila Topminnow and Loach Minnow near Midnight Canyon. More Gila Topminnow and Desert Pupfish were stocked near the Reservation Boundary in 2015.

The Department monitored for these three species after stocking because the stocking locations were outside of the BLM fixed monitoring sites. At the Reservation Boundary stocking site, 0 Gila Topminnow were captured in 2015 and 31 were captured in 2016. At the Midnight Canyon stocking site, 143 topminnows were captured in 2015 and 55 in 2016. No Desert Pupfish were detected at the Reservation Boundary stocking site in 2015 and 2016. For Loach Minnow downstream of Midnight Canyon, one was detected in 2015 and none in 2016.

Results: On September 26, 2017, Department staff monitored for Gila Topminnow, Desert Pupfish, and Loach Minnow in Bonita Creek. Collapsible minnow traps were set at the reservation boundary stocking pool and at the confluence of Midnight Canyon to monitor for Gila Topminnow. At the Reservation Boundary stocking site, 280 Gila Topminnow were captured, whereas at the Midnight Canyon stocking site 85 Gila Topminnow were captured (Table 3). Both size classes of Gila Topminnow were captured indicating that reproduction had occurred. Gila Topminnow will likely establish at both the Reservation Boundary site and the Midnight Canyon site. The beaver dam pool at Reservation Boundary where Desert Pupfish were previously stocked was dry, so traps were set about 80 to 100 m downstream. No Desert Pupfish were captured (Table 3), making this the third year that Desert Pupfish were absent from the catch. Loach Minnow were monitored using single-pass electrofishing at three 100-m sites downstream of the Midnight Canyon confluence (Table 4). No Loach Minnow were captured, making it the second consecutive year that none have been captured.

[1] Chub in Bonita Creek were previously classified as Gila Chub.

On September 27, 2017, Department, USFWS, and BLM staff reassessed habitat for Loach Minnow between Red Knoll and Midnight Canyon. In this section, there was 520.5 m of riffle habitat that the Department considered was suitable for Loach Minnow; USFWS and BLM staff reserved their judgement as to suitability.

Recommendations: The Department, BLM, and USFWS need to reach an agreement as to whether or not habitat in the reach between Red Knolls and Midnight Canyon is suitable for loach minnow. If deemed suitable, then more Loach Minnow should be stocked in 2018. Regardless, annual monitoring for Loach Minnow between Midnight Canyon and Cottonwood Canyon should be completed through 2019.

Monitoring of Desert Pupfish and Gila Topminnow at the Reservation Boundary sites and Gila Topminnow at the Midnight Canyon site, should continue until at least 2018. Desert Pupfish do not appear to be establishing, so further augmentations are not recommended.

Arizona trout stream Loach Minnow repatriations

Recovery Objectives:

- Loach Minnow recovery objective 6.3. Reintroduce Loach Minnow to selected reaches.
- Loach Minnow recovery objective 6.4. Monitor success/failure of reintroductions.

Background: The purpose of this project was to stock Loach Minnow into secure Apache Trout Recovery streams. During 2007-2009 Department staff coordinated with Apache-Sitgreaves National Forest and the Department's Region 1 regarding potential repatriation streams. The best potential streams were determined to be West Fork Black River and Bear Wallow Creek. Fish Creek was a third choice, but became impaired after the 2011 Wallow Fire, which caused damage to the existing fish barrier. Much work is required before Loach Minnow could be repatriated. The Department's Sport Fish Conservation and Mitigation Program (CAMP) began in 2011, and had a similar project, therefore the Department decided to have the CAMP program implement the Loach Minnow repatriations in Apache Trout streams. The preferred source lineage was East Fork Black River, but unfortunately it was last captured in 2006. The next preferred source is White River, but that is on White Mountain Apache Tribe (WMAT) land. The Department and U. S. Forest Service (USFS) have been communicating with WMAT for years to acquire White River Loach Minnow and bring them to the hatchery. The Program provided funds to WMAT to conduct surveys to better determine the status of Loach Minnow in the White River drainage.

Results: No work was completed on this task during the reporting period. However, during the performance period, Department staff evaluated several Arizona trout streams for loach minnow habitat, details of which are summarized under the Assess Potential Repatriation Waters priority action.

Recommendations: The project could be dropped from the list of priority actions, because the Department's CAMP program is implementing the actions.

Gila Topminnow stockings

Recovery goals(s):

- Gila Topminnow 1999 draft revised recovery plan objective 2.2. Reestablish Gila topminnow in suitable habitats following geographic guidelines.
- Gila Topminnow 1999 draft revised recovery plan objective 3. Monitor natural and reestablished populations and their habitats.
- Desert Pupfish recovery objective 2. Re-establish Desert Pupfish populations.
- Desert Pupfish recovery objective 5. Monitor and maintain natural, re-established, and refugium populations.

Overall Background: The purpose of this action is to establish Gila Topminnow populations throughout the Gila River Basin in Arizona. The target is six new repatriations per year. Desert Pupfish are sometimes stocked into the same sites because the species utilize similar habitats. The Department coordinates with USFWS about locations to stock and sources and lineages of fish to use. The strategy is to stock over 500 Gila Topminnow initially, and for any subsequently needed augmentations to establish a population. Populations are typically augmented if fewer than 100 fish are captured or observed during monitoring. After stocking, the populations are monitored at 6-months and then annually thereafter for three years after the last stocking event. If they are considered established after the third post-stocking monitoring, then the monitoring responsibilities are passed on to other Department programs or other agencies, and augmentation responsibilities are passed on to other Department programs or the USFWS. Monitoring techniques are consistent from year to year for a given site, and usually involve 10 minnow trap sets per site, but dip nets or seines are sometimes used if habitat is amenable.

Sites Visited During 2017:

Arnett Creek

Background: In 1992, the Department, Tonto National Forest, and USFWS identified an opportunity to reestablish a native fish community in Arnett Creek and its tributary Telegraph Canyon. In the late 1990s, after environmental planning, a fish barrier was built, the stream was chemically treated to remove nonnative fishes, and a few native fish were stocked. Unfortunately those fish did not establish populations, likely because too few were stocked and drought greatly reduced the amount of perennial water in the system.

The partners re-evaluated the stream in 2007, and determined that the small amount of habitat was probably only suitable for Longfin Dace and Gila Topminnow. The plan was to stock

Longfin Dace first, and if they established a population, to move forward with Gila Topminnow. Longfin Dace were stocked in 2007, and they did establish.

During 2010-2015, Department staff surveyed the few tanks and potential perennial reaches upstream of the proposed stocking locations and did not detect any nonnative fish.

Results: On May 15, 2017, Department, Tonto National Forest, and USFWS staff stocked 522 Gila Topminnow into Arnett Creek. All fish were stocked into the two pools located within the perennial reach. The majority of fish stocked were >20 mm; however, there were some ≤20 mm individuals that were born overnight in the cooler. Fish behaved normally upon release; there were 11 mortalities during collection and transport (8 were ≤20 mm). Gila Topminnow were collected from Timbucktwo Pond (Redrock Canyon lineage) on May 12, 2017 and held over the weekend inside the Department Headquarters' warehouse.

On October 18, 2017, Department staff monitored for Gila Topinnow in Arnett Creek. They set 10 minnow traps for over 2 hours and captured 74 Gila Topminnow (13 were ≤20 mm) and 77 Longfin Dace (6 were ≤40 mm). They also performed 14 dip net sweeps and captured 16 Gila Topminnow (3 were ≤20 mm), 6 Longfin Dace (≤40 mm), and 2 Lowland Leopard Frogs (tadpoles).

Recommendations: Gila Topminnow in Arnett Creek should be monitored until at least 2020, or longer if more are stocked, to determine if they establish. The USFS is scheduled to complete the removal of invasive oleander in Telegraph Canyon in early 2018. Once the oleander removal is completed, Gila Topminnow should be stocked into Telegraph Canyon, and then monitored for at least three years to determine if they establish.

Black Canyon City Heritage Park Pond

Background: Black Canyon City Heritage Park Pond is located within the Agua Fria Drainage in Yavapai County, Arizona. In 2006, the Albin Family donated 30 acres of land, which included a large pond, to Black Canyon City. It was then that the Black Canyon City Council contacted the Department in an effort to establish native fish populations within this man-made pond. In August 2011, Department staff stocked 3,000 Gila Topminnow and 986 Desert Pupfish into Black Canyon City Heritage Park Pond. In November 2012, Department staff stocked an additional 205 Desert Pupfish into the pond. Both Gila Topminnow and Desert Pupfish became established in the pond.

In fall 2016, the Department and Black Canyon City decided to drawdown and dry the pond to eliminate Western Mosquitofish and Tilapia that were illegally stocked into the pond. Before the drawdown, Desert Pupfish were salvaged from the pond and held overwinter at the Department Headquarters' warehouse. Gila Topminnow were not salvaged because of the close similarity to Western Mosquitofish. The pond was drained, left to dry for several weeks, and refilled.

Results: On March 29, 2017, Department staff stocked 122 Desert Pupfish into Black Canyon City Heritage Park Pond. Fish behaved normally upon release; there were no mortalities during translocation.

On November 20, 2017, Department and BLM staff surveyed for Desert Pupfish in the Black Canyon City Heritage Park Pond. They set 20 collapsible minnow traps for a minimum of 2 hours and performed five seine hauls with a 30 ft x 4 ft bag seine. In the minnow traps, 23 Desert Pupfish (20 were ≤20 mm) and 3 American Bullfrogs (tadpoles) were captured. In the seine hauls, 599 Desert Pupfish (484 were ≤20 mm) and several American Bullfrogs (tadpoles and adults) were captured. There were 19 Desert Pupfish mortalities during sampling. Staff did not detect any other fish species in the pond.

Recommendations: Desert Pupfish in Black Canyon City Heritage Park Pond should be monitored until at least 2020 to determine if the population establishes. Additional Desert Pupfish should be stocked in the pond to increase the founding population size. Gila Topminnow should be restocked into the pond in 2018. Roundtail Chub[1] can be stocked in 2018 or later, after Desert Pupfish are established.

Charlebois Spring

Background: Charlebois Spring is located in the Salt River Drainage within Tonto National Forest. In June 1983, Charlebois Spring was stocked with 200 Gila Topminnow and the population persisted there until 2006. In 2015, Department staff confirmed the presence of Gila Topminnow in La Barge Canyon, roughly 7 km downstream of Charlebois Spring. It is likely that these Gila Topminnow came from Charlebois Spring and were flushed downstream during heavy monsoon rains. Since Gila Topminnow persisted at Charlebois Spring for over 20 years, Department staff recommended restocking the species back into the site.

Results: On May 17, 2017, Department staff collected Gila Topminnow (mixed lineage) from Rio Salado Audubon Center and held them overnight inside the Department Headquarters' warehouse. The next day they stocked 622 Gila Topminnow into Charlebois Spring. The majority of fish stocked were >20 mm; however, there were some ≤20 mm individuals that were born overnight in the cooler. Fish behaved normally upon release. There were 14 mortalities during transport, most of which were < 20 mm TL.

On October 19, 2017, Department staff surveyed for Gila Topminnow at Charlebois Spring. They set 10 collapsible minnow traps (7 in the main spring, 3 in the pools below) and captured 14 Gila Topminnow (>20 mm), 2 Lowland Leopard Frogs (tadpole), and 1 Sonora Mud Turtle (juvenile). They also performed 13 dip net sweeps in several pools below the main spring and

[1] Chub to be stocked into Black Canyon City Heritage Pond were previously classified as Gila Chub.

captured 4 Gila Topminnow (>20 mm) and 2 lowland leopard frogs (1 tadpole and 1 juvenile). Visual observations detected about 60 Gila Topminnow, 200 Lowland leopard frogs (mostly juveniles/adults), and 7 Sonora Mud Turtles (adults) throughout the wetted section of Charlebois Spring.

Recommendations: Gila Topminnow in Charlebois Spring should be monitored until at least 2020 to determine if they establish. Additional stockings may occur if deemed necessary. Vegetation removal is recommended to reduce shade over the spring and open up the canopy for Gila Topminnow.

Hidden Water Spring

Background: Hidden Water Spring is located in Cane Spring Canyon, about 0.6 km upstream of the confluence with Cottonwood Creek which flows into Saguaro Lake. Gila Topminnow were stocked into Hidden Water Spring in 1976 and 1981. Gila Topminnows were detected in 2010, but then not in 2011, 2012, or 2013. Therefore, Department staff stocked 544 Gila Topminnow in 2016.

Results: On August 1, 2017, Department staff monitored for Gila Topminnow at Hidden Water Spring. They set 13 collapsible minnow traps for 2 to 3 hours and performed 3 seine hauls. In the minnow traps, 401 Gila Topminnow (78 were ≤20 mm), 283 Longfin Dace (174 were ≤40 mm), and 163 Lowland Leopard Frog tadpoles were captured. In the seine hauls, 24 Gila Topminnow (3 were ≤20 mm), 60 Longfin Dace (38 were ≤40 mm), and 9 Lowland Leopard Frogs (1 adult, 8 tadpoles) were captured. Visual observations also detected about 65 Gila Topminnow. All Gila Topminnow were captured and observed between the upper stocking and the downstream water's end. Longfin dace and Lowland Leopard Frogs were present throughout the entire wetted section of Hidden Water Spring. There were 3 Gila Topminnow and 2 Longfin Dace mortalities during sampling.

Recommendations: Gila Topminnow in Hidden Water Spring should be monitored until at least 2020 to determine if they establish. Additional stockings may occur if deemed necessary.

International Wildlife Museum

Background: The Safari Club International Wildlife Museum (IWM) at 4800 Gates Pass Road, Tucson, has an outdoor exhibit pond consisting of three large, connected pools with a water pump that recirculates water through the system. In 1998, IWM was issued a Wildlife Holding Permit to display federally endangered native fish for educational purposes, as well as to act as a refuge for native fish populations. Subsequently, Gila Topminnow and Desert Pupfish were stocked into the IWM outdoor exhibit pond during 1999. Roundtail Chub[1] were introduced to

[1] Chub stocked into IWM pond were previously classified as Gila Chub.

IWM in 2002. Roundtail Chub[1] were salvaged from O'Donnell Creek before an antimycin treatment to remove nonnative fish.

In August 2015, Western Mosquitofish were detected in the IWM outdoor exhibit pond. As a result, Department staff salvaged Desert Pupfish and Roundtail Chub from the pond and IWM drained and dried the pond to remove Western Mosquitofish. IWM also repaired leaks and then refilled the pond in 2016. Department staff stocked 356 salvaged Desert Pupfish on September 23, 2016 after the pond was refilled.

Results: On June 20, 2017, Department staff removed Goldfish from the IWM outdoor exhibit pond to prepare the pond for Gila Topminnow. They observed about 15 Goldfish in the lower pool; Desert Pupfish were present in all pools. A total of 10 Goldfish were removed from the pond using dip nets and green meanies (experimental gill nets). Seines and collapsible minnow traps (n=14; 2 hour sets) were also used; however, only Desert Pupfish were captured with these methods. In the collapsible minnow traps, 252 Desert Pupfish were captured. Since the removal required staff to be present in the water, the removal effort was ended early to reduce impact to the pond vegetation and water quality.

Recommendations: Additional removal efforts should occur in the IWM outdoor exhibit pond to remove nonnative Goldfish. Additional Desert Pupfish should be stocked in the pond to increase the founding population size. Gila Topminnow and possibly Roundtail Chub[1] should be restocked into the pond in 2018. A few Razorback Suckers should also be stocked to facilitate outreach and education of IWM visitors.

Las Cienegas NCA - Bill's Wildlife Pond

Background: Bill's Wildlife Pond is located in the Gardner Canyon drainage about 2.1 km upstream of the confluence with Cienega Creek. In spring of 2016, BLM informed the Department that work on the pond was completed and it was ready for fish. On August 27, 2016, Department staff stocked 841 Gila Topminnow into Bill's Wildlife Pond.

Results: On August 7, 2017 Department staff monitored for Gila Topminnow in Bill's Wildlife Pond. They set 6 collapsible minnow traps and performed 4 dip net sweeps. In the collapsible minnow traps, 18 Gila Topminnow (11 were ≤20 mm) were captured. In the dip net sweeps, 4 Gila Topminnow (≤20 mm) were captured. Visual observations detected young-of-year Gila Topminnow throughout the pond.

On August 21, 2017, Department staff stocked 636 Gila Topminnow into Bill's Wildlife Pond. Fish were collected earlier in the day from Gaucho Tank (Cienega Creek lineage). There were no mortalities during translocation.

[1] Chub in these locations were previously classified as Gila Chub.

Recommendations: Gila Topminnow in Bill's Wildlife Pond should be monitored until at least 2020 to determine if they establish. Additional stockings may occur if deemed necessary.

Las Cienegas National Conservation Area - Clyne Pond

Background: Clyne Pond is located in the Mud Springs Canyon drainage about 10.5 km upstream of the confluence with Cienega Creek. The pond is adjacent to a private ranch, and the rancher uses the pond to provide water to his livestock. On August 19, 2015 Department and BLM staff stocked 501 Gila Topminnow into Clyne Pond. Since no Gila Topminnow were detected during sampling in August 2016, Department and BLM staff stocked an additional 541 Gila Topminow on August 30, 2016. Seventy-six Roundtail Chub[1] from Cienega Creek were also stocked into Clyne Pond on the same date.

Results: On June 29, 2017, Department and USFWS staff stocked 75 Roundtail Chub[1] (51-100 mm) into Clyne Pond. Fish were salvaged earlier in the day from Cienega Creek (near Mattie Canyon) due to concerns about potential ash flows after the Sawmill Fire. Fish behaved normally upon release; there were 13 mortalities (≤50 mm) during collection and transport.

On August 7-8, 2017, Department and BLM staff monitored for Roundtail Chub[1] and Gila Topminnow in Clyne Pond. To monitor for Roundtail Chub[1], they set 15 mini-hoop nets overnight (14 hour sets) on the shoreline with air pockets to reduce potential stress on Chiricahua Leopard Frogs. To monitor for Gila Topminnow, they set 18 collapsible minnow traps (two hour sets). In the mini-hoop nets, 9 Chiricahua Leopard Frogs (adults) were captured. In the collapsible minnow traps, 92 Gila Topminnow (1 was ≤20 mm) and 1 Chiricahua Leopard Frog (adult) were captured. Visual observations also detected about 475 Gila Topminnow swimming near the collapsible minnow traps during trap checking. No Roundtail Chub[1] were captured or observed during sampling.

On August 22, 2017, Department staff conducted a second monitoring effort at Clyne Pond to detect Roundtail Chub[1]. Ten large hoop nets were set for 2 hours throughout the pond. No Roundtail Chub[1] were captured; however, one Roundtail Chub[1] (>100 mm TL) was visually observed from a kayak while checking traps.

Recommendations: Gila Topminnow and Roundtail Chub[1] monitoring in Clyne Pond should continue until at least 2020 to determine if they establish. More fish of both species may be stocked if deemed necessary.

Las Cienegas NCA - Cieneguita Wetland Crescent Pond

[1] Chub in these locations were previously classified as Gila Chub.

Background: Crescent Pond is one of three ponds in the Cieneguita Wetland in the Empire Gulch drainage about 2.1 km upstream of the confluence with Cienega Creek. It was previously referred to as Cieneguita Wetland Pond #3. In July 2013, Department and BLM staff stocked 290 Desert Pupfish and 240 Gila Topminnow into Crescent Pond. The Desert Pupfish were acquired from Robbins Butte Wildlife Area's Twin Tanks, Desert Botanical Garden, Deer Valley High School, McDowell Mountain Regional Park's Nursery Tank, International Wildlife Museum, and Spur Cross Conservation Area. The Gila Topminnow were captured from Cienega Creek. On August 29, 2016, Department and BLM staff stocked 216 Desert Pupfish into Crescent Pond. These fish were acquired from Cottonwood Tank at Robbins Butte Wildlife Area.

Results: On August 7, 2017, Department and BLM staff monitored for Gila Topminnow and Desert Pupfish in Crescent Pond. They set 5 collapsible minnow traps and 613 Gila Topminnow (244 were ≤20 mm) and 12 Desert Pupfish (2 were ≤20 mm) were captured. Visual observations also detected several hundred Gila topminnow and Desert Pupfish in Cieneguita Wetland Crescent Pond. This was the fourth consecutive year after stocking that Gila Topminnow were detected Crescent Pond and each year over 500 were captured.

Recommendations: Gila Topminnow are considered established at Crescent Pond. However, because Desert Pupfish were stocked in 2016, monitoring should continue until 2019.

Las Cienegas National Conservation Area - Cieneguita Wetland Egret Pond

Background: Egret Pond is one of three ponds in the Cieneguita Wetland in the Empire Gulch drainage about 2.1 km upstream of the confluence with Cienega Creek. It was previously referred to as Cieneguita Wetland Pond #1. In May 2013, Department and BLM staff stocked 751 Gila Topminnow and on August 19, 2015 they stocked 99 Desert Pupfish into Egret Wildlife Pond. On August 29, 2016, Department and BLM staff stocked an additional 252 Desert Pupfish into Egret Pond. These fish were acquired from Cottonwood Tank at Robbins Butte Wildlife Area.

Results: On August 7, 2017, Department and BLM staff monitored for Gila Topminnow and Desert Pupfish in Cieneguita Wetland Heart Pond. They set five collapsible minnow traps and 1,204 Gila Topminnow (409 were ≤20 mm) and 24 Desert Pupfish (14 were ≤20 mm) were captured. There was one Gila Topminnow (≤20 mm) and one Desert Pupfish (≤20 mm) mortality during sampling. Gila Topminnow have been captured for four consecutive years post-stocking, and each year over 500 individuals were captured.

Recommendations: Gila Topminnow are considered established at Egret Wildlife Pond. However, because additional Desert Pupfish were stocked in 2016, monitoring should continue until 2019.

Las Cienegas National Conservation Area - Cieneguita Wetland Heart Pond

Background: Heart Pond is one of three ponds in the Cieneguita Wetland in the Empire Gulch drainage about 2.1 km upstream of the confluence with Cienega Creek. It was previously referred to as Cieneguita Wetland Pond #4. On May 6, 2013, Department and BLM staff stocked 199 Desert Pupfish in Heart Pond. These fish were acquired from Cottonwood Tank at Robbins Butte Wildlife Area, as well as the International Wildlife Museum. During sampling in August 2014, 328 Desert Pupfish were captured; however, in July 2015, only 31 Desert Pupfish were detected (Love-Chezem et al. 2015, Mosher et al. 2016). As a result, Department and BLM staff stocked and additional 99 Desert Pupfish on August 19, 2015. These fish were acquired from Robbins Butte and TNC Lower San Pedro River Preserve pond (Mosher et al. 2016). During annual monitoring in August 2017, Department staff captured 73 Desert Pupfish.

Results: On August 7, 2017, Department and BLM staff monitored for Desert Pupfish in Cieneguita Wetland Heart Pond. They set 5 collapsible minnow traps and 87 Desert Pupfish (11 were ≤20 mm) captured. There were 16 Desert Pupfish (>20 mm) mortalities during sampling.

Recommendations: Desert Pupfish were last stocked in 2015, so this site will be monitored until 2018. One more stocking may be done to help the species establish.

Las Cienegas NCA - Cottonwood Tank

Background: Cottonwood Tank is located in the Gardner Canyon drainage about 5.2 km upstream from the confluence with Cienega Creek. The pond is one of a set of two connected ponds, and is separated from the second pond by a berm and fence. Livestock are allowed to water in the north pond but are excluded from the south pond. On July 15, 2013, Department and BLM staff stocked 269 Desert Pupfish into the south pond. Since only 4 Desert Pupfish were captured during sampling in August 2014, Department and BLM staff stocked an additional 177 Desert Pupfish in October 2014. During sampling in July 2015, 851 Desert Pupfish were captured; however, in August 2016, only 34 Desert Pupfish were captured.

Results: On August 7, 2017, Department staff monitored for Desert Pupfish in Cottonwood Tank. They set 15 collapsible minnow traps and 34 Desert Pupfish (15 were ≤20 mm) were captured. Visual observations also detected several Desert Pupfish in the center of the pond, as well as around the minnow traps.

On August 21, 2017, Department staff stocked 155 Desert pupfish into Cottonwood Tank. Fish were collected earlier in the day from the Phoenix Zoo's Mandarin and Arizona Trail Ponds (Santa Clara Slough lineage). There were no mortalities during translocation.

Recommendations: Desert Pupfish were last stocked in 2017, so monitoring needs to continue until at least 2020 to determine if they establish.

Las Cienegas NCA - Gaucho Tank

Background: Guacho Tank is located in the Gardner Canyon drainage about 1.3 km east of Cottonwood Wildlife Pond. Gila Topminnow was discovered in Gaucho Tank in 2014, and likely were inadvertently transferred to the pond in aquatic plants when preparing the pond for frogs. Since the founder population was unknown, Department staff stocked 512 Gila Topminnow in 2014 to increase genetic diversity. During sampling in July 2015, 1,145 Gila Topminnow, 25 Desert Pupfish, and 1 leopard frog tadpole were captured. Desert Pupfish were not originally stocked into Gaucho Tank, so it is possible that Desert Pupfish were also unintentionally introduced when aquatic vegetation was translocated into the pond. Since the founding population was unknown, Department staff stocked 365 Desert Pupfish into Gaucho Wildlife Pond in August 2015. During annual monitoring in August 2016, 1,132 Gila Topminnow and 56 Desert Pupfish were captured. Thousands of fish were also observed swimming near the surface of the pond.

Results: On August 7, 2017, Department and BLM staff monitored Gaucho Tank for Gila Topminnow and Desert Pupfish. They set 10 collapsible minnow traps and 2,785 Gila Topminnow (1,692 were ≤20 mm) and 166 Desert Pupfish (37 were ≤20 mm) were captured.

Recommendations: This was the third year of post-stocking monitoring for Gila Topminnow and based on catch over that period, Gila Topminnow are considered established at Gaucho Tank. However, because Desert Pupfish were last stocked in 2015, monitoring should continue until 2018.

Las Cienegas NCA - Nogales Spring

Background: Nogales Spring is located in the upper portion of the Wakefield Canyon drainage, about 10 km upstream of the confluence with Cienega Creek. Department and BLM staff stocked 833 Gila Topminnow in May 2012. Nogales Spring was visually surveyed by Department and BLM staff on July 10th, 2012, who observed about 50-100 large and 50 small Gila Topminnow. However, no fish were seen or captured during monitoring in July 2013. Habitat looked suitable in pools downstream, so Department staff stocked 485 more Gila Topminnow in August 2013. However, only 3 Gila Topminnow were captured in August 2014, and none in July 2015. The site appeared to have suitable habitat and was subsequently stocked with 612 Gila Topminnow in August 2015. If fish do not establish, Nogales Spring should be removed as a potential repatriation site or environmental characteristics (water quality and canopy cover) should be evaluated to determine if they are preventing Gila Topminnow establishment.

Results: On August 8, 2017, Department staff monitored for Gila Topminnow in Nogales Spring. They set 7 collapsible minnow traps and 3 Gila Topminnow (>20 mm) were captured. No other fish were observed at the site.

Recommendations: Gila Topminnow were last stocked in 2015, therefore monitoring should continue until at least 2018. Water quality and canopy cover should be assessed during monitoring.

Las Cienegas National Conservation Area – Spring Water Wetland

Background: Spring Water Wetland is located just east of Cienega Creek about 0.4 km upstream of the confluence with Spring Water Canyon. Department and BLM staff stocked 674 Gila Topminnow in May 2013; the fish were acquired from Cienega Creek. Over 8,000 Gila Topminnow were captured during monitoring in 2014, over 1,000 in 2015, and over 12,000 in 2016.

Results: On June 19, 2017, Department and USFWS staff stocked 85 Roundtail Chub[1] into Spring Water Wetland. Fish were salvaged earlier in the day from Cienega Creek between Sanford and Stevenson Canyons due to concerns about potential ash flows after the Sawmill Fire. Initial plans were to move salvaged chub to Clyne Pond; however, there were concerns about water level and frog egg mass predation by Roundtail Chub[1]. Therefore, the Roundtail Chub[1] were translocated to Spring Water Wetland. Fish behaved normally upon release; there were 2 mortalities (≤50 mm) during collection and transport.

Recommendations: Gila Topminnow are considered established in Spring Water Wetland. However, because Roundtail Chub[1] were stocked in 2017, monitoring should continue until at least 2020. Additional Roundtail Chub should be stocked in the pond to increase the founding population size.

San Pedro Riparian NCA - Horse Thief Draw

Background: Horse Thief Draw is a tributary of the San Pedro River, located about 1.2 km north of Highway 80 and 1.3 km west of the San Pedro River. It has about 300 m of perennial water, consisting of shallow runs and glides with interspersed pools, and mixed substrate of cobble, gravel, sand, and clay. Department and BLM staff stocked 519 Desert Pupfish in August 2011. The fish were obtained from Phoenix Zoo and Desert Botanical Garden. On October 20, 2011 Department and BLM staff stocked 381 Gila Topminnow (Cottonwood Spring lineage) and were acquired from ARCC. During monitoring in September 2012, 1 Desert Pupfish and 1 Gila Topminnow were captured, and in July 2013, 2 Desert Pupfish were captured and 8 were observed but no Gila Topminnow were captured or observed. Department staff recommended augmentations of each species. In September 2013, an additional 324 Desert Pupfish and 389

[1] Chub in these locations were previously classified as Gila Chub.

Gila Topminnow were stocked. However, during monitoring in August 2014, only three Gila Topminnow and no Desert Pupfish were captured. In July 2015 and August 2016, no fish were captured or observed (Mosher et al. 2016). Flooding was noted to have changed the habitat in 2014 as most of the stocking pools were filled in with sediment and the head cut at the Gila Topminnow stocking location had advanced upstream (Love-Chezem et al. 2015b).

Results: On August 7, 2017, Department staff monitored for Gila Topminnow and Desert Pupfish in Horse Thief Draw. They performed 10 seine hauls and no Gila Topminnow or Desert Pupfish were captured.

Recommendations: Desert Pupfish and Gila Topminnow have not been detected at the site since 2013 and 2014, respectively. Therefore, both species are considered to have failed to establish and are likely extirpated from the site. As a result, Horse Thief Draw should be removed from further consideration as a repatriation site for Gila Topminnow or Desert Pupfish until habitat quality improves.

San Pedro Riparian NCA - Murray Spring

Background: Murray Spring is an east flowing tributary of the San Pedro River. A perennial section begins about 2.8 km west of the San Pedro River and extends about 1.6 km through a cienega and has pools, runs, and glides. A wastewater facility exists about 1.8 km upstream and provides groundwater input to Murray Spring. About 1.5 km upstream from the confluence with the San Pedro River, is a concrete barrier that seemingly prevents nonnative fishes from moving upstream. Gila Topminnow and Desert Pupfish were stocked in Murray Spring in 2011, 2013, and 2014; however, both species do not appear to be establishing at the site. Gila Topminnow and Desert Pupfish continue to persist at the site, but their abundances are low. It is possible that Longfin Dace are affecting the ability of Gila Topminnow and Desert Pupfish to establish at the site due to competition for habitat and resources. The creek is also thick with sedges and cattails which has decreased available pool habitat for Gila Topminnow and Desert Pupfish over the years.

Results: On August 7, 2017, Department staff monitored for Gila Topminnow and Desert Pupfish in Murray Spring. They set 15 collapsible minnow traps (2 to 2.5 hour sets) and performed 11 dip nets sweeps. In the collapsible minnow traps, 10 Gila Topminnow (>20 mm), 1 Desert Pupfish (>20 mm), 61 Longfin Dace (7 were ≤20 mm), and 48 Northern Crayfish were captured. In the dip net sweeps, 7 Longfin Dace (1 was ≤20 mm) and 3 Northern Crayfish were captured.

On August 21, 2017, Department staff stocked 1,221 Gila Topminnow in two locations in Murray Spring. Fish were collected earlier in the day from Phoenix Zoo (530 individuals of Peck Canyon lineage) and Gaucho Tank (691 individuals of Cienega Creek lineage). There were 29 mortalities during translocation.

Recommendations: Gila Topminnow in Murray Spring should be monitored until at least 2020 to determine if they establish. Since cattails have greatly expanded in the stream bottom and very few pools are left, stream channel improvements at this site are recommended.

Robbins Butte Wildlife Area – Cottonwood Tank

Background: Robbins Butte Wildlife Area is located southwest of Buckeye, south of the Gila River and just west of Highway 80. Cottonwood Tank is located north of the headquarters, past Twin Tanks. Cottonwood Tank is considered an established Desert Pupfish repatriation site; however, due to its proximity to Swimming Pool Tank and Stop Sign Tank, it was monitored in 2017.

Results: On July 25, 2017, Department staff monitored for Desert Pupfish at Cottonwood Tank. They set 10 minnow traps for a minimum of two hours and 38 Desert Pupfish (3 were ≤20 mm) were captured. Visual observations also detected 100 or more Desert Pupfish swimming around the center of the pond.

Recommendations: Periodic monitoring to confirm the population persists and is abundant.

Robbins Butte Wildlife Area – Stop Sign Tank.

Background: Robbins Butte Wildlife Area is located southwest of Buckeye, south of the Gila River and just west of Highway 80. Stop Sign Tank is located just north of the entrance road, and about 2.1 km west of Highway 80. Department staff stocked 571 Gila Topminnow in April 2010. The fish were acquired from Deer Valley High School (Bylas Spring lineage), and Desert Harbor High School (Redrock Canyon lineage).

Department staff monitored the Gila Topminnow in the pond during November 2010, June 2011 and June 2012, and captured over 4,000 topminnow each time, so topminnow were considered established (Pearson 2013). Over 1,000 were captured in June of 2013 for an experiment at ARCC. However, Department staff visited the site in 2014 and did not capture or see any fish. The same was true in nearby Swimming Pool Pond. The Wildlife Area Manager reported that the pond was very green with algae and that boy scouts had removed cattails from the pond, and it was cloudy the day of removal. Too much sediment may have been kicked up and caused the pond to go anoxic, killing all of the fish. Department staff recommended that water be pumped into the pond on a more regular basis to improve conditions for fish. Department staff also planned to restock Gila Topminnow into the pond. In August 2015, Department staff collected Sharp Spring lineage of Gila Topminnow from AD Wash, Buckhorn Spring, and ASU Animal Care Facility and stocked 554 into Stop Sign Tank. In April 2016, Department staff monitored Stop Sign Tank and one Gila Topminnow (>20 mm) was captured.

Results: On July 25, 2017, Department staff monitored for Gila Topminnow at Stop Sign Tank. They set 10 collapsible minnow traps for a minimum of two hours and 652 Gila Topminnow (13 were ≤20 mm) were captured.

Recommendations: Gila Topminnow were last stocked in 2015, therefore monitoring should continue until at least 2018. Department staff recommend that the Area Manager add water to the pond more often to help improve water quality.

Robbins Butte Wildlife Area – Swimming Pool Tank.
Background: Robbins Butte Wildlife Area is located southwest of Buckeye, south of the Gila River and just west of Highway 80. Swimming Pool Tank is located near the headquarters. Department staff stocked 639 Gila Topminnow in November 2009. The fish were acquired from ARCC and were Sharp Spring lineage.

Department staff monitored the Gila Topminnow in the pond during November 2010, June 2011 and June 2012, and captured over 4,000 topminnow each time, so topminnow were considered established (Pearson 2013). However, Department staff visited the site in 2014 and did not capture or see any fish. The Wildlife Area Manager reported that the pond had been drawn down most of the way during maintenance of an adjacent road. Afterwards water was not added and conditions became unsuitable for the fish. Department staff recommended that water be pumped into the pond on a more regular basis to improve conditions for fish. Department staff also planned to restock Gila Topminnow into the pond. In August 2015, Department staff collected Sharp Spring lineage of Gila Topminnow from AD Wash, Buckhorn Spring, and ASU Animal Care Facility and stocked 558 into Swimming Pool Tank. In April 2016, Department staff monitored Swimming Pool Tank and captured 91 Gila Topminnow (>20 mm).

Results: On July 25, 2017, Department staff monitored for Gila Topminnow in Swimming Pool Tank. They set 5 collapsible minnow traps for a minimum of two hours and 390 Gila Topminnow (64 individuals were ≤20 mm) were captured. Water level was low and greenish in color.

Recommendations: Gila Topminnow were last stocked in 2015, therefore monitoring should continue until at least 2018. Department staff recommend that the Area Manager should keep water levels in the tank high at all times, and periodically allow some out flow to improve water quality.

Robbins Butte Wildlife Area – Twin Tanks
Background: Robbins Butte Wildlife Area is located southwest of Buckeye, south of the Gila River and just west of Highway 80. Twin Tanks is located north of the headquarters. Twin

Tanks is considered an established Desert Pupfish repatriation site; however, due to its proximity to Swimming Pool Tank and Stop Sign Tank, it was monitored in 2017.

Results: On July 25, 2017, Department staff monitored for Desert Pupfish at Twin Tanks. They set 10 minnow traps for a minimum of two hours and 507 Desert Pupfish (91 were ≤20 mm) were captured. Visual observations also detected about 50 Desert Pupfish swimming in the north pond at Twin Tanks.

Recommendations: Periodic monitoring to confirm the population persists and remains abundant.

Rock Creek.

Background: Rock Creek is located in the Three Bar Wildlife Area within Tonto National Forest. It is a tributary to the Salt River and flows into Roosevelt Lake. Initial plans were to translocate Longfin Dace from Hidden Water Creek (to help reduce competition and improve establishment success of Gila Topminnow) and stock these fish into Rock Creek. If Longfin Dace persisted at the site, then Gila Topminnow would be stocked in Rock Creek. On July 8, 2016, Department staff collected 274 Longfin Dace from Hidden Water Spring and stocked them into Rock Creek near Three Bar Cabin. There were 10 mortalities during translocation; these fish were small, stressed, and died during transport.

Results: On May 11, 2017, Department and Tonto National Forest staff monitored for Longfin Dace in Rock Creek. Three randomly-selected 100-m backpack electrofishing transects were established throughout the wetted section of the creek. No fish were captured or observed during electrofishing. Based on debris in the riparian area, it appears that the creek may experience high flows during the wet seasons.

Recommendations: Since Longfin Dace do not appear to have persisted at Rock Creek, it is not currently recommended to stock Gila Topminnow. Water quality at the site may not be suitable for fish. Further habitat evaluations should be conducted at the site and further upstream in the canyon-bound section during dryer months.

Rock Spring.

Background: Rock Spring is located in the Mazatzal Mountains within the Tonto National Forest about two miles west of Highway 87 near Sunflower, Arizona. The spring is in the stream bed and produces about a 0.25 km perennial stream immediately downstream; the remaining section of stream is intermittent or ephemeral (Bahm and Carter 2007). In the perennial section of the stream, two pools are located above and three pools below a 1.5 m tall dam. The perennial portion is fenced with a four-strand barbed wire fence to exclude livestock and protect habitat. Gila Topminnow (Lower Santa Cruz River lineage) were initially stocked in Rock Spring (above

and below the dam) in 2013, and later augmented below the dam in 2014 (Frear et al. 2015). Department staff captured 49 Gila Topminnow in October 2013, 130 in August 2014 and 53 in June 2015; both size classes were captured each time (Frear et al. 2015; Mosher et al. 2016). In July 2016, Department staff captured 794 Gila Topminnow and observed 150 Gila Topminnow.

Results: On July 26, 2017, Department staff monitored for Gila Topminnow in Rock Spring. They set 10 collapsible minnow traps for a minimum of two hours and performed six seine hauls. One large Longfin Dace (ripe with eggs) and two adult Sonora Mud Turtles were captured during sampling; however, no Gila Topminnow were captured or observed. Department staff also hiked about 200m downstream from the spring and found seasonal water, but did not observe any fish. This was the third year of post-stocking monitoring for Gila Topminnow and Gila Topminnow abundance has declined, and they are possibly extirpated. Although abundance was high in 2016, no Gila Topminnow were captured in 2017. It is unclear why Gila Topminnow have had a difficult time establishing at Rock Spring. It is possible that water at the site may recede too low during dryer months and that water quality or availability is not suitable for Gila Topminnow.

Recommendations: Rock Spring should be monitored two more times to confirm that Gila Topminnow is absent. A temperature logger should be installed in the deepest portion of the main pool to determine if it goes dry.

Sabino Canyon.

Background: Sabino Canyon is located northeast of Tucson, Arizona within the Coronado National Forest and Sabino Canyon Recreation Area. Sabino Creek, a tributary to the Santa Cruz River, flows southwest through Sabino Canyon and empties into Tanque Verde Wash within Tucson. Sabino Creek was chemically treated in 1999 to remove nonnative Green Sunfish, and afterwards was stocked with salvaged Roundtail Chub[1] (Ehret and Dickens 2009). In August 2015, Department, Coronado National Forest, and USFWS staff stocked 510 Gila Topminnow into Sabino Canyon near a location locally known as The Crack. Gila Topminnow were collected the previous day from Cienega Creek and Road Canyon Tank (Cienega Creek lineage). Since only 72 Gila Topminnow were captured during sampling in June 2016, Department and BLM staff stocked and additional 985 Gila Topminnow on August 30, 2016. These fish were collected earlier in the day from Road Canyon Tank (Cienega Creek lineage).

Results: On June 12, 2017, Department staff monitored for Gila Topminnow in Sabino Canyon. The survey was focused between the original stocking pool and Tram Stop 8; however opportunistic seine hauls and dip net sweeps were also conducted between Tram Stop 8 and Tram Stop 1. In the section between the stocking pool and Tram Stop 8, five seine hauls and two dip net sweeps were conducted and 365 Roundtail Chub[1] and 42 Gila Topminnow (21 were

[1] Chub stocked into Sabino Canyon were previously classified as Gila Chub.

≤20mm) were captured. Eight collapsible minnow traps and one seine haul were also conducted in the stocking pool. Minnow Traps were set for 1 hour and 575 Roundtail Chub[1] were captured; the seine haul captured 101 Roundtail Chub[1]. No Gila topminnow were observed or captured in the stocking pool. In the section below Tram Stop 8 to Tram Stop 1, 12 seine hauls and nine dip net sweeps were conducted. Most of the available water in the latter section was restricted to the bridge crossings. In this section, 637 Roundtail Chub[1] and 63 Gila Topminnow (19 were ≤20 mm) were captured. Gila Topminnow were detected in the lowest pool surveyed which was located just above Tram Stop 1. Gila Topminnow were stocked into Sabino Canyon during 2015 and 2016, and based on monitoring in 2016 and 2017, they are persisting.

Recommendations: Annual monitoring should continue until at least 2019. Gila Topminnow are planned to be stocked in upper Sabino Canyon near the confluence of East Fork Sabino Creek in 2018.

Sheepshead Canyon

Background: Sheepshead Canyon is located within the Coconino National Forest north of Cornville, Arizona. Perennial water begins below a dry waterfall about 1.84 km upstream of the creeks' confluence with Oak Creek. The perennial section of the creek is comprised of a network of channels, pools, and wetlands that are maintained by ground water discharge from numerous springs and seeps within the drainage. A diversion ditch is located about 0.6 km downstream of the dry waterfall and flows southeast to private property in Cornville. In September 2014, 819 Gila Topminnow (Middle Santa Cruz River lineage) were stocked into Sheepshead Canyon: 336 in the pool below the dry waterfall and 483 into the pool above the diversion ditch (Mosher et al. 2016). During monitoring in June 2015, only two Gila Topminnow were captured. An additional 511 Gila Topminnow were stocked in June 2015 immediately after the monitoring. Since only 2 Gila Topminnow were captured during sampling in September 2016, Department staff stocked an additional 656 Gila Topminnow on October 18, 2016. These fish were collected earlier in the day from the Phoenix Zoo (Middle Santa Cruz River lineage).

Results: On September 6, 2017, Department staff monitored Sheepshead Canyon for Gila Topminnow. They set thirteen collapsible minnow traps at let them fish for 3.5 - 5 hours: five in the upper stocking pool, two in the middle stocking pool, and six in the lower stocking pool. In the upper pool, traps captured one Gila topminnow (>20 mm) and two Sonora Mud Turtles. Staff also observed 325 Gila Topminnow swimming outside of the traps. In the middle pool, minnow traps captured 82 Gila Topminnow (10 were ≤20 mm), 1 Sonora Mud Turtle, and 5 Northern Crayfish. Also in the middle pool, staff observed about 50 Gila Topminnow swimming outside of the traps. In the lower pools, traps captured one Northern Crayfish, but staff observed about 25 Gila Topminnow swimming in the pool above the diversion dam.

Recommendations: Gila Topminnow were last stocked in 2016, therefore monitoring should continue until at least 2019. About 1990 fish have been stocked in Sheepshead Canyon since 2014; however, detection of fish during annual monitoring has remained low until 2017. It is possible that habitat may be limiting the ability of Gila Topminnow to establish at this site, so additional monitoring is needed to determine if this species is establishing.

Tortilla Creek

Background: Tortilla Creek is located within the Salt River Drainage within in the Tonto National Forest. It is a tributary to the Salt River and flows into Canyon Lake near Tortilla Flat, AZ. Tortilla Creek has an established population of Gila Topminnow in the lower most section of the creek. Gila Topminnow in this section of Tortilla Creek likely originated from a population stocked in Mesquite Tank #2 (above Unnamed Drainage #68-B) on June 3, 1982. A valve on the dam of Mesquite Tank #2 was opened, allowing it to drain and completely dry out. As a result, Gila Topminnow washed downstream and established a population in Unnamed Drainage #68-B. They either were dispersed further downstream at that time, or were dispersed by floods afterward. As a result the species established in perennial pools in lower Mesquite Creek and lower Tortilla Creek. Due to steep gradient and a few waterfalls, Gila Topminnow did not disperse upstream into the upper perennial section of Tortilla Creek (about 4.3 km upstream of the confluence with Mesquite Creek). Habitat in this section was deemed suitable for Gila Topminnow. The only fish species present in this upper perennial section were nonnative Fathead Minnow; which are thought to have few negative interactions with native fish. Therefore, the plan was to attempt to establish Gila Topminnow in this upper perennial section.

Results: On June 8, 2017, Department staff stocked 548 Gila Topminnow into Tortilla Creek about 4.5 km upstream of the confluence of Tortilla Creek and Mesquite Creek. Gila Topminnow were collected the day prior from the Phoenix Zoo (Middle Santa Cruz River lineage) and held overnight in coolers at Tortilla Campground. Fish behaved normally upon release; however, there were 59 mortalities during transport. Mortalities were likely high as the hike to the site involved walking along a creek bed with extensive boulder scrambling and fish got sloshed around a lot in the transport buckets.

On November 1, 2017, Department and Tonto National Forest staff conducted the first post-stocking monitoring for Gila Topminnow in upper Tortilla Creek. During the hike up to the stocking location, they conducted 20 dip net sweeps in several pools in lower Tortilla Creek (about 200 – 900 m above the confluence with Mesquite Creek) and captured roughly 409 Gila Topminnow throughout this section; these fish are likely migrants from downstream. At the stocking location, they set 10 collapsible minnow traps for two hours and captured 829 Gila Topminnow (211 were ≤20 mm), 110 Fathead Minnow, and 1 Sonora Mud Turtle (juvenile). Leopard Frogs were also observed at the site. Staff also observed Gila Topminnow in a large perennial pool about 280 m below the stocking site.

Recommendations: Gila Topminnow in upper Tortilla Creek should be monitored until at least 2020 to determine if they establish. Additional stockings may occur if deemed necessary.

West Fork Pinto Creek

Background: West Fork Pinto Creek is a tributary to Pinto Creek and is located in the Salt River Drainage within the Tonto National Forest. West Fork Pinto Creek is predominantly dry near Miles Ranch Trailhead; however, there is a ~200 m long perennial section located about 500 m downstream of the confluence of Spencer Spring Creek. This upper perennial section has series of shallow runs and pools and is inhabited by Longfin Dace. Downstream of the Miles Ranch Trailhead, there are several large plunge pools also inhabited by Longfin Dace. Further downstream is a waterfall below which Green Sunfish, Longfin Dace and Desert Sucker were detected in 2016. After three habitat assessments in 2016-2017, and discussions between the Department, USFS, and USFWS, Department recommended attempting to establish Gila Topminnow into the upper perennial section in 2017.

Results: On May 25, 2017, Department and USFS staff stocked 705 Gila Topminnow into West Fork Pinto Creek about 650m below its confluence with Spencer Spring Creek. The majority of fish stocked were >20 mm; however, there were some ≤20 mm individuals that were born overnight in the cooler. Fish behaved normally upon release; there were 6 mortalities during transport. Gila Topminnow were collected the day prior from Robbins Butte Wildlife Area's Swimming Pool Tank (Sharp Spring lineage) and held overnight inside the Department Headquarters' warehouse.

On October 31, 2017, Department, USFS, and USFWS staff monitored for Gila Topminnow in West Fork Pinto Creek. During the survey, there was significantly less water in the creek compared to when Gila Topminnow were stocked in May. The stocking pool, which was about 30 m x 3 m (max depth of 1.1 m) in May, was reduced to 10 m x 0.5 m (max depth of 0.18 m). In addition, water was no longer present at Miles Ranch Trailhead near the old corral and barn. Staff conducted 14 seine hauls from the stocking pool to about 200m upstream where the water ended. They captured 398 Gila Topminnow (238 were ≤20 mm), 336 Longfin Dace (185 were ≤40 mm), and 136 Lowland Leopard Frogs (133 tadpoles, 3 adults). They also conducted a few dip net sweeps in two isolated, perennial pools downstream of the stocking pool; however, only Longfin Dace were captured there.

Recommendations: Habitat is limited in upper West Fork Pinto Creek and this section of stream can likely only support Gila Topminnow and Longfin Dace. Therefore, Department staff recommend that this project be merged with Gila Topminnow Stockings. Additional assessments of West Fork Pinto Creek downstream of Miles Ranch may be of interest as there

are several large plunge pools that may be suitable for Roundtail Chub[1]. Also, USFS indicated there may be suitable habitat for Gila Topminnow at other locations in the drainage (Paradise Spring and Rock Creek), therefore the Department recommends that these locations be evaluated in 2018.

Arnett Creek repatriations

This task was moved under the Gila Topminnow Stockings project; information is provided there.

Spring Creek (Oak Creek tributary) repatriations

Recovery Objectives:

- Spikedace recovery objective 6.3. Reintroduce Spikedace to selected reaches.
- Spikedace recovery objective 6.4. Monitor success/failure of reintroductions.
- Gila Topminnow 1999 draft revised recovery plan objective 2.2. Reestablish Gila topminnow in suitable habitats following geographic guidelines.
- Gila Topminnow 1999 draft revised recovery plan objective 3. Monitor natural and reestablished populations and their habitats.

Background: Spring Creek is a tributary to Oak Creek in the Verde River drainage, and contains Roundtail Chub[2], Speckled Dace, Longfin Dace, Sonora Sucker, Desert Sucker, and Northern Mexican Gartersnake *Thamnophis eques megalops*. A small diversion dam about 0.95 km upstream of Oak Creek seemingly prevented most nonnative fishes from entering the stream above, but there were some records from the 1970s and 1980s of Smallmouth Bass *Micropterus dolomieu* and Fathead Minnow. Green Sunfish were detected below the diversion dam in 2011, and in May 2014 Green Sunfish were captured 2.5 km above the dam. Program and CAMP staff began removal efforts immediately and completed 7 removals in June and July 2014, after which the Department's CAMP staff assumed responsibility of the removal efforts above the dam and completed an additional 5 days of removal in 2014.

The purpose of this multi-agency project was to protect the existing Spring Creek population of Roundtail Chub[1] and other native aquatic species against possible future upstream incursion of nonnative fishes from Oak Creek and the Verde River. Additional benefits would accrue from securing habitat for stocking Spikedace, Gila Topminnow, and possibly Loach Minnow.

Reclamation finished construction of a fish barrier about 1.1 km upstream from the Verde River in April 2015. On May 11, 2015, Department staff stocked 221 Spikedace (Aravaipa Creek lineage), and on August 12, they stocked 668 Gila Topminnow (Lower Santa Cruz lineage).

[1] Chub to be repatriated were previously classified as Gila Chub.
[2] Chub in Spring Creek were previously classified as Gila Chub.

During the first monitoring in September 2015, Department staff captured three Spikedace, three Gila Topminnow, 74 Roundtail Chub[1], 22 Longfin Dace, 95 Speckled Dace, 17 Desert Sucker, and one Northern Crayfish. During the second monitoring in September 2016, no Spikedace were captured. However, one Spikedace (died after capture) was captured outside of the transects during the CAMP Green Sunfish removal. Because so few Spikedace and Gila Topminnow were captured during 2016 monitoring, Department staff stocked 67 more Spikedace and 688 more Gila Topminnow on October 18, 2016. The Spikedace were acquired from ARCC, and the numbers stocked were low because that was all that were available.

Results: During September 5 – 6, 2017, Department and U. S. Fish and Wildlife Service staff completed the annual monitoring of Spikedace and Gila Topminnow in Spring Creek and helped the Department's Region 2 CAMP staff complete a nonnative fish removal. Three 100-m transect electrofishing transects were sampled in Spring Creek and one Spikedace (61mm TL) and two Gila Topminnow (>20mm) were captured (Table 5). In between these stations, during the nonnative removal portion of the trip, 10 Spikedace and 73 Gila Topminnow were captured.

To monitor for Gila Topminnow, 10 collapsible minnow traps were set in the lower U. S. Forest Service section of Spring Creek in the large pool above the fish barrier and 11 collapsible minnow traps were set in the upper U. S. Forest Service section in the two pools adjacent to the Willow Point road crossing. Traps soaked for roughly 5 hours in the lower U. S. Forest Service section and 2 to 2.5 hours in the upper U. S. Forest Service section. In the lower U. S. Forest Service section, 120 Gila Topminnow (3 individuals were ≤20 mm), 88 Roundtail Chub[1] and 5 Northern Crayfish were captured in traps (Table 6); two dip net sweeps were also conducted below the fish barrier and 12 Gila Topminnow were captured. In the upper U.S. Forest Service section, 14 Longfin Dace, 10 Speckled Dace, 30 Roundtail Chub[1], and 68 Northern Crayfish were captured (Table 6).

Recommendations: Because Gila Topminnow and Spikedace were stocked in 2016, and more will likely be stocked in 2018, monitoring should continue until at least 2021. More of each species should be stocked to help them establish populations. Few Spikedace were available for stocking from ARCC in 2016, and a thousand or so were available in 2017 but were held overwinter so that they could grow larger before being stocked in 2018. If no Spikedace or Gila Topminnow are captured for three consecutive years after the final stocking, then consideration should be given to abandoning this site as a recovery stream for these species; or a different stocking strategy should be considered.

Comments: CAMP staff performed a single-pass electrofishing removal through the entire stream length on the two Forest Service sections during September 2017. No Green Sunfish were captured above the constructed fish barrier. One Spikedace was captured in the lower

[1] Chub in Spring Creek were previously classified as Gila Chub.

section of Forest Service property. The Department has now completed 21 removal efforts, and no Green Sunfish have been detected upstream of the fish barrier for the last nine surveys. Based on removal and monitoring events, it is likely that Green Sunfish have been eradicated from Spring Creek above the barrier.

Blue River native fish restoration

Recovery Objectives:

- Spikedace recovery objective 6.3. Reintroduce Spikedace to selected reaches.
- Spikedace recovery objective 6.4. Monitor success/failure of reintroductions.
- Loach Minnow recovery objective 6.3. Reintroduce Loach Minnow to selected reaches.
- Loach Minnow recovery objective 6.4. Monitor success/failure of reintroductions.

Background: The Blue River Native Fish Restoration Project was implemented by the Department, Forest Service, Reclamation, and USFWS, with goals to protect and restore the entire assemblage of native fishes within the Blue River drainage and benefit their conservation status within the Gila River Basin (Reclamation 2010). The major components of the project were construction of a fish barrier, mechanical removal of non-native fishes, and repatriation and monitoring of federally listed warm-water fishes in the Blue River. The focus of the project was in the lower 19 km of the Blue River, from Fritz Ranch to the confluence with the San Francisco River (Figure 8), but additional activities were envisioned upstream (Figure 9) if actions were successful in the lower reach. The Reclamation-funded fish barrier, located in the Blue River about 0.8 km upstream from the confluence with the San Francisco River, was completed in June 2012. Later in the same month, 539 Spikedace and 142 Roundtail Chub were stocked into the lower Blue River above the barrier. Spikedace were upper Gila River lineage and Roundtail Chub were Eagle Creek lineage and both were acquired from ARCC or were directly translocated from the donor streams to the Blue River. Efforts to remove non-native piscivorous fish from the lower Blue River were done once before barrier emplacement (Robinson et al. 2010) and annually thereafter.

During annual post-stocking monitoring, Spikedace catch rates were relatively flat during 2012 through 2014, but then increased in 2015 and 2016 (Figure 10). After the 2015 monitoring, 296 more Spikedace were stocked into the lower Blue River. Electrofishing catch rates for Roundtail Chub showed a similar pattern, but hoop net catch rates dropped from 2012 to 2013, then increased in 2014 and increased again in 2015, but then decreased in 2016. In 2015 876 more Roundtail Chub were stocked into the lower Blue River before the monitoring (Figure 10).

Efforts to mechanically remove piscivorous fish seem to be working (Figures 11 and 12). Nonnative fish are removed both during removal trips, and during annual post-stocking monitoring of native fishes. Catfish were the main targets of removal efforts, and were removed by snorkeling and spearfishing. During the first removal, in June 2009, 70 Channel Catfish and

four Flathead Catfish were removed from the Blue River between Fritz Ranch and the mouth (Robinson et al. 2010). During the June 2012 removal, after the 2011 Wallow Fire related fish kills, and after the fish barrier was constructed, only seven Channel Catfish were captured and removed, but one Green Sunfish was also detected (the first record in the drainage; Robinson et al. 2013). During the November 2012 annual monitoring, no catfish were captured, but 106 Green Sunfish were captured, and removed, throughout the lower Blue River.

In April 2013, Department staff set 87 traps in the reach between Steeple Creek and Fritz Ranch to determine if Green Sunfish had dispersed upstream (Robinson et al. 2014). No Green Sunfish were captured. During the June 2013 catfish removal, only three Channel Catfish were observed and subsequently removed, but 37 Green Sunfish were observed of which 5 were removed. No catfish and six Green Sunfish were detected during annual monitoring in 2013.

In 2014, in addition to the annual snorkeling and spearfishing to remove catfish, two trips to remove Green Sunfish, by trapping and electrofishing, were completed (Robinson and Love-Chezem 2015). During the June 2014 catfish removal, no catfish were detected, but eight Green Sunfish were detected. During the first Green Sunfish removal effort in May 2014, two Green Sunfish were removed from the lower Blue River. During the second Green Sunfish removal, in June 2014, 10 Green Sunfish were removed; no catfish were detected. Five Green Sunfish and no catfish were captured and removed during the October 2014 annual monitoring.

During early June 2015, Department staff set traps in the lower Blue River, and captured and removed nine Green Sunfish (Robinson et al. 2016). Later in June, during the catfish removal, Department staff did not detect any catfish, but did detect seven Green Sunfish. No Green sunfish or catfish were detected during the September 2015 annual monitoring.

To summarize, the number of catfish detected and removed each year has decreased, and was zero for 2014 through 2016 (Figure 11). Similarly, the number of Green Sunfish detected during annual monitoring and the total number removed during all activities has decreased since 2012 (Figure 12).

The USFWS monitored above and below the fish barrier November 14-15, 2017 as part of the post barrier construction effort, and below the barrier found five Channel Catfish and one Green Sunfish (Ehlo 2017). The nonnative fish captured below the fish barrier were PIT tagged and released to evaluate the barrier's effectiveness.

Results: The Department completed native fish conservation actions in the lower Blue River and middle Blue River during 2017. Results of the lower Blue River are presented first.

During June 26 – 27, 2017, Department staff completed the annual piscivore removal in the lower Blue River. They visited 134 pools or locations that were previously pools. 83 pools were snorkeled, 44 were observed from above water because they were too shallow to snorkel through, and 7 pools (001, 002, 003, 009, 010, and 101; all Reach 1) were dry. During the removal, no Green Sunfish or Catfish were detected in the lower Blue River. This is the first year that Green Sunfish were not detected and the fourth year that Catfish were not detected (Figure 10). Estimated numbers of individuals for each species observed during snorkeling was: 1,203 Spikedace, 611 Roundtail Chub, 585 Speckled Dace, 373 Longfin Dace, 811 Sonora Sucker, 761 Desert Sucker, 2 Red Shiner, over 500 larval fish, and over 500 Northern Crayfish.

During the same trip, to capture Green Sunfish, Department staff set 40 mini- hoop nets overnight in all trappable pools from the fish barrier to about 3.3 miles upstream of the barrier (Reach 1 and the lower third of Reach 2), as well as further upstream in pools where deep undercuts or thick vegetation was present. No Green Sunfish were captured. Traps captured 15 Roundtail Chub, 26 Desert Sucker, 42 Sonora Sucker, 15 Sonora Mud turtles, 5 Canyon Treefrog tadpoles, and 446 Northern Crayfish. Mortalities in traps were 4 Sonora Sucker, 2 Desert Sucker, 5 tadpoles, and possibly 2 Sonora Mud Turtles. All Northern Crayfish captured were killed. Three traps were removed from the water by an unknown mammal (bear, raccoon or coati) and 4 traps were not set effectively to catch fish (not zipped shut). One PIT tagged chub (#989001004016797) was captured at Pool 58b (Reach 4). This was the first time this chub was captured since it was stocked in April 2015 near the USGS gage; it was captured about 1.55 km downstream of where it was stocked. This individual was 128 mm TL when it was marked at ARCC on February 23, 2015, and when recaptured on June 27, 2017 it was 258 mm TL.

During October 22-24, Department staff completed the annual post-stocking native fish monitoring in the lower Blue River. Spikedace was the most abundant species captured by electrofishing, followed by Desert Sucker, Speckled Dace, Sonora Sucker, Loach Minnow, Longfin Dace, and Roundtail Chub (Table 7). The only nonnative fish species captured was Red Shiner, and only one was captured. Spikedace, Roundtail Chub, and Loach Minnow were captured in every reach in 2017, and so are well distributed in the Lower Blue River. Electrofishing catch rates for Spikedace, Loach Minnow, and Roundtail Chub have been increasing since 2014 (Figure 10). Roundtail Chub catch rates in hoop nets have not shown the same trend (Figure 10), likely because hoop nets are only set in pools, whereas all habitat types are sampled by electrofishing. The stocking of Spikedace in December 2015 likely contributed to the increased catch rate in 2016 (Figure 10); a similar pattern seemed evident for Roundtail Chub in 2015 and Loach Minnow in 2017. Based on examination of length-frequency diagrams, two cohorts of Spikedace and Roundtail Chub were obvious in 2016 and 2017, but less so in previous years (Figures 13 and 14). Also, YOY Roundtail Chub and Spikedace were obvious in 2014, 2015, and 2016, and YOY Loach Minnow in 2015 and 2016 (Figure 15). We conclude

that Spikedace and Roundtail Chub are established in the lower Blue River. Loach Minnow appear to be recovering in abundance following the fish kill after the 2011 Wallow Fire.

Eight of the Roundtail Chub captured during the annual monitoring, all from electrofishing, had PIT tags. These chub were marked at the hatchery before being stocked in 2015 near the USGS gage just downstream of Juan Miller Crossing. All of the chub were captured upstream of where they were stocked: one was 1.13 km, four were 2.28 km, two were 2.83 km, and one was 3.81 km upstream.

In hoop nets Department staff captured 32 Roundtail Chub, 1 longfin Dace, 48 Sonora Sucker, 3 Desert Sucker, 1 Fathead Minnow, and 76 Northern Crayfish (Table 8). Relatively low numbers of fish were captured in hoop nets in 2017 and 2016 (85 and 107 respectively) compared to 2015 when 1,244 fish were caught in hoop nets (Robinson et al. 2017; Robinson and Love-Chezem 2016). It is unclear why the number of fish captured in hoop nets has fluctuated so much over the six years of monitoring. Department staff captured fewer chub in hoop nets this year (37) compared to last year (52), but more Sonora Suckers (61 this year and 55 last year). Plus they captured Desert sucker in hoops this year, but none last year. Note that hoop net catch rates in 2016 were number of fish per 12 hours but the 12 hours was inadvertently omitted from the table (Robinson et al. 2017). Department staff also captured, and took pictures of a Lowland Leopard Frog (and saw a few more), and an Arizona Toad, and found a dead Blacknecked Gartersnake on the bottom of the stream (something had eaten its head off).

On September 11, 2017, Department staff baited and set 22 large hoop nets overnight (18-19 h) in Lazy YJ Ranch Pond. A total of 274 Roundtail Chub (97 – 223 mm TL), 72 Sonora Sucker, 6 Desert Sucker, 23 Longfin Dace, 186 Northern Crayfish, and 1 Painted Turtle (*Chrysemys picta*) were captured.

On September 12, 2017, Department staff set 18 large hoop nets overnight (17-20 hour soak times) in the middle Blue River between The Box and McKittrick Creek. A total of 57 Roundtail Chub (119 – 228 mm TL), 78 Sonora Sucker, 15 Desert Sucker, 50 Longfin Dace (1 mortality), 18 Speckled Dace (1 mortality), 106 Northern Crayfish, and 1 Narrow-headed Gartersnake (mortality; eaten by crayfish), and were captured. Most of the Roundtail Chub were captured between The Box and Cole Flat, but they were captured as far as 600m downstream of Cole Flat (UTM NAD83 12S 667131 3712501). Chub were originally stocked in 2016 at two locations within this reach – 566 chub were stocked in the pool below the waterfall below The Box, and 628 were stocked at the upper end of Cole Flat, so some had dispersed about 1.1 km downstream of the stocking location. The narrow-headed gartersnake was captured at UTM NAD83 12S 666731 3711139.

On September 13, 2017, Department staff stocked 448 Spikedace (plus 51 mortalities) into two locations about 100-m apart in the upper Blue River at Cole Flat. Mortalities for Spikedace were likely high because the fish were part of an eDNA study and were held in collapsible minnow traps for several hours before release. Spikedace were collected by seining from the lower Blue River near Juan Miller Crossing on September 12, 2017.

Recommendations: Continued monitoring of Spikedace and Roundtail Chub in the lower Blue River should continue until at least 2018, even though the monitoring data indicate that they have established. Roundtail chub should be monitored through 2021 in the middle Blue River, between The Box and McKittrick Creek to determine if they have established there. Spikedace should be monitored through 2022 in the middle Blue River to determine if they have established there.

Green Sunfish removals in the lower Blue River should be continued for at least 2-4 more years to confirm that they are eradicated. Snorkeling through all pools, in addition to trapping, should also continue because snorkeling seems to be the most efficient way to detect Green Sunfish.

Miscellaneous stock tank surveys

Recovery Objectives:

- Gila Chub draft recovery plan objective 2.1. Prepare and protect streams appropriate for replications
- Spikedace recovery objective 6.2.3 Assess status of non-native fishes in the watershed.
- Loach Minnow recovery objective 6.2.3 Assess status of non-native fishes in the watershed.
- Gila Topminnow 1999 draft revised recovery plan objective 2.4 Protect habitats of reestablished or potential populations from detrimental nonnative aquatic species.

Background: The purpose of this action was to survey all stock tanks in stream systems where nonnative fish removal efforts and fish barriers were planned, to determine the sources of nonnative fishes. Stock tank surveys have been completed in the O'Donnell Creek drainage (Ehret and Frederick 2008), Mineral Creek drainage (Crowder and Robinson 2011; Crowder et al. 2014), Blue River drainage (Crowder et al. 2013), and most of the Grapevine Canyon drainage (New River; Robinson 2009), and most of the Sonoita Creek drainage (Ehret and Dickens 2009b). These surveys were typically completed by making several hauls of a large bag seine across the ponds.

Results: Department staff surveyed stock tanks in one drainage during 2017. During May – June 2017, Department staff used a bag siene (30 ft x 4 ft bag seine with 4 ft bag) to survey 43 stock tanks in the Red Tank Draw (Rarick/Mullican Canyon) drainage for nonnative fish (Table 9; Figure 16). Of the 43 stock tanks surveyed, only three locations contained fish: Mullican

Place Tank, Rarick Tank, and the large tank/pool below Gnat Tank. In Mullican Place Tank, 1 Green Sunfish, 17 Black Bullhead, and 1 Northern Crayfish were captured in three seine hauls. In Rarick Tank, 509 Fathead Minnow (adult and YOY) and 11 Northern Leopard Frog (1 adult, 10 tadpoles/juveniles) were captured in three seine hauls. In the large tank/pool about 40 m below Gnat Tank, 39 Fathead Minnow (adult and YOY) were captured in three seine hauls (15ft x 3ft straight seine).

The only stock tank that Department staff was unable to survey in the Red Tank Draw drainage was Bruce Place Tank. This tank is located on private property and the landowner would not permit access to his property. The landowner did indicate that there were fish present in his tank.

Recommendations: For 2018, if the winter of 2017-2018 is dry, the stock tanks with fish in Red Tank Draw drainage should be revisited to determine if they went dry.

Assess potential repatriation waters

Recovery Objectives:

- Spikedace recovery objective 6.2. Identify river or stream systems for reintroductions.
- Loach Minnow recovery objective 6.2. Identify river or stream systems for reintroductions.
- Gila Topminnow 1999 draft revised recovery plan objective 2.1. Identify habitats suitable for reestablishment of Gila topminnow.
- Gila Chub draft recovery plan objective 2.1. Prepare and protect streams appropriate for replications.

Background: The purpose of this project is to assess waters in the Gila River Basin to determine if they are suitable for repatriations of Spikedace, Loach Minnow, Gila Topminnow, Roundtail Chub[1], or other native fishes. Below are summaries of each of the waters assessed during 2017, with coordinates provided in Table 10.

Results: A map showing locations of each of the streams assessed is in Figure 17.

Buehman Canyon and Bullock Canyon. On October 12, 2017, Department and Pima County personnel did an initial assessment of potential fish habitat within Buehman Canyon drainage in Pima County; participants included Ross Timmons and Kaleb Smith from AGFD, and Ian Murray and Marisa Rice from Pima County. The perennial pools and springs along the Bullock Canyon and Buehman Canyon drainages, were visited, but staff did not hike through Buehman Canyon. Habitat that may prove suitable for topminnow was found at Bullock Canyon (1 small, 1 medium and 1 large pool), with the largest pool potentially suitable to sustain 100-300 chub and a few thousand Gila Topminnow. Bullock Canyon is a tributary to Buehman Canyon.

Habitat also suitable for topminnow was found at an unnamed spring on a private parcel along Buehman Canyon. About 700 m of surface waters was detected. Ian Murray with Pima County

reports surface waters here are greatly reduced by June, with the pool at the spring dwindling to perhaps as small as 100 m by 2 m by 1 m deep. The only fish seen in Bullock and Buehman canyons was Longfin Dace. Other species observed include Sonora Mud Turtle (12S 541290E 3582592N), Lowland Leopard Frog, Red-spotted Toad and Canyon Treefrog.

Recommendations: Buehman Canyon and Bullock Canyons need to be examined during June to evaluate it during the driest period, to determine whether suitable habitat persists. Pima County personnel carry-out wet-dry mapping during June, and AGFD should accompany them and do a comprehensive assessment then. However, Buehman Canyon has been assessed in past years, and every assessment has concluded that it is suitable for Gila Topminnow. Therefore Department staff recommend that Gila Topminnow be stocked into Buehman Canyon and Bullock Canyon at the locations visited during the October 2017 survey. The private landowners upstream and downstream of Pima County Property will need to be contacted before any stockings occur.

Cave Creek, North Fork Cave Creek, and South Fork Cave Creek. During July 10 – 11, 2017, Department staff assessed stream habitat in Cave Creek, South Fork Cave Creek, and North Fork Cave Creek in the Chiricahua Mountains. Survey efforts were focused at two 100-m transects in Cave Creek (UTM NAD83 12S 673178 3529697 and 666262 3526586), five 100-m transects in South Fork Cave Creek (UTM NAD83 12S 671370 3527216, 670483 3525251, 669658 3524809, 668829 3524359, and 668492 3524164), and one 100-m transect in Cave Creek (UTM NAD83 12S 665185 3529976). All transects, except for the lowest transect in South Fork Cave Creek were surveyed by the Department's Native Trout Program in 2015. Overall, the locations surveyed did not appear suitable for Loach Minnow, Gila Topminnow, or Roundtail Chub[1] at this time as much of the habitat in each stream was either dry or consisted of high gradient riffle and cascade habitat. Dace were present in interrupted pools in the lower portion of South Fork Cave Creek near the South Fork Campground. No dace were observed higher up in South Fork Cave Creek, though stream habitat appeared suitable for dace in these sections.

Recommendations: None of the streams in the Cave Creek drainage currently appeared suitable for Gila Topminnow, Spikedace, Loach Minnow, or Roundtail Chub[1], therefore these streams can be removed from consideration as repatriation locations for these species. The streams should be evaluated every 5 years to determine if habitat has recovered enough to support other fish species.

Copper Creek: On February 22, 2017 Department staff joined Tonto National Forest Service personnel, USFWS personnel, the rancher and ranch hand in a trip to Copper Spring and Silver Creek. Department staff asked the rancher and ranch hand if Copper Creek near copper Spring always held water. They both replied that it had gone dry twice in the last 5 years. The stream

[1] Chub to be considered for repatriations were previously classified as Gila Chub.

below the spring had flowing water, but it had rained substantially the week before, so the soil in the area was still saturated. There was a pool (at about 414339mE, 3784419mN; NAD 83) below the two waterfalls and the associated high gradient, that had deer grass around it and that was about 0.75 m deep; this pool looked suitable for fish if it was perennial. The rancher and ranch hand indicated that even this pool went dry. Personnel hiked upstream of the two waterfalls to a pool that the ranch hand thought held water for the longest period. That pool however was in bedrock and in a fairly high gradient stretch, so was not very suitable for Gila Topminnow.

Recommendations: To confirm the rancher's claim, Copper Creek needs to be visited in June to better assess if it is suitable for fish establishment. A temperature logger could be installed at deepest part of the lower pool, which would provide data on whether or not the pool goes dry; if it went dry the daily fluctuations in temperature would greatly and quickly increase.

East Turkey Creek. On July 11, 2017, Department staff assessed stream habitat in East Turkey Creek in the Chiricahua Mountains. Survey efforts were focused at five randomly-selected 100-m transects in the creek (UTM NAD83 12S 668015 3533601, 667138 3532627, 666541 3532160, 665281 3531683, and 664767 3531454). Habitat above the main road crossing in East Turkey Creek was flowing continuously and consisted predominately of slick bedrock runs and pools. This section looked suitable for Speckled Dace and possibly Roundtail Chub[1]; however, there were several bedrock waterfalls and slides (2 m to 3 m high) throughout this reach which may reduce interactions between stocked fish. Fish could also potentially be washed out from this section during flash floods. The portion of East Turkey Creek below the road crossing consisted of interrupted habitat with shallow riffle, runs, and pools. The largest pool observed was located above a 10 m tall waterfall and was 4 m x 4 m with a max depth of 0.83 m. This section appeared suitable for Speckled Dace; however, habitat is limited.

Recommendations: Speckled Dace can be stocked into East Turkey Creek upstream of the main road. However, because Speckled Dace is not a priority species for GRNFCP, the Department's Region V staff or WMAQ staff could take the lead if deemed a priority.

Foote Creek. During July 17 – 18, 2017, Department staff assessed habitat (primarily for Loach Minnow) in Foote Creek, a tributary of the Blue River. All stream habitat was walked in Foote Creek; however survey efforts were focused at three randomly-selected 100-m transects in the creek (UTM NAD83 12S 671684 3719141, 671463 3720499, and 671461 3723300). Based on these transects, Foote Creek consisted of predominately riffle habitat with cobble substrate. Substrate embeddeness was moderate to high in Foote Creek and was typically greater than 50% at each transect. Overall, Foote Creek may be suitable for Loach Minnow if the substrate embeddedness reduces over time; however, it is unclear if the creek is perennial as yellow-brown algae covered most of the substrate throughout the creek and water flows doubled following

[1] Chub considered for repatriation were previously classified as Gila Chub.

afternoon and evening thunderstorms. Although standardized fisheries surveys were not conducted during the assessment, staff visually observed Speckled Dace, suckers, and Brown Trout in the creek. The Brown Trout appeared to be restricted to the most downstream pools in Foote Creek near its confluence with the Blue River.

Recommendations: It is unclear how much perennial habitat is available in Foote Creek. Plus, the cobble and boulders were embedded. Therefore, Department staff does not recommend stocking Loach Minnow into Foote Creek at this time.

Haunted Canyon: On March 27, 2017 Department staff assessed fish habitat in Haunted Canyon, tributary to Pinto Creek on Tonto National Forest west of Globe, Arizona. They assessed the reach between Pinto Creek up to Tony's Ranch Spring. Water was flowing throughout most of Haunted Canyon, but much of it appeared to be winter runoff (the upper portion above Powers Gulch appeared sterile with few insects and little algae). They visited three random 100-m electrofishing transects, and electrofished other locations of interest. Transect 1 (499072 3695799) below the narrows was dry. They walked up the stream channel from there to determine if there was a waterfall in the narrows (topographic contour lines were very close together), but none was found. Above the narrows they sampled Transect 2 (498340 3695496) and Transect 3 (494989 3694636; about 100m below Tony's Ranch Spring) which consisted of predominantly riffle and run habitat; shallow pools and cascades were also present. No fish were captured at either of these sites and both sites did not appear to be perennial (although one pool in Transect 3 looked like it may be permanent). If Transect 3 is actually perennial, it may provide suitable habitat for Gila Topminnow. They did detect a potential fish barrier below Transect 3 at 495572 3695199. The barrier consisted of a 3m bedrock/boulder drop located next to a steep bedrock slide; this portion was dry. They also electrofished below an unnamed spring (495648 3695277) downstream to 495693 3695361 and did not capture any fish; they did observe water striders, stonefly larva, hellgrammites, and a dead Madrean Alligator Lizard. This spring was gushing water out of the base of a limestone cliff, and given the volume of water flowing out is probably perennial. Also, there was a section of stream near the confluence with Pinto Creek that looked perennial based on the amount and kinds of algae and aquatic insects, and also had numerous large pools. This section still needs to be evaluated, but because there is no waterfall between it and Pinto Creek, Green Sunfish have been captured in this reach, so would pose a threat to Gila Topminnow. However, the area could be suitable for other species like Roundtail Chub[1].

Recommendations: Overall, Haunted Canyon remains a possibility for Gila Topminnow introductions; however, further surveys are recommended during dryer months to better determine if the portions with the best habitat are perennial. Also, Tonto FS and Department

[1] Chub proposed for repatriation were previously classified as Gila Chub.

staff recommend that Kennedy Spring, which is on USFS property about 1.1 km upstream of Tony Spring be evaluated to determine if suitable habitat exists there for Gila Topminnow.

Mule Spring. On May 25, 2017, Department, Tonto National Forest, and Carlota Mine staff assessed Mule Springs (UTM NAD83 12S 499294 3693737). Mule Spring is a tributary to Powers Gulch, which is tributary to Haunted Canyon. Mule Springs was a lush riparian area with about 200 – 300 m of perennial water. There were several pools present within the perennial section of Mule Springs with the largest pool measuring 10 m x 3 m with a max depth of 1.1 m. Sedges were the predominate instream vegetation and were thick throughout the site. Riparian trees included sycamore, willow, oak, and ash. No fish were captured in dip net sweeps or observed during the survey; however, frogs were heard jumping into the water. Overall, Mule Springs appears to be suitable for Gila Topminnow. It is about 2 km from Mule Spring to the confluence of Powers Gulch and Haunted Canyon, and most if not all of Powers Gulch is ephemeral, so Mule Spring is isolated. There may also be waterfalls in Powers Gulch that would further isolate Mule Spring from perennial water in lower Haunted Canyon that is occupied by Green Sunfish.

Recommendations: Mule Spring has suitable habitat for Gila Topminnow. However, Carlota Mine has concerns that Gila Topminnow could be washed downstream and occupy the lower perennial portion of Haunted Canyon or the downstream portion of Pinto Creek. The perennial portions of lower Haunted Canyon and Pinto Creek are also occupied by Green Sunfish, so it is unlikely that topminnow would be able to establish a population there. The Department, Tonto NF, USFWS and Carlotta Mine will need to discuss and work out any ESA issues before topminnow are stocked into Mule Spring.

Pigeon Creek and Turkey Creek. On August 28 – 29, 2017, Department staff conducted fish surveys and habitat assessments in two tributaries of the Blue River, Pigeon Creek and Turkey Creek. Staff accessed the streams via FR8937 to Shipping Tank, then hiked down the 577 Trail to Pigeon Creek, and then hiked downstream. Water was flowing at the 577 Trail crossing and extended 1.4 km downstream to the last transect and below that for an unknown distance. Survey efforts were focused at four randomly-selected 100-m transects (UTM NAD83 12S 663116 3683347, 662095 3683215, 661407 3682908, and 661407 3682908); three transects in Pigeon Creek (one below the confluence with Turkey Creek and two above) and one transect in Turkey Creek below the large waterfall barrier. In Pigeon Creek, stream habitat consisted of run (42.1%), riffle (39.2%), pool (18.0%), and dry (0.6%) habitat among all three transects. Substrate was similar among transects and consisted mostly of sand, large cobble, boulders and bedrock; substrate embeddedness was typically less than 50%. Staff conducted single-pass backpack electrofishing through each transect for a combined total of 1,798 seconds. A total of 188 Speckled Dace, 23 Longfin Dace, 49 Desert Sucker, 14 Sonora Sucker and 1 Northern Crayfish were captured. Desert Sucker and Sonora Sucker appeared to be restricted to below the

small fall (UTM NAD83 12S 662153 3683244) in Pigeon Creek as none were captured or observed above it. However, during a tributary waterfall assessment in October 2013, Longfin Dace were observed upstream of the 577 Trail.

In Turkey Creek, stream habitat consisted of run (33.1%), riffle (62.7%) and pool (4.2%) habitat within the 100-m transect. Max depth of the pool in this transect was 0.65 m deep. Substrate embeddedness was typically less than 50% and consisted of a significant amount of bedrock. Staff backpack electrofished for 549 seconds and captured 78 Speckled Dace, 48 Longfin Dace, 53 Desert Sucker, and 6 Sonora Sucker. Upstream of the transect to the waterfall barrier, the stream consisted primarily of pool habitat. The stream flows for about 1.13 km from the waterfall to the confluence with Pigeon Creek. Perennial water extends at least 3 km upstream of the waterfall.

Recommendations: Overall, Pigeon Creek and Turkey Creek may be suitable habitat for Loach Minnow. Turkey Creek, below the waterfall barrier, appeared to have suitable pool habitat for Roundtail Chub[1]. Additional surveys should be conducted during 2018 in lower Pigeon Creek to better determine overall habitat suitability for these species throughout the creek.

Raspberry Creek. On July 18, 2017, Department staff assessed habitat (primarily for loach minnow) in Raspberry Creek, a tributary of the Blue River. Staff walked up the streambed and surveyed three randomly-selected 100-m transects in the creek (UTM NAD83 12S 664946 3708831, 663785 3709329, and 662652 3710016). Water was flowing continuously form the Blue River to the uppermost transect; about 4.5 km. Based on these transects, Raspberry Creek consisted of predominantly riffle habitat with cobble substrate. Substrate embeddedness was moderate to high in the lower portion of Raspberry Creek and was typically greater than 50%; however, 100% substrate embeddedness was common in these transects. Lower Raspberry Creek still appeared to be experiencing post-fire impacts and there was a lot of sediment and huge log jams throughout this portion of the creek. Habitat in upper Raspberry Creek above and below the waterfall appeared suitable for Loach Minnow. These sections featured riffles with low substrate embeddedness (typically less than 40%) and did not seem to be experiencing post-fire impacts like the habitat downstream. This section also featured several small pools and cascades that may be a suitable site for native trout. Although standardized fisheries surveys were not conducted during the assessment, staff observed Speckled Dace in Raspberry Creek. Speckled dace appeared to be restricted to below a small, 1 m high barrier downstream of the main waterfall.

Recommendations: Habitat in Raspberry Creek near the waterfall had habitat suitable for Loach Minnow. Therefore, the Department recommends that Loach Minnow be stocked into this

[1] Chub considered for repatriation were previously classified as Gila Chub.

portion of Raspberry Creek; the CAMP will lead this repatriation. Apache-Sitgreaves NF should consult with FWS regarding ongoing activities and effects on Loach Minnow.

Sabino Canyon. On June 13, 2017, Department staff assessed roughly 2 miles of stream habitat in upper Sabino Canyon. One crew assessed habitat from East Fork Sabino to West Fork Sabino Canyon, while another crew assessed from East Fork Sabino Canyon downstream to the stopping point of the habitat assessment in 2016 (UTM NAD83 12S 520672 3579822). Most of the habitat in the reach below East Fork Sabino Canyon consisted of small, marshy interrupted pools that likely go dry; however, there we some larger, deeper pools (about 1 m deep) scattered throughout the reach. Cattails were abundant in this section. Directly above East Fork Sabino Canyon, there was a series of large, deep pools (ranging between 2 to 4 m max depth) connected by marshy habitat. Shoreline habitat consisted of sedges and cattails. These pools looked like they would provide excellent habitat for Gila Topminnow, as well as other native fish species. From UTM NAD83 12S 520734 3581206 to 519972 3581716, the creek was mostly dry or consisted of interrupted seasonal pools. There were a few long, deep perennial pools present in this section ranging between 20 to 54 m long with max depths between 1 to 1.75 m. There was also one extremely deep 69 m x 10 m pool (known as Hutch's Pool) near the end of the reach (UTM NAD83 12S 519545 3581947; the pool was too deep to record measurement or see the bottom). Overall, there appears to be suitable habitat for a variety of native fish species in this section of Sabino Canyon. Although habitat is interrupted, there are several large, perennial pools that would serve as refuges during dry summer months and floods.

Recommendations: Habitat in Sabino Creek near the confluence with East Fork Sabino Creek appeared to be perennial and suitable for Gila Topminnow and possibly Roundtail Chub[1], suckers, and speckled Dace. Department staff recommends that Gila Topminnow and Roundtail chub be stocked into this portion to expand their distribution in Sabino Creek. Chub could be translocated from downstream. Gila Topminnow could be translocated from Cienega Creek or one of the many populations of the same lineage on Las Cienegas National Conservation Area, or from downstream in Sabino Creek if their abundance increases.

West Fork Pinto Creek. On March 28, 2017, Department and Tonto National Forest staff performed a second assessment of West Fork Pinto Creek below Miles Ranch. They focused survey efforts within the perennial pools that are located above and below the natural barrier (NAD83 12S 494289 3700038) to determine if Green Sunfish were present. They set eight mini hoop nets, five large hoop nets, and four minnow traps in the pools above the natural barrier, and two mini hoop nets in the pool directly below the barrier. Traps were set for a minimum of two hours and 17 Longfin Dace (15 individuals were >40 mm) were captured. During trap sets, they think they saw a larger fish, possibly a Green Sunfish in the pool directly above the barrier. They electrofished the pool and set one Green Meanie (experimental gill net), but failed to catch

[1] Chub in Sabino Canyon were previously classified as Gila Chub.

or observe any Green Sunfish. They recommend revisiting the site again during a dryer month, when water temperatures are warmer, to conduct further surveys for Green Sunfish.

They also observed that most of the cattails and vegetation on the sides of the pools were scoured out, which was evidence that this section of West Fork Pinto Creek experienced high flows related to 2016-2017 winter rains. Cattails were re-growing; however, staff were concerned that there is limited habitat available for Gila Topminnow to take refuge in during high flow events. Further assessment is warranted to determine if Gila Topminnow should be stocked at this site. On a positive note, these pools still appear suitable for Roundtail Chub[1].

On April 10, 2017, Department staff conducted a fish and habitat assessment of West Fork Pinto Creek upstream of Miles Ranch. A 700 m long section, located 500 m downstream of Jerky Spring, was surveyed; this area was identified as perennial habitat by the USFS in 2012. The surveyed section consisted of riffles, shallow runs, and step pools, as well as larger pool habitat that appeared to be suitable for Gila Topminnow. The largest pool was located at the upstream survey point and measured 30m x 3m (with a max depth of 1.1m). Water levels likely drop during dryer periods (grass was present 0.2m below the water line in some habitats); however, it appears that most of the pools/runs in this sections remain perennial. Based on debris and vegetation, it does appear that this upper section may also experience some scouring. Longfin Dace were abundant throughout the entire reach. Department staff backpack electrofished 797 seconds through the reach and captured 35 Longfin Dace (1 individual was <40mm).

Recommendations: Habitat in the perennial reach about 500 m downstream of Jerky Spring was judged to be perennial and suitable for Gila Topminnow. As a result of this survey, Gila Topminnow were stocked into West Fork Pinto Creek (see Gila Topminnow Stockings section of this report).

Aquatic Research and Conservation Center O&M

Recovery Objectives:

- Spikedace recovery objective 8. Plan and conduct investigations on captive holding, propagation and rearing.
- Loach Minnow recovery objective 8. Plan and conduct investigations on captive holding, propagation and rearing.
- Gila Topminnow draft revised (1999) recovery tobjective 1.1. Maintain refugia populations of natural populations to ensure survival of the species.
- Desert Pupfish recovery objective 2. Reestablish Desert Pupfish populations.

Background: Reclamation funded construction of a native fish conservation facility on the grounds of the Department's Bubbling Ponds Hatchery. The main purposes of the facility were

[1] Chub proposed for repatriation were previously classified as Gila Chub.

to develop propagation techniques for Loach Minnow and Spikedace, to establish refuge populations of all of the lineages, and to propagate fish for repatriations. A wet lab was constructed in 2000, a well was installed in 2003 to supply water to the facility, and open-air production and grow-out building was constructed in 2007. Loach Minnow (N=115, from Aravaipa Creek) were first brought into the facility in 2002, to develop propagation techniques (Childs 2004). In 2005, 35 Spikedace and an additional 27 Loach Minnow were brought in from Aravaipa Creek (Ward 2008). In 2007, 254 Aravaipa Creek Loach Minnow, 71 Blue River Loach Minnow, 143 upper Gila River Loach Minnow, 258 Aravaipa Creek Spikedace, and 640 Gila River Spikedace were brought in to the facility to increase production. More fish of most these lineages were periodically brought to the facility through 2015. Gila River forks Spikedace were first brought in to the facility in 2009, whereas Loach Minnow from the same location were first brought in in 2014. San Francisco River Loach Minnow were brought in in 2014. Table 11 shows, for Spikedace and Loach Minnow, the size of the broodstock and number of fish produced from 2007 through 2017; some information is missing.

Other fish species were brought to the facility for similar purposes to Loach Minnow and Spikedace. Woundfin were brought to the facility in 2008 to attempt to produce offspring for stocking into the Hassayampa River. Gila Topminnow (Sharp Spring lineage) and Desert Pupfish were brought in in 2009 for a competition experiment, but most were stocked out afterwards. Eagle Creek Roundtail Chub were brought to the facility in 2010 to establish a refuge population, and so that fish produced could be stocked into the Blue River. In 2012, the Cottonwood Springs lineage of Gila Topminnow was brought in to establish a broodstock so that fish produced could be used in repatriations. The facility holds various other species for research or educational purposes.

The facility was originally named Bubbling Ponds Native Fish Conservation Facility, but in 2015 was renamed the Aquatic Research and Conservation Center (ARCC). Beginning in 2014, Reclamation began providing funds (through USFWS) for a variety of improvements to ARCC, including a new outdoor building to hold more tanks, a new quarantine building and new ponds.

Results: The Department continued to operate ARCC in 2017. The ARCC maintains refuge populations of three lineages of Spikedace (Aravaipa Creek, upper Gila River, Gila River Forks) and four lineages of Loach Minnow (Blue River, Aravaipa Creek, San Francisco River, and Gila River Forks). In 2017, ARCC produced 1,341 Aravaipa Creek Spikedace, 384 upper Gila River Spikedace, 1,183 Gila River Forks Spikedace, 47 Blue River Loach Minnow, 305 Aravaipa Creek Loach Minnow, 177 San Francisco River Loach Minnow, and 7 Gila River Forks Loach Minnow (Table 11). Due to limited space at ARCC in 2017, lineages were split into two or more tanks with variable densities.

During 2017, ARCC staff implemented several operational changes. They focused on better documentation and better planning for upcoming spawning seasons. An annual report was

drafted that summarized all the operational details for the spawning and non-spawning seasons. The report includes what fish were fed, where they were held, flow rates, structure types, recirculation type if applicable, and most importantly, densities of fish in each tank and weekly counts of larval fish. Logs were kept to track mortality, algae growth and removal, temperature and light intensity for all spawning tanks and larval fish production by raceway, and the information was included in the annual report. The documentation of conditions during the last season and the associated number of fish produced helped staff plan for the upcoming spawning season. They also drafted a Hatchery Management Plan, which will be finalized in 2018.

Another change was the development of an annual study plan for the upcoming season. The study plan is intended to help guide staff set up tanks for the spawning season based off the information learned the previous year. The study plan also informs other staff and agency partners what research will be implemented to help increase production of Spikedace and Loach Minnow with the available resources at the facility.

The ARCC staff began compiling results from previous years' investigations that have not been formally synthesized. To date, no published peer-reviewed studies are available regarding captive propagation of Loach Minnow and Spikedace. Limited past studies focused on anecdotal observations attempted to identify a host of factors that may affect spawning of these species in captivity. The results from this synthesis and the first year of baseline data collection have been formulated into a peer-reviewed manuscript, currently submitted to the North American Journal of Aquaculture for publication. Some of this information was also presented at the National American Fisheries Society meeting in Tampa in 2017.

Physical improvements to ARCC continued in 2017. During Phase 1.5 (completed March 2017), ARCC staff plumbed and installed 20 new spawning raceways with collections sumps. Raceways receive water from the artesian well but can also be filled during an emergency or for cleaning with the pressure water system. Raceways were fitted with individual variable speed programmable recirculation pumps to create spawning flows and a regenerative blower to provide supplemental aeration. Water from the 20 new raceways is collected in the central trough and can be sent to Phase 2 ponds or through a bypass to the new main hatchery outflow.

During Phase 2.0 (completed August 2017), a large retaining wall was added to level the property and to create space for new ponds, research projects and the building intended to be installed in Phase 3. A 10' tall chain link perimeter fence was installed around the entire property for terrestrial predator control and two new large PVC lined ponds with individual collection sumps were also added. Lastly, plumbing was installed for research tanks and the existing large steel tank (pond 3).

A variety of activities were completed during Phase 2.5. Three new 12' X 32' sheds were installed. One of these sheds will be a dedicated quarantine building with six 400-gallon tanks isolated from each other with dividing walls and draw curtains. The second shed will be renovated and made into a work shop and tool storage area. The third shed will be divided into an insulated feed room and gear storage areas. Also during Phase 2.5, staff installed six 12' diameter and 5' deep fiberglass tanks and a previously constructed 21' diameter tank was reconstructed as two separate tanks. The facility power was rerouted to a new transformer located in front of main building, the existing power pole was removed, and the power supply was increased from 200 to 800 amps. Lastly a perimeter electric wire was installed around the property on the chain-link fence to limit the ability for predators to climb over the fence, and a net cover was installed above the 20 raceways added in phase 1.5.

Recommendations: For 2018, ARCC staff should focus on propagating lineages of Spikedace and Loach Minnow that are planned to be repatriated that year: Aravaipa Spikedace, Blue River Loach Minnow, and any lineages that New Mexico Department of Game and Fish plans to stock. Staff should also focus on research to improve propagation success. ARCC staff should also finalize the Hatchery Management Plan by autumn 2018. Renovations to the facility will be continued and may be completed in 2018.

Expand Roundtail Chub[1] population in Harden Cienega Creek

Recovery Objectives:

- Gila Chub draft recovery plan objective 2. Ensure representation, resiliency, and redundancy by expanding the size and number of populations within Gila chub historical range via replication of remnant populations within each RU.

Background: During the course of this project, Roundtail Chub[1] were surveyed and collected from Harden Cienega Creek. During the surveys a waterfall was discovered, above which no Roundtail Chub[1] occurred. In April 2013 Department staff surveyed above the waterfall and only detected Speckled Dace, and determined that there is about 1.4 km of perennial water above the waterfall. Department staff recommended that chub be moved above the waterfall to expand their distribution in Harden Cienega Creek. The CAP Policy committee approved the project in February 2014. On April 9, 2015, Department staff translocated 102 Roundtail Chub[1] from lower Harden Cienega Creek to above the waterfall.

Results: Department staff monitored Roundtail Chub[1] in upper Harden Cienega Creek during April 24 – 25, 2017. The survey was focused from the start of the perennial water near Prospect Canyon (UTM NAD83 12S 675842 3674119) downstream to a series of natural waterfalls (UTM NAD83 12S 676730 3673454). During the survey, 30 mini-hoop nets were set in pools and runs throughout the reach. The mini-hoop nets were set to fish overnight with set times ranging

[1] Chub at this location were previously classified as Gila Chub.

between 15 to 19 hours. Mini-hoop nets captured 391 Roundtail Chub[1] (273 individuals were >100 mm, 118 individuals were 51-100 mm), 1 Longfin Dace, 1 Speckled Dace, and 1 Green Sunfish. Since the mesh size of the mini-hoop nets was too large to capture young of year Roundtail Chub[1] (≤50 mm), young of year chub were visually estimated in each of the pools/runs that were trapped; estimates yielded 146 young of year Roundtail Chub[1] across all pools. One albino adult Roundtail Chub[1] was also observed during the survey. Overall, Roundtail Chub[1] appear to be establishing in upper Harden Cienega Creek as they were abundant throughout the creek and all age classes were present. Additional Roundtail Chub[1] translocations are recommended into upper Harden Cienega Creek to maintain genetic integrity.

Recommendations: Upper Harden Cienega Creek should continue to be monitored until at least 2020. However, because only 102 chub were moved above the waterfall, it is recommended that several hundred more be moved above the waterfall to better ensure genetic similarity of chub in the two reaches of the stream.

Fish health assessments of translocation populations

Recovery Objectives:

- Gila Chub draft recovery plan objective 1.3.1. Eliminate or control problematic nonnative aquatic organisms.

Background: To minimize the transfer of unwanted parasites and pathogens from one location to another, the Department assesses the health of fish in all donor sites before any translocation. Department staff collects 30 to 60 fish, typically of the species to be translocated, and either the Department's Fish Health Specialist or an outside organization (e.g., USFWS Southwest Native Aquatic Resource and Recovery Center, or Washington Animal Disease Diagnostic Laboratory) assesses the fish. In 2015 the Department finished construction and outfitting its fish health laboratory at the Phoenix headquarters, so by 2016 all health assessments could be performed by the Department's Fish Health Specialist.

Results: On February 2, 2017 Department staff collected 60 Gila Topminnow from Phoenix Zoo's ranarium pond and transported them to AZGFD's fish health lab in Phoenix.

On March 20, 2017, Department staff collected 60 Gila Topminnow from Swimming Pool Tank and 60 from Stop Sign Tank at Robbins Butte Wildlife Area, and 60 Gila Topminnow and 30 Desert Pupfish from Nina Pulliam Rio Salado Audubon Center pond for fish health assessments. Results of the assessments will not be finalized until next reporting period.

On August 23, 2017, Department staff collected 60 Spikedace from ARCC and transported them to the Department's fish health lab in Phoenix.

Recommendations: In 2016 the Department's Fish Health Specialist indicated that an assessment is valid for only one year. Therefore in the future, all translocation donor sites will

be assessed within 12 months before the translocation. This project should be removed from the priority list and instead be reported under each individual project stocking.

Eagle Creek repatriations

Background: Eagle Creek is a tributary to the Gila River near Clifton Arizona, and flows across U.S. Forest, San Carlos Apache, and private lands. Native fish documented from Eagle Creek include Spikedace, Loach Minnow, Roundtail Chub[1], Speckled Dace, Longfin Dace, Desert Sucker, Gila Sucker, and Gila Trout. However, Spikedace were last recorded in 1989 and Loach Minnow in 1997. Various nonnative fish species occupy Eagle Creek but the upper reach above Willow Creek confluence is now occupied by only native species. Freeport McMoran pumps water from the Black River into Eagle Creek for use at the Morenci Mine; nonnative fish from the Black River are thus transmitted into the Eagle Creek drainage. In a management plan, Freeport McMoran committed to building a barrier on upper Eagle Creek above the Willow Creek confluence. The U.S. Bureau of Reclamation is providing engineering expertise for design of the barrier. Once the barrier is in place, the Department will repatriate Spikedace and Loach Minnow upstream.

Results: On November 8, 2017, Department, USFWS, and BOR staff collected eDNA samples from seven locations on upper Eagle Creek between Sheep Wash and Honeymoon Campground. Samples were sent to Rocky Mountain Research Station in Missoula, Montana for analysis.

Recommendations: Bureau of Reclamation indicated that the barrier would likely not be constructed until 2019. The Department recommends additional eDNA sampling in upper Eagle Creek in 2018 to lend further confirmation that Spikedace and Loach Minnow are extirpated from this reach. The Department also recommends additional fish surveys in upper Eagle Creek to search for Spikedace and Loach Minnow.

West Fork Pinto Creek native fish repatriations

This task was moved under the Gila Topminnow Stockings project; information is provided there.

Red Tank Draw native fish restoration

Recovery Objectives:

- Gila Chub draft recovery plan objective 1.3.1. Eliminate or control problematic nonnative aquatic organisms.
- Gila Chub draft recovery plan objective 7. Monitor remnant, repatriated, and refuge populations to inform adaptive management strategies.

[1] Both Roundtail Chub and the form previously classified as Gila Chub are documented in Eagle Creek.

- Gila Topminnow 1999 draft revised recovery plan objective 2.2. Reestablish Gila topminnow in suitable habitats following geographic guidelines.
- Gila Topminnow 1999 draft revised recovery plan objective 2.4 Protect habitats of reestablished or potential populations from detrimental nonnative aquatic species.
- Gila Topminnow 1999 draft revised recovery plan objective 3. Monitor natural and reestablished populations and their habitats.

Background: Red Tank Draw is a tributary to Wet Beaver Creek and is on the Coconino National Forest. The draw is occupied by Roundtail Chub[1], Longfin Dace, Desert Sucker, Sonora Sucker, and several nonnative species including Green Sunfish, Black Bullhead, Fathead Minnow, and Northern Crayfish. Roundtail Chub[1] inhabit an interrupted reach between the USGS gage and Mullican Canyon. Most of the rest of the drainage is dry, but perennial pools may persist in some locations. The Department's Regional staff (Matt Rinker, personal communication) walked from the confluence with Wet Beaver Creek upstream to the chub occupied portion and did not observe any waterfalls that might restrict the upstream movement of nonnative fish; but most of the distance was dry which would restrict upstream movement to when the stream was flowing. The purpose of this project was to remove Green Sunfish and Black Bullhead from the Roundtail Chub[1] occupied reach, and the entire drainage above the chub occupied reach if possible.

Results: During April 3-5, 2017, Department staff conducted a nonnative removal effort at Red Tank Draw. Staff backpacked electrofished about 1.7 km of stream from the lowest perennial pool (about 100 m downstream of the confluence of the drainage containing Blue Grade Tank) to about 1.4 km downstream of the Mullican Canyon confluence, and captured 88 Green Sunfish, 3 Black Bullhead, 10 Roundtail Chub[1] (5 were <50 mm TL), and 28 Fathead Minnow. Ten large hoop nets and 15 mini- hoop nets (4 to 10 hour sets) were also set from the lowest perennial pool to the uppermost perennial pool (UTM NAD83 12S 436503 3841965) and 89 Green Sunfish (41 – 211 mm TL) and 5 Fathead Minnow (67 – 96 mm TL) were captured. Roundtail Chub[1], Desert Sucker, and Northern Crayfish were also observed while setting and pulling traps. The Green Sunfish were palpitated to express eggs or milt, but none did so. All nonnative species captured were removed.

On April 19, 2017, Department staff conducted a second nonnative removal effort at Red Tank Draw. Staff backpacked electrofished through the same 1.7 km of stream. Staff shocked for 9,095 seconds and captured 111 Roundtail Chub[1] (68 – 212 mm TL), 4 Desert Sucker (189 – 231 mm TL), 63 Green Sunfish (42 – 185 mm TL), 7 Black Bullhead (106 – 177 mm TL), and 26 Fathead Minnow (49 – 96mm TL). Northern Crayfish were also observed while shocking. All nonnative fish were checked for ripeness and 4 Green Sunfish and 5 Fathead Minnows produced

[1] Chub in Red Tank Draw were previously classified as Gila Chub.
[1] Chub in Red Tank Draw drainage were previously classified as Gila Chub.

eggs. All nonnative species captured were removed. Floating algae was present in most of the larger pools where sunfish were present. These conditions made shocking less effective as it was difficult to see and catch fish.

Throughout April 2017, staff surveyed several drainages upstream of the Red Tank Draw removal site to identify perennial water and presence of nonnative fish (Figure 18). In the upper Rarick Canyon, about 4.3 km was surveyed, visually and with dip nets, down to about the confluence of the drainage that contains Doe Tank. Fathead Minnow were present in 15 of the 18 pools within this section of Rarick Canyon. Fathead Minnow were observed above a 3.5 to 4 m high waterfall (at pool F17; UTM NAD83 12S 440235 3845340) indicating that the fish are likely coming from an upstream source. During another survey, Fathead Minnow were observed further downstream in shallow, seasonal pools between downstream of the Rarick and Mullican Canyons confluence. Staff also hiked the Mullican Canyon drainage from the concrete dam at Mullican Place Tank to the confluence of Rarick and Mullican Canyons. Much of the water in this drainage appeared to be seasonal; however, there were a several pools that appeared to be perennial. Green Sunfish were observed throughout this section. Black Bullhead and Northern Crayfish were also observed. There were a several natural barriers within the section surveyed, ranging from 4 m to 30 m tall; Green Sunfish were observed below all of these barriers, indicating that they are likely coming from an upstream source. In the drainage below Purgatory Tank, several ephemeral pools were present with barriers ranging from 3 m to 10 m high. No fish were detected in the wetted section of this drainage (Figure 18); however, Canyon Tree Frogs, Tiger Salamanders (aquatic form), and Black-necked Gartersnakes were observed. Staff also hiked the unnamed drainage from Three-Jim Tank down to an impassible 40 m high natural barrier about 2.6 km downstream. The drainage consisted of intermittent, ephemeral pools with several small bedrock barriers (2 to 10 m high); however, no fish were observed.

Stock tank surveys were also conducted in the Red Tank Draw (Figure 16) drainage during the performance period. These surveys are reported under the Miscellaneous stock tank surveys priority action.

Recommendations: This project should be discussed by the Region II Native Fishes Conservation Team in their meeting in early 2018. Department staff recommend that Roundtail Chub[1] be moved upstream in Rarick Canyon to the perennial tinajas, and that Gila Topminnow be stocked into the same locations. Department staff also recommend that the Fathead Minnow be eradicated from the two tanks in the Rarick drainage where they exist (Rarick Tank and Gnat Tank, which are the only tanks in the Rarick drainage that had fish), and in the upper part of Rarick Canyon down to the first waterfall upstream of Mullican Canyon. Roundtail Chub and Gila Topminnow can be stocked into those tanks and tinajas after fathead minnow are eradicated, or could be stocked there even if Fathead Minnow are not eradicated.

[1] Chub in Red Tank Draw drainage were previously classified as Gila Chub.

Department staff recommend that nonnative fish be eradicated from the two tanks in Mulican Canyon drainage that had fish present (Mullican Place Tank and Bruce Tank), which are the likely sources of Green Sunfish and Black Bullhead to Red Tank Draw downstream. However, Bruce Tank is on private land. Further attempts to talk to the landowner to see if cooperation could be gained are recommended.

Sharp Spring native fish restoration

Recovery Objectives:

- Gila Chub draft recovery plan objective 1.3.1. Eliminate or control problematic nonnative aquatic organisms.
- Gila Chub draft recovery plan objective 2. Ensure representation, resiliency, and redundancy by expanding the size and number of populations within Gila chub historical range via replication of remnant populations within each RU.
- Gila Chub draft recovery plan objective 7. Monitor remnant, repatriated, and refuge populations to inform adaptive management strategies.
- Gila Topminnow 1999 draft revised recovery plan objective 2.2. Reestablish Gila topminnow in suitable habitats following geographic guidelines.
- Gila Topminnow 1999 draft revised recovery plan objective 2.4 Protect habitats of reestablished or potential populations from detrimental nonnative aquatic species.
- Gila Topminnow 1999 draft revised recovery plan objective 3. Monitor natural and reestablished populations and their habitats.

Background: Sharp Spring is a tributary to the Santa Cruz River in the San Rafael Valley, about 2 km from the U.S.A. – Mexico border, and is on San Rafael State Natural Area. Sharp Spring is perennial, and flows form a series of pools in cienga-like habitat; the larger pools have numbered staff gauges to help detect changes over time. Sharp Springs was historically occupied by Gila Topminnow. Nonnative Western mosquitofish were first found in Sharp Springs in 1979. Monitoring by the Department and partners documented the disappearance of Gila Topminnow, which has not been detected since 1999. The extirpation was attributed to predation and competition with nonnative mosquitofish, and reduced flooding. The purpose of this project is to eradicate Western Mosquitofish from Sharp Spring, and then repatriate Gila Topminnow and Roundtail Chub[1]. The Sharp Springs lineage of Gila Topminnow would be translocated from one or more of the replicate populations in the state. Roundtail Chub[1] from the nearby Sheehy Spring would be translocated to Sharp Spring.

During June 2013, Department staff attempted to dry the pools in Sharp Spring by pumping water out. They pumped down the two uppermost pools, but because of the large amount of fine sediment in the bottom of the pools, could not pump all of the water out. The pools partially

[1] Chub in Sheehy Spring to be repatriated into Sharp Spring were previously classified as Gila Chub.

refilled overnight, and mosquitofish were observed in them the next morning. The effort was terminated because the pools could not be completely dried. Afterwards, other ideas for eradicating the mosquitofish were proposed including: treating with rotenone, treating with ammonia, heating the water in each pool, adding organic matter to the pools to create anoxic conditions, covering the pools with black plastic or adding dye to the pools to create anoxic conditions.

Results: On January 26, 2017 Department and State Parks staff met to discuss eradication of Western Mosquitofish from Sharp Spring and options to attain that goal. State Parks staff indicated they would talk to upper management to determine if they would support the project.

Recommendations: Department staff thinks that the most effective way to eradicate mosquitofish from Sharp Spring would be treatment with rotenone. The Department will coordinate with State Parks to see if they will approve of the project.

Boyce Thompson Ayer Lake native fish restoration

Background: Ayer Lake at Boyce-Thompson Arboretum, near Superior, has served as a refuge for Gila Topminnow and Desert Pupfish since the 1970's. In addition, Arizona Game and Fish Department uses these Ayer Lake populations to establish new populations of these two species throughout the Gila River Basin. Gila topminnow was first stocked into Ayer Lake in 1971, then in 1972, and 1978. Desert pupfish were first stocked in 1977. Nonnative fish invaded the reservoir, and so Ayer Lake was chemically treated with piscicides three times; in 1979 to remove black bullhead, in 1980 to again remove black bullhead, and in 1983 to remove mosquitofish. After the third renovation, a mixed stock of Monkey Springs and Monkey Springs-Cocio Wash-Bylas Springs populations of Gila Topminnow were stocked in 1985 (USFWS 1998). A mixed Lower Colorado River Delta stock of Desert Pupfish were acquired from Santa Clara Slough, Dexter National Fish Hatchery, and Deer Valley High School (USFWS 1993) and stocked in 1984 and 1985. During 1986 monitoring, nonnative Fathead Minnow were discovered in the pond, and have been present ever since. Red Swamp Crayfish, another nonnative species, was first observed during 1976 monitoring, and it continues to inhabit Ayer Lake. Western Mosquitofish was detected in xxxx, after which the Department discontinued using Ayer Lake as a source of Gila Topminnow for translocations. In addition to the fish species, native herptiles Sonoran Mud Turtle and Lowland Leopard Frog inhabit the lake, as do native aquatic plants such as cattails Typha spp. and hard-stem bulrush Schoenoplectnus acutus, and a wide array of aquatic invertebrates.

In 2008, Arizona State Parks staff were concerned about treating Ayer Lake with a piscicide, because watchable invertebrates (dragonflies and damselflies) would also be temporarily eradicated and the lake's water was needed for irrigation. However, in 2015, the Director of Boyce Thompson Arboretum agreed to again consider partially draining the pond and treating it

to remove the nonnative species. The park was going to try to install a new well, after which the pond could be partially drained and the treatment done.

The purpose of this project is to eradicate the nonnative fishes, and if possible the nonnative crayfish from Ayer Lake and then reestablish Gila Topminnow and Desert Pupfish, and possibly establish Roundtail Chub[1].

Results: No work performed on this task during 2017 because the state park was waiting on funding for a new well.

Recommendations: Department staff should contact Boyce Thompson State Park to determine if they have installed a new well. Determine what steps are necessary to move forward with eradication of nonnative fishes from Ayer Lake.

PROJECTS REMOVED FROM PRIORITY LIST

Fossil Creek repatriations. Completed in 2016.

Mineral Creek drainage renovation and repatriations. Removed until State Land Department approves of wildlife translocations on their managed lands.

Post-repatriation evaluations. This project was removed from the priority list because post-repatriation evaluations (monitoring) are reported under each specific priority action.

Transfer Roundtail Chub[1] and Gila Topminnow to New Mexico. Removed from priority list until New Mexico is ready to request more fish.

Sands Draw repatriations. This project was removed from the priority list in 2016 until BLM has the habitat ready for fish.

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FIGURES

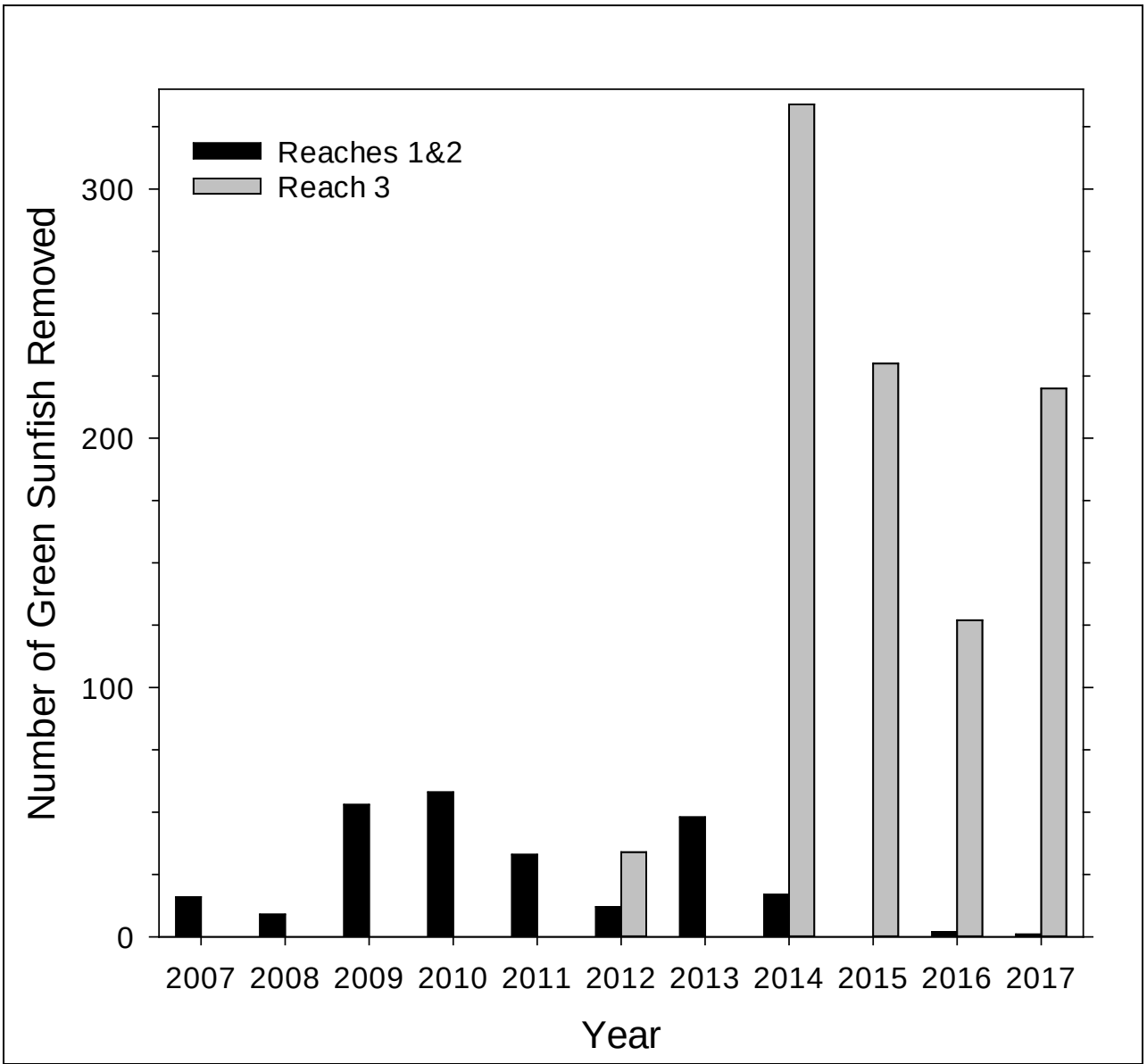

Figure 1. Number of Green Sunfish removed during annual spring-time removal efforts and autumn monitoring from three reaches of Redfield Canyon, Arizona during 2007-2017.

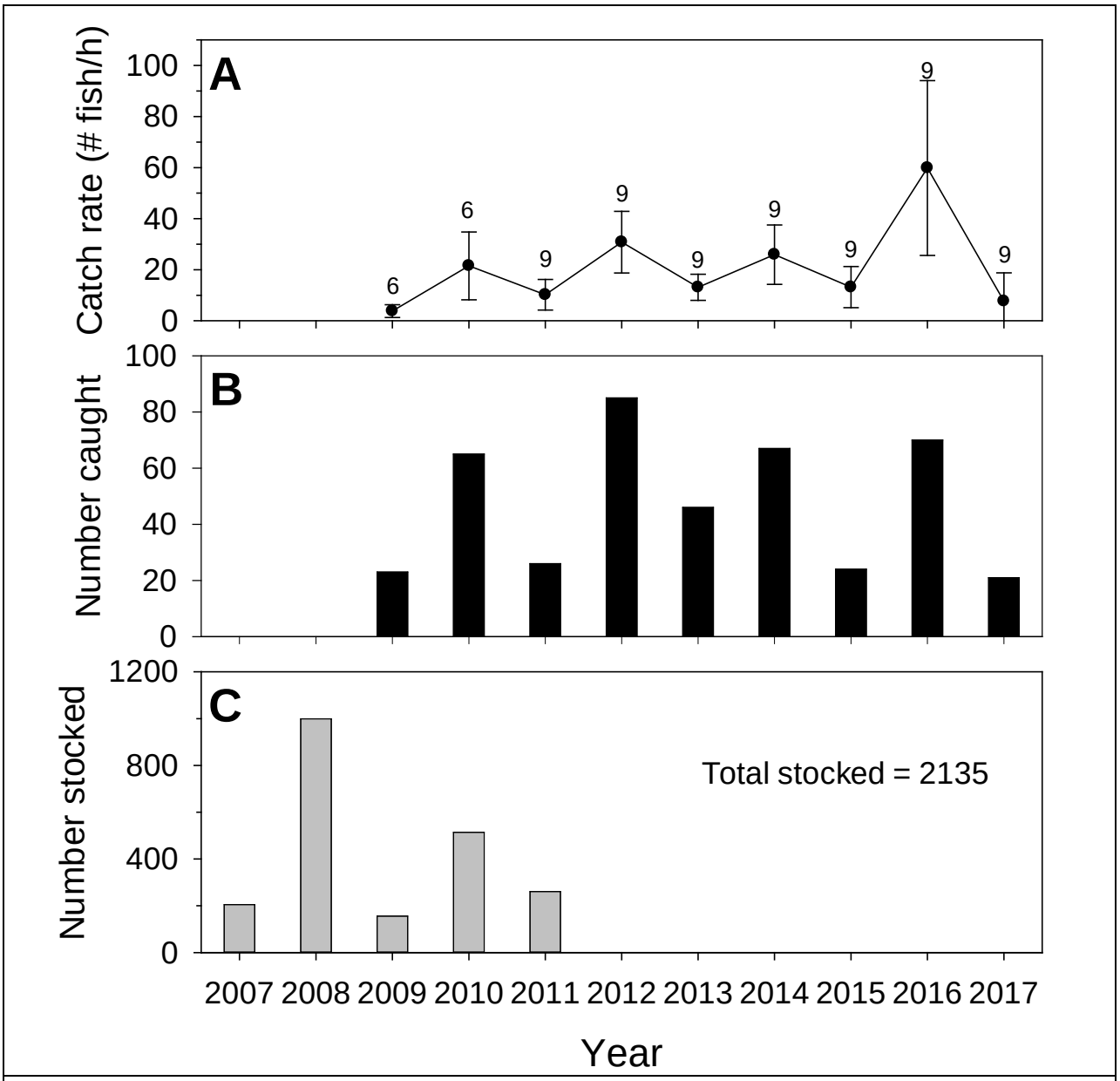

Figure 2. Summary of Loach Minnow stocked and captured in Hot Springs Canyon, AZ, 2007 thru 2017, showing (A) backpack electrofishing catch rates with the number above the error bar representing the sample size which equaled the number of 100-m transects surveyed, (B) total number captured, and (C) total number stocked.

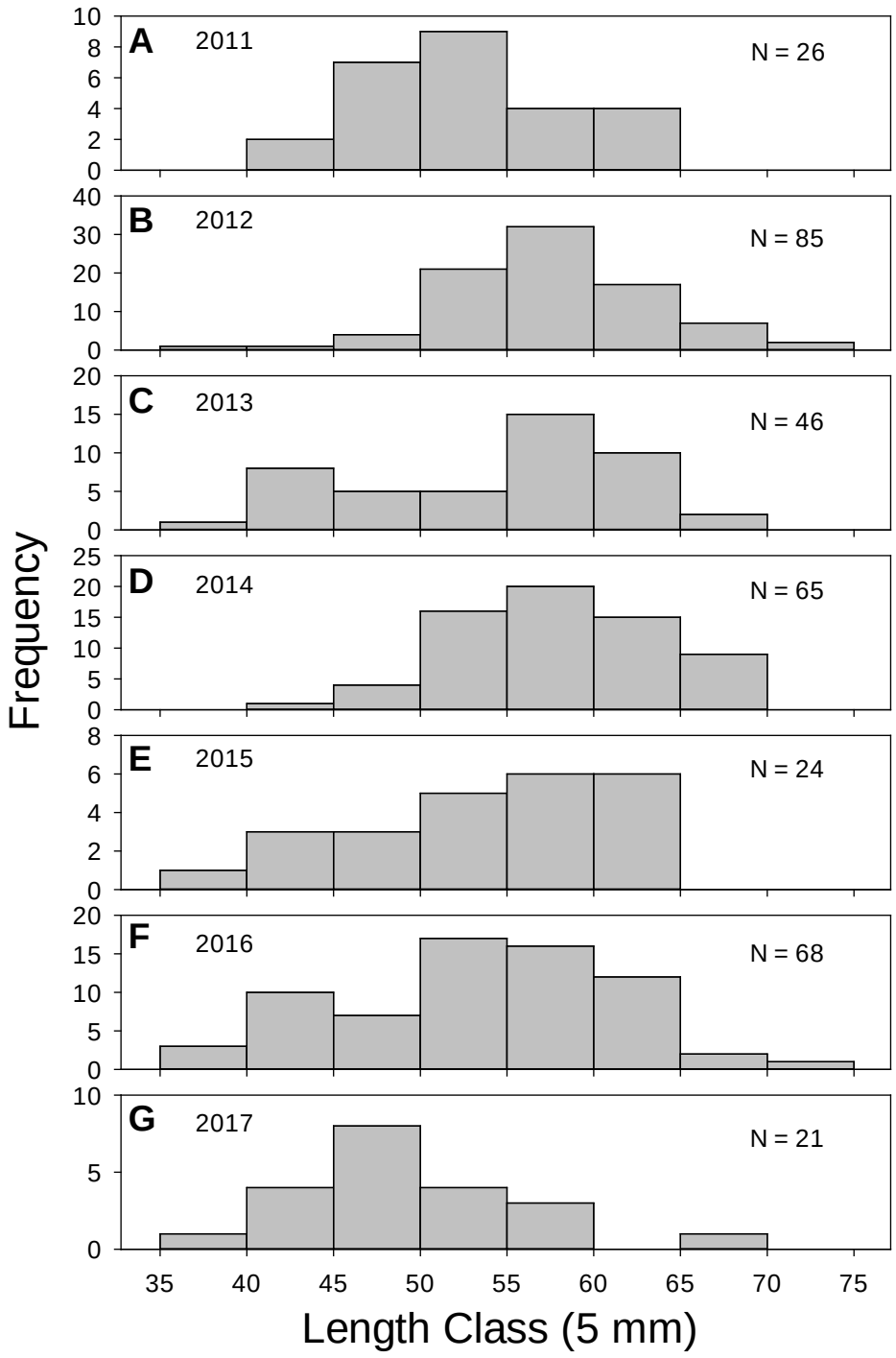

Figure 3. Length frequency distributions in 5-mm classes for Loach Minnow captured during annual monitoring in Hot Springs Canyon, 2011 through 2017.

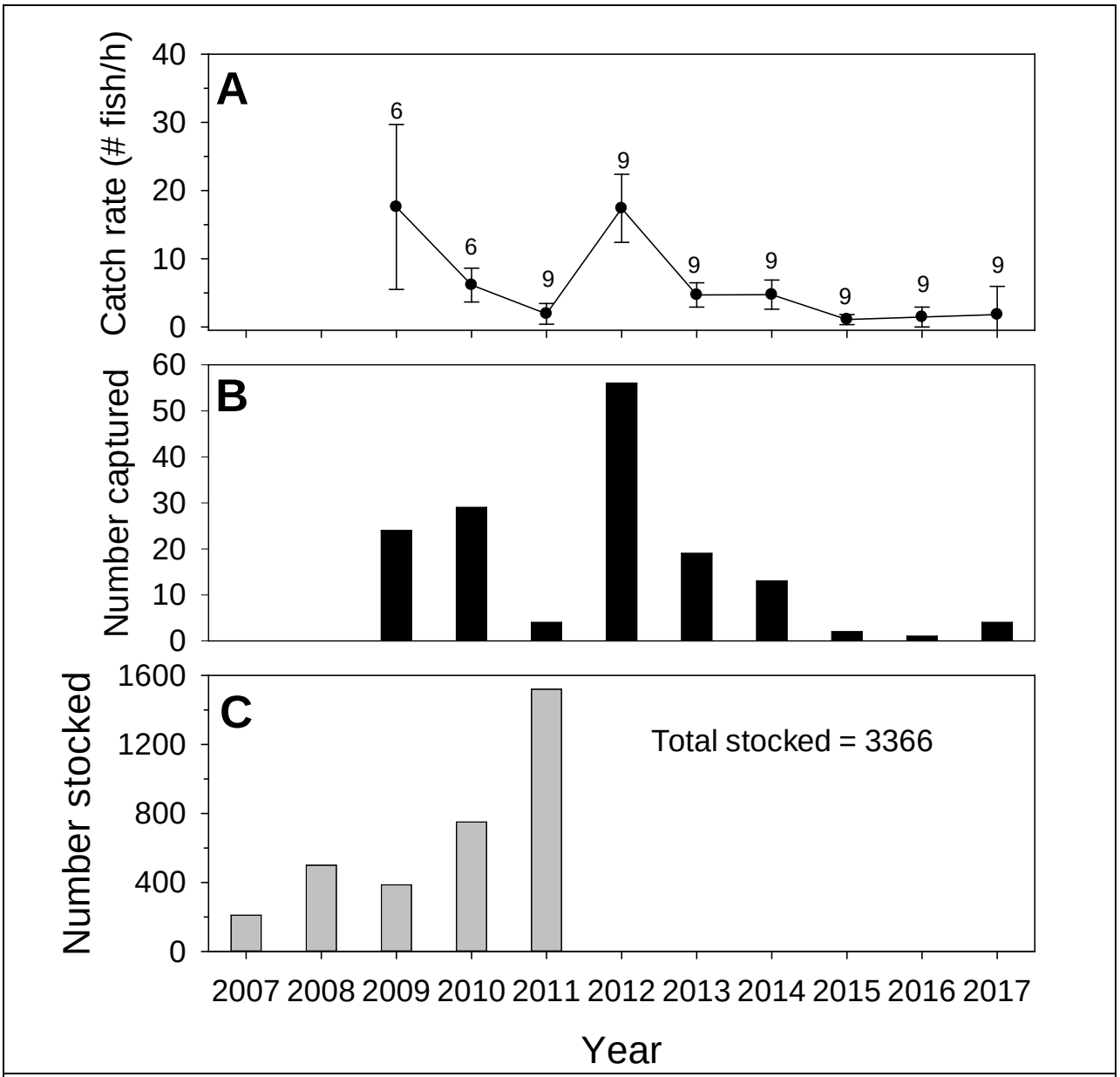

Figure 4. Spikedace stocked and captured in Hot Springs Canyon, Arizona, 2007 thru 2017, showing (A) backpack electrofishing catch rates with the number above the error bar representing the sample size which equaled the number of 100-m transects surveyed, (B) total number captured, and (C) total number stocked.

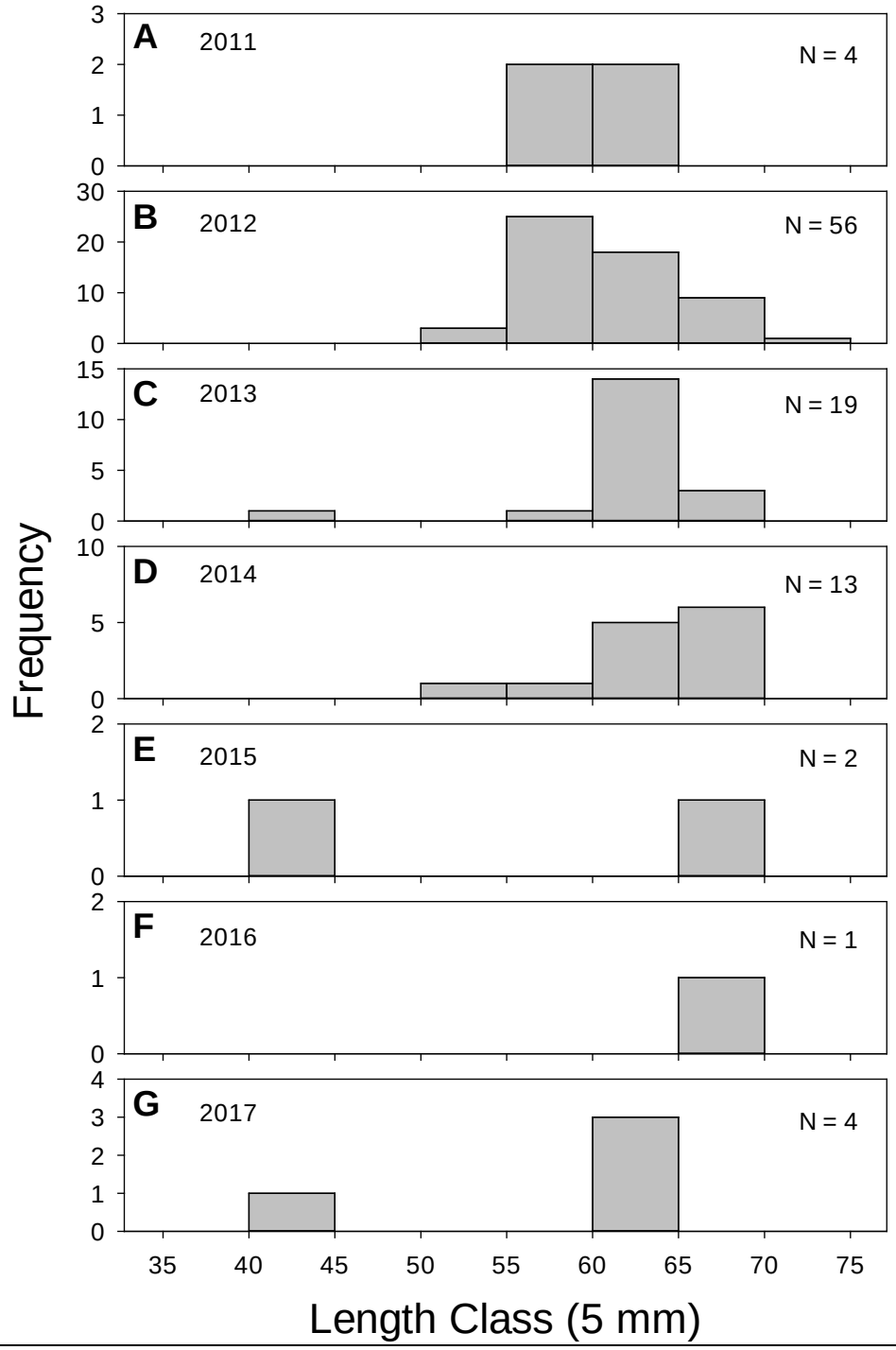

Figure 5. Length frequency distributions in 5-mm classes for Spikedace captured during annual monitoring in Hot Springs Canyon, 2011 through 2017.

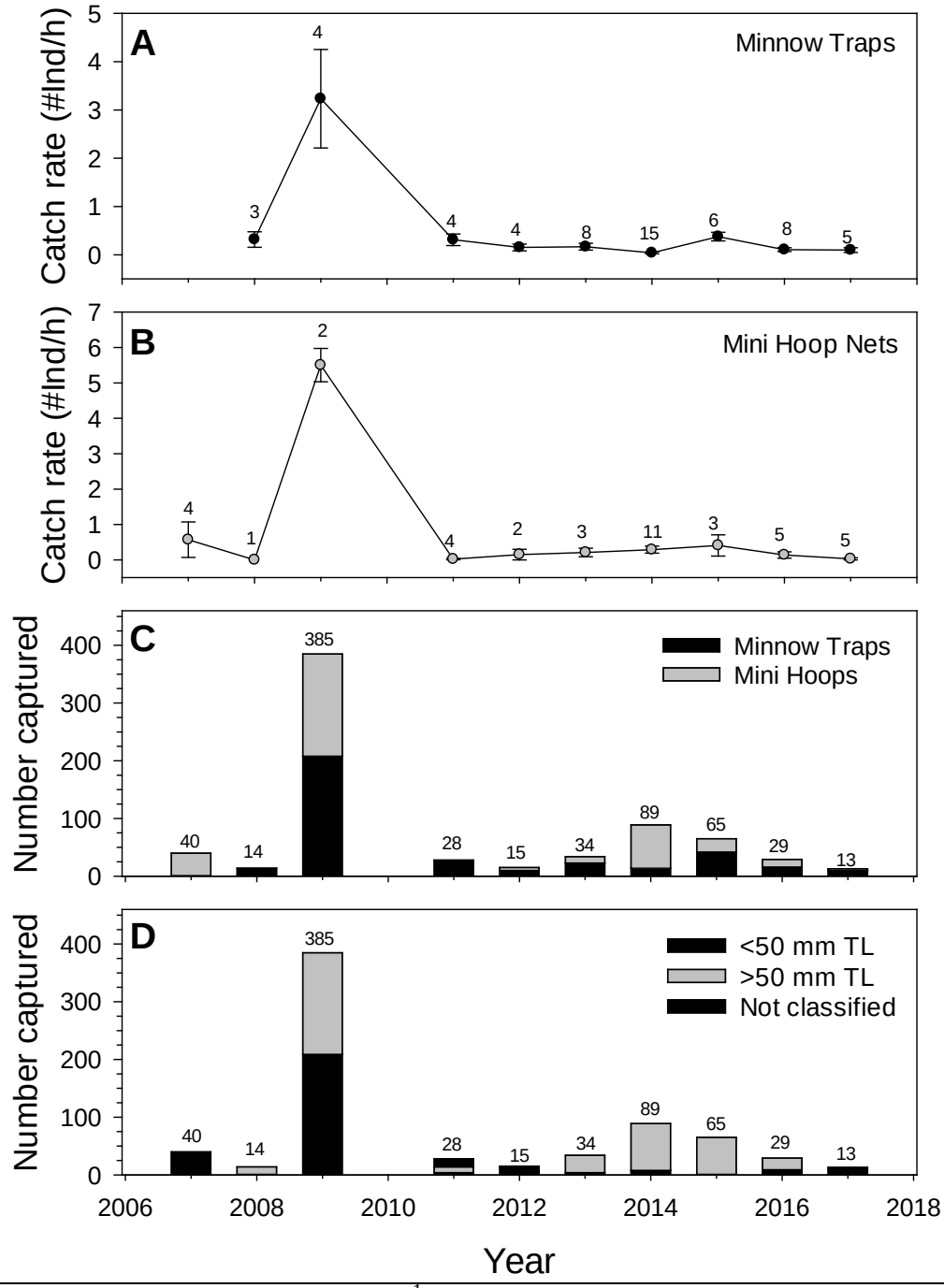

Figure 6. Annual catch of Roundtail Chub[1] from 2007 through 2017, in Sheehy Spring, San Rafael Valley, Arizona: A) mean minnow trap catch rates, b) mean mini-hoop net catch rate, C) total number of chub captured in minnow traps and hoop nets combined, and D) total number of chub captured by size class. Numbers above the symbols in the catch rate graphs are the number of traps. Numbers above the bars in the lower graphs are total number of chub captured. Data from 2010 were not found.

[1] Chub in Sheehy Spring were previously classified as Gila Chub.

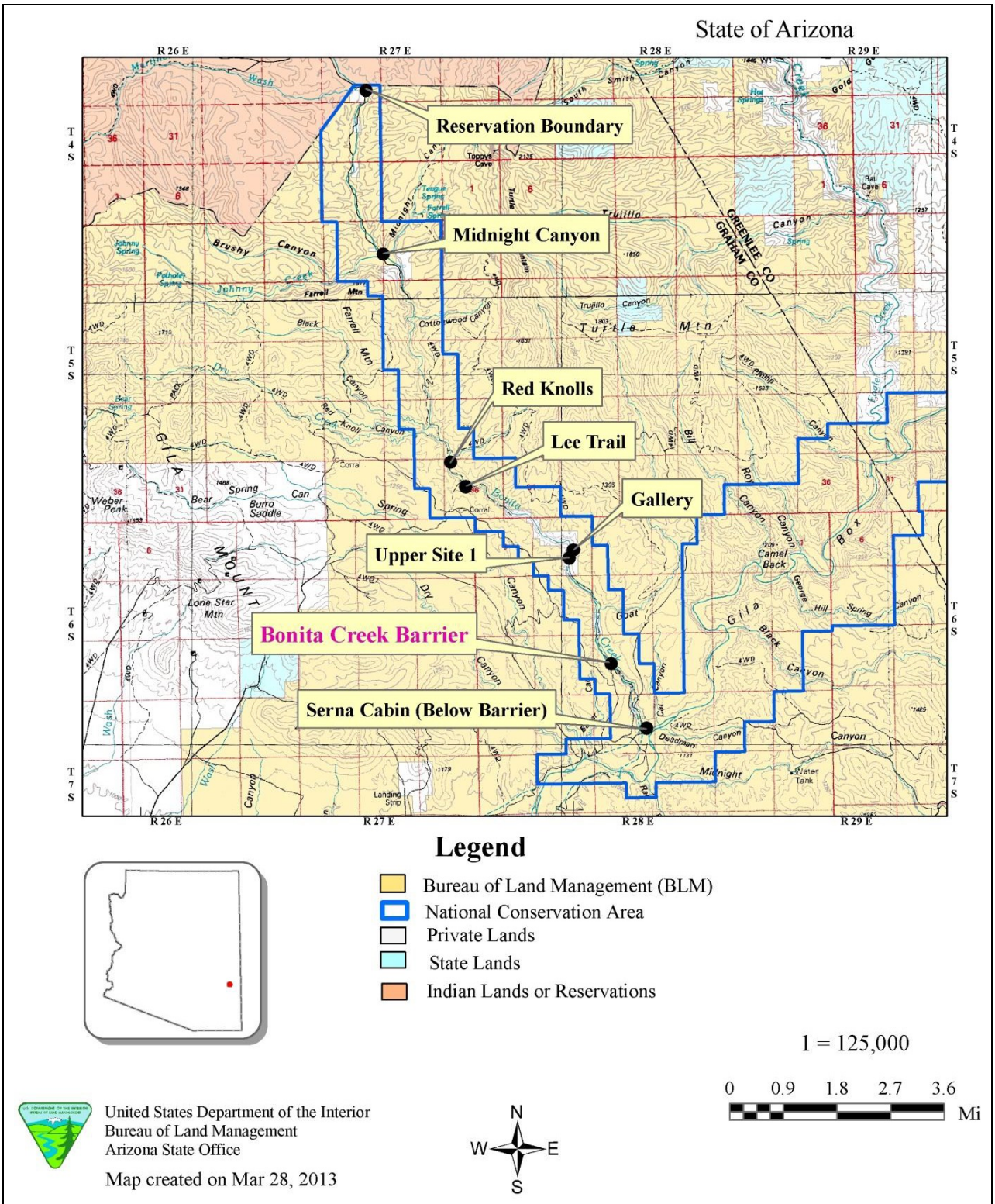

Figure 7. Map showing locations of Bureau of Land Management monitoring sites in Bonita Creek, north of Safford, Arizona.

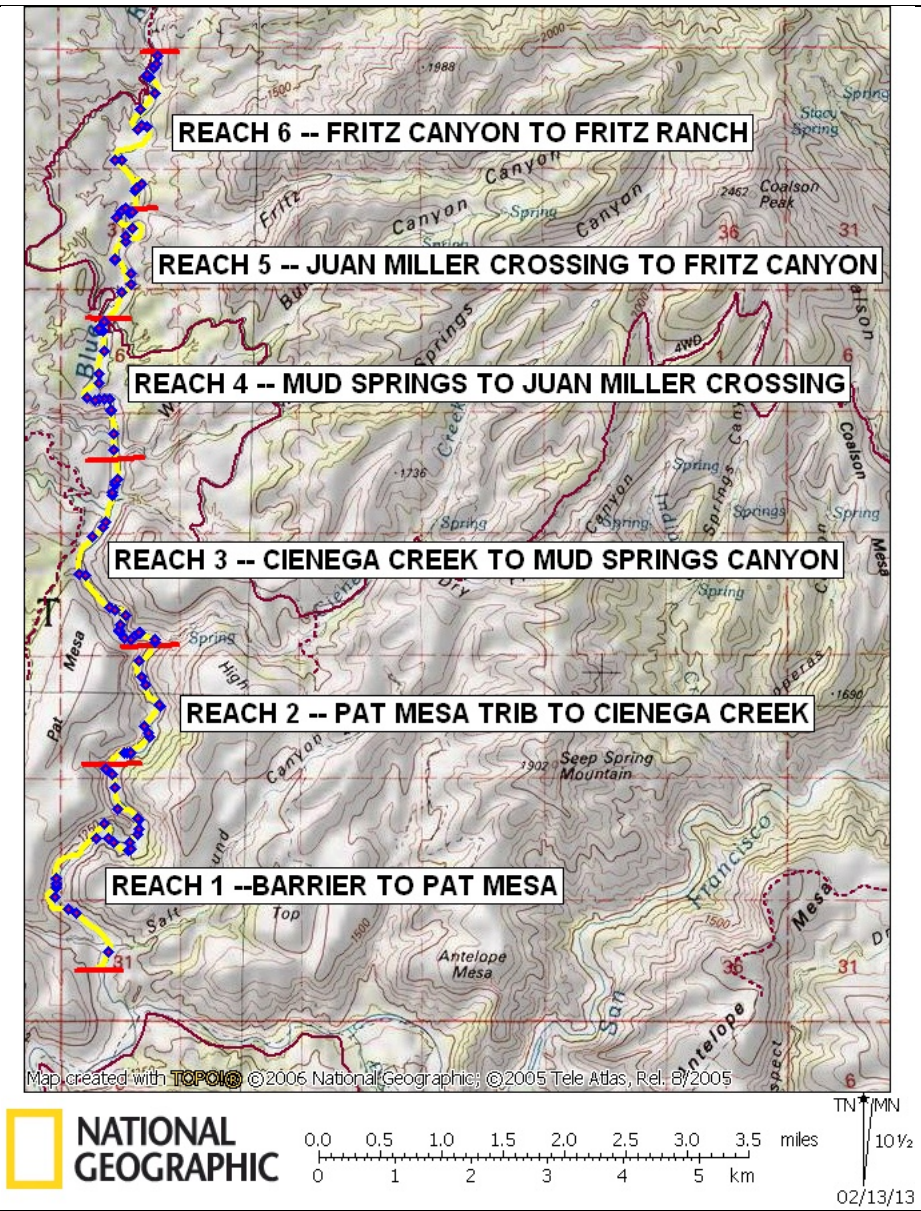

Figure 8. Map of the lower Blue River, Arizona showing the project reach (yellow line) divided by the red lines into the six sub-reaches. The blue dots are pools with maximum depth >1 m.

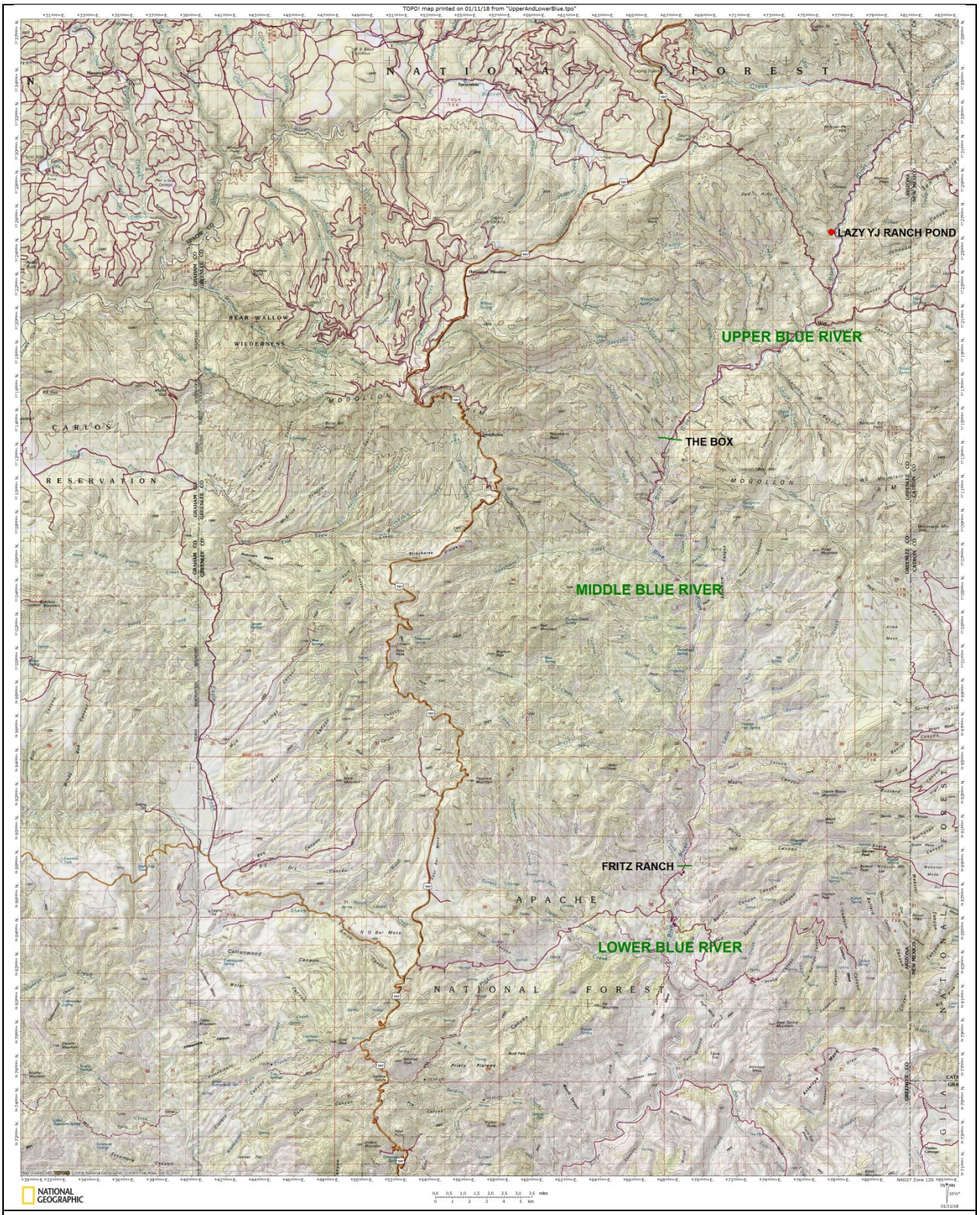

Figure 9. Map showing upper, middle, and lower sections of the Blue River, and Lazy YJ Ranch Pond.

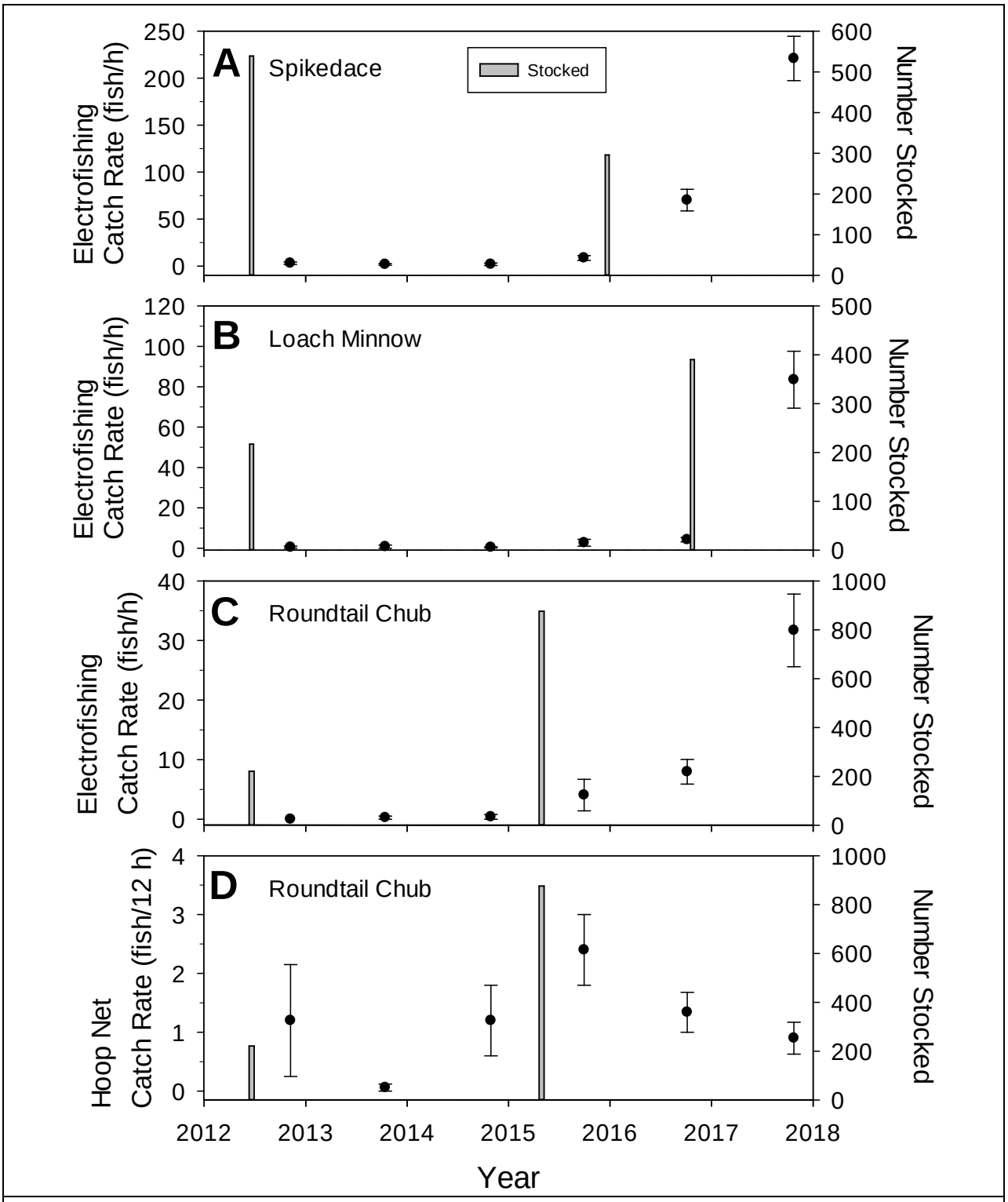

Figure 10. Mean and standard error of the electrofishing catch rates during annual monitoring and number stocked each year (grey bars) in the lower Blue River for A) Spikedace, B) Loach Minnow, and C) Roundtail Chub, and D) hoop net catch rates (number per 12 hours) for Roundtail Chub.

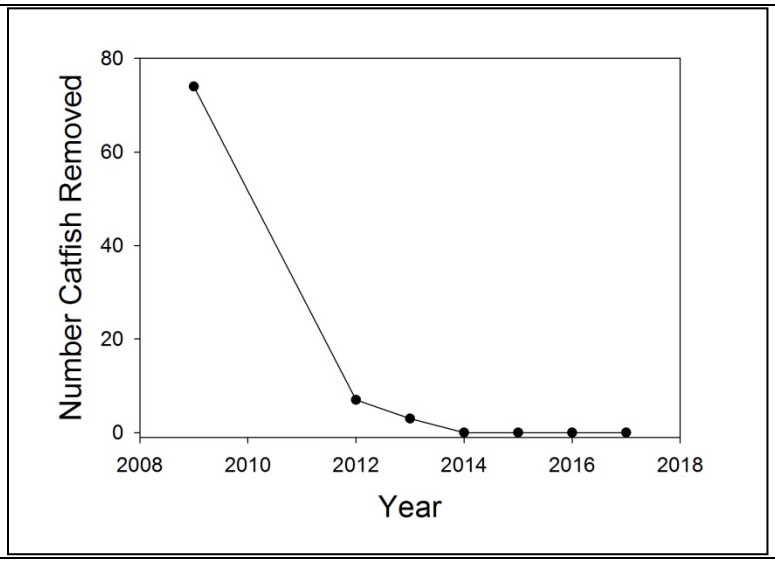

Figure 11. Trends in number of catfish removed during annual snorkeling-spearfishing from the lower Blue River, Arizona, 2009 through 2017.

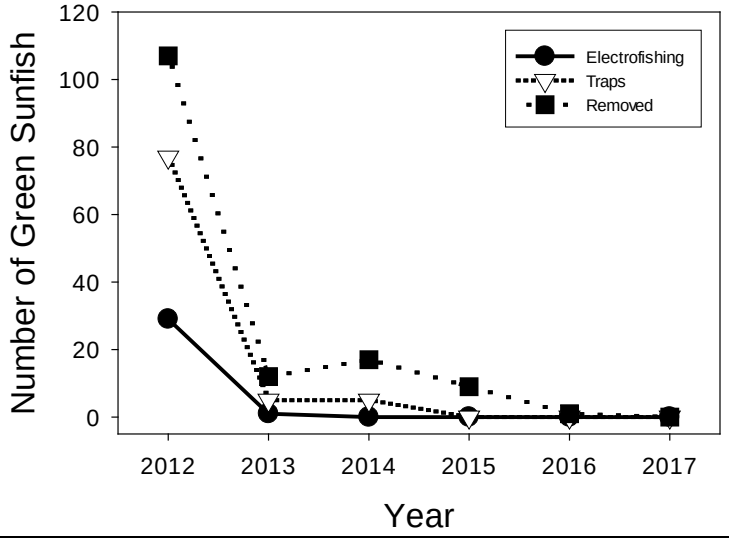

Figure 12. Trends in Green Sunfish catch during annual monitoring (electrofishing and hoop nets) and total number of individuals removed each year, during all activities, from the lower Blue River, Arizona, 2012 thru 2017.

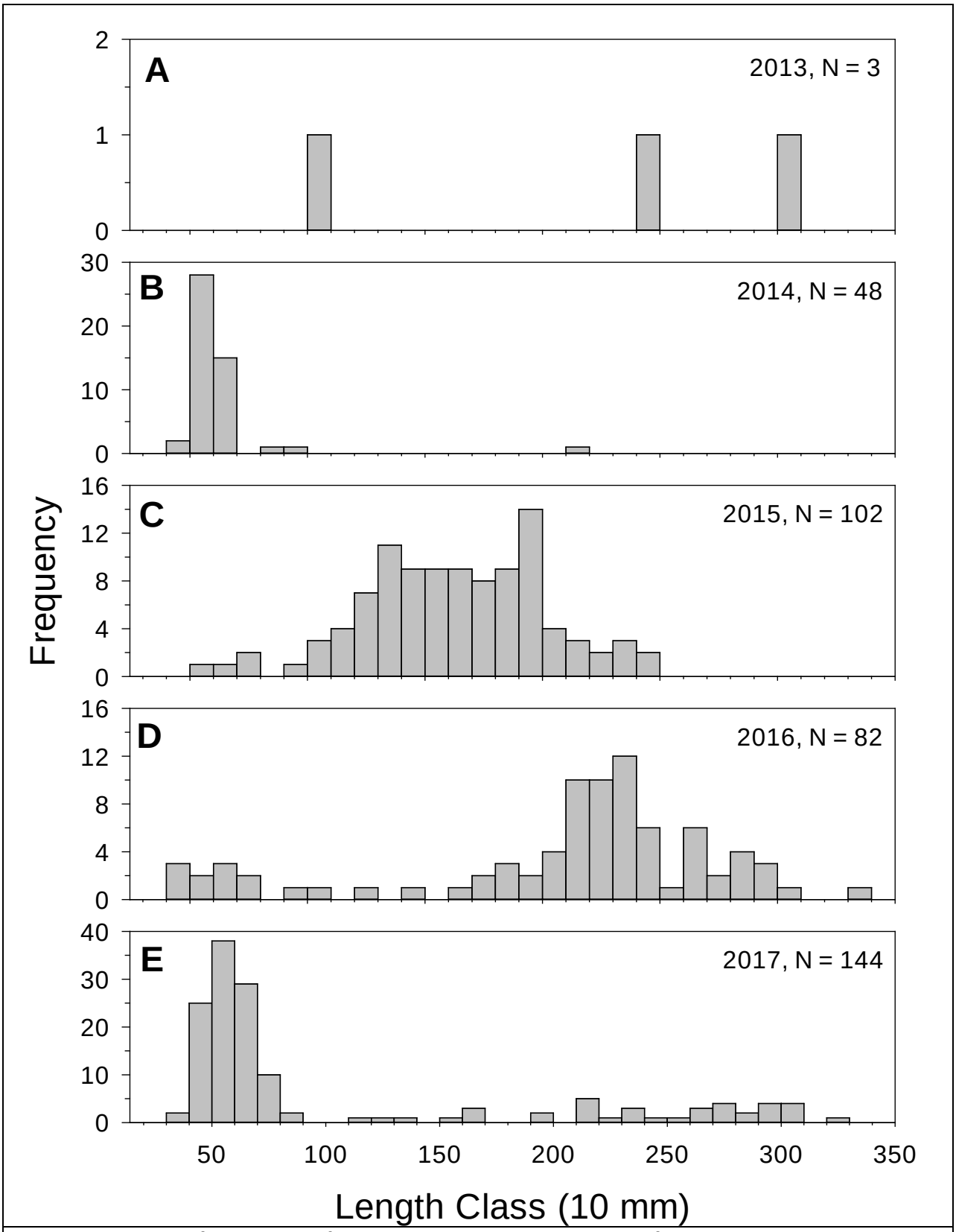

Figure 13. Length frequencies of Roundtail Chub captured during fall annual monitoring in the lower Blue River, Arizona, 2013-2017.

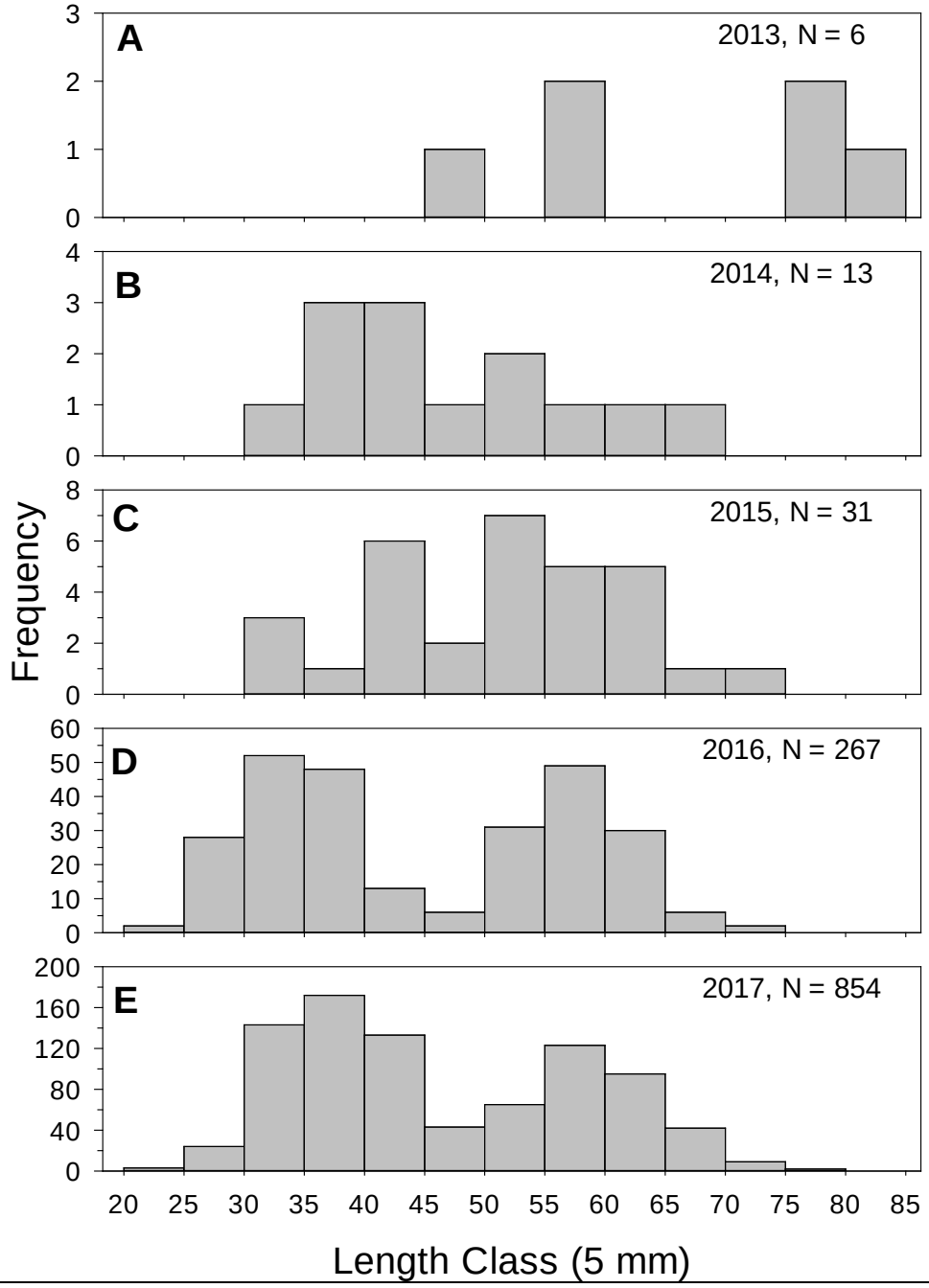

Figure 14. Length frequencies of Spikedace captured during fall annual monitoring in the lower Blue River, Arizona, 2013-2017.

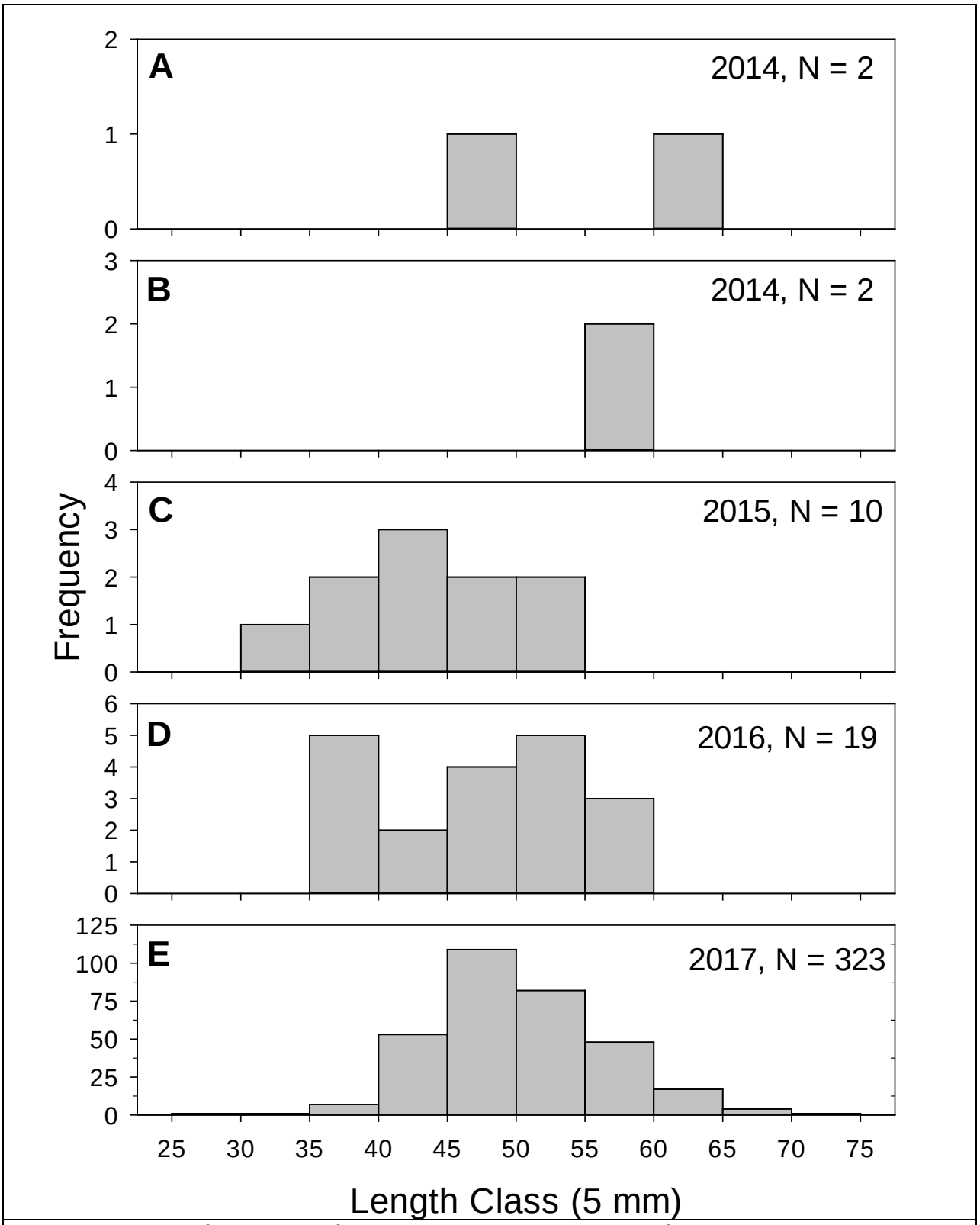

Figure 15. Length frequencies of Loach Minnow captured during fall annual monitoring in the lower Blue River, Arizona, 2013-2017.

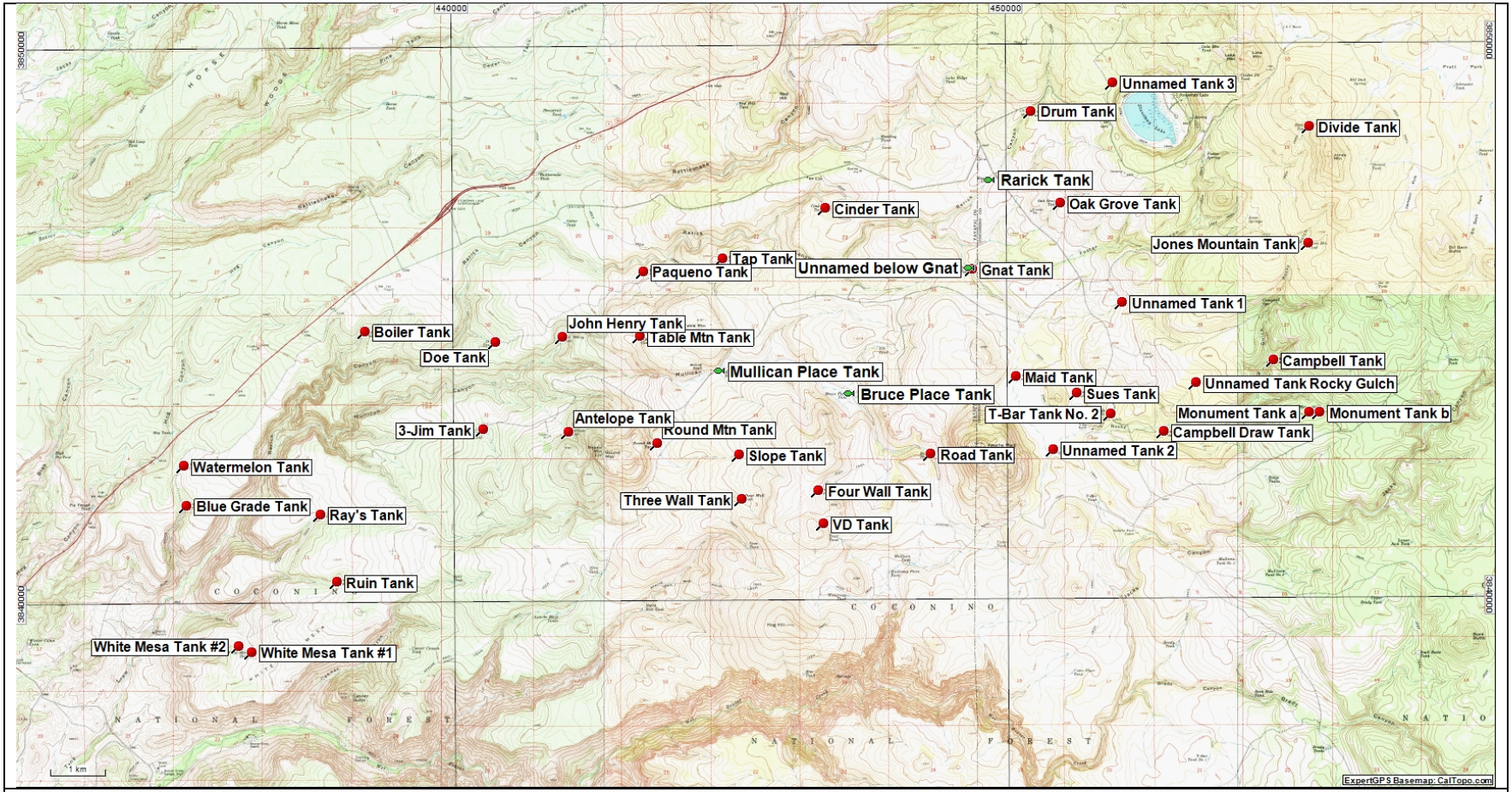

Figure 16. Map showing locations of livestock tanks in the Red Tank Draw drainage, all of which were surveyed during 2017. The four tanks with fish present are indicated with the green fish symbol.

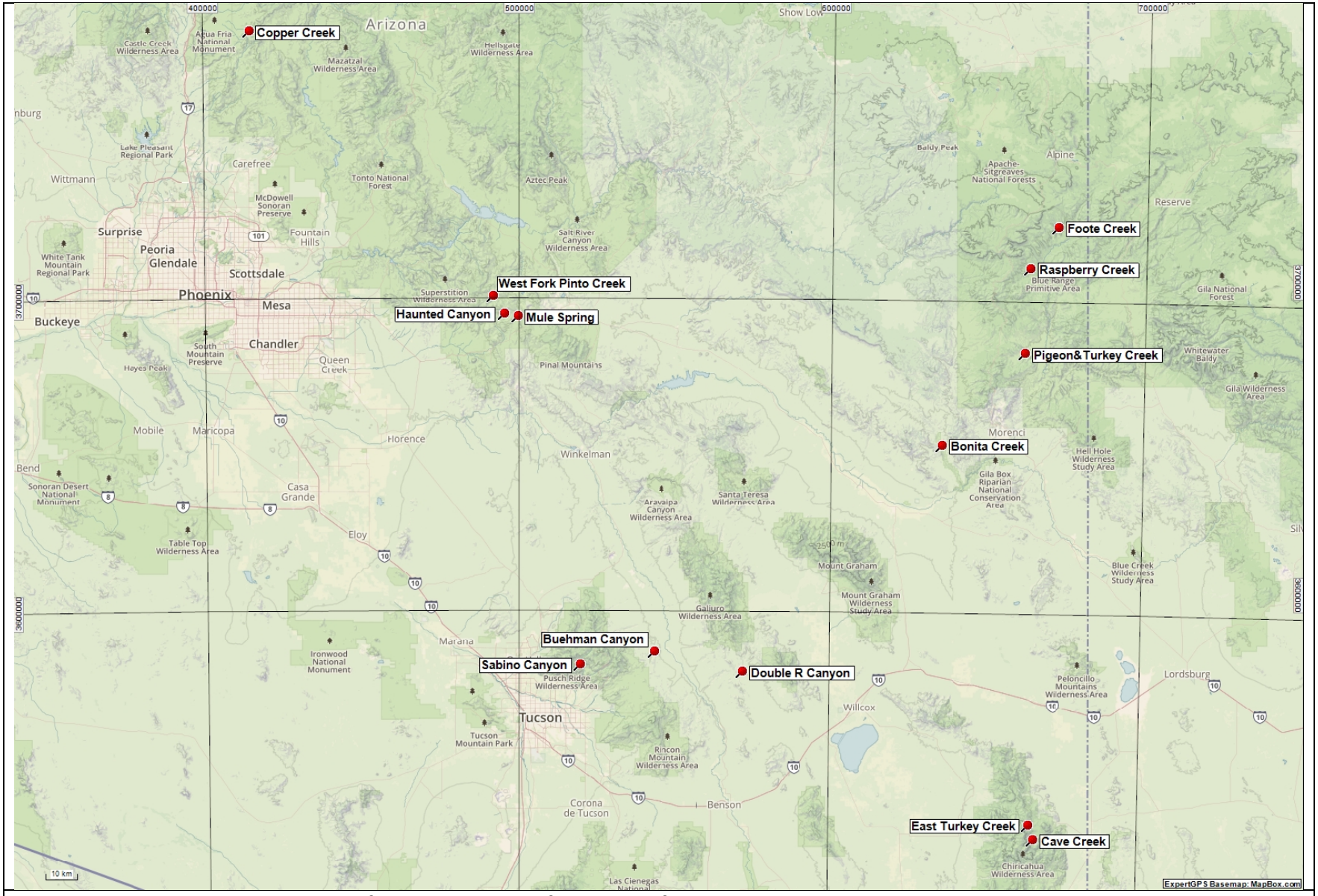

Figure 17. Map showing locations of streams assessed for suitable fish habitat in the Gila River basin in 2017.

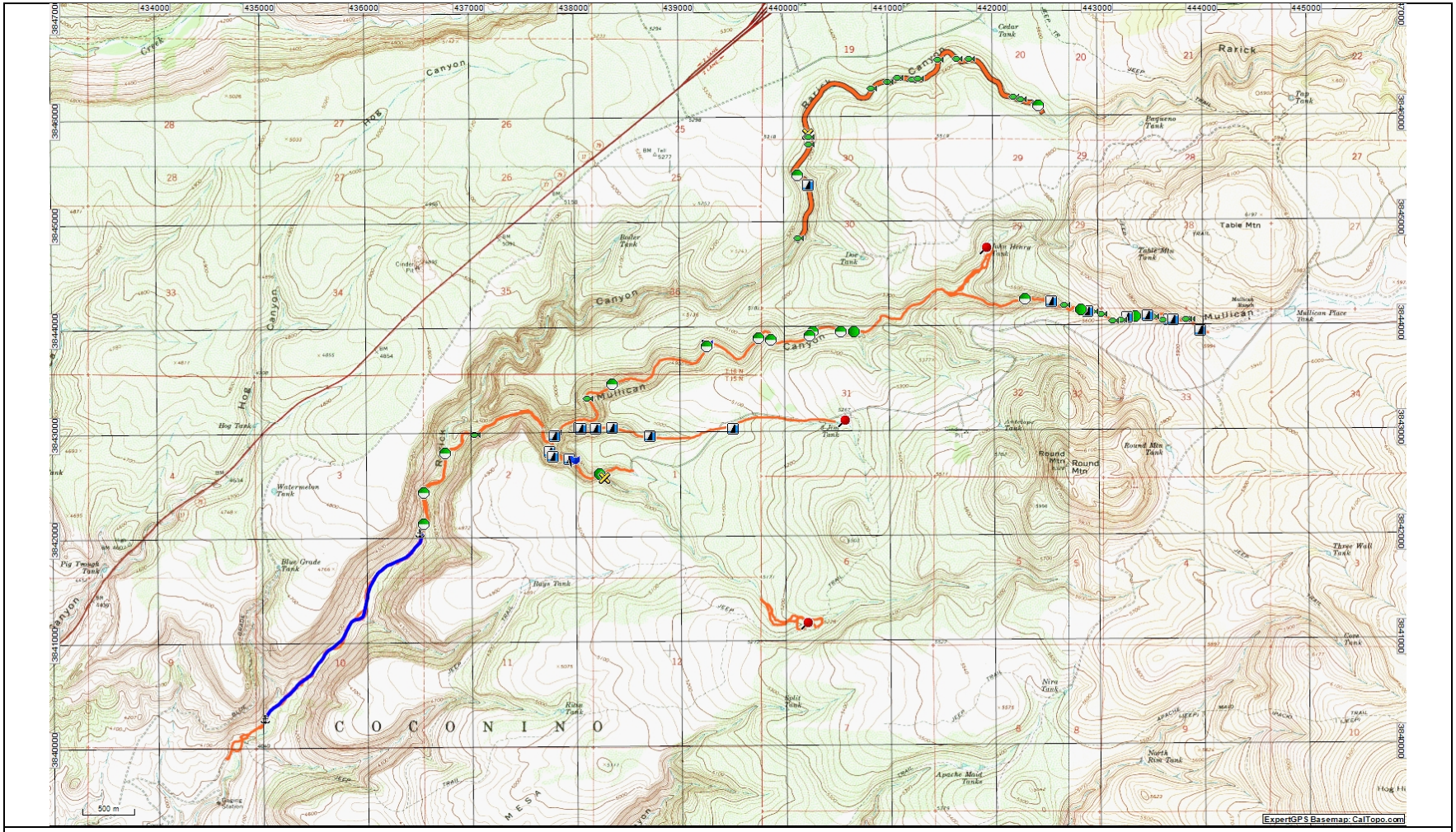

Figure 18. Map showing sections of the Red Tank Draw surveyed (orange and blue lines) and locations of pools and waterfalls. Pools that were judged to be ephemeral are denoted with the circle that is half white and half green, pools judged to be perennial are denoted with a solid green circle, and pools where fish were detected are denoted with a green fish symbol. Waterfalls are denoted with a square and dam symbol. Livestock tanks are denoted with a red push pin symbol. Locations where Narrow-headed Gartersnakes were detected are denoted with a yellow cross. Pools with fish in the Rarick Canyon drainage contained Fathead Minnow, whereas those in the Mullican Canyon drainage contained Green Sunfish and some Yellow Bullhead.

TABLES

Table 1. Summary of fish captured during single-pass backpack electrofishing surveys of nine 100-m transects in Hot Springs Canyon and one 100-m transect in upper Redfield Canyon Arizona during September 18-19, 2017. N is the number of transects per reach, and #Ind/h = mean number of fish captured per hour.

Stream	Reach	N	Statistic	Spikedace	Loach Minnow	Speckled Dace	Longfin Dace	Roundtail[1] Chub	Desert Sucker	Sonora Sucker	Gila Topminnow	Total
Hot Springs Canyon	1	3	#Ind	0	7	251	89	28	47	3	0	425.00
			#Ind/h		9.19	403.26	159.53	41.21	66.94	4.11		684.23
			SE		(9.19)	(168.57)	(51.63)	(18.80)	(27.53)	(2.43)		(165.88)
	2	3	#Ind	4	14	163	93	42	55	18	1	390.00
			#Ind/h	5.45	13.80	171.36	106.77	54.98	65.87	22.01	1.38	441.62
			SE	(3.58)	(5.59)	(39.29)	(11.70)	(27.96)	(27.37)	(7.71)	(1.38)	(19.91)
	3	3	#Ind	0	0	14	109	13	4	3	0	143.00
			#Ind/h			22.25	203.82	20.66	6.36	4.77		257.86
			SE			(22.25)	(4.17)	(20.66)	(6.36)	(4.77)		(49.88)
	Total	9	#Ind	4	21	428	291	83	106	24	1	958.00
			#Ind/h	1.82	7.66	198.96	156.71	38.95	46.39	10.30	.46	461.24
			SE	(1.38)	(3.71)	(74.90)	(20.78)	(12.45)	(15.14)	(3.99)	(.46)	(79.65)
Redfield Canyon	0	1	#Ind					26		17		43
			#Ind/h					105.52		69		174.52

[1] Chub in these locations were previously classified as Gila Chub.

Table 2. Number of fish captured and number caught per hour in minnow traps in two locations in Bass Canyon, Wildcat Canyon, and number caught and number caught per meter squared area seined in Mint Spring on September 18, 2017 at Muleshoe Ranch CMA, Arizona.

Water	N	Statistic	Speckled dace	Roundtail[1] chub	Desert sucker	Sonora sucker	Desert pupfish	Gila topminnow	Total fish	Lowland Leopard Frog
Bass Canyon-Lower	9	#Ind	2	141	2	4		3	152	
		#Ind/h	0.11	7.43	0.11	0.22		0.15	8.02	
		SE	(0.11)	(1.83)	(0.11)	(0.17)		(0.15)	(1.92)	
Bass Canyon - upper	13	#Ind		207		1		25	233	2
		#Ind/h		6.98		0.03		0.85	7.86	0.06
		SE		(2.69)		(0.03)		(0.45)	(2.56)	(0.04)
Wildcat Canyon	9	#Ind						341	341	
		#Ind/h						148.90	148.90	
		SE						(131.48)	(131.48)	
Mint Spring	7	#Ind					56		56	
		#Ind/h					0.51			
		SE					(0.11)			

[1] Chub in these locations were previously classified as Gila Chub.

Table 3. Summary of fish caught in minnow traps at three locations in Bonita Creek during annual monitoring on September 26, 2017. N = number of traps, #Ind = number of individuals captured, #Ind/h = mean number of individuals captured, and standard error.

Location	N	Statistic	Lognfin dace	Speckled dace	Roundtail [1] chub	Sonora sucker	Gila topminnow	Fathead minnow	Larval fish	Total fish	American bullfrog
Midnight Canyon POOC	12	#Ind	0	2	34	1	85	0	0	122	13
		#Ind/h	0.00	.04	.74	.02	1.90	0.00	0.00	4.06	.29
		SE	(.00)	(.03)	(.31)	(.02)	(1.24)	(.00)	(.00)	(1.78)	(.17)
Reservation Boundary CYMA	10	#Ind	0	0	17	0	9	0	7	33	1
		#Ind/h	0.00	0.00	.84	0.00	.44	0.00	.34	2.02	.05
		SE	(.00)	(.00)	(.59)	(.00)	(.34)	(.00)	(.20)	(.68)	(.05)
Reservation Boundary POOC	13	#Ind	12	0	26	0	280	8	0	326	0
		#Ind/h	.41	0.00	.91	0.00	9.47	.26	0.00	17.95	0.00
		SE	(.29)	(.00)	(.47)	(.00)	(4.78)	(.16)	(.00)	(7.61)	(.00)

Table 4. Summary of fish caught in three electrofishing transects in Bonita Creek during annual monitoring on September 26, 2017. For each transect, #Ind is the number of individuals captured, and #Ind/h is the number of individuals per hour, and the mean #Ind/h and SE are the given for the total of the three transects.

Transect	Seconds shocked	Statistic	Longfin Dace	Speckled Dace	Roundtail Chub[1]	Desert Sucker	Sonora Sucker	Gila Topminnow	Fathead Minnow	American Bullfrog
2-Random (635799 3652126)	732	#Ind	0	54	54	32	65	0	1	1
		#Ind/h	0.00	265.57	265.57	157.38	319.67	0.00	4.92	4.92
13-Fixed (635436 3653125)	613	#Ind	21	65	21	82	76	6	1	26
		#Ind/h	123.33	381.73	123.33	481.57	446.33	35.24	5.87	152.69
14-Random (635351 3653170)	433	#Ind	11	39	52	75	38	3	0	14
		#Ind/h	91.45	324.25	432.33	623.56	315.94	24.94	0.00	116.40
Total	1778	#Ind	32	158	127	189	179	9	2	41
		Mean	51.78	268.43	171.97	275.98	315.00	14.75	4.26	66.20
		SE	64.02	58.08	154.66	238.95	74.23	18.12	3.15	77.01

[1] Chub in these locations were previously classified as Gila Chub.

Table 5. Summary of fish captured in three electrofishing transects in Spring Creek during annual monitoring on September 5, 2017.

Transect	Statistic	Speckled Dace	Roundtail chub[1]	Desert Sucker	Sonora Sucker	Northern Crayfish
Random 1-1	#Ind	22	22	5	0	4
	#Ind/h	108.49	108.49	24.66		19.73
Random 2-1	#Ind	24	30	4	0	0
	#Ind/h	104.85	131.07	17.48		
Fixed 2-1	#Ind	26	12	3	2	0
	#Ind/h	113.46	52.36	13.09	8.73	
Total	#Ind	72	64	12	2	4
	#Ind/h	108.93	97.31	18.41	8.73	19.73
	SE	4.32	40.53	5.84		

Table 6. Summary of fish captured in minnow traps in two reaches of Spring Creek during annual monitoring on September 5-6, 2017.

Reach	N	Statistic	Longfin dace	Speckled dace	Roundtail[1] chub	Gila topminnow	total fish	Northern crayfish
Near Barrier	10	#Ind	0	0	88	122	210	5
		#Ind/h			1.94	2.70	4.65	.11
		SE			(0.59)	(1.47)	(2.01)	(0.09)
Near Willow Point Rd	10	#Ind	14	10	30	0	54	68
		#Ind/h	0.56	0.40	1.19		2.15	2.81
		SE	(0.29)	(0.19)	(0.42)		(0.72)	(0.80)
Total	20	#Ind	14	10	118	122	264	73
		#Ind/h	0.28	0.20	1.57	1.35	3.40	1.46
		SE	(0.15)	(0.10)	(0.36)	(0.78)	(1.08)	(0.50)

[1] Chub in these locations were previously classified as Gila Chub.

Table 7. Summary of fish captured by backpack electrofishing 200-m transects in the lower Blue River during annual monitoring during October 22-24, 2017. N is the number of transects per reach, #Ind is the number of individuals captured, and SE is the standard error of the mean.

Reach	N	Statistic	Spikedace	Loach minnow	Speckled dace	Longfin dace	Roundtail chub	Desert sucker	Sonora sucker	Red Shiner	Total fish
2	2	#Ind	175	20	56	14	27	29	25	0	346
		Mean Ind/h	304.28	35.31	97.41	23.76	47.02	50.99	43.88		602.63
		SE	(36.81)	(11.67)	(10.66)	(20.14)	(3.64)	(10.46)	(6.73)		(42.39)
3	2	#Ind	134	53	55	37	19	103	50	0	451
		Mean Ind/h	226.73	90.87	94.02	63.33	31.61	176.07	84.61		767.25
		SE	(83.16)	(4.73)	(11.47)	(5.90)	(24.43)	(21.73)	(30.77)		(182.20)
4	2	#Ind	163	66	69	56	25	113	53	1	545
		Mean Ind/h	254.38	105.71	110.07	87.47	39.04	177.78	85.76	1.51	860.22
		SE	(83.59)	(18.20)	(10.49)	(27.19)	(12.25)	(30.43)	(31.45)	2.14	(93.34)
5	3	#Ind	119	100	151	88	35	115	87	0	695
		Mean Ind/h	144.60	110.65	170.95	96.75	40.63	131.68	103.12		798.37
		SE	(36.59)	(52.28)	(44.90)	(44.36)	(10.21)	(26.71)	(33.06)		(133.20)
6	3	#Ind	263	84	331	95	10	307	129	0	1219
		Mean Ind/h	215.98	68.66	269.08	81.94	7.68	246.22	107.95		997.51
		SE	(13.69)	(6.32)	(28.28)	(36.51)	(5.13)	(32.00)	(18.55)		(34.15)
total	12	#Ind	854	323	662	290	116	667	344	1	3256
		Mean Ind/h	221.04	83.48	160.26	73.77	31.69	161.95	88.48	0.87	820.65
		SE	(23.59)	(14.10)	(23.87)	(14.96)	(6.06)	(21.85)	(11.80)	0.25	(55.05)

Table 8. Summary of fish captured in hoop nets in the lower Blue River during annual monitoring during October 22-23, 2017. N is the number of hoop nets per reach, #Ind is the number of individuals captured, and SE is the standard error of the mean.

Reach	N	Statistic	Longfin dace	Roundtail chub	Desert sucker	Sonora sucker	Fathead minnow	Northern Crayfish	Total fish
2	4	#Ind	1	7	1	7	0	17	16
		Mean #Ind/12h	0.16	1.15	0.16	1.15		2.79	2.63
		SE	(.16)	(.94)	(.16)	(.32)		(1.12)	(1.04)
3	5	#Ind	0	15	0	7	1	0	23
		Mean #Ind12/h		1.94		0.90	0.13		2.97
		SE		(.92)		(.48)	(.13)		(1.23)
4	5	#Ind	0	3	1	6	0	10	10
		Mean #Ind/12h		0.38	0.13	0.77		1.28	1.28
		SE		(.16)	(.13)	(.37)		(.53)	(.41)
5	4	#Ind	0	7	0	16	0	25	23
		Mean #Ind/12h		1.14		2.61		4.08	3.75
		SE		(.31)		(2.20)		(2.24)	(2.25)
6	6	#Ind	0	0	1	12	0	24	13
		Mean #Ind/12h			0.11	1.29		2.59	1.40
		SE			(.11)	(.44)		(.95)	(.39)
Total	24	#Ind	1	32	3	48	1	76	85
		Mean #Ind/12h	0.03	0.87	0.08	1.30	0.03	2.06	2.30
		SE	(.03)	(.27)	(.04)	(.38)	(.03)	(.53)	(.49)

Table 9. List of stock tanks present and surveyed in the Red Tank Draw (Rarick/Mullican Canyon) drainage during 2017. All coordinates are in NAD83, zone 12S.

Tank Name	Easting	Northing	Wet/dry	Fish & Comments
Antelope Tank	442057	3843027	wet	fishless
Blue Grade Tank	435163	3841734	wet	fishless
Boiler Tank	438402	3844839	wet	fishless
Bruce Place Tank	447147	3843717	wet	Not permitted access; likely fish
Campbell Draw Tank	452806	3842976	wet	fishless
Campbell Tank	454789	3844259	wet	fishless
Cinder Pit Tank	454203	3849396	dry	fishless
Cinder Tank	446746	3847049	wet	fishless
Divide Tank	455451	3848451	wet	fishless
Doe Tank	440754	3844650	wet	fishless
Drum Tank	450438	3848757	wet	fishless
Four Wall Tank	446572	3841951	wet	fishless
Gnat Tank	449364	3845912	wet	fishless
John Henry Tank	441943	3844739	wet	fishless
Jones Mountain Tank	455426	3846338	wet	fishless
Lake Mountain Tank	453505	3849907	wet	fishless
Maid Tank	450134	3843984	wet	fishless
Monument Tank	455427	3843316	wet	fishless
Mullican Place Tank	444825	3844127	wet	LECY, AMME, ORVI
No Name	452070	3845299	dry	fishless
No Name	450803	3842661	wet	fishless
No Name	451917	3849264	wet	fishless
No Name below Gnat	449335	3845954	wet	PIPR
Oak Grove Tank	450958	3847102	wet	fishless
Paqueno Tank	442805	3845715	wet	fishless
Purgatory Tank	440146	3841165	wet	fishless
Rarick Tank	449623	3847434	wet	PIPR

Rays Tank	437597	3841569	wet	fishless
Road Tank	448623	3842609	wet	fishless
Round Mountain Tank	443666	3842808	wet	fishless
Ruin Tank	437862	3840335	wet	fishless
Sues Tank	451239	3843673	wet	fishless
T-bar Tank Number Two	451848	3843296	wet	fishless
Table Mountain Tank	443356	3844747	wet	fishless
Table Mountain Tank	453390	3843846	wet	fishless
Tap Tank	444849	3846155	wet	fishless
Three-Jim Tank	440519	3843069	wet	fishless
Three Wall Tank	445187	3841806	wet	fishless
V D Tank	447672	3844546	wet	fishless
Watermelon Tank	435117	3842451	dry	fishless
White Mesa Tank	436314	3839099	wet	fishless
White Mesa Tank Two	436075	3839199	wet	fishless
Slope Tank	445109	3842580	wet	fishless

Table 10. Waters assessed during 2014 through 2017 to determine suitability for native fish repatriations, showing coordinates (NAD 83 UTM, zone 12S) of the upstream and downstream points for each reach assessed, the estimated length of perennial water within the assessed reach at the time of the survey, and the species for which the water was considered be suitable for.

			Upstream		Downstream			
Year	Date	Water Name	Easting	Northing	Easting	Northing	Length Perennial (m)	Suitable for Species
2014	4/1/2014	South Fork Deadman Crk	452891	3770077	450817	3772961	4400	RHCO, MEFU, GIRO, POOC
2014	4/1/2014	Deadman Creek	450829	37731164	450780	3772923	600	GIRO, POOC
2014	4/14/2014	Bonita Creek - upper	637499	3647178	391883	3740709	5875	RHCO, MEFU, POOC
2014	10/16/2014	Copper Creek - upper	415294	3783300	414957	3784056	500	maybe POOC, GIRO
2015	3/10/2015	Reimer Spring	410156	3811873	410268	3812368	250	POOC
2015	3/10/2015	Indian Creek	413535	3798878	413325	3798872	220	POOC
2015	3/17/2015	Seven Springs	421594	3758300	420324	3758595	1600	MEFU, POOC, GIRO, RHOS, CACL
2015	3/18/2015	Lime Creek - upper	421976	3771582	423842	3769530	1300	POOC, GIRO
2015	3/23/2015	Towel Creek	434879	3807874	431708	3808163	50	maybe AGCH, RHOS
2015	3/24/2015	Cottonwood Creek	487568	3723472	487595	3724000	600	POOC
2015	3/24/2015	Rock Creek - upper	471383	3730666	471381	3730670	1300	maybe AGCH, GIRO
2015	3/24/2015	Rock Creek - lower	475856	3731040	476451	3730776	700	AGCH, POOC
2015	4/21/2015	Turkey Creek	389109	3792493	388400	3790285	4000	AGCH
2015	4/22/2015	Wilson Spring	415381	3815195	415355	3815206	20	POOC
2015	4/22/2015	Little Ash Creek	406593	3805271	404663	3805086	>1300	POOC and GIRO
2015	7/27/2015	Copper Creek - lower	414957	3784056	414324	3784428	32	POOC
2016	2/19/2016	Bishop Creek	401782	3789224	403890	3788175	30	Maybe POOC
2016	2/27/2016	Grapevine Canyon	412756	3766285	412770	3766280	500	POOC, GIRO
2016	3/7/2016	Tortilla Creek	467373	3708578	464233	3710019	500	POOC
2016	3/15/2016	South Fork Sheep Creek	448077	3754778	446914	3756529	100	POOC
2016	4/12/2016	Ash Creek	607829	3632197	607789	3632123	?	Maybe AGCH
2016	4/12/2016	Deadman Creek	611373	3623016	611398	3623118	?	Maybe GIRO
2016	6/5/2016	Home Tank Draw	452192	3827223	452117	3826994	25	None
2016	6/8/2016	Russell Spring	430492	3831022	429941	3831305	59	None
2016	6/28/2016	Sabino Canyon	520661	3579809	520551	3579167	700	GIRO, CACL, RHOS

2016	7/6/2016	Mesquite Spring	429471	3816410	428902	3815864	4	None
2016	7/6/2016	Cottonwood Spring	429239	3816482	429063	3816016	0	None
2016	7/6/2016	Doren's Defeat Spring	438093	3810597	436636	3811691	15	None
2016	7/6/2016	Willow Spring	438429	3811400	436636	3811691	10	None
2016	7/6/2016	Big Willow Spring	437993	3811651	437803	3811414	6	None
2016	7/26/2016	Long Gulch Artesian	487919	3732399			10	None
2016	10/20/2016	West Fork Pinto Creek	493978	3699996	495059	3700174	1070	POOC, GIRO, CACL
2016	11/2/2016	Reavis Creek	484483	3710381	484521	3711190	500	Maybe POOC, GIRO
2017	02/22/2017	Copper Creek	414532	3784291	414339	3784419	250	Might dry; Maybe POOC
2017	03/27/2017	West Fork Pinto Creek	491038	3700111	491607	3700234	700	GIRO if remove sunfish
2017	03/28/2017	Haunted Canyon	494989	3694636	499072	3695799	100	Mostly dry; maybe POOC
2017	05/25/2017	Mule Spring	499294	3693737	499384	3693766	100	POOC
2017	06/13/2017	Sabino Canyon-upper	519538	3582136	520672	3579822	400	POOC, GIRO, maybe CACL, RHOS
2017	06/13/2017	Double R Canyon	571778	3579977	571730	3579864	120	POOC
2017	07/10/2017	Cave Creek	666262	3526586	673178	673178	>100	RHOS
2017	07/10/2017	South Fork Cave Creek	668492	3524164	671370	3527216	>200	RHOS
2017	07/11/2017	North Fork Cave Creek	665086	3529901	665185	3529976	>100	Maybe ONGI
2017	07/11/2017	East Turkey Creek	664767	3531454	668015	3533601	>350	RHOS, maybe GIRO
2017	07/17/2017	Foote Creek	671461	3723300	671684	3719141	4700	Maybe TICO
2017	07/18/2017	Raspberry Creek	662652	3710016	664946	3708831	2800	TICO near waterfall
2017	07/27/2017	Bonita Creek	635217	3653338	635728	3651703	2000	TICO
2017	08/28/2017	Pigeon Creek	661479	3682954	663116	3683347	2500	TICO
2017	08/29/2017	Turkey Creek (Pigeon)	662599	3683742	662715	3683641	250	Maybe TICO, GIRO
2017	10/12/2017	Buehman Canyon	543564	3586521	544076	3586841	700	POOC, maybe GIRO
2017	10/12/2017	Bullock Canyon	541290	3582592	541463	3582742	250	POOC, maybe GIRO

Table 11. Summary of number of broodstock (#B), number of offspring produced (#P), number of offspring stocked (#S) for each species and lineage held at the Aquatic Research and Conservation Center, from 2007 through 2017. Numbers stocked do not include fish transferred to New Mexico.

Taxa	Extant Lineage/Stream		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Spikedace	upper Gila River, NM	#B	640	XX	XX	XX	XX	XX		380	392	531	267
		#P		740	165	2555	539	1300		1000	296	0	384
		#S		448	165	545		539			296		327
	Gila River Forks	#B			17	267	XX	XX	XX	250	204	138	122
		#P	NA	NA	0	379	0	800	700	300		0	1183
		#S											1000
	Aravaipa Creek	#B	258	XX	XX	XX	XX	XX		480	412	262	382
		#P	100	1650	410	5993	4663	3471		221	35	120	1347
		#S	125	1600	386	2954	4663	3471			221	67	
Loach Minnow	upper Gila River, NM	#B	143							NA	NA	NA	NA
		#P											
		#S											
	Gila River Forks	#B								57	81	96	128
		#P	NA	NA	0	0	0			250		220	7
		#S											159
	San Francisco R., NM	#B								27	119	215	314
		#P	NA	NA	NA					500		26	177
		#S											243
	Blue River	#B	71	XX	XX	XX	150		XX	180	245	214	156
		#P		670	22	164	722		1500	288		426	47
		#S		678		156		217	310	288		390	
	Aravaipa Creek	#B	254	XX	XX	XX	XX		XX	340	316	297	490
		#P	1004	3250	274	1623	1035		951	0		265	305
		#S	124	4003	156	1561	527		951				
Roundtail chub	Eagle Creek	#B					XX			85	85	101	99
		#P					149			1500	2000	0	57
		#S						221			876	1194	

APPENDIXES

Appendix 1. Summary of native fish stocked in Arizona during 2017 by the Department under the Gila River Basin Native Fishes Conservation Program.

Taxa	Water Name	Site Name	Easting	Northing	Date	Lineage	# Stocked	# Mortalities
Desert Pupfish	Las Cienegas-Cottonwood Tank		536015	3514060	8/21/2017	Santa Clara Slough	155	0
Gila Topminnow	Arnett Creek	0.1 km below Telegraph Cyn	487224	3680592	5/15/2017	Redrock Canyon	522	9
Gila Topminnow	Charlebois Spring		468132	3702314	5/18/2017	mixed	622	14
Gila Topminnow	Double R Canyon		571730	3579864	9/18/2017	Bylas Springs	574	131
Gila Topminnow	Las Cienegas-Bill's Pond		537981	3516423	8/21/2017	Cienega Creek	636	0
Gila Topminnow	Murray Spring		578791	3493570	8/21/2017	Cienega Creek	453	2
Gila Topminnow	Murray Spring		578791	3493570	8/21/2017	Peck Canyon	322	0
Gila Topminnow	Murray Spring		578670	3493539	8/21/2017	Cienega Creek	238	26
Gila Topminnow	Murray Spring		578670	3493539	8/21/2017	Peck Canyon	208	1
Gila Topminnow	Tortilla Creek-upper	4.6 km above Mesquite Wash	467239	3708615	6/08/2017	Peck Canyon	548	59
Gila Topminnow	West Fork Pinto Creek	0.5 km below Jerky Spr.	491033	3700110	5/25/2017	Sharp Spring	705	6
Gila Topminnow	Wildcat Canyon	85 m below spring trib	569907	3580920	9/18/2017	Bylas Springs	128	4
Roundtail Chub[1]	Las Cienegas-Spring Water Wetland		539147	3518983	6/19/2017	Cienega Creek	85	2
Roundtail Chub[1]	Las Cienegas-Clyne Pond		546711	3514452	6/29/2017	Cienega Creek	75	13
Spikedace	Blue River	Cole Flat-upper	667145	3713223	9/13/2017	Upper Gila River	226	30

Spikedace	Blue River	Cole Flat-lower	667143	3713097	9/13/2017	Upper Gila River	222	21

[1] Chub repatriated to Spring Water Wetland and Clyne Pond were previously classified as Gila Chub.

Appendix 2. Summary of monitoring results during 2017 for the five priority species and other target native fish species that were previously stocked into various waters in the Gila River Basin Arizona.

Taxa	Location	Date	Gear Type	Sample Size	Statistics	2017
Desert Pupfish	Black Canyon City Heritage Park Pond	11/20/2017	Minnow Trap	20	#Ind	23
					%YOY	91
					Mean CPUE	0.6
					SE	0.22
Desert Pupfish	Black Canyon City Heritage Park Pond	11/20/2017	Seine	5	#Ind	599
					%YOY	82
					Mean CPUE	0.6
					SE	0.28
Desert Pupfish	Bonita Creek	09/26/2017	Minnow Trap	10	#Ind	0
					%YOY	0
					Mean CPUE	0
					SE	
Desert Pupfish	Las Cienegas-Cottonwood Tank	8/7/2017	Minnow Trap	15	#Ind	34
					%YOY	9
					Mean CPUE	1.0
					SE	0.32
Desert Pupfish	Las Cienegas-Crescent Pond	8/7/2017	Minnow Trap	5	#Ind	12
					%YOY	17
					Mean CPUE	1.0
					SE	0.67
Desert Pupfish	Las Cienegas-Egret Pond	8/7/2017	Minnow Trap	5	#Ind	24
					%YOY	58
					Mean CPUE	1.8
					SE	0.59
Desert Pupfish	Las Cienegas-Gaucho Tank	8/7/2017	Minnow Trap	10	#Ind	166
					%YOY	22
					Mean CPUE	6.1
					SE	0.87

Taxa	Location	Date	Gear Type	Sample Size	Statistics	2017
Desert Pupfish	Las Cienegas-Heart Pond	8/7/2017	Minnow Trap	5	#Ind	87
					%YOY	13
					Mean CPUE	1.8
					SE	1.42
Desert Pupfish	Muleshoe CMA-Mint Spring	9/18/2017	Seine	7	#Ind	56
					%YOY	28.6
					Mean CPUE	0.5
					SE	0.11
Desert Pupfish	Robbins Butte-Cottonwood Tank	7/25/2017	Minnow Trap	10	#Ind	38
					%YOY	8
					Mean CPUE	1.5
					SE	0.54
Desert Pupfish	Robbins Butte-Twin Tanks	7/25/2017	Minnow Trap	10	#Ind	507
					%YOY	18
					Mean CPUE	21.2
					SE	1.15
Desert Pupfish	San Pedro Riparian NCA-Murray Spring	8/7/2017	Minnow Trap	15	#Ind	1
					%YOY	0
					Mean CPUE	0.03
					SE	0.09
Desert Pupfish	San Pedro Riparian NCA-Murray Spring	8/7/2017	Dip Net	11	#Ind	0
					%YOY	0
					Mean CPUE	
					SE	
Desert Pupfish	San Pedro Riparian NCA-Horse Thief Draw	8/7/2017	Seine	10	#Ind	0
					%YOY	0
					Mean CPUE	
					SE	

Taxa	Location	Date	Gear Type	Sample Size	Statistics	2017
Gila Topminnow	Arnett Creek	10/18/2017	Minnow Trap	10	#Ind	74
					%YOY	18
					Mean CPUE	3.5
					SE	0.83
Gila Topminnow	Arnett Creek	10/18/2017	Dip Net	14	#Ind	16
					%YOY	19
					Mean CPUE	2.2
					SE	0.25
Gila Topminnow	Bass Canyon - upper	09/18/2017	Minnow Trap	13	#Ind	25
					%YOY	48
					Mean CPUE	0.9
					SE	0.45
Gila Topminnow	Bass Canyon - lower	09/18/2017	Minnow Trap	9	#Ind	3
					%YOY	0
					Mean CPUE	0.2
					SE	0.15
Gila Topminnow	Bonita Creek-Res. Boundary	09/26/2017	Minnow Trap	12	#Ind	280
					%YOY	1.4
					Mean CPUE	9.5
					SE	4.78
Gila Topminnow	Bonita Creek- Midnight Canyon	09/26/2017	Minnow Trap	13	#Ind	85
					%YOY	28
					Mean CPUE	1.9
					SE	1.24
Gila Topminnow	Charlebois Spring	10/19/2017	Minnow Trap	10	#Ind	14
					%YOY	0
					Mean CPUE	0.7
					SE	0.32
Gila Topminnow	Charlebois Spring	10/19/2017	Dip Net	13	#Ind	4

Taxa	Location	Date	Gear Type	Sample Size	Statistics	2017
					%YOY	0
					Mean CPUE	0.8
					SE	0.42
Gila Topminnow	Hidden Water Spring	8/1/2017	Minnow Trap	13	#Ind	401
					%YOY	19
					Mean CPUE	12.3
					SE	1.01
Gila Topminnow	Hidden Water Spring	8/1/2017	Seine	3	#Ind	24
					%YOY	13
					Mean CPUE	1.8
					SE	0.79
Gila Topminnow	Las Cienegas-Bill's Wildlife pond	8/7/2017	Minnow Trap	6	#Ind	18
					%YOY	61
					Mean CPUE	1.0
					SE	0.49
Gila Topminnow	Las Cienegas-Bill's Wildlife Pond	8/7/2017	Dip Net	4	#Ind	4
					%YOY	100
					Mean CPUE	-
					SE	-
Gila Topminnow	Las Cienegas-Clyne Pond	8/8/2017	Minnow Trap	18	#Ind	92
					%YOY	1
					Mean CPUE	2.4
					SE	0.36
Gila Topminnow	Las Cienegas-Egret Pond	8/7/2017	Minnow Trap	5	#Ind	1204
					%YOY	34
					Mean CPUE	91.4
					SE	2.74
Gila Topminnow	Las Cienegas-Crescent Pond	8/7/2017	Minnow Trap	5	#Ind	613
					%YOY	40

Taxa	Location	Date	Gear Type	Sample Size	Statistics	2017
					Mean CPUE	52.8
					SE	3.31
Gila Topminnow	Las Cienegas-Gaucho Tank	8/7/2017	Minnow Trap	10	#Ind	2785
					%YOY	61
					Mean CPUE	102.4
					SE	2.48
Gila Topminnow	Las Cienegas-Nogales Spring	8/8/2017	Minnow Trap	7	#Ind	3
					%YOY	0
					Mean CPUE	0.2
					SE	0.24
Gila Topminnow	Lime Creek	3/16/2017	Seine	32	#Ind	143
					%YOY	8
					Mean CPUE	0.5
					SE	0.22
Gila Topminnow	Lime Creek	3/16/2017	Dip Net	24	#Ind	0
					%YOY	0
					Mean CPUE	
					SE	
Gila Topminnow	San Pedro Riparian NCA-Murray Spring	8/7/2017	Minnow Trap	15	#Ind	10
					%YOY	0
					Mean CPUE	0.3
					SE	0.27
Gila Topminnow	San Pedro Riparian NCA-Murray Spring	8/7/2017	Dip Net	11	#Ind	0
					%YOY	0
					Mean CPUE	
					SE	
Gila Topminnow	San Pedro Riparian NCA-Horse Thief Draw	8/7/2017	Seine	10	#Ind	0
					%YOY	0
					Mean CPUE	

Taxa	Location	Date	Gear Type	Sample Size	Statistics	2017
					SE	
Gila Topminnow	Robbins Butte Swimming Pool Tank	7/25/2017	Minnow Trap	5	#Ind	390
					%YOY	16
					Mean CPUE	34.9
					SE	3.40
Gila Topminnow	Robbins Butte Stop Sign Tank	7/25/2017	Minnow Trap	10	#Ind	652
					%YOY	2
					Mean CPUE	30.3
					SE	2.46
Gila Topminnow	Rock Spring	7/26/2017	Minnow Trap	10	#Ind	0
					%YOY	0
					Mean CPUE	
					SE	
Gila Topminnow	Rock Spring	7/26/2017	Seine	6	#Ind	0
					%YOY	0
					Mean CPUE	
					SE	
Gila Topminnow	Sabino Canyon	6/12/2017	Minnow Trap	8	#Ind	0
					%YOY	0
					Mean CPUE	
					SE	
Gila Topminnow	Sabino Canyon	6/12/2017	Seine	19	#Ind	104
					%YOY	38
					Mean CPUE	0.4
					SE	0.23
Gila Topminnow	Sabino Canyon	6/12/2017	Dip Net	11	#Ind	1
					%YOY	100
					Mean CPUE	0.5
					SE	0.39

Taxa	Location	Date	Gear Type	Sample Size	Statistics	2017
Gila Topminnow	Sheepshead Canyon	9/16/2017	Minnow Trap	13	#Ind	84
					%YOY	12
					Mean CPUE	1.9
					SE	0.63
Gila Topminnow	Spring Creek	9/6/2017	Minnow Trap	20	#Ind	122
					%YOY	4
					Mean CPUE	1.4
					SE	0.42
Gila Topminnow	Spring Creek	9/5/2017	Dip Net	2	#Ind	12
					%YOY	-
					Mean CPUE	85
					SE	3.3
Gila Topminnow	Tortilla Creek	11/1/2017	Minnow Trap	10	#Ind	829
					%YOY	25
					Mean CPUE	37.8
					SE	1.52
Gila Topminnow	Wildcat Canyon	09/18/2017	Minnow Trap	9	#Ind	341
					%YOY	15
					Mean CPUE	148.9
					SE	131.48
Gila Topminnow	West Fork Pinto Creek	10/31/2017	Seine	14	#Ind	398
					%YOY	60
					Mean CPUE	5.5
					SE	0.69
Loach Minnow	Blue River	10/22/2017	Backpack Electrofisher	12	#Ind	323
					%YOY	3
					Mean CPUE	83.5
					SE	14.1
Loach Minnow	Bonita Creek	09/26/2017	Backpack Electrofisher	3	#Ind	0

Taxa	Location	Date	Gear Type	Sample Size	Statistics	2017
					%YOY	0
					Mean CPUE	
					SE	
Loach Minnow	Hot Springs Canyon	09/18/2017	Backpack Electrofisher	9	#Ind	21
					%YOY	24
					Mean CPUE	7.7
					SE	3.17
Roundtail Chub[1]	Harden Cienega Creek	04/25/2017	Mini-Hoop Net	30	#Ind	391
					%YOY	30
					Mean CPUE	0.80
					SE	0.17
Roundtail Chub[1]	Las Cienegas-Clyne Pond	8/8/2017	Mini-Hoop Net	15	#Ind	0
					%YOY	0
					Mean CPUE	
					SE	
Roundtail Chub[1]	Las Cienegas-Clyne Pond	8/22/2017	Hoop Net	10	#Ind	0
					%YOY	0
					Mean CPUE	
					SE	
Roundtail Chub	Blue River-lower	10/24/2017	Hoop Net	24	#Ind	32
					%YOY	56
					Mean CPUE	0.9
					SE	0.27
Roundtail Chub	Blue River-lower	10/24/2017	Backpack Electrofisher	12	#Ind	116
					%YOY	61
					Mean CPUE	31.7
					SE	6.06

[1] Chub in these locations were previously classified as Gila Chub.

Roundtail Chub	Blue River-upper	09/13/2017	Hoop Net	19	#Ind	57
					%YOY	0
					Mean CPUE	1.8
					SE	0.91
Roundtail Chub	Blue River-upper-Lazy YJ Ranch Pond	09/12/2017	Hoop Net	22	#Ind	274
					%YOY	2
					Mean CPUE	8.5
					SE	3.02
Spikedace	Blue River-lower	10/24/2017	Backpack Electrofisher	12	#Ind	854
					%YOY	40
					Mean CPUE	221.0
					SE	23.59
Spikedace	Hot Springs Canyon	09/18/2017	Backpack Electrofisher	9	#Ind	4
					%YOY	25
					Mean CPUE	1.8
					SE	1.38
Spikedace	Spring Creek	09/05/2017	Backpack Electrofisher	3	#Ind	0
					%YOY	0
					Mean CPUE	
					SE	

Appendix 3. Populations of threatened and endangered species repatriated under the Gila River Basin Native Fishes Conservation Program, 2007 through 2017. Estimated population size is given for those considered established (i.e., reproducing to the point that they are self-sustaining). Topminnow and pupfish begin reproducing during their first year of life, so populations that have increased in numbers and continue to persist for three years after the final stocking are considered established. Spikedace, Loach Minnow, and Longfin Dace begin reproducing at age-1, and have a life span of about three years, so can probably be considered established if there is evidence of reproduction and increase in population over three to four years after the final stocking. Roundtail chub begin reproducing at age-1 or age-2, and live for about eight years, so it is probably necessary to monitor for five years after the final stocking before a relatively confident assessment of establishment can be made. The population size was estimated based catch during the most recent monitoring and size of stream or pond.

Species	Metapopulation	Lineage	Replicated Locations	Year Replicated	Population Status/Size
Gila Topminnow	Bylas Springs	Bylas Springs	Bass Canyon (Muleshoe Ranch CMA)	2014-2016	TBD
			Bonita Creek (lower)	2008	100-499
			Bonita Creek (upper)	2010-2015	>10000
			Burro Cienega, NM	2008	1000-4999
			Double R Canyon (Muleshoe Ranch CMA)	2017	TBD
			Headquarters Spring (Muleshoe Ranch CMA)	2008	1000-4999
			Howard Well	2008	5000-9999
			Kei Sundt pond	2012	1000-4999
			Redfield Canyon (Muleshoe Ranch CMA)	~2009	1000-4999
			Redrock Wildlife Area Pond, NM	2010-2011	Failed
			Secret Spring (Muleshoe Ranch CMA)	2007	1000-4999
			Swamp Spring (Muleshoe Ranch CMA)	2007-2008	1000-4999
			TNC Lower San Pedro Preserve's west pond	2006	>10000
			Wildcat Canyon (Muleshoe Ranch CMA)	2014	500-999
	Upper Santa Cruz	Sharp Spring	Buckhorn Spring	2011	1000-4999
			Chalky Spring	2009	0-99

Species	Metapopulation	Lineage	Replicated Locations	Year Replicated	Population Status/Size
			Fossil Creek	2007-2010	5000-9999
			Morgan City Wash	2009	500-999
			Page Springs Hatchery SRP Topminnow Pond	2009	100-499
			Robbins Butte Stop Sign Tank	2015	TBD
			Robbins Butte Swimming Pool Tank	2015	TBD
			San Rafael Cattle Company Pasture #2 Pond	2013	0-99
			San Rafael Cattle Company Pasture #9 Pond	2016	TBD
			West Fork Pinto Creek	2017	TBD
	Lower Santa Cruz	Peck Canyon	Hidden Water Spring	2016	TBD
			Phoenix Zoo Ranarium	2012	1000-4999
			Rock Spring	2013-2014	0-99
			Sheepshead Canyon	2014-2016	TBD
			Spring Creek	2015-2016	TBD
			Tortilla Creek (upper)	2017	TBD
		Redrock Canyon	Arnett Creek	2017	TBD
			Walnut Spring (#392)	2012-2013	500-1000
	Monkey&Cottonwood	Cottonwood Spr	Ben Spring (San Pedro Riparian NCA)	2011	Failed
			Cottonwood Spring (Goldfield Mountains)	2008	1000-4999
			Horse Thief Draw (San Pedro Riparian NCA)	2011	Failed
			Murray Spring (San Pedro Riparian NCA)	2011-2017	TBD
		Monkey Spring	Pemberton Pond (McDowell Mountain Reg. Park)	2009	Failed
			Spur Cross Ranch Cons. Area Solar Oasis pond	2009	Failed

Species	Metapopulation	Lineage	Replicated Locations	Year Replicated	Population Status/Size
			Usery Mountain Regional Park pond	2011	1000-4999
			Willow Spring (San Pedro Riparian NCA)	2009	Failed
	Cienega Creek	Cienega Creek	Bill's Wildlife Pond (Las Cienegas NCA)	2016, 2017	TBD
			Clyne Tank (Las Cienegas NCA)	2015-2016	TBD
			Crescent Pond (Las Cienegas NCA)	2013	1000-4999
			Egret Pond (Las Cienegas NCA)	2013	5000-9999
			Empire Tank (Las Cienegas NCA)	2013	1000-4999
			Gaucho Wildlife Pond (Las Cienega NCA)	2014	TBD
			Little Nogales Spring (Las Cienegas NCA)	2012	Failed
			Nogales Spring (Las Cienegas NCA)	2012-2015	TBD
			Road Canyon Tank (Las Cienegas NCA)	2012	5000-9999
			Sabino Canyon	2015-2016	TBD
			Spring Water Wetland (Las Cienegas NCA)	2013	5000-9999
	mixed	mixed	Charlebois Spring	2017	TBD
Desert Pupfish	Santa Clara/El Doctor		Bonita Creek (lower)	2008	Failed
			Bonita Creek (upper)	2010-2015	Failed
			Cinco Canyon Tank (Las Cienegas NCA)	2013	1000-4999
			Cherry Spring Canyon (Muleshoe Ranch CMA)	2007	Failed
			Cottonwood Pond (Las Cienegas NCA)	2013, 2017	500-999
			Crescent Pond (Las Cienegas NCA)	2013	500-999
			Egret Tank (Las Cienegas NCA)	2015-2016	TBD
			Empire Tank (Las Cienegas NCA)	2013	500-999
			Gaucho Wildlife Pond (Las Cienegas NCA)	2015	TBD
			Headquarters Spring (Muleshoe Ranch CMA)	2008	Failed
			Heart Pond (Las Cienegas NCA)	2013	500-999

Species	Metapopulation	Lineage	Replicated Locations	Year Replicated	Population Status/Size
			Horse Thief Draw (San Pedro Riparian NCA)	2011	Failed
			Howard Well	2008-2009	100-499
			Kei Sundt Pond	2010	100-499
			Larry & Charlie Tank (Muleshoe Ranch CMA)	2009	100-499
			Little Joe Spring (San Pedro Riparian NCA)	2013	1000-4999
			Mint Spring (Muleshoe Ranch CMA)	2015-2016	TBD
			Mud Spring (#18)	2007-2009	100-499
			Murray Spring (San Pedro Riparian NCA)	2011-2014	TBD
			Nursery Tank (McDowell Mnt. Regional Park)	2010	1000-4999
			Pemberton Pond (McDowell Mountain Reg. Park)	2009	100-499
			Road Canyon Tank (Las Cienegas NCA)	2012	500-999
			Robbins Butte Wildlife Area Cottonwood Tank	2010	1000-4999
			Robbins Butte Wildlife Area Twin Tanks	2009	1000-4999
			Secret Spring (Muleshoe Ranch CMA)	2007-2011	100-499
			Spur Cross Ranch Cons. Area Solar Oasis pond	2009	500-999
			Swamp Spring (Muleshoe Ranch CMA)	2007	Failed
			TNC Lower San Pedro Preserve's east pond	2009	5000-9999
			Tule Creek	2007-2009	Failed
			Walnut Spring (#20)	2008	Failed
Longfin Dace		Coal Mine Canyon	Fresno Canyon	2008	1000-4999
		Hassayampa	Arnett Creek	2007	500-999

Species	Metapopulation	Lineage	Replicated Locations	Year Replicated	Population Status/Size
		River			
		Hassayampa River	Telegraph Canyon	2007	500-999
		Hidden Water Spr	Rock Creek	2016	TBD
		Seven Sprs Wash	Spur Cross Ranch Cons. Area Solar Oasis pond	2008	0-99
		Tangle Creek	Fossil Creek	2008-2009	1000-4999
Loach Minnow		Aravaipa Creek	Hot Springs Canyon	2007-2011	100-499
			Bonita Creek (lower)	2008	Failed
			Bonita Creek (upper)	2009-2014	TBD
			Redfield Canyon (Muleshoe Ranch CMA)	2007-2010	Failed
			Fossil Creek	2007-2013	Failed
Spikedace		Aravaipa Creek	Fossil Creek	2007-2012	1000-4999
			Spring Creek	2015-2016	TBD
			Hot Springs Canyon	2007-2011	TBD
			Redfield Canyon (Muleshoe Ranch CMA)	2007-2010	Failed
		Upper Gila River	Blue River	2012	1000-4999
			Bonita Creek (lower)	2008	Failed
			Bonita Creek (upper)	2009-2010	Failed
Roundtail Chub					
		Eagle Creek	Blue River	2012-2016	500-999
		Cienega Creek[1]	Clyne Pond (Las Cienegas NCA)	2016, 2017	TBD
		Harden Cienega[1]	Harden Cienega (upper)	2015	TBD
		Harden Cienega[1]	Mule Creek NM	2012-2014	TBD

[1] Chub in these locations were previously classified as Gila Chub.

Species	Metapopulation	Lineage	Replicated Locations	Year Replicated	Population Status/Size
		Redfield Canyon[1]	Redfield Canyon (upper)	2007	500-999
		Dix Creek[1]	Redrock Wildlife Area, NM	2010-2011	Failed
		Cienega Creek[1]	Spring Water Wetland (las Cienegas NCA)	2017	TBD
		Verde River	TNC Gila Riparian Preserve (Farm), NM	2008	Failed
		O'Donnell Creek[1]	TNC Lower San Pedro Preserve's west pond	2010-2011	1000-4999
Razorback Sucker		Lake Mohave	Fossil Creek	2008-2014	Failed

[1] 1 Chub in these locations were previously classified as Gila Chub.