

2021

Gila River Basin Native Fishes Conservation
Program Budget and Work Plan



**GILA RIVER BASIN
NATIVE FISHES
CONSERVATION PROGRAM**

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New Mexico Work Plan

Project 1: Removal of Nonnative Fishes from West Fork Gila River

(Task ID: NM-2006-1)

Implementing Entity: New Mexico Department of Game and Fish (Department), US Fish and Wildlife Service (USFWS), US Forest Service (USFS)

Start Year: 2006

Location(s): West Fork Gila River

Species Protected: Loach Minnow, Spikedace, Roundtail Chub, Gila Trout, Desert Sucker, Sonora Sucker, Speckled Dace, Longfin Dace.

Project Description:

Background – The West Fork Gila River supports an intact native fish assemblage, including Federally Endangered priority species Loach Minnow and Spikedace. Nonnative fishes are the primary threat to native fishes in the West Fork Gila River. Ten species of nonnative fishes have been documented in the river including Brown Trout, Rainbow Trout, Smallmouth Bass, and Yellow Bullhead. Since 2006, the Gila River Basin Native Fish Conservation Program (GRBNFCP) has provided funding to the Department, USFS, and USFWS to systematically remove nonnative fishes from an approximately 4 km reach of the West Fork Gila River. Propst et al. (2014) evaluated these efforts using data from 2007 to 2012, results indicated reduced biomass of some nonnatives as well as an increase in biomass of Spikedace. The Whitewater Baldy Fire of 2012 and subsequent flooding had severe effects on the West Fork Gila River within the project area. Nonnative fishes were greatly reduced, but have since increased in abundance. This project is planned to continue on an annual basis unless analysis reveals it is having no effect on fish populations.

Geographical Area – The project area is the 4 km of the West Fork Gila River between the confluences of Little Creek and the Middle Fork Gila River. This project affects one population of Spikedace and Loach Minnow; however it is part of one of New Mexico's largest interconnected populations. The project takes place on the Department owned Heartbar Wildlife Management Area.

Methodologies – Nonnative removal efforts will occur at least once per year, most likely in early June. Sampling will be conducted using backpack electrofishers and seines depending on the mesohabitat being sampled. All fish collected will be identified and enumerated by mesohabitat, all nonnatives are removed. All mesohabitats within the project area are sampled. Length will be collected on all fish weight will be collected on fish over 100 mm total length. Each mesohabitat is measured for area, average width, average depth, and average velocity. This effort consists of two crews sampling in conjunction, with a habitat data crew and fish processing crew following behind and requires 6 to 9 people to complete. Additional removal efforts may be conducted as necessary if piscivorous nonnative fish are prevalent. In any additional removal efforts, data will only be collected from nonnative fishes removed. Annual reports summarizing the fish community will be submitted. The GRBNFCP is in the process of developing benchmarks to aid in deciding when to adjust the frequency or intensity of removal and when projects can be deemed successful or unsuccessful. Data will be analyzed in a way to evaluate these benchmarks, once established.

Program Priorities

This project protects existing populations of Loach Minnow and Spikedace through removal of nonnative fish within the project area. Data collected from this project also aids in monitoring critical Spikedace and Loach Minnow populations and contributes to repatriation efforts by providing an indicator of how many fish can be translocated to other streams or sent to the hatchery. Other species that may benefit include Desert Sucker, Gila Trout, Longfin Dace, Roundtail Chub, Sonora Sucker, and Speckled Dace.

Partnerships

This project is a multi-agency collaborative effort between the Department, USFWS and, USFS. This project is a continuation of a project currently funded by the GRBNFCP.

Strategic Plan Goals:

- Prevent extinction and manage toward recovery
 - Goal 3. Protect native fish populations from nonnative fish invasions.
 - Goal 4. Remove nonnative aquatic species threats.
 - Goal 9. Monitor to quantitatively measure and evaluate project success in improving the status of target species and their habitats.

Recovery goals:

- Loach Minnow Recovery Plan (1991)
 - Task 2.5 (priority 1): Monitor community composition including range of natural variation
 - Task 3.1-2 (priority 2): Identify nature and significance of interaction with nonnative fishes
- Spikedace Recovery Plan (1991)
 - Task 2.5 (priority 1): Monitor community composition including range of natural variation
 - Task 3.1-2 (priority 2): Identify nature and significance of interaction with nonnative fishes

Estimated Time and Cost:

- Total Cost: \$46,001
 - New Mexico Department of Game and Fish: \$24,301
 - USFWS: \$10,300
 - USFS: \$11,400
- Urgency: The nonnative fish community in the West Fork Gila River appears to be increasing making removal of nonnatives in this area urgent.
- Readiness: The project is ongoing and ready to implement immediately.
- *Does this project have in-kind or matching funds?* No

Project 2: New Mexico T&E Fish Repatriations and Monitoring

(Task ID: NM-2002-1)

Implementing Entity: New Mexico Department of Game and Fish (Department), US Fish and Wildlife Service (USFWS), US Forest Service (USFS)

Start Year: 2002

Location(s):

- San Francisco River Drainage: Upper San Francisco River, Saliz Canyon, Mule Creek
- Upper Gila River Drainage: Little Creek
- Blue River Drainage: Dry Blue Creek
- Other locations as needed for evaluation

Species Protected: Loach Minnow, Spikedace, Roundtail Chub (formerly Gila Chub), Gila Topminnow

Project Description:

Background – This project will identify potential repatriation streams, evaluate potential donor populations and repatriation sites, conduct repatriation of identified streams, monitor streams post-repatriation, and work with hatchery populations as needed. It is intended to encompass all New Mexico streams within the Gila, San Francisco, and Blue River basins that might undergo repatriation attempts in the future. This project also encompasses collecting live fish for the purposes of direct stocking, quarantine at Arizona’s Aquatic Research and Conservation Center (ARCC), or development and maintenance of brood stock at ARCC. Repatriation stockings are scheduled to continue in 2021 in Saliz Canyon (Loach Minnow). San Francisco River (Loach Minnow and Spikedace), and Little Creek (Loach Minnow) were stocked previously and annual post stocking monitoring is scheduled for 2021. Additional streams have been identified as potential repatriation sites and more will be evaluated going forward. This is an ongoing project that needs continued across the Gila Basin until species are recovered.

Geographical Area – This project covers the entire Gila River Basin in New Mexico, and is proposed in a way to include work on all populations of priority species in New Mexico.

Methodologies – Potential repatriation sites will be evaluated for habitat, water quality, and fish disease. Multiple stockings into each repatriation stream will be performed successively for 3-5 consecutive years or until the desired populations are established or is considered unsustainable. Repatriation stockings can be direct transfers of fish from a wild population or stocking from ARCC. After a population is considered established, it will be surveyed at least once every five years.

Program Priorities

This project increases the resiliency and redundancy of priority species by replicating populations of Spikedace, Loach Minnow, Roundtail Chub, and Gila Topminnow in the wild. In addition, captive production of priority species is benefited by supplementing hatchery brood stock with wild fish. It can provide immediate benefits on the ground if new populations are successfully established.

Partnerships

This project is a collaborative effort between the Department, USFS, and USFWS. It directly addresses recovery plan goals for GRBNFCP priority species and is an ongoing GRBNFCP project.

Strategic Plan Goals:

- Build the scientific foundation for recovery efforts
 - Goal 1. Identify critical streams and populations in need of protection and replication
- Prevent extinction of rare populations and species
 - Goal 1. Acquire and maintain hatchery/pond stocks of critically endangered populations as insurance against extinction in the wild and to provide sources for population replications
 - Goal 6. Replicate rare populations and their associated native fish community into protected streams and other surface waters
- Manage Toward recovery
 - Goal 4. Continue and expand repatriations of native fish communities.
 - Goal 7. Monitor on-the-ground activities to quantitatively measure and evaluate programmatic success in improving the status of target species and their habitats.
 - Goal 9. Periodically evaluate the success of species repatriations and surface water renovations.

Recovery goals:

- Loach Minnow Recovery Plan (1991)
 - Task 6.2 (priority 3): Identify and prepare sites for reintroduction
 - Task 6.3-4 (priority 3): Reintroduce into selected reaches and monitor
 - Task 6.5-6 (priority 3): Determine reasons for success/failure and rectify as necessary
 - Task 8.2 (priority 3): Collect hatchery stocks
- Spikedace Recovery Plan (1991)
 - Task 6.2 (priority 3): Identify and prepare sites for reintroduction
 - Task 6.3-4 (priority 3): Reintroduce into selected reaches and monitor
 - Task 6.5-6 (priority 3): Determine reasons for success/failure and rectify as necessary
 - Task 8.2 (priority 3): Collect hatchery stocks
- Gila Topminnow Recovery Plan (1999 Draft)
 - Task 1.1 (priority 1): Maintain refugia populations of natural populations
 - Task 2.2 (priority 1): Reestablish into suitable habitats

Estimated Time and Cost:

Total Cost: \$67,745

- New Mexico Department of Game and Fish: \$34,445
- USFWS: \$17,400
- USFS: \$15,900
- Urgency: This project works directly towards recovery plan goals and work needs to be completed on an annual basis to achieve those goals.
- Readiness: A basin wide stocking Section 7 Biological Evaluation has been completed for stocking Loach Minnow, Spikedace, Roundtail Chub, and Gila Topminnow from ARCC in New Mexico. Some stocking projects are ongoing and ready to implement, others require preliminary approval. Several projects are in the monitoring phase of repatriation.
- *Does this project have in-kind or matching funds?* No

Project 3: Remote Site Inventory and Assessment

(Task ID: NM-2017-2)

Implementing Entity: New Mexico Department of Game and Fish (Department), US Fish and Wildlife Service (USFWS), US Forest Service (USFS)

Start Year: 2017

Location(s): West Fork Gila River

Species Protected: Loach Minnow, Spikedace, Roundtail Chub, Gila Trout, Speckled Dace, Longfin Dace, Desert Sucker, Sonora Sucker

Project Description:

Background – Much of the Gila River Basin in New Mexico is extremely remote and thus difficult to sample. The system is dynamic and there have been significant changes in the Upper Gila River Basin since the GRBNFCP funded an inventory of the Gila River forks from 2005-2008. The Whitewater-Baldy Fire affected large portions of the basin in 2012. The subsequent flooding eliminated nonnative fishes from at least one tributary (Willow Creek) of the Middle Fork Gila River and may have created opportunities for native fish protection and repatriation in other locations.

Remote surveys in the Middle and East forks of the Gila River have been previously funded by this agreement. The lower Middle Fork Gila River was surveyed in the summer of 2017 and the upper reaches were surveyed in the summer of 2018. The East Fork Gila River and tributaries, excluding Black Canyon Creek were surveyed in 2019. Black Canyon Creek is scheduled to be surveyed in 2020.

In 2021, we propose to continue this inventory in the West Fork Gila River. The lower reaches of the West Fork Gila River have not been surveyed since the GRBNFCP surveys in 2006 and 2007. Loach Minnow, Spikedace, and Roundtail Chub are expected to occupy the West Fork Gila River. In previous surveys, Loach Minnow were not found in the West Fork Gila River, including at an annual monitoring site near the Gila Cliff Dwellings at that time. Since 2014, Loach Minnow have been captured annually at the fall monitoring site. The current upper extent of these populations is unknown. This is an ongoing project with plans to monitor at least one remote site location per year until the assessment is complete, and then update status approximately every ten years.

Geographical Area –This project will take place on the West Fork Gila River within the Gila National Forest; which is a collaborator on the project. The project will affect a large “Gila Forks” population of Loach Minnow and Spikedace, as well as Roundtail Chub.

Methodologies – Proposed sampling includes establishing representative 100 m sites in difficult to access remote areas within the West Fork Gila River and all perennial tributaries. Sampling will be conducted using backpack electrofishers and seines depending on the mesohabitat being sampled. All fish collected will be identified and enumerated by mesohabitat. Length will be collected on all fish and weight will be collected on fish over 100 mm total length. Each mesohabitat is measured for length, average width, average depth, and average velocity. The inventory will indicate what additional measures may be needed to remove nonnative fishes, show the current status of native fishes, and identify potential repatriation

sites. The remote nature of sampling will require pack stock for most sampling. It is possible the West Fork Gila system cannot be completed in one year.

Program Priorities

This project assesses population status of Loach Minnow, Spikedace, and Roundtail Chub in the West Fork Gila River. This project may lead to the identification of new repatriation sites which could provide areas for Loach Minnow, Spikedace or Roundtail Chub replication.

Partnerships

This project is a collaborative effort between the Department, USFS, and USFWS. It builds upon previous GRBNFCP funded projects sampling the Middle Fork Gila River and the East Fork Gila River as well as perennial tributaries.

Strategic Plan Goals:

- Build the scientific foundation for recovery efforts
 - Goal 1. Identify critical streams and populations in need of protection and replication
 - Goal 5. Survey poorly-studied stream systems to document existing fish communities.

Recovery goals:

- Loach Minnow Recovery Plan (1991)
 - Task 1.1 (priority 1): Identify all populations and determine level of protection
 - Task 2.5 (priority 1): Monitor community composition including range of natural variation
 - Task 3.1-2 (priority 2): Identify nature and significance of interaction with nonnative fishes
 - Task 6.2 (priority 3): Identify and prepare sites for reintroduction
- Spikedace Recovery Plan (1991)
 - Task 1.1 (priority 1): Identify all populations and determine level of protection
 - Task 2.5 (priority 1): Monitor community composition including range of natural variation
 - Task 3.1-2 (priority 2): Identify nature and significance of interaction with nonnative fishes
 - Task 6.2 (priority 3): Identify and prepare sites for reintroduction

Estimated Time and Cost:

- Total Cost: \$62,978
 - New Mexico Department of Game and Fish: \$26,578
 - USFWS: \$16,700
 - USFS: \$19,700
- Urgency: Loach Minnow and Spikedace populations in the West Fork Gila River have not been assessed since 2007.
- Readiness: This project is ready to implement.
- *Does this project have in-kind or matching funds?* No

Project 4: Gila Permanent Site Monitoring

(Task ID: NM-2020-1)

Implementing Entity: New Mexico Department of Game and Fish, US Fish and Wildlife Service, US Forest Service, Bureau of Land Management

Start Year: 2020

Location(s): East Fork Gila River, Gila River, Middle Fork Gila River, San Francisco River, Tularosa River, West Fork Gila River

Species Protected: Loach Minnow, Spikedace, Roundtail Chub, Speckled Dace, Longfin Dace, Desert Sucker, Sonora Sucker

Project Description:

Background – The Gila River Basin is dynamic and native fish populations fluctuate throughout the basin. Since 1988, several permanent sites have been monitored throughout the basin in New Mexico. Over time, some sites have been added and some shifted, currently there are nine permanent sites sampled annually. Annual sampling provides a baseline for status of native fish populations throughout the Gila Basin and also assesses nonnative fish populations. Data gathered from this sampling informs recovery actions for listed species including Spikedace, Loach Minnow, and Roundtail Chub. Knowledge of the current status of Spikedace and Loach Minnow populations aids with decisions for repatriation, including collection for supplementing hatchery broodstock or translocation. This long term data set is used to document the status, trends, and habitat use of fish assemblages in the Gila River Basin. The project is planned to continue in perpetuity.

Geographical Area –This project occurs across the Gila Basin in New Mexico. Land ownership varies but land management agencies are supporters of the project. Gila National Forest and Bureau of Land Management (BLM) are both collaborators on this effort.

Methodologies – Established fixed sites will be surveyed which vary from 100 to 200 meters in length. All fish collected will be identified and enumerated by habitat. Morphometric data will be collected on fish over 100 mm total length. Each mesohabitat is measured for area, average width, average depth, and average velocity. Annual reports summarizing the data and highlighting unique findings will be submitted by the New Mexico Department of Game and Fish.

Program Priorities

This project can detect long term trends in existing populations of Loach Minnow, Spikedace, and Roundtail Chub. The project also can detect changes in nonnative abundance. This dataset has the potential to aid in understanding the effects of flow, mesohabitat use, etc.

Partnerships

This project is a collaborative effort between the Department, USFWS, USFS, and BLM. It is a continuation of a currently funded GRBNFCP project.

Strategic Plan Goals:

- Build the scientific foundation for recovery efforts

- Goal 1. Identify critical streams and populations in need of protection and replication
- Goal 5. Survey poorly-studied stream systems to document existing fish communities.

Recovery goals:

- Loach Minnow Recovery Plan (1991)
 - Task 1.1 (priority 1): Identify all populations and determine level of protection
 - Task 2.5 (priority 1): Monitor community composition including range of natural variation
 - Task 3.1-2 (priority 2): Identify nature and significance of interaction with nonnative fishes
 - Task 6.2 (priority 3): Identify and prepare sites for reintroduction
- Spikedace Recovery Plan (1991)
 - Task 1.1 (priority 1): Identify all populations and determine level of protection
 - Task 2.5 (priority 1): Monitor community composition including range of natural variation
 - Task 3.1-2 (priority 2): Identify nature and significance of interaction with nonnative fishes
 - Task 6.2 (priority 3): Identify and prepare sites for reintroduction

Estimated Time and Cost:

- Total Cost: \$41,643
 - New Mexico Department of Game and Fish: \$24,759
 - USFWS: \$2,910
 - USFS: \$4,124
 - BLM: \$9,850
- Urgency: This project needs completed on an annual basis to keep the 30 year dataset intact.
- Readiness: This project is ready to implement.
- *Does this project have in-kind or matching funds?* No

Arizona Work Plan

Project 5: Muleshoe ecosystem stream and spring repatriations

(Task ID: AZ-2003-1)

Implementing Entity: Arizona Game and Fish Department

Start Year: 2003

Location(s): Redfield Canyon, Bass Canyon, and Double R Canyon.

Species Protected: Gila Topminnow (3), Roundtail Chub¹ (1), Speckled Dace, Longfin Dace, Desert Sucker, Sonora Sucker.

Project Description:

Redfield Canyon

Background: Redfield Canyon is an ongoing project with conservation efforts beginning in 2007. Spikedace and Loach Minnow were stocked into Redfield Canyon in 2007, 2008 and 2010, but failed to establish. In 2007, Roundtail Chub¹, Sonora Sucker, and Speckled Dace were translocated upstream of a waterfall in Redfield Canyon to expand their range in that system, and have established in the upstream reach. Gila Topminnow have dispersed downstream from Swamp Springs Canyon (where they were stocked in 2008-2009), and have become established in Redfield Canyon. One to two Green Sunfish removals have been conducted in Redfield Canyon each year since 2007. During 2008-2012, The Nature Conservancy led removals and typically completed one removal in March-April, and the second in May-June. These removals focused on the upper perennial reach that extends upstream from about 1 km below Swamp Springs Canyon. In 2012 Green Sunfish were discovered in large pools near the western wilderness boundary, in what was referred to as the lower perennial reach or Reach 3. Beginning in 2014, one removal, in May-June, was completed in each reach. Green Sunfish captures in the upper perennial reach fluctuated from year to year, but generally declined from 2010 through 2019. Green Sunfish do not appear to be established in the upper perennial reach, but are able to move upstream into the upper perennial reach from the lower perennial reach that spans BLM wilderness and private land. Permission to access and conduct removals on the private land has not yet been granted. The population in the lower perennial reach is well established. A barrier was planned, but postponed indefinitely in 2018 because the State Land Department would not agree to transfer property to Reclamation. As a result, upstream movement of Green Sunfish cannot be prevented. The private landowner has been contacted multiple times in 2019 and 2020 in an attempt to gain access to their property. The landowners have not communicated a definitive response as of January, 2020.

If the private landowner denies access to their property for removals, the goal of the project will be suppression of Green Sunfish. Work planned for 2021 includes a removal trip with multiple passes in April and a second removal trip with multiple passes in June. Removals will continue into future years for as long as suppression is considered a priority. If the private landowner grants permission for removals on their property, then the goal will shift to eradication and the area of removals and number of removal trips will be increased to achieve eradication. Removals will continue until Green Sunfish are not detected for five consecutive passes, or when eDNA samples are negative for Green Sunfish, at which time the species would be considered eradicated and the project would end.

¹ Chub in Redfield Canyon were previously classified as Gila Chub.

Geographical Area: The project area for Redfield Canyon currently includes Redfield Canyon from the upper barrier (UTM 12S 563858/3589841) downstream to the wilderness boundary (559591/3589178). The project area is occupied by single populations of Roundtail Chub¹, Gila Topminnow, Longfin Dace, Speckled Dace, Sonora Sucker, and Desert Sucker. The current project area is divided into three reaches. Reach 1 is the most upstream reach and extends from the Sunfish barrier to the confluence with Swamp Springs Canyon and is mostly perennial. Reach 2 extends from the confluence with Swamp Springs Canyon downstream to the confluence with Rock House tributary and is mostly intermittent with surface water in June limited to just a few hundred meters downstream of Swamp Spring Canyon. Reach 3 extends from the Rock House tributary downstream to the wilderness boundary and is mostly intermittent except for the most downstream several hundred meters. Reach 3 is dominated by Green Sunfish. Currently, movement of nonnative fishes from the San Pedro River into Redfield Canyon is only prevented by an ephemeral reach approximately 11.5 kilometers in length. Land ownership within the project area includes BLM, State Trust land, TNC and private land. Land management agencies and TNC are supportive of ongoing native fish conservation efforts. The downstream private landowner has not expressed a lack of interest in native fish conservation, but has not yet granted permission to carry out conservation actions on their property.

Methodologies: If the private landowner does not grant access to their property to conduct removals, the goal of removals in Redfield Canyon will be suppression of Green Sunfish in Reaches 1 and 2. Typically, a single pass of backpack electrofishing is carried out each June through all surface water present in Reaches 1 and 2. Removals occur in June when water levels are lowest with the assumption that capture probability of Green Sunfish is highest. If more than 10 Green Sunfish are captured, additional electrofishing passes will be carried out until none are captured. The goal of removals in Reach 3 is also to suppress the number of Green Sunfish so that fewer fish are able to disperse upstream into Reaches 1 and 2 when sufficient flows are present. There are pools too deep to capture sunfish with backpack electrofishing equipment in Reach 3, so mini-hoop nets and angling are used in combination. Mini-hoop nets will be dispersed throughout deeper water in Reach 3, and set for 2-24 hours. Each set of traps will be considered one pass. A minimum of three passes will be completed, or until there is a 33% reduction from the first pass. Multiple removal trips may be necessary to achieve this goal. All Green Sunfish captured will be removed and measured to the nearest millimeter in total length (mm TL). Length frequency histograms of fish captured will be analyzed by removal reach to assess whether spawning is occurring in reaches one and two. Catch per unit effort (CPUE) will also be calculated to assess trends in relative abundance of sunfish. Increasing CPUE or presence of juvenile size classes will indicate that current effort is not sufficient for effective suppression. A successful suppression effort will be characterized by annual decreases in CPUE and absence of juvenile Green Sunfish in Reaches 1 and 2.

If the private landowner grants permission to their property for removals, the goal will shift to eradication of Green Sunfish. Removals will be completed in all surface water on both private and public land. The number of passes completed each year will be increased to achieve eradication. A single pass consists of electrofishing or trapping all perennial water in Redfield Canyon from the downstream extent of perennial flow on private land upstream to the natural fish barrier. At least six passes will be completed in 2021. Ideally, removals will be completed during spring to early summer before Green Sunfish are able to spawn. Removals will continue until Green Sunfish are not detected for five consecutive passes, or when eDNA samples are negative for Green Sunfish, at which time the species will be considered eradicated and the project will end.

Bass Canyon

Background: Bass Canyon is an ongoing project with conservation efforts beginning in 2014 when Gila Topminnow were stocked between Muleshoe Road and the confluence with Hot Springs Canyon (i.e., lower Bass Canyon). Gila Topminnow were first stocked in upper Bass Canyon in 2017 and augmented in 2018 after poor returns during the first two years of monitoring. Relative abundance of Gila Topminnow was low during monitoring in September, 2019. Work planned for 2021 includes monitoring during the late summer or early autumn. Gila Topminnow were last stocked in 2018, so monitoring will continue until 2021, at which time the Gila Topminnow establishment monitoring in Bass Canyon portion of the Muleshoe project will be complete.

Geographical Area: Bass Canyon is a tributary to Hot Springs Canyon and drains the southwestern portion of the Galiuro Mountains. Bass Canyon has an upper perennial reach approximately 2.5 kilometers in length from near the confluence with Pine Canyon downstream to near the confluence with Double R Canyon (571749/3579501). The lower perennial-intermittent reach extends from the confluence with Double R Canyon downstream to the confluence with Hot Springs Canyon. The project area is protected from nonnative fishes by a barrier on Hot Springs Canyon located about 9.6 km downstream from Bass Canyon. The project area is located on land owned by BLM and TNC with both agencies being supportive of ongoing native fish conservation efforts.

Methodologies: The techniques used, sample design, and planned analysis are consistent with the methodologies described for post-stocking monitoring of Gila Topminnow in the most recent annual progress report to Reclamation (Hickerson and Robinson 2019). Ten to 20 minnow traps will be dispersed from the uppermost stocking site to several hundred meters downstream, set in slow velocity habitats and fished for a minimum of 2 h. Captured fish will be counted by size class and released alive back to the stream. Total number captured and mean catch rates (CPUE, fish per hour) will be calculated and reported.

Double R Canyon

Background: Double R Canyon is an ongoing project with conservation efforts beginning in 2017 when Gila Topminnow were initially stocked. The population was augmented in 2018 after poor returns during the first two years of monitoring. Relative abundance of Gila Topminnow increased during monitoring in September, 2019, but was still relatively low. Planned work for 2021 includes monitoring in late summer or early autumn. Annual monitoring will continue for three years after the final stocking, so if no fish are stocked in 2020, then the monitoring will end 2021.

Geographical Area: Double R Canyon is a tributary to Hot Springs Canyon that originates on the west slope of the Galiuro Mountains near the Redfield Canyon Wilderness boundary. Double R Canyon has a perennial reach of approximately 2.5 kilometers in length from near the confluence with Hackberry Canyon downstream to the confluence with Bass Canyon (571534/3579633). The project area is protected from nonnative fishes by a barrier on Hot Springs Canyon located about 9.6 km downstream from Bass Canyon. The project area is located on land owned by BLM and TNC with both agencies being supportive of ongoing native fish conservation efforts.

Methodologies: The techniques used, sample design, and planned analysis are consistent with the methodologies described for post-stocking monitoring of Gila Topminnow in the most recent annual

progress report to Reclamation (Hickerson and Robinson 2019). Ten to 20 minnow traps will be dispersed from the uppermost stocking site to several hundred meters downstream, set in slow velocity habitats and fished for a minimum of 2 h. Captured fish are counted by size class and released alive back to the stream. Total number captured and mean catch rates (CPUE, fish per hour) will be calculated and reported.

Program Priorities

This project stabilizes an existing population of Gila Topminnow and Roundtail Chub¹ in Redfield Canyon through mechanical removals of nonnative Green Sunfish. Existing populations of Speckled Dace, Longfin Dace, Sonora Sucker and Desert Sucker also benefit from Green Sunfish removals. This project will establish two Level II population replicates of Bylas Spring lineage Gila Topminnow of at Double R Canyon and Bass Canyon. This project is part of a larger action to establish populations of Gila Topminnow in streams throughout the Gila River Basin, and to protect native fish populations by removal of nonnative fish predators throughout the basin. This project provides an immediate on-the-ground benefit for Gila Topminnow by attempting to establish two wild populations and protecting a third from nonnative species. The sub-project in Redfield Canyon provides immediate benefit to Gila Topminnow, Gila Chub, Longfin Dace, Speckled Dace, Desert Sucker and Sonora Sucker by suppressing or possibly eradicating nonnative Green Sunfish which prey on and compete with the native species.

Partnerships

This project has been implemented as part of a larger cooperative effort between the Department, TNC, BLM, USFWS, and Reclamation. This project builds upon work already funded within the Muleshoe Cooperative Management Area because Gila Topminnow stockings began several years ago and it often requires several years of stocking and to establish populations of Gila Topminnow. Furthermore, additional post-stocking monitoring is necessary to determine if topminnow have established in both Bass Canyon and Double R Canyon. Similarly, nonnative removals in Redfield Canyon have been ongoing since 2007 and are now necessary to prevent reestablishment of Green Sunfish in the upper perennial reach, given that the construction of a barrier has been canceled.

Strategic Plan Goals:

- Preventing Extinction and Managing Toward Recovery
 - Goal 4a. Eradicate nonnative aquatic species from a minimum of five surface waters to prepare them for repatriations of native fishes
 - Goal 5a. Replicate Gila topminnow stocks into a minimum of 10 surface waters.
 - Goal 9. Monitor to quantitatively measure and evaluate project success in improving the status of target species and their habitats.

Recovery goals:

- Gila Topminnow recovery plan (1999 draft)
 - Task 2.2 (priority 1): Reestablish into suitable habitats.
 - Task 2.4 (priority 1): Protect suitable reestablishment habitats from detrimental nonnative aquatic species.
 - Task 3.1 (priority 1): Develop standardized population and habitat monitoring protocols and implement them.
- Gila Chub draft Recovery plan (2014)

¹ Includes locations where the species was previously classified as Gila Chub.

- Task 1.3.1 (priority 1) Eliminate or control problematic nonnative aquatic organisms

Estimated Time and Cost:

- Cost: The estimated cost of this project for FY21 is \$28,100.
- Urgency: This project is urgent because a lapse in Green Sunfish removals may allow Green Sunfish to reestablish in the upper reach of Redfield Canyon. Failure to monitor in Double R or Bass Canyon will postpone any determination of establishment at these locations.
- Readiness: All necessary compliance has been completed for all partners involved.
- Matching Funds: This project has in-kind match in the form of salaries of TNC staff.

Project 6: Gila Topminnow Stockings

(Task ID: AZ-2002-1)

Implementing Entity: Arizona Game and Fish Department

Start Year: 2002

Location(s): Black Canyon City Heritage Pond, Edgar Canyon, Harden Cienega Creek, Las Cienegas Maternity Well, Mud Spring, Peterson Ranch Pond, Rarick Canyon, Sabino Canyon, and locations stocked in 2020 or proposed to be stocked in 2021, which tentatively are: Aravaipa Creek, Buehman Canyon, Dix Creek, Mescal Creek, Mule Spring, Reavis Creek, Sands Draw, San Pedro River at Three Links, Sycamore Creek, Tortilla Creek, and Sharp Spring

Species Protected: Gila Topminnow (18), Desert Pupfish (1)

Project Description:

Note, the methodologies are only presented for the overall project because they are the same for all of the below listed subprojects. In addition to the subprojects listed below, three to five sites will be assessed in 2021 to determine if they have suitable habitat for Gila Topminnow.

Black Canyon City Heritage Pond

Background: Black Canyon City is an ongoing project that began in 2017 after the pond was refilled after being drawn-down and dried in late 2016. Desert Pupfish were stocked early in 2017, and hundreds were captured during subsequent annual monitoring in 2017, 2018, and 2019, and are now considered established. Gila Topminnow (Sharp Spring Lineage) were stocked in 2018, and over 500 were captured in 2018 and 2019. Because the captures were over 500, no additional topminnow were stocked. Annual monitoring will be performed in 2020. Work planned for 2020 only includes the annual monitoring. Post-stocking annual monitoring will continue for three years after the final stocking so 2021 will be the final year of monitoring.

Geographical Area: Black Canyon City Heritage Pond is a constructed pond located just east of Old Black Canyon Highway and just north of the Agua Fria River(pond coordinates are 393791; 3770567). The pond surface area is 3,275 m², and has a maximum depth of about 1.5 m. The pond was previously invaded by nonnative fish, which was why it was drawn down and dried in 2016. Black Canyon City owns the park and is a partner in the project.

Edgar Canyon

Background: Edgar Canyon is an ongoing project. Gila Topminnow (Redrock Canyon lineage) were first stocked in 2019 in an attempt to establish a population. Results of post-stocking monitoring in 2019 indicated the population was reproducing and increasing in abundance. Work planned for 2021 includes an annual monitoring trip in summer and potentially an augmentation stocking if fewer than 100 topminnow are detected. Post-stocking annual monitoring will continue for three years after the final stocking. The subproject could end as early as 2022 if additional stockings do not occur.

Geographical Area: Edgar Canyon is a tributary of the San Pedro River and originates near Mount Bigelow in the Santa Catalina Mountains. Edgar Canyon is primarily ephemeral with a few short intermittent and

perennial reaches. The most downstream perennial reach is located on Pima County lands approximately 5 km upstream of the confluence with the San Pedro River (UTM 12S 543288/3590508). This perennial reach is at least 600 meters in length, but Pima County conducts annual wet-dry mapping and has more refined data on the minimum extent of the perennial reach. Edgar Canyon is ephemeral for approximately 5 km from the perennial reach downstream to confluence with the San Pedro River, which prevents nonnative fish from moving upstream from the San Pedro River. Fish had not been documented in Edgar Canyon prior to the stocking of Gila Topminnow in 2019. Pima County recommended the site for Gila Topminnow establishment, and continue to be supportive.

Las Cienegas Maternity Well

Background: Maternity Well is a new project location located on Las Cienegas Conservation Area . The pond was planned for excavation in early 2020. Gila Topminnow will be stocked in 2020 if the pond is successfully excavated and ready for fish. Gila Topminnow will be stocked in 2021 if the pond is not ready for fish in 2020. Gila Topminnow will be monitored in Maternity Well for three years after the final stocking with an anticipated project completion date of 2023 (final stocking in 2020) or 2024 (final stocking in 2021) if no additional translocations are required.

Geographical Area: Maternity Well is a small well-fed pond located on Las Cienegas Conservation area (UTM 12S 531700/3514064) within the Gardner Canyon Watershed. The Cienega Creek Watershed is largely free of nonnative fishes, so there is little risk of invasion of nonnative fish. The pond is located on Bureau of Land Management property, and the BLM is supportive of native fish conservation at this location, and many similar locations on Las Cienegas Conservation Area.

Mud Spring

Background: Mud Spring (Coronado National Forest) is an ongoing project where Gila Topminnow were first stocked in 2018. Both age classes were present and the population had increased tenfold during the first monitoring in 2019. Work planned for 2021 includes the final annual monitoring during the summer. Post-stocking monitoring will continue for three years after the final stocking. The subproject could end as early as 2021 if additional stockings do not occur.

Geographical Area: Mud Spring is located on the southwest slope of the Huachuca Mountains in the Sycamore Canyon drainage within the upper San Pedro River drainage on the Coronado National Forest (UTM 12R 558192/3473527). The pond is at 1,700 m elevation and has a surface area of about 255 m² and is about 2 m deep in the middle. The pond is fed by a spring and is on the south-facing slope of the hills, which apparently moderates winter water temperatures. In addition to the population of Gila Topminnow, the pond is occupied by Chiricahua Leopard Frog and is slated to be a Mexican Gartersnake repatriation site.

Peterson Ranch Pond

Background: Peterson Ranch Pond is an ongoing project and was initially stocked in 2018. Both age classes were present during the first annual monitoring in 2019, but relative abundance was low. Work planned for 2021 includes annual monitoring during the summer. Post-stocking monitoring will continue for three years after the final stocking. The subproject could end as early as 2021 if additional stockings do not occur.

Geographical Area: Peterson Ranch Pond is located in Scotia Canyon (tributary to the Santa Cruz River in the San Rafael Valley) at 1,892 m elevation in the Coronado National Forest (UTM 12R 557228/3480412). The pond is about 670 m², has a maximum depth of about 3 m, and is fed by a spring which moderates winter water temperatures. In addition to the population of Gila Topminnow, Chiricahua Leopard Frogs, Longfin Dace (stocked in 2015), and Mexican Gartersnakes (introduced in 2018) also inhabit the pond.

Sabino Canyon

Background: Sabino Canyon is an ongoing project and Gila Topminnow (Cienega Creek lineage) were first stocked in 2015 within the Sabino Canyon Recreation Area. Fewer than 100 topminnow were captured during the first annual monitoring in June 2016, so the Department stocked more Gila Topminnow on August 30, 2016. During annual monitoring in 2017, just over 100 Gila Topminnow were captured. Also in 2017 pools upstream of the recreation area were assessed to determine if topminnow could be moved further upstream. In June 2018 about 275 Gila Topminnow were captured during annual monitoring, and the pools near the confluence with East Fork Sabino were reassessed. Later in 2018, Department and USFS staff translocated Gila Topminnow from the pools below Sabino Dam to a pool near the confluence with East Fork Sabino Canyon. In May 2019 Department staff monitored for Gila Topminnow in the recreation area but detected fewer than 100 fish. They also monitored the pools near East Fork Sabino but did not capture or observe any topminnow there. In September 2019, Department and USFS staff translocated about 500 more Gila Topminnow from below Sabino Dam to the pools near East Fork Sabino. In 2020, planned work includes annual monitoring in the recreation area and upstream near East Fork Sabino. If fewer than 100 topminnow are detected at the upstream site, a third and final stocking will be carried out. Work planned for 2021 includes post-Bighorn Fire assessment of habitat in upper Sabino Creek near East Fork, annual monitoring at the upstream location near East Fork Sabino Canyon, and potential augmentations if habitat still appears suitable. Post-stocking monitoring will continue for three years after the final stocking. The subproject could end as early as 2022 if additional stockings do not occur.

Geographical Area: Sabino Canyon is a tributary to Tanque Verde Wash which flows into the Rillito River and then the Santa Cruz River in the Tucson area. Sabino Canyon is largely an intermittent stream during winter-spring and the monsoons, when flows are typically continuous from within the project area (about 7.6 km from East Fork Sabino down to the first road Crossing below Sabino Dam). During the driest time of year (May-June), water is reduced to isolated perennial pools scattered from the recreation area up to the confluence with West Fork Sabino. If Gila Topminnow established in the upper location, they would likely become distributed throughout all suitable perennial pools down through the recreation area and be considered one large population. Sabino Dam prevents nonnative fish from moving upstream, and thus protects the population. But there are also many miles of typically dry streambed in the lower portion of Sabino Canyon and in Tanque Verde Wash that function as a barrier to upstream movement of nonnative fishes from the Santa Cruz River. Sabino Canyon within the project area is located entirely within the Coronado National Forest, which has supported and participated in the project.

Sycamore Creek

Background: The Sycamore Creek project has been proposed but delayed since 2008. Prescott National Forest wanted to revise Section 7 consultation regarding ongoing grazing activities, and requested that the project be postponed. At the 2019 Gila River Basin Native Fishes Conservation Program Technical meeting in December 2019, the Prescott National Forest Biologist suggested that the Forest may be ready for the Department to stock Gila Topminnow into Sycamore Creek, and in January 2020 indicated they would set

up a meeting with the allotment permittee. Therefore, the Department plans to stock Gila Topminnow into Sycamore Creek below Double T Ranch falls in summer 2020. Work planned for 2021 would be annual post-stocking monitoring and possibly an augmentation stocking if fewer than 100 topminnow are detected during monitoring. Post-stocking monitoring will continue for three years after the final stocking. Up to three stocking attempts may be made to establish a population. Therefore the annual monitoring and thus the project could be completed by 2023-2025.

Geographical Area: Sycamore Creek is a tributary to the Agua Fria River, and drains the Pine Mountain Wilderness and nearby area. The uppermost portion of the stream above Double T Ranch is occupied by rainbow trout, which are largely restricted to this reach because of water temperatures. Below Double T Ranch falls there are three perennial sections, each only about 100-m long: one immediately below the falls, one at a location known as Middle Box, and a third at a location known as Lower Box. If Gila Topminnow are established they will be considered as one population throughout these locations. Roundtail Chub¹ are found in each of these perennial sections. A waterfall near Lower Box, and the fact that large sections of the stream are intermittent or ephemeral, prevent the upstream movement of nonnative fishes from the lower portion of the creek near Dugas and from the Agua Fria River. The perennial water sections above Lower Box and below Double T Ranch falls are on Prescott National Forest. The Forest is supportive of the project, as long as they have finished their ESA Section 7 consultation.

Sharp Spring

Background: Sharp Spring was historically occupied by a relict population of Gila Topminnow until nonnative Western Mosquitofish were introduced into Sharp Spring in 1979. Gila Topminnow were extirpated by 1999, likely as a result of negative interactions with mosquitofish. The purpose of this project is to eradicate Western Mosquitofish from Sharp Spring, and then repatriate Gila Topminnow and Roundtail Chub¹. The Sharp Spring lineage of Gila Topminnow would be translocated from one or more of the replicate populations in the state. Roundtail Chub¹ from the nearby Sheehy Spring (or other refuge site) would also be translocated into Sharp Spring. An attempt was made to eradicate Western Mosquitofish by pumping the pools dry with trash pumps in June, 2013. The effort was ultimately unsuccessful due to the rapid refill rate of the pools and equipment limitations. In January 2017, Department and Arizona State Parks staff met to discuss the project and potential methods of nonnative fish control. Arizona State Park staff indicated they would draft a proposal for approval by their executive staff. In 2020, Department staff and Arizona State Parks communicated and determined how to move the project forward. The Department drafted its internal Phase I Piscicide Project document in autumn 2020, and will submit it to executive staff by the end of 2020. The Department has also drafted Arizona State Parks Commercial Rental Permit for Research and Monitoring, and will submit it to State Parks once the Phase 1 document is approved. Work planned for 2021 would be continued planning and coordination for a potential chemical treatment of Sharp Spring.

Geographical Area: Sharp Spring is a tributary to the Santa Cruz River in the San Rafael State Natural Area (Arizona State Parks), about 2 km from the United States – Mexico border (UTM 12R 540522/ 3468775). It is a perennial spring with approximately 1.2 km of flow which forms a series of pools in cienega-like habitat.

Tentative Locations: The following locations still need more coordination, planning, and possibly environmental compliance, so implementation would only start after that is complete. No funding is

¹ Chub in this location were previously classified as Gila Chub.

currently allocated for these, so if they do start in 2021 or become a priority, the Department will recommend that the workplan be revised. Tentative Gila Topminnow Stocking locations are: Aravaipa Creek, Buehman Canyon, Dix Creek, Mule Spring, Mescal Creek, Reavis Creek, Sands Draw, the San Pedro River at Three Links, Telegraph Canyon, and Boyce Thompson Arboretum.

Methodologies: Standard sampling for Gila Topminnow consists of setting at least ten collapsible minnow traps for a minimum soak time of two hours. Opportunistic seining and dip netting is carried out when stream conditions and time allow. Captured fish are counted by size class and released alive to the stream. Relative abundance (fish per hour), population size structure and dispersal are evaluated each year to determine establishment. Gila Topminnow are typically monitored for three years before determining population establishment or failure.

Program Priorities

This project will replicate up to 18 populations of Gila Topminnow and one population of Desert Pupfish in the wild. This project will provide immediate on the ground benefits by establishing multiple new Gila Topminnow populations within the Gila River basin.

Partnerships

This project is in partnership with the U. S. Forest Service, Bureau of Land Management, U. S. Fish and Wildlife Service and Reclamation. This project is part of a larger collaborative effort to restore Gila Topminnow to suitable habitats within the historical range. This project builds upon previously funded work by monitoring topminnow at previously stocked locations and attempting to establish populations at locations where habitat assessments were carried out.

Strategic Plan Goals:

- Preventing Extinction and Managing Toward Recovery
 - Goal 1. Identify critical streams and populations in need of protection and potential replication
 - Goal 5a. Replicate Gila topminnow stocks into a minimum of 10 surface waters.
 - Goal 9. Monitor to quantitatively measure and evaluate project success in improving the status of target species and their habitats.

Recovery goals:

- Gila Topminnow recovery plan (1999 draft)
 - Task 2.2 (priority 1): Reestablish into suitable habitats
 - Task 3.1 (priority 1): Develop standardized population and habitat monitoring protocols and implement them
- Gila Chub draft Recovery plan (2014)
 - Task 2.2 (priority 1) Repatriate Gila Chub to new protected streams
 - Task 3.2 (priority 2) Conduct monitoring

Estimated Time and Cost:

- Cost: The estimated cost of this project is \$45,200.
- Urgency: This project is urgent because failure to monitor topminnow sites will postpone any determination of establishment at these locations.

- Readiness: Compliance for this project is dependent on location. Locations where topminnow have previously been stocked have all required compliance completed. Many of the tentative locations still require some aspect of compliance or funding to be completed before stockings can take place.
- Matching Funds: This project does not have matching or in-kind funds.

Project 7: Spring Creek (Oak Creek tributary) Repatriations

(Task ID: AZ-2013-1)

Implementing Entity: Arizona Game and Fish Department

Start Year: 2013

Location(s): Spring Creek

Species Protected: Spikedace (1), Gila Topminnow (1), Roundtail Chub¹(1), Speckled Dace, Longfin Dace, Sonora Sucker, Desert Sucker, Northern Mexican Gartersnake.

Project Description:

Background: The Spring Creek Repatriations project has been ongoing since 2013, when mechanical removals of Green Sunfish began upstream of a diversion structure that acted as a temporary barrier. Green Sunfish were successfully removed by 2015 and Reclamation completed a fish barrier near the location of the diversion structure. Spikedace and Gila Topminnow were stocked soon after the completion of the barrier. The Gila Topminnow population was augmented in 2016, the species was captured each year during monitoring, and is now considered established. The Spikedace population was augmented in 2016 and 2018 after poor initial monitoring returns. Spikedace monitoring will continue for five years after the final establishment stocking. Therefore, if the final establishment stocking was 2018, post-stocking monitoring will be completed in 2023.

Geographical Area: The geographic extent for this project includes the perennial reach of Spring Creek from the barrier (UTM 12S 416634/3845826) upstream about 4 km to the springs at the source of perennial flow (415654/ 3848706). Populations of Spikedace and Gila Topminnow are established within the project area. The project area is protected from upstream invasion of nonnative fish by a fish barrier built by Reclamation in 2015. Land ownership is a mixture of Coconino National Forest and private lands. The Coconino National Forest is supportive of ongoing efforts to conserve native fishes in Spring Creek. The private landowners within the project area do not currently allow access for sampling.

Methodologies:

The Spikedace population in Spring Creek is monitored by single pass backpack electrofishing at two randomly selected 100 meter long transects from Willow Point Road downstream to the barrier. Three pass backpack electrofishing is carried out at one fixed site near Willow Point Road. Total length of all Spikedace captured is measured to the nearest millimeter. Sampling is carried out each September. Success is measured by an annual increase in mean CPUE (fish per hour) and evidence of recruitment in successive years with multiple age classes present.

Program Priorities

This project replicates populations of Spikedace (Aravaipa Creek lineage) and Gila Topminnow (Peck Canyon lineage) and protects and existing population of Roundtail Chub¹ above a barrier built by Reclamation. This project has immediate on the ground benefits by securing wild populations of Spikedace and Loach Minnow above a barrier.

¹ Chub in this location were previously classified as Gila Chub.

Partnerships

This project is in partnership with the Coconino National Forest, U.S. Fish and Wildlife Service and Reclamation. This project builds upon previously funded GRBNFCP projects by continuing to assess establishment of Spikedace above a Reclamation funded fish barrier.

Strategic Plan Goals:

- Preventing Extinction and Managing Toward Recovery
 - Goal 4. Remove nonnative aquatic species threats.
 - Goal 5b. Replication each of the other priority species into a minimum of one surface water.
 - Goal 9b. Develop/identify monitoring standards as necessary to adequately evaluate fish barrier function, success and failure of eradications, and success and failure of repatriations.

Recovery goals:

- Spikedace and Loach Minnow recovery plan (1991)
 - Task 6.3-4 (priority 3) Reintroduce into selected reaches and monitor
- Gila Topminnow recovery plan (1999 draft)
 - Task 2.2 (priority 1) Reestablish into suitable habitats
 - Task 2.4 (priority 1) Protect suitable reestablishment habitats from detrimental nonnative aquatic species.
 - Task 3.1 (priority 1) Develop standardized population and habitat monitoring protocols and implement them.
- Gila Chub draft Recovery plan (2014)
 - Task 1.3.1 (priority 1) Eliminate or control problematic nonnative aquatic organisms
 - Task 3.2 (priority 2) Conduct monitoring

Estimated Time and Cost:

- Cost: The estimated cost of this project for FY21 is \$6,800.
- Urgency: This project is urgent because failure to monitor in Spring Creek will postpone any determination of establishment at this location.
- Readiness: All necessary compliance has been completed for all partners involved.
- Matching Funds: This project does not have matching or in-kind funds.

Project 8: Blue River Native Fish Restoration

(Task ID: AZ-2002-3)

Implementing Entity: Arizona

Start Year: 2002

Location(s): Blue River

Species Protected: Spikedace (1), Loach Minnow (1), Roundtail Chub (1), Longfin Dace, Speckled Dace, Sonora Sucker, Desert Sucker

Project Description:

Background: The Blue River Native Fish Restoration Project is an ongoing project. The project has consisted of multiple phases starting with the construction of a Reclamation funded fish barrier in 2012, followed by a combination of mechanical removals and stocking of native fish in the lower 19 kilometers of the Blue River. Nonnative fish are eradicated from the lower Blue River above the fish barrier as of 2017. Spikedace and Roundtail Chub were successfully established in the lower Blue River and monitoring efforts were passed onto the monitoring contract in 2020. Conservation efforts were continued upstream in a reach known as the middle Blue River near the Blue Box in 2016. Roundtail Chub were stocked in 2016 and 2019 and Spikedace in 2017 and 2018. Efforts to expand Roundtail Chub upstream of the box began in 2020. Work planned for 2021 includes conducting the final nonnative removal effort in the lower Blue River, collecting eDNA samples in each of the six reaches to verify that nonnatives have been eradicated, annual monitoring in the middle Blue River, annual monitoring of Spikedace and Roundtail Chub in the upper Blue River, and additional translocations to the upper Blue River as necessary.

Project Timeline.

2009: First nonnative removal effort above planned barrier location.

2012: Completion of Reclamation funded fish barrier. First nonnative removal effort after barrier construction. First stocking of Roundtail Chub, Spikedace and Loach Minnow. First annual monitoring.

2013: Continuation of nonnative removal efforts. Annual monitoring.

2014: Continuation of nonnative removal efforts. Annual monitoring.

2015: Continuation of nonnative removal efforts. Annual monitoring. Translocation of additional Spikedace and Roundtail Chub

2016: Continuation of nonnative removal efforts. Annual monitoring. Translocation of additional Loach Minnow. Stocking of Roundtail Chub in Middle Blue River.

2017: Continuation of nonnative removal efforts in the lower Blue River. Annual monitoring in lower Blue River. Stocking of Spikedace in Middle Blue River. First annual monitoring of Roundtail Chub in Middle Blue River.

2018: Continuation of nonnative removal efforts. Annual monitoring in lower Blue and middle Blue. Translocation of additional Spikedace to the middle Blue River.

2019: Continuation of nonnative removal efforts. Final annual monitoring in lower Blue River. Annual monitoring in middle Blue River. Translocation of additional Roundtail Chub to middle Blue River.

2020: Continuation of nonnative removal effort in lower Blue River. Annual monitoring in middle Blue River. Additional translocations in the middle Blue River as necessary. Potential translocation of Roundtail Chub and Spikedace into the upper Blue River above the box.

2021: Final nonnative removal effort in lower Blue River. Verification of eradication of nonnative fishes in the lower Blue River using eDNA. Annual monitoring in middle Blue River. Monitoring of Roundtail Chub and Spikedace in the upper Blue River. Additional translocations as necessary.

2022: Annual monitoring in the middle Blue River and upper Blue River.

2023: Annual monitoring in the middle Blue River and upper Blue River.

2024: Final annual monitoring in the middle Blue River. Annual monitoring in the upper Blue River.

2025: Final annual monitoring in the upper Blue River.

Estimated project completion date: 2025 (if no additional Roundtail Chub or Spikedace are stocked into the upper Blue River after 2020).

Geographical Area: The project area includes three distinct reaches of the Blue River. The lower Blue River extends from the reclamation funded barrier (UTM 12S 668092/3676500) upstream to near XXX Ranch (668586/ 3688479). The lower Blue River is protected from future threats by the Reclamation funded barrier downstream. The entire lower Blue River is on Apache-Sitgreaves National Forest Lands, and the forest is supportive of ongoing native fish conservation actions. The Middle Blue River extends from the confluence with McKittrick Creek (666307/ 3709546) upstream to The Box (667287/3713513; ~ the confluence with Horse Canyon). The middle Blue River is protected from upstream invasion of nonnative fishes by the Reclamation funded fish barrier, but Brown Trout from upstream tributaries are occasionally captured within this reach. Populations of Spikedace, Roundtail Chub and Loach Minnow are located within this reach, which additional populations of Loach Minnow in tributaries. Landownership is a combination of Apache-Sitgreaves National Forest and private lands. Both the Forest and the downstream landowner are supportive of native fish conservation activities within this reach and allow access for sampling. The upper Blue River extends from The Box (a waterfall just below Horse Canyon acts as a fish barrier during base flows) upstream to the confluence of Campbell Blue and Dry Blue Creeks (681179/3732889). Populations of Loach Minnow previously existed within the reach along with a newly introduced population of Roundtail Chub. Landownership is a combination of Apache-Sitgreaves National Forest and private lands. The Forest is supportive of conservation of Roundtail Chub in the upper Blue River. Some private landowners are supportive of native fish conservation in the upper Blue River.

Methodologies: The Roundtail Chub and Spikedace population in the Middle Blue River is monitored by single pass backpack electrofishing at nine randomly selected 100 meter long transects and three pass backpack electrofishing at three fixed sites with one in each of the three sub-reaches. Total length of all Roundtail Chub and Spikedace captured is measured to the nearest millimeter. Sampling is carried out in late September each year. Success is measured by an annual increase in mean CPUE (fish per hour) and evidence of recruitment in successive years with multiple age classes present. A similar monitoring strategy will be utilized for evaluating translocation success in the upper Blue River.

Program Priorities

This project replicates multiple populations of Spikedace and Roundtail Chub and protects existing population of Loach Minnow above a barrier built by Reclamation. This project benefits two of the priority species and benefits Longfin Dace, Speckled Dace, Sonora Sucker and Desert Sucker. This project has immediate on the ground benefits by securing wild populations of Spikedace above a barrier and expanding their range within an 83 km long river system. The Blue River may now support the most abundant Spikedace population within the range of the species.

Partnerships

This project has been carried out in partnership with Apache-Sitgreaves National Forest and private landowners. This project builds on the work funded by the GRBNFCP in the lower Blue River by continuing to expand the range of Spikedace and Roundtail Chub upstream of the Reclamation funded fish barrier.

Strategic Plan Goals:

- Preventing Extinction and Managing Toward Recovery
 - Goal 1. Identify critical streams and populations in need of protection and replication
 - Goal 4a. Eradicate nonnative aquatic species from a minimum of five surface waters to prepare them for repatriations of native fishes.
 - Goal 5b. Replication each of the other priority species into a minimum of one surface water.
 - Goal 9. Monitor to quantitatively measure and evaluate project success in improving the status of target species and their habitats.

Recovery goals:

- Spikedace and Loach Minnow recovery plan (1991)
 - Task 6.3-6.4 (priority 3) Reintroduce into selected reaches and monitor

Estimated Time and Cost:

- Cost: The estimated cost of this project for FY21 is \$40,600.
- Urgency: This project is urgent because failure to translocate additional fish or monitor in the Blue River will postpone any determination of establishment at this location.
- Readiness: All necessary compliance has been completed for all partners involved in the Middle Blue. Discussions with USFS staff, USFWS staff and private landowners likely need to take place before Spikedace are translocated to the upper Blue River.
- Matching Funds: This project does not have matching or in-kind funds.

Project 9: Harden Cienega Creek Native Fish Restoration (Task ID: AZ-2014-1)

Implementing Entity: Arizona Game and Fish Department

Start Year: 2014

Location(s): Harden Cienega Creek and stock tanks within the drainage.

Species Protected: Gila Topminnow, Roundtail Chub¹, Longfin Dace, Speckled Dace, Desert Sucker, Sonora Sucker

Project Description:

Background: Department staff discovered a waterfall barrier in Harden Cienega Creek in 2013, and only detected Longfin Dace upstream. Downstream of the barrier the fish assemblage included Roundtail Chub¹, Desert Sucker, Sonora Sucker, Speckled Dace, and Longfin Dace. The Department proposed expanding the chub distribution above the waterfall, and the first translocation was completed in 2015. Monitoring data from 2017-2019 indicated a healthy chub population was beginning to establish above the barrier, however Green Sunfish were also detected both above and below the barrier at the same time. This was not the first record of Green Sunfish in Harden Cienega Creek; McKell (2005)¹ captured a Green Sunfish in Harden Cienega Creek but did not specify the location, and it was assumed the source was the San Francisco River. Gila Topminnow were translocated to suitable habitat in lower Harden Cienega Creek in 2019. Stock tank surveys to identify the upstream source of Green Sunfish and downstream removal efforts were initiated in 2020.

Project Timeline.

2015: Roundtail Chub¹ translocated above the natural barrier in Harden Cienega Creek

2017: First monitoring of Roundtail Chub¹ above the barrier in Harden Cienega Creek. Discovery of Green Sunfish above the barrier.

2018: Monitoring of Roundtail Chub¹ above the barrier. Translocation of five additional chub above the barrier. Capture of two Green Sunfish above the barrier.

2019: Monitoring of Roundtail Chub¹. Translocation of 100 chub above the barrier. Translocation of Gila Topminnow below the barrier. Capture of four Green Sunfish below the barrier.

2020: Tank surveys completed on AZ portion of Harden Cienega Creek drainage. Planning for potential removal of Green Sunfish from stock tanks in 2021. First mechanical removal pass in Harden Cienega Creek. Final monitoring of Roundtail Chub¹ above the barrier. Annual monitoring of Gila Topminnow and augmentation if necessary.

2021: Potential removal of Green Sunfish from stock tanks within the Harden Cienega drainage. Surveys of tributary streams (Prospect Canyon, Chimney Rock Canyon, Antelope Canyon) for isolated populations of Green Sunfish. Mechanical removal pass in Harden Cienega Creek. Annual monitoring of Gila Topminnow and augmentation if necessary.

2022: Continue removals of Green Sunfish from stock tanks within the Harden Cienega drainage. Mechanical removal pass in Harden Cienega Creek. Annual monitoring of Gila Topminnow.

¹ McKell, M. D. 2005. Region I Gila Chub surveys in Dix and Harden Cienega creeks, June 2-3, 2005. Arizona Game and Fish Department, Pinetop, AZ.

2023: Final removal pass in Harden Cienega Creek. Verification of Green Sunfish eradication with eDNA samples. Annual monitoring of Gila Topminnow if necessary.
Estimated project completion date: 2023.

Geographical Area: The project area includes the perennial reach of Harden Cienega Creek from about 750 m above the confluence with the San Francisco River (UTM 12S 673690/3675061) upstream to about 50 m past the confluence with Prospect Canyon (676599/3673548). In addition, there are a total of 43 stock tanks within the Harden Cienega Creek drainage in Arizona and an additional 33 in New Mexico. The project area includes populations of Roundtail Chub¹ upstream and downstream of the barrier, and populations of Gila Topminnow, Longfin Dace, Speckled Dace, Desert Sucker and Sonora Sucker downstream of the barrier. The perennial reach downstream of the barrier is apparently protected from upstream invasion of nonnative fishes from the San Francisco River by a short ephemeral reach of approximately 0.75 km, as nonnative fishes have rarely been detected in the lower reach. The upstream Roundtail Chub¹ population is protected from upstream invasion of nonnative fishes by a waterfall barrier approximately 3-4 meters in height. Green Sunfish appear to be dispersing from an unknown upstream location, which is likely a stock tank. Land ownership within the perennial reach of Harden Cienega Creek is Apache-Sitgreaves National Forest and managed by Gila National Forest Staff. Stock tanks within the drainage occur on Apache-Sitgreaves and Gila National Forests and private lands in Arizona and New Mexico. The Gila National Forest is supportive of native fish conservation activities in Harden Cienega Creek. Permission from private landowners in New Mexico would be required to sample stock tanks on their properties.

Methodologies: The primary method used to remove nonnative fish from the perennial reach of Harden Cienega Creek will be backpack electrofishing. To track removal success and ensure complete coverage, removal efforts each year will consist of a series of full-reach passes. For the purpose of this project, a single full pass is defined as electrofishing all water from the downstream terminus of perennial flow upstream to the confluence with Prospect Canyon. If a full pass is not completed on a given sampling day, personnel will begin sampling the next day at the previous day's endpoint and sample up to Prospect Canyon. Several removal passes may be required each year to achieve eradication, but the number of passes completed each year will depend on staff availability. In addition to backpack electrofishing, passive gears including minnow traps and mini-hoop nets will be set in deep pools throughout the reach to more effectively sample habitats too deep for effective backpack electrofishing. Passive gears will be retrieved after a minimum soak time of two hours. Mini-hoop nets and minnow traps may be left to soak overnight if removals are occurring on successive days. Ideally, removals will occur in June when the stream is near base flow in an effort to maximize capture probability of Green Sunfish. At the end of each year, staff will evaluate size structure and relative abundance of nonnative fish populations. A successful eradication effort will be characterized by decreasing relative abundance (CPUE) and a shift in population size structure to primarily smaller, juvenile fish with few large adults present. Similarly, targets for native fish populations are an increase in CPUE and a size structure characterized by multiple year classes of both adult and juvenile fish. It is possible that Green Sunfish are not yet abundant enough to make measurable impact on the native fish population. Measures of success will be evaluated within and between years. Removals should continue until Green Sunfish are absent from Harden Cienega Creek for three successive passes and absence is verified with eDNA samples. If the source of Green Sunfish cannot be eradicated, the

¹ Chub in this location were previously classified as Gila Chub.

goal of removal efforts should be suppression of the Green Sunfish population in Harden Cienega Creek with the primary objective being prevention of spawning and establishment.

Green Sunfish will be eradicated from any stock tank where they are detected using either chemical or mechanical methods pending compliance with Department policies and coordination with USFS staff. Protocols for treatment of stock tanks will follow those outlined in Rinker et al. (2018)¹. If Green Sunfish are not detected in stock tanks within the drainage, Department staff will walk along the stream beds of Harden Cienega Creek and tributaries Prospect Canyon and Chimney Rock Canyon to determine whether Green Sunfish persist in isolated perennial pools.

For Gila Topminnow monitoring, the techniques used, sample design, and planned analysis are consistent with the methodologies described for post-stocking monitoring of Gila Topminnow in the most recent annual progress report to Reclamation (Hickerson and Robinson 2019). Ten to 20 minnow traps will be dispersed from the uppermost stocking site to several hundred meters downstream, set in slow velocity habitats and fished for a minimum of 2 h. Captured fish are counted by size class and released alive back to the stream. Total number captured and mean catch rates (CPUE, fish per hour) will be calculated and reported.

Program Priorities

This project will stabilize one existing population of Gila Topminnow and two populations of Roundtail Chub² through mechanical removal. This population replicates a population of Harden Cienega Creek lineage Roundtail Chub². In addition, populations of Longfin Dace, Speckled Dace, Sonora Sucker and Desert Sucker will benefit from removal actions. This project will provide immediate on the ground benefits in the form of identifying the upstream source of Green Sunfish to Harden Cienega Creek and removing a potential source of nonnative fish to the San Francisco River.

Partnerships

This project is in partnership with the New Mexico Department of Game and Fish, Gila National Forest, the U.S. Fish and Wildlife Service and Reclamation. This project builds upon previously funded GRBNFCP work to translocate Roundtail Chub² above the barrier in Harden Cienega Creek. With recent detection of Green Sunfish, mechanical removals are required to ensure progress made during previous native fish conservation efforts is not lost.

Strategic Plan Goals:

- Preventing Extinction and Managing Toward Recovery
 - Goal 1. Identify critical streams and populations in need of protection and potential replication.
 - Goal 4. Remove nonnative aquatic species threats.
 - Goal 5b. Replicate each of the other priority species into a minimum of one surface water.

¹ Rinker, Matthew, J. Carter and S. Rogers. 2018. Coconino National Forest stock tank nonnative fish removal project evaluation report. Arizona Game and Fish Department, Phoenix.

² Chub in this location were previously classified as Gila Chub.

- Goal 9b. Develop/identify monitoring standards as necessary to adequately evaluate fish barrier function, success and failure of eradications, and success and failure of repatriations.

Recovery goals:

- Gila Topminnow recovery plan (1999 draft)
 - Task 2.2 (priority 1) Reestablish into suitable habitats
 - Task 2.4 (priority 1) Protect suitable reestablishment habitats from detrimental nonnative aquatic species.
 - Task 3.1 (priority 1) Develop standardized population and habitat monitoring protocols and implement them.
- Gila Chub draft Recovery plan (2014)
 - Task 1.3.1 (priority 1) Eliminate or control problematic nonnative aquatic organisms
 - Task 2.2 (priority 1) Repatriate Gila Chub to new protected streams
 - Task 3.2 (priority 2) Conduct monitoring

Estimated Time and Cost:

- Cost: The estimated cost of this project is \$41,900.
- Urgency: This project is urgent because Green Sunfish are currently at a low density and only adults have been captured, suggesting that sunfish are not currently established within Harden Cienega Creek. A majority of the successful mechanical removal efforts completed by this program were characterized by low initial abundance of target nonnative fishes.
- Readiness: All compliance is complete for the monitoring and mechanical removal portions of this project. Additional compliance is likely needed for chemical treatment or manual pumping of stock tanks to eradicate Green Sunfish.
- Matching Funds: This project does not have matching or in-kind funds.

Project 10: Eagle Creek repatriations

(Task ID: AZ-2018-1)

Implementing Entity: Arizona Game and Fish Department

Start Year: 2018

Location(s): Eagle Creek

Species Protected: Spikedace, Loach Minnow, Roundtail Chub¹, Longfin Dace, Speckled Dace, Desert Sucker, Sonora Sucker

Project Description:

Background: Spikedace and Loach Minnow historically occupied Eagle Creek and were last detected in 1989 and 1997 respectively. Neither species was detected in eDNA samples collected in 2019. A barrier on Eagle Creek is tentatively planned to be built by Freeport McMoran in 2020 as part of a Habitat Conservation Plan.

Project Timeline.

2018: Eagle Creek monitoring plan drafted

2019: Habitat assessment and eDNA sample collection within the project area.

2020: Preliminary partial baseline monitoring.

2021: Potential barrier construction. First baseline monitoring of fish community within the project area. eDNA collection from middle Eagle Creek.

2022: Translocation of Spikedace and Loach Minnow above the barrier. First annual monitoring of Spikedace and Loach Minnow

2023: Monitoring of Spikedace and Loach Minnow. Additional translocations as necessary.

2024: Monitoring of Spikedace and Loach Minnow. Additional translocations as necessary.

2025: Monitoring of Spikedace and Loach Minnow.

2026: Monitoring of Spikedace and Loach Minnow.

Estimated project completion date: 2026

Geographical Area: The project area includes 11.6 km of Eagle Creek from the proposed barrier location (UTM 12S 640388/3698328) upstream to the confluence of Dry Prong Creek and East Eagle Creek (642203/3707035). This reach is currently occupied by populations of Roundtail Chub¹, Longfin Dace, Speckled Dace, Desert Sucker and Sonora Sucker. The project area will be protected from upstream invasion of nonnative fishes following completion of the barrier. The land ownership within the project area is primarily Apache-Sitgreaves National Forest with some parcels of Freeport McMoRan and private lands. The Forest is supportive of native fish conservation efforts. The primary private landowner has been cooperative with and supportive of several previous native fish conservation activities.

Methodologies: Monitoring of Eagle Creek will follow a similar approach to other Spikedace and Loach Minnow repatriation projects. Sampling will occur annually each September. Backpack electrofishing will be carried out within 100-meter long transects with up to four fixed transects and the remaining transects selected randomly. Three-pass depletion electrofishing will be carried out within fixed sites to estimate

¹ Chub in this location were previously classified as Gila Chub.

abundance and capture probability. Trends in relative abundance (CPUE) and population size structure will be evaluated to determine establishment.

Program Priorities

This project will stabilize existing populations of Roundtail Chub¹, Longfin Dace, Speckled Dace, Desert Sucker and Sonora Sucker upstream of a fish barrier. This project will also replicate populations of Spikedace and Loach Minnow upstream of the barrier within historically occupied habitat. This project will have an immediate on the ground benefit by providing a secure reach of historically occupied stream for Spikedace and Loach Minnow.

Partnerships

This project is in partnership with the Apache-Sitgreaves National Forest, USFWS, Reclamation and Freeport McMoRan.

Strategic Plan Goals:

- Preventing Extinction and Managing Toward Recovery
 - Goal 1. Identify critical streams and populations in need of protection and potential replication.
 - Goal 5b. Replicate each of the other priority species into a minimum of one surface water
 - Goal 9. Monitor to quantitatively measure and evaluate project success in improving the status of target species and their habitats.

Recovery goals:

- Spikedace and Loach Minnow recovery plan (1991)
 - Task 6.3-6.4 (priority 3) Reintroduce into selected reaches and monitor
- Gila Chub draft Recovery plan (2014)
 - Task 3.2 (priority 2) Conduct monitoring

Estimated Time and Cost:

- Cost: The estimated cost of this project is \$33,800.
- Urgency: This project is urgent because failure to translocate additional fish or monitor in Eagle Creek will postpone any determination of establishment at this location.
- Readiness: The stocking and monitoring phases of this project are ready to implement following construction of the barrier.
- Matching Funds: This project does not have matching or in-kind funds.

¹ Chub in this location were previously classified as Gila Chub.

Project 11: Red Tank Draw native fish restoration
(Task ID: AZ-2016-2)

Implementing Entity: Arizona Game and Fish Department

Start Year: 2016

Location(s): Red Tank Draw, Rarick Canyon, Mullican Canyon

Species Protected: Roundtail Chub¹(2), Gila Topminnow, Desert Sucker.

Project Description:

Background: The Red Tank Draw native fish restoration project is an ongoing project. Removals of nonnative Green Sunfish, Black Bullhead and Fathead Minnow began in 2016 and continued through 2019. A survey of tanks in the Red Tank Draw watershed detected Green Sunfish and Black Bullhead in Mullican Place Tank in the Mullican Canyon drainage. Bruce Place Tank, which is immediately upstream from Mullican Place Tank, likely supports both Green Sunfish and Black Bullhead based on conversations with the private landowner. The landowner was not interested in cooperating with native fish conservation efforts as of 2017. A survey of isolated pools in the Rarick Canyon drainage from 2017-2018 detected Black Bullhead in some of the isolated pools. Intensive mechanical removals efforts in 2019 resulted in the eradication of Black Bullhead from the Rarick Canyon drainage. Additional surveys of tanks in the Rarick Canyon drainage that supported Fathead Minnow in 2017 confirmed that Black Bullhead were no longer present in upstream tanks. Roundtail Chub¹ from Red Tank Draw were translocated above a natural barrier into three isolated pools in the Rarick Canyon drainage in 2019.

Project Timeline:

2016: Mechanical removals begin in Red Tank Draw

2017: Mechanical removals continued in Red Tank Draw. Black Bullhead and Green Sunfish detected in Mullican Place Tank. Landowner denied access to Bruce Place Tank.

2018: Mechanical removals continued in Red Tank Draw. Black Bullhead detected in Rarick Canyon. Natural barrier discovered in Rarick Canyon.

2019: Mechanical removals continued in Red Tank Draw. Black Bullhead eradicated from Rarick Canyon. Roundtail Chub¹ translocated into three pools in Rarick Canyon.

2020: Mechanical removals continued in Red Tank Draw. Roundtail Chub¹ monitored in Rarick Canyon. Additional Roundtail Chub¹ translocated to Rarick Canyon. Gila Topminnow translocated to Rarick Canyon. Attempts made to contact and secure cooperation of Bruce Place Tank landowner.

2021: Mechanical removals continued in Red Tank Draw. Additional Roundtail Chub¹ and Gila Topminnow translocated to Rarick Canyon as necessary. Gila Topminnow and Roundtail Chub¹ monitored in Rarick Canyon.

2022: Roundtail Chub¹ and Gila Topminnow monitored in Rarick Canyon.

2023: Roundtail Chub¹ and Gila Topminnow monitored in Rarick Canyon.

2024: Roundtail Chub¹ and Gila Topminnow monitored in Rarick Canyon.

Estimated year of completion: 2024

Geographical Area: The project area consists of the upper perennial reach of Red Tank Draw from near the USGS gauging station (UTM 12S 435034/3840290) upstream to near the confluence between Rarick and Mullican Canyons (436447/3841870). This reach of Red Tank Draw supports a population of Roundtail Chub¹ and Desert Sucker. Bruce Place Tank, and the Mullican Canyon watershed downstream, act as a source of nonnative fishes to the perennial reach of Red Tank Draw. The project area also includes isolated perennial pools in Rarick Canyon. Roundtail Chub¹ were translocated into isolated pools in Rarick Canyon in 2019. A waterfall barrier (~10 meters high) in Rarick Canyon prevents upstream movement of nonnative fishes from the perennial reach of Red Tank Draw. Red Tank Draw, Rarick Canyon and a majority of Mullican Canyon are owned by the Coconino National Forest which is supportive of native fish conservation activities. A small portion of Mullican Canyon, including Bruce Place Tank, is located on private land where the landowner is not supportive of native fish conservation activities.

Methodologies: The perennial portion of Red Tank Draw does not have effective barriers to invasion of nonnative fishes, so the objective of mechanical removal is suppression of nonnative fishes. Red Tank Draw has complex habitat with several parallel channels and deep pools in some reaches. This complex habitat necessitates the use of multiple gear types to effectively capture and remove nonnative fish. However, the primary method used to remove nonnative fish from the perennial reach of Red Tank Draw will be backpack electrofishing. To track removal success and ensure complete coverage, removal efforts each year will consist of a series of full-reach passes. For the purpose of this project, a single full pass is defined as electrofishing all water from the first perennial pool upstream of the USGS gage (UTM 12S 435029/3840284) to the most upstream perennial pool (UTM 12S 436526/3842008). If a full pass is not completed on a given sampling day, personnel will begin sampling the next day at the previous day's endpoint and sample up to the most upstream perennial pool. Several removal passes will likely be required each year to suppress nonnative fish populations, but the number of passes completed each year will depend on staff availability. In addition to backpack electrofishing, passive gears including minnow traps, mini-hoop nets and gill nets will be set in deep pools throughout the reach to more effectively sample habitats too deep for effective backpack electrofishing. Passive gears will be retrieved after a minimum soak time of two hours. Mini-hoop nets and minnow traps may be left to soak overnight if removals are occurring on successive days. All sampling (backpack electrofishing and passive gears) will be consistent with the draft Gila River Basin Native Fishes Conservation Program monitoring protocols.

Ideally, removals will occur January through May so that nonnative fish are removed before they begin to spawn. At the end of each year, staff will evaluate size structure and relative abundance of nonnative fish populations. A successful suppression effort will be characterized by decreasing relative abundance (fish/hour) and a shift in population size structure to primarily smaller, juvenile fish with few large adults present. Similarly, targets for native fish populations are an increase in CPUE and a size structure characterized by multiple year classes of both adult and juvenile fish. Measures of success will be evaluated within and between years. Removals should continue until nonnative fish are absent from Red Tank Draw or Roundtail Chub¹ are successfully established above the barrier falls in Rarick Canyon.

The Roundtail Chub¹ population in the perennial pools in Rarick Canyon will be monitored with a combination of collapsible minnow traps and mini-hoop nets consistent with the draft Gila River Basin Native Fishes Conservation Program monitoring protocols. Monitoring will occur annually each fall in all

perennial pools where Roundtail Chub¹ have been translocated. Targets for native fish populations are an increase in CPUE and a size structure characterized by multiple year classes of both adult and juvenile fish. Measures of success will be evaluated within and between years.

For Gila Topminnow, the techniques used, sample design, and planned analysis are consistent with the methodologies described for post-stocking monitoring of Gila Topminnow in the most recent annual progress report to Reclamation (Hickerson and Robinson 2019). Ten to 20 minnow traps will be dispersed from the uppermost stocking site to several hundred meters downstream, set in slow velocity habitats and fished for a minimum of 2 h. Captured fish are counted by size class and released alive back to the stream. Total number captured and mean catch rates (CPUE, fish per hour) will be calculated and reported.

Program Priorities

This project stabilizes an existing population of Roundtail Chub¹ in Red Tank Draw through nonnative removals. This project also created the first replicate population of the Red Tank Draw lineage of Roundtail Chub¹ upstream of a barrier waterfall in Rarick Canyon. This project provides immediate on the ground benefits by removing nonnative fishes from Red Tank Draw and establishing two new populations of priority fish species.

Partnerships

This project is in partnership with the Coconino National Forest, U. S. Fish and Wildlife Service and Reclamation. This project builds on previously funded removals in Rarick Canyon and Red Tank Draw.

Strategic Plan Goals:

- Preventing Extinction and Managing Toward Recovery
 - Goal 1. Identify critical streams and populations in need of protection and potential replication.
 - Goal 4a. Eradicate nonnative aquatic species from a minimum of five surface waters to prepare them for repatriations of native fishes.
 - Goal 5a. Replicate Gila topminnow stocks into a minimum of 10 surface waters.
 - Goal 5b. Replicate each of the other priority species into a minimum of one surface water
 - Goal 9. Monitor to quantitatively measure and evaluate project success in improving the status of target species and their habitats.

Recovery goals:

- Gila Topminnow recovery plan (1999 draft)
 - Task 2.2 (priority 1): Reestablish into suitable habitats
 - Task 2.4 (priority 1): Protect suitable reestablishment habitats from detrimental nonnative aquatic species
 - Task 3.1 (priority 1): Develop standardized population and habitat monitoring protocols and implement them
 - Gila Chub draft Recovery plan (2014)
 - Task 1.3.1 (priority 1) Eliminate or control problematic nonnative aquatic organisms
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- Task 2.2 (priority 1) Repatriate Gila Chub to new protected streams
- Task 3.2 (priority 2) Conduct monitoring

Estimated Time and Cost:

- Cost: The estimated cost of this project is \$36,300.
- Urgency: This project is urgent because the Red Tank Draw lineage of Roundtail Chub¹ is not replicated at any other locations.
- Readiness: All necessary compliance in order to implement this project is completed.
- Matching Funds: This project does not have matching or in-kind funds.

Project 12: Upper Verde River native fish restoration

(Task ID: AZ-2020-2)

Implementing Entity: Arizona Game and Fish Department

Start Year: 2020

Location(s): Verde River, stock tanks within the upper Verde River drainage

Species Protected: Spikedace, Loach Minnow, Gila Topminnow, Roundtail Chub, Longfin Dace, Speckled Dace, Desert Sucker, Sonora Sucker

Project Description:

Background: The upper Verde River Native Fish Restoration Project is a multi-agency effort focused on protecting and restoring the native fish assemblage within the upper Verde River drainage in central Arizona. The Verde River historically supported populations of Spikedace and Loach Minnow, but currently supports a species assemblage dominated by nonnative fishes. The project consists of three main components: construction of two fish barriers, control of nonnative fishes, and reintroduction of Spikedace and Loach Minnow. Attempts to eradicate nonnative fishes will occur following completion of the first fish barrier.

Project Timeline.

2019: A draft stock tank removal plan was created in 2019 and included an analysis to identify tanks most likely to support populations of nonnative fishes.

2020: Department staff assisted with planning efforts for nonnative fish removal in the Verde River and stock tanks.

2021: Department staff will assist with the planning of nonnative fish removal in the Verde River and will begin to survey stock tanks in the Upper Verde River drainage for presence of nonnative fishes.

2022: Department staff will assist with the planning of nonnative fish removal in the Verde River and will likely complete stock tank surveys. Department staff may also begin the planning and implementation of nonnative fish removals from stock tanks within the Verde River drainage. A monitoring plan will be developed and finalized.

2023: Anticipated completion of upper barrier. Department staff will carry out nonnative fish removals within the Verde River and stock tanks within the drainage.

2024: Native fishes will be translocated above the upper barrier and monitored if removal efforts are successful. A nonnative removal effort will be carried out between the barriers if the lower barrier is completed.

2025: Native fishes will be translocated above the lower barrier if removal efforts are successful. Native fishes will be monitored in the fall.

2026: Monitoring of native fish populations and additional translocations as necessary.

2027: Monitoring of native fish populations and additional translocations as necessary.

2028: Monitoring of native fish populations and additional translocations as necessary.

2029: Monitoring of native fish populations and additional translocations as necessary.

Estimated year of completion: 2029

Geographical Area: The project area includes the Verde River and tributaries from Sullivan Lake

downstream to the proposed lower barrier location near Sycamore Creek. This reach of the Verde River will be protected from upstream invasion of nonnative fishes by a series of two barriers built by Reclamation. The Verde River is mostly owned by Prescott National Forest within this reach with some small inholdings of Department and private land. Prescott National Forest is supportive of the Verde River native fish restoration project.

Prior to treatment of the Verde River, stock tanks within the upper Verde River drainage will be surveyed for presence of nonnative fishes. Approximately 1,266 stock tanks exist within the upper Verde River watershed.

Methodologies:

Nonnative removals.—Nonnative fishes will be removed from stock tanks in the upper Verde River drainage prior to removals in the mainstem Verde River. As part of the stock tank removal plan, tanks were prioritized by analyzing national agricultural imagery program (NAIP) imagery for presence of water using normalized difference water index (NDWI) in an automated approach. Previous stocking history and distance to the Verde River were also considered in the prioritization. A total of 146 tanks were identified as high priority for sampling of nonnative fishes. Once necessary planning and compliance has been completed by the Department and partner agencies, stock tanks will be surveyed for presence of nonnative fishes. Stock tank surveys will occur in the summer when water levels are lowest. Nonnative fishes will be removed from any tanks where they are detected by either chemical treatment or manual pumping.

The second phase of nonnative fish removal efforts will occur in the Verde River. A detailed treatment plan will be developed prior to renovation following Department protocols and policies. Targets for removal success will be included in the removal plan.

Native fish translocations.—A monitoring plan will be developed to evaluate post-stocking success of native fishes. The monitoring plan will likely have species specific sampling strategies. Targets for success and planned analyses will also be included.

Program Priorities

The upper Verde River native fish restoration project will stabilize existing populations of Roundtail Chub in the wild and will replicate populations of Spikedace and Loach Minnow within historically occupied habitat. A population of Gila Topminnow will also be replicated above the barrier. Following construction of two Reclamation funded fish barriers, nonnative fish will be removed. This project will have immediate on the ground benefits by securing nearly all species of Gila River Basin native fishes upstream of barriers within historically occupied range.

Partnerships

This project is part of a larger collaborative effort with the Prescott National Forest, U.S. Fish and Wildlife Service and Reclamation. This project builds upon previously funded work to plan for and construct the barrier.

Strategic Plan Goals:

- Preventing Extinction and Managing Toward Recovery

- Goal 1. Identify critical streams and populations in need of protection and potential replication.
- Goal 4a. Eradicate nonnative aquatic species from a minimum of five surface waters to prepare them for repatriations of native fishes.
- Goal 5a. Replicate Gila topminnow stocks into a minimum of 10 surface waters.
- Goal 5b. Replicate each of the other priority species into a minimum of one surface water.
- Goal 9b. Develop/identify monitoring standards as necessary to adequately evaluate fish barrier function, success and failure of eradications, and success and failure of repatriations.

Recovery goals:

- Spikedace and Loach Minnow recovery plan (1991)
 - Task 6.3-6.4 (priority 3): Reintroduce into selected reaches and monitor
- Gila Topminnow recovery plan (1999 draft)
 - Task 2.2 (priority 1): Reestablish into suitable habitats
 - Task 2.4 (priority 1): Protect suitable reestablishment habitats from detrimental nonnative aquatic species.
 - Task 3.1 (priority 1): Develop standardized population and habitat monitoring protocols and implement them

Estimated Time and Cost:

- Cost: The estimated cost of this project is \$54,200.
- Urgency: This project is urgent because pre-treatment planning, tank surveys and barrier construction all need to occur simultaneously.
- Readiness: This project still requires substantial compliance work to be completed including NEPA compliance by the Forest for stock tank treatments, the Verde River treatment and construction of the barrier and Departmental compliance for rotenone projects.
- Matching Funds: The Department will provide in-kind-match in the form of Regional staff salaries.

Project 13: West Fork Black River Nonnative Fish Removals

(Task ID: AZ-2021-1)

Implementing Entity: AZGFD

Start Year: 2021

Location(s): West Fork Black River, Thompson Creek

Species Protected: Loach Minnow, Roundtail Chub, Apache Trout, Desert Sucker, Speckled Dace

Project Description:

Background: Reclamation funded and constructed a fish barrier on the West Fork Black River near the confluence with the East Fork Black River in 2016 to secure habitat for Loach Minnow. Renovation of the stream above the newly constructed barrier has not occurred because Brook Trout are present above the original barrier locations on Apache-Sitgreaves National Forest and tribal lands. Because the White Mountain Apache Tribe has been opposed to chemical renovations of streams on their lands in recent years, mechanical removals must be carried out to eradicate Brook Trout from the upper reaches of the streams. The U.S Fish and Wildlife Service's Arizona Fish and Wildlife Conservation Office has been carrying out mechanical removals on the tribal reaches of both Thompson Creek and the West Fork Black River for a number of years, but removal effort has fluctuated year to year due to limited staff resources. However, in 2021 they will be implementing a 1-2 year expanded effort to determine if complete eradication is feasible.

The upper West Fork Black River and Thompson Creek were initially treated with antimycin in 1996 to remove nonnative Brown Trout and Brook Trout. The treatment was believed to have been successful until Brook Trout were detected above the original fish barriers in 2006. Department Regional and Native Trout Program staff opportunistically carried out removals of Brook Trout on Apache-Sitgreaves National Forest Lands until 2014 when they developed a monitoring plan. Regional and Native Trout Program staff carried out mechanical removals each year from 2014 through 2019 following the new protocol. The new removal plan recommends 3-5 annual removal passes. The purpose of this project is to assist the Department's Region I Aquatic Wildlife Program and the Native Trout Program by carrying out additional mechanical removal passes on the Apache-Sitgreaves reaches of Thompson Creek and West Fork Black River above the original fish barrier to supplement Department regional efforts. The goal of this project is to help eradicate Brook Trout. In 2021, Department GRB staff will carry out up to four removal passes on Thompson Creek and West Fork Black River above the original fish barriers. Additional passes will be conducted only if requested by Region I Aquatic Wildlife Program. If further requested, removal passes will be carried out each year until alternative removal strategies are approved by the White Mountain Apache Tribe, eradication is achieved, or the year 2024. The estimated year of completion for the GRB portion of this project is 2024 or sooner if eradication is achieved.

Geographical Area: Thompson Creek is a tributary to the West Fork Black River and originates on the Fort Apache Indian Reservation. Thompson Creek flows for approximately 4 km on tribal lands and 2 km on Apache-Sitgreaves National Forest lands before reaching its confluence with the West Fork Black River (UTM 12S 640494/3751011). The West Fork Black River originates on the Fort Apache Indian Reservation near Baldy Peak and flows downstream for approximately 7 km on tribal lands. The West Fork Black River then flows through Apache-Sitgreaves National Forest lands for approximately 5 km to

the location of the original fish barriers (641740/3749985). The removal reach for this project would include all of Thompson Creek and the West Fork Black River on Apache-Sitgreaves National Forest lands downstream to the original fish barriers.

This project would protect existing populations of Apache Trout, Desert Sucker and Speckled Dace. Importantly, Loach Minnow can be translocated into this reach following eradication of Brook Trout. This reach is protected from upstream invasion of nonnative fish by a series of three downstream fish barriers. The project area is entirely owned by Apache-Sitgreaves National Forest which has been supportive of native fish conservation activities in the West Fork Black River watershed.

Methodologies: Mechanical removal of non-native Brook Trout will take place in the West Fork Black River and Thompson Creek upstream of the original fish barriers to the Fort Apache Indian Reservation boundary. The project area will be divided into a total of fourteen 500 meter long reaches and sampled using backpack electrofishing equipment. There are 10 reaches within the project area on the West Fork Black River and 4 reaches on Thompson Creek. Each reach will be sampled in an upstream direction using single-pass electrofishing. A full pass consists of sampling all 14 reaches.

During the first pass each year, all native species will be counted, measured (total length, nearest millimeter, TL mm) and returned to the stream at the end of each 500 m reach. Only Apache Trout will be counted and measured (TL mm) during all subsequent passes within each year. All nonnative fish captured will be measured (TL mm), euthanized, and checked internally to determine sex and maturity.

Three to four removal passes will be carried out in 2021. Additional passes will be conducted only if requested by the Department's Region 1 Aquatic Wildlife Program. The minimum goal for each year is to prevent Brook Trout spawning by removing all sexually mature Brook Trout and those that will reach sexual maturity by late fall when spawning occurs. Based on data from the West Fork Black River in 2013 and 2014, female Brook Trout reach sexual maturity at approximately 170 mm TL. In order to achieve suppression, the mean size of all Brook Trout captured needs to be 150 mm TL or less. Brook trout are known for early maturation, particularly in response to declining abundance. Regional staff, using non-GRB funds, will evaluate maturation size each year based on the most recent removals and the target size will be adjusted as necessary.

Program Priorities

This project will prepare the West Fork Black River for a replicated population of Loach Minnow through nonnative removal. Loach Minnow will be secured from future invasions of nonnative fish by at least one existing fish barrier. This project will also benefit Apache Trout, Roundtail Chub, Desert Sucker and Speckled Dace. This project will have immediate on-the-ground benefits by preparing a relatively large reach of stream above the Reclamation funded fish barrier for introduction of Loach Minnow.

Partnerships

This project is in partnership with Department regional staff, the U. S. Fish and Wildlife Service, Apache-Sitgreaves National Forest and Reclamation. This project is part of a larger collaborative effort between the Department, U.S. Fish and Wildlife Service and White Mountain Apache Tribe to remove nonnative Brook Trout from the West Fork Black River. This project will build upon previously funded work by

Reclamation to construct a fish barrier in the West Fork Black River by preparing the stream for introduction of Loach Minnow.

Strategic Plan Goals:

- Preventing Extinction and Managing Toward Recovery
 - Goal 4a. Eradicate nonnative aquatic species from a minimum of five surface waters to prepare them for repatriations of native fishes.
 - Goal 5b. Replicate each of the other priority species into a minimum of one surface water.

Recovery goals:

- Spikedace and Loach Minnow recovery plan (1991)
 - Task 6.2 (priority 3) Identify and prepare sites for reintroduction
 - Task 6.3-6.4 (priority 3): Reintroduce into selected reaches and monitor

Estimated Time and Cost:

- Cost: The estimated cost of this project for FY2021 is \$33,800. The total estimated project cost is unknown because the number of passes completed by other Department staff may vary year to year.
- Urgency: This project is urgent because eradication of Brook Trout in the upper reach can be achieved much quicker with a greater amount of removal effort. Eradication of Brook Trout would expedite the process of translocating Loach Minnow to the West Fork Black River.
- Readiness: All compliance necessary to implement this project has been completed.
- Matching Funds: This project has in-kind donations in the form of other Departmental staff performing some nonnative removal passes each year.

Project 14: Nonnative fish removal from Bonita and Aravaipa Creeks

(Task ID: AZ-2009-1)

Implementing Entity: The Bureau of Land Management, Safford Field Office.

Start Year: 2009 for Bonita Creek and 2010 for Aravaipa Creek. Both projects were implemented prior to receiving funds from the Gila River Basin Native Fish Conservation Program (GRBNFCP).

Location(s): The project areas include the Gila Box Riparian National Conservation Area (RNCA), specifically Bonita Creek, and the Aravaipa Ecosystem Management Area, specifically Aravaipa Creek.

Aravaipa Creek Project Information:

Species Protected in Aravaipa Creek: Nonnative fish removal from Aravaipa Creek will help secure and protect populations of federally endangered Loach Minnow (*Tiaroga cobitis*) and Spikedace (*Meda fulgida*). Other species that would benefit from continued nonnative fish removal include Roundtail Chub (*Gila robusta*), Longfin Dace (*Agosia chrysogaster*), Speckled Dace (*Rhinichthys osculus*), Sonora Sucker (*Catostomus insignis*), Desert Sucker (*Pantosteus clarkii*), and Lowland Leopard Frog (*Rana yavapaiensis*).

Broodstock of the genetic lineages of Aravaipa Creek Loach Minnow and Spikedace are maintained at the Aquatic Research and Conservation Center (ARCC) as refuge stock, for repatriations into appropriate and protected streams within Arizona and New Mexico, and for research. Currently, new broodstock is obtained annually from Aravaipa Creek for both species, which makes it imperative to secure and protect the extant populations by eliminating nonnative predators and competitors from the system.

Project Description:

The proposed projects are continuation of work partially funded by Gila River Basin Native Fishes Conservation Program in 2013 and 2018 for Bonita and Aravaipa Creeks, respectively. Both systems are unique in that they still support intact native fish assemblages, despite nonnative fishes. Bureau of Land Management (BLM), Safford Field Office (SFO) plans to continue mechanical removal of nonnative fish species, with an emphasis on Yellow Bullhead (*Ameiurus natalis*), from 1.9-miles of Bonita creek and 17-miles of Aravaipa Creek. The effort is collaborative, ongoing, and is required to protect the native fish assemblages in both creeks.

Background for Aravaipa Creek - Considered one of the premiere native fish assemblages in the state, Aravaipa Creek (Figure 1) supports seven populations of native fish species, including Loach Minnow, Spikedace, Roundtail Chub, Speckled Dace, Longfin Dace, Sonora Sucker, and Desert Sucker. Additionally, nonnative predatory and competitive fishes, including Yellow Bullhead and Red Shiner (*Cyprinella lutrensis*) inhabit the mainstem of Aravaipa Creek and threaten the native fishes. A third nonnative fish species, Green Sunfish (*Lepomis cyanellus*), was successfully removed from Horse Camp Canyon, a tributary to Aravaipa Creek, from 2010 to 2015 by BLM, SFO and partners using a variety of gear types, including Promar nets, Gee metal minnow traps, dipnets, seines, and backpack electrofishers. A total of 3,910 Green Sunfish and one Yellow Bullhead were removed from Horse Camp Canyon. Most Green Sunfish, 2,675 (68%) were captured in traps and nets, 1,125 (29%) were removed

by seining, 105 (3%) were captured with an aquarium dipnet, and five (less than one percent) by backpack electrofishing. Zero Green Sunfish were captured in 2013, four were captured in 2014, three in 2015, and zero were captured in 2018. If all removal methods are combined, juvenile Green Sunfish comprised 43% (n=1,676) of total catch, adults comprised 40% (n=1,555), and 679 (17%) were unknown. With the successful removal of Green Sunfish, the BLM, SFO and partners-initiated removal of Yellow Bullhead from Aravaipa Creek in 2017 as nonnative fish are the greatest threat to the native fish community in this system.

The purpose of this task is to remove nonnative fishes, Yellow Bullhead and Red Shiner from Aravaipa Creek to protect the extant native fish community. Although both species prey upon and compete with the native species, removal efforts will focus primarily on habitats occupied by Yellow Bullhead, which includes pools, backwaters, and streambank margins. By focusing on these habitats, impacts to federally endangered Loach Minnow and Spikedace will be minimal. Red Shiner will not be targeted directly since their habitat preferences tend to overlap with both Loach Minnow and Spikedace.

Summary of Past Results for Aravaipa Creek: The BLM, SFO and partners have conducted nine removal efforts since September 2017, resulting in 674 Yellow Bullheads removed (Table 1). Additionally, Yellow Bullhead have been captured and removed during Loach Minnow and Spikedace hatchery augmentation collections, during fish health assessments, and during backpack electrofishing demonstrations, resulting in an additional 61 Yellow Bullhead removed.

Geographical Area - Aravaipa Creek is a tributary to the San Pedro River and is located in southeastern Arizona about 50 miles west of Safford, Arizona, along the border of Graham and Pinal counties (Figure 1). The creek becomes perennial at Aravaipa Spring near Stowe Gulch on lands owned and managed by The Nature Conservancy and flows west to the San Pedro River approximately 22-miles. The watershed covers 558 square miles (356,984 acres) and includes multiple tributaries, some which contribute flow to the mainstem. Landownership is comingled with private, federal, and tribal inholdings. The two primary managers/landowners, BLM, SFO and The Nature Conservancy are supportive of the project. Permission to remove Yellow Bullhead from private lands on the west end is in progress with permission granted so far from 16 of the 19 landowners contacted.

Paired fish barriers constructed in 2001 by Bureau of Reclamation protect Aravaipa Creek from future invasions of nonnative fishes from the San Pedro River.

Methodology - To document and track Yellow Bullhead distribution, Aravaipa Creek was delineated into 79, 500-meter reaches. Catch and effort will be recorded for each stream reach. Coordinates of pools, backwater habitats, and streambank margins supporting Yellow Bullhead will be recorded. Removal efforts will then focus on those stream reaches and habitats supporting Yellow Bullhead. Removal efforts may be from upstream to downstream (east to west end) or vice versa (west end to east). However, an upstream to downstream (east to west end) approach is preferred, since native fish populations are highest on the east end for most of the species. Removal efforts will focus on adults prior to spawning (i.e., March) since larger individuals usually have greater fecundity (Birkeland and Dayton, 2005; Danylchuk and Fox, 1994; and Blumer 1985) and during periods of low flow. From mid-May to June sections of Aravaipa Creek near the constructed fish barriers start to dry eliminating habitat and stranding and killing fish in pools. This drying will allow for selective removal of nonnatives. Flood events will also be exploited as flooding events potentially stress and wash nonnative fish downstream likely temporarily reducing the population. Winter flood events are more likely to fill in pool habitat, reducing preferred habitat for Yellow Bullhead and increasing sampling effectiveness.

Total length measurements will be taken of Yellow Bullhead and Red Shiner and sexed if gametes expressed. Following data collection, all nonnative fish species will be euthanized with an overdose of tricaine methanesulfonate (MS-222) and disposed of out of public view. Non-targeted native fish species and Lowland Leopard Frog will be released at site of capture to minimize impacts to them.

Gear Type: Mechanical removal using backpack electrofishers, Gee metal minnow traps (25 cm diameter, 47 cm long, double throat, 0.6 or 0.3 cm mesh), collapsible Promar nets (0.3 m diameter, 0.6 and 0.9 m long, double throat, 1.2 cm mesh), and seines will be implemented due to their proven effectiveness in this stream. Benefits of these removal methods include low impact to non-targeted species and neutral to positive public acceptance. Chemical renovation is not feasible due to lack of public support, habitat complexity, and adverse impacts to threatened and endangered fish species.

A minimum of eight removals will be conducted in 2021. Removals in March and April will target Yellow Bullhead prior to spawning (Table 2).

Data Analysis: Data collected during bi-annual monitoring will be used to determine long term trends in fish species abundance and community composition within Aravaipa Creek over time. Removal and bi-annual fish morning data will be used to track presence, absence, and distribution of both native and nonnative fish species. Data will be used to provide relative abundance that shows what effect, if any, removal has on native and nonnative fish species. This information will be provided in a final report along with methods, results, discussion, and conservation and management recommendations.

Bonita Creek Project Information:

Species Protected in Bonita Creek: Nonnative fish removal from Bonita Creek will help secure and protect populations of federally endangered Gila Chub (*Gila intermedia*) and Gila Topminnow (*Poeciliopsis occidentalis occidentalis*). Other species that would benefit from continued nonnative fish removal include Longfin Dace, Speckled Dace, Sonora Sucker, Desert Sucker, and Sonora Mud turtle (*Kinosternon sonoriense*).

Background for Bonita Creek - In 2008, as part of a multi-agency native fish restoration project, to protect the extant fish fauna including endangered Gila Chub, Longfin Dace, Speckled Dace, Sonora Sucker, and Desert Sucker and to secure habitat for the repatriation of other imperiled Gila basin fish, the Bureau of Reclamation (BOR) constructed a fish barrier across lower Bonita Creek to prevent upstream incursion of nonnative aquatic species from the Gila River into lower and upper segments of Bonita Creek (Figure 2). Additionally, the reach of Bonita Creek between the City of Safford infiltration gallery dike and the fish exclusion barrier was chemically renovated with the piscicide rotenone to eliminate nonnative fishes. Shortly after the chemical treatment, nonnative fishes, Western Mosquitofish (*Gambusia affinis*) and Green Sunfish in 2009, Fathead Minnow (*Pimephales promelas*) in 2010, and Yellow Bullhead in 2011 were discovered in the renovated portion of Bonita Creek. With the discovery of Green Sunfish in 2009, BLM, SFO initiated mechanical removal since retreatment of the stream with piscicides was deemed not feasible due to habitat complexity (which is likely the reason the first treatment failed), public perception, and permitting requirements

Eradication of Green Sunfish began August of 2009 with their discovery and ended September 4, 2018. A total of 23,282 Green Sunfish were removed from a 1.9-mile reach of lower Bonita Creek (Table 3). Although a variety of different gear types were used to eradicate Green Sunfish, the majority, 21,742

were captured in standard Gee metal minnow traps and large Promar nets. Gee metal minnow traps captured 15,384 of the Green Sunfish, Promar nets captured 5,602, and a mix of Promar nets and Gee metal minnow traps that were not differentiated captured 756, which took an effort of 47,034 net sets. The remaining 1,540 Green Sunfish were captured with ancillary gear types.

Effort varied over the years and was largely dependent on funding and personnel availability. In 2016, increased funding from the BLM Washington Office and the Bureau of Reclamation's Gila River Basin Native Fishes Conservation Program allowed for the hiring of a dedicated removal crew that was able to more than double our overall effort in 2016 from 2015. This increased effort reduced Green Sunfish numbers to a point that recruitment was effectively eliminated.

The results for Bonita Creek suggest that in systems that are isolated either naturally or with a barrier, nonnative mechanical removal can be effective in either eliminating or reducing the numbers of nonnative fish species. The importance of timing the removal effort to reduce the number of spawning adults is equally as important as the amount of effort expended. Underestimating the effort needed, funding constraints, and lack of personnel are the primary reasons it took nine years to eliminate Green Sunfish from Bonita Creek.

Summary of Past Results for Bonita Creek: Mechanical removal of Yellow Bullhead is ongoing and is utilizing removal techniques and strategies like those used for Green Sunfish.

A total of six removal trips were conducted from February through November 2019. No Green Sunfish were collected or observed (Table 4), which continues to support their eradication from Bonita Creek. Summary of catch and effort by trip is provided below.

February 11-12, 2019: Seven-five Promar Nets and 75 Gee metal minnow traps were set between road crossings 1 and 2. Forty-two Yellow Bullhead, six Mosquitofish, 161 Fathead Minnow, seven Sonora Sucker, and four Gila Chub were captured. All nonnative fish captured were humanely euthanized with an overdose of tricaine methanesulfonate (MS-222).

July 15-16, 2019: Fifty Promar Nets and 50 Gee metal minnow traps were set between road crossings 1 and 2. Eighty-two Yellow Bullhead, 54 Mosquitofish, 182 Fathead Minnow, five Sonora Sucker, and four Gila Chub were captured. All nonnative fish captured were humanely euthanized with an overdose of tricaine methanesulfonate (MS-222).

July 15-16, 2019: Fifteen Promar Nets and 15 Gee metal minnow traps were set between road crossings 2 and 3. Seventeen Yellow Bullhead, 160 Mosquitofish, 11 Fathead Minnow, and two Gila Chub were captured. All nonnative fish captured were humanely euthanized with an overdose of tricaine methanesulfonate (MS-222).

July 16-17, 2019: Twenty-five Promar Nets and 25 Gee metal minnow traps were set between road crossings 2 and 3. Twenty-seven Yellow Bullhead, 284 Mosquitofish, four Fathead Minnow, two Sonora Sucker, and six Gila Chub were captured. All nonnative fish captured were humanely euthanized with an overdose of tricaine methanesulfonate (MS-222).

July 29-30, 2019: Thirty Promar Nets and 30 Gee metal minnow traps were set between road crossings 2 and 3. Eighty-nine Yellow Bullhead, 188 Mosquitofish, 17 Fathead Minnow, six Sonora Sucker, 60 Gila Chub, and two Gila Topminnow were captured. All nonnative fish captured were humanely euthanized with an overdose of tricaine methanesulfonate (MS-222).

November 12-13, 2019: Fifteen Promar Nets and 15 Gee metal minnow traps were set between road crossings 2 and 3 in the upper section. Nine Yellow Bullhead, one Mosquitofish, one Fathead Minnow, seven Sonora Sucker, 57 Gila Chub, and three Gila Topminnow were captured. All nonnative fish captured were humanely euthanized with an overdose of tricaine methanesulfonate (MS-222).

November 12-13, 2019: Fifty Promar Nets and 50 Gee metal minnow traps were set between road crossings 3 and 4. Four Yellow Bullhead, one Mosquitofish, six Fathead Minnow, 20 Sonora Sucker, 217 Gila Chub, and one Gila Topminnow were captured. All nonnative fish captured were humanely euthanized with an overdose of tricaine methanesulfonate (MS-222).

November 13-14, 2019: Thirty-two Promar Nets and 32 Gee metal minnow traps were set between road crossings 4 and 5. Fifteen Yellow Bullhead, three Fathead Minnow, eight Sonora Sucker, and 97 Gila Chub were captured. All nonnative fish captured were humanely euthanized with an overdose of tricaine methanesulfonate (MS-222).

November 13-14, 2019: Forty-three Promar Nets and 43 Gee metal minnow traps were set between road crossings 5 and 6. Twenty-six Yellow Bullhead, one Fathead Minnow, 27 Sonora Sucker, 244 Gila Chub, and one Sonora Mud turtle (*Kinosternon sonoriensis*) were captured. All nonnative fish captured were humanely euthanized with an overdose of tricaine methanesulfonate (MS-222).

Geographical Area - Bonita Creek originates in the Gila Mountains on the San Carlos Apache Indian Reservation and flows southeasterly from its headwaters approximately 46 miles to its confluence with the Gila River. The Bonita Creek watershed drains approximately 236,000 acres (370 square miles) and is a mixture of federal, city, tribal, and private lands. From the reservation boundary downstream, BLM, SFO manages approximately 92% of the lands and the remaining 8% are City of Safford and private holdings. The two managers/landowners, BLM, SFO and City of Safford are supportive of the project.

A fish barrier constructed in 2008 by Bureau of Reclamation protects Bonita Creek from future invasions of nonnative fishes from the Gila River.

Methodology - Removal strategies and gear type used will follow those successfully used for Green Sunfish removal. To make the removal process more manageable, we divided Bonita Creek into 14 segments based on the low water road crossings and three reaches, lower, middle, and upper. The lower reach extends from the fish barrier upstream to road crossing 4, middle reach includes road crossing 4 upstream to road crossing 10, and the upper reach includes road crossing 10 upstream to road crossing 15. Removal efforts will focus on the upper reaches of the creek as they appear to support fewer Yellow Bullhead, but more native fish. Suppression efforts will continue in the lower reaches during this time.

All species collected will be identified and enumerated; nonnative Yellow Bullhead will be measured in millimeters and enumerated. Yellow Bullhead ≥ 140 mm TL will be classified as adult, whereas < 140 TL will be classified as juvenile. Nonnative fish will be humanely euthanized with an overdose of tricaine methanesulfonate (MS-222).

Gear Type - Gear types will include collapsible Promar nets (0.3 m diameter, 0.6 and 0.9 m long, double throat, 1.2 cm mesh), Gee metal minnow traps (25 cm diameter, 47 cm long, double throat, 0.6 or 0.3 cm mesh), hoop nets (0.66 m diameter, 1.2 m long, two-hoop, single throat, 0.6 cm mesh), backpack electrofisher, and seines.

Promar nets will be baited with both wet and dry Purina dog chow, whereas Gee traps will only be baited with dry Purina dog chow. Nets will be sprayed with animal repellent to deter other wildlife from entering or pulling nets out of water. Nets and traps will be set in daytime, allowed to fish overnight, and set in pairs (one Gee and one Promar). Time of deployment and retrieval of nets and minnows traps will be recorded, but effort will be summarized as net sets regardless of the actual time fished. Promar traps will be set with air-pockets to prevent non-targeted animals from drowning.

A minimum of six removals will be conducted in 2021. Removals in March and April will target Yellow Bullhead prior to spawning (Table 5).

Data Analysis - Removal and annual fish morning data will be used to track presence, absence, and distribution of both native and nonnative fish species. Data will be used to provide relative abundance that shows what effect, if any, removal has on native and nonnative fish species. This information will be provided in a final report along with methods, results, discussion, and conservation and management recommendations.

Program Priorities:

The ongoing effort to remove nonnative fish from Bonita and Aravaipa Creeks, if successful, will stabilize and secure six wild populations of Gila River basin fishes (i.e., BLM Sensitive Speckled Dace, Longfin Dace, Sonora Sucker, and Desert Sucker), including two priority species, Gila Chub and Gila Topminnow in Bonita Creek and seven wild populations of Gila River basin fishes (i.e., BLM Sensitive Roundtail Chub, Speckled Dace, Longfin Dace, Sonora Sucker, and Desert Sucker), including two priority species, Loach Minnow and Spikedace in Aravaipa Creek.

Immediate, on-the-ground benefits result with each Yellow Bullhead removed as a dietary analysis of 243 Yellow Bullhead collected from Aravaipa Creek from 2005 through 2006 confirmed predation on native fishes and frogs, including federally endangered Loach Minnow. Fifteen native fish and one lowland leopard frog were removed from the intestinal tracts of 14 of the 243 Yellow Bullhead captured (one stomach had two fish, a Desert Sucker and Longfin Dace). In addition, The National Aquatic Monitoring Center identified 93 fish parts from 43 of the Yellow Bullhead intestinal tracts. Predation on native fish ova, larvae, and small juveniles may have escaped detection because early life stages digest rapidly and become unrecognizable among gut contents.

Bureau of Land Management, Safford Field Office, United States Fish and Wildlife Service, Arizona Game and Fish Department, Bureau of Reclamation, and The Nature Conservancy recognize the value of both creeks as native fisheries and the importance of eliminating or reducing nonnative fishes. Partners have invested over \$5,000,000 through the installation of fish barriers, chemical and mechanical removal treatments, repatriations, and monitoring on these two systems to eradicate nonnative fish species, and to prevent future upstream incursions of nonnative fish into these systems.

Partnerships:

The Bonita Creek nonnative fish removal project was initiated by BLM, SFO in 2009 and the Aravaipa Creek nonnative fish removal project in 2010. Both projects have been partially funded through the Gila River Basin Native Fish Conservation Program. Other partners that have worked on these projects include, Arizona Game and Fish Department, US Fish and Wildlife Service, Bureau of Reclamation, The Nature Conservancy, University of Arizona, Gila Watershed Partnership, and volunteers.

Strategic Plan Goals:

- Scientific Foundation
 - Goal 1a. Seek at least one opportunity to partner or fund new control methods or improvements upon existing methods. The mechanical removal of Yellow Bullhead from Aravaipa Creek will provide new information on efficacy of this technique in larger systems.

- Preventing Extinction and Managing Toward Recovery
 - Goal 4a. Eradicate nonnative aquatic species from a minimum of five surface waters to prepare them for repatriations of native fishes. The proposed projects will eradicate Yellow Bullhead from Bonita and Aravaipa Creeks to protect and secure the extant fish assemblage, which includes federally endangered Loach Minnow, Spikedace, Gila Chub, and Gila Topminnow. Other species to benefit include populations of BLM sensitive fish species, including one-population of Roundtail chub, two-populations of Speckled Dace, two-populations of Longfin Dace, two-populations of Sonora Sucker, and two-populations of Desert Sucker.

 - Goal 9b. Develop/identify monitoring standards as necessary to adequately evaluate fish barrier function, success, and failure of eradications, and success and failure of repatriations. The proposed project will require monitoring to determine efficacy of nonnative removal projects.

Recovery goals:

- Loach Minnow and Spikedace recovery plans (1991)
- 5) Enhance or restore habitats occupied by depleted populations.
- 5.1 (Priority 2) Identify target areas amenable to management.
 - 5.2 (Priority 2) Determine necessary habitat and landscape improvements. This includes removal or other control of nonnative fishes, where they are problematic.
 - 5.3 (Priority 3) Implement habitat improvement. This includes repeated management to remove nonnatives.
- 6) Reestablish populations to selected streams within historic range.
- 6.2.2 (Priority 3) Enhance habitat as necessary.
 - 6.2.3 (Priority 3) Assess status of nonnative fishes in watershed.
 - 6.2.5 (Priority 3) Reclaim as necessary to remove nonnative fishes.
- Gila Topminnow draft recovery plan (1999)
- 2) Reestablish and protect populations throughout historic range.
- 2.4 (Priority 1) Protect habitats of reestablished or potential populations from detrimental nonnative aquatic species.
- 3) Monitor natural and reestablished populations and their habitats.
- 3.1 (Priority 1) Develop standardized population and habitat monitoring protocols and implement them.
- Gila Chub draft recovery plan (2015)

1) Protect and manage remnant populations and their habitats.

1.3.1 - Eliminate or control problematic nonnative aquatic organisms.

7) Use adaptive management practices to guide future recovery actions where uncertainty exists.

7 - Monitor remnant, repatriated, and refuge populations to inform adaptive management strategies.

Estimated Time and Cost:

Estimated cost of project this year and if known total estimated project costs? The BLM, SFO is requesting \$34,732.50 for fiscal year 2021 to continue Yellow Bullhead removal from Bonita and Aravaipa Creeks. The estimated project cost to eliminate Yellow Bullhead from both systems is unknown currently. Results from 2020 data will be used to estimate project costs to eliminate Yellow Bullhead from both systems.

What is the urgency of this project?

The native fish communities in Bonita and Aravaipa Creeks have been able to persist with Yellow Bullhead under current conditions. Removal of Yellow Bullhead from both systems will increase resiliency of the native fish populations in both streams, which will help them withstand or recover from ongoing and future stressors such as climate change and water withdrawals.

Is this project ready to implement or are other compliance documents needed?

Removal of Yellow Bullhead from Bonita and Aravaipa Creeks is ongoing. No ESA or NEPA compliance documents are required.

Does this project have in-kind or matching funds?

The BLM, SFO is requesting \$34,732.50 from GRBNFCP and is providing a match of \$31,980.96, which covers salary, vehicle, supplies, and equipment for Yellow Bullhead removal at Bonita and Aravaipa Creeks.

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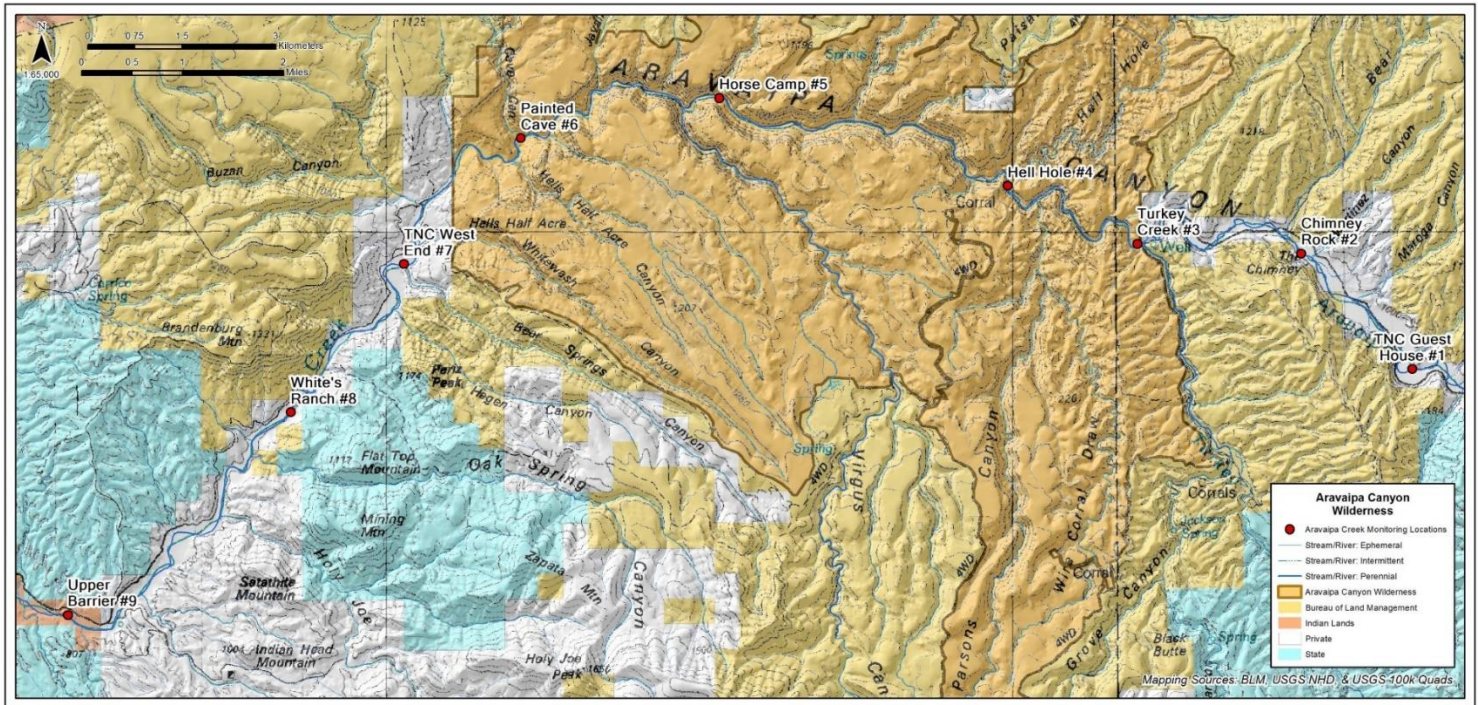


Figure 1. Map of Aravaipa Creek showing land ownership and permanent fish monitoring sites.

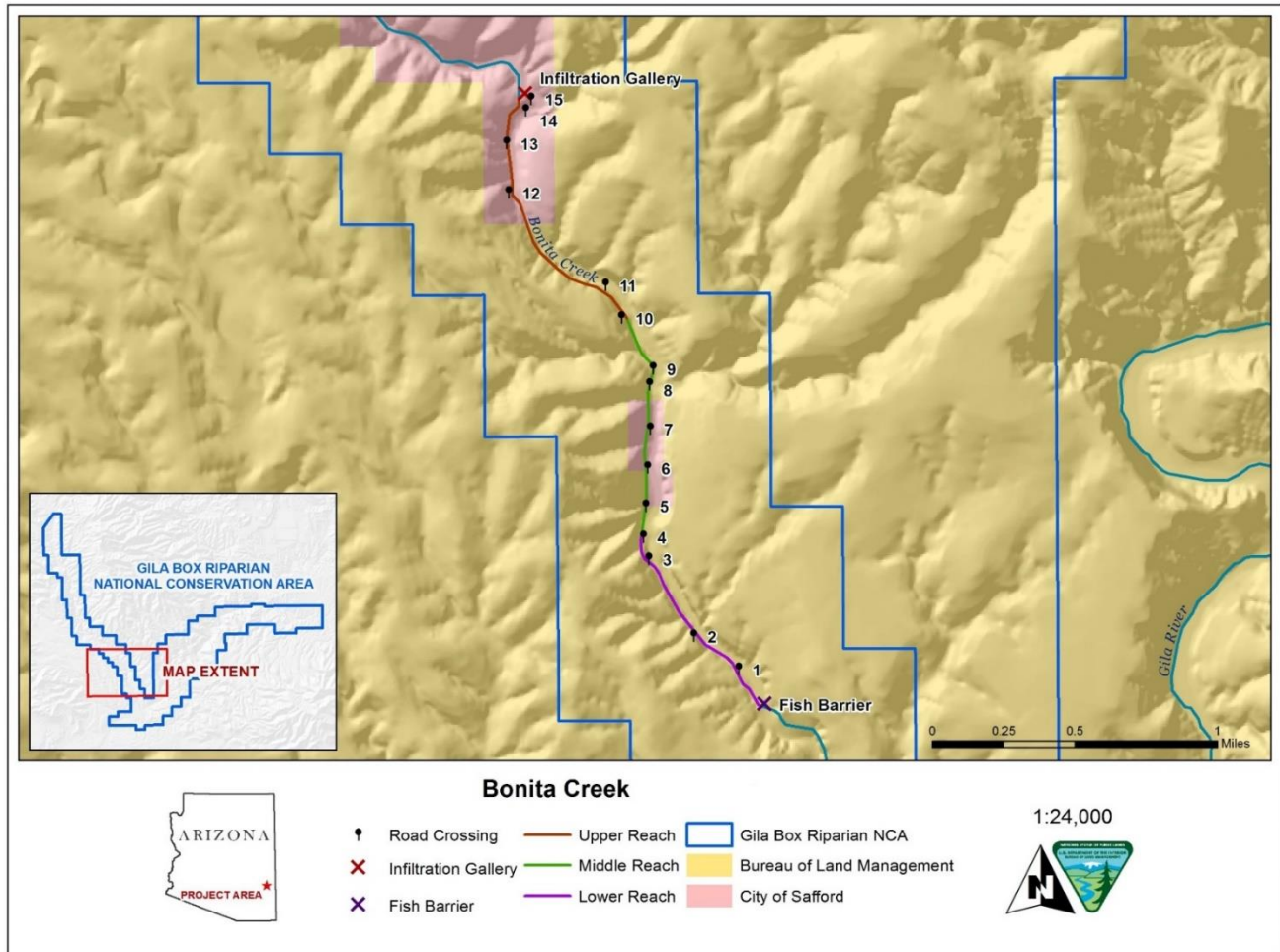


Figure 2. Map of Bonita Creek showing location of low water road crossings, City of Safford infiltration gallery, fish barrier, and reaches.

Table 1. Summary table of Yellow Bullhead removal from Aravaipa Creek from September 14, 2017 through January 14, 2020.

Removal Date	Location	Distance Covered (miles)	Effort (Seconds)	# of Yellow Bullhead Removed	Comments
9/14/2017	East and West Ends	11.17	18,360	311	
10/15/2017	West End	0.29	1,222	27	Collected during a backpack electrofishing demonstration
11/6/2017	East End	0.11		8	Incidental to Loach Minnow and Spikedace hatchery collection
02/26-03/01/2018	East End	8.30	9,152	89	
3/13/2018	East and West Ends	4.06	17,877	85	
4/15/2018	West End	0.29	1,354	11	Collected during a backpack electrofishing demonstration
04/23-26/2018	East End	2.03	13,198	48	
03/4-6/2019	East End	5.06	19,492	17	

3/26/2019	West End	0.22		12	Incidental to fish health collection
04/8-11/2019	West End	5.60	12,981	61	
10/20/2019	West End			3	Collected during a backpack electrofishing demonstration
11/6/2019	West End	0.62	3,274	40	
1/9/2020	West End	0.62	882	2	
1/14/2020	West End	2.48	3,469	21	
Total		37.75	101,261	735	

Table 2. Proposed timeline for Yellow Bullhead removal from Aravaipa Creek for 2021.

Timeline 2021											
Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
	X	X-2	X	X	X			X	X		

Table 3. Gear type and total number of Green Sunfish removed from Bonita Creek, 2009-2019.

Gear Type	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Gee Minnow Trap	137	1,647	2,323	3,701	1,152	2,278	1,329	2,815	2			15,384
Promar Net	155	471	820	1,623	857	521	574	576	5			5,602
Hoop Net			76	224	148	198	204	126				976
Gee and Promar - Combined			756									756
Seine	173				186			12				371
Dip Net					93							93
Red Promar	7				4			42				53
Backpack Electrofisher	10	8	10			2						30
Tote Barge Shocker						7						7
Custom Trap						8	1					9
Crab Trap					1							1
Total	482	2,126	3,985	5,548	2,441	3,014	2,108	3,571	7	0	0	23,282

Table 4. Summary table of Yellow Bullhead removal from Bonita Creek in 2019.

Removal Date	Location – Road Crossings	Gee Metal Minnow Trap Effort (net night)	Promar Net Effort (net night)	# Green Sunfish Removed	# Yellow Bullhead Removed
2/11-12/2019	1-2	75	75	0	42
07/15-16/2019	1-2 and 2-3	65	65	0	99
07/16-17/2019	2-3	25	25	0	27
07/29-30/2019	2-3	30	30	0	89
11/12-13/2019	2-3 and 3-4	65	65	0	13
11/13-14/2019	4-5 and 5-6	75	75	0	41
Total		335	335	0	287

Table 5. Proposed Timeline Yellow Bullhead removal from Bonita Creek for 2021.

Timeline 2021											
Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
	X	X	X	X	X			X			

Hatchery Workplan

Project 15: Aquatic Research and Conservation Center Populations

(Task ID: HA-2006-2)

Implementing Entity: AZGFD

Start Year: 2003 and 2006

Location(s): Aravaipa Creek and Blue River; Aquatic Research and Conservation Center

Species Protected: Spikedace (3), Loach Minnow (4), Gila Topminnow, Desert Pupfish and Roundtail Chub

Project Description:

Background: This project has two major components: 1) acquiring Spikedace and Loach Minnow and other rare species from the wild, and 2) all activities to maintain and propagate populations at the Aquatic Research and Conservation Center (ARCC).

Acquisition of Spikedace and Loach Minnow and other rare species from the wild

This is an ongoing project dating back to 2003. The scope of the project includes all occupied remnant or recently occupied streams with Spikedace and Loach Minnow: Aravaipa Creek, Blue River, East Fork Black River, upper Verde River, White River, and Eagle Creek in Arizona, and the San Francisco River, upper Gila River and Gila River Forks in New Mexico. The scope of the project also includes collections of remnant populations of Roundtail Chub¹ as needed: chub have previously been collected from Eagle Creek, Dix Creek, and Harden Cienega Creek. Collections of Aravaipa Creek Spikedace and Loach Minnow have occurred annually since 2013 with semi-annual collections dating back to 2007. Collections of Loach Minnow from the Blue River are more sporadic with a total of seven collections from 2007-2019. During 2007 through 2015 the Department made multiple attempts to collect Loach Minnow from East Fork Black River, Spikedace from the Verde River, and Spikedace and Loach Minnow from Eagle Creek, without success. Collections from New Mexico were primarily completed by New Mexico Department of Game and Fish (NMDGF), and were sporadic with five collections of Spikedace and six collections of Loach Minnow from 2009-2018 at the Gila River Forks. The last Upper Gila River collections for Spikedace and Loach Minnow occurred in 2009 and 2007 respectively. San Francisco River Loach Minnow were only collected in 2013. Eagle Creek Roundtail Chub¹ were collected in 2010 and 2011. Roundtail Chub¹ were temporarily brought into ARCC from Dix and Harden Cienega Creeks during 2010-2014 before being transferred to NMDGF for stocking into Mule Creek.

Work planned for 2021 includes collections of Spikedace and Loach Minnow from Aravaipa Creek and collection of Loach Minnow from Blue River. Collections from other Arizona streams will only be attempted if other biologists detected the species in those streams. Collections from these same streams will continue annually until there is no longer a need for captive refuge and propagation of Spikedace and Loach Minnow.

Aquatic Research and Conservation Center

Bureau of 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 to develop propagation techniques for Loach Minnow and Spikedace, to establish refuge populations of all of the lineages, and to

propagate fish for repatriations. 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, Bureau of Reclamation began providing funds (through U. S. Fish and Wildlife Service) for a variety of improvements to ARCC, including a new outdoor building to hold more tanks, a new quarantine building, and new ponds.

In 2021, ARCC staff will focus on propagating lineages of Spikedace and Loach Minnow that are planned to be repatriated that year, including Aravaipa Spikedace, upper Gila River Spikedace, Blue River Loach Minnow, and any lineages that New Mexico Department of Game and Fish plan to stock. Staff may also work on propagating chub from Sheehy Spring so that the progeny can be stocked into appropriate locations. Staff will focus on research to improve propagation success, and survival of stocked fish. Health assessments of fish from donor sites will be completed prior to any translocation to ARCC, and an annual health assessment of fish at ARCC will be performed before any fish from ARCC are stocked.

Geographical Area:

Acquisition of Spikedace and Loach Minnow and other rare species from the wild

This project primarily occurs within the Aravaipa Creek drainage and the Blue River drainage in Arizona. The target species have not been detected in the other Arizona streams in recent decades. Aravaipa Creek supports relict populations of Spikedace and Loach Minnow above a barrier. Collections are most frequently made near the upstream end of perennial flow (UTM 12S 556069/3638045), where both Spikedace and Loach Minnow are typically abundant. Aravaipa Creek is owned and managed cooperatively by the Bureau of Land Management (BLM) and The Nature Conservancy (TNC), with some smaller parcels of private land downstream. The BLM and TNC are both supportive of ongoing native fish conservation activities.

The Blue River drainage supports a large relict metapopulation of Loach Minnow above a constructed barrier near the mouth. Loach Minnow inhabit the Blue River and its tributaries including Little Blue Creek, Grant Creek, KP Creek, Campbell Blue Creek, Dry Blue Creek, Pace Creek, and Frieborn Creek, and may occur in other tributaries. Collections have typically been made near the confluence with Campbell Blue Creek (680777/3732393) or downstream near Juan Miller Crossing (668032/3685120). The majority of the Blue River drainage is owned by Apache-Sitgreaves National Forest with some inholdings of private land. The Forest is supportive of ongoing native fish conservation activities.

If Spikedace or Loach Minnow are detected in drainages where they are currently presumed to be extirpated, the Department would likely attempt to collect fish for ARCC. Spikedace were last detected in the upper Verde River in 1999 and in Eagle Creek in 1989. Loach Minnow were last detected in East Fork Black River in 2004 and in Eagle Creek in 1997. Apparent extirpations are most likely due to negative interactions with nonnative aquatic species. All project area locations are on U.S. Forest Service (USFS) property which is supportive of recovery actions.

Aquatic Research and Conservation Center

The ARCC facility is located near Page Springs, Arizona.

Methodologies:

Acquisition of Spikedace and Loach Minnow and other rare species from the wild

ARCC staff determines the target number of wild fish necessary to maintain broodstocks of each lineage at the end of each year. The U.S. Fish and Wildlife Service (USFWS) collaborates with the Department and other partners (BLM and University of Arizona for Aravaipa Creek) to evaluate survey information and determine how many fish (a quota) can be removed from a donor stream without negatively affecting the population. Quotas do not necessarily meet the target number requested by ARCC staff.

A fish health assessment will be carried out early each year by collecting 60 individuals of the target species or a closely related surrogate species (Longfin Dace, Speckled Dace) from each donor stream. Fish will typically be collected by seining or electrofishing. If parasites or pathogens of concern are not detected during the fish health assessment process, collections of target fish can proceed. Fish are collected from donor populations by seining or electrofishing and transported to ARCC in aerated coolers filled with water treated with salt and Amquel to minimize fish stress during transport. Other species (Gila Topminnow, Roundtail Chub, and Desert Pupfish) may be brought on station as needed.

Aquatic Research and Conservation Center

Propagation techniques and study designs can be found in the draft hatchery operation manual developed by ARCC staff.

Program Priorities

The project helps protect remnant populations of Spikedace and Loach Minnow by maintaining captive refuge populations of each remnant lineage. The project helps to replicate remnant populations of Spikedace and Loach Minnow in the wild by bringing fish to a hatchery setting for propagation, and producing offspring for translocation to wild sites. This project further helps replicate populations by allowing for the development of propagation techniques and other research to improve reintroduction success. This project helps to stabilize existing wild populations by stocking offspring produced at ARCC into existing wild populations. This project has immediate on the ground benefits by providing source populations for future translocations of Spikedace and Loach Minnow.

Partnerships

This is part of a larger collaborative effort to secure remnant populations and establish new populations of Spikedace and Loach Minnow. Partners include USFWS, NMDGF, BLM, and U.S. Bureau of Reclamation (Reclamation). The NMDGF collects Spikedace and Loach Minnow from the remnant populations in New Mexico and transfers them to ARCC. This is a continuing project that has been funded by GRBNFCP since its inception in 2003. Continuous funding for this project is required to maintain the refuge populations, broodstock, and offspring for research and future translocations. This project builds upon GRBNFCP work by continuing to maintain previously collected broodstocks in a facility funded by the program.

Strategic Plan Goals:

- Scientific Foundation
 - Goal 3a. At a minimum, identify and implement at least one research project aimed at improving propagation.
 - Goal 5a. At a minimum, document existing stocking strategies, identify locations with poor survival, and identify likely causes of poor survival.

- Preventing Extinction and Managing Toward Recovery
 - Goal 2b. Develop a broodstock management plans for captive populations.
 - Goal 2c. Augment hatchery populations as outlined in broodstock management plans.
 - Goal 2e. Ensure the Aquatic Research and Conservation Center (ARCC) has the staff support and supplies necessary to improve propagation of Spikedace and Loach Minnow by 25% from the previous 5 years provided wild fish are available.
 - Goal 2f. Develop a hatchery management plan for ARCC.

Recovery goals:

- Spikedace and Loach Minnow recovery plans (1991); note these are two separate plans
 - Task 8.1 (priority 3): Select stocks to be used for hatchery brood stock
 - Task 8.2 (priority 3): Collect hatchery stocks
 - Task 8.3 (priority 3) Hold and maintain stocks in a hatchery
 - Task 8.4-8.5 (priority 3) Evaluate and assess propagation techniques and life-cycle requirements
- Gila Topminnow recovery plan (1999 draft)
 - Task 1.1 (priority 1) Maintain refugia populations of natural populations
- Gila Chub draft Recovery plan (2014)
 - Task 4 (priority 2) Establish and maintain refuge populations in protected ponds or hatcheries as appropriate

Estimated Time and Cost:

- Cost: Total = \$123,245
 - *Acquisition of spikedace and loach minnow and other rare species from the wild: \$10,800.*
 - *Aquatic Research and Conservation Center: \$112,445.*
- Urgency: This project is urgent because propagation of the remaining Spikedace and Loach Minnow lineages is of high importance for several planned restoration projects funded by this program. This project is also urgent because wild fish are typically needed each year to maintain broodstocks.
- Readiness: All compliance necessary to implement this project has been completed. Annual fish health assessments need to be completed for each donor location, and for ARCC.
- Matching Funds: This project does not have matching or in-kind funds.

Project 16: ASU Topminnow Holding

(Task ID: HA-1998-1)

Implementing Entity: Arizona State University

Start Year: 1998

Location(s): Arizona State University, Tempe, Arizona

Species Protected: Gila Topminnow, Yaqui Topminnow

Project Description:

Gila Topminnow and Yaqui Topminnow are two federally-listed endangered fish species that are native to Arizona. Several stocks of these species have been held in protective custody by Arizona State University (ASU) since the early 1990s. These stocks are maintained for the primary purpose of providing a genetics refugium against catastrophic loss of wild stocks in nature.

There are currently six stocks of Gila Topminnow (Bylas Springs, Cienega Creek, Monkey Spring, Parker Canyon, Red Rock Canyon, Sharp Spring) and one stock of Yaqui Topminnow (North Pond and Tule Spring from San Bernardino National Wildlife Refuge [SBNWR], combined) housed in raceways within the Department of Animal Care and Technologies (DACT) on the ASU Tempe campus. DACT staff provide routine maintenance and care of these animals and augment each existing stock with wild-caught individuals, as available, at least every other year.

The following are the most recent augmentations from wild populations: Bylas Springs (July 12 and August 24, 2017); Cienega Creek (May 30, 2018), Monkey Spring (June 4, 2018), and SBNWR (September 13, 2018). The scheduled Bylas augmentation timeframe of spring-summer 2019 was not met, but fish will be acquired when made available by the Tribe. Cienega Creek and Monkey Spring are scheduled for summer 2020 and SBNWR for autumn 2020.

Program Priorities

This project will help to maintain genetically viable refuge populations of Gila Topminnow, a priority species identified in the biological opinions, and provides a refugium against catastrophic loss of wild Gila Topminnow in the wild.

Partnerships

This project is in partnership with the U.S. Fish and Wildlife Service and Arizona Game and Fish Department. This project is part of a larger collaborative effort to maintain and provide a genetics refugium against catastrophic loss of wild Gila Topminnow and Yaqui Topminnow stocks in nature. This project is a continuation of GRBNFCP work that has been funded since 1998.

Strategic Plan Goals:

- Preventing Extinction and Managing Toward Recovery.
 - Goal 2b. Ensure ASU has the staff support and supplies necessary to maintain genetically viable refuge populations of Gila Topminnow.

Recovery goals:

- Gila Topminnow draft revised recovery plan (1999)

- Task 1.1 (priority 1) Maintain refugia populations of natural populations
- Task 2.2 (priority 1) Reestablish into suitable habitats
- Task 4.1 (priority 2) Facilitate genetic exchange among reestablished populations as needed
- Task 4.2 (priority 2) Conduct additional genetic studies of POOC populations

Estimated Time and Cost:

- Cost: The estimated cost (including direct and indirect costs) of this project for FY2021 is \$26,232.00.
- Urgency: This project is urgent as funding is required to maintain the existing stocks of Gila Topminnow and Yaqui Topminnow at ASU.
- Readiness: All compliance necessary to implement this project has been completed.
- Matching Funds: This project does not have matching or in-kind funds.

Project Ranking

The ranking table below does not constitute a final decision on project selection. The evaluation form used to develop the ranking table is part of the process (but not the only element) that the Committees use to help evaluate project merits and recommendations to approve or reject.

Table 1. Results of project prioritization scoring. Projects were scored using the Program scoring form by each technical and affiliate committee member. The projects below the red line (also shaded) exceed the \$550,000 threshold committed by Reclamation.

Project #	Project Title	Mean Rank	Mean Score	Project Cost	Sub Total
15	ARCC O&M	1	40.3	\$ 123,245	\$ 123,245
14	Nonnative Removal from Bonita and Aravaipa	2	40.7	\$ 34,733	\$ 157,978
2	NM T&E Repatriations	3	39.4	\$ 67,745	\$ 225,723
5	Muleshoe ecosystem	4	38.7	\$ 28,100	\$ 253,823
8	Blue River Native Fish Restoration	5	38.2	\$ 40,600	\$ 294,423
10	Eagle Creek Repatriations	6	37.3	\$ 33,800	\$ 328,223
9	Harden Cienega Native Fish Restoration	7	36.7	\$ 41,900	\$ 370,123
7	Spring Creek (oak) Repatriations	7	36.2	\$ 6,800	\$ 376,923
12	Upper Verde River Native Fish Restoration	9	36.5	\$ 54,200	\$ 431,123
6	Gila Topminnow stockings	10	35.3	\$ 45,200	\$ 476,323
1	Removal of Nonnative Fishes from W. Fork Gila River	11	35.8	\$ 46,001	\$ 522,324
16	ASU Topminnow Holding	12	34.3	\$ 26,232	\$ 548,556
13	West Fork Black River Nonnative Fish Removal	12	34.0	\$ 33,800	\$ 582,256
11	Red Tank Draw Native Fish Restoration	14	35.2	\$ 36,300	\$ 618,656
3	Remote site inventory	15	34.2	\$ 62,978	\$ 681,634
4	Gila Permanent Site Monitoring	16	32.0	\$ 41,643	\$ 723,277

FY19-FY21 Budget

2019							
Task ID	Start Year	Task Name					Total
New Mexico Recovery Actions			NMGF	FWS	USFS	BLM	
NM-2006-1	2006	West Fork Gila River Mechanical Removal	\$16,400	\$7,955	\$11,400		\$35,755
NM-2002-1	2002	T&E Fish Repatriations and Monitoring	\$20,900	\$10,885	\$15,900		\$47,685
NM-2017-1	2017	Remote Site Inventory and Assessment (Previously Middle Fork Gila Inventory & Assessment)	\$18,800	\$20,354	\$19,700		\$58,854
NM-2014-1	2014	Survey on BLM Lands				\$15,000	\$15,000
Arizona Recovery Actions			AZGFD	FWS	BLM		
AZ-2003-2	2003	Acquisition of Spikedace, Loach Minnow, and rare populations of other native fish	\$12,900				\$12,900
AZ-2003-1	2003	Muleshoe ecosystem stream and spring repatriations	\$21,900				\$21,900
AZ-2006-1	2006	Fresno Canyon repatriations	\$32,200				\$32,200
AZ-2002-1	2002	Gila Topminnow Stockings	\$55,400				\$55,400
AZ-2013-1	2013	Spring Creek (Oak) repatriations	\$12,900				\$12,900
AZ-2002-3	2002	Blue River native fish restoration	\$38,600				\$38,600
AZ-2004-1	2004	Miscellaneous stock tank surveys	\$55,200				\$55,200
AZ-2008-1	2008	Assessment of Potential Repatriation Waters	\$21,900				\$21,900
AZ-2014-1	2014	Expand Roundtail Chub populations in Harden Cienega Creek	\$12,900				\$12,900
AZ-2018-1	2018	Eagle Creek Repatriation	\$12,900				\$12,900
AZ-2016-2	2016	Red Tank Draw removals	\$32,200				\$32,200
AZ-2016-3	2016	Sharp Spring native fish restoration	\$12,900				\$12,900
AZ-2000-1	2016	Boyce Thompson Ayer Lake native fish restoration	\$6,400				\$6,400
AZ-2019-1	2019	Sweetwater Dam Pond Restoration	\$6,400				\$6,400
AZ-2009-1	2009	Nonnative fish removal from Bonita and Aravaipa Creeks			\$0		\$0
AZ-2019-2	2019	Eagle Creek Spikedace and Loach Minnow eDNA Survey		\$27,000			\$27,000
Hatchery Actions			AZGFD	ASU			
HA-2006-2	2006	ARCC O&M	\$109,000				\$109,400

HA-1998-1	1998	Topminnow Stock Maintenance		\$16,800			\$16,800
Total		Recovery and Nonnative Control Total					\$645,194
		2020					
Task ID	Start Year	Task Name					Total
		New Mexico Recovery Actions	NMGF	FWS	USFS	BLM	
NM-2006-1	2006	West Fork Gila River Mechanical Removal	\$16,400	\$10,300	\$11,400		\$38,100
NM-2002-1	2002	T&E Fish Repatriations and Monitoring	\$20,900	\$17,400	\$15,900		\$54,200
NM-2017-1	2017	Remote Site Inventory and Assessment (Previously Middle Fork Gila Inventory & Assessment)	\$18,800	\$16,700	\$19,700		\$55,200
NM-2020-1	2020	Gila Permanent Site Monitoring	\$8,136	\$2,910	\$4,124	\$6,850	\$22,020
		Arizona Recovery Actions	AZGFD	FWS	BLM		
AZ-2003-2	2003	Acquisition of Spikedace, Loach Minnow, and rare populations of other native fish	\$13,300				\$13,300
AZ-2003-1	2003	Muleshoe ecosystem stream and spring repatriations	\$26,500				\$26,500
AZ-2020-1	2020	Sweetwater Dam Pond Removals	\$45,100				\$45,100
AZ-2002-1	2002	Gila Topminnow Stockings	\$59,700				\$59,700
AZ-2013-1	2013	Spring Creek (Oak) repatriations	\$8,000				\$8,000
AZ-2002-3	2002	Blue River native fish restoration	\$35,800				\$35,800
AZ-2008-1	2008	Assessment of Potential Repatriation Waters	\$8,000				\$8,000
AZ-2014-1	2014	Expand Roundtail Chub populations in Harden Cienega Creek	\$55,700				\$55,700
AZ-2018-1	2018	Eagle Creek Repatriation	\$13,300				\$13,300
AZ-2016-2	2016	Red Tank Draw removals	\$33,200				\$33,200
AZ-2016-3	2016	Sharp Spring native fish restoration	\$13,300				\$13,300
AZ-2000-1	2016	Boyce Thompson Ayer Lake native fish restoration	\$13,300				\$13,300
AZ-2020-2	2020	Upper Verde River native fish restoration	\$6,600				\$6,600
AZ-2009-1	2009	Nonnative fish removal from Bonita and Aravaipa Creeks			\$25,000		\$25,000
		Hatchery Actions	AZGFD	ASU			
HA-2006-2	2006	ARCC O&M	\$112,400				\$112,400

HA-1998-1	1998	Topminnow Stock Maintenance		\$20,800			\$20,800
Total		Recovery and Nonnative Control Total					\$659,520
		2021					
Task ID	Start Year	Task Name					Total
		New Mexico Recovery Actions	NMGF	FWS	USFS	BLM	
NM-2006-1	2006	West Fork Gila River Mechanical Removal	\$24,301	\$10,300	\$11,400		\$46,001
NM-2002-1	2002	T&E Fish Repatriations and Monitoring	\$34,445	\$17,400	\$15,900		\$67,745
NM-2017-1	2017	Remote Site Inventory and Assessment (Previously Middle Fork Gila Inventory & Assessment)	\$26,578	\$16,700	\$19,700		\$62,978
NM-2020-1	2020	Gila Permanent Site Monitoring	\$24,759	\$2,910	\$4,124	\$9,850	\$41,643
		Arizona Recovery Actions	AZGFD	FWS	BLM		
AZ-2003-1	2003	Muleshoe ecosystem stream and spring repatriations	\$28,100				\$28,100
AZ-2002-1	2002	Gila Topminnow Stockings	\$45,200				\$45,200
AZ-2013-1	2013	Spring Creek (Oak) repatriations	\$6,800				\$6,800
AZ-2002-3	2002	Blue River native fish restoration	\$40,600				\$40,600
AZ-2014-1	2014	Expand Roundtail Chub populations in Harden Cienega Creek	\$41,900				\$41,900
AZ-2018-1	2018	Eagle Creek Repatriation	\$33,800				\$33,800
AZ-2016-2	2016	Red Tank Draw removals	\$36,300				\$36,300
AZ-2020-2	2020	Upper Verde River native fish restoration	\$54,200				\$54,200
AZ-2021-1	2021	West Fork Black River Nonnative Fish Removals	\$33,800				\$33,800
AZ-2009-1	2009	Nonnative fish removal from Bonita and Aravaipa Creeks			\$34,733		\$34,733
		Hatchery Actions	AZGFD	ASU			
HA-2006-2	2006	ARCC O&M	\$123,245				\$123,245
HA-1998-1	1998	Topminnow Stock Maintenance		\$26,232			\$26,232
Total		Recovery and Nonnative Control Total					\$723,277