2023

Gila River Basin Native Fish Conservation Program Budget and Work Plan

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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, Longfin Dace, Sonora Sucker, Speckled Dace

Project Description:

Background – The West Fork Gila River supports an intact native fish assemblage, including Federally Endangered, Gila River Basin Native Fishes Conservation Program (GRBNFCP) priority species Loach Minnow and Spikedace. Nonnative fishes are the primary threat to native fishes in the West Fork Gila River. Brown Trout, Rainbow Trout, Smallmouth Bass, and Yellow Bullhead are the most problematic nonnatives in the area. Since 2006, GRBNFCP has provided funding to the Department, USFS, and USFWS to remove nonnative fishes from an approximately 4 km reach of the West Fork Gila River. Although this reach of the West Fork Gila River is not protected from reinvasion by nonnatives, it is a stronghold for Spikedace, Loach Minnow, and Roundtail Chub. The objective of this project is to suppress nonnative fishes to a sustainable level for native fishes. An evaluation of these efforts indicated that biomass of some nonnatives decreased and biomass of Spikedace increased from 2007 to 2012 (Propst et al. 2014). 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 after the fire, but have since increased in abundance. The Department is currently analyzing all data collected since 2007 and will use the results of this analysis to determine the effect of removals on native fish populations and to develop benchmarks for removal in future years. The analysis is anticipated to be completed in 2022, with any benchmarks developed for nonnative removal implemented the following year.

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 but it is part of one of New Mexico's largest interconnected populations of both species. The project takes place on the Department-owned Heart Bar Wildlife Management Area.

Methodologies –Nonnative removal efforts will occur at least once per year, most likely in early June. Sampling will be conducted using two backpack electrofishers and seines depending on the mesohabitat sampled. All mesohabitats within the project area are sampled. All fish collected will be identified and enumerated by mesohabitat and all nonnatives are removed. The first 50 fish of each native species captured on each day of sampling will be measured for total length (TL) and weighed if over 99 mm TL. Total length will then be measured for all other Catostomids, Loach Minnow, Roundtail Chub, and

Spikedace captured each day. Total length will be measured on all nonnative species and weighed if over 99 mm TL. Because multiple capture techniques are used, each mesohabitat is measured for area in order to calculate abundance estimates. 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. A single pass usually takes 5 days, dependent on the number of fish captured. If a single pass is completed in 3 days and nonnative fishes were present, a second pass will be completed. In any additional removal efforts, TL and weight measurements will only be collected from nonnative fishes.

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: $44,709
    - New Mexico Department of Game and Fish: $25,354
    - USFWS: $7,955
    - 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: Harden Cienega tanks, Saliz Canyon
- Upper Gila River Drainage: Bear Creek, Sapillo Creek
- Other locations as needed for evaluation

Species Protected: Loach Minnow, Spikedace, Gila Chub

Project Description:

Background – The objective of this project is to identify potential repatriation streams and sites, evaluate potential donor populations, conduct repatriation of identified streams, and monitor streams post-repatriation. This project also covers fish salvages and collections for transfer to Arizona Department of Game and Fish (AZDGF) Aquatic Research and Conservation Center (ARCC) for broodstock and refuge population maintenance. This is an ongoing project that needs to be continued across the Gila Basin until species are recovered.

Geographical Area – This project covers the entire Gila River Basin in New Mexico, and all existing and potential future populations of the priority species in New Mexico. The project area is on federal, state, local government, and private lands. Repatriation locations will likely be those that are free of and secure from ingress of nonnative fishes, or have low levels of nonnative fishes. Specific locations to be assessed or stocked in 2023 are listed below. Other waterbodies that could be potentially investigated in 2023 will be determined after 2022 work is completed.

Bear Creek*:* Loach Minnow were salvaged from Bear Creek in 2020 and transferred to ARCC after the Tadpole Fire. Remaining salvaged fish will be restocked into Bear Creek in 2022 or 2023. The population should be resurveyed at least one-year post-repatriation.

Harden Cienega Creek*:* Green Sunfish were detected in Harden Cienega Creek by AZDGF in 2017. The Department and AZDGF surveyed several tanks in the headwaters of the drainage for Green Sunfish in 2021. Several tanks are located on private property and were not surveyed during that initial visit. The Department plans to survey any remaining tanks in 2022 and 2023 to develop a plan to remove Green Sunfish from any tanks where they are found. Removals are tentatively scheduled for 2024. These surveys are directly related to Harden Cienega Creek Native Fish Restoration (AZ-2014-1) and will be conducted in coordination with AZDGF.

Saliz Canyon*:* Saliz Canyon was stocked with Loach Minnow in 2016, 2017, and 2019. Subsequent surveys indicated that the species is present in the stream, but has yet to expand from the original stocking location near Cottonwood Campground. In 2023, additional stocking locations will be

investigated with stocking at any identified suitable location occurring in autumn 2023 or 2024 with fish from ARCC.

Sapillo Creek*:* In 2021, lower Sapillo Creek was investigated and identified as a potential repatriation site. Nonnatives were absent at most sites surveyed and habitat seemed suitable for both Loach Minnow and Spikedace. Sapillo Creek will be stocked for three years with both Loach Minnow and Spikedace beginning in 2023 with fish from ARCC.

Methodologies –
Potential repatriation sites: Potential repatriation sites are determined by maps, aerial photographs, and professional opinions of people familiar with the area. Once determined, locations will be visually evaluated for habitat and water quality parameters will be measured. Surveys of the current fish community will be conducted by a single pass using backpack electrofishers and seines. The particular method used to obtain specimens depends upon mesohabitat being sampled. Broad shallow runs, and similar mesohabitats with smooth substrates, are sampled with drag seines (normally 3.0 x 1.2 m, 3.2 mm mesh). A battery-powered backpack electrofisher is used to stun fishes in cobble-bottomed runs, debris pools, and similar mesohabitats, and specimens are then collected with dip nets. A seine and backpack electrofisher are used in tandem to collect fishes from rapid-velocity habitats (e.g., riffles and chutes). Waterbodies to be investigated in 2023 will to be determined after the 2022 field season is complete.

Stocking: Multiple stockings into each repatriation stream will be performed successively for 3 to 5 years or until the desired population is established or is considered unsustainable. Repatriation stockings can be direct transfers of fish from a wild population or stocking from ARCC.

Monitoring: Annual surveys will begin after the last year of stocking. Fish surveys will be conducted by a single pass using backpack electrofishers and seines. The particular method used to obtain specimens depends upon the type of mesohabitat being sampled. Broad shallow runs, and similar mesohabitats with smooth substrates, are sampled with drag seines (normally 3.0 x 1.2 m, 3.2 mm mesh). A battery-powered backpack electrofisher is used to stun fishes in cobble-bottomed runs, debris pools, and similar mesohabitats, and specimens are then collected with dip nets. A seine and backpack electrofisher are used in tandem to collect fishes from rapid-velocity habitats (e.g., riffles and chutes). A population is considered established when recruitment is documented, there are increases in abundance, expansion of distribution, or some combination of those factors. Once established, the population will be surveyed at least once every five years using the same methods as above.

Program Priorities
This project increases the resiliency and redundancy of priority species by replicating populations of Spikedace, Loach Minnow, and Gila Chub 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. The project is part of a larger action to establish and maintain refuge populations at ARCC, and to replicate the priority species in wild locations across their historic ranges.

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: $62,921

- New Mexico Department of Game and Fish: $36,136
- USFWS: $10,885
- 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, Gila 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): San Francisco River
Species Protected: Loach Minnow, Spikedace, Roundtail Chub, Gila Trout, Desert Sucker, Longfin Dace, Speckled Dace, Sonora Sucker

Project Description:

Background – Much of the Gila River Basin in New Mexico is extremely remote and thus difficult to sample. The distribution of the priority and nonnative species in the remote sections of the Gila River and its forks were last surveyed in the mid-2000s and Department records indicate that the remote lower canyons of the San Francisco River have never been surveyed. The system is dynamic and there have been significant changes in the basin in recent years. Remote surveys in the middle and east forks of the Gila River have been completed with funding from GRBNFCP. The lower Middle Fork Gila River was surveyed in the summer 2017 and the upper reaches were surveyed in the summer 2018. The East Fork Gila River and tributaries, excluding Black Canyon Creek were surveyed in 2019. Black Canyon Creek was surveyed in 2020 and the lower West Fork Gila River was surveyed in 2021 and the upper West Fork Gila is scheduled to be surveyed in 2022. 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.

In 2023, we propose to inventory remote reaches of the lower San Francisco River. The San Francisco River has rarely been sampled below the Glenwood permanent site and an inventory needs to be conducted to assess distribution of priority and nonnative species. Sites surveyed by the Department near Big Dry Creek in 2017 detected no priority species; however, nearby sites surveyed by Marsh and Associates in 2020 detected Loach Minnow, Roundtail Chub, and Spikedace. In addition, the Department has documented downstream expansion of Spikedace from the stocking location (Ferguson and Zeigler 2020) and Smallmouth Bass were collected at the San Francisco River permanent site, near Glenwood, for the first time in 2020. Aside from the reach near Big Dry Creek, there is no recent sampling records between Glenwood and the Arizona border (approximately 20 miles).

Geographical Area –This project will take place in the lower San Francisco River within the Gila National Forest. Sampling will occur from below Pleasanton, NM downstream to approximately the Arizona/New Mexico border. There is an expanding population of Loach Minnow, a newly repatriated population of Spikedace, and Roundtail Chub were recently documented in the San Francisco River. This project will provide further information on the status and distribution of these populations as well as nonnative species in the river. The San Francisco River has several diversions that may prohibit fish movement at times.

Methodologies –Sampling will take place in May or June. Representative 100 m sites will be established in difficult to access remote areas within the San Francisco River and all perennial tributaries that have not been surveyed recently. Single pass sampling will be conducted using backpack electrofishers and seines. The particular method used to obtain specimens depends upon mesohabitat being sampled. Broad shallow runs, and similar mesohabitats with smooth substrates, are sampled with drag seines (normally 3.0 x 1.2 m, 3.2 mm mesh). A battery-powered backpack electrofisher is used to stun fishes in cobble-bottomed runs, debris pools, and similar mesohabitats, and specimens are then collected with dip nets. A seine and backpack electrofisher are used in tandem to collect fishes from rapid-velocity habitats (e.g., riffles and chutes). 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 nonnative fishes are present and their distribution, describe the current status and distribution of native fishes, and identify potential repatriation sites (within perennial tributaries). The remote nature of sampling will require pack stock for most sampling. It is possible the San Francisco River system cannot be completed in one year due to logistical constraints. In this case we will request funding to complete any remaining sampling in 2024.

Program Priorities

This project assesses population status of Loach Minnow, Spikedace, and Gila Chub in the San Francisco River. This project may lead to the identification of new repatriation sites which could provide areas for Loach Minnow, Spikedace or Gila 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, East Fork Gila River, and West Fork Gila River, as well as perennial tributaries. This project updates the current distribution of Loach Minnow,Spikedace, and Gila Chub within their historic range which is vital information for any species status assessment or recovery criteria.

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: $66,911
  - New Mexico Department of Game and Fish: $26,857
  - USFWS: $20,354
  - USFS: $19,700
- Urgency: The remote portions of the lower San Francisco River have never been surveyed and given the expanding native fish population in the regularly surveyed portions of the river, it is important to inventory the rest of the river to document the status and distribution of both priority and nonnative species. In addition, Smallmouth Bass have been captured at the San Francisco River permanent site for the first time in 2020. The proposed survey could provide valuable information regarding the source of these fish.
- Readiness: This project is ready to implement.
- *Does this project have in-kind or matching funds?* No

Arizona Work Plan

Project 4: 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
Species Protected:

- Gila Topminnow: one of nine wild replicated populations of the Bylas management unit (MU).
- Gila Chub[1]: one remnant population not replicated elsewhere.
- Other native species: one population each of Speckled Dace, Longfin Dace, Desert Sucker, Sonora Sucker.

Project Description:

Redfield Canyon

Background: This is an ongoing project with GRBNFCP-funded conservation efforts beginning in 2007. The objectives of this project were to establish Spikedace and Loach Minnow in Redfield Canyon and to suppress Green Sunfish to benefit the native fish community. The first objective is completed and the second is ongoing. Spikedace and Loach Minnow were stocked into Redfield Canyon in 2007, 2008 and 2010, but failed to establish. In 2007, Gila Chub, Sonora Sucker, and Speckled Dace were translocated upstream of a waterfall in Redfield Canyon to expand their range. Gila Topminnow (Bylas lineage and MU) have dispersed downstream from Swamp Springs Canyon (where they were stocked in 2008 and 2009), and have become established in Redfield Canyon.

One Green Sunfish removal occurred each year since 2007, with two removals occurring in 2010, 2012, 2020 and 2021. The Nature Conservancy led removals from 2008-2012. These removals focused on the upper perennial reach that extends upstream from about 1 km below Swamp Springs Canyon (referred to as reaches 1 and 2). In 2012, Green Sunfish were discovered in large pools on BLM land near the western wilderness boundary with private land, in what was referred to as the lower perennial reach or reach 3. Beginning in 2014, one removal, in May or June, was completed in each reach. Green Sunfish captures in reaches 1 and 2 fluctuated from year to year, but generally declined from 2010 through 2021 (58, 33, 12, 48, 17, 0, 2, 1, 15, 20, 4 and 0 captured in each respective year; Hickerson et al. 2021). Green Sunfish do not appear to be established in reaches 1 and 2, and it is unlikely that the Green Sunfish are sufficiently abundant to negatively influence native fish abundance in the upper reach. Green Sunfish may be able to disperse upstream from reach 3 to reaches 1 and 2 during periods of sufficient flow.

Permission to access and conduct removals on the private land in reach 3 has not been granted. The

[1] In 2016, the American Fisheries Society and the American Society of Ichthyologists and Herpetologists reclassified and merged Roundtail Chub *Gila robusta*, Gila Chub *Gila intermedia*, and Headwater Chub *Gila nigra* into one species, the Roundtail Chub.

Green Sunfish population in reach 3 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 was contacted multiple times in 2019 and 2020 and provided a short outline of proposed green sunfish removal work in an attempt to gain access to their property. After initial phone conversations with the landowner, they have not replied to any further phone messages or emails as of the end of 2021.

If the private landowner continues to deny access to their property for removals, the objective of the project will remain suppression of Green Sunfish in reaches 1 and 2 (see methodologies section for targets). Work planned for FY2023 includes a removal trip with multiple passes in May or June. Removals will continue for as long as suppression is considered a priority. If the private landowner grants permission for removals on their property, we will request a modification to this work plan and the goal will shift to eradication and the area of removals and number of removal trips will be increased to attempt eradication. Removals will continue until Green Sunfish are considered eradicated (see methodologies).

Geographical Area: The project area for Redfield Canyon currently includes Redfield Canyon from the upper waterfall barrier (UTM 12S 563858/3589841) downstream to the wilderness boundary (559591/3589178). The project area is occupied by Gila Chub, 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 km 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 been contacted multiple times but has not yet allowed access.

Methodologies: If the private landowner does not grant access to their property to conduct removals, the objective in Redfield Canyon will be suppression of Green Sunfish in reaches 1 and 2. Typically, a single pass of backpack electrofishing with a three-person crew is carried out each May or June through all surface water present in reaches 1 and 2. Removals occur in late May through 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. There are pools too deep to capture sunfish with backpack electrofishing equipment in reach 3, so baited mini-hoop nets and angling are used together. Ten to 15 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. For a given trip, a minimum of three passes will be

completed or until fewer than 100 Green Sunfish are captured in the final pass. All Green Sunfish captured will be removed and measured to the nearest millimeter in total length (mm TL). Native fish will be counted and returned alive to the stream. 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 annual suppression effort in reaches 1 and 2 will be characterized by the absence of Green Sunfish after all removal passes are completed and the absence of juvenile Green Sunfish in any of the passes. A successful annual suppression effort in reach 3 will be characterized by 100 or fewer Green Sunfish on the final pass.

If the private landowner grants permission for removals on their property, we will request that the work plan be amended, and 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 three passes will be completed in 2023 if permission is granted to access private property. Ideally, removals will be completed during spring to early summer before Green Sunfish are able to spawn. After the first removal pass where no Green Sunfish are captured, a pass of eDNA samples will be collected every 500 m to determine whether any sunfish are still present and pinpoint the distribution of any remaining sunfish from positive samples. Removals will continue until a full removal pass without Green Sunfish is followed by a full eDNA pass without Green Sunfish detections. Results, analysis, discussion of results, and recommendations for future work will be presented in the annual report.

Program Priorities

This project stabilizes an existing wild replicate population of Gila Topminnow and a remnant population of Gila Chub in Redfield Canyon through mechanical removal of nonnative Green Sunfish. Existing populations of Speckled Dace, Longfin Dace, Sonora Sucker and Desert Sucker in Redfield Canyon may also benefit from Green Sunfish removals (Marks 2009, Coggins and Yard 2010, Propst et al 2014). This project 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 native fishes.

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, including past nonnative fish removals in Redfield Canyon, and the establishment efforts for Spikedace, Loach Minnow, and Gila Topminnow in Redfield Canyon. The nonnative removals in Redfield Canyon have been ongoing since 2007 and are necessary to prevent reestablishment of Green Sunfish in the reaches 1 and 2, given that the construction of a barrier has been indefinitely postponed.

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.
- Gila Chub draft Recovery plan (2015)
  - 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 FY2023 is $15,000.
- Urgency: This project is moderately urgent. A lapse in Green Sunfish removals may allow Green Sunfish to recolonize and increase in abundance within reaches 1 and 2 of Redfield Canyon. However, Green Sunfish have been present since the 1990's (BLM 1998). Green Sunfish were not detected in 1989 (Griffith and Tiersch 1989), so presumably, at some point after that they invaded Redfield Canyon.
- 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.

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Project 5: Gila Topminnow Stockings

(Task ID: AZ-2002-1)

Implementing Entity: Arizona Game and Fish Department
Start Year: 2002
Location(s): Edgar Canyon, Aravaipa Canyon, Sabino Canyon, , Telegraph Canyon, Maternity Wildlife Pond, Rarick Canyon, Unnamed Drainage 68B, and locations stocked in 2022 or proposed to be stocked in 2023, which may include (but is not necessarily limited to): Buehman Canyon, Dix Creek, Mule Spring, Mescal Creek, Sands Draw, San Pedro River at Three Links, and Boyce Thompson Arboretum.

Species Protected:

- Gila Topminnow
    - Five existing replicate populations: two replicates of Lower Santa Cruz MU, two replicates of Cienega Creek MU, one replicate of Monkey and Cottonwood Spring MU.
    - Three new populations: one new replicate of Bylas MU, one new replicate of Lower Santa Cruz MU, one new replicate of Lower Santa Cruz MU.
    - Eight proposed populations (various MU's).
- Gila Chub [2]
    - One remnant population in Sabino Canyon
    - One replicate population in Rarick Canyon of Red Tank Draw.

Project Description:
The objective of this project is to establish new viable populations of Gila Topminnow within historic range; Desert Pupfish and Gila Chub are stocked into some of the same sites if habitat is deemed suitable. Methodologies are generally consistent across subprojects and are only described once for the overall project. Fish will be collected from potential donor locations for health assessments before stockings take place.

Edgar Canyon
Background: Edgar Canyon is an ongoing subproject. Gila Topminnow (Redrock Canyon lineage of Lower Santa Cruz MU) were first stocked in 2019 in an attempt to establish a population. Results of post-stocking monitoring in 2019 and 2020 indicated the population was reproducing and increasing in abundance. The Bighorn Fire burned a portion of the upper watershed of Edgar Canyon in 2020 and post-fire flooding occurred in 2021. Topminnow were not captured or observed during annual monitoring in 2021, but topminnow should be stocked in 2022 or 2023 if habitat conditions return to pre-fire conditions. If habitat had sufficiently recovered from post-fire impacts, work planned for FY2023 includes annual monitoring, and augmentation to establish a viable population as necessary. Post-stocking annual monitoring will continue for three years after the final stocking. Evaluation of stream habitat will occur in 2022 to determine if stream habitat in Edgar Canyon has sufficiently recovered to

[2] In 2016, the American Fisheries Society and the American Society of Ichthyologists and Herpetologists reclassified and merged Roundtail Chub *Gila robusta*, Gila Chub *Gila intermedia*, and Headwater Chub *Gila nigra* into one species, the Roundtail Chub.

warrant additional translocations of topminnow, if habitat has not sufficiently recovered, this subproject will be put on hold and no work will occur in 2023.

Geographical Area: Edgar Canyon is a tributary of the San Pedro River and originates 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 five km upstream from the confluence with the San Pedro River. This perennial reach is about 350 meters in length. Edgar Canyon is ephemeral for approximately five 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 before the stocking of Gila Topminnow in 2019. Pima County recommended the site for Gila Topminnow establishment, and continues to be supportive.

Aravaipa Creek

Background: The Department is planning to stock Gila Topminnow into Aravaipa Creek in April 2022. The Department coordinated with USFWS to determine the appropriate donor location and lineage to use. Any MU lineage can be stocked into the San Pedro drainage, however Bylas lineage fish were chosen because previous efforts in Aravaipa Creek utilized this lineage. Work planned for FY2023 includes post-stocking annual monitoring and augmentation if necessary. Monitoring will involve setting at least ten minnow traps in sufficiently deep habitat within the vicinity (~100-200 m) of the initial stocking location. Trapping effort will be supplemented with opportunistic seine hauls in the same vicinity, and potentially up to 500 m downstream. The stocking location is approximately 1.5 km upstream from the most upstream permanent monitoring site. Data from seine hauls at permanent monitoring sites will provide additional information about the persistence and dispersal of Gila Topminnow in the system. Monitoring will continue for three years after the final stocking. The subproject will be complete by 2025 if additional stockings do not occur.

Geographical Area: Aravaipa Creek is a tributary to the San Pedro River about 17 km south of the confluence of the Gila and San Pedro Rivers. It drains the east and north end of the Galuiro Mountains, the southwest portion of the Pinalenos, and the southern portion of the Santa Teresa Mountains. The creek becomes perennial at Aravaipa Spring near Stowe Gulch and flows west to the San Pedro River approximately 35 km. There are two constructed fish barriers (Reclamation funded) at the west end of the creek that prevent upstream movement of nonnative fishes. However, nonnative Green Sunfish, Yellow Bullhead, and Red Shiner were present in the creek before the barriers were constructed. Ongoing nonnative removals led by BLM have largely eliminated Green Sunfish, but Yellow Bullhead were still common as of April 2021. Topminnow are currently not present in the stream, although there was an attempt to establish populations in 1969 and 1977 (Weedman 1999). If the topminnow population establishes in Aravaipa Creek, it would represent one of the longer occupied reaches upstream of a fish barrier and would have substantial conservation value.

Landownership is a combination of private, federal, and tribal lands. The two primary landowners for the perennial portion of the stream are BLM and TNC, both of which are supportive of the subproject, and the latter initially recommended pursuing this subproject. All necessary compliance and coordination for stocking on TNC property has been completed. Department and TNC staff contacted

private landowners throughout the canyon, and only received supportive responses to the subproject proposal.

Sabino Canyon

Background: Sabino Canyon is an ongoing subproject. The first part of the subproject resulted in the establishment of a population of Gila Topminnow (Cienega Creek lineage, Cienega Creek MU) mostly downstream of Sabino Dam. In 2017 and 2018, pools in Sabino Canyon upstream of the confluence with East Fork Sabino Canyon were assessed and determined to be suitable for Gila Topminnow and Gila Chub. In 2018, Gila Topminnow were translocated from the pools below Sabino Dam to a pool near the confluence with East Fork Sabino Canyon. Topminnow were not detected during monitoring in 2019, and Gila Chub were translocated to a pool just downstream of the topminnow stocking location. In October 2019, the Gila Topminnow population was augmented. Monitoring in May, 2020 failed to detect Gila Topminnow near the stocking location, but 13 Roundtail Chub were captured and more were observed near the original stocking location. Stream habitat was impacted by the Bighorn Fire in June 2020, but 18 chub were captured during annual monitoring in 2021. Topminnow were not detected in 2021. Work planned for FY2023 includes annual monitoring of Gila Topminnow and Gila Chub near East Fork Sabino Canyon. If habitat is deemed to still be suitable following post-fire impacts during monitoring efforts in 2022, the topminnow populations may be augmented one final time. Post-stocking monitoring will continue for three years after the final stocking for topminnow and five years after stocking for chub. The subproject will be complete by 2024 if additional stockings do not occur.

Geographical Area: Sabino Canyon is a tributary to Tanque Verde Wash in the Tucson area. Sabino Canyon is largely an intermittent stream with flows typically continuous within the subproject area (about 7.6 km from East Fork Sabino down to the first road Crossing below Sabino Dam) during winter-spring and the monsoons. During the driest time of year (May-June), water is reduced to isolated perennial pools throughout the subproject area. An established topminnow population near the confluence with East Fork Sabino Canyon would allow for topminnow to disperse downstream of the subproject area. Sabino Dam prevents nonnative fish from moving upstream, and thus protects the upstream populations. In addition, several kilometers of typically dry streambed in the lower portion of Sabino Canyon and Tanque Verde Wash hinder upstream movement of nonnative fishes from the Santa Cruz River. Sabino Canyon within the subproject area is located entirely within the Coronado National Forest. The Forest is supportive of and has participated in the subproject.

Telegraph Canyon

Background: The purpose of this subproject is to establish Gila Topminnow in Telegraph Canyon. In May, 2021 Department staff stocked 389 Gila Topminnow (Redrock Canyon lineage, Lower Santa Cruz MU) in Telegraph Canyon. A total of 563 topminnow were captured during the first post-stocking monitoring effort in October, 2021. Gila Topminnow were also detected downstream in Arnett Creek for the first time since 2018 during the same monitoring effort. Work planned for FY2023 includes post-stocking monitoring in Telegraph Canyon and Arnett Creek, and augmentation to establish a viable population as necessary. Up to three stocking attempts may be made to establish a population. The subproject will be complete by 2024 if additional if additional stockings do not occur.

Geographical Area: Telegraph Canyon is a tributary to Arnett Creek and drains from the north side of Picketpost Mountain. Telegraph Canyon and Arnett Creek are protected from upstream invasion of nonnative fishes from Queen Creek by a constructed fish passage barrier. The stream is located entirely on Tonto National Forest Lands. The Forest is supportive of the subproject and have completed all necessary consultation.

Maternity Wildlife Pond

Background: The purpose of this subproject is to establish Gila Topminnow in Maternity Wildlife Pond on Las Cienegas National Conservation Area. In April, 2021, Department staff stocked 248 Gila Topminnow (Cienega Creek lineage, Cienega Creek MU) in Maternity Wildlife Pond. A total of 1,554 topminnow were captured during the first post-stocking monitoring effort in August, 2021. Work planned for FY2023 includes post-stocking monitoring and augmentation to establish a viable population as necessary. Up to three stocking attempts may be made to establish a population. The subproject will be complete by 2024 if additional stockings do not occur.

Geographical Area: Maternity Wildlife Pond is a constructed, well-fed wildlife pond located on Las Cienegas National Conservation Area. Nonnative fish are largely absent from the Cienega Creek drainage, and wildlife ponds are accompanied by signage informing the public of the consequences of illegal fish introduction. The pond is located entirely on Bureau of Land Management Lands. BLM is supportive of the subproject and have completed all necessary consultation.

Rarick Canyon

Background: The purpose of this subproject is to establish Gila Topminnow and Gila Chub in Rarick Canyon. Rarick Canyon was previously included under the 'Red Tank Draw removals' project. The removal component was not prioritized for funding in FY2022, and the proposed subproject better aligns with the 'Gila Topminnow Stockings' project. A survey of isolated pools in the Rarick Canyon drainage from 2017 to 2018 detected Black Bullhead. 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. Gila Chub from Red Tank Draw were translocated above a natural barrier into three isolated pools in the Rarick Canyon drainage in 2019 and augmented in 2020 and 2021. Gila Topminnow (Redrock Canyon lineage, Lower Santa Cruz MU) were also translocated to one of the same isolated pools above the barrier in April, 2020. No topminnow were captured during annual monitoring in October 2021. Work planned for FY2023 includes post-stocking monitoring of Gila Chub and Gila Topminnow. Augmentation of the topminnow population may occur if necessary. The subproject will be complete by 2026 if additional stockings do not occur.

Geographical Area: The subproject area includes isolated perennial pools in Rarick Canyon. 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 and Rarick Canyon are managed by the Coconino National Forest which is supportive of native fish conservation activities and has completed all necessary compliance.

Unnamed Drainage #68B

Background: Gila topminnow were discovered in Unnamed Drainage #68B in 1985 as a result of dispersal from Mesquite Tank #2 (Site #68A) which was stocked in 1982 from Boyce Thompson Arboretum (Monkey Spring lineage, Monkey and Cottonwood Spring MU). Gila topminnow persisted in the drainage until 2020 when surveys in March and December by Marsh and Associates failed to detect any fish. In October 2021 Department and Reclamation staff verified the extirpation of Gila Topminnow in Unnamed Drainage #68B and evaluated the site for restocking. Extirpation of the population was likely due to severe flooding in fall 2019. The Gila Topminnow population persisted in the canyon for at least 35 years before the flooding event. Severe flooding is a continuing concern for restocking this population, however, the population persisted for so long it is valuable to try and establish this population again. The initial topminnow stocking is planned for April, 2022. Work planned for FY2023 includes the initial post stocking monitoring. Augmentation of the population may occur if necessary. The subproject will be complete by 2026 if additional stockings do not occur.

Geographic Area: Unnamed drainage #68B is located on the Tonto National Forest and is a tributary to Mesquite Creek, which flows into Tortilla Creek, just upstream of Canyon Lake. At the time of the last survey, at least three isolated pools and 248 m of connected water were documented in the canyon between the confluence with Mesquite Creek and where the west prong becomes impassible. In the east prong there is an additional 35 m of water before the prong becomes impassible. Past reports indicated similar lengths with about 200 m of perennial water. The upstream watershed is relatively small, with only 0.21 km^2 above Mesquite Tank, which likely allowed the population to persist for so long in the canyon. Mesquite Creek is located on Tonto National Forest lands and the Forest is supportive of ongoing native fish conservation efforts.

Tentative Locations: The following locations still need more coordination, planning, and possibly environmental compliance, before implementation. Funding is not currently allocated for these locations and the Department will recommend revisions to the work plan if implementation occurs in 2022 or 2023. Tentative Gila Topminnow stocking locations are: Buehman Canyon, Dix Creek, Mule Spring, Mescal Creek, Sands Draw, San Pedro River at Three Links, San Pedro River at Lower San Pedro Wildlife Area, and Boyce Thompson Arboretum.

Methodologies: The Department usually coordinates with USFWS to select stocking locations, donor populations, and appropriate lineages of fish for each stocking. Fish for translocations will be collected, transported, and stocked according to Department fish collection, transport, and stocking protocols (best management practice #4; AGFD 2011), and Hazard Analysis and Critical Control Point (HACCP) practices. Fish will be collected using gear appropriate for the given water. Typical gear types utilized are seines, minnow traps, and dip nets. Collected fish will be placed into aerated 5-gallon buckets from which they will be sorted to confirm species identity and assess condition. Fish will then be transferred into transport coolers (100 qt. minimum) equipped with aerators and filled with well water treated with salt and Amquel®. At the translocation site, the fish will be transferred from the transport cooler back to aerated 5-gallon buckets and carried to the stocking location. Water quality characteristics in the buckets and the stocking location will be measured. Conductivity (µS), salinity (mg/L), total dissolved solids (mg/L), pH, and water temperature (°C), will be measured using a Hach® Combo meter, and dissolved oxygen (mg/L) using a Sper Scientific® dissolved oxygen meter. Fish will be acclimated to stocking site conditions by exchanging 25 to 50% of transport bucket water with stream water, about

every 10 minutes, until bucket temperatures are within two degrees of the receiving water. Fish will be sorted a final time to verify species identity, assess condition, and determine a final count before being released into the stream.

The Department's sampling approach for Gila Topminnow consists of setting at least 10 baited collapsible minnow traps for a minimum soak time of two hours (Robinson and Hickerson 2018). Opportunistic seining and dip netting is carried out when stream conditions and time allow. Captured fish are counted by size class and released alive. Relative abundance (fish per hour), population size structure and dispersal (when possible) are evaluated each year to determine establishment. Gila Topminnow are monitored for three years before determining population establishment or failure. The minimum target for a viable population is 500 over-wintering adults (Weedman 1999). If fewer than 100 topminnow are captured during annual monitoring, additional topminnow may be stocked to help the population establish. This threshold is based on the assumption that capture probability for minnow traps is typically less than 0.25. Results, analysis, discussion of results, and recommendations for future work will be presented in the annual report.

Program Priorities

This project will replicate up to eight populations of Gila Topminnow and two populations of Gila Chub in the wild. This project will provide immediate on the ground benefits by establishing multiple new Gila Topminnow and Gila Chub 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 completed.

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 (2015)
    - 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 in FY2023 is $32,800.
- Urgency: This project is moderately urgent. Failure to regularly monitor translocation sites would delay determinations of population establishment. Postponement of translocations at new sites would delay progress toward meeting recovery goals for the species.
- 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 compliance or funding to be completed before stockings can occur. Modifications to the work plan will be requested should any of the tentative sites become ready to stock during FY2023.
- Matching Funds: This project does not have matching or in-kind funds.

Literature Cited:

Arizona Game and Fish Department. 2011. Fish Collection, transport, and stocking protocol: best management practice (BMP #4). Arizona Game and Fish Department, Phoenix.

Robinson, A. and B. Hickerson. 2018. Generalized monitoring plan for the repatriation of native fishes. Aquatic Wildlife Branch, Arizona Game and Fish Department, Phoenix.

Weedman, D. A. 1999. Gila topminnow, Poeciliopsis occidentalis occidentalis, revised recovery plan. Draft. August 1999. U.S. Fish and Wildlife Service, Phoenix, AZ.

Project 6: 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: one replicate of Aravaipa Creek lineage.
- Gila Topminnow: one of nine wild replicates of Lower Santa Cruz MU.
- Gila Chub[3]: one remnant population not replicated elsewhere.
- Other native species: populations of Speckled Dace, Longfin Dace, Sonora Sucker, Desert Sucker, Northern Mexican Gartersnake.

Project Description:

Background: The Spring Creek Repatriations project had two components: the eradication of Green Sunfish and the establishment of Spikedace and Gila Topminnow. 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 partial barrier. Green Sunfish were successfully removed by 2015 and Reclamation completed a fish barrier near the location of the diversion structure. The eradication was initiated by the Program, but completed by the Department's Conservation and Mitigation Program. 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 was considered established as of 2020. The Spikedace population was augmented in 2016 and 2018 after poor initial monitoring returns. An additional 100 PIT tagged fish were stocked following monitoring in 2020 as part of ongoing research of Spikedace survival and movement. A total of 1,717 Spikedace were stocked in March 2022. Spikedace monitoring will continue until FY2025. Work planned for FY2023 includes the annual post-stocking monitoring effort.

Project Timeline.
FY2014: Green Sunfish removals initiated.
FY2015: Barrier completed. Initial Spikedace and Gila Topminnow stockings.
FY2016: Initial annual monitoring effort.
FY2017: Annual monitoring. Augmentation of Spikedace and Gila Topminnow populations.
FY2018: Annual monitoring. Augmentation of Spikedace population.
FY2019: Annual monitoring.
FY2020: Annual monitoring. Topminnow population considered established.
FY2021: Annual monitoring of Spikedace.
FY2022: Annual monitoring of Spikedace. Augmentation of Spikedace population.
FY2023: Annual monitoring of Spikedace.
FY2024: Annual monitoring of Spikedace.

[3] In 2016, the American Fisheries Society and the American Society of Ichthyologists and Herpetologists reclassified and merged Roundtail Chub *Gila robusta*, Gila Chub *Gila intermedia*, and Headwater Chub *Gila nigra* into one species, the Roundtail Chub.

FY2025: Final annual monitoring of Spikedace.

Geographical Area: The geographic extent for this project includes the perennial reach of Spring Creek from the barrier upstream about 4 km to the springs which are the upstream extent of perennial flow. A population of Gila Topminnow is 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. 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 backpack electrofishing through three 100-m long sub-reaches in the reach from Willow Point Road downstream to the barrier. A crew of 3 to 5 people performs single-pass backpack electrofishing at two randomly selected sub-reaches. Three-pass backpack electrofishing is utilized at the one fixed sub-reach that encompasses Willow Point Road. All Spikedace captured are measured to the nearest millimeter in total length (TL mm). Sampling is carried out annually in 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. Results, analysis, discussion of results, and recommendations for future work will be presented in the annual report.

Program Priorities

This project replicates populations of Spikedace (Aravaipa Creek lineage) and Gila Topminnow (Lower Santa Cruz MU) and protects a remnant population of Gila Chub above a barrier built by Reclamation. This project has immediate on the ground benefits by securing wild populations of Spikedace and Gila Topminnow above a barrier.

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. This project is part of larger collaborative efforts to replicate populations of Spikedace and Gila Topminnow throughout their historical range.

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 3. Monitor natural and reestablished populations and their habitats.
- Gila Chub draft Recovery plan (2015)
    - Task 3.2 (priority 2) Conduct monitoring

Estimated Time and Cost:

- Cost: The estimated cost of this project for FY2023 is $5,500.
- Urgency: This project is moderately urgent because failure to monitor the Spikedace population in Spring Creek will postpone any determination of establishment success.
- Readiness: All necessary compliance has been completed for all partners involved.
- Matching Funds: This project does not have matching or in-kind funds.

Project 7: Blue River Native Fish Restoration

(Task ID: AZ-2002-3)

Implementing Entity: Arizona Game and Fish Department
Start Year: 2002
Location(s): Blue River
Species Protected:

- Spikedace: one of two replicates of upper Gila River lineage.
- Loach Minnow: remnant population, with one attempted replicate (Bonita Creek).
- Roundtail Chub: the only wild replicate of the Eagle Creek lineage.
- Other native fish species: 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 removal of nonnative fish and stocking of native fish in the lower 19 km. Nonnative fish appear to be eradicated from the lower Blue River above the fish barrier since 2017. Spikedace and Roundtail Chub were successfully established in the lower Blue River and monitoring efforts were transferred to the Reclamation monitoring contract in 2020. Conservation efforts continued upstream in a reach known as the middle Blue River near the Box in 2016. Roundtail Chub were stocked in 2016 and 2019 and Spikedace in 2017 and 2018. Roundtail Chub and Spikedace were salvaged from the lower Blue River following the Brigham Fire, and translocated to the upper Blue River near Bobcat Flat and Upper Blue Campground respectively in 2020. Work planned for FY2023 includes 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.

FY2009: First nonnative removal effort above planned barrier location.
FY2012: 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.
FY2013: Annual monitoring. Continuation of nonnative removal efforts.
FY2014: Annual monitoring. Continuation of nonnative removal efforts.
FY2015: Annual monitoring. Continuation of nonnative removal efforts.
FY2016: Annual monitoring. Translocation of additional Spikedace and Roundtail Chub. Continuation of nonnative removal efforts.
FY2017: Annual monitoring. Translocation of additional Loach Minnow. Stocking of Roundtail Chub in Middle Blue River. Continuation of nonnative removal efforts in the lower Blue River.
FY2018: Annual monitoring in lower Blue River. Stocking of Spikedace in Middle Blue River. First annual monitoring of Roundtail Chub in Middle Blue River. Continuation of nonnative removal efforts.
FY2019: Annual monitoring in lower Blue and middle Blue. Translocation of additional Spikedace to the middle Blue River. Continuation of nonnative removal efforts.

FY2020: Annual monitoring in middle Blue River. Translocation of additional Roundtail Chub to middle Blue River. Salvage of Roundtail Chub, Spikedace and Loach Minnow and translocation to the upper Blue River at Bobcat Flat, upper Blue River at Upper Blue Campground, and Campbell Blue Creek respectively.
FY2021: Annual monitoring in middle Blue River. First annual monitoring of upper Blue River. Additional translocations to upper reach, and if necessary to middle reach. Final nonnative removal effort in lower Blue River. Verification of eradication of nonnative fishes in the lower Blue River using eDNA.
FY2022: Annual monitoring in the middle Blue River and upper Blue River. Spikedace translocation to lower Blue River. Additional translocations to upper Blue River as necessary.
FY2023: Annual monitoring in the middle Blue River and upper Blue River.
FY2024: Final annual monitoring in the middle Blue River. Annual monitoring in the upper Blue River.
FY2025: Final annual monitoring in the upper Blue River.
Estimated project completion date: FY2025 (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 upstream to near XXX Ranch. The lower Blue River is protected from 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 upstream to The Box (near 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, with 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 reach extends from Blue Crossing campground upstream to the New Mexico border. A waterfall at The Box (just below Horse Canyon) acts as a barrier to upstream movement of fish into the upper Blue River during base flows. A remnant population of Loach Minnow exists within this reach along with newly introduced populations of Roundtail Chub and Spikedace. Land ownership is a combination of Apache-Sitgreaves National Forest and private lands. The Forest is supportive of conservation of Roundtail Chub and Spikedace in the upper Blue River. Some private landowners are supportive of native fish conservation in the upper Blue River.

Methodologies: The Department coordinates with USFWS and USFS about locations to stock and quotas of Spikedace and Loach Minnow to acquire for ARRC or collect from the wild for translocations. Fish for augmentations will be stocked into the same locations that fish were originally stocked unless locations with better habitat are detected during monitoring. Fish for translocations will be collected, transported, and stocked according to Department fish collection, transport, and stocking protocols (best management practice #4; AGFD 2011), and Hazard Analysis and Critical Control Point (HACCP) practices. Fish will be collected using seines or backpack electrofishing. Collected fish will be placed into aerated 5-gallon buckets from which they will be sorted to confirm species identity and assess condition. Fish will then be transferred into transport coolers (100 qt. minimum) equipped with aerators and filled with well water treated with salt and Amquel®. At the translocation site, fish will be transferred from the

transport cooler back to aerated 5-gallon buckets and carried to the stocking location. Water quality characteristics in the buckets and the stocking location will be measured. Conductivity (µS), salinity (mg/L), total dissolved solids (mg/L), pH, and water temperature (°C), will be measured using a Hach® Combo meter, and dissolved oxygen (mg/L) using a Sper Scientific® dissolved oxygen meter. Fish will be acclimated to stocking site conditions by exchanging 25 to 50% of transport bucket water with stream water, about every 10 minutes, until bucket temperatures were within two degrees of the stream. Fish will be sorted a final time to verify species identity, assess condition, and determine a final count before being released into the stream.

The Roundtail Chub and Spikedace populations in the middle Blue River are monitored by a backpack electrofishing crew of 3 to 4 people making a single pass through 10 randomly selected 100-meter long sub-reaches, and three passes through the two fixed sub-reaches located in two of the three monitoring reaches. Total length of all Roundtail Chub and Spikedace captured is measured to the nearest mm TL. 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 is utilized for evaluating translocation success in the upper Blue River: three monitoring reaches, with three fixed 100-m sub-reaches, and 12 random sub-reaches. Results, analysis, discussion of results, and recommendations for future work will be presented in the annual report.

Program Priorities

The nonnative removal portion of the project helped secure the existing Loach Minnow population and facilitated the establishment of Spikedace and Roundtail Chub populations above the fish passage barrier built by Reclamation. This project created one of two replicates of the upper Gila River Spikedace lineage, and created the first wild replicate of the Eagle Creek lineage of Roundtail Chub. This project expanded the range of the Spikedace and Roundtail Chub populations such that they are dispersed throughout the entire 83 km river system. This project also benefits other native fish species: Longfin Dace, Speckled Dace, Sonora Sucker, and Desert Sucker. This project has immediate on-the ground benefits by establishing and securing wild populations of Spikedace and Roundtail Chub above a barrier and expanding their range within an 83 km long river system.

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. This project is part of larger collaborative efforts to conserve Roundtail Chub populations (Six Species Conservation Agreement) and to replicate Spikedace throughout the species historical range.

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. 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 plans (1991)
  - Task 6.2.5 (priority 3) Reclaim as necessary to remove nonnative fishes
  - 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 FY2023 is $29,000.
- Urgency: This project is urgent because failure to translocate additional fish or monitor populations in the Blue River will postpone any determination of establishment success.
- Readiness: All necessary compliance has been completed for all partners involved in the Middle Blue and upper Blue.
- Matching Funds: This project does not have matching or in-kind funds

Literature Cited:

Arizona Game and Fish Department. 2011. Fish Collection, transport, and stocking protocol: best management practice (BMP #4). Arizona Game and Fish Department, Phoenix.

Project 8: 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 livestock tanks within the drainage.
Species Protected:

- Gila Topminnow: one of nine wild replicated populations of the Bylas management unit (MU).
- Gila Chub[4]: one remnant population, which was replicated in Mule Creek, NM.
- Other native fish species: one population each of Longfin Dace, Speckled Dace, Desert Sucker, and Sonora Sucker.

Project Description:

Background: The purpose of this project was to expand the distribution of Roundtail Chub in Harden Cienega Creek and to establish Gila Topminnow in the lower portion of the creek, but Green Sunfish were detected in 2017 and a nonnative removal component was added to the project in 2020. 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 Gila Chub, 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 to 2020 indicated a healthy chub population was established above the barrier, however Green Sunfish were also detected both above and below the barrier at the same time (1, 2, and 4 were removed in 2017 through 2019 respectively). This was not the first record of Green Sunfish in Harden Cienega Creek; McKell (2005)[5] 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. Given that relatively few Green Sunfish were detected, it was assumed that they were not yet sufficiently abundant to effect native fish populations in the stream. Gila Topminnow (Bylas lineage, Bylas MU) were translocated to suitable habitat in lower Harden Cienega Creek in 2019 (no Green Sunfish had been detected in this lower reach before stocking). Topminnow were not detected during monitoring in June, 2020 and plans were made to translocate more topminnow to Harden Cienega Creek in the spring of 2021. All stock tanks in the Arizona portion of the drainage were surveyed in 2020, and all were fishless. Beginning in 2021, this project became a joint project with NMDGF (see project NM-2002-1). All stock tanks on Gila National Forest lands in New Mexico were surveyed in 2021 and Green Sunfish were present in three stock tanks. These tanks, and possibly others in New Mexico appear to be sources of Green Sunfish to lower Harden Cienega Creek. Nonnative fish removal efforts in Harden Cienega Creek were initiated in 2020: 38 Green sunfish were removed (22 by electrofishing and 16 by hoop netting). A total of 23 Green Sunfish were removed in two removal passes (pass 1 = 16, pass 2 = 7) during 2021. Work planned for FY2023 includes two mechanical removal passes in Harden Cienega Creek and annual monitoring of Gila Topminnow.

[4] In 2016, the American Fisheries Society and the American Society of Ichthyologists and Herpetologists reclassified and merged Roundtail Chub *Gila robusta*, Gila Chub *Gila intermedia*, and Headwater Chub *Gila nigra* into one species, the Roundtail Chub.

5 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.

Project Timeline.
FY2016: Gila Chub translocated above the natural barrier in Harden Cienega Creek
FY2018: First monitoring of Gila Chub above the barrier in Harden Cienega Creek. Discovery of Green Sunfish above the barrier.
FY2019: Monitoring of Gila Chub above the barrier. Translocation of five additional chub above the barrier. Capture of two Green Sunfish above the barrier.
FY2020: Monitoring of Gila Chub. Translocation of 100 chub above the barrier. Translocation of Gila Topminnow below the barrier. Capture of four Green Sunfish below the barrier. Tank surveys completed on AZ portion of Harden Cienega Creek drainage. First mechanical removal pass in Harden Cienega Creek (38 Green Sunfish captured and removed). Final monitoring of Gila Chub above the barrier. Annual monitoring of Gila Topminnow.
FY2021: Augmentation of Gila Topminnow population below barrier. Two mechanical removal passes in Harden Cienega Creek. Annual monitoring of Gila Topminnow. Surveys of stock tanks within the Harden Cienega drainage in New Mexico.
FY2022: Augmentation of Gila Topminnow below barrier if necessary. Two mechanical removal passes in Harden Cienega Creek. Annual monitoring of Gila Topminnow.
FY2023: Two mechanical removal passes in Harden Cienega Creek. Annual monitoring of Gila Topminnow.
FY2024: Continue removal passes in Harden Cienega Creek. Surveys of tributary streams of intermittent portions of Harden Cienega Creek for isolated populations of Green Sunfish if sunfish are eradicated from source tanks in New Mexico. Verification of Green Sunfish eradication with eDNA samples if three consecutive passes have been completed without detection of Green Sunfish. Final monitoring of Gila Topminnow if no additional augmentations occur after FY2021.
Estimated project completion date: FY2024.

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 upstream to about 50 m past the confluence with Prospect Canyon. 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 Gila Chub 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, and have yet to show evidence of reproduction, in the lower reach. The upstream Gila Chub population is protected from upstream invasion of nonnative fishes by a waterfall barrier approximately 3 to 4 meters in height. Land ownership within the perennial reach of Harden Cienega Creek is Apache-Sitgreaves National Forest and managed by Gila National Forest. Stock tanks within the drainage occur on Apache-Sitgreaves and Gila National Forests and private lands in Arizona and New Mexico. Green Sunfish appear to be dispersing from at least one stock tank in New Mexico. The Gila National Forest is supportive of native fish conservation activities in Harden Cienega Creek. Permission is required to sample stock tanks on private lands in New Mexico.

Methodologies: The immediate goal of the removal effort will be suppression of Green Sunfish in Harden Cienega Creek. 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 will consist of a series of full-reach passes each year. Work planned for FY2023 includes two full removal passes. 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. In addition to backpack electrofishing, mini-hoop nets will be baited and set in deep pools throughout the reach to more effectively sample habitats too deep for effective backpack electrofishing. Nets will be retrieved after a minimum soak time of two hours. Mini-hoop nets may be left to soak overnight if removals are occurring on successive days. Ideally, removals will occur in May-June when the stream is near base flow in an effort to maximize capture probability of Green Sunfish. Relatively few Green Sunfish were captured from 2017-2021, and spawning (presence of juveniles) has not been documented.

At the end of each year, staff will evaluate size structure and relative abundance of nonnative fish populations. Progress toward successful eradication will be characterized by decreasing relative abundance (CPUE). Measures of success will be evaluated within and between years. A successful annual suppression effort will be characterized by decreasing Green Sunfish relative abundance with each successive pass and the absence of YOY Green Sunfish.

For Gila Topminnow augmentations, fish for translocations will be collected, transported, and stocked according to Department fish collection, transport, and stocking protocols (best management practice #4; AGFD 2011), and Hazard Analysis and Critical Control Point (HACCP) practices. Fish will be collected using gear appropriate for the given water; typical gear types are seines, minnow traps, and dip nets. Collected fish will be placed into aerated 5-gallon buckets from which they will be sorted to confirm species identity and assess condition. Fish will be transferred into transport coolers (100 qt. minimum) equipped with aerators and filled with well water treated with salt and Amquel®. At the translocation site, fish will be transferred from the transport cooler back to aerated 5-gallon buckets and carried to the stocking location. Water quality characteristics in the buckets and the stocking location will be measured. Conductivity (µS), salinity (mg/L), total dissolved solids (mg/L), pH, and water temperature (°C), will be measured using a Hach® Combo meter, and dissolved oxygen (mg/L) using a Sper Scientific® dissolved oxygen meter. Fish will be acclimated to stocking site conditions by exchanging 25 to 50% of transport bucket water with stream water, about every 10 minutes, until bucket temperatures were within two degrees of the stream. Fish will be sorted a final time to verify species identity, assess condition, and determine a final count before being released into the stream.

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 et al. 2021). Ten to twenty 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 two hours. 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.

Results, analysis, discussion of results, and recommendations for future work will be presented in the annual report.

Program Priorities

This project will stabilize one population of Gila Chub, one replicated Gila Topminnow population, and populations of Longfin Dace, Speckled Dace, Sonora Sucker, and Desert Sucker through mechanical removal of nonnative Green Sunfish. This project will create a wild replicate of the Bylas MU of Gila Topminnow, and expand the distribution of the population of Harden Cienega Creek lineage Gila Chub. This project will provide immediate on the ground benefits by identifying the upstream source of Green Sunfish to Harden Cienega Creek, removing Green Sunfish from those tanks and 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 Gila Chub 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. The project is part of larger collaborative efforts to conserve chub (Six Species Conservation Agreement) and to replicate populations of Gila Topminnow throughout their range.

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.
    - 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. Monitor natural and reestablished populations and their habitats.

- Gila Chub draft Recovery plan (2015)
    - 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 in FY2023 is $29,000.
- 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 reproducing 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.
- Matching Funds: This project does not have matching or in-kind funds.

Literature Cited:

Arizona Game and Fish Department. 2011. Fish Collection, transport, and stocking protocol: best management practice (BMP #4). Arizona Game and Fish Department, Phoenix.

Hickerson, B. T., J. Walters and A. T. Robinson. 2021. Gila River Basin Native Fishes Conservation Program: Arizona Game and Fish Department's native fish conservation efforts during 2020. An Arizona Game and Fish Department Annual Report for Cooperative Agreement No. R16AC00077 submitted to U.S. Bureau of Reclamation, Phoenix Area Office. Arizona Game and Fish Department, Aquatic Wildlife Branch, Phoenix.

Project 9: 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, tributaries to Verde River, stock tanks within the upper Verde River drainage
Species Protected:

- Spikedace: possible replicate population (lineage TBD), if nonnative fishes are eradicated from the river.
- Loach Minnow: possible replicate population (lineage TBD), if nonnative fishes are eradicated from the river.
- Gila Topminnow: possible replicate population (lineage TBD), if nonnative fishes are eradicated from the river.
- Other native fish species: one population each of the existing lineages of 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, Loach Minnow, Speckled Dace, Longfin Dace, Roundtail Chub, Colorado Pikeminnow, Desert Sucker, Sonora Sucker, Razorback Sucker, and likely Gila Topminnow, 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, Loach Minnow, and Gila Topminnow. Extensive planning for the nonnative control and species reintroduction components is necessary before implementation. All stock tanks in the drainage need to be evaluated, to identify those with water, those that harbor nonnative fish, and which tanks pose the highest risk of being sources of nonnative fish to the Verde River.

Project Timeline.
FY2019: Stock tank survey plan drafted, identification of tanks most likely to support populations of nonnative fishes.
FY2020: Department staff participated in planning meetings.
FY2021: Department staff began stock tanks surveys in the Upper Verde River drainage for presence of nonnative fishes. Department staff will participate in planning meetings.
FY2022: Department staff will likely complete stock tank surveys. Department staff will begin drafting a nonnative removal plan for tanks that pose the highest risk of being sources of nonnative fish to the Verde River.
FY2023 and beyond: Department staff will survey drainages downstream of stock tanks with nonnative fishes to determine distribution and abundance of nonnative fish in tributary streams. Additional work is dependent upon approval of the Department's piscicide treatment planning and procedures process. If the Department is unable to move forward on this subproject, GRBNFCP funds can be reprioritized to lower priority projects pending approval of technical and or policy committees.

Geographical Area: The riverine portion of the project area includes the Verde River and tributaries from Sullivan Lake downstream to the proposed lower barrier location near Sycamore Canyon. This reach of the Verde River will be protected from upstream invasion of nonnative fishes by a series of two barriers built by Reclamation. This reach of the Verde River is mostly owned by Prescott National Forest with some small inholdings of Department and private land. Prescott National Forest is supportive of the Verde River native fish restoration project. The project area also includes all livestock tanks within the Verde River drainage above Sycamore Canyon that are potential sources of nonnative fish to the Verde River. There are about 1,266 stock tanks within the upper Verde River watershed, but only 146 of those are likely perennial and within 30 km of the Verde River. Before treatment of the Verde River, these 146 stock tanks within the upper Verde River drainage will be surveyed for presence of nonnative fishes. The stock tanks are on Prescott National Forest, Kaibab National Forest, state trust, and private lands. The Forests are supportive of the surveys, but the private landowners need to grant permission before tanks on their properties can be surveyed. Prescott National Forest completed NEPA for nonnative removals from the stock tanks on its lands, but Kaibab National Forest is still developing the NEPA for nonnative removals for tanks on their lands.

Methodologies:

Stock Tank Surveys. The objective of stock tank surveys in the upper Verde drainage is to identify tanks that contain nonnative fishes, which could potentially be dispersal sources to the Verde River downstream. Stock tanks were prioritized for sampling by analyzing national agricultural imagery program (NAIP) imagery for presence of water using normalized difference water index (NWDI) 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. Stock tank surveys began in 2021 during July and August. Department staff will visit all 146 potentially perennial stock tanks within 30 km of the Verde River pending landowner permission. Tanks that have water will be surveyed for fish. For most tanks, a bag seine will be hauled across each tank for a minimum of three passes (unless the entire tank can be seined in one or two hauls, or the tank is too shallow to use a seine). Trammel or gill nets will be set in tanks that are too large or deep to seine and dip nets will be used in tanks that are too shallow to seine. Tanks with undesirable nonnative fish will be identified as targets for nonnative removals.

Nonnative removals. The first phase of nonnative fish removal efforts will target stocks tanks within the upper Verde River drainage. The purpose of the first phase will be to eliminate high-risk sources of nonnative fish to the Verde River. Utilizing the results from tank surveys, in FY2023, the Department's Region 3 and Native Aquatics Program staff will develop a nonnative fish removal plan for the tanks identified as having nonnative fish present and that are considered high risk. All standard methods of fish removal will be evaluated for feasibility. If piscicides are chosen as a removal method, the Department's Region 3 and Native Aquatics Program staff will complete all plans and compliance specified in the Department's Piscicide Planning and Treatment Procedures manual. Nonnative fishes will be removed from stock tanks in the upper Verde River drainage before implementation of removals in the Verde River.

The second phase of nonnative fish removal efforts will occur in the Verde River. If piscicides are chosen as the mechanism of nonnative fish removal, the Department's Region 3 and Native Aquatics Program staff will complete all plans and compliance specified in the Department's Piscicide Planning

and Treatment Procedures manual. Targets for removal success will be included in the removal plan. This work will be detailed in a future work plan.

Native fish translocations. The Department's Region 3 and Native Aquatic Program staff will develop a plan for native fish translocations, which will be detailed in a future work plan in the proposed year that translocations are initiated.

Post-stocking monitoring. The Department's Region 3 and Native Aquatic Program staff will develop a monitoring plan to evaluate post-stocking establishment of native fishes. The monitoring plan will likely have species specific sampling strategies. Targets for success and planned analyses will also be included. To be consistent with other monitoring plans for Spikedace and Loach Minnow, a stratified-random study design will likely be used, and include several fixed sites at stocking locations or access points. This work will be detailed in a future work plan.

For all methodologies subsections, results, analysis, discussion of results, and recommendations for future work will be presented in the annual report.

Program Priorities

The upper Verde River native fish restoration project will stabilize existing populations of Roundtail Chub, Speckled Dace, Longfin Dace, Desert Sucker, and Sonora Sucker in the wild through barrier installations and nonnative removals. The project will also replicate populations of Spikedace and Loach Minnow within historically occupied habitat (lineages to be determined). A wild replicate population of Gila Topminnow, lineage to be determined, will also be replicated above the barrier. 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. Monitor natural and reestablished populations and their habitats.

Estimated Time and Cost:

- Cost: The estimated cost of this project in FY2023 is $79,100.
- Urgency: This project is moderately urgent because pre-treatment planning, tank surveys and barrier construction all need to occur simultaneously.
- Readiness: The stock tank and stream surveys, and planning proposed for FY2023 are ready to execute. The NEPA compliance by the Prescott National Forest for stock tank treatments was completed. This project still requires substantial compliance work to be completed including Wild and Scenic Analysis, NEPA compliance by Reclamation for construction of the fish passage barriers, construction of the barriers, Departmental and Forest Service compliance for rotenone projects if treatments are approved, and control of nonnative fishes in the Verde River.
- Matching Funds: The Department will provide in-kind-match in the form of Regional and Headquarters Aquatic Wildlife Program staff salaries.

Project 10: Sharp Spring Native Fish Restoration

(Task ID: AZ-2016-3)

Implementing Entity: Arizona Game and Fish Department
Start Year: 2016
Location(s): Sharp Spring
Species Protected:

- Gila Topminnow: one new wild replicate of the Sharp Spring lineage, of which seven exist.
- Gila Chub[6]: potential replicate of Sheehy Spring lineage.

Project Description:

Background: The Sharp Spring native fish restoration project is ongoing. Sharp Spring was historically occupied by a remnant population of Gila Topminnow until nonnative Western Mosquitofish were detected in 1979. Gila Topminnow were extirpated by 2002, likely as a result of negative interactions with mosquitofish. 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 refill rate of the pools and equipment limitations. In January 2017, Department and Arizona State Parks (AZSP) staff met to discuss the project and potential methods of nonnative fish control. Arizona State Park staff indicated they would move to get approval, but then did not communicate any progress until 2020. In 2020 Department staff and Arizona State Parks communicated and determined how to move the project forward. AZSP staff approved a commercial rental permit for research and monitoring (CRPRM) in early 2021 and Department staff completed Phases 1 and 2 of the Department's Piscicide Treatment Planning and Procedures manual (PTPPM). Phase 3 of the PTPPM was completed and an initial rotenone treatment is planned for FY22.

The purpose of this project is to eradicate Western Mosquitofish from Sharp Spring, reintroduce Gila Topminnow and potentially translocate Gila Chub. The Sharp Spring lineage of Gila Topminnow will be translocated from one or more of the replicate populations in the state. Gila Chub from nearby Sheehy Spring could potentially be translocated into Sharp Spring. Sheehy Spring is located on private land and the landowner has expressed concern over the collection of fish from Sheehy Spring to establish a population in Sharp Spring. All proposed work for Gila Chub is contingent on landowner cooperation. Work planned by year is presented below.

Project Timeline.
FY2020: Coordination with AZ State Parks. Drafted AZSP CRPRM application.
FY2021: Completed Stage 1 of Piscicide Treatment Planning Procedures, initiated Stage 2.
FY2022: Completion of Stage 2 and Stage 3. Rotenone treatment and stocking of Gila Topminnow.
FY2023: Initial monitoring of Gila Topminnow, additional translocations as necessary. Potential second treatment if necessary. Potential translocation of Gila Chub.

[6] In 2016, the American Fisheries Society and the American Society of Ichthyologists and Herpetologists reclassified and merged Roundtail Chub *Gila robusta*, Gila Chub *Gila intermedia*, and Headwater Chub *Gila nigra* into one species, the Roundtail Chub.

FY2024: Annual monitoring of Gila Topminnow and Gila Chub.
FY2025: Final monitoring of Gila Topminnow and annual monitoring of Gila Chub.
FY2026: Annual monitoring of Gila Chub.
FY2027: Annual monitoring of Gila Chub.
FY2028: Final monitoring of Gila Chub.
Estimated year of completion: FY2028.

Geographical Area: Sharp Spring is a tributary to the Santa Cruz River in San Rafael State Natural Area (Arizona State Parks), about 2 km from the international border with Mexico. It is a perennial spring with approximately 0.3 km of surface water which forms a series of at least 16 pools in cienega-like habitat. Arizona State Parks is supportive of the project.

Methodologies: Rotenone treatment of Sharp Spring is targeted for June 2022. The treatment will be considered successful if Western Mosquitofish are eradicated. Five successive fish monitoring passes will be completed within the two weeks following treatment, and the treatment will be considered successful if no fish are detected. One pass will consist of baited minnow traps set in each pool for at least two hours, and seine hauls and dip net sweeps in locations where traps are not effective. Following verification of eradication, Gila Topminnow will be stocked into each of the major pools. Translocation procedures, monitoring protocols, establishment criteria and monitoring targets will follow those described in the methodology subsection of the Gila Topminnow Stocking project. Gila Chub will be stocked at least one year after Gila Topminnow are initially stocked to allow for topminnow to increase in abundance prior to the introduction of a potential predator. Gila Chub will be monitored for five years after the final establishment stocking. Results, analysis, discussion of results, and recommendations for future work will be presented in the annual report.

Program Priorities
This project will prepare an historical Gila Topminnow location for the reintroduction of Sharp Spring lineage topminnow through the removal of nonnative Western Mosquitofish. This project will also have the potential to create the only wild replicate of the Sheehy Spring lineage of Gila Chub. This project will have the immediate on the ground benefit of securing a historical location for reintroduction of Gila Topminnow and potential replicate Gila Chub population.

Partnerships
This project is in partnership with Arizona State Parks, U.S. Fish and Wildlife Service, and Reclamation. The project is part of larger collaborative efforts to conserve chub (Six Species Conservation Agreement) and to replicate populations of Gila Topminnow throughout their range. This project builds upon a previously funded GRBNFCP project that attempted, but failed, to eradicate nonnative fish by pumping down the spring pools.

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 (2015)
  - 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 in FY2023 is $16,600.
- Urgency: This project is urgent because compliance documentation requires that a treatment take place within a five year window of approval.
- Readiness: AZSP granted permission to proceed with the project through a CRPRM. Department compliance through the piscicide treatment planning procedures should be complete in FY22.
- Matching Funds: This project does not have matching or in-kind funds.

Project 11: Remote Site Inventory and Assessment
(Task ID: AZ-2023-1)

Implementing Entity: Arizona Game and Fish Department
Start Year: 2023
Location(s): San Francisco River
Species Protected: Loach Minnow, Spikedace, Roundtail Chub, Desert Sucker, Longfin Dace, Speckled Dace, Sonora Sucker

Project Description:

Background – In New Mexico much of the Gila River Basin is extremely remote and difficult to sample. New Mexico Department of Game and Fish has an ongoing remote site inventory project designed to document the status and distribution of both priority and nonnative species. In 2023, NMDGF and partners propose to inventory remote reaches of the lower San Francisco River from near Big Dry Creek to the Arizona/New Mexico border (Task # NM-2017-2). To compliment this work, the Department plans to sample the remote section of the San Francisco River from the state line to Martinez Ranch. The last time this section of the river was sampled was in 1996 (Bagley et al 1996) and little is known about the current status of native species in the area.

Geographical Area –This project will take place in the lower San Francisco River within the Apache-Sitgreaves National Forest from the state line downstream to Martinez Ranch. This project will provide further information on the status and distribution of these populations as well as nonnative species in the river. The San Francisco River has several diversions that may prohibit fish movement at times.

Methodologies –Sampling will take place in May or June. Representative 100 m sites will be established in difficult to access remote areas within the San Francisco River that have not been surveyed recently. Surveys will be conducted by a backpack electrofishing crew of 3 to 4 people making a single pass through randomly selected 100-meter long sub-reaches, environmental DNA, and if time permits a three passes through a smaller number of fixed sub-reaches. All fish collected will be identified and enumerated by mesohabitat. Length of each mesohabitat will be recorded. Total length (TL mm) will be collected for all Spikedace, Loach Minnow, Roundtail Chub and nonnative piscivores (e.g., Smallmouth Bass, Channel Catfish, Green Sunfish) captured. Other native species encountered (e.g., Desert Sucker, Longfin Dace) and small bodied nonnative fishes (e.g., Western Mosquitofish) will be counted by size class (for details see Robinson and Hickerson 2018). The inventory will provide updated information on the distribution and abundance of both native and nonnative fishes in this remote reach of the San Francisco River. The remote nature of sampling may require pack stock or helicopter support to expedite sampling. It is possible the San Francisco River system cannot be completed in one year due to logistical constraints. In this case we will request funding to complete any remaining sampling in 2024.

Program Priorities

This project assesses population status of Loach Minnow, Spikedace, and Roundtail Chub in the San Francisco 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, NMDGF, USFS, and USFWS. It coincides with New Mexico's remote site inventory for the San Francisco River. This project updates the current distribution of Loach Minnow, Spikedace, and Roundtail Chub within their historic range which is vital information for any species status assessment or recovery criteria.

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:

- Cost: The estimated cost of this project in FY2023 is $29,000.
- Urgency: The remote portions of the lower San Francisco River have never been surveyed and given the expanding native fish population in the regularly surveyed portions of the river, it is important to inventory the rest of the river to document the status and distribution of both priority and nonnative species.
- Readiness: This project is ready to implement.
- Matching Funds: This project does not have matching or in-kind funds.

Project 12: 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 purpose of this task is to continue mechanical removal of nonnative fishes, specifically Yellow Bullhead (*Ameiurus natalis*), from 1.9-miles of Bonita creek and 17-miles of Aravaipa Creek. Both systems are unique in that they still support intact or relatively intact native fish assemblages, despite the presence of nonnative fishes and they are closed systems as the Bureau of Reclamation (BOR) through their Gila River Basin Native Fish Conservation Program constructed fish barriers across them that prevent nonnatives from moving upstream. These projects are collaborative, ongoing, and are necessary 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.

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

Summary of Past Results for Aravaipa Creek: The BLM, SFO and partners conducted 23 removal trips since September 2017, resulting in 7,537 Yellow Bullhead 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 188 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.

Methodology: To document and track Yellow Bullhead distribution and removal progress, Aravaipa Creek will be delineated into 79, 500-meter reaches. Catch and effort will be recorded for each stream reach. Removal 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. Removal 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 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 Blumer1985) 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 or if breeding colors present. Following data collection, all nonnative fish species will be euthanized with an overdose of tricane 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.

***Gear Type*:** Mechanical removal using backpack electrofishers will be the primary method used as it has proven to be effective in Aravaipa Creek. Promar traps (0.3 m diameter, 0.6 and 0.9 m long, double throat, 1.2 cm mesh) and seines will be implemented if a habitat due to complexity or depth can't be effectively electrofished. 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 five removals will be conducted in 2023. 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 (P*oeciliopsis 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 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 traps. Gee metal minnow traps captured 15,384 of the Green Sunfish, Promar traps captured 5,602, and a mix of Promar 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.

Removal 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 in the beginning we utilized removal techniques and strategies similar to what was used for Green Sunfish. However, starting in February 2021, we eliminated Gee metal minnow traps and hoop nets as they have proven to be ineffective in catching Yellow Bullhead. Additionally, a new trap, 6-hole collapsible Krey Traps™ (0.3 m high, 0.5 m long, 0.95 m across, 8 sided with 6 holes, 0.3 x 0.3 cm mesh), was assessed during the July 2021 removals for its effectiveness in catching Yellow Bullhead and appears to be a viable option for inclusion in future efforts.

A total of eight removal trips were conducted from February through July 2021. No Green Sunfish were collected or observed, which continues to support their eradication from Bonita Creek. Summary of catch and effort by trip for 2021 is provided in table 4.

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.

Methodology: Removal strategies and gear type used will follow those successfully used for Green Sunfish removal. To make the removal process more manageable, Bonita Creek will be divided 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: Primary gear types will include collapsible Promar and Krey traps. Backpack electrofisher and seines may also be used in shallower habitats where traps are not effective.

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

A minimum of six removals will be conducted in 2023. 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 over the years include, Arizona Game and Fish Department, US Fish and Wildlife Service, Bureau of Reclamation, The Nature Conservancy, University of Arizona, Gila Watershed Partnership, Arizona-Sonora Desert Museum, United States Forest Service, Arizona and New Mexico, 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 $30,000 for fiscal year 2023 to continue Yellow Bullhead removal from Bonita and Aravaipa Creeks. The estimated project cost to eliminate Yellow Bullhead from both systems is currently unknown.

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 $30,000.00 from GRBNFCP and is providing a match of $32,115.60, which covers salary, vehicle, supplies, and equipment for Yellow Bullhead removal at Bonita and Aravaipa Creeks.

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Hatchery Workplan

Project 13: Aquatic Research and Conservation Center Populations

(Task ID: HA-2006-2)

Implementing Entity: Arizona Game and Fish Department
Start Year: 2003 and 2006
Location(s): Aravaipa Creek and Blue River; Aquatic Research and Conservation Center
Species Protected:

- Spikedace: three refuge populations (Aravaipa Creek, Upper Gila River and Gila River Forks), of the two existing, still detected, remnant populations; the latter two are genetically equivalent.
- Loach Minnow: three refuge populations (Aravaipa Creek, Blue River, San Francisco River) of the five existing, still detected, remnant populations.
- Gila Topminnow: currently no populations.
- Desert Pupfish: currently no populations.
- Roundtail Chub: one refuge population of the Eagle Creek lineage which is replicated in Blue River.

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, 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 Chub[1] 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 less consistent with a total of nine collections from 2007-2021. During 2007 through 2015 the Department made multiple unsuccessful attempts to collect Loach Minnow from East Fork Black River, Spikedace from the Verde River, and Spikedace and Loach Minnow from Eagle Creek. Collections from New Mexico were primarily completed by New Mexico Department of Game and Fish (NMDGF), and were sporadic with seven collections of Spikedace and seven collections of Loach Minnow from 2009-2021 from the Gila River Forks. The last Upper Gila River collections for Spikedace occurred in 2009. San Francisco River Loach Minnow were only collected in 2013. Eagle Creek Roundtail Chub[1] were collected in 2010 and 2011. Roundtail Chub[1] 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 FY2023 includes collections of Spikedace and Loach Minnow from Aravaipa Creek and

[1] Including populations previously classified as Gila Chub.

collection of Loach Minnow from the Blue River. Collections from other Arizona streams will only be attempted if other biologists detect either species. Collections from all 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

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 translocations. The facility was originally named Bubbling Ponds Native Fish Conservation Facility, but in 2015 was renamed the Aquatic Research and Conservation Center (ARCC). Beginning in 2014, Reclamation began providing funds (through U. S. Fish and Wildlife Service) for a variety of improvements to ARCC, including new spawning raceways between existing structures, a new quarantine building, and new ponds.

In FY2023, ARCC staff will focus on propagating lineages that are slated for translocations, including Eagle Creek Roundtail Chub, 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 will focus on research to improve propagation success, and survival of stocked fish. Health assessments of fish from donor sites will be completed before 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 (Eagle Creek, Verde River, and East Fork Black River) in recent decades. Aravaipa Creek supports remnant populations of Spikedace and Loach Minnow above a barrier. Collections are most frequently made near the upstream end of perennial flow 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. The BLM and TNC are both supportive of ongoing native fish conservation activities.

The Blue River drainage supports a large remnant metapopulation of Loach Minnow above a constructed barrier near the confluence with the San Francisco River. 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. 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 a quota of fish to be removed from each 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 each year by collecting 30 individuals of the target species or a closely related surrogate species (Longfin Dace, Speckled Dace) from each donor stream. Fish are typically 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[1], 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 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.

[1] Including populations previously classified as Gila Chub.

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 (2015)
    - Task 4 (priority 2) Establish and maintain refuge populations in protected ponds or hatcheries as appropriate

Estimated Time and Cost:

- Cost: The estimated cost of this project in FY2023 is $117,000
    - *Acquisition of Spikedace and Loach Minnow and other rare species from the wild:* $2,000.
    - *Aquatic Research and Conservation Center:* $115,000.
- 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 Ranking

Proj #	Project Name	Mean Rank Order	Mean Score	Project Cost	Subtotal
13	ARCC O&M	1	39.4	$ 117,000	$ 117,000
12	Nonnative fish removal from Bonita and Aravaipa Creeks	2	40	$ 30,000	$ 147,000
7	Blue River native fish restoration	3	37.1	$ 29,000	$ 176,000
2	T&E Fish Repatriations and Monitoring	4	37.125	$ 62,921	$ 238,921
8	Harden Cienega Creek Native Fish Restoration	5	36	$ 29,000	$ 267,921
4	Muleshoe ecosystem stream and spring repatriations	6	35.6	$ 15,000	$ 282,921
5	Gila Topminnow Stockings	7	35.2	$ 32,800	$ 315,721
9	Upper Verde River native fish restoration	8	35.8	$ 79,100	$ 394,821
11	Remote Site Inventory and Assessment	9	35.5	$ 29,000	$ 423,821
1	West Fork Gila River Mechanical Removal	10	34.5	$ 44,709	$ 468,530
6	Spring Creek (Oak) repatriations	11	33.2	$ 5,500	$ 474,030
10	Sharp Spring Native Fish Restoration	12	34	$ 16,600	$ 490,630
3	Remote Site Inventory and Assessment (Previously Middle Fork Gila Inventory & Assessment)	13	33.375	$ 66,911	$ 557,541

FY21-FY23 Budget

		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**
		2022					

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	$7,955	$11,400		$43,656
NM-2002-1	2002	T&E Fish Repatriations and Monitoring	$33,918	$10,885	$15,900		$60,703
NM-2017-1	2017	Remote Site Inventory and Assessment (Previously Middle Fork Gila Inventory & Assessment)	$26,578	$20,354	$19,700		$66,632
		Arizona Recovery Actions	AZGFD	FWS	BLM		
AZ-2003-1	2003	Muleshoe ecosystem stream and spring repatriations	$13,800				$13,800
AZ-2002-1	2002	Gila Topminnow Stockings	$21,300				$21,300
AZ-2013-1	2013	Spring Creek (Oak) repatriations	$5,000				$5,000
AZ-2002-3	2002	Blue River native fish restoration	$26,400				$26,400
AZ-2014-1	2014	Harden Cienega Creek Native Fish Restoration	$26,400				$26,400
AZ-2016-2	2016	Red Tank Draw removals	$6,300				$6,300
AZ-2020-2	2020	Upper Verde River native fish restoration	$96,600				$96,600
AZ-2016-3	2016	Sharp Spring Native Fish Restoration	$40,200				$40,200
AZ-2009-1	2009	Nonnative fish removal from Bonita and Aravaipa Creeks			$30,000		$30,000
		Hatchery Actions	AZGFD	ASU			
HA-2006-2	2006	ARCC O&M	$117,000				$117,000
Total		**Recovery and Nonnative Control Total**					**$553,991**
		2023					
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	$25,354	$7,955	$11,400		$44,709
NM-2002-1	2002	T&E Fish Repatriations and Monitoring	$36,136	$10,885	$15,900		$62,921
NM-2017-1	2017	Remote Site Inventory and Assessment (Previously Middle Fork Gila Inventory & Assessment)	$26,857	$20,354	$19,700		$66,911

		Arizona Recovery Actions	AZGFD	FWS	BLM		
AZ-2003-1	2003	Muleshoe ecosystem stream and spring repatriations	$15,000				$15,000
AZ-2002-1	2002	Gila Topminnow Stockings	$32,800				$32,800
AZ-2013-1	2013	Spring Creek (Oak) repatriations	$5,500				$5,500
AZ-2002-3	2002	Blue River native fish restoration	$29,000				$29,000
AZ-2014-1	2014	Harden Cienega Creek Native Fish Restoration	$29,000				$29,000
AZ-2020-2	2020	Upper Verde River native fish restoration	$79,100				$79,100
AZ-2016-3	2016	Sharp Spring Native Fish Restoration	$16,600				$16,600
AZ-2023-1	2023	Remote Site Inventory and Assessment	$29,000				$29,000
AZ-2009-1	2009	Nonnative fish removal from Bonita and Aravaipa Creeks			$30,000		$30,000
		Hatchery Actions	AZGFD	ASU			
HA-2006-2	2006	ARCC O&M	$117,000				$117,000
Total		**Recovery and Nonnative Control Total**					**$557,541**

Proposed Changes to Work Plan for FY23

(December 2022)

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

- No cost change.
- Specific locations to be assessed in 2023 updated to the following:
    - Bear Creek*:* Loach Minnow were salvaged from Bear Creek in 2020 and transferred to ARCC after the Tadpole Fire. Remaining salvaged fish will be restocked into Bear Creek in 2022 or 2023. The population should be resurveyed at least one year post-repatriation.
    - Harden Cienega Creek*:* Green Sunfish were detected in Harden Cienega Creek by AZDGF in 2017. The Department and AZDGF surveyed several tanks in the headwaters of the drainage for Green Sunfish in 2021 and 2022. Several tanks are located on private property and permission to survey was not granted by the landowners. The Department plans to make further attempts to survey the remaining tanks on private land in 2023. These surveys are directly related to Harden Cienega Creek Native Fish Restoration (AZ-2014-1) and will be conducted in coordination with AZDGF.
    - Saliz Canyon*:* Saliz Canyon was stocked with Loach Minnow in 2016, 2017, and 2019. Subsequent surveys indicated that the species is present in the stream, but has yet to expand from the original stocking location near Cottonwood Campground. In 2023, additional stocking locations will be investigated with stocking at any identified suitable location occurring in autumn 2023 or 2024 with fish from ARCC.
    - Tularosa River: The Tularosa River currently supports Loach Minnow but not Spikedace. However recent work by Crosby (2020) indicated that the river is suitable for the species. We will stock Spikedace in the Tularosa River at suitable locations in 2023. Stocking will continue to 2025. Surveys will be completed in 2026 to assess the success of the stocking effort.
    - Glenwood Pond: The Department recently acquired a property in Glenwood, NM that contains a large pond. We will sample the pond to determine the fish community and water quality. This pond could be a location for a Roundtail Chub population and potentially a broodstock pond.

Project 4: Muleshoe ecosystem stream and spring repatriations

- Cost updated to $9,754.

Project 5: Gila Topminnow Stockings

- Cost updated to $45,728.
- New location of Gila Chub stocking added for Sycamore Creek with the below description.
    - <u>Background:</u> The purpose of this subproject is to extend the current distribution of Roundtail (Gila) Chub in Sycamore Canyon. A natural waterfall barrier (Double T Ranch Falls) exists downstream of Double T Ranch, which prevents upstream movement of all fish species. Translocation of these fish upstream of the falls would greatly extend their range in the system and increase the resilience of this chub lineage to disturbances. Sycamore Creek was evaluated in November, 2022 and determined to be too cold to support Gila Topminnow translocations. Work planned for FY2023 includes a survey of

the donor population downstream of Double T Ranch to determine how many fish are available for translocation, and collection and translocation at a later date. Augmentation of the chub population may occur if necessary. The subproject will be complete by 2027 if additional stockings do not occur.

- Geographic Area: Sycamore Creek is located on the Prescott National Forest and is a tributary to the Agua Fria River. Populations of Roundtail Chub occupy three isolated sections of the stream; Rock Bottom Box, Middle Box, and Double T Box. These populations are currently isolated from populations of nonnative fish that exist downstream near the townsite of Dugas by the presence of several natural fish barriers. A small population of Rainbow Trout exists mostly upstream of Double T Ranch Falls, with some individuals persisting with the chub population downstream of the falls.

Project 6: Spring Creek (Oak Creek tributary) Repatriations

- Cost updated to $10,311.
- Additional translocation of Gila Topminnow to Spring Creek added.

Project 7: Blue River Native Fish Restoration

- Cost updated to $42,917.
- Additional Translocation of Spikedace and Roundtail Chub to the upper and lower Blue River added.

Project 8: Harden Cienega Creek Native Fish Restoration

- Cost updated to $29,359.

Project 9: Upper Verde River native fish restoration

- Cost updated to $14,949.

Project 10: Sharp Spring Native Fish Restoration

- Cost updated to $25,014.

Project 11: Remote Site Inventory and Assessment

- Cost updated to $36,464.

Project 13: Aquatic Research and Conservation Center Populations

- Cost updated to a total of $138,442.
  - *Acquisition of Spikedace and Loach Minnow and other rare species from the wild updated to* $6,696.
  - *Aquatic Research and Conservation Center cost updated to* $131,746.
- One Gila Topminnow (Parker Canyon lineage) refuge population added.