2022

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, Sonora Sucker, Speckled Dace, Longfin Dace.

Project Description:

Background – The West Fork Gila River supports an intact native fish assemblage, including Federally Endangered, Gila River Basin Native Fish 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. Propst et al. (2014) evaluated these efforts using data from 2007 to 2012; results indicated reduced biomass of some nonnatives as well as an increase in biomass of Spikedace. The Whitewater Baldy Fire of 2012 and subsequent flooding had severe effects on the West Fork Gila River within the project area. Nonnative fishes were greatly reduced 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.

Geographical Area – The project area is the 4 km of the West Fork Gila River between the confluences of Little Creek and the Middle Fork Gila River. This project affects one population of Spikedace and Loach Minnow; however, it is part of one of New Mexico's largest interconnected populations 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 species will be measured for total length (TL), and weight will be measured for fish over 99 mm TL. Total length will be measured on all Catostomids. 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. 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.

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: $43,656
    - New Mexico Department of Game and Fish: $24,301
    - 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: Upper San Francisco River, Saliz Canyon, Mule Creek
- Upper Gila River Drainage: Little Creek
- Blue River Drainage: Dry Blue Creek
- Other locations as needed for evaluation

Species Protected: Loach Minnow, Spikedace, Gila Chub

Project Description:

Background – This objective of this project is to identify potential repatriation streams and sites, evaluate potential donor populations and site suitability, conduct repatriation of identified streams, and monitor streams post-repatriation. This project encompasses all New Mexico streams within the Gila, San Francisco, and Blue River basins that might serve as repatriation or donor sites or require evacuation of priority species due to wildfire or drought. In 2022, repatriation stockings and surveys are scheduled to continue in Saliz Canyon (Ferguson and Zeigler 2020). In 2021, lower Sapillo Creek is being investigated as a potential repatriation site and could be stocked in 2022 if conditions are suitable. Bear Creek and Negrito Creek will be surveyed in 2021 to determine distribution of Loach Minnow. Although Loach Minnow is present in lower Negrito and Bear Creek, it is possible there are isolated places upstream that would be suitable for repatriation. Other waterbodies to be investigated in 2022 will be determined after 2021 work is completed. 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 covers 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.

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 is used in tandem to collect fishes from rapid-velocity habitats (e.g., riffles and

chutes). Waterbodies to be investigated in 2022 will to be determined after the 2021 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 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 is 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: $60,703

- New Mexico Department of Game and Fish: $33,918
- 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, Roundtail Chub, and Gila Topminnow from ARCC in New Mexico. Some stocking projects are ongoing and ready to implement, others require preliminary approval. Several projects are in the monitoring phase of repatriation.
- *Does this project have in-kind or matching funds?* No

Project 3: Remote Site Inventory and Assessment

(Task ID: NM-2017-2)

Implementing Entity: New Mexico Department of Game and Fish (Department), US Fish and Wildlife Service (USFWS), US Forest Service (USFS)
Start Year: 2017
Location(s): San Francisco River
Species Protected: Loach Minnow, Spikedace, Roundtail Chub, Gila Trout, Speckled Dace, Longfin Dace, Desert Sucker, Sonora Sucker

Project Description:

Background – Much of the Gila River Basin in New Mexico is extremely remote and thus difficult to sample. The 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 West Fork Gila River is scheduled to be surveyed in 2021. 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 2022, 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. There is an expanding population of Loach Minnow, a newly repatriated population of Spikedace, and newly documented Roundtail Chub 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 is 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 2023.

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, 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 and Spikedace 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: $66,632
    - New Mexico Department of Game and Fish: $26,578
    - 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: The objectives of this project were to establish Spikedace and Loach Minnow in Redfield Canyon and to suppress Green Sunfish to benefit the native fishes; the first objective is finished and the second is ongoing. This is an ongoing project with GRBNFCP-funded conservation efforts beginning in 2007. Spikedace and Loach Minnow were stocked into Redfield Canyon in 2007, 2008 and 2010, but failed to establish. In 2007, Gila Chub, Sonora Sucker, and Speckled Dace were translocated upstream of a waterfall in Redfield Canyon to expand their range in that system, and have established there. Gila Topminnow (Bylas lineage and MU) have dispersed downstream from Swamp Springs Canyon (where they were stocked in 2008-2009), and have become established in Redfield Canyon.

One Green Sunfish removal was performed each year since 2007, except two were performed in 2010, 2012, and 2020. During 2008-2012, The Nature Conservancy led removals and typically completed one removal in March-April, and again in May-June. 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 near the western wilderness boundary, in what was referred to as the lower perennial reach or Reach 3. Beginning in 2014, one removal, in May or June, was completed in each reach. Green Sunfish captures in the upper perennial reach fluctuated from year to year, but generally declined from 2010 through 2020 (58, 33, 12, 48, 17, 0, 2, 1, 15, 20, and 4 captured in each respective year; Figure 1; Hickerson et al. 2021). Green Sunfish do not appear to be established in the upper perennial reach, and fewer than 21 were captured each year since 2014, so it is likely they have little influence on native fish abundance in this upper reach. However, during flow events that connect the two perennial sections, they are able to move upstream into the upper perennial reach from the lower perennial reach that spans BLM wilderness and private land. Permission to access and conduct removals on the private land has not been granted. The Green Sunfish population in the lower perennial reach is well established (Figure 1). A barrier was planned,

but postponed indefinitely in 2018 because the State Land Department would not agree to transfer property to Reclamation. As a result, upstream movement of Green Sunfish cannot be prevented. The private landowner has been contacted multiple times in 2019 and 2020 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 2020.

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 2022 includes a removal trip with multiple passes in 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).

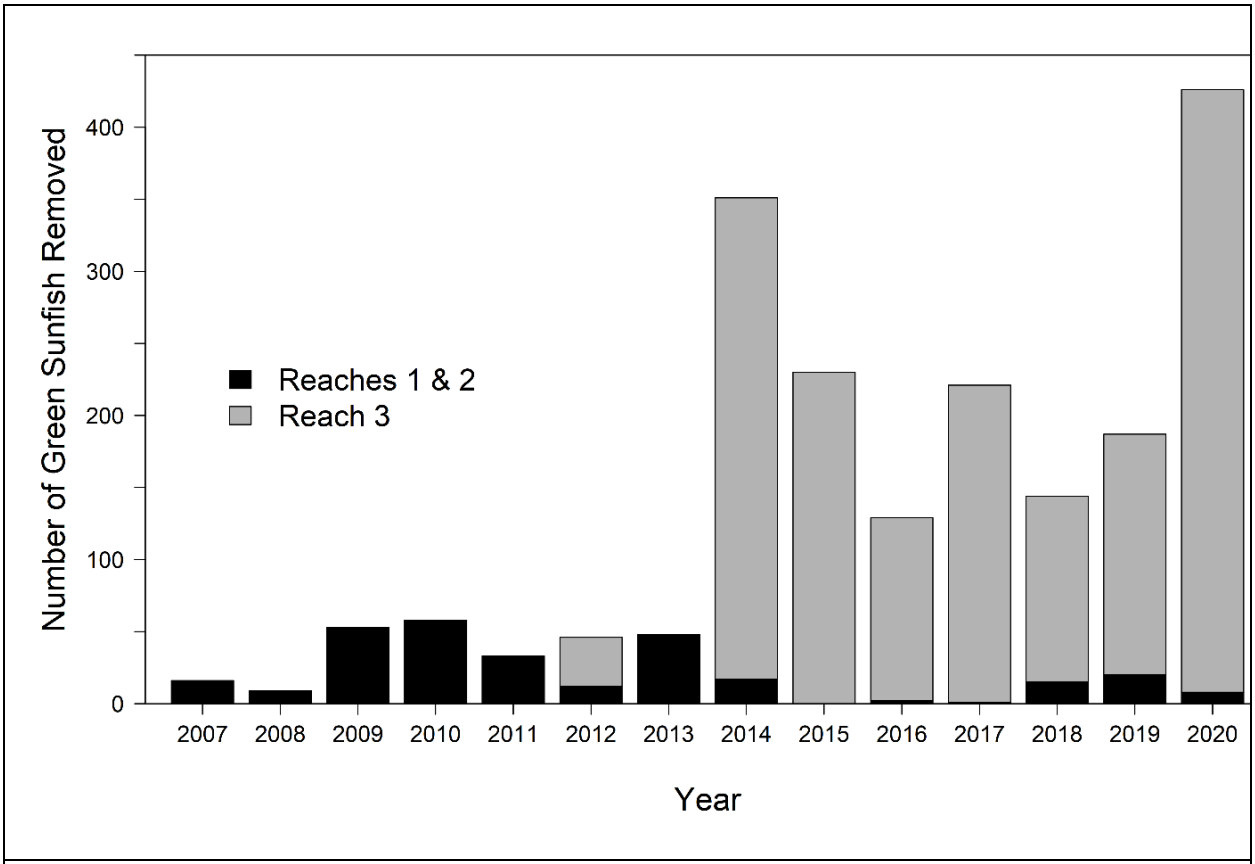

Figure 1.—Number of Green Sunfish removed during annual spring removal efforts and autumn monitoring from three reaches of Redfield Canyon, Arizona during 2007-2020.

Geographical Area: The project area for Redfield Canyon currently includes Redfield Canyon from the upper barrier (UTM 12S 563858/3589841) downstream to the wilderness boundary (559591/3589178).

The project area is occupied by Gila Chub[2], Gila Topminnow, Longfin Dace, Speckled Dace, Sonora Sucker, and Desert Sucker. The current project area is divided into three reaches. Reach 1 is the most upstream reach and extends from the sunfish barrier to the confluence with Swamp Springs Canyon and is mostly perennial. Reach 2 extends from the confluence with Swamp Springs Canyon downstream to the confluence with Rock House tributary and is mostly intermittent with surface water in June limited to just a few hundred meters downstream of Swamp Spring Canyon. Reach 3 extends from the Rock House tributary downstream to the wilderness boundary and is mostly intermittent except for the most downstream several hundred meters. Reach 3 is dominated by Green Sunfish. Currently, movement of nonnative fishes from the San Pedro River into Redfield Canyon is only prevented by an ephemeral reach approximately 11.5 kilometers in length. Land ownership within the project area includes BLM, State Trust land, TNC, and private land. Land management agencies and TNC are supportive of ongoing native fish conservation efforts. The downstream private landowner has been contacted multiple times but has not yet allowed access. Therefore, we do not have permission to carry out conservation actions on their property.

Methodologies: If the private landowner does not grant access to their property to conduct removals, the 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-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 six passes will be completed in 2022 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 removals 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 the native species.

Partnerships

This project has been implemented as part of a larger cooperative effort between the Department, TNC, BLM, USFWS, and Reclamation. This project builds upon work already funded within the Muleshoe Cooperative Management Area, including past nonnative fish removals in Redfield Canyon, and the establishment efforts of 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 upper perennial reach, 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 (2014)
    - 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 FY22 is $13,800.

- Urgency: This project is moderately urgent. A lapse in Green Sunfish removals may allow Green Sunfish to increase in the upper reach 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, Sycamore Creek, Tortilla Creek, and locations stocked in 2021 or proposed to be stocked in 2022, which may include: Buehman Canyon, Dix Creek, Mule Spring, Mescal Creek, Sands Draw, San Pedro River at Three Links, and Boyce Thompson Arboretum.

Species Protected:

- Gila Topminnow
    - Three existing wild replicate populations: 2 of 9 replicates of Lower Santa Cruz MU, 1 of 7 replicates of Cienega Creek MU.
    - Two new populations: 1 new replicate of Cienega Creek MU, 1 new replicate of Lower Santa Cruz MU.
    - Eight proposed populations (various MU's).
    - One proposed population: Monkey Spring MU.
- Gila Chub[3] : One remnant population in Sabino Canyon.

Project Description:
The objective of this project is to establish new viable populations of Gila Topminnow within historic range; Desert Pupfish are stocked into some of the same sites if habitat is deemed suitable. The methodologies are only presented for the overall project because they are the same for all listed subprojects. Fish will be collected from potential donor locations for health assessments before stockings taking place.

Edgar Canyon
Background: Edgar Canyon is an ongoing project. 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. Work planned for 2022 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. The subproject will end in 2022 if additional stockings do not occur.

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 of 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

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2019. Pima County recommended the site for Gila Topminnow establishment, and continues to be supportive.

Aravaipa Creek

Background: Aravaipa Creek is a new project. The Department will coordinate with USFWS to determine the appropriate donor location and lineage to use. Any MU lineage can be stocked into the San Pedro drainage, so the lineage most in need of replication will likely be chosen. Work planned for 2022 includes the initial stocking and six month monitoring. Post-stocking annual monitoring will continue for three years after the final stocking. The subproject will end in 2025 if additional stockings do not occur.

Geographical Area: Aravaipa Creek is a tributary to the San Pedro River about 17 km south of Winkelman, AZ and 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 22-miles. There are two constructed fish barriers (Reclamation funded) at the west end of the creek that prevent incursion of nonnative fishes upstream. 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 them in 1969 and 1977 (Weedman 1999). If topminnow become established, they would represent a Level 2 replicate population in a large stream.

Landownership is comingled with private, federal, and tribal inholdings. The two primary landowners for the perennial portion of the stream are BLM and TNC, both of which are supportive of the project, and the latter actually recommended pursuing the project. 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 project.

Sabino Canyon

Background: Sabino Canyon is an ongoing project. The first part of the project resulted in the establishment of a population of Gila Topminnow (Cienega Creek lineage and 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 Gila Chub were captured and more were observed near the original stocking location. Stream habitat was impacted by the Bighorn Fire in June 2020, and will be assessed further in 2021. In 2022, planned work includes annual monitoring of Gila Topminnow and Gila Chub near East Fork Sabino. If habitat remains suitable following post-fire impacts, topminnow and possibly chub will be augmented. Post-stocking monitoring will continue for three years after the final stocking for topminnow and five years after stocking for chub. The subproject could end as early as 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 project 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 project area. An established topminnow population near the confluence with East Fork Sabino Canyon would allow for topminnow to disperse downstream of the project 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 project area is located entirely within the Coronado National Forest. The Forest is supportive of and has participated in the project.

Sycamore Creek

Background: The purpose of this project is to establish Gila Topminnow in Sycamore Creek. Prescott National Forest staff indicated re-consultation for ongoing activities would be completed in FY21, so the Department would likely be able to stock topminnow in 2021. Therefore, the Department plans to stock Gila Topminnow (Redrock Canyon lineage of Lower Santa Cruz MU) into Sycamore Creek below Double T Ranch falls in 2021. Work planned for 2022 would be the first post-stocking monitoring and augmentation to establish a viable population as necessary. Post-stocking monitoring will continue for three years after the final establishment stocking. Up to three stocking attempts may be made to establish a population. Therefore the annual monitoring and thus the project could be completed by 2024 if additional establishment augmentations are not required.

Geographical Area: Sycamore Creek is a tributary to the Agua Fria River, and drains from the Black Hills and Pine Mountain Wilderness. The uppermost portion of the stream is occupied by Rainbow Trout, which are largely restricted to this reach because of water temperature. Below Double T Ranch falls there are three perennial sections, each only about 100-m long: one immediately below the falls, one at a location known as Middle Box, and a third at a location known as Lower Box. Gila Chub are found in each of these perennial sections. A waterfall near Lower Box, prevents upstream movement of nonnative fish, and large sections of the stream being intermittent or ephemeral, hinder the upstream movement of nonnative fishes from the lower portion of the creek near Dugas and the Agua Fria River. The perennial reaches above Lower Box and below Double T Ranch falls are on Prescott National Forest lands. The Forest is supportive of the project, pending completion of ESA Section 7 consultation.

Tortilla Creek

Background: Tortilla Creek is an ongoing project. Tortilla Creek was initially stocked with Peck Canyon lineage (Lower Santa Cruz MU) in 2017, about 4.5 km upstream of the confluence with Mesquite Creek. Topminnow abundance increased during monitoring in 2017 and 2018 before drastically declining in 2019. The population was augmented with 374 fish in April, 2020 and monitoring in October detected several hundred individuals. Since this population was augmented in 2020, monitoring should continue until 2022 unless a final augmentation to establish a viable population is attempted. Work planned for 2022 includes the final post-stocking monitoring and the project is expected to be completed in 2022.

Geographical Area: Tortilla Creek is located within the Salt River Drainage in the Tonto National Forest and flows into Canyon Lake near Tortilla Flat, AZ. The lower portion of Tortilla Creek has an established population of Gila Topminnow (Monkey and Cottonwood springs MU) near Tortilla Flat. Gila Topminnow in the lower reach of Tortilla Creek likely originated from a population stocked in 1982 in Mesquite Tank #2 (above Unnamed Drainage #68-B). Due to the steep gradient and multiple waterfall barriers, Gila Topminnow never dispersed upstream into the upper perennial section of Tortilla Creek (about 4.3 km upstream of the confluence with Mesquite Creek). The natural barriers also prevent any potential upstream movement of nonnative fishes from Canyon Lake. The Tonto National Forest is supportive of this project.

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 2021 or 2022. 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 about locations to stock and sources and lineages of fish to use. Fish for repatriations 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 then be transferred into transport coolers (100 qt. minimum) equipped with aerators and filled with well water treated with salt and Amquel®. At the repatriation 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 ten baited collapsible minnow traps for a minimum soak time of two hours. Opportunistic seining and dip netting is carried out when stream conditions and time allow. Captured fish are counted by size class and released alive. 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. If during the first and second year of monitoring, fewer than 100 topminnow are captured, additional topminnow may be stocked to help the population establish. The threshold number is based on the assumption that trapping captures at

best only 25% of the local population. The minimum target for a viable population is 500 over-wintering adults (Weedman 1999). So if fewer than 100 topminnow are captured, a proportion of which may be juveniles, it is unlikely that there will be 500 adults in the population.

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

Program Priorities

This project will replicate at least five populations of Gila Topminnow in the wild. This project will provide immediate on the ground benefits by establishing multiple new Gila Topminnow populations within the Gila River basin.

Partnerships

This project is in partnership with the U. S. Forest Service, Bureau of Land Management, U. S. Fish and Wildlife Service, and Reclamation. This project is part of a larger collaborative effort to restore Gila Topminnow to suitable habitats within the historical range. This project builds upon previously funded work by monitoring topminnow at previously stocked locations and attempting to establish populations at locations where habitat assessments were 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 (2014)—*For Sabino Canyon Project only*
    - 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 FY22 is $21,300.
- Urgency: This project is moderately urgent. If the sites are not monitored then we would be unable to determine if the populations are established or if more individuals need to be stocked to help the establishment. If the two new sites are not stocked, then we would not be increasing the number of wild replicates of the specified lineages.
- 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 FY22.

- Matching Funds: This project does not have matching or in-kind funds.

Literature Cited:

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 araService, 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: one remnant population not replicated elsewhere.
- Other native fish 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 GRBNFCP, but completed by the Department's Conservation and Mitigation Program (CAMP). 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 as of 2020 was considered established. 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. Spikedace monitoring will continue for five years after the final establishment stocking. Therefore, the final post-stocking monitoring will be completed in 2023 if no additional establishment stockings occur.

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.
FY2023: 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 transects 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 transects, and at the one fixed transect that encompasses Willow Point Road, three-pass backpack electrofishing. 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 (of the Middle 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 (2014)
    - Task 3.2 (priority 2) Conduct monitoring

Estimated Time and Cost:

- Cost: The estimated cost of this project for FY22 is $5,000.
- Urgency: This project is moderately urgent because failure to monitor in Spring Creek will postpone any determination of establishment at this location.
- Readiness: All necessary compliance has been completed for all partners involved.
- Matching Funds: This project does not have matching or in-kind funds.

Project 7: Blue River Native Fish Restoration

(Task ID: AZ-2002-3)

Implementing Entity: Arizona
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 removals and stocking of native fish in the lower 19 kilometers. Nonnative fish appear to be eradicated from the lower Blue River above the fish barrier as of 2017. Spikedace and Roundtail Chub were successfully established in the lower Blue River and monitoring efforts were transferred to the Reclamation monitoring contract in 2020. Conservation efforts were 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 2022 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. 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. Loach Minnow existed within the 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 how many Spikedace and Loach Minnow can be acquired from ARRC or collected from the lower Blue River for translocation to the middle and upper Blue River. 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 repatriations 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 repatriation 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 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 population in the middle Blue River is monitored by a backpack electrofishing crew of 3 to 4 people making a single pass through ten randomly selected 100-meter long transects, and three passes through the two fixed sites located in two of the three sub-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 will be utilized for evaluating translocation success in the upper Blue River: three reaches, with two fixed 100-m transects, and 13 random transects.

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 allowed the replicated 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. Replication each of the other priority species into a minimum of one surface water.
- Goal 9. Monitor to quantitatively measure and evaluate project success in improving the status of target species and their habitats.

Recovery goals:

- Spikedace and Loach Minnow recovery 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 FY22 is $26,400.
- Urgency: This project is urgent because failure to translocate additional fish or monitor in the Blue River will postpone any determination of establishment at this location.
- Readiness: All necessary compliance has been completed for all partners involved in the Middle Blue and upper Blue.
- Matching Funds: This project does not have matching or in-kind funds.

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: 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 2019 indicated a healthy chub population was beginning to establish above the barrier, however Green Sunfish were also detected both above and below the barrier at the same time (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)[4] 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) were translocated to suitable habitat in lower Harden Cienega Creek in 2019 (no Green Sunfish had been detected in this lower reach before this trip). 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. However, one stock tank in the New Mexico portion of the drainage visited had Green Sunfish present, so this tank, 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).

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.

4 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.

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. Surveys of tributary streams (Prospect Canyon, Chimney Rock Canyon, Antelope Canyon) for isolated populations of Green Sunfish after eradication of sunfish from source tanks.
FY2023: Continue removal passes in Harden Cienega Creek. Annual monitoring of Gila Topminnow.
FY2024: Continue removal passes in Harden Cienega Creek. 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 failed to establish, 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. Green Sunfish appear to be dispersing from at least one stock tank in New Mexico. 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. The Gila National Forest is supportive of native fish conservation activities in Harden Cienega Creek. Permission from private landowners in New Mexico would be required to sample stock tanks on their properties.

Methodologies: The immediate goal of the removal effort will be suppression of Green Sunfish from Harden Cienega Creek. However, if Green Sunfish are eradicated in the upstream stock tank(s) in New Mexico, then the goal for Harden Cienega Creek removals will shift to eradication. The primary method used to remove nonnative fish from the perennial reach of Harden Cienega Creek will be backpack electrofishing. To track removal success and ensure complete coverage, removal efforts each year will consist of a series of full-reach passes. In FY 2022, we plan on completing two full 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. Few Green Sunfish were captured 2017-2020, and spawning (presence of juveniles) has not been documented. Our target is decreasing relative abundance of Green Sunfish with each successive pass.

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). Similarly, targets for native fish populations are an increase in CPUE and a size structure characterized by multiple year classes of both adult and juvenile fish. However, it is possible that Green Sunfish are not yet abundant enough to make measurable impact on the native fish population. Measures of success will be evaluated within and between years. 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.

If Green Sunfish are eradicated from the upstream tank(s) in New Mexico, we will request that the work plan be amended, and the goal will shift to eradication. After the first 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.

We are willing to request a modification to this work plan if NMDGF requests Department assistance for Green Sunfish removal from stock tanks in New Mexico. Once Green Sunfish are eradicated from stock tanks within the drainage, Department staff will walk along the stream beds of Harden Cienega Creek and tributaries Prospect Canyon and Chimney Rock Canyon to determine whether Green Sunfish persist in isolated perennial pools. If Green Sunfish are detected, those pools will be targeted for mechanical removal of the species.

For Gila Topminnow augmentations, fish for repatriations 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 then be transferred into transport coolers (100 qt. minimum) equipped with aerators and filled with well water treated with salt and Amquel®. At the repatriation 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 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 20 minnow traps will be dispersed from the uppermost stocking site to several hundred meters downstream, set in slow velocity habitats and fished for a minimum of 2 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

Through mechanical removal of nonnative Green Sunfish, this project will stabilize one population of Gila Chub, one replicated Gila Topminnow population, and populations of other native fish species; Longfin Dace, Speckled Dace, Sonora Sucker, and Desert Sucker. This project creates a wild replicate of the Bylas MU of Gila Topminnow, and expands 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 itself thus benefiting the native fish populations, 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 (2014)
  - Task 1.3.1 (priority 1) Eliminate or control problematic nonnative aquatic organisms.
  - Task 2.2 (priority 1) Repatriate Gila Chub to new protected streams.
  - Task 3.2 (priority 2) Conduct monitoring.

Estimated Time and Cost:

- Cost: The estimated cost of this project in FY22 is $26,400.
- 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.

Project 9: Red Tank Draw native fish restoration

(Task ID: AZ-2016-2)

Implementing Entity: Arizona Game and Fish Department
Start Year: 2016
Location(s): Red Tank Draw, Rarick Canyon, Mullican Canyon
Species Protected:

- Gila Chub[5]: one remnant population whose distribution was expanded upstream into Rarick Canyon. The Red Tank Draw remnant population is not replicated anywhere.
- Gila Topminnow: one new wild replicate population that represents 1 of 9 replicates of Lower Santa Cruz MU.
- Desert Sucker: one population.

Project Description:

Background: The original purpose of this project was to remove nonnative fish to benefit Roundtail Chub[1] and other native fishes in Red Tank Draw, but a chub range expansion and Gila Topminnow establishment component were subsequently added. The Red Tank Draw native fish restoration project is an ongoing project. The project originally focused on nonnative fish removals in the perennial section which is located within the reach from the USGS gage upstream to near Mullican Canyon. Removals of nonnative Green Sunfish, Black Bullhead, and Fathead Minnow began in 2016 and continued through 2020. A survey of constructed tanks and natural tinajas in the Red Tank Draw watershed detected Green Sunfish and Black Bullhead in Mullican Place Tank in the Mullican Canyon drainage, Green Sunfish in nine tinajas in the Mullican Canyon drainage, and Fathead minnow in Gnat Tank and Rarick Tank in the Rarick Canyon drainage. Bruce Place Tank, which is on private land immediately upstream from Mullican Place Tank, likely supports both Green Sunfish and Black Bullhead based on conversations with the private landowner. The landowner was not interested in cooperating with native fish conservation efforts as of 2017. Based on the tank surveys, Mullican Canyon tinajas, Mullican Place Tank, and Bruce Place Tank are upstream sources of Green Sunfish and Black Bullhead to the perennial section of Red Tank Draw. There is no natural waterfall in Red Tank Draw that prevents upstream migration of nonnative fishes from Wet Beaver Creek, but Red Tank Draw below the removal reach is intermittent to ephemeral, which hinders upstream migration of nonnative fish.

A survey of isolated pools in the Rarick Canyon drainage from 2017 to 2018 detected Black Bullhead in some of the isolated pools. Intensive mechanical removals efforts in 2019 resulted in the eradication of Black Bullhead from the Rarick Canyon drainage. Additional surveys of tanks in the Rarick Canyon drainage that supported Fathead Minnow in 2017 confirmed that Black Bullhead were no longer present in upstream tanks. Roundtail Chub[1] 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. Gila Topminnow were also translocated to one of the same isolated pools above the barrier in April, 2020.

In Red Tank Draw, multiple removal efforts (electrofishing and trapping) were performed each year since 2016: four partial passes in 2016, two partial passes in 2017, three partial passes in 2018, two full

[5] Roundtail Chub in the Red Tank Draw drainage were previously classified as Gila Chub.

passes in 2019, and three full passes in 2020. Department staff removed 277, 212, 1048, 212, and 871 Green Sunfish, and 153, 10, 75, 0, and 0 Black Bullhead in each respective year from 2016 through 2020. Native fish captured during removal efforts in Red Tank Draw included Roundtail Chub and Desert Sucker. Black Bullhead and Green Sunfish cannot be fully eradicated from Red Tank Draw, because they can freely move into Red Tank Draw from upstream (Bruce Place Tank) and downstream sources (Wet Beaver Creek). Work planned for 2022 includes post-stocking monitoring in Rarick Canyon and if needed, augmentations of Gila Topminnow and Roundtail Chub[6].

Project Timeline:
FY2016: Mechanical removals begin in Red Tank Draw
FY2017: Mechanical removals continued in Red Tank Draw. Black Bullhead and Green Sunfish detected in Mullican Place Tank. Landowner denied access to Bruce Place Tank.
FY2018: Mechanical removals continued in Red Tank Draw. Black Bullhead detected in Rarick Canyon. Natural barrier discovered in Rarick Canyon.
FY2019: Mechanical removals continued in Red Tank Draw. Black Bullhead eradicated from Rarick Canyon.
FY2020: Roundtail Chub[1] translocated into three pools in Rarick Canyon. Mechanical removals continued in Red Tank Draw. Gila Topminnow translocated to Rarick Canyon.
FY2021: Roundtail Chub[1] and Gila Topminnow monitored in Rarick Canyon. Additional Roundtail Chub[1] translocated to Rarick Canyon. Mechanical removals continued in Red Tank Draw.
FY2022: Roundtail Chub[1] and Gila Topminnow monitored in Rarick Canyon. Additional Roundtail Chub[1] and Gila Topminnow translocated to Rarick Canyon as necessary.
FY2023: Roundtail Chub[1] and Gila Topminnow monitored in Rarick Canyon.
FY2024: Roundtail Chub[1] and Gila Topminnow monitored in Rarick Canyon.
FY2025: Roundtail Chub[1] and Gila Topminnow monitored in Rarick Canyon.
Estimated year of completion: FY2025

Geographical Area: The project area consists of the upper perennial reach of Red Tank Draw from near the USGS gauging station upstream to near the confluence between Rarick and Mullican Canyons. This reach of Red Tank Draw supports a population of Roundtail Chub[1] and Desert Sucker. Below this perennial reach, the stream is intermittent to ephemeral down to the confluence with Wet Beaver Creek. There are no waterfall barriers in Red Tank Draw to prevent the upstream migration of nonnative fishes from Wet Beaver Creek. Bruce Place Tank, and the Mullican Canyon watershed, are upstream sources of nonnative fishes to the perennial reach of Red Tank Draw. The project area also includes isolated perennial pools in Rarick Canyon. Roundtail[1] Chub were translocated into isolated pools in Rarick Canyon in 2019. A waterfall barrier (~10 meters high) in Rarick Canyon prevents upstream movement of nonnative fishes from the perennial reach of Red Tank Draw. Red Tank Draw, Rarick Canyon and a majority of Mullican Canyon are owned by the Coconino National Forest which is supportive of native fish conservation activities. A small portion of Mullican Canyon, including Bruce Place Tank, is located on private land where the landowner is not supportive of native fish conservation activities.

[6] Roundtail Chub in the Red Tank Draw drainage were previously classified as Gila Chub.

Methodologies: For stockings, fish for repatriations were 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. Chub will be collected from Red Tank Draw and translocated to stocking sites in Rarick Canyon. The Redrock Canyon lineage of Gila Topminnow will be collected from one or more donor sites as determined by the Department in coordination with USFWS. Fish will be collected using gear appropriate for the given water; typical gear types are seines, minnow traps, or electrofishing. 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 transferred into transport coolers (100 qt. minimum) equipped with aerators and filled with well water treated with salt and Amquel®. At the repatriation 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 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[7] population in the perennial pools in Rarick Canyon will be monitored with a combination of collapsible baited minnow traps and mini-hoop nets consistent with Gila River Basin Native Fishes Conservation Program monitoring protocols. Monitoring will occur annually each autumn. Multiple traps will be set in all perennial pools where Roundtail Chub[1] have been translocated and fished for at least 2 h. Targets for Roundtail Chub[1] are an increase in CPUE and a size structure characterized by multiple year classes of both adult and juvenile fish. Measures of success will be evaluated within and between years.

For Gila Topminnow, the techniques used, sample design, and planned analysis are consistent with the methodologies described for post-stocking monitoring of Gila Topminnow in the most recent annual progress report to Reclamation (Hickerson et al. 2021). Ten to 20 minnow traps will be dispersed from the uppermost stocking site to several hundred meters downstream, set in slow velocity habitats and fished for a minimum of 2 h. Captured fish are counted by size class and released alive back to the stream. Total number captured and mean catch rates (CPUE, fish per hour) will be calculated and reported. Targets for topminnow are an increase in CPUE and a size structure characterized by both adult and juvenile fish.

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

Program Priorities

This project stabilizes an existing population of Roundtail Chub[1] and Desert Sucker in Red Tank Draw through nonnative removals, and creates a new replicate population of Roundtail Chub[1] in Rarick Canyon. The establishment of Roundtail Chub in Rarick Canyon will expand the distribution of Roundtail Chub[1] in the Red Tank Draw drainage. This project also creates a new wild replicate population of the

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

Lower Santa Cruz genetic management unit of Gila Topminnow, and thus becomes 1 of 9 replicates of that management unit in Arizona. This project provides immediate on the ground benefits by removing nonnative fishes from Red Tank Draw to benefit existing populations of Roundtail Chub[1] and Desert Sucker, expanding the distribution of the Roundtail Chub[1] population, and establishing a new population of Gila Topminnow.

Partnerships

This project is in partnership with the Coconino National Forest, U. S. Fish and Wildlife Service, and Reclamation. This project builds on previously funded removals in Rarick Canyon and Red Tank Draw. 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 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. Monitor natural and reestablished populations and their habitats.
- Gila Chub draft Recovery plan (2014)
    - Task 1.3.1 (priority 1) Eliminate or control problematic nonnative aquatic organisms
    - Task 2.2 (priority 1) Repatriate Gila Chub to new protected streams
    - Task 3.2 (priority 2) Conduct monitoring

Estimated Time and Cost:

- Cost: The estimated cost of this project in FY22 is $6,300.
- Urgency: This project is urgent because the Red Tank Draw lineage of Roundtail Chub[8] is not replicated at any other locations.
- Readiness: All necessary compliance to implement this project is completed.
- Matching Funds: This project does not have matching or in-kind funds.

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

Project 10: Upper Verde River native fish restoration

(Task ID: AZ-2020-2)

Implementing Entity: Arizona Game and Fish Department
Start Year: 2020
Location(s): Verde River, stock tanks within the upper Verde River drainage
Species Protected:

- Spikedace: possibly one replicated population of a yet to be determined lineage, if nonnative fishes are eradicated from the river.
- Loach Minnow: possibly one replicated population of a yet to be determined lineage, if nonnative fishes are eradicated from the river.
- Gila Topminnow: possibly one replicated population of a yet to be determined lineage, 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. Possibly additional replicates of Roundtail Chub or Longfin Dace in stock tanks in the drainage once nonnative fish are eradicated.

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, of those, which ones pose the highest risk of being sources of nonnative fish to the Verde River.

Project Timeline.
FY2019: Stock tank survey plan drafted and included an analysis to identify tanks most likely to support populations of nonnative fishes.
FY2020: Department staff participated in planning meetings.
FY2021: Department staff will begin to survey stock tanks 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: Work is dependent upon approval of the Department's piscicide treatment planning and procedures process.

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. The Verde River is mostly owned by Prescott National Forest within this reach with some small inholdings of Department and private land. Prescott National Forest is supportive of the Verde River native fish restoration project. 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 from tanks on their lands.

Methodologies:

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

Stock Tank Surveys.—The objective for surveying stock tanks in the upper Verde drainage is to identify tanks that contain nonnative fishes that could be sources of those species 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. Necessary planning and compliance should be completed in 2021 by the Department and partner agencies, after which stock tanks will be surveyed for presence of nonnative fishes. Stock tank surveys will occur in the summer of 2021 and 2022 when water levels are lowest. Department staff will visit all 146 potentially perennial stock tanks within 30 km of the Verde River. 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 FY2022, 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. We do not plan to initiate any removals until at least FY2023. 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.

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 FY22 is $96,600.
- Urgency: This project is moderately urgent because pre-treatment planning, tank surveys and barrier construction all need to occur simultaneously.
- Readiness: The stock tank surveys and planning proposed for FY22 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 11: 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.
- Roundtail Chub[9]: this would be the only replicate of the Sheehy Spring lineage.

Project Description:

Background: The Sharp Spring native fish restoration project is ongoing. Sharp Spring was historically occupied by a relict 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 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. The Department drafted its internal Phase I Piscicide Project document in autumn 2020, and received approval to proceed with Phase 2 planning in early 2021. Also in early 2021, the Department received an Arizona State Parks Commercial Rental Permit for Research and Monitoring, necessary to carry out the work on Arizona State Parks Lands.

The purpose of this project is to eradicate Western Mosquitofish from Sharp Spring, and then repatriate Gila Topminnow and Roundtail Chub[1]. The Sharp Spring lineage of Gila Topminnow would be translocated from one or more of the replicate populations in the state. Roundtail Chub[1] from the nearby Sheehy Spring would also be translocated into Sharp Spring. Work planned by year is presented below.

Project Timeline.
FY2020: Coordination with AZ State Parks. Drafted AZ State Park's CRPRM application. Completed Stage 1 Piscicide Planning document.
FY2021: Completion of Stage 2 (including public meetings) and Stage 3 (preliminary treatment plan) Piscicide planning documents for Commission approval.
FY2022: Chemical treatment and stocking of Gila Topminnow.
FY2023: Monitoring Gila Topminnow, additional translocations as necessary. Translocation of Roundtail Chub[1].
FY2024: Annual monitoring of Gila Topminnow and Roundtail Chub[1].
FY2025: Final monitoring of Gila Topminnow and annual monitoring of Roundtail Chub[1].

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

FY2026: Annual monitoring of Roundtail Chub[10].
FY2027: Annual monitoring of Roundtail Chub[1].
FY2028: Final monitoring of Roundtail Chub[1].
Estimated year of completion: FY2028.

Geographical Area: Sharp Spring is a tributary to the Santa Cruz River in the San Rafael State Natural Area (Arizona State Parks), about 2 km from the United States – Mexico border). It is a perennial spring with approximately 0.6 km of flow which forms a series of 10 pools in cienega-like habitat. The project would create a new wild replicate of the Sharp Spring lineage of Gila Topminnow, of which seven exist. The project would also create a new replicate of the Sheehy Spring lineage of Roundtail Chub, which is not yet replicated. Arizona State Parks is supportive of the project.

Methodologies: Ideally, eradication of Western Mosquitofish will be achieved with a chemical treatment of Sharp Spring. A treatment plan will be developed before a chemical treatment. A treatment would ideally occur in early summer or early autumn when water levels are lowest. 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 if no mosquitofish are captured, they will be considered eradicated. A pass will be at least 10 baited traps set in each pool for at least 2 h, and seine hauls and dip net sweeps in locations where traps are not effective. Following verification of eradication and within 30 days from the treatment, Gila Topminnow will be stocked into each of the major pools. This will return a food source for Northern Mexican Gartersnake. Gila Topminnow will be monitored at 6-months post-stocking, and annually thereafter using standard fish sampling gear. Standard post-stocking monitoring for Gila Topminnow will consist of setting at least one baited collapsible minnow trap in each of the 10 pools for a minimum soak time of two hours. Opportunistic seining and dip netting will be carried out when stream conditions and time allow. Captured fish will be counted by size class and released alive to the stream. Relative abundance (fish per hour), population size structure and dispersal will be evaluated each year. Gila Topminnow will be monitored for three years after the final establishment stocking before determining population establishment or failure. If more than 500 topminnow, with all size classes, are captured during the third post-stocking monitoring, the population will be considered established. To allow at least a year for topminnow to increase in abundance, Roundtail Chub[1] will be stocked one year after Gila Topminnow are initially stocked, and augmented for up to two years if necessary to establish a population. Roundtail Chub[1] will be monitored for five years after their final establishment stocking. If more than 500 chub, with all size classes, are captured during the fifth post-stocking monitoring, the population will be considered established.

Results, analysis, discussion of results, and recommendations for future work will be presented in the annual report. Targets for topminnow and chub are an increase in CPUE and a size structure characterized by multiple age classes (both adult and juvenile fish).

Program Priorities
This project will prepare an historical Gila Topminnow location for the repatriation of the species through the removal of nonnative Western Mosquitofish. This project will replicate the Sharp Springs

[10] Chub in Sheehy Spring that will be stocked into Sharp Spring were previously classified as Gila Chub.

lineage of Gila Topminnow by reestablishing the species in its historical wild location. This project will also 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 reestablishment of Gila Topminnow and repatriation of Gila Chub.

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 (2014)
    - Task 1.3.1 (priority 1) Eliminate or control problematic nonnative aquatic organisms
    - Task 2.2 (priority 1) Repatriate Gila Chub to new protected streams
    - Task 3.2 (priority 2) Conduct monitoring

Estimated Time and Cost:

- Cost: The estimated cost of this project in FY22 is $40,200.
- Urgency: This project is not urgent because Gila Topminnow have already been extirpated from this location. However, the project is more urgent for Gila Chub because no other similar suitable wild refuge sites exist for Sheehy Spring lineage Gila Chub in the San Rafael Valley.
- Readiness: This project will require compliance with Department procedures for planning and executing a chemical renovation project. In addition, Arizona State Parks will also likely require their own internal compliance before a chemical renovation could take place.
- 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 (BLM), Safford Field Office (SFO).

Start Year: Yellow Bullhead (*Ameiurus natalis*) removal was initiated in 2017 for Bonita and Aravaipa Creeks. Earlier removal efforts in both systems targeted Green Sunfish (*Lepomis cyanellus*) and switched to Yellow Bullhead with their elimination.

Location(s): The project areas include Bonita and Aravaipa Creeks. Bonita Creek is located within the Gila Box Riparian National Conservation Area (RNCA) and approximately eight miles of Aravaipa Creek is located within the Aravaipa Canyon Wilderness.

Species Protected in Bonita Creek: Project continuation will help secure and protect populations of federally endangered Gila Chub (*Gila intermedia*) and Gila Topminnow (P*oeciliopsis occidentalis*). Other species that would benefit from continued nonnative fish removal include Longfin Dace (*Agosia chrysogaster*), Speckled Dace (*Rhinichthys osculus*), Sonora Sucker (*Catostomus insignis*), Desert Sucker (*Pantosteus clarkii*), and Sonora Mud turtle (*Kinosternon sonoriense)*.

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 include Roundtail Chub (*Gila robusta*), Longfin Dace, Speckled Dace, Sonora Sucker, Desert Sucker, and Lowland Leopard Frog (*Rana yavapaiensis*).

Protecting and securing the genetic lineages of two of the rarest endemic fishes of the Gila River basin, Loach Minnow and Spikedace, through nonnative predator removal is imperative as both species are collected annually from Aravaipa Creek to augment refuge populations that are maintained at the Aquatic Research and Conservation Center (ARCC) as protection against catastrophic loss in the wild. The ARCC refuge populations of Loach Minnow and Spikedace are also used to replicate new, or repatriate lost populations into appropriate and protected streams within Arizona and New Mexico and for research purposes.

Project Description: The proposed projects are continuation of work partially funded by Bureau of Reclamation's (BOR) Gila River Basin Native Fishes Conservation Program for Bonita and Aravaipa Creeks. Both systems are unique in that they still support intact native fish assemblages, despite presence of nonnative fishes. The BLM, SFO plans to continue mechanical removal of nonnative fish species, with an emphasis on Yellow Bullhead from 1.9-miles of Bonita creek and 22-miles of Aravaipa Creek. The effort is collaborative, ongoing, and is required to protect the native fish assemblages in both creeks.

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 about 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.

Background for Bonita Creek: In 2008, 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 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 (Figure 1). 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 not feasible due to habitat complexity (which is likely the reason the first treatment failed), and public perception.

Removal of Green Sunfish began August of 2009 with their discovery and ended September 4, 2018 as they are no longer detectable. A total of 23,282 Green Sunfish were removed from a 1.9-mile reach of lower Bonita Creek (Table 1). Although a variety of different gear types were used to eradicate Green Sunfish, the majority, 21,742 were captured in standard Gee metal minnow traps and large Promar nets. Gee metal minnow traps captured 15,384 of the Green Sunfish, Promar nets captured 5,602, and a mix of Promar nets and Gee metal minnow traps that were not differentiated captured 756, which took an effort of 47,034 net sets. The remaining 1,540 Green Sunfish were captured with ancillary gear types. Yellow Bullhead removal began in 2011 with their detection. A total of 4,817 Yellow Bullhead have been removed to date using gear types similar to what was used for Green Sunfish.

Removal effort varied over the years and was largely dependent on funding and personnel availability. In 2016, with increased funding from the BLM Washington Office and the Bureau of Reclamation's Gila River Basin Native Fishes Conservation Program, we were able to hire a dedicated removal crew that was able to more than double our overall removal effort in 2016 from 2015. This increased removal 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 important, but the amount of effort expended is likely the most significant factor in removal effectiveness. Underestimating the effort needed, funding constraints, and lack of personnel are the primary reasons it took nine years to eliminate Green Sunfish from Bonita Creek.

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

A total of 4,817 Yellow Bullhead were removed from Bonita Creek from 2011 through 2020 (Table 2). An additional 15 Yellow Bullhead were removed during annual fish monitoring in March. A length-frequency histogram of all the fish removed, except for one not measured, from Bonita Creek in 2020 depict several age classes of Yellow Bullhead including young-of-year fish (less than 50 mm TL), juveniles less than 140 mm TL, and adults 140 mm TL or greater (Figure 2). Current removal effort is not enough for eradication, but does maintain a level of suppression, which allows for reproduction and recruitment of native fish in reaches with Yellow Bullhead.

Methodology: A variety of gears will be used to remove nonnative fish species, including Promar collapsible nets (0.3 m diameter, 0.6 and 0.9 m long, double throat, 1.2 cm mesh), Gee metal minnow traps (25 cm diameter, 47 cm long, double throat, 0.6 or 0.3 cm mesh), hoop nets (0.7 m diameter, 1.2 m long, two-hoop, single throat, 0.6 cm mesh), backpack electrofishers (Smith-Root LR-24 or LR-20B), and seines. Collapsible nets and minnow traps will be the primary gear used due to proven effectiveness in deeper pool habitats. Nets and minnow traps will be baited with wet or dry dog food. Net ties will be sprayed with animal repellent to deter wildlife from entering or pulling nets out of water. Nets and minnow traps will be set in daytime and fished overnight. Time of deployment and retrieval of nets and minnow 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.

All species collected will be identified, classified as either juvenile or adult, and enumerated. Total length (TL) measurements in millimeters (mm) will be recorded for Yellow Bullhead and sexed if gametes expressed. Yellow Bullhead ≥140 mm TL will be classified as adult, whereas <140 TL will be classified as juvenile.

All nonnative fish species will be placed in a bucket and euthanized with an overdose of tricane methanesulfonate (MS-222) and discreetly placed away from the creek and visitors in a debris pile or buried. Non-targeted native species, including Sonora Mud Turtle (*Kinosternon sonoriense*) will be returned to the water immediately at or near the point of capture to minimize impacts to them.

A minimum of six removals trips will be conducted at Bonita Creek in 2022. Removals before June will target Yellow Bullhead before spawning (Table 3).

Data Analysis: To assist in data analysis and to track Yellow Bullhead distribution, removal efforts will be recorded by low-water road crossings (n=14), which divide Bonita Creek into 15 segments. Data will be entered and maintained in a Microsoft Access® database to facilitate analysis. Data analysis will include number of each species and total number of all fish removed by segment, catch per unit effort (CPUE) by segment, and total CPUE (per trip). Removal and annual fish monitoring 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 could show 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.

Background for Aravaipa Creek: Considered one of the premiere native fish assemblages in the state, Aravaipa Creek (Figure 3) 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, was successfully removed from Horse Camp Canyon, a tributary to Aravaipa Creek, by BLM, SFO and partners using a variety of gear types, including Promar nets, Gee metal minnow traps, dipnets, seines, and backpack electrofishers from 2010 to 2015. With the elimination 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. Future invasions of nonnative fishes from the San Pedro River are unlikely due to paired fish barriers that were constructed in 2001 by Bureau of Reclamation.

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

Geographical Area: Aravaipa Creek is a tributary to the San Pero River and is in southeastern Arizona about 50 miles west of Safford, Arizona, along the border of Graham and Pinal counties (Figure 3). 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 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 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 18 of the 19 landowners contacted.

Summary of Past Results for Aravaipa Creek: The BLM, SFO and partners completed eleven removal trips in 2020. One-hundred and sixty-three stream segments, totaling approximately 82.5 river kilometers were sampled in 2020. A total of 2,896 Yellow Bullhead were removed. Juveniles comprised 74% (n=2,153) of total catch and adults comprised 26% (n=742). One Yellow Bullhead was not measured. An additional 127 juvenile Yellow Bullhead were removed during the fall 2020 bi-annual fish monitoring (Table 4). A length-frequency histogram of all the fish removed (excluding those collected during fish monitoring) from Aravaipa Creek in 2020 depict several age classes of Yellow Bullhead including young-of-year fish (less than 50 mm TL), juveniles less than 140 mm TL, and adults 140 mm TL or greater (Figure 4).

Overall, seventeen removal trips have been completed since 2017 and a total of 3,520 Yellow Bullhead have been removed. Additionally, 188 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 3,708 Yellow Bullhead removed from Aravaipa Creek (Table 5).

Methodology: A variety of gears will be used to remove nonnative fish species, including backpack electrofishers, seines, Promar collapsible nets, and Gee metal minnow traps. See Bonita Creek methodology for equipment dimensions and model types. Backpack electrofishing will be the primary method used due to its proven effectiveness at Aravaipa Creek. Backpack electrofishing used in conjunction with dip-nets, or seines ("block and shock") will be used in pool habitats and along streambank margins. Typical settings (*e.g.,* volts 140, frequency 30-45, and duty cycle 12%) that have been effective with capturing Yellow Bullhead while minimizing injury to native cyprinids will used. Seines, traps, or nets will be used in deeper pool habitats where electrofishing is not effective. If traps or nets are used, their location will be marked with a UTM coordinate or conspicuously identified if no GPS signal is available, they will be baited with wet or dry dog food and set for a maximum of two hours. Benefits of these removal methods include low impact to non-targeted species and neutral to positive public acceptance.

Total length measurements in millimeters will be recorded for Yellow Bullhead and Red Shiner and sexed if gametes expressed. All nonnative fish species will be placed in a bucket and euthanized with an overdose of tricane methanesulfonate (MS-222) and discreetly placed away from the creek and visitors in a debris pile or buried. Non-targeted native species, including Lowland Leopard Frog will be returned to the water immediately at or near the point of capture to minimize impacts to them.

Removal efforts, when feasible, will focus on adults before 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 allows for selective removal of nonnatives.

A minimum of five removals will be conducted in 2022. Removals before June will target Yellow Bullhead before spawning (Table 6).

Data Analysis: To assist in data analysis and to track Yellow Bullhead distribution, removal efforts will be recorded in discrete 500-meter segments (n=79) along the entirety of the 22-mile target reach. Data will be entered and maintained in a Microsoft Access® database to facilitate analysis. Data analysis will include number of each species removed by site and total number of fish removed, catch per unit effort (CPUE) by site (500-meter segment) and total CPUE (per trip), and total length-frequency by nonnative species. Removal and bi-annual fish monitoring 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 could show what effect, if any, removal has on native and nonnative fish species. The purposeful avoidance of catching native fish species during electrofishing in Aravaipa Creek will preclude analysis of native fish trends from these data. However, bi-annual monitoring conducted on both streams along with trapping conducted during removal efforts will be available for analysis. 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 four priority species, Gila Chub and Gila Topminnow in Bonita Creek and Loach Minnow and Spikedace in Aravaipa Creek. Aravaipa Creek supports one of only three remnant populations of Loach Minnow in Arizona and the only

remnant population of Spikedace in Arizona. Additionally, two populations of Speckled Dace, Longfin Dace, Sonora Sucker, and Desert Sucker and one population of Roundtail Chub will benefit from nonnative fish removal from these two creeks.

Immediate, on-the-ground benefits are attained 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 intact native fish, 93 fish parts, and one lowland leopard frog were removed from the intestinal tracts of 57 of the 243 Yellow Bullhead captured (one stomach had two fish, a Desert Sucker and Longfin Dace). Presence of 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 and Aravaipa Creeks nonnative fish removal projects were initiated in 2009 and 2010, respectively, and targeted Green Sunfish. Yellow Bullhead are now being targeted as Green Sunfish populations in both creeks have either been eliminated or they are at non-detectable levels. Both projects have been partially funded through Bureau of Reclamation's Gila River Basin Native Fish Conservation Program. Other partners that have contributed or worked on these projects include, US Fish and Wildlife Service, The Nature Conservancy, University of Arizona, Gila Watershed Partnership, and volunteers.

Strategic Plan Goals:

- *Scientific Foundation*
  Goal 1a. Seek at least one opportunity to partner or fund new control methods or improvements upon existing methods.
- *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 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:

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 historical 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 historical 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.

3) Monitor remnant and replicated populations to ensure they are persisting, and threats are being managed.

3.2. Conduct monitoring.

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 2022 to continue Yellow Bullhead removal from Bonita and Aravaipa Creeks (Table 7). Complete eradication of Yellow Bullhead from Bonita Creek will likely require an effort comparable to what was done for Green Sunfish and would entail a minimum of three interns working weekly, four days per week, for up to one-year. Budget costs to hire three interns full-time for one year are estimated at $113,695. This would cover salary for three full-time interns for one-year, 100 Promar nets, two-500 grams bottles of MS-222, five

aquarium dipnets, five, five-gallon buckets, three measuring boards, and equipment and supplies for two Clemson beaver pond levelers (Table 8).

What is the urgency of this project? The native fish communities in Bonita and Aravaipa Creeks have been able to persist with Yellow Bullhead although predation has been documented. Removal of Yellow Bullhead from both systems will help the native fish better withstand stressors such as drought, 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 covers salary, vehicle, supplies, and equipment for Yellow Bullhead removal at Bonita and Aravaipa Creeks (Table 7).

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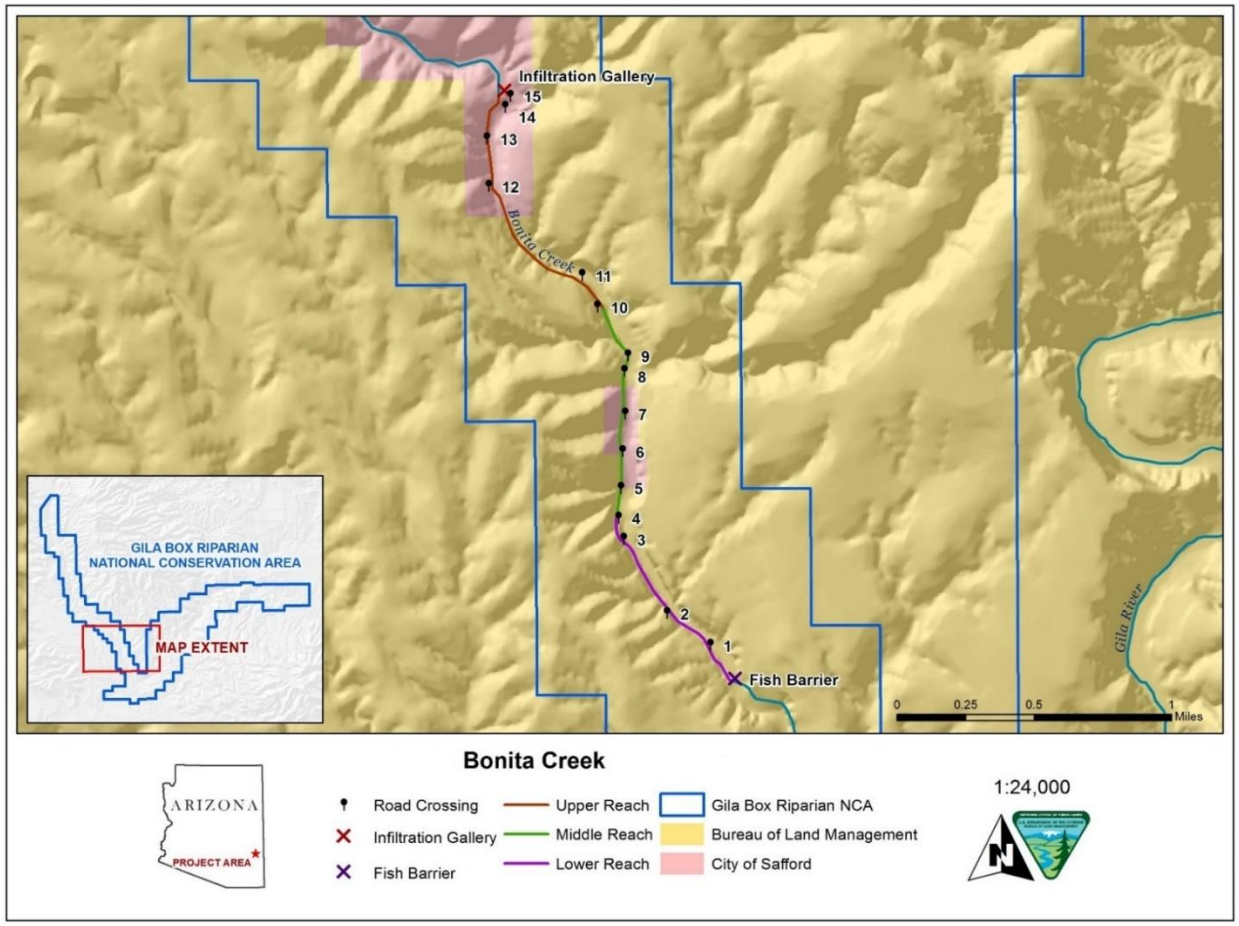

Figure 1. Project area showing low water road crossings, City of Safford infiltration gallery, fish barrier, and stream reaches of Bonita Creek.

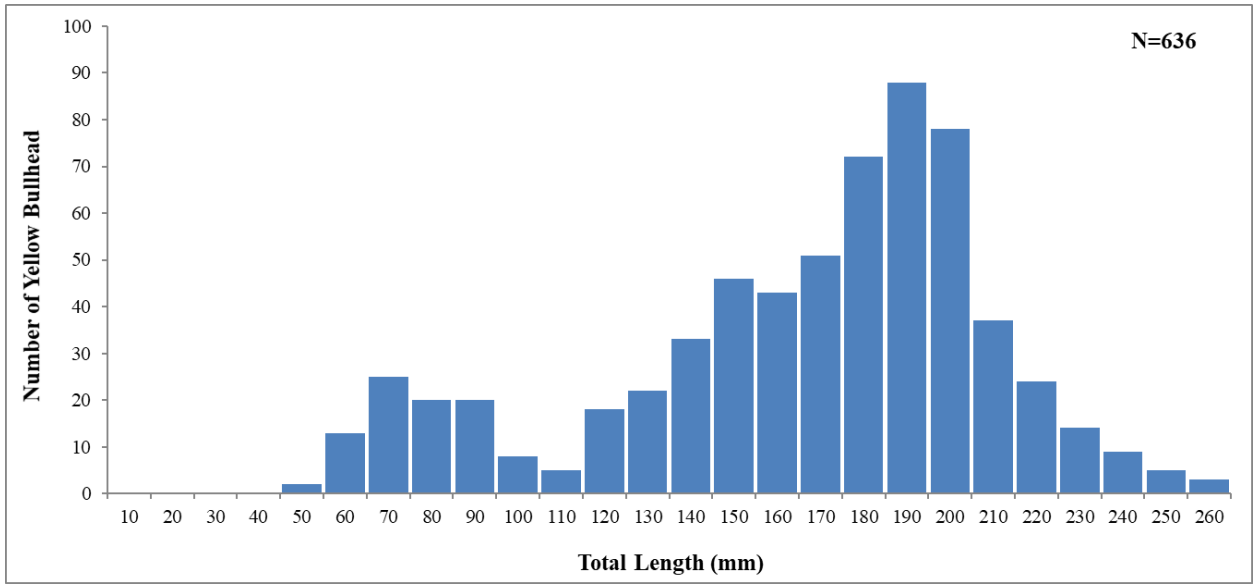

Figure 2. Length frequency histogram of Yellow Bullhead catch in Bonita Creek, January-September 2020.

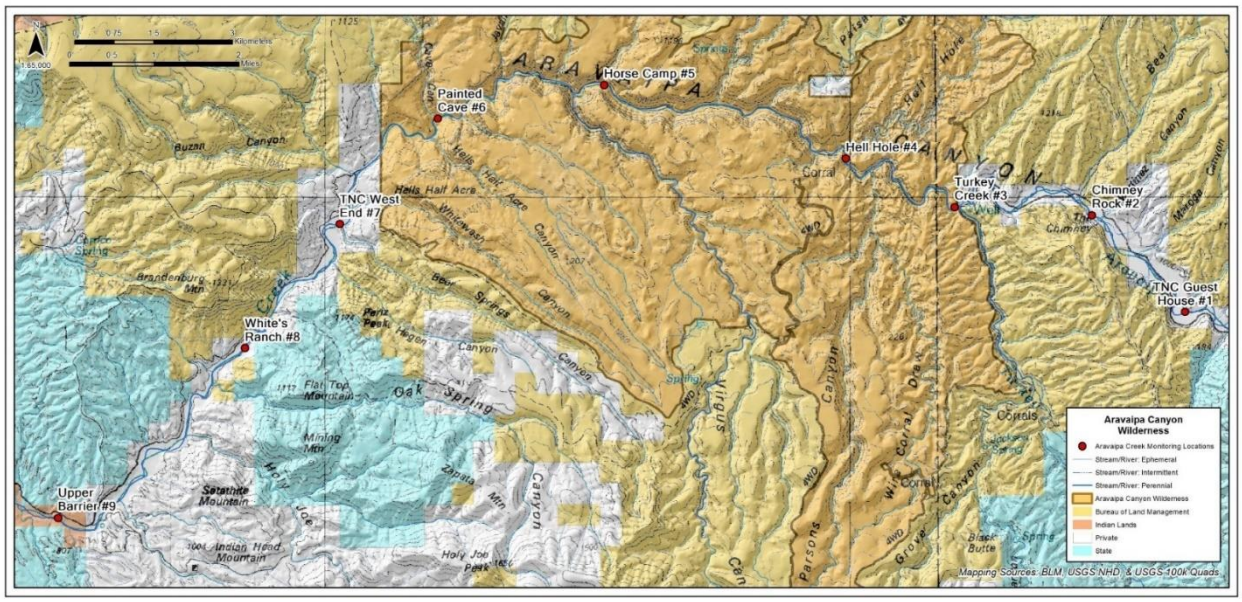

Figure 3. Project area showing landownership, ephemeral, intermittent, and perennial reaches, and permanent fish monitoring sites of Aravaipa Creek.

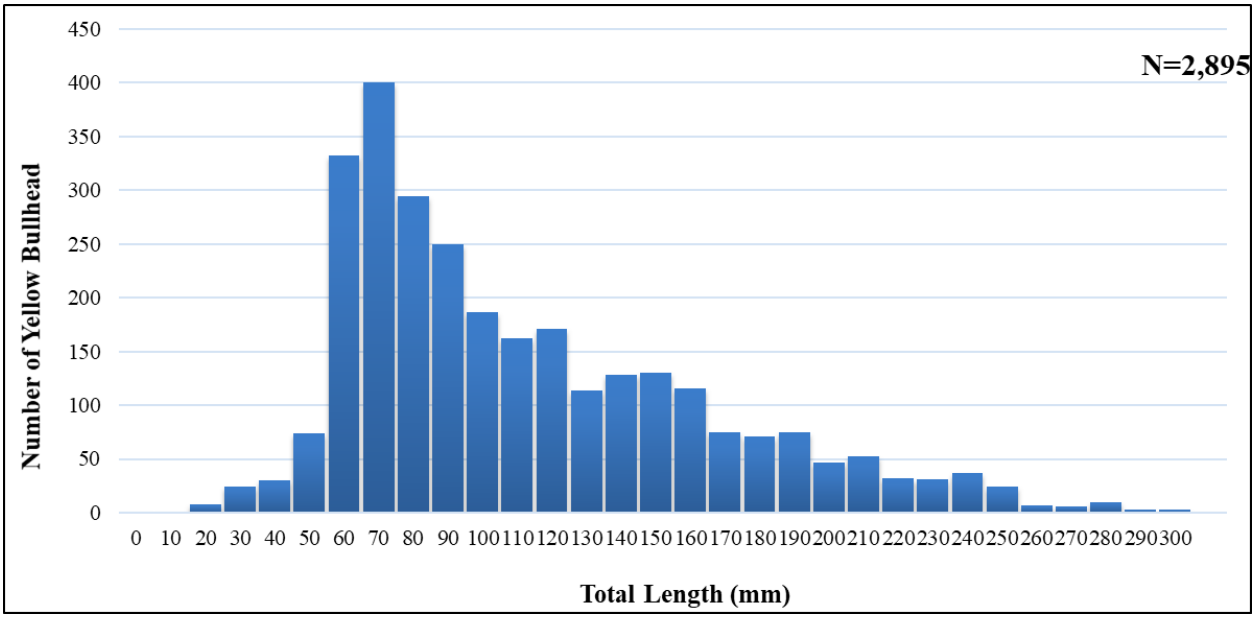

Figure 4. Length frequency histogram of Yellow Bullhead catch in Aravaipa Creek, January-November 2020.

Table 1. Gear type and total number of Green Sunfish removed from Bonita Creek, 2009-2020.

Gear Type	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
Gee Minnow Trap	137	1,647	2,323	3,701	1,152	2,278	1,329	2,815	2				15,384
Promar Net	155	471	820	1,623	857	521	574	576	5				5,602
Hoop Net			76	224	148	198	204	126					976
Gee and Promar - Combined			756										756
Seine	173				186			12					371
Dip Net					93								93
Red Promar	7				4			42					53
Backpack Electrofisher	10	8	10			2							30
Tote Barge Shocker						7							7
Custom Trap						8	1						9
Crab Trap					1								1
Total	482	2,126	3,985	5,548	2,441	3,014	2,108	3,571	7	0	0	0	23,282

Table 2. Summary of Yellow Bullhead removal from Bonita Creek from 2011 to 2020.

Gear Type	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Gee Minnow Trap	1	2	172	18	16	180	54	6	10	38	497
Promar Net	21	80	351	393	378	1019	325	186	299	599	3,651
Hoop Net						7	1				8
Seine			21			334					355
Dip Net			60								60
Red Promar			3								3
Backpack Electrofisher							242				242
Custom Trap				1							1
Total	22	82	607	412	394	1,540	622	192	309	637	4,817

Table 3. Proposed Timeline Yellow Bullhead removal from Bonita Creek for 2022.

Timeline 2022											
January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
	X	**X**	**X**	**X**	**X**			**X**			

Table 4. Summary of Yellow Bullhead removal from Aravaipa Creek from January 9, 2020 through November 12, 2020.

Removal Date	Location	Distance Covered	Effort (Seconds)	Number of Yellow Bullhead Removed	Comments
1/9/2020	West End	1.0 rkm	882	2	
1/14/2020	West End	4.0 rkm	3,469	21	
2/24-27/2020	West End	7.0 rkm	22,246	182	
2/24-27/2020	West End	-----	-----	2	Caught in Promar Net.
4/16/2020	East End	-----	-----	1	Caught in Promar Net.
4/27-30/2020	East End	12.0 rkm	26,511	163	
5/11-14/2020	East End	12.5 rkm	16,229	95	
5/25-28/2020	West End	8.0 rkm	25,407	250	
6/22-25/2020	West End	13.0 rkm	41,098	367	
7/11/2020	West End	5.0 rkm	6,353	94	
7/27-31/2020	East End	12.0 rkm	19,417	453	
10/16-17/2020	East & West Ends			127	Collected during bi-annual fish monitoring.
11/9-12/2020	East End	8.0 rkm	31,836	1,155	

11/9-12/2020	East End	-----	-----	111	43 seine hauls.
Total		82.5 rkm	193,448	3,023	

Table 5. Summary of Yellow Bullhead removal from Aravaipa Creek from September 14, 2017 through November 12, 2020.

Removal Date	Location	Distance Covered	Effort (Seconds)	Number of Yellow Bullhead Removed	Comments
9/14/2017	East & West Ends	18.0 rkm	18,360	284	
10/15/2017	West End	0.47 rkm	1,222	27	Collected during a backpack electrofishing demonstration.
11/6/2017	East End	0.18 rkm		8	Incidental to Loach Minnow and Spikedace hatchery collection.
2/26-3/1/2018	East End	13.4 rkm	9,152	89	
3/13/2018	East & West Ends	6.5 rkm	17,877	85	
4/15/2018	West End	0.47 rkm	1,354	11	Collected during a backpack electrofishing demonstration.
4/23-26/2018	East End	3.3 rkm	13,198	48	
3/4-6/2019	East End	9.0 rkm	19,492	17	
3/26/2019	West End	0.35 rkm		12	Incidental to fish health collection.
4/8-11/2019	West End	9.0 rkm	12,981	61	
10/20/2019	West End			3	Collected during a backpack electrofishing demonstration.
11/6/2019	West End	1.0 rkm	3,274	40	
1/9/2020	West End	1.0 rkm	882	2	
1/14/2020	West End	4.0 rkm	3,469	21	
2/24-27/2020	West End	7.0 rkm	22,246	182	
2/24-27/2020	West End	-----	-----	2	Caught in Promar Nets.
4/16/2020	East End	-----	-----	1	Caught in Promar Nets.
4/27-30/2020	East End	12.0 rkm	26,511	163	
5/11-14/2020	East End	12.5 rkm	16,229	95	
5/25-28/2020	West End	8.0 rkm	25,407	250	
6/22-25/2020	West End	13.0 rkm	41,098	367	
7/11/2020	West End	5.0 rkm	6,353	94	

7/28-31/2020	East End	12.0 rkm	19,417	453	
10/16-17/2020	East & West Ends			127	Collected during fall fish monitoring.
11/9-12/2020	East End	12.0 rkm	31,836	1,155	
11/9-12/2020	East End	-----	-----	111	43 seine hauls.
Total		148.17 rkm	290,358	3,708	

Table 6. Proposed timeline for Yellow Bullhead removal from Aravaipa Creek for 2022.

Timeline 2022											
January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
	X	**X**	**X**	**X**				**X**			

Table 7. Proposed Budget for Yellow Bullhead Removal in 2022.

Budget Categories:	**Rate or Cost Explanation**	**CAP Program to Fund:**	**Applicant Contribution:**	**Total Cost per Category:**
Personnel (Labor)	$37.83*50 hrs. per month on nonnative removal projects.		$22,698	$22,698
Fringe Benefits (ERE)			$7,263	$7,263
Supplies (AOO)	Nets, MS222, field supplies		$1,250	$1,250
Contractual (Professional Outside Services)	$5,500.00*8 removal trips. Technician for individual trips $15.00/hr.*250 hrs.; Senior Biologist for individual trips $30/hr.*75 hrs.	$30,000	$0.00	$30,000
Other	Vehicle Mileage (2,208 miles *$0.575/mile)		$1,270	$1,270
Total Cost per Year		$30,000	$32,481	**$62,481**

Table 8. Total cost to hire three interns for one year to mechanically remove Yellow Bullhead from Bonita Creek.

Budget Categories:	**Rate or Cost Explanation**	**Total Cost per Category**
Partner Expenses (Federal Financial Assistance Agreement)		
Personnel (Labor)	3*$13.00*2080 hrs.	$81,120
Fringe Benefits (ERE)	3*$4,056	$12,168
Other	Vehicle Mileage (10,400 miles *$0.575/mile)	$5,980
Total Direct Charges		$99,268
Indirect Charges	10% of total costs	$9,927
BLM		
Supplies (AOO)	Nets, MS222, field supplies	$4,500
Total Cost per Year		**$113,695**

Hatchery Workplan

Project 13: Aquatic Research and Conservation Center Populations

(Task ID: HA-2006-2)

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

- Spikedace: 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, White River, and Eagle Creek in Arizona, and the San Francisco River, upper Gila River and Gila River Forks in New Mexico. The scope of the project also includes collections of remnant populations of Roundtail 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 more sporadic with a total of eight collections from 2007-2020. During 2007 through 2015 the Department made multiple attempts to collect Loach Minnow from East Fork Black River, Spikedace from the Verde River, and Spikedace and Loach Minnow from Eagle Creek, without success. Collections from New Mexico were primarily completed by New Mexico Department of Game and Fish (NMDGF), and were sporadic with six collections of Spikedace and six collections of Loach Minnow from 2009-2019 at 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 2022 includes collections of Spikedace and Loach Minnow from Aravaipa Creek and collection of Loach Minnow from the Blue River. Collections from other Arizona streams will only be

[1] Including populations previously classified as Gila Chub.

attempted if other biologists detected the species in those streams. Collections from these same streams will continue annually until there is no longer a need for captive refuge and propagation of Spikedace and Loach Minnow.

Aquatic Research and Conservation Center

Bureau of Reclamation funded construction of a native fish conservation facility on the grounds of the Department's Bubbling Ponds Hatchery. The main purposes of the facility were to develop propagation techniques for Loach Minnow and Spikedace, to establish refuge populations of all of the lineages, and to propagate fish for repatriations. The facility was originally named Bubbling Ponds Native Fish Conservation Facility, but in 2015 was renamed the Aquatic Research and Conservation Center (ARCC). Beginning in 2014, Bureau of Reclamation began providing funds (through U. S. Fish and Wildlife Service) for a variety of improvements to ARCC, including a new outdoor building to hold more tanks, a new quarantine building, and new ponds.

In 2022, ARCC staff will focus on propagating lineages of Spikedace and Loach Minnow that are planned to be repatriated that year, including Aravaipa Spikedace, upper Gila River Spikedace, Blue River Loach Minnow, and any lineages that New Mexico Department of Game and Fish plan to stock. Staff 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 relict 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 downstream. The BLM and TNC are both supportive of ongoing native fish conservation activities.

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

If Spikedace or Loach Minnow are detected in drainages where they are currently presumed to be extirpated, the Department would likely attempt to collect fish for ARCC. Spikedace were last detected in the upper Verde River in 1999 and in Eagle Creek in 1989. Loach Minnow were last detected in East Fork Black River in 2004 and in Eagle Creek in 1997. Apparent extirpations are most likely due to negative

interactions with nonnative aquatic species. All project area locations are on U.S. Forest Service (USFS) property which is supportive of recovery actions.

Aquatic Research and Conservation Center
The ARCC facility is located near Page Springs, Arizona.

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

A fish health assessment will be carried out early each year by collecting 60 individuals of the target species or a closely related surrogate species (Longfin Dace, Speckled Dace) from each donor stream. Fish will typically be collected by seining or electrofishing. If parasites or pathogens of concern are not detected during the fish health assessment process, collections of target fish can proceed. Fish are collected from donor populations by seining or electrofishing and transported to ARCC in aerated coolers filled with water treated with salt and Amquel to minimize fish stress during transport. Other species (Gila Topminnow, Roundtail Chub[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 (2014)
    - 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 FY22 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

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

In FY2022, funding is limited to the $550,000 threshold committed by Reclamation under the 2008 CAP BO. After discussions with the Technical Committee, proposed projects were withdrawn from the FY2022 funding request including Gila Site Permanent Monitoring (NM-2020-1) and Eagle Creek Repatriations (AZ-2018-1). Following project ranking and additional discussions, the proposed projects ASU Topminnow Holding (HA-1998-1) and West Fork Black River Nonnative Fish Removals (AZ-2021-1) were not selected for FY2022 funding. Descriptions for these propose projects are not included in the FY2022 Workplan; however, they are available upon request.

Table 1. Results of project prioritization scoring. Projects were scored using the Program scoring form by each technical and affiliate committee member. The projects below the red line (also shaded) exceed the $550,000 threshold committed by Reclamation and will not be supported in FY22 with Program funds.

Proj #	Project Name	Rank Mean	Scoring Mean	Project cost	Subtotal
13	ARCC O&M	1	39.8	$117,000	$117,000
12	Nonnative fish removal from Bonita and Aravaipa Creeks	2	40.4	$30,000	$147,000
7	Blue River Native Fish Restoration	3	37.2	$26,400	$173,400
2	New Mexico T&E Fish Repatriations and Monitoring	4	36.5	$60,703	$234,103
4	Muleshoe ecosystem stream and spring repatriations	5	35.8	$13,800	$247,903
1	Removal of Nonnative Fishes from West Fork Gila River	5	35.8	$43,656	$291,559
8	Harden Cienega Creek Native Fish Restoration	7	35.6	$26,400	$317,959
10	Upper Verde River native fish restoration	8	34.6	$96,600	$414,559
11	Sharp Spring Native Fish Restoration	9	34.8	$40,200	$454,759
5	Gila Topminnow Stockings	10	34.2	$21,300	$476,059
3	Remote Site Inventory and Assessment	11	34.1	$66,632	$542,691
6	Spring Creek (Oak Creek tributary) Repatriations	12	32.8	$5,000	$547,691
9	Red Tank Draw native fish restoration	13	33	$6,300	$553,991
	ASU Topminnow Holding	14	32.2	$16,671	$570,662
	West Fork Black River Nonnative Fish Removals	15	33	$16,950	$587,612

FY20-FY22 Budget

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

		Hatchery Actions	AZGFD	ASU			
HA-2006-2	2006	ARCC O&M	$112,400				$112,400
HA-1998-1	1998	Topminnow Stock Maintenance		$20,800			$20,800
Total		**Recovery and Nonnative Control Total**					**$659,520**
		2021					
Task ID	**Start Year**	**Task Name**					**Total**
		New Mexico Recovery Actions	NMGF	FWS	USFS	BLM	
NM-2006-1	2006	West Fork Gila River Mechanical Removal	$24,301	$10,300	$11,400		$46,001
NM-2002-1	2002	T&E Fish Repatriations and Monitoring	$34,445	$17,400	$15,900		$67,745
NM-2017-1	2017	Remote Site Inventory and Assessment (Previously Middle Fork Gila Inventory & Assessment)	$26,578	$16,700	$19,700		$62,978
NM-2020-1	2020	Gila Permanent Site Monitoring	$24,759	$2,910	$4,124	$9,850	$41,643
		Arizona Recovery Actions	AZGFD	FWS	BLM		
AZ-2003-1	2003	Muleshoe ecosystem stream and spring repatriations	$28,100				$28,100
AZ-2002-1	2002	Gila Topminnow Stockings	$45,200				$45,200
AZ-2013-1	2013	Spring Creek (Oak) repatriations	$6,800				$6,800
AZ-2002-3	2002	Blue River native fish restoration	$40,600				$40,600
AZ-2014-1	2014	Expand Roundtail Chub populations in Harden Cienega Creek	$41,900				$41,900
AZ-2018-1	2018	Eagle Creek Repatriation	$33,800				$33,800
AZ-2016-2	2016	Red Tank Draw removals	$36,300				$36,300
AZ-2020-2	2020	Upper Verde River native fish restoration	$54,200				$54,200
AZ-2021-1	2021	West Fork Black River Nonnative Fish Removals	$33,800				$33,800
AZ-2009-1	2009	Nonnative fish removal from Bonita and Aravaipa Creeks			$34,733		$34,733
		Hatchery Actions	AZGFD	ASU			
HA-2006-2	2006	ARCC O&M	$123,245				$123,245
HA-1998-1	1998	Topminnow Stock Maintenance		$26,232			$26,232

Total		**Recovery and Nonnative Control Total**					**$723,277**
		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				
HA-2006-2	2006	ARCC O&M	$117,000				$117,000
Total		**Recovery and Nonnative Control Total**					**$553,991**

Proposed Changes to Work Plan for FY22
(December 2021)

Project 6: Spring Creek (Oak Creek tributary) Repatriations

- No cost change
- Propose stocking Aravaipa lineage Spikedace from ARCC into Spring Creek to determine whether fish will establish with reduced crayfish and large chub density and habitat changes following flooding in 2021.

Project 7: Blue River Native Fish Restoration

- No cost change
- Propose stocking Gila River lineage Spikedace from ARCC into the lower Blue River to help population re-establish following post-fire impacts and flooding in 2021.